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Quoc Thang Nguyen

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THÈSE DE DOCTORAT

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Megatrends and resilience in global trade: Three empirical investigations

Soutenue par

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Megatrends and resilience in global trade: Three empirical investigations

Thang Nguyen-Quoc

Under the supervision of Emmanuelle Lavallé and François Roubaud

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I would like to express my deepest appreciation to my supervisors, Emmanuelle Lavallée and François Roubaud. Your unwavering support, kind understanding, and clear guidance has made this adventure possible and enjoyable (to a limit, of course). I also learnt tremendously from you on a professional and personal level about what is truly important and what is simply nice to have. Lessons that hopefully will stay forever.

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I write this line, in the middle of boxes, the day when Beeboo turns two and the night before our family all move to Singapore. This week also marks the 15th anniversary of me going abroad. What a journey it has been. Thank you, life.

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~ To T&T ~

General introduction

The COVID-19 pandemic created havoc to the global economic system. In 2020, the value of global trade in goods and services declined by 9.6%, while world GDP contracted by 3.3% (WTO, 2021). Such collapse reached the levels observed during the Global Financial Crisis in late 2000s and marked one of the worst declines since World War II (Arriola et al., 2022).¹ While trade volume quickly recovered in 2021, the pandemic facilitated several megatrends, which could fundamentally reshape the global trading system going forward.

The pandemic has accelerated the digitalisation process that transforms the way we produce, consume and trade. During the pandemic, lockdowns and other social distancing measures have accelerated digital adoption during the pandemic. Across the 66 countries where data is available, the share of internet users who made online purchases averaged 60% in 2020/21, an increase from 53% in 2019 (UNCTAD, 2022).² Health-related restrictions and the need to facilitate trade during the critical contraction have heightened investments in digitalising the supply chain, especially in the areas of trade finance and international payment (BIS, 2022).³

In addition, global trade is also verging towards protectionist measures and regionalism. In the early phases of the pandemic, over 80 countries had implemented export bans of medical and personal protective goods (UNCTAD, 2021).⁴ New measures to contain the spread of the virus also made crossing borders more cumbersome and costly. In 2021, the

¹ Arriola, C., Kowalski, P., & van Tongeren, F. (2021). The impact of COVID-19 on directions and structure of international trade.

² UNCTAD (2022) COVID-19 boost to e-commerce sustained into 2021, new UNCTAD figures show.

³ Markus, K., Harold, J., & Jean-Pierre, L. (2019). The Digitalization of Money. *BIS Working Papers* No. 941.

⁴ UNCTAD (2021) COVID-19 and NTMs database, August 2021 update.

number of new Sanitary & Phyto-Sanitary (SPS) notifications to the WTO exploded to the highest level since 2000, when recording started.

In this highly uncertain environment, regionalism is rising to the fore. Governments and businesses now consider relocating offshore production facilities back to home country (reshoring) or to a nearby country (near-shoring), especially for the production of key goods (Javorcik, 2020).⁵ Geopolitical concerns such as the Russian invasion of Ukraine and China-US tension also fractionalise the global economic system through new barriers, bans and sanctions to international trade and investments.

These processes of digitalisation, protectionism and regionalisation are not new. They were already in motion in the last decades. For example, the share of internet users globally increased six-fold from 7% in 2000 to 43% in 2015, according to data from the International Telecommunication Union. Trade barriers also proliferated, exemplified by the escalation of import tariffs between the U.S and China in the second half of 2010s. Similarly, the global trade cooperation already moved towards smaller regional blocs in the last decades. By June 2021, WTO records 349 regional trade agreements – many of them are going ever deeper in their commitments.

The sustained focus on these megatrends in the WTO's annual flagship World Trade Reports (WTR) underline the importance role they play for global development (Table 1). The four WTR editions published between 2017 and 2020 all tackled aspects of digitalisation and trade: automation and jobs, e-commerce, service trade and innovation in the digital age. Other WTR editions looked into details how trade barriers, especially non-tariff ones, can affect trade flows. Across all editions, international cooperation at the regional level becomes increasingly prevalent, partly due to the difficulty in reaching consensus at the WTO.

⁵ Javorcik, B. (2020). Reshaping of global supply chains will take place, but it will not happen fast. *Journal of Chinese Economic and Business Studies*, 18(4), 321-325.

Table 1. The role of digitalisation, protectionism and regionalism in past World Trade Reports

Year	Title	Digit.	Proc.	Reg.
2020	Government policies to promote innovation in the digital age	<input checked="" type="checkbox"/>		
2019	The future of services trade	<input checked="" type="checkbox"/>		
2018	The future of world trade: How digital technologies are transforming global commerce	<input checked="" type="checkbox"/>		
2017	Trade, technology and jobs	<input checked="" type="checkbox"/>		
2016	Levelling the trading field for SMEs	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
2013	Factors shaping the future of world trade	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>
2012	Trade and public policies: A closer look at non-tariff measures in the 21st century		<input checked="" type="checkbox"/>	
2011	The WTO and preferential trade agreements: From co-existence to coherence			<input checked="" type="checkbox"/>
2007	Six decades of multilateral trade cooperation: What have we learnt?			<input checked="" type="checkbox"/>
2005	Trade, standards and the WTO		<input checked="" type="checkbox"/>	

Note: This non-exhaustive list reflects author’s categorisation based on the summaries and tables of content for each World Trade Report published on WTO website. Digit. = Digitalisation, Proc. = Protectionism, Reg. = Regionalism.

Megatrends and resilience in global trade environment: Gaps and contributions

The COVID-19 crisis has also shifted the focus of global trade from efficiency to resilience. The pandemic induced severe disruptions and various uncertainties in managing a global supply chain, prompting firms and countries to rethink their risk management

strategies. However, the interaction between trade and resilience is a complex process. The interconnection of people, capital and goods flows, and the interdependence of global production may transmit and amplify global shocks such as epidemics and financial crises. Following this logic, the diversification and (conversely) concentration of trade among firms, partners, products and sectors reflects the exposure to risks. At the same time, openness, interdependence and networked technologies can strengthen resilience by making firms and economies more innovative and adaptable (WTO, 2022).⁶

This new policy objective demands further research on the links between the megatrends and trade resilience. In some areas such as the firm-level concentration of national trade flows, the research efforts remain open and active. Analysing custom transaction data from 32 countries, Freund and Pierola (2020)⁷ show that the top 5 exporters in each country account for almost half of export growth. Surveying this recent literature, they also conclude that further research is needed to explain the drivers behind the rising concentration of export sales among these “export superstars”.

In other cases, empirical investigation can help reconcile where economic theories may yield contradicting predictions. For instance, information theory would suggest that quality standards could induce trade because they act positively as a quality signal. However, these standards could yet deter trade because they impose additional compliance costs. Foreign producers will now have to adjust their products and processes to meet the new requirements in the destination markets. Identifying the net impact of standards on trade relationship thus requires empirical investigation.

Understanding the impacts of these megatrends on trade patterns is particularly important for policymakers, especially those in developing countries. First, export-led de-

⁶ World Trade Organization. (2021). *World Trade Report. Economic Resilience and Trade*.

⁷ Freund, C., & Pierola, M. D. (2020). The origins and dynamics of export superstars. *The World Bank Economic Review*, 34(1), 28-47.

development remains a popular strategy in many developing countries. Much of this popularity was inspired by the success of the Asian tigers in the latter half of the 20th century. Export patterns have the potentials to shape the distribution of economic rents within the society – across sectors, firms and workers. Second, the existing trade structure of many developing countries is vulnerable to shocks in the global economy due to their dependence on few commodity and agricultural exports. Third, the capacity to anticipate and response to global shock may not be as strong in developing countries due to various factors such as lower productivity level, weak institutions, limited management skills, and a lack of information, quality inputs and financial tools.

The scant evidence base and the importance of local contexts make impact evaluation in developing countries’ context even more important. For example, the impacts of regional trade agreements on export diversification remain understudied in Africa, despite the numerous efforts for regional integration and the ambition of the ongoing African Continental Free Trade Area. The lack of continent-specific evaluations is particularly concerning because the specific policy and geographical context often matters in determining the impact of trade agreements. A large literature points out that South-South free trade agreements may be more conducive to export diversification from developing countries than North-South agreements (Regolo, 2013⁸). Recent literature also emphasises the importance of specific commitments within each trade agreement for its outcome (Vicard, 2009⁹; Mattoo et al., 2020¹⁰).

This Ph.D. thesis investigates how these three megatrends in global trade environment affect the export resilience for developing countries. Through three papers, I empirically

⁸ Regolo, J. (2013). Export diversification: how much does the choice of the trading partner matter?. *Journal of International Economics*, 91(2), 329-342.

⁹ Vicard, V. (2009). On trade creation and regional trade agreements: does depth matter?. *Review of World Economics*, 145(2), 167-187.

¹⁰ Mattoo, A., Rocha, N., & Ruta, M. (Eds.). (2020). Handbook of deep trade agreements. *World Bank Publications*.

evaluate the impacts of regionalism, protectionism and digitalisation on the behaviours of exporters from developing countries (see Table 2 for a summary).

The chapters cover a broad range of geographic context: East Africa, Vietnam as well as a panel of 11 low and middle-income countries (spreading across Asia, Africa, Eastern Europe and Latin America). The difference in the unit of analysis employed in these chapters reflect the mix of macro and micro approaches. The first chapter employs bilateral trade flows disaggregated by products. The other two chapters use firm-level transaction data from official customs agencies to tease out the heterogeneity of firms. In particular, the second chapter brings novel data from Vietnam. Collectively, these papers dissect the dimensions of trade resilience from both a vulnerability (export diversification and concentration) and a shock-response perspective.

Table 2. Summary of approaches in the three chapters

	Chapter 1*	Chapter 2	Chapter 3
Megatrends	Regionalism	Protectionism	Digitalisation
Geographic context	Rwanda & East African Community	Vietnam	11 developing countries
Dimension of resilience	Diversification of product-destination	Ability to response to shocks	Concentration of export sales
Unit of analysis	Sectoral bilateral trade flows	Firm-level transactions	Firm-level transactions

* This is a joint paper with Rodrigo Deiana (WB) and Elisa Saint-Martin (OECD).

Source: Author's elaboration.

The rest of this introduction provides an expanded summary of these three chapters. The chapters are designed as independent stand-alone pieces. Papers and chapters are thus used interchangeably.

Chapter 1

The recent African Continental Free Trade Area has generated high expectations on the continent that it will help diversify Africa's export basket. African leaders have explicitly committed to "promote industrial development through diversification and regional value chain development, agricultural development and food security". To match this ambition, countries are agreeing to not only liberalise tariffs but also cooperate in other critical areas such as tackling non-tariff barriers and facilitating logistics and finance for intra-Africa trade.

Despite the political importance of the AfCFTA, economic theory is not clear whether such policy is the appropriate tool for diversification. On one hand, traditional trade theory would suggest that trade policy would lead to even more concentration as countries can better exploit their comparative advantages. On the other hand, lower trade costs could reduce the productivity cut-offs needed for firms to start trading profitably, hence improving the extensive margins of aggregate export.

There is thus a clear need for empirical works in the African continent. Existing literature emphasise the importance of local context and the specificity of each agreement for the trade impact of regional trade agreements. Furthermore, certain aspects of export dynamics remain understudied. To the best of our knowledge, only a handful of studies have analysed export churning in an African context despite Africa having the highest level of churning among world regions (Kamuganga, 2012¹¹; Cadot et al., 2013¹²).

¹¹ Kamuganga, D. N. (2012). Does intra-Africa regional trade cooperation enhance Africa's export survival? (No. 16/2012). *Graduate Institute of International and Development Studies Working Paper*.

¹² Cadot O., L. Iacovone, M.D. Pierola, F.Rauch (2013), Success and failure of African exporters, *Journal of Development Economics*, Volume 101,2013, Pages 284-296.

This paper brings new evidence on the case of Rwanda joining the East African Community's Customs Union in mid-2009. Among the eight existing regional economic communities in Africa, the EAC shares the most similar features with the AfCFTA in terms of depth of the agreements and diversity of member countries. Furthermore, because Rwanda must accept the *acqui* – existing terms negotiated by the original EAC members, the variation in tariff reduction provides a source of exogeneity to evaluate the causal impact of the policy changes.

We exploit disaggregated bilateral trade flows for Rwanda's exports during the 1998-2020 period to understand the impact of joining EAC on Rwanda's export dynamics. We evaluate the response at the product-destination flows. This approach helps us go beyond aggregate indicators of export diversification and control for the dynamic characteristics of each flow such as the level of familiarity with products and destinations.

Our results suggest that joining the EAC expanded Rwanda's basket of products exported to this market. First, accession to the EAC boosted Rwanda's export participation at the product level to the bloc by 5.4 percentage points (p.p.). For comparison, joining the COMESA FTA boosted Rwanda's export participation by only 0.1 pp. Second, the EAC accelerates the churning process for Rwanda's export – driving up entry by 3.4pp and exit by 2.2pp.

When focusing solely on EAC-induced tariff reductions, we find that the product lines that benefited from higher tariff reduction experienced higher entry and participation rates but not survival. This is consistent with existing models of trade hysteresis under uncertainty. By reducing the sunk cost in exporting, regional cooperation can simultaneously induce firms to change their export status – i.e. non-exporters to enter and active exporters to exit exporting.

Third, the accession had a positive impact for diversifying trade in intermediate goods and non-traditional products, albeit this impact is considerably weaker than that for

trade in final goods and in traditional goods, respectively. We also find evidence that EAC accession did not result in lower participation or entry rates for Rwandan exporters in destinations similar to the EAC. This suggests that the impact of the accession on EAC-bound exports is not driven by trade diversion from other destinations.

The results suggest cautious optimism for using trade agreements to facilitate export diversification. They confirm the potentials of connecting regional markets for realising the continent's diversification. However, they may not help increasing the sustainability of export relationship. To the extent that resilience has gained policy importance following the COVID-19 pandemic, such dynamics must be taken into account.

Chapter 2

Sanitary and phytosanitary (SPS) standards have been increasingly used since 2000. The number of new SPS notifications to the World Trade Organisation related to SPS almost quadrupled from 2000 to 2019 before reaching an all-time-high in 2020. These standards matter for exporters from developing countries in particular. They are most common for agri-food products, which constitute a large share of developing countries' exports. Furthermore, exporters from developing countries with weaker capacity may find it more difficult to adapt to the (often higher) import standards imposed in high-income markets.

From a theoretical perspective, the current literature suggests two opposing roles of import standards on international trade. One approach views standards as non-tariff barriers to trade due to higher compliance cost. The possibility of border rejections due to food safety introduces additional uncertainty for potential exporters. Another approach suggests that regulatory standards can also act as catalyst for trade. Application of SPS standards ensures a minimum level of quality, such that they create a signal of product quality to customers that help further induce trade. The trade effect of SPS

measure thus depend on which of these two opposing forces will prevail, and thus it calls for empirical investigation.

The empirical literature has assessed the impact of standards on trade from three broad approaches. The first approach, popular in the Global Value Chain literature, often involves case studies of firms' responses of to a specific change in standards. The second approach analyses the cross-country impact of standards in a gravity model with bilateral trade flows. This paper most closely relates to the third and most recent strand of literature which focuses on firm heterogeneity using firm-level custom registries.

This paper investigates the impact of SPS standards on existing agri-food exporters from Vietnamese by exploiting a new dataset based on custom registries from Vietnam. The dataset covers the universe of agri-food exports at firm level recorded by the Vietnamese custom agency between 2005 and 2011. The application of more stringent standards is captured by a rich dataset on specific trade concerns (STCs) that member countries raise at the WTO committee on SPS standards. The magnitude of impact is comparable to that for exporter from other countries such as France and Peru as found in previous literature.

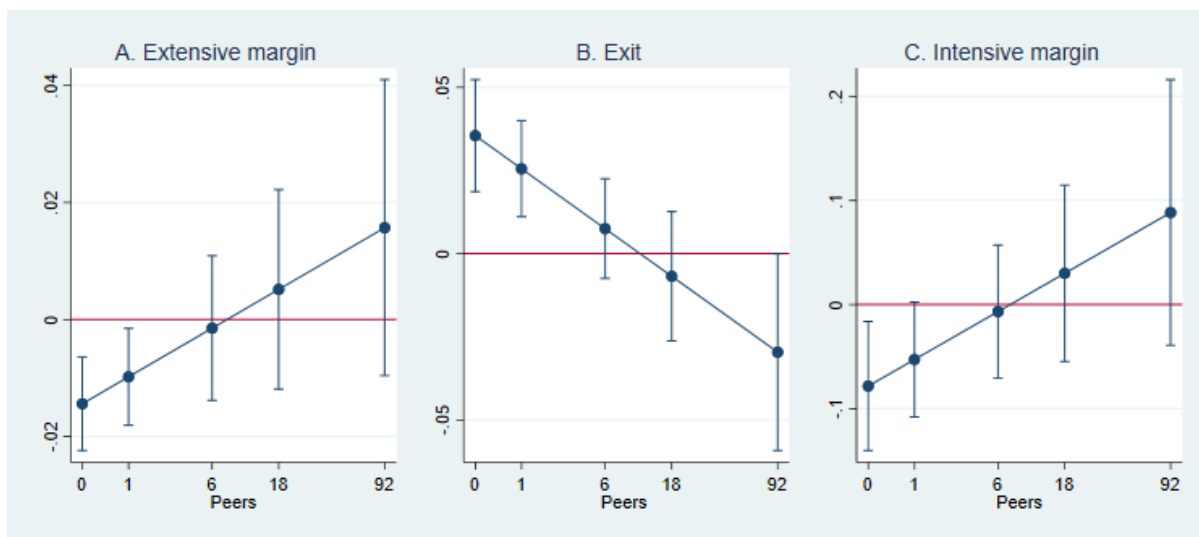
The paper first shows that the imposition of more stringent standards in the destination countries negatively affects the margins of trade among Vietnamese exporters. Exporters are less likely to participate and more likely to terminate serving a certain product-destination when there is an active SPS-related specific trade concerns in this market.

Second, exporters serving markets with more stringent standards also record higher product price (proxied by unit values) and quality. We estimate product quality at the

firm–product–destination level by exploiting information on product prices and quantity exported following the methods outline in Khandelwal et al. (2013).¹³

Third, the local production network matters for exporters’ response to stringent standards. Specifically, the negative impact is particularly severe for pioneer exporters, those who export to destination–product markets where no other exporter from Vietnam participates. Having more exporters from the same region that serve the same product–destination helps alleviate this negative impact of import standards on trade margins (Figure 1). Furthermore, when facing more stringent standards, exporters with more peers are associated with higher product quality than those with fewer peers.

Figure 1. Average marginal effects of SPS concerns on trade margins



Note: Linear projections based on results from columns (4)–(6) in Table 2.2. The x-axis label indicates the number of peers at different moment: 0 (min), 1 (median), 6 (75th percentile), 18 (90th percentile), 27 (95th percentile) and 92 (max).

Source: Author’s calculations.

This paper advances the literature on exporters’ response to import standards in three directions. First, it brings new data and context to on the recent and relative thin approach of assessing firm-level response to standards using custom registries. Most of this literature are based on the experience of exporters from high income countries (such as

¹³ Khandelwal, A. K., Schott, P. K., & Wei, S. J. (2013). Trade liberalization and embed-ded institu-tional reform: Evidence from Chinese exporters. *American Economic Review*, 103(6), 2169-95.

France and U.S.). The case of Vietnam is informative particularly for other developing countries given the importance of agri-food sector behind its export growth, and the relative similarity of context.

Second, the paper highlights the importance of local production network as a source of heterogeneity. In this regard, our findings echo the Global Value Chains literature that emphasise the importance of local context for individual firm's responses to import standards. Third, the paper further explores the relationship between standards and quality upgrading. Understanding this process is important for policymakers due to the central role of upgrading in production capacity for long-run development. In this aspect, our findings suggest a nuanced balance in the role of SPS standards both as trade barriers and as upgrading catalyst.

Chapter 3

Export sales increasingly concentrate among the largest firms across the world. In a sample of 32 countries, Freund and Pierola (2015)¹⁴ find that the top 5 firms account for 30% of non-oil exports. These superstars account for almost half of export growth as well (Freund and Pierola, 2020).¹⁵

This concentration of export sales has important implications for policymakers regarding consumer welfare, macroeconomic volatility, mark-ups and inequality among others. In the context of COVID-19, understanding firm-concentration becomes an important policy objective in order to avoid excessive exposure to idiosyncratic shocks from a few firms

¹⁴ Freund, C., & Pierola, M. D. (2015). "Export Superstars." *Review of Economics and Statistics* 97 (5): 1023-32.

¹⁵ Freund, C., & Pierola, M. D. (2020). The origins and dynamics of export superstars. *The World Bank Economic Review*, 34(1), 28-47.

and avoid supply chain bottlenecks. Despite its importance, the drivers behind this rising concentration remain an open question for research.

This paper is the first to suggest that the global expansion of the internet contributes to the rising concentration of goods export among the top exporters. It exploits detailed information on firm-level export transactions at firm-level come from the World Bank Exporter Dynamic Database, which covers exporters from 11 developing countries (mostly) in the 2000s. The use of internet for trading between two countries is proxied by the minimum level of internet penetration rate in this country pair.

The paper first evaluates if internet adoption leads to a more concentrated distribution of firm-level export sales. It particularly focuses on the interaction between internet penetration rate and the Pareto exponent of export sales in a bilateral trade flow. The Pareto distribution is central to workhorse models of heterogeneous-firm theory and has been shown empirically to better approximate the upper tail of export sales. Through a simple log-log ranks-sales regression, we can estimate the Pareto exponent that governs the spread (heterogeneity) of the distribution.

To evaluate the impact of the internet on export sales heterogeneity, we augment the log-log ranks-sales regression with the interaction between the internet penetration rate and sale ranks. The results suggest that the spread of the internet steepens the slope of the log-log ranks-sales relationship among exporters in each origin-destination pair. This shift implies a concentrating distribution of export sales toward the top exporters.

The concentration of exports among a few firms in a given year may not necessarily imply a reliance on the superstars if the composition of firms in this group changes frequently. In contrast, an “entrenchment”, where the top exporters who retain their dominance from one year to another, would suggest sustained concentration over time and raise concerns for policymakers.

Adopting a linear probability model, we find that incumbent export superstars are more likely to retain their status in an environment with better internet. In the main specification suggests, doubling internet adoption is expected to boost the chance for the incumbent top exporter to retain its top position by 11.7%. It also increases the likelihood that the incumbent top 5% of exporters would persist in their position by 22.7%. This increase suggests an “entrenchment” effect where the internet reduces churning at the top.

Recent literature can help reconcile these findings from the lens of information frictions (Akerman et al., 2021¹⁶; Lenoir et al., 2022¹⁷). In a nutshell, connectivity can alter the level of competition faced by exporters by exposing each importer to many more potential exporters. As buyers can now easily find substitutes, demand becomes more elastic to prices – an argument dating back to Hirschman’s first rule of derived demand. Importers become more likely to source from the most productive producers who could offer the lowest prices. High-productivity exporters are thus better placed than low-productivity ones to boost their sales from this heightened visibility and expand their market share. Consequently, the expansion of the Internet is expected to increase export concentration among the superstars.

In an extension of our empirical models, we find evidence confirming the importance of information frictions as a key channel for this relationship. We find that the impact of the internet on the Pareto exponent and superstar entrenchment is stronger for exports of differentiated goods than for exports of homogenous goods. Trading of differentiated goods is typically more information intensive where sellers and buyers need more com-

¹⁶ Akerman, A., Leuven, E., & Mogstad, M. (2022). Information frictions, internet, and the relationship between distance and trade. *American Economic Journal: Applied Economics*, 14(1), 133-63.

¹⁷ Lenoir, C., J. Martin, I. Mejean (2022) Search Frictions in International Goods Markets. *Journal of the European Economic Association*.

munication to convey various product specifications and characteristics. In contrast, information frictions are less constraining for homogeneous goods that trade on commodity trading platforms or use referenced prices.

These findings question the existing literature on the internet and international trade which emphasise its role in reducing fixed trade cost. Under a heterogeneous firm model such as Chaney (2008),¹⁸ a reduction in fixed cost would simply shift the cut-off for active exporters in the distribution, but not the shape of the Pareto distribution itself.

The paper thus provides a multi-country perspective to the empirical literature that dissect the anatomy and distribution of bilateral export sales. It also adds to the growing literature on market concentration in the digital economy that has been documented in other fields such as industrial organisation and innovation.

¹⁸ Chaney, T. (2008). Distorted gravity: the intensive and extensive margins of international trade. *American Economic Review*, 98(4), 1707-21.

Synthèse

La pandémie de COVID-19 a provoqué des ravages dans le système économique mondial. En 2020, la valeur du commerce mondial des biens et services a diminué de 9,6 %, tandis que le PIB mondial s'est réduit de 3,3 %. Cet effondrement a atteint les niveaux observés pendant la crise financière mondiale et a marqué l'un des pires déclinés depuis la Seconde Guerre mondiale. Si le volume des échanges s'est rapidement redressé en 2021, la pandémie a accéléré plusieurs mégatendances, qui pourraient remodeler fondamentalement le système commercial mondial à l'avenir.

Tout d'abord, la pandémie a accéléré le processus de numérisation qui transforme la façon dont nous produisons, consommons et échangeons. Pendant la pandémie, les confinements et autres mesures de distanciation sociale ont accéléré l'adoption du numérique. Dans les 66 pays pour lesquels des données sont disponibles, la part des internautes ayant effectué des achats en ligne a atteint une moyenne de 60 % en 2020/21, soit une augmentation par rapport à 53 % en 2019. Les restrictions liées à la santé et la nécessité de faciliter le commerce ont intensifié les investissements dans la numérisation des chaînes d'approvisionnement, en particulier dans les domaines du financement du commerce et des paiements internationaux.

En outre, la pandémie a également intensifié la mise en place de mesures protectionnistes et le régionalisme. Dans les premières phases de la pandémie, plus de 80 pays ont mis en place des interdictions d'exportation de biens médicaux et de protections individuelles. Les nouvelles mesures visant à contenir la propagation du virus rendent également le passage des frontières plus lourd et plus coûteux. En 2021, le nombre de notifications de nouvelles normes SPS à l'OMC a explosé pour atteindre le niveau le plus élevé depuis 2000, date à laquelle le suivi a commencé.

Dans cet environnement très incertain, le régionalisme prend le devant de la scène. Les gouvernements et les entreprises envisagent désormais de relocaliser les installations de production délocalisées vers leur pays d'origine (reshoring) ou vers un pays voisin (nearshoring), en particulier pour la production de biens essentiels. Les préoccupations géopolitiques telles que l'invasion de l'Ukraine par la Russie et les tensions entre la Chine et les États-Unis fractionnent également le système économique mondial en créant de nouvelles barrières, interdictions et sanctions pour le commerce et les investissements internationaux.

Ces processus de numérisation, de protectionnisme et de régionalisation étaient déjà en marche au cours de la dernière décennie. Par exemple, la part des utilisateurs d'Internet dans le monde a été multipliée par six, passant de 7 % en 2000 à 43 % en 2015, selon les données de l'Union internationale des télécommunications. Les barrières commerciales ont également proliféré, comme en témoigne l'escalade des droits de douane à l'importation entre les États-Unis et la Chine dans la seconde moitié des années 2010. De même, la coopération commerciale mondiale s'est orientée vers des blocs régionaux plus petits au cours des dernières décennies. En juin 2021, l'OMC enregistrait 349 accords commerciaux régionaux, dont beaucoup vont de plus en plus loin dans leurs engagements.

L'attention soutenue portée à ces mégatendances dans les rapports annuels phares de l'OMC sur le commerce mondial (WTR) souligne le rôle important qu'elles jouent pour le développement mondial (tableau 1). Les quatre éditions du WTR publiées entre 2017 et 2020 ont toutes abordé des aspects de la numérisation et du commerce : automatisation et emplois, commerce électronique, commerce des services et innovation à l'ère numérique. D'autres éditions du WTR ont examiné en détail comment les barrières commerciales, notamment non tarifaires, peuvent affecter les flux commerciaux. Dans toutes les éditions, la coopération internationale au niveau régional devient de plus en plus prévalente, en partie en raison de la difficulté de parvenir à un consensus au sein de l'OMC.

Mégatendances et résilience dans le commerce mondial: lacunes et contributions

La crise du COVID-19 a également déplacé l'attention du commerce mondial de l'efficacité vers la résilience. La pandémie a entraîné de graves perturbations et diverses incertitudes dans la gestion des chaînes d'approvisionnement mondiales, incitant les entreprises et les pays à repenser leurs stratégies de gestion des risques. Toutefois, les interactions entre le commerce et la résilience constituent un processus complexe. L'interconnexion des flux de personnes, de capitaux et de marchandises et l'interdépendance de la production mondiale peuvent transmettre et amplifier les chocs mondiaux tels que les épidémies et les crises financières. La diversification et (à l'inverse) la concentration des échanges entre les entreprises, les partenaires, les produits et les secteurs reflètent cette exposition aux risques. Dans un même temps, l'ouverture, l'interdépendance et les technologies en réseau peuvent renforcer la résilience en rendant les entreprises et les économies plus innovantes et adaptables (OMC, 2022).

Ce nouvel objectif politique exige des recherches supplémentaires sur les liens entre les mégatendances et la résilience du commerce. Dans certains cas, comme la compréhension de la concentration des flux commerciaux nationaux au niveau des entreprises, les efforts de recherche restent ouverts et actifs. En analysant les données de transactions douanières de 32 pays, Freund et Pierola (2015) montrent que les 5 premières entreprises représentent 30% des exportations non pétrolières. Dans une étude ultérieure, ils constatent que ces superstars représentent également près de la moitié de la croissance des exportations (Freund et Pierola, 2020). À travers une revue de la littérature récente, Freund et Pierola (2020) concluent que des recherches supplémentaires sont nécessaires pour expliquer les moteurs de la concentration croissante des ventes à l'exportation parmi ces "superstars de l'exportation".

Dans d'autres cas, l'analyse empirique peut aider à réconcilier des théories économiques qui peuvent donner lieu à des prédictions contradictoires. Par exemple, la théorie de l'information suggère que les normes de qualité pourraient induire le commerce parce qu'elles agissent positivement comme un signal de qualité. Cependant, ces normes pourraient également décourager le commerce car elles imposent des coûts supplémentaires aux producteurs étrangers pour ajuster leurs produits et leurs processus afin de répondre aux nouvelles exigences des marchés de destination. L'identification de l'impact net des normes sur les relations commerciales nécessite donc une enquête empirique.

Comprendre l'impact de ces mégatendances sur la structure des échanges est particulièrement important pour les décideurs politiques, notamment ceux des pays en développement. Tout d'abord, le développement axé sur les exportations reste une stratégie populaire dans de nombreux pays en développement - en grande partie inspirée par le succès des tigres asiatiques à la fin du 20e siècle. Les modèles d'exportation ont le potentiel de façonner la distribution des rentes économiques au sein de la société - entre les secteurs, les entreprises et les travailleurs. Deuxièmement, la structure commerciale actuelle de nombreux pays en développement est vulnérable aux chocs économiques mondiaux en raison de leur dépendance à certains produits de base et exportations agricoles. Troisièmement, la capacité d'anticiper et de réagir aux chocs mondiaux peut ne pas être aussi forte dans les pays en développement en raison de divers facteurs tels qu'un niveau de productivité inférieur, des institutions faibles, des compétences de gestion limitées et un manque d'informations, d'intrants de qualité et d'outils financiers.

L'insuffisance des données probantes et l'importance des contextes locaux rendent l'évaluation de l'impact dans le contexte des pays en développement encore plus importante. Par exemple, les impacts des accords commerciaux régionaux sur la diversification des exportations restent peu étudiés en Afrique, malgré les nombreux efforts et l'ambition de la Zone de libre-échange continentale africaine en cours. Le manque d'évaluations

spécifiques au niveau du continent est particulièrement inquiétant car le contexte politique et géographique spécifique est souvent important pour déterminer l'impact des changements sur l'économie locale. Une vaste littérature souligne que les accords de libre-échange Sud-Sud peuvent être plus propices à la diversification des exportations des pays en développement que les accords Nord-Sud (Regolo, 2013). La littérature récente souligne également l'importance des engagements spécifiques de chaque accord commercial pour son résultat (Vicard, 2009 ; Mattoo et al., 2020).

Cette thèse de doctorat étudie comment les mégatendances affectant l'environnement commercial mondial affectent la résilience des exportations des pays en développement. À travers trois articles, j'évalue empiriquement les impacts du régionalisme, du protectionnisme et de la numérisation sur les comportements des exportateurs des pays en développement (voir le tableau 2 pour un résumé).

Les chapitres couvrent un large éventail de contextes géographiques : L'Afrique de l'Est, le Vietnam ainsi qu'un panel de 11 pays à revenu faible ou intermédiaire répartis en Asie, en Afrique, en Europe de l'Est et en Amérique latine. Collectivement, ces articles dissèquent les dimensions de la résilience commerciale à la fois du point de vue de la vulnérabilité et de la réponse aux chocs. Les différences dans l'unité d'analyse employée dans ces chapitres reflètent le mélange d'approches macro et micro. Le premier chapitre utilise les flux commerciaux bilatéraux désagrégés par produits. Les deux autres chapitres utilisent des données de transaction au niveau des entreprises provenant des registres des douanes pour mettre en évidence l'hétérogénéité des entreprises. En particulier, le deuxième chapitre apporte de nouvelles données provenant du Vietnam.

Tableau 2. Résumé des approches dans les trois chapitres

	Chapitre 1*	Chapitre 2	Chapitre 3
Mégatendances	Régionalisme	Protectionnisme	Numérisation
Contexte géographique	Rwanda et Communauté d'Afrique de l'Est	Vietnam	11 pays en développement
Dimension de la résilience	Diversification de la destination et des produits	Capacité de réaction aux chocs	Concentration des ventes à l'exportation
Unité d'analyse	Flux commerciaux bilatéraux sectoriels	Transactions au niveau des entreprises	Transactions au niveau des entreprises

* Ce document a été rédigé conjointement avec Rodrigo Deiana (Banque mondiale) et Elisa Saint-Martin (OCDE).

Source : Élaboration de l'auteur.

Le premier chapitre étudie l'impact de l'adhésion du Rwanda à l'Union douanière de la Communauté d'Afrique de l'Est en 2009/10 sur la dynamique de diversification des exportations du pays. En appliquant diverses techniques économétriques de panel aux flux commerciaux bilatéraux, nous constatons que l'adhésion a augmenté les exportations du Rwanda vers les pays du bloc de 5,4 points de pourcentage (pp). À titre de comparaison, l'adhésion à l'accord de libre-échange du COMESA a stimulé les exportations du Rwanda vers ces pays de 0,1 point de pourcentage. Cette expansion est due à la création de nouvelles relations commerciales mais est contrebalancée par une augmentation du renouvellement de ces relations (baisse de leur durabilité). La réduction des droits de douane et la coopération sur les aspects non tarifaires ont joué des rôles importants mais légèrement différents sur la dynamique des exportations. Nous avons également constaté

une hétérogénéité considérable des impacts en fonction des produits exportés. Ces résultats donnent un aperçu du potentiel des accords commerciaux régionaux dans la diversification des exportations africaines. Ils sont essentiels pour éclairer le processus actuel de mise en place de la Zone de libre-échange continentale africaine.

Le deuxième chapitre fournit de nouvelles preuves empiriques sur la façon dont les exportateurs répondent aux normes publiques imposées par les pays de destination. Il exploite un nouvel ensemble de données sur les entreprises basé sur le registre des douanes au Vietnam. Nous observons que des normes plus strictes sur le marché de destination d'un produit ont un effet négatif sur les marges extensives des exportateurs vietnamiens. Les normes strictes sont également associées à des prix et à une qualité de produit plus élevés pour les exportateurs. Ces résultats contribuent à équilibrer le rôle des normes d'importation pour les exportateurs des pays en développement, représentant à la fois des barrières non tarifaires mais aussi des catalyseurs de modernisation. Les réseaux de production locaux, mesurés par la présence d'autres exportateurs dans la région desservant le même marché, jouent un rôle dans la réponse des entreprises aux normes sanitaires et phytosanitaires (SPS). La compréhension de cette hétérogénéité sera importante pour les décideurs politiques afin d'optimiser leur stratégie d'exportation dans un environnement commercial de plus en plus hostile.

Le troisième chapitre présente des preuves empiriques selon lesquelles l'expansion d'Internet joue un rôle dans l'augmentation du niveau de concentration des exportations. À ma connaissance, il s'agit de la première tentative d'explication de l'émergence de "superstars de l'exportation" liées aux avancées technologiques. En utilisant des données de transactions douanières au niveau des entreprises de 11 pays en développement, je montre d'abord que la diffusion de l'adoption d'Internet est associée à une concentration accrue des ventes à l'exportation parmi les principaux exportateurs. Ensuite, les superstars en place sont également plus susceptibles de conserver leur statut grâce à un meilleur accès à Internet, créant ainsi un cycle auto-renforcé de concentration croissante. Pour

ces deux résultats, l'impact est plus fort pour les exportations de biens différenciés à forte intensité d'information que pour les exportations de biens homogènes - ce qui suggère le rôle des frictions informationnelles dans l'explication des résultats.

Dans l'ensemble, ces résultats soulignent que les décideurs politiques doivent mieux comprendre les conséquences de l'évolution de l'environnement commercial mondial. Ces mégatendances peuvent affecter fondamentalement les modèles d'exportation des pays en développement à l'avenir : le type de biens et de partenaires commerciaux, le type d'entreprises qui exportent et leur part dans les ventes globales, la durée et l'échelle des relations d'exportation, ainsi que les bénéfices que les pays tirent des activités d'exportation. Dans ce processus, ils créeront inévitablement des perdants et des gagnants. Les stratégies de développement axées sur les exportations doivent donc réévaluer les aspects économiques des mesures existantes dans ce nouveau contexte et actualiser leurs leviers politiques en fonction de cette nouvelle réalité.

En cherchant des preuves de causalité, ces articles de recherche n'ont réussi à évaluer chacune des mégatendances que sous un angle étroit. S'inspirer d'événements passés présente également le risque que leur dynamique ne soit pas une indication parfaite de l'avenir. Par exemple, le troisième chapitre documente l'impact d'Internet à un stade antérieur de la numérisation. En outre, la dépendance de la thèse à l'égard des registres douaniers empêche les trois articles d'analyser d'autres flux importants en dehors du commerce formel de marchandises. Le commerce des services est devenu de plus en plus important, notamment avec l'accélération rapide de l'économie numérique. En outre, les registres officiels des douanes négligent le rôle du commerce transfrontalier informel, une caractéristique importante pour de nombreux pays en développement. L'interaction entre ces flux et les politiques publiques reste complexe et actuellement peu étudiée.

À l'avenir, les conclusions et les méthodologies de cette thèse pourraient contribuer à étendre la recherche dans plusieurs directions. Alors que les trois chapitres ont traité

chaque mégatendance séparément, les intersections de la numérisation, du protectionnisme et du régionalisme peuvent s'avérer des domaines de recherche fertiles. En outre, l'exploitation de l'ensemble des données du registre des douanes vietnamiennes de façon plus approfondie et leur mise en relation avec d'autres bases de données relatives aux entreprises et à leur localisation peuvent nous aider à mieux comprendre les réponses hétérogènes des entreprises à ces mégatendances.

Le reste de cette introduction fournit un résumé détaillé de ces trois chapitres. Les chapitres sont conçus comme des éléments indépendants les uns des autres. Les articles et les chapitres sont donc utilisés de manière interchangeable.

Chapitre 1

La récente Zone de libre-échange continentale africaine (ZLECAf) a suscité de grandes attentes sur le continent, qui espère qu'elle contribuera à diversifier le panier d'exportation de l'Afrique. Les dirigeants africains se sont explicitement engagés à "promouvoir le développement industriel par la diversification et le développement des chaînes de valeur régionales, le développement agricole et la sécurité alimentaire" (UA, 2018). Pour être à la hauteur de cette ambition, les pays acceptent non seulement de libéraliser les droits de douane, mais aussi de coopérer dans d'autres domaines essentiels, comme la levée des barrières non tarifaires et la facilitation de la logistique et du financement du commerce intra-africain.

Malgré son importance politique, la théorie économique ne permet pas de savoir si cette politique est l'outil approprié pour la diversification. D'une part, la théorie traditionnelle du commerce suggérerait que la politique commerciale conduirait à une concentration encore plus forte, les pays pouvant mieux exploiter leurs avantages comparatifs. D'autre part, des coûts commerciaux moins élevés pourraient réduire les seuils de productivité

nécessaires aux entreprises pour commencer à commercer de manière rentable, améliorant ainsi les marges extensives des exportations globales.

Il existe donc un besoin évident de travaux empiriques dans les contextes africains. La littérature existante souligne l'importance du contexte local et la spécificité de chaque accord pour l'impact commercial des accords commerciaux régionaux. Par ailleurs, certains aspects de la dynamique des exportations restent peu étudiés. À notre connaissance, seule une poignée d'études ont analysé la durabilité des exportations dans un contexte africain, bien que l'Afrique ait le plus haut niveau de renouvellement des relations commerciales parmi les régions du monde (Kamuganga, 2012 ; Cadot et al., 2013).

Cet article apporte de nouvelles preuves sur le cas du Rwanda qui a rejoint l'Union douanière de la Communauté d'Afrique de l'Est (CAE) à la mi-2009. Parmi les huit communautés économiques régionales existantes en Afrique, la CAE partage les caractéristiques les plus similaires à la ZLECAf en termes de profondeur des accords et de diversité des pays membres. En outre, étant donné que le Rwanda doit accepter les conditions préalablement négociées par les membres initiaux de la CAE, la variation de la grille tarifaire fournit une source d'exogénéité pour évaluer l'impact causal des changements de politique.

Nous exploitons les flux commerciaux bilatéraux désagrégés pour les exportations du Rwanda pendant la période 1998-2020 pour comprendre l'impact de l'adhésion à la CAE sur la dynamique des exportations du Rwanda. Au-delà des indicateurs statiques de diversification des exportations, nous évaluons la réponse au niveau des flux produit-destination, ce qui permet de contrôler les caractéristiques dynamiques de chaque flux, comme le niveau de familiarité avec les produits et les destinations.

Nos résultats montrent que l'adhésion à la CAE a élargi le panier de produits exportés par le Rwanda vers ce marché. Tout d'abord, l'adhésion à la CAE a augmenté de 5,4 points de pourcentage (p.p.) les exportations du Rwanda vers les pays du bloc. À titre

de comparaison, l'adhésion à l'accord de libre échange du COMESA n'a augmenté les exportations du Rwanda vers ces pays que de 0,1 p.p.

Deuxièmement, la CAE accélère le processus de renouvellement des relations d'exportations du Rwanda, en augmentant les entrées sur le marché d'exportations de 3,4 points de pourcentage et les sorties de 2,2 points de pourcentage. En se concentrant uniquement sur la composante tarifaire, nous constatons que les produits qui ont bénéficié d'une réduction tarifaire plus importante ont connu des taux d'entrée et de participation plus élevés, mais pas de durabilité des relations commerciales dans le temps. Ce résultat est conforme aux modèles existants d'hystérésis commerciale dans un contexte d'incertitude (Baldwin, 1990 ; Baldwin et Krugman, 1989). En réduisant le coût irrécupérable des activités d'exportation, la coopération régionale peut simultanément inciter les entreprises à changer leur statut d'exportateur - c'est-à-dire que les non-exportateurs entrent sur le marché tandis que les exportateurs actifs le quittent.

Troisièmement, l'adhésion a eu un impact positif sur la diversification du commerce des biens intermédiaires et des produits non traditionnels, bien que cet impact soit considérablement plus faible que celui du commerce des biens finaux et des biens traditionnels, respectivement. Nous trouvons également des preuves que l'adhésion à la CAE n'a pas entraîné une baisse des taux de participation ou d'entrée des exportateurs rwandais dans des destinations similaires à la CAE. Cela suggère que l'impact de l'adhésion sur les exportations à destination de la CAE n'est pas dû à un détournement des échanges vers d'autres destinations.

Les résultats suggèrent un optimisme prudent quant à l'utilisation des accords commerciaux pour faciliter la diversification des exportations. Ils confirment le potentiel de la connexion des marchés régionaux pour réaliser la diversification du continent. Cependant, ils peuvent ne pas contribuer à accroître la durabilité des relations d'exportation. Le processus de renouvellement peut être un élément naturel du processus de découverte

des exportations, au cours duquel les exportateurs du Rwanda en apprennent davantage sur leur compétitivité par rapport au marché mondial. Dans la mesure où la résilience a gagné en importance politique suite à la pandémie de COVID-19, cette dynamique doit être prise en compte.

Chapitre 2

Les normes sanitaires et phytosanitaires (SPS) sont de plus en plus utilisées depuis 2000. Le nombre de nouvelles notifications à l'Organisation mondiale du commerce (OMC) liées à l'application de normes SPS a presque quadruplé entre 2000 et 2019 avant d'atteindre un niveau record en 2020. Ces normes jouent un rôle majeur pour les exportateurs des pays en développement en particulier. Elles sont plus courantes pour les produits agroalimentaires, qui constituent une part importante des exportations des pays en développement. En outre, les exportateurs des pays en développement sont plus susceptibles d'être confrontés à des problèmes de capacité de mise en conformité lorsqu'ils s'adaptent aux normes d'importation (souvent plus élevées) imposées sur les marchés à revenu élevé.

D'un point de vue théorique, la littérature actuelle suggère deux rôles opposés des normes d'importation sur le commerce international. Une première approche considère les normes comme des obstacles non tarifaires au commerce en raison du coût de conformité plus élevé. La possibilité de rejet à la frontière en raison de la sécurité sanitaire des aliments introduit une incertitude supplémentaire pour les exportateurs potentiels (Bees-termöller et al., 2018). Dans un même temps, les normes réglementaires peuvent également servir de catalyseur pour le commerce (Ponte & Ewert, 2009 ; Tokatli, 2013 ; Yeung & Coe, 2015). L'application des normes SPS garantit un niveau de qualité minimum, de sorte qu'elle crée un signal de qualité des produits pour les clients qui aident à stimuler

davantage le commerce. L'effet de la mesure SPS sur le commerce dépend donc la prévalence de ces deux forces opposées, et appelle donc une étude empirique.

La littérature a évalué l'impact des normes sur le commerce selon trois grandes approches. La première approche, populaire dans la littérature sur les chaînes de valeur mondiales, implique souvent des études de cas qui se concentrent sur les réponses des entreprises à un changement spécifique des normes. La deuxième approche analyse l'impact transnational des normes dans un modèle de gravité avec des flux commerciaux bilatéraux. Ce document se rapproche le plus du troisième et plus récent volet de la littérature, qui se concentre sur l'hétérogénéité des entreprises en utilisant des données au niveau des entreprises provenant des registres douaniers.

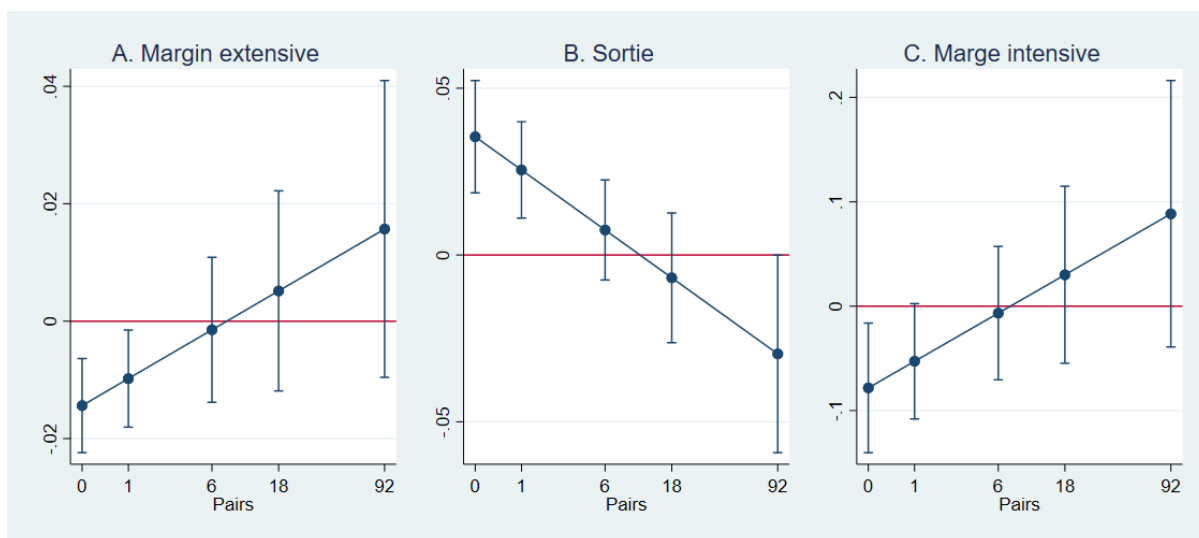
Cet article étudie l'impact des normes SPS sur les exportateurs agroalimentaires vietnamiens existants en exploitant un nouvel ensemble de données basé sur les registres douaniers du Vietnam. L'ensemble de données couvre l'univers des exportations agroalimentaires au niveau des entreprises enregistrées par l'agence douanière vietnamienne entre 2005 et 2011. L'application de normes plus strictes est mesurée par un riche ensemble de données sur les préoccupations commerciales spécifiques (STC) que les gouvernements soulèvent au comité de l'OMC sur les normes SPS. L'ampleur de l'impact est comparable à celui des exportateurs d'autres pays tels que la France et le Pérou, tel que constaté dans la littérature précédente.

Le document montre que l'imposition de normes plus strictes dans les pays de destination affecte les marges commerciales ainsi que la qualité des produits des exportateurs vietnamiens. Premièrement, les exportateurs sont moins susceptibles de participer et plus susceptibles de cesser de desservir un certain produit-destination lorsqu'un problème commercial spécifique lié aux SPS est soulevé à l'encontre de ce marché.

Deuxièmement, les exportateurs qui desservent des marchés où les normes sont plus strictes enregistrent également des prix (exprimés par des valeurs unitaires) et une qualité de produit plus élevés. Nous estimons la qualité des produits au niveau entreprise-produit-destination en exploitant les informations sur les prix des produits et la quantité exportée, conformément à Khandelwal et al. (2013).

Troisièmement, le réseau de production local a une incidence sur la réaction des exportateurs aux normes strictes. Plus précisément, la présence de davantage d'exportateurs de la même région desservant le même produit-destination permet d'atténuer l'impact négatif des normes d'importation sur les marges extensive et intensive du commerce (Image 1). En revanche, l'impact négatif est particulièrement important pour les exportateurs pionniers, exportant vers des marchés de produits de destination où aucun autre exportateur vietnamien ne participe. Lorsqu'ils sont confrontés à des normes plus strictes, les exportateurs ayant plus de pairs sont associés à une meilleure qualité de produit que ceux ayant moins de pairs.

Image 1. Effets marginaux moyens des préoccupations SPS sur les marges commerciales



Notes : Projections linéaires basées sur les résultats des colonnes (4)-(6) du tableau 2.2. L'axe des abscisses indique le nombre de pairs selon différents paramètres : 0 (min), 1 (médiane), 6 (75e percentile), 18 (90e percentile), 27 (95e percentile) et 92 (max).

Ce document fait progresser la littérature sur la réponse des exportateurs aux normes d'importation selon trois directions. Premièrement, il s'agit d'une approche récente et relativement peu répandue qui consiste à évaluer la réaction des entreprises aux normes à l'aide des registres douaniers. La plupart de cette littérature est basée sur l'expérience des exportateurs des pays à revenu élevé. Le cas du Vietnam est instructif, en particulier pour les autres pays en développement, étant donné l'importance du secteur agroalimentaire dans la croissance de ses exportations et la similarité relative du contexte.

Deuxièmement, l'article souligne l'importance du réseau de production local comme source d'hétérogénéité. À cet égard, nos résultats font écho à la littérature sur les chaînes de valeur mondiales qui souligne l'importance du contexte local pour les réponses des entreprises individuelles aux normes d'importation.

Troisièmement, le document explore davantage la relation entre les SPS et l'amélioration de la qualité - une considération critique pour les décideurs politiques. Le processus et les déterminants de l'amélioration de la qualité sont une composante essentielle de l'amélioration économique et un élément important du développement à long terme (voir Verhoogen, 2020 pour une analyse). À cet égard, nos résultats suggèrent un équilibre nuancé dans le rôle des normes SPS en tant que barrières commerciales et en tant que catalyseur de l'amélioration de la qualité.

Chapitre 3

Les ventes à l'exportation se concentrent de plus en plus entre les plus grandes entreprises à travers le monde. Sur un échantillon de 32 pays, Freund et Pierola (2015) constatent que les 5 premières entreprises représentent 30 % des exportations non pétrolières. Dans une étude ultérieure, ils constatent que ces superstars représentent également près de la moitié de la croissance des exportations (Freund et Pierola, 2020).

Cette concentration des ventes à l'exportation a des implications importantes pour les décideurs politiques en ce qui concerne le bien-être des consommateurs, la volatilité macroéconomique, les marges et les inégalités, entre autres. Dans le contexte du COVID-19, comprendre la concentration des entreprises devient un objectif politique important afin d'éviter une exposition excessive aux chocs idiosyncratiques de quelques entreprises et d'éviter les goulots d'étranglement dans la chaîne d'approvisionnement. Malgré son importance, les moteurs de cette concentration croissante restent une question ouverte à la recherche (Freund et Pierola, 2020).

Cet article est le premier à suggérer que l'expansion mondiale d'Internet contribue à la concentration croissante des exportations de biens parmi les principaux exportateurs. Il exploite des informations détaillées sur les transactions d'exportation au niveau des entreprises provenant de la base de données dynamique des exportateurs (EDD) de la Banque mondiale, qui couvre les exportateurs de 11 pays en développement (pour la plupart) dans les années 2000. L'utilisation d'Internet pour les échanges entre deux pays est représentée par le niveau minimum du taux de pénétration d'Internet pour cette paire de pays.

L'article évalue d'abord si l'adoption d'Internet conduit à une distribution plus concentrée des ventes à l'exportation au niveau des entreprises. Il se concentre particulièrement sur l'interaction entre le taux de pénétration d'Internet et l'exposant de Pareto des ventes à l'exportation dans un flux commercial bilatéral. La distribution de Pareto est au cœur des modèles phares de la théorie des entreprises hétérogènes (Chaney, 2008) et il a été démontré empiriquement que la queue supérieure des ventes à l'exportation est plus proche (Nigai, 2017). Grâce à une simple régression log-log des ventes par rangs (classement des entreprises selon leurs ventes), nous pouvons estimer l'exposant de Pareto qui régit la dispersion (hétérogénéité) de la distribution.

Pour évaluer l'impact d'Internet sur l'hétérogénéité des ventes à l'exportation, nous augmentons la régression log-log rangs-ventes avec l'interaction entre le taux de pénétration d'Internet et les rangs de vente. Les résultats suggèrent que la diffusion d'Internet accentue la pente de la relation log-log rangs-ventes parmi les exportateurs dans chaque paire origine-destination. Ce changement implique une distribution concentrée des ventes à l'exportation vers les principaux exportateurs.

La concentration des exportations entre quelques entreprises au cours d'une année donnée n'implique pas nécessairement une dépendance à l'égard des superstars si la composition des entreprises de ce groupe change fréquemment, c'est-à-dire s'il y a un fort taux de renouvellement. En revanche, un "enracinement, où les principaux exportateurs conservent leur domination d'une année sur l'autre, suggérerait une concentration soutenue dans le temps et susciterait des inquiétudes chez les responsables politiques. L'analyse statistique de Freund et Pierola (2020) montre que 71% des cinq premiers exportateurs d'une année donnée figuraient déjà dans le top 1% des exportateurs cinq ans auparavant.

En adoptant un modèle de probabilité linéaire, nous constatons que les superstars de l'exportation en place sont plus susceptibles de conserver leur statut dans un environnement où l'Internet est plus performant. La spécification principale suggère qu'un doublement de l'adoption d'Internet augmenterait de 22,7 % la probabilité que le premier exportateur en place conserve sa position et de 11,7 % la probabilité que les 5 % d'exportateurs en place restent dans le top 5%. Cette augmentation suggère un effet de "retranchement" où l'Internet réduit le renouvellement au sommet de la hiérarchie.

La littérature récente peut aider à concilier ces résultats sous l'angle des frictions informationnelles (Akerman et al., 2021 ; Lenoir et al., 2022). En bref, la connectivité peut modifier le niveau de concurrence auquel sont confrontés les exportateurs en exposant chaque importateur à beaucoup plus d'exportateurs potentiels. Comme les acheteurs peuvent désormais trouver facilement des substituts, la demande devient plus élastique

aux prix - un argument qui remonte à la première règle de la demande dérivée de Hirschman. Les importateurs sont désormais plus susceptibles de s'approvisionner auprès des producteurs les plus productifs qui pourraient offrir les prix les plus bas aux vendeurs à bas coûts. Les exportateurs à forte productivité sont mieux placés que ceux à faible productivité pour augmenter leurs ventes grâce à cette visibilité accrue et accroître leur part de marché. Par conséquent, l'expansion d'Internet devrait accroître la concentration des exportations parmi les superstars.

Dans une extension de nos modèles empiriques, nous trouvons des preuves confirmant l'importance des frictions de l'information comme canal clé de cette relation. Nous constatons que l'impact d'Internet sur la concentration des exportations est plus fort pour les exportations de biens différenciés que pour les exportations de biens homogènes. Le commerce de biens différenciés est généralement plus intensif en information, les vendeurs et les acheteurs ayant besoin de plus de communication pour transmettre les différentes spécifications et caractéristiques des produits. En revanche, les frictions liées à l'information sont moins contraignantes pour les biens homogènes qui se négocient sur des plateformes d'échange de marchandises ou qui utilisent des prix référencés.

Ces résultats remettent en question la littérature existante sur Internet et le commerce international qui souligne son rôle dans la réduction des coûts fixes du commerce (par exemple Freund et Weinhold [2002] et [2004]). Dans le cadre d'un modèle d'entreprise hétérogène tel que celui de Chaney (2008), une réduction des coûts fixes ne ferait que déplacer le seuil des exportateurs actifs dans la distribution, mais pas la forme de la distribution de Pareto elle-même.

Ce document apporte une perspective multi-pays à la littérature empirique qui dissèque l'anatomie et la distribution des ventes bilatérales à l'exportation, comme Head et al.

(2014) et Nigai (2017). Il s'ajoute également à la littérature croissante sur la concentration du marché dans l'économie numérique qui a été documentée dans d'autres domaines tels que l'organisation industrielle (Tirole, 2020) et l'innovation (Paunov et al., 2019).

Chapter 1: Regional integration and export diversification: The case of Rwanda's accession to the East African Community

* This is a joint work where I am the lead author, together with Elisa Saint-Martin (OECD) and Rodrigo Deiana (University of Maryland).

1. Introduction

“Africa must unite or perish!”

– Kwame Nkrumah, at the founding of the Organisation of African Unity in 1963

The entry into force of the African Continental Free Trade Area (AfCFTA) in January 2021 has generated high expectations in its potentials to diversify Africa’s export basket. African leaders have long recognised the importance of regional integration in Africa, initially to achieve self-reliance against the legacies of colonialism and later as a tool for long-term prosperity and development (Aniche, 2020). Despite the long-standing commitment, Africa’s economies remain largely dependent on exports of natural resource and agricultural commodities. The intra-regional share of total trade remains a much smaller in Africa compared to other world regions (AUC/OECD, 2022). In this context, the AfCFTA agreement, the latest and most ambitious effort for creating a single continental market, makes explicit its goal to “promote industrial development through diversification and regional value chain development, agricultural development and food security” (AU, 2018).

A large literature as far back as Prebisch (1950) and Singer (1950) have emphasised the role of export diversification, especially through export entrepreneurship, for economic development. In the context of developing countries in particular, dependence on exports of primary products is associated with the vicious cycle of deteriorating terms of trade, macroeconomic volatility, and depressed long-term growth.

Empirical works such as Klinger and Lederman (2006) and Cadot et al. (2011) argue that export diversification occurs mostly along the product extensive margin (i.e. exporting new products). It first increases and then decreases with income. This process is

similar to the hump-shaped pattern found for production diversification in Imbs and Wacziarg (2003). Following this conjecture, the policy prescription would thus focus on encouraging exporters to tap new product and destination markets. This process creates important information on the cost structure and the potential for the economy to profitably pursue new activities (Rodrik and Hausman, 2003).

However, it is not clear whether regional integration is the appropriate tool for promoting diversification. On the one hand, traditional trade theory would suggest that trade policy would lead to specialisation as countries can better exploit their comparative advantages. On the other hand, lower trade costs could reduce the productivity cut-offs needed for firms to start trading profitably, hence improving the extensive margins of aggregate export (e.g. Chaney [2008]). The theoretical ambiguity thus calls for empirical investigations.

In the context of the AfCFTA, further empirical research on trade agreements with similar characteristics and economic environment could help improve our understanding of its potential impact for export diversification. Previous research highlights the region-specific effects of trade agreements on export dynamics. Existing literature suggests that trade partners matter for export diversification due to supply factors such as endowments (Regolo, 2013) and demand factors such as quality preference (Soderbom and Teal [2003], Fajgelbaum et al., [2013]). The depth of trade agreements also matters. Orefice and Rocha (2014) find a positive link between production networks trade and deep integration in the Asian region, where production sharing is an extremely important phenomenon, but not in other regions such as Africa. So far, rigorous research on this area remains scant for the African context.

This paper fills this gap by exploring the impact of Rwanda's accession to the East African Community's (EAC) Customs Union in 2009/10 on the dynamics of Rwanda's export diversification process. To our best knowledge, the paper is the first to evaluate

the impact of Rwanda's joining the EAC on export diversification. The experience of intra-African trade agreements can be arguably more relevant than most existing literature that focus on trade agreements between African countries and their external partners (e.g. Frazer and Van Biesebroeck [2010]; Fernandes et al. [2019]). Furthermore, among the eight existing regional economic communities, the EAC shares the most similar features with the AfCFTA in term of depth and diversity of member countries (see Section 3.2). Last but not least, the variation in policy effect is largely exogenous to Rwanda's exporters because Rwanda had to adopt the pre-defined *acquis* that were negotiated among the original EAC members.

We exploit disaggregated bilateral trade flows for Rwanda's exports during the 1998-2020 period to understand the impact of joining EAC on Rwanda's export dynamics. We focus on diversification at the product-importer level rather than the aggregate product level diversification due to the emphasis on destination-specific impacts. This approach enables us to account for the characteristics of export flows and the heterogeneity of products. We go beyond assessing static indicators of export diversification to look into the dynamics of export flows such as participation, entry and exit.

Our results show that joining the EAC expanded Rwanda's basket of products exported there but also accelerated the churning process. First, accession to the EAC boosted Rwanda's export participation at the product level to the bloc by 5.4 percentage points (p.p.). For comparison, joining the COMESA FTA boosted Rwanda's export participation by 0.1 pp. Furthermore, EAC accession did not result in lower participation or entry rates for Rwandan exporters in destinations similar to the EAC. This suggests that the impact of the accession on EAC-bound exports is not driven by trade diversion from other destinations.

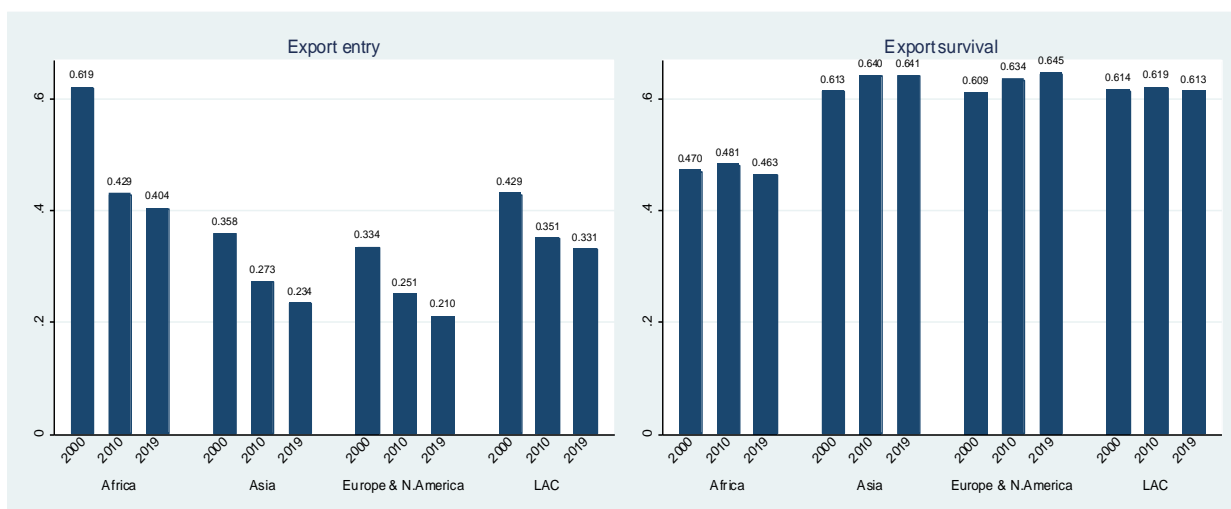
Second, the EAC accelerates the churning process for Rwanda's export – driving up entry by 3.4pp and exit by 2.2pp. This is consistent with existing models of trade hysteresis. Regional cooperation can reduce the sunk cost and uncertainty can simultaneously induce firms to encourage their export status – i.e. non-exporters to enter and active exporters to exit exporting.

Third, the accession had a positive impact for diversifying trade in intermediate goods and non-traditional products, albeit this impact is considerably weaker than that for trade in final goods and in traditional goods, respectively.

In addition to its policy relevance, this paper contributes to the academic literature in several ways. First, the paper adds to the smaller literature that analyses export survival, an important component of export diversification. Existing literature indicate that the ability to maintain export relationships (“export resilience” hereafter) may be even more important for export diversification than exporting new products or targeting new destinations (“export discovery” hereafter). For example, using a panel of bilateral trade data disaggregated by products, Brenton and Newfarmer (2007) show that a high level of export discovery occurs simultaneously with also high level of discontinuation of export relationship. Of the two factors, the survival and expansion of existing export relationships is much more important for export growth than the entry of new ones.

The African context is particularly interesting as the level of churning in Africa is highest among all the world regions. This would suggest that African exporters are active with the experimentation and discovery process, but such efforts are much less likely to survive past the initial attempt (Figure 1.1; World Bank, 2012). A major World Bank publication [Brenton et al, 2012] on export resilience in Africa suggested that “the author needs substantial additional work on the nature and causes of low export survival rates.”

Figure 1.1 Export entry and survival across world regions



Source: Authors' calculation based on data from CEPII's BACI database (2022).

Beyond its importance for export diversification, the focus on resilience becomes even more pertinent in its own rights during the COVID-19 pandemic (Hynes et al, 2020). In the African context, many exporters of agricultural goods did not possess the capacity to deal with trade disruptions and meet the higher sanitary and phytosanitary demands from importers during the crisis (AUC/OECD, 2022).

The links between trade agreements and the longevity of export relationship remain under-studied. The theoretical model from Besedeš et al (2016) point to an ambiguous effect of economic integration agreements on export survival depending on the productivity distribution of the induced exporters. Recalde, Florensa and Degiovanni (2016) find that the depth of trade agreements also matters for export survival.

The rest of the paper is structured as follows: section two reviews existing literature on regional integration and the extensive margin of trade. Section three presents the overall economic and regional integration context in Africa and the East Africa Community, especially with regard to Rwanda's policy objectives and strategic frameworks for development. Section four presents the presents the main empirical strategy. Section five presents results from the baseline model as well as from robustness checks, while section six

dissects the heterogeneity of such impacts. The final section summarizes the paper and concludes with policy implications of the findings.

2. Literature review

Empirical research on export diversification has mostly focused on aggregate measure of diversification at the country level. One approach is to decompose the evolution of export sales for each country into an intensive, the export value of each trade relationship and an extensive margin, typically the number of products or export destinations (Hummel and Klenow [2005]; Helpman et al. [2008]; Cadot et al. [2011]; Baier et al. [2014]). However, this type of measures face two challenges: (1) such measures depend on the arbitrary choice of the first and last year used for comparison, and (2) the static comparison will not be able to capture for the natural churning in traded goods (potentially due to changes in technology or tastes).¹⁹ In term of results, these studies often show the contrasting effects of reducing trade costs on the intensive and extensive margins in term of direction, magnitude and timing of impacts (see for example Dutt et al. (2013), Lawless (2010) and Santos-Silva, Tenreyro and Wei (2014)).

Another approach looks at the extensive margins of trade measured by the (weighted) aggregate number of firms, sectors, or destination countries that export in each bilateral trade flow. However, this approach does not enable us to account for the specificity of export flows from Africa and other developing countries. Exports from Africa are often characterised by a large share of agricultural and natural resource-based commodities marked by volatility in term of both prices and duration (due to agricultural venting practice). Furthermore, trade agreements can have spill-overs effect on exports to third countries through potential trade diversion and learning across products and markets.

¹⁹ A notable exception is Kehoe and Ruhl (2013) who empirically evaluated growth-based measures of extensive margins.

Failing to take into account the specificity of trade experience can lead to omitted variable bias.

Following Frazer and Van Biesebroeck (2010) and Fernandes et al (2019), we adopt a different approach by analysing the dynamics of product-destination flows over time. We focus on export participation, entry and survival as the main measure for the extensive margin. Compared to the aggregate approaches, analysing at the flow level helps accounting for the heterogeneity of export flows across countries by explicitly accounting for their specific characteristics. “Learning by exporting” may dynamically alter the evolution of export relationships, and such phenomenon may particularly be relevant in developing country’s context such as Rwanda’s where the scope for learning is higher.

Most existing trade models converge that trade liberalisation is expected to enhance export entry – i.e. new export relationship at product-destination level - through lower fixed and variable cost of trade. By reducing trade cost, trade agreements would induce new firms to enter export markets as the benefit now outweighs the cost (see for example, Chaney [2008] and Krugman [1980]).

In comparison, the theories, and empirics regarding the impact of trade agreements on survival are more ambiguous. In reviewing the literature on trade margins, Baier et al (2019) concluded that “[r]aising the sustainability of exports (which requires an understanding of the reasons for their low survival) is one underexplored margin of trade support.”

Most theoretical models on export dynamics relate to the model of investment under sunk cost and uncertainty to explain the phenomenon of “trade hysteresis” or trade stickiness. Under these assumptions, high market entry costs can discourage exporters from discontinuing existing trade relationships even if such activities are no longer profitable. This theory was notably used to explain the resilience of exporters in foreign

markets in the context of exchange rates shocks (Baldwin, 1990; Baldwin and Krugman, 1989).

Uncertainty also plays an important role in explaining trade hysteresis following Dixit (1989). It can originate from different sources including foreign demand (Nguyen, 2012; Albornoz et al., 2012), costs (Freund and Pierola 2010; Albornoz et al., 2012) or the inability to settle international dispute due to weak institutions in partner countries (Araujo et al., 2016). The inability to predict the future outcome of a trade relationship leads buyers to start with small purchases and eventually increase the purchase value if the supplier manages to meet buyer's expectations or end the relationship otherwise (Rauch and Watson, 2003).

In this regard, regional integration efforts such as the EAC may reduce the incidence of trade hysteresis. Harmonising product standards and mutual recognition agreements reduce the need for producers to make additional investments to adapt existing products to requirements of the new market. By reducing the market entry cost (which will be sunk upon exporting), trade agreements such the EAC can simultaneously incentivise both new marginal firms to export and existing exporters to discontinue unprofitable activities.

Furthermore, several studies suggest that trade agreements could also reduce the uncertainty involved in exporting – thus alleviating hysteresis. For example, WTO membership can provide assurance about host government's commitment toward creating a level playing field for foreign products and thus create certainty about market access (Bagwell and Staiger, 2001). Dutt et al (2013) show that joining the WTO improves the extensive margins for countries, and they allude to this channel as the most important driver. Similarly, Handley and Limão (2015) show that Portugal's accession to the European Community helped remove uncertainty about future European trade policies. The accession boosted Portuguese export sales and increased export entry in new product lines.

In contrast to theoretical predictions of the trade hysteresis model, early empirical studies on trade agreements and export survival would indicate a positive impact of trade agreements on export survival. Besedeš and Blyde (2010) find that free trade agreements increase the survival of bilateral export flows from Latin American countries during the 1975-2005 period. Similarly, Kamuganga (2012) finds a positive impact of African regional trade agreements on the survival of bilateral export flows, with the depth of the arrangement playing a significant role. These studies both adopt the Cox proportional hazard model following path-breaking work by Besedes and Prusa (2006a).

More recent literature points out several shortcomings in using a continuous-time survival model such as Cox regression for this application (see Hess and Persson [2012] for a summary). First, bilateral trade data is often recorded at yearly interval, with the majority of trade flows discontinue in the first or second year. The presence of many tied duration times will bias the coefficient estimates and standard errors. Second, due to the incidental parameter problem, the Cox model cannot control for unobserved heterogeneities across trade flows via high dimensional fixed effects. Third, the Cox model imposes the restrictive assumption of proportional hazards whereby the effect of the explanatory variables (such as trade policy) on the hazard rate is constant over time. A number of empirical studies based on bilateral trade data show that this is not the case.

Later studies that correct for this methodological concern suggest a more nuanced, if not contradictory, impact of trade agreement on export survival. Adopting a linear probability model, Carrère and Strauss-Kahn (2017) find that preferential trade agreement leads to higher entry but also lowers survival. This implies that easy market access disproportionately induces the entry of non-performing exporters. Similarly, Besedeš et al. (2016) results show that economic integration agreements help existing export relationships become longer and grow more, while new relationships are shorter, grow less, and start with smaller values.

3. Economic and policy context

3.1. Trade and regional integration in Africa

Regional integration has been a longstanding objective for Africa's policy makers. Inter-governmental co-operation is nothing new, with a variety of regional bodies and institutions covering issues from peace and security to natural resource management or shared monetary policy (Lawan and Deiana, 2018). In the years following independence, pan-Africanism and continental unity was a key component of the strategy for decolonisation and the struggle against neo-colonialism (Aniche, 2020). In recent years, regional integration serves to facilitate economic transformation and diversification.

The continental integration agenda follows the vision of an African Economic Community (i.e. a single African market) by the year 2028 as a result of six successive stages. In 1991, African Heads of State and Government signed *the Treaty Establishing the African Economic Community* (also referred to as the Abuja Treaty), which provides the guiding principles and goals, and a continental framework to implement the integration agenda. Milestones in this agenda include: (i) stronger coordination and collaboration among regional economic communities (RECs); (ii) trade policy harmonisation and free trade regimes (including through a customs union); and (iii) common sector policies as well as harmonised fiscal and monetary policies.

The Abuja Treaty framework created regional integration arrangements or encompassed pre-existing arrangements, which then became building blocks of the African Economic Community. Creating blocs in the form of RECs, such as the Economic Community of West African States (ECOWAS), the East African Community (EAC), the Southern African Development Community (SADC), would allow countries to integrate sub-regionally before merging the eight RECs to form the African Economic Community (Pearson, 2019). The Abuja Treaty formalised and articulated the integration process, building

on the RECs to establish the AEC through “the co-ordination and harmonisation of activities among the existing and future economic communities.”

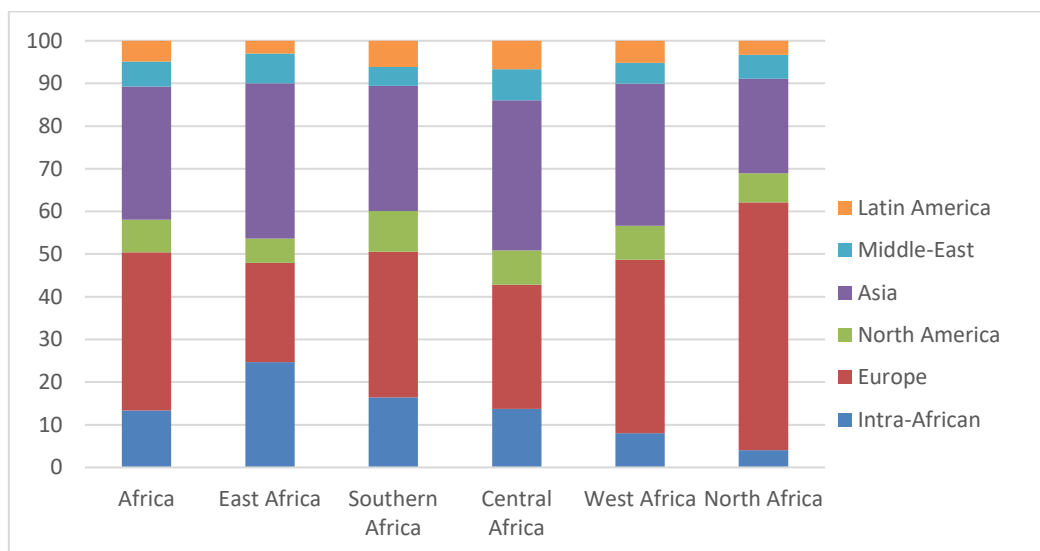
Since 2018, progress towards a single African market has been accelerating. The AfCFTA became operational in July 2019 and officially came into force in January 2021 with the objective to contribute to Africa’s development and strengthen resilience to external shocks. In particular, it aims to create a single continental market for goods and services and expand intra-African trade in order to diversify economies and boost mutual reliance through regional value chains.

Despite the various initiatives, Africa remains a highly fragmented set of national markets. Firms remain segmented by destination market and rarely achieve scale efficiency by serving customers of one single country. African firms’ exports to intra-African markets are 4.5 times more diverse than those to extra-African markets but have a value of just under 12% of exports to China (AUC/OECD, 2019). Exporting to multiple neighbouring markets therefore becomes crucial to achieving economies of scale and operating more efficiently and sustainably.

Intra-African trade lags behind other regions due to weak economic integration and limited regional production networks. While on the rise in the last two decades, intra-African merchandise exports still make up less than 16% of the total, compared to 63% in Europe (EU-28) and 58% in Asia (UNCTAD, 2021). Trade in intermediate goods stands at only 4.1% of GDP in Africa, compared to 24.2% in Asia and 16.6% in the European Union (AUC/OECD, 2018). These low levels of regional sourcing for inputs underscore the low level of value chain integration both regionally and globally. Indeed, since the mid-1990s, Africa’s share in global value chain (GVC) participation has hovered around 1.4-2.2%. The share of intra-African value addition in exports is highest in East Africa

at 25%, driven by the development of the East African Economic Community (Figure 1.2).

Figure 1.2. Sources of value addition in African exports



Source: AfDB/OECD/UNDP (2014) *Africa's Economic Outlook 2014*.

The way trade is regulated therefore plays an important role in determining the success of African exporters. This paper looks at economic integration in the continent, focusing on regional organisations built around “a reciprocal reduction in tariffs and non-tariff barriers” (de Melo, Nouar and Solleder, 2017) and the subsequent steps towards a single market. Ex-ante modelling of the AfCFTA suggests that tackling non-tariffs barriers and implementing trade facilitation reforms would increase intra-Africa trade by between 50% to 132% and GDP gains by between 1 to 4% (World Bank, 2020).

In particular, the extensive margin plays an important role for growth of Africa's export. Diversifying exports remains a challenge for most African economies who continue to rely primarily on commodity exports (44 countries out of 54 in 2019), hindering their economic development and resilience (UNCTAD, 2019). Africa is one of the few world regions experiencing export growth at the extensive margin, with most countries exporting new products or targeting new markets. Over the 1995-2005 period, 43% of the export growth in sub-Saharan Africa came from the extensive margin (Brenton and

Newfarmer, 2007). At the firm level, African firms have been trying to diversify their exports, but only 18% of the continent’s new exporters survive after their third year compared to 22% of exporters in other developing countries (AUC/OECD, 2019).

Table 1.1 offers a preliminary look into Africa and EAC countries’ export dynamics compared to other developing regions. In 2000, Africa exported to 91 countries a total of 1 607 products (proxied by the number of HS 6-digit subsection) and engaged in 23 798 active export relationships (defined as product-destination pairs). In 2018, these figures grew to 122 destinations, 1,679 products and 27,754 active export relationships. However, this represents a slowdown compared to 2010, which could suggest the limited survival associated with the export discovery process.

Table 1.1. Count of export destinations, products and relationship

	Destinations			Products			Active export relationships			Annual export growth (%)
	2000	2010	2018	2000	2010	2018	2000	2010	2018	2000-18
<i>Africa</i>	91	118	122	1 607	1 795	1679	23 798	29 220	27 754	10.4
<i>Developing Asia</i>	143	158	153	3 047	3 093	3038	86 283	174 506	195 081	11.7
<i>LAC</i>	114	137	138	2 287	2 380	2252	21 688	30 947	30 823	7.7
Rwanda	37	79	97	69	342	710	97	596	1 282	29.9
Burundi	37	62	68	47	161	161	81	281	315	18.4
Kenya	125	154	169	1631	2 406	2 230	4 505	9 311	8 705	9.0
Uganda	94	134	134	422	1 262	1 285	991	3 197	3 442	12.7
Tanzania	126	148	146	673	1 475	1 718	1 895	4 320	6 272	11.7
<i>EAC average</i>	84	115	123	568	1 129	1 221	1 514	3 541	4 003	16.3

Source: Authors’ calculation based on data from CEPII’s BACI database (2022).

3.2. The East African Community and Rwanda’s accession

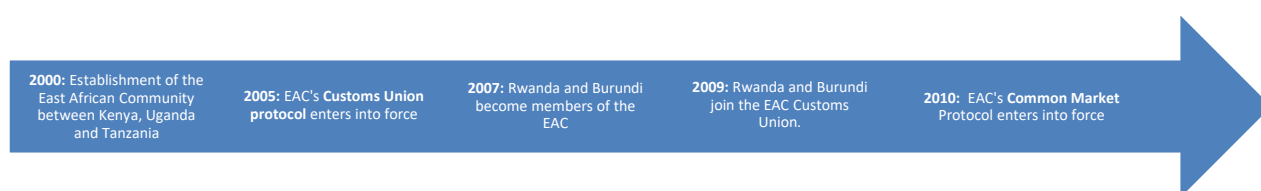
The East African Community is one of the eight RECs recognised by the Abuja Treaty.²⁰

The Treaty establishing the EAC was originally signed by Kenya, Tanzania and Uganda in November 1999, and officially entered into force on July 7th 2000. The three founding

²⁰ The other seven RECs recognised by the Abuja Treaty and the African Union are: the Economic Community of Central African States (ECCAS), the Community of Sahel-Saharan States (CEN-SAD), the Common Market for Eastern and Southern Africa (COMESA), the Economic Community of West African States (ECOWAS), the Intergovernmental Authority on Development (IGAD), the Southern African Development Community (SADC) and the Arab Maghreb Union (UMA).

members then deepened their integration process by establishing a Customs Union in 2005, which would become fully operational after five years. In 2007, Rwanda and Burundi became members of the EAC and began implementing the Customs Union in July 2009 (MINEAC, 2012). In 2010, the Customs Union became fully operational, launching a five-year transition period to implement the EAC Common Market (see Figure 1.3). However, in effect, the complete operationalisation of the EAC Customs Union remains ongoing, delaying the implementation of the Common Market. In 2016, South Sudan joined the EAC as the sixth member state. In March 2022, the Democratic Republic of the Congo joined the EAC as the seventh member state.

Figure 1.3 Timeline of Rwanda’s accession to the EAC



Among the existing efforts for regional integration in Africa, the EAC experience is the most relevant for two reasons.

First, the EAC is a “deeply integrated” regional bloc – a single market with free movement of goods, services, capital and people (albeit with some frictions). As a single market, the EAC conducts trade policy as one bloc. All countries apply a Common External Tariff (CET) to goods imported from outside the region, while intra-EAC exports enjoy duty free access.²¹ Furthermore, policy and regulatory harmonisation cover all sectors, from financial markets to education, from agricultural standards to tourism.

²¹ Reality is never that simple, with overlapping REC memberships (40 African countries are members of more than one REC) and Rules of Origin requirements painting a more complicated picture. However, this paper focuses on exports originating from within the EAC, thus sparing the authors – and the reader – a long-winded discussion on legal and trade policy requirements.

Recent literature emphasises the importance of free trade agreements' depth in reshaping trade flows. For instance, Mattoo, Mulabic and Ruta (2017) find that countries involved into "deep" trade agreements (i.e. covering additional policy areas such as trade remedies and subsidies, intellectual property rights, and standards) saw their bilateral trade increase by up to 44%. Their results suggest that signing a preferential trade agreement with the "highest depth" would increase bilateral trade by approximately 12.5%. At the same time, and perhaps of greater relevance for our analysis, deep provisions such as labour market regulations, visa regimes and taxation were found to have increased trade between 44% and 164% among European Union countries.

Second, EAC member countries are more representative group for African countries with both least developed countries (Burundi, Rwanda, Tanzania, and Uganda) and middle-income country (Kenya). In contrast, the other custom union in Africa, SACU, comprises of only middle-income countries (as Botswana, Eswatini, Lesotho, Namibia and South Africa). Given that the gains from trade often depend on countries' comparative advantage, this similarity between the EAC and Africa helps strengthen the comparison.

Rwanda's accession to the EAC Customs Union in 2009 meant the country had to adopt a pre-existing framework. All EAC Partner States apply the CET to goods imported from outside the region. The CET and other fundamental rules were negotiated and put in place by the three EAC founding members, Kenya, Tanzania and Uganda, and constitute an *acquis*²² accepted by new members. Thus, Rwanda's accession to the EAC involved three major shifts from its national trade policy (TMEA, 2014):

- i. First, the EAC Common External Tariff replaced Rwanda's traditional tariff structure (0% tariff for raw material, 5% on goods with economic importance,

²² The term is often used in the context of *acquis communautaire* and refers to the body of legal rules and provisions of the European Union which countries must abide by in order to maintain or achieve membership. For a basic explanation, see Hilf (2009).

15% on semi-finished goods and 30% on finished goods) with a three-band structure (0% on raw materials, 10% on semi-finished goods and 25% on finished goods). Overall, the tariff structure of Rwanda became much more extreme as 90% of trade with non-EAC members is either at zero tariffs or at very high tariffs (>25%). The CET also introduced a “Sensitive Items” list, which is re-negotiated annually and allows for tariffs above 25% for selected goods (e.g. 100% on sugar, 35-75% on wheat, 60% on dairy products).

- ii. Second, regional integration efforts are also striving to address non-tariff barriers affecting intra-EAC trade. The EAC treaty allows for 16 areas of cooperation. Some areas such as cooperation over standardization, quality assurance, metrology & testing could reduce the barrier to entry for producers. Some other areas such as gaining access to the East African court of Justice may also reduce the risks and uncertainties for Rwanda exporters in tapping the regional markets. Another example is the establishment of a Single Customs Territory (SCT) between Kenya, Uganda and Rwanda. Under the SCT, countries streamlined regulatory procedures and introduced electronic cargo tracking. As a result, road freight costs from Mombasa (Kenya) to Kigali decreased by over 30% while travel times halved (NCTTCA, 2017). A cost-benefit analysis of the SCT found time savings with an economic value of USD 13.38 per hour along the corridor (Vanguard Economics, 2017).
- iii. Third, changes for intra-EAC trading rules appears most significant for trade with Tanzania, with which Rwanda had no agreements in place (see **Error! Reference source not found.**). In contrast, trade with Uganda already benefited from a bilateral preferential trade agreement entailing an 80% reduction on MFN tariffs. Likewise, trade with Kenya and Burundi could qualify for the Common Market for Eastern and Southern Africa (COMESA) FTA, which meant that most products were already eligible for duty free trade. Rules of origins in EAC and

COMESA FTA are also fairly similar in design and eligibility threshold (Draper et al., 2016).

- iv. Fourth, intra-EAC transport costs were removed from the calculation of Cost, Insurance and Freight (CIF). While significant from a technical standpoint, this last implication plays a minimal role in the analysis carried out by this paper.

Table 1.2. Summary of trade policy implications of Rwanda’s accession to the EAC

Trade partners	Pre – EAC Trade	Impact of the EAC on trade	Impact on CIF
EAC Countries			
• Kenya and Burundi	COMESA-FTA duty free trade	New rules of origin	Zero transport cost included
• Tanzania	MFN Tariffs	From MFN to duty free; new rules of origin	
• Uganda	Preferential tariffs	From preferential to duty free; new rules of origin	
COMESA-FTA (Non-EAC)	COMESA-FTA, duty free	No change; duty free trade continues	Only transport up to the EAC border included
All other countries	MFN Tariffs	New MFN tariff code (EAC-CET)	

Source: Author’s compilation.

3.3. Rwanda’s economy & export structure

Rwanda’s economy is one of the fastest growing in Africa. GDP growth was 9.5% in 2019 and expected to remain in the 6-8% range over the medium term despite the impact of the COVID-19 crisis during which Rwanda’s economy contracted by about 3.4%% according to IMF’s projections (IMF, 2022). Growth was broad-based, led by strong public investment and with low and stable inflation and limited currency depreciation (World Bank and Government of Rwanda, 2020). After a 34% jump in 2017, exports stagnated in 2018 (+0.8%), highlighting the country’s exposure to volatility in regional and global demand.

Rwanda’s production structure is polarised between agriculture – the largest sector by employment – and services – the largest sector by output. The country aims to become a service-oriented and knowledge-intensive economy, betting heavily on industries such as financial services, ICT and tourism. Service industries make up 21 of the top 30

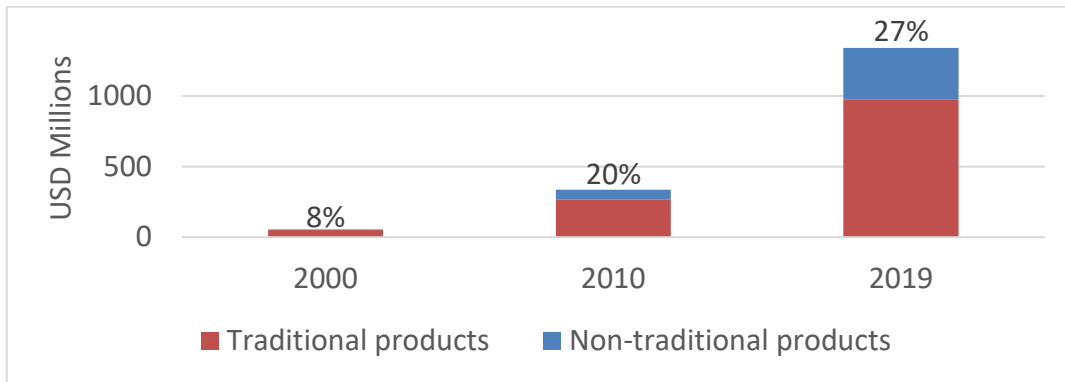
industries in terms of labour productivity (Newfarmer, Page and Tarp, 2018). Tourism receipts account for over 16% of total exports of goods and services, well above both the global (5.7%) and continental (8%) average (Gereffi, 2015).

While Rwanda is historically a country with a small export base, the country stands out for its exceptional rate of sustained export growth since 2000, averaging 17% per year. Over the same period, its share of exports as a percentage of GDP increased from 6% to 18%. However, even with this level of growth, Rwanda's share of exports over GDP remains below the average (around 25%) for countries with comparable income levels (World Bank and Government of Rwanda, 2020). Being a small landlocked country with a nascent consumer class, Rwanda cannot exclusively rely on its domestic market to upgrade its productive inputs and capabilities in different sectors and increase production sophistication for different products.

Rwanda's reliance on a few established export products (such as coffee, tea and minerals) makes the country vulnerable to price fluctuations and weather shocks. However, the level of concentration has declined over time. Exports of "traditional products", defined as those exported in at three years during the 1996-2000 period, represented 92% of Rwanda's export in 2000 and were down to 73% in 2019. In contrast, the share of non-traditional products increased from 8% in 2000 to 27% in 2019 (see Figure 1.4). This is partly due to the rapid expansion in the export of other goods including live animals, non-processed agricultural goods, plastic products, construction materials, and beverages, mostly exported to neighbouring markets (especially the EAC). In addition, the increasing share of re-exports transiting through Rwanda also contributed to this shift. In 2016, they accounted for 30% of total exports with petroleum products constituting more than half of that.²³

²³ While they do not create a lot of value added, these re-exports indicate the country's potential to become a transport hub within the East and Central Africa regions (World Bank, 2017).

Figure 1.4. Composition of Rwanda's export basket, 2010-19

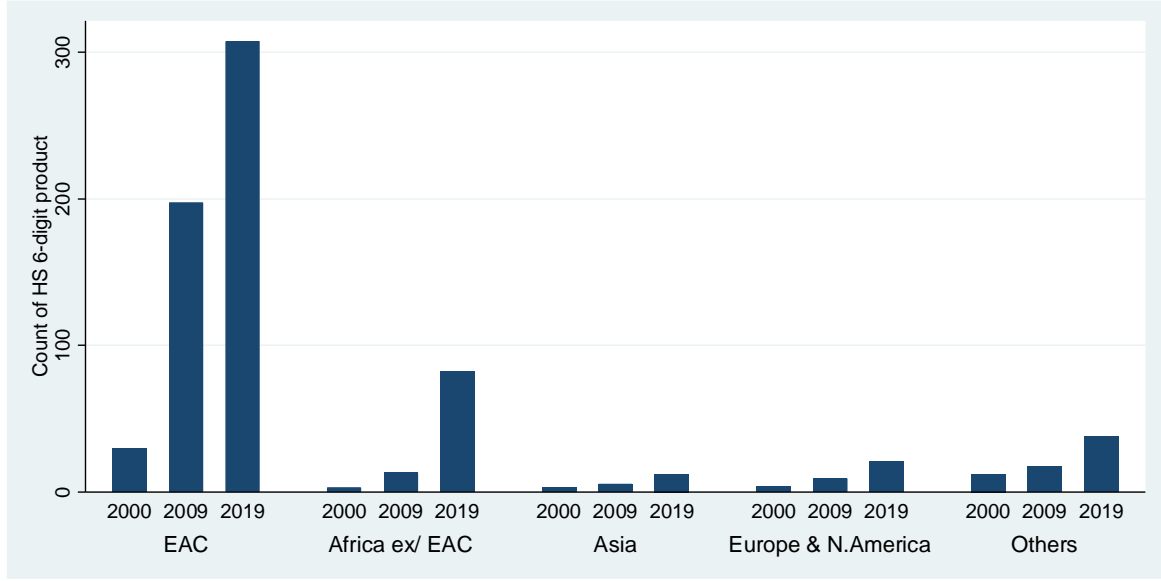


Note: Share of non-traditional products in total export basket is expressed in percentage.

Source: Authors' calculations.

The EAC market is a preferred destination for Rwanda's export (see Figure 1.5). In 2010, Rwanda exported 197 products (proxied by the number of HS 6-digit subsection) to EAC destinations on average. This number increased to 308 products per destination by 2019. For comparison, Rwanda's typically send on average 82 products to other African destinations, 12 products to each Asian countries and 21 products to Europe and North America in 2019. It is important to note that the value per export line is typically much lower for export towards EAC and other African markets. For example, the typical value per export line to EAC destination averages around USD 0.09 million in 2019. In contrast, the value per export line to Asian destination averages at USD 1.43 million, largely driven by Rwanda's gold export to the United Arab Emirates, and (to a smaller extent) tin ores export to Thailand and tea export to Pakistan.

Figure 1.5 Average number of products exported from Rwanda per destination



Source: Authors' calculations based on CEPII (2022) BACII dataset.

4. Empirical strategy

4.1. Participation

We use disaggregated bilateral trade data between 1996 and 2019 from CEPII's BACI database at the 6-digit level to analyse the role of Rwanda's integration to the EAC on several export's dynamics features.²⁴ We limit the product scope to only products and destination markets exported by Rwanda for at least one year during the whole period. We then square the matrix to create all combinations (triads) of 2 742 products across 167 destinations over the whole period that Rwandan exporters could have reached.

Our baseline specification follows the following form:

$$\Pr(Y_{jkt} = 1) = \beta_1 EAC_{jt} + COMESA_{jt} + X_{jkt} + growth_{jt} + \theta_k + \gamma_t + \mu_j + \varepsilon_{j,k,t} \quad (1)$$

²⁴ This dataset draws from data provided by the UN COMTRADE database but applies a harmonisation procedure reconciling mirror flows, providing a more complete and refined geographical coverage of trade flows at product level. It also removes re-exporting which account for a considerable share of Rwanda's trade with East and Central Africa countries. It includes annual information on product, exporter, importer, value and quantity traded between 1996 and 2018.

where Y_{jkt} refers to our outcome variables of interest for Rwanda's export to destination j of product k in year t . When first evaluating the effect on export participation, our dependent variable $Participation_{jkt}$ is a dichotomous variable that indicates positive export flows into a certain product-destination combination.

In this baseline specification, EAC_{jt} is our main explanatory variable of interest. This dummy variable takes the value of 1 for Rwanda's export to other EAC members (Burundi, Kenya, Uganda or Tanzania) after 2010 (the year of Rwanda's accession).

X_{jkt} is a vector capturing dynamic determinants of the exporting experience through spill-over effects of cross-product and cross-destination learning (Chaney [2014]; Cadot et al. [2013]). Following the literature, we include two time-varying measures: *market experience* denoted as the number of products Rwanda exported to a certain country and *product experience* denoted as the number of destinations to which Rwanda exported a certain product in the same year. Both of these count variables are added with unity and transformed into natural logarithm.

Apart from joining the EAC, Rwanda has also been a member of the COMESA Free Trade Agreement since 2004. To tackle concerns over overlapping trade membership, we include a time-varying dummy variable ($COMESA_{jt}$) which indicates if both Rwanda and the destination country are members of the COMESA FTA in the considered year.²⁵ In addition, GDP growth helps capture fluctuation in overall economic and demand condition in the importer country.

It is worth pointing out that the possible reverse causality may not be as large a concern in this application. For example, previous studies suggest that the presence of trade

²⁵ Note that membership of COMESA and COMESA FTA differs slightly across time and country. Information on COMESA FTA membership based on information from COMESA official website (www.comesa.int).

relationship, especially production network trade, increases the demand among the private sector for cross-border policy effects, and hence the realisation of (deeper) trade agreements (see for example Baier and Berstrand [2007]; Antràs and Staiger [2012]). Reserve causality would occur when Rwanda's existing export patterns affect its decision to join the EAC. This is likely not the case. As explained in section 2, regional integration processes in Africa have often been criticised as top-down, driven by high-level political agenda of continental integration, rather than emerged endogenously from trading relationships. Private sector has often been under-represented from the formulation, negotiation and implementation of trade agreements.

We further address endogeneity concerns by employing multiple sets of fixed effects. The product-level fixed effects θ_k help control for various characteristics specific to the product level such as Rwanda's domestic competitiveness and industry-specific elasticity of substitution. The year fixed effects γ_t control for factors such as shocks in Rwanda's macroeconomic condition, changes in overall domestic competitiveness or the effects of the global financial crisis in late 2000s and the COVID-19 crisis in 2020.

The importer country fixed effects μ_j account for time-invariant factors that affect bilateral trade such as geographical distance (in log), common languages, or former colonial relationships. They also control for other factors that are instrumental to export dynamics such as the average development of financial systems and institutions over the period studied, which are unlikely to vary intertemporally (Jaud et al., 2019; Besedes and Blyde, 2010; Araujo et al., 2016).²⁶ Past research shows that trade relationships involving developing countries tend to exhibit shorter export relationships and more limited export

²⁶ Jaud et al. (2019), Besedes and Blyde (2010) and Araujo et al. (2016) find that the level development of financial systems and institutions that support contract enforceability tend to lengthen the duration of export relationships.

growth compared to relationships between developed and/or emerging economies (Fuggazza and Molina, 2011; Hausmann and Rodrik, 2003).

The importer fixed effects also control for unobservable factors that affect Rwanda's decision to sign the EAC agreement such as cultural ties. Furthermore, Rwanda benefited from preferential trade agreements such as U.S.'s African Growth and Opportunity Act (AGOA), EU's Everything But Arms (EBA) and other Generalized System of Preferences (GSPs) granted unilaterally to Least Developed Countries. The destination fixed-effect accounts for the average impact of these preferential treatment as our period of study mostly falls within the time window when these agreements are already in place.²⁷

Nonetheless, this baseline model may yet suffer from omitted variable bias due to time-varying importer-specific characteristics unobserved in the model such as the cost of import procedures at destination. For example, civil conflicts in the destination could disrupt the flows of goods trade from Rwanda. While the time-varying GDP growth rate by destination can somewhat alleviate this concern, research on gravity model would often recommend the inclusion of destination-year fixed effect (Baier et al., 2019). Because our main policy variable varies at destination-year level, the baseline models cannot incorporate importer trend fixed effects.

To address this concern, we run an additional set of regressions that focus on the impacts of tariff cuts as the main policy variable (see equation [2]). While all intra-EAC trade enjoy tariff-free rate following 2010, the initial (pre-accession) tariff levels varied across products. Consequently, tariff reductions vary at product-importer-year level. Focusing on the impacts of tariff reductions allows us to incorporate the importer-year fixed effects (μ_{jt}). The inclusion of these fixed effects absorbs the time-varying variations in destina-

²⁷ As a robustness check, we also employ destination-product heading fixed effects which address the sectoral level heterogeneity in preferential treatment provided by some of these trade agreements.

tion markets. Equally important for our identification strategy is the fact that the variation in tariff cuts is largely exogenous to Rwanda’s exporters because Rwanda had to adopt the pre-defined *acquis*. $Tariff_cut_{jk}$ refers to pre-EAC tariff levels that Rwandan exporters faced in the EAC markets. We obtain effectively applied tariffs in *ad valorem* equivalent (disaggregated at destination-HS 6-digit level) from ITC MacMap database, and average over the 2007-09 period to ensure sufficient coverage.

$$\Pr(Y_{jkt} = 1) = \beta_1 EAC_{jt} \times \ln(1 + Tariff_cut_{jk}) + X_{jkt} + \mu_{jt} + \gamma_k + \varepsilon_{jkt} \quad (2)$$

Despite the benefits, a major drawback of this approach (hence our decision to focus on the baseline model) is that reducing the EAC accession down to tariff reduction would overlook its non-tariff components. For example, regional cooperation to address trade facilitation and non-tariff barriers can affect both exports of products experiencing positive tariff cuts and exports of products experiencing no tariff cuts (those already in in 0% tariff-class prior to EAC accession). A large literature, such as those on the impacts of WTO membership, suggest that cooperation outside tariff accounts for a dominant share of trade agreements’ impact on trade patterns (Bagwell and Staiger, 2001). Focusing solely on tariff reduction is thus likely to underestimate the impact of EAC accession.

Table 1.3 provides summary statistics. Overall, Rwanda only reported positive export flow to 0.3% of destination-product-year triads globally. This share is higher for EAC destinations at 8.4%.

Table 1.3. Summary statistics for regressions on export participation and entry

Sample	Variable name	N	Mean	SD	Min	Median	Max
All destinations	Participation	13866936	0.003	0.055	0	0	1
	Entry	13269336	0.002	0.04	0	0	1
	EAC	13866936	0.006	0.076	0	0	1
	log(1+Tariff cut)	12290989	0	0.007	0	0	0.683
	COMESA	13866936	0.043	0.202	0	0	1
	GDP growth (log)	13866936	0.058	0.134	-0.968	0.059	1.399
	Product experience (log)	13866936	0.253	0.489	0	0	4.159
	Market penetration (log)	13866936	0.913	1.209	0	0.693	7.644
EAC-bound	Participation	188623	0.084	0.277	0	0	1
	Entry	165981	0.033	0.179	0	0	1
	EAC	188623	0.427	0.495	0	0	1
	log(1+Tariff cut)	188139	0.029	0.047	0	0	0.683
	COMESA	188623	0.642	0.479	0	1	1
	GDP growth (log)	188623	0.07	0.088	-0.101	0.077	0.372
	Product experience (log)	188623	0.29	0.533	0	0	4.159
	Market penetration (log)	188623	4.295	1.922	0	4.905	6.51

Source: Authors' calculations.

4.2. Export entry

We expand the analysis to evaluate the impact of joining the EAC on the entry of export flows. To do this, we re-estimate equations (1) and (2) in section 4.1 but with export entry as the outcome variable of interest. Our dichotomous dependant variable $Entry_{jkt}$ takes the value of 1 if Rwanda exports to a product-destination in year t but not in year $t-1$, and takes the value of 0 otherwise.

The rest of the specification employs a similar setup to that used for evaluating export participation. In

Table 1.3, we observe that Rwanda registered new entry in 0.2% of the triads globally, and 3.3% for EAC destinations. However, the sample size is slightly reduced because the information from the first year of the panel (1996) is used to construct the entry condition.

4.3. Export survival

To analyse export survival, we focus on active export relationships from Rwanda instead of looking at all possible destination-product-year combination that Rwanda can export. This approach has been used extensively in the literature looking at the survival of bilateral export flows (such as Besedes et al [2016] and Carrère and Strauss-Kahn [2017]). Following this literature, our dependent variable of interest is $Survival_{jkt}$ - a dummy variable taking the value of 1 when an *export relationship* existing in year t continues to exist in year $t+1$, and 0 if the flow is discontinued in $t+1$.

$$\begin{aligned} \Pr (Survival_{jkt} = 1) = & \beta_1 EAC_{jt} + COMESA_{jt} + X_{jkt} + growth_{jt} \\ & + \theta_k + \gamma_t + \mu_j + \varepsilon_{jkt} \end{aligned} \quad (3)$$

Similar to the previous setups, this model controls for COMESA ownership, product and market experience, destination’s annual GDP growth, as well as product, year and importer fixed effects.

In addition, the vector X_{jkt} includes additional controls for two other types of dynamic experiences that affect export survival. First, a large literature shows that that export flows experiences higher survival rates as they “age”. Using a longer (albeit less granular) panel of bilateral trade data that extend back until 1962, Carrère & Strauss-Kahn (2017) show that surviving the first two years following new entry is most important for long term survival of aggregate export flows from developing countries. To address the survivor bias, we add two dummies to whether the export relationship has just started ($Age_{jkt} = 1$), or in the second year ($Age_{jkt} = 2$), compared against those flows that are more experienced (in the third year or more – omitted from the regression).

Second, we also include initial export value of the export relationship. Sales in the first year of an export flow is commonly assumed as a proxy for the idiosyncratic confidence of buyers and sellers in the potential success of the new partnership. Several empirical studies report that the initial size is associated with a higher probability of survival

(Besedeš and Prusa, 2006a, 2006b; Brenton et al., 2010; Fugazza and Molina, 2011; Albornoz et al, 2012; Stirbat et al, 2015).

Table 1.4 summarises the main variables used in the survival analysis. Focusing on active export relationships considerably reduces the sample size to 41 418 observations. The majority of observed export relationships are of very short duration (see supplementary Figure A.1.1 for a visualisation of hazard rate). Among all 32 991 export relationships, 74.3% of them observed for just a single year; 88.5% of relationships lasted for 2 years or less and only 11.2% of relationships lasted until the third year. Interestingly, the aggregate survival appears similar between Rwanda’s exports to the EAC bloc and Rwanda’s export to the rest of the world.

Table 1.4. Summary statistics for analysis of export survival

Variable	N	Mean	SD	Min	Median	Max
Survival 1 year	41418	0.347	0.476	0	0	1
Survival 2 year	36011	0.209	0.407	0	0	1
EAC	41418	0.279	0.448	0	0	1
log(1+Tariff cut)	38998	0.025	0.052	0	0	0.683
COMESA	41418	0.231	0.421	0	0	1
GDP growth (log)	41418	0.060	0.110	-0.840	0.067	0.778
Product experience (log)	41418	1.518	0.843	0.693	1.386	4.159
Market penetration (log)	41418	4.718	1.711	0.693	4.82	7.644
Age=1	41418	0.667	0.471	0	1	1
Age=2	41418	0.152	0.359	0	0	1
Initial sales (log)	41418	7.214	2.692	0	7.083	17.762

Source: Authors’ calculations.

5. Baseline results & robustness

5.1. Baseline

Column 1 of Table 1.5 reports the impact of EAC accession on export participation using the baseline specification in equation (1). We estimate using linear probability model to avoid incidental parameters problem when controlling for the fixed effects in our model (Olsen, 1980). The coefficient for EAC_{jt} indicates a positive and statistically significant impact: accession to the EAC boosted Rwanda’s export participation to the bloc by 5.4

percentage points. For comparison, Rwanda's exporters participated in only 0.3% of possible product-country combinations during the 1996-2020 period.

The high impact of the EAC variable is particularly striking when comparing with the impact of Rwanda's joining the COMESA FTA, which boosted Rwanda's export participation by 0.1 percentage point. These results are consistent with Mayer and Thoenig (2016) who show that the EAC customs union was more successful than the COMESA FTA and SADC in boosting bilateral trade among their members.

Existing literature offers several factors that could explain the difference. First, globally, Roy (2010) and Hoffman et al. (2017) find that custom unions such as the EAC have positive impact of larger magnitude on trade than FTAs. Second, the stronger cooperation in EAC than in COMESA, especially in infrastructure aspects, could help facilitate trade (see section 3.2). Extrapolating this result to the context of AfCFTA suggests the potential upside from moving the continental integration process towards combining a continental custom union and cooperation on broad arrays of issues.

Other controls in the baseline specification also conforms to previous literature. Market experience has a positive and significant impact on export participation: the coefficient suggests that doubling the number of products exported by Rwanda to a certain destination in the previous year would increase the likelihood for Rwanda to export a given product to that destination by 1.1 percentage point. Similarly, Rwanda is also more likely to participate in a certain destination-product flow if they have strong experience in exporting this product. For a given product, doubling the number of destination that Rwanda exported that product in the previous year would boost the likelihood of participation in any market by 0.5 percentage point.

Table 1.5. Results for the EAC accession's effect on export participation

VARIABLES	(1) Participation	(2) Entry	(3) Survival	(4) Participation	(5) Entry	(6) Survival
EAC	0.054 ^a [0.001]	0.034 ^a [0.001]	-0.022 ^b [0.010]			
COMESA FTA	0.001 ^a [0.000]	0.001 ^a [0.000]	-0.004 [0.024]			
EAC × Tariff cut				0.384 ^a [0.017]	0.229 ^a [0.017]	0.015 [0.075]
Product experience	0.011 ^a [0.000]	0.007 ^a [0.000]	0.022 ^a [0.007]	0.012 ^a [0.000]	0.008 ^a [0.000]	0.014 ^b [0.007]
Market penetration	0.005 ^a [0.000]	0.003 ^a [0.000]	0.035 ^a [0.004]			
GDP growth	0.001 ^a [0.000]	0.001 ^a [0.000]	0.120 ^a [0.026]			
Age=1			-0.185 ^a [0.007]			-0.181 ^a [0.007]
Age=2			-0.135 ^a [0.008]			-0.113 ^a [0.008]
Initial sales			0.018 ^a [0.001]			0.019 ^a [0.001]
Observations	13,866,936	13,269,336	40,758	13,960,498	13,356,563	44,022
R-squared	0.287	0.035	0.335	0.336	0.065	0.408
Product FE	Y	Y	Y	Y	Y	Y
Importer FE	Y	Y	Y			
Year FE	Y	Y	Y			
Importer-Year FE				Y	Y	Y

Note: Robust standard errors: ^a p<0.01; ^b p<0.05; ^c p<0.1

Source: Authors' calculations.

Column (2) reports results of Rwanda's EAC accession on export entry. We find a positive impact of EAC accession in inducing export entry. Integration to the EAC boosts Rwanda's export entry to the bloc by 3.4 percentage points. These results are consistent with past literature where lower trade costs reduce the productivity cut-off and induce marginal exporters to join the export market. This increase is considerable given that the average entry rate for Rwanda's export is 0.2% globally, and 3.3% for exports to EAC markets. Moreover, the effect is higher than that observed by joining the COMESA FTA (at 0.1 pp).

The estimated effects of the controls export entry on are also consistent with previous literature. When having more experience with a certain product/destination increases the entry likelihood. A number of studies demonstrate that exporters can find it easier to reach new market as they gain experience from exporting to other destinations and products. For example, financing to start a new export line can become more accessible when domestic financial institutions are more familiar with the final market and the profit structure of a specific product (Cadot, 2013). As firms engage in a new export relationship, they may also gain access to a new network of potential partners which again help them expand to new markets (Chaney, 2014).

Column (3) of Table 1.5 presents the baseline results regarding the impact of EAC accession on the survival of export relationships. We find a significant and negative impact of EAC integration on the likelihood of export survival for an additional year: accession to the EAC lowers Rwanda's probability of export survival to other EAC member by 2.2 percentage points.

This is consistent with the view that trade agreements reduce trade hysteresis and increase churning. Section 3.3 documents several components of the EAC integration process that could reduce trade hysteresis by reducing the barrier to entry and alleviating uncertainty involved in predicting future profitability. Combining with the baseline results on participation and entry, these results suggest that while trade agreements benefited Rwanda's extensive margins of exports towards other EAC members, these newly created trade relationships were only short-lived.

Other explanatory variables included in our baseline specification align with previous literature on export survival. Product experience has a significant positive impact on export survival: our results suggest that doubling the number of destination that Rwanda exported a given product to in the previous year would boost its probability of survival for an additional year by 2.2 percentage points. Furthermore, new spells suffer lower

survival rate than more experienced ones. Export relationships in their first year face a lower survival likelihood of 18.5 percentage points than those in third year or more. In addition, initial value of exports demonstrates a significant positive impact reflecting the importance of trust and reliability on survival.

5.2. Impact of tariff cuts

We now turn our focus to the impact of EAC-induced tariff cuts on export dynamics. In column (4) of Table 1.5, we estimate the impact of tariff cuts induced by EAC accession on export participation by estimating equation (2). The result shows that following the accession, Rwanda became more likely to export to the EAC the goods that benefited from higher tariff cuts. This additional set of regression confirms our baseline result and implies robustness of the impact even when controlling for the importer-trend fixed effects as demanded in the gravity literature.²⁸ Similarly, in column (5), we find a positive impact of EAC-induced tariff reductions on export entry to the EAC.

Interestingly, we find no impact of tariff cuts on survival (column [6]). While this result may seemingly contradict the negative impact on survival that we found for the EAC accession as a whole, it is actually consistent with models of investment under uncertainty à la Dixit (1989). Tariff reductions affect neither the sunk cost nor the uncertainty involved in exporting – the two components that would affect export exit decision. This result highlights again the importance of evaluating trade agreements beyond the simple tariff reductions component.

²⁸ The inclusion of the importer trend also absorbs several explanatory variables in the baseline model, specifically destination experience, COMESA memberships and GDP growth which vary at the country-year level.

5.3. Robustness

We now test the robustness of the results against alternative model specifications. We first replace the two separate set of fixed effects for products and year with the combined product-year fixed effects. These fixed effects account for product trends such as the evolution of Rwanda’s competitive advantage across products. As a consequence, they absorb the product experience variable. They also account for shocks to Rwanda’s product-specific production such as natural disasters or locust plague. This is particularly important to control for “venting” behaviour where firms only seek to sell their products abroad when there is excess production. This behaviour is particularly commonplace in the agricultural sector, which accounts for the bulk of Rwanda’s export.

Under this setup, the direction of the results is largely similar to those found in section 5.2. We find a positive effect of the accession on export participation and entry, both in the baseline (column [1]-[2]) and in the tariff-reduction model (columns [4]-[5]). EAC-accession as a whole is associated with lower survival rates, but we find no statistically significant impact of tariff reduction on survival – consistent with the baseline model.

Table 1.6. Robustness check with alternative fixed effect specification

VARIABLES	(1) Participation	(2) Entry	(3) Survival	(4) Participation	(5) Entry	(6) Survival
EAC	0.120 ^a [0.001]	0.041 ^a [0.001]	-0.039 ^a [0.009]			
EAC × Tariff cut				0.384 ^a [0.017]	0.231 ^a [0.017]	-0.046 [0.097]
Observations	13,866,936	13,269,336	28,217	13,960,498	13,356,563	31,085
R-squared	0.084	0.034	0.490	0.342	0.070	0.569
Product-Year FE	Y	Y	Y	Y	Y	Y
Importer FE	Y	Y	Y			
Importer-Year FE				Y	Y	Y

Note: Several controls are suppressed from the table for brevity of presentation. All regressions include controls for COMESA FTA and GDP growth. Columns (1)-(3) also control for market penetration. Additionally, columns (3) and (6) also control for export relationship’s age and initial sales. Robust standard errors: ^a p<0.01; ^b p<0.05; ^c p<0.1

Source: Authors’ calculations.

We then replace the destination fixed effect in the last model with product-importer fixed effects. This change could help control for factors such as product-market specific trade costs, the market difference among consumer preferences and minimum standards for each specific product. It also helps account for average tariff rate applied by the importing country to Rwanda's export during the period studied. Particularly, it addresses the sectoral level heterogeneity in preferential treatments that may benefit Rwandan exporters. The results presented in Table A.1.2 are qualitatively similar to that of the baseline.

The slow adjustment of export flows to trade conditions may also create a downward bias on the magnitude of impacts. Trade cooperation may intensify progressively over time both in term of scope and depth. Previous literature also suggested that trade relationship often take several years to start and adjust to new trade agreements. To control for possible contamination, we further interact the policy variable with two time period that the EAC has been in effect (2010-14 and 2015-20).

Table 1.7 summarises the results. While the direction of impact appears consistent with the baseline model, it is worth noting that the magnitude of impact is generally higher in the second half of the 2010's than in the first half. This is consistent with the view that trade agreements take time to materialise their full impact.

Table 1.7. Impact by 5-year period

VARIABLES	(1) Participation	(2) Entry	(3) Survival	(4) Participa- tion	(5) Entry	(6) Sur- vival
EAC 2010-14	0.044 ^a [0.001]	0.032 ^a [0.001]	0.007 [0.013]			
EAC 2015-20	0.064 ^a [0.002]	0.037 ^a [0.001]	-0.040 ^a [0.011]			
EAC × Tariff cut, 2010-14				0.251 ^a [0.023]	0.154 ^a [0.023]	-0.055 [0.103]
EAC × Tariff cut, 2015-20				0.496 ^a [0.024]	0.294 ^a [0.024]	0.078 [0.098]
Observations	13,866,936	13,269,336	40,758	13,960,498	13,356,563	44,022
R-squared	0.287	0.035	0.335	0.336	0.065	0.408
Product FE	Y	Y	Y	Y	Y	Y
Importer FE	Y	Y	Y			
Year FE	Y	Y	Y			
Importer-Year FE				Y	Y	Y

Note: Several controls are suppressed from the table for brevity of presentation. All regressions include controls for COMESA FTA and GDP growth. Columns (1)-(3) also control for market penetration. Additionally, columns (3) and (6) also control for export relationship's age and initial sales. Robust standard errors: ^a p<0.01; ^b p<0.05; ^c p<0.1

Source: Authors' calculations.

The effect of joining the EAC may also be contaminated by trade diversion. Rwanda's accession to the EAC could induce Rwandan exporters to reallocate export sales from other destination to the EAC. This adjustment would inflate the potential trade creation effect of joining the EAC.

To evaluate the robustness of the results against trade diversion, we perform a placebo test. The idea is that trade diversion often occurs across markets at the same level of development where exporters sell similar products. In such case, Rwanda's export to destinations similar to the EAC in the post-accession period would be associated with a lower level of export participation and entry. It would be associated with higher exit rate as well.

We first identify non-EAC destinations that most resembled EAC destinations in terms of Rwanda's export basket in the pre-treatment period. We rank non-EAC destination countries by the total number of products that Rwanda exported both to this destination and to the EAC markets during the pre-2010 period. We then assign a placebo treatment status to the top three developing countries in this list as if Rwanda was forming a custom union with these countries instead. In this analysis, the treatment variable takes the value of 1 for Rwanda's export to Ghana, Malawi and South Sudan since 2010, and the value of 0 otherwise. This analysis would compare the Rwanda's export to these placebo destinations against Rwanda's to the rest of the world (excluding EAC countries).

If trade diversion was driving the results, we would expect the placebo treatment to have a negative impact on Rwanda's export participation and entry. Similarly, the negative impact on trade margins would be stronger for product lines that receive a higher tariff-reduction thanks to EAC's accession. The results reported in Table 1.8 suggests that this is simply not the case. We do not find statistically significant evidence to suggest that the placebo treatment (placebo destinations post-2010) is associated with lower participation nor entry, or with higher survival rate. For certain outcomes, we find that the placebo treatment has a similar effect to those observed among EAC countries. One potential explanation is the positive cross-over when experience gained in EAC markets are reflected in these comparable destinations. Overall, the results strongly suggest that the large responses of Rwanda's export to the EAC in our baseline model are not merely a consequence of redirected exports from other destinations.

Table 1.8. Placebo treatment for destinations similar to EAC

VARIABLES	(1) Participa- tion	(2) Entry	(3) Sur- vival	(4) Participa- tion	(5) Entry	(6) Sur- vival
Placebo dest. × Post-2010	0.000 [0.000]	0.003 ^a [0.000]	-0.096 ^b [0.046]			
Placebo dest. × Post-2010 × Tariff cut				0.100 ^a [0.008]	0.068 ^a [0.006]	0.208 [0.198]
Observations	13602653	13036536	18237	17122009	16413492	21750
R^2	0.143	0.017	0.362	0.200	0.017	0.433
Product FE	Y	Y	Y	Y	Y	Y
Importer FE	Y	Y	Y			
Year FE	Y	Y	Y			
Importer-Year FE				Y	Y	Y

Note: Tariff cut is calculated the average level of tariff cuts across the EAC countries for each product. Several controls are suppressed from the table for brevity of presentation. All regressions include controls for COMESA FTA and GDP growth. Columns (1)-(3) also control for market penetration. Additionally, columns (3) and (6) also control for spell age and initial sales. Robust standard errors: ^a $p < 0.01$; ^b $p < 0.05$; ^c $p < 0.1$.

Source: Authors' calculations.

We also find qualitatively similar results when limiting the sample to Rwanda's exports to other developing countries (Table A.1.3). The idea is that Rwanda's export to other countries at lower level of income and development serve as a better control group against exports to other EAC countries. Rwanda's export to high income countries can be structurally different from export to other developing countries due to the difference such as consumer preferences and product standards. For example, sales per product for Rwanda's export to EAC countries are more similar to sales per product for export to other developing countries.

6. Heterogeneity of impact

6.1. Intermediate goods

In this section, we assess the heterogeneous impacts of the EAC on products of different end-use (i.e. final goods vs. intermediate goods). This is important as African policy-makers are looking at the AfCFTA as a major tool to develop regional value chains in

Africa. For example, the South African government recently announced that they are switching their focus from tapping global value chain to positioning South Africa as a base for the regionalisation of global supply chain (Nomalungelo, 2022).

Previous studies suggest that the impact of trade agreements may differ between goods for final consumption and intermediate goods for further production. For example, Freeman & Pienknagura (2019) point out that while economic integration agreements promote trade in all goods, intermediate goods tend to benefit more given their reliance on certainty over logistic and supply chains as well as trust and reliability among production partners. Orefice and Rocha (2014) find that on average, signing deeper trade agreements, as is the case for the EAC, increases trade in parts and components between member countries by almost 12 percentage point. The impact differs across sectors, with trade in automotive parts and ITC products increasing by 36% and 11% respectively, while trade in textiles experiencing no impact at all.

Table 1.9 presents the impact of EAC integration on participation, entry and survival across product end-use. In columns (1)-(2), we find that EAC accession has a positive impact on export participation and entry of Rwanda's export. Joining the EAC boosts the probability that Rwanda would export a final goods by 8.7 percentage points. The impact is positive but weaker for intermediate goods at 3.9 percentage points. Similar results are observed for entry, with Rwanda's exports in final goods experiencing a boost in probability of entry following EAC integration by 5.2 percentage point compared to a more muted impact for intermediate goods at 2.7 percentage point. Interestingly, the accession has a negative impact on the survival on intermediate goods but not on the survival of final goods.

Table 1.9. Differentiated impacts by product end-use and product experience

VARIABLES	(1) Participation	(2) Entry	(3) Survival	(4) Participation	(5) Entry	(6) Survival
EAC × Final Good	0.087 ^a [0.002]	0.052 ^a [0.002]	0.012 [0.012]			
EAC × Intermediate Good	0.039 ^a [0.001]	0.027 ^a [0.001]	-0.047 ^a [0.011]			
EAC × Traditional product				0.227 ^a [0.010]	0.131 ^a [0.012]	-0.005 [0.019]
EAC × Non-traditional product				0.052 ^a [0.001]	0.034 ^a [0.001]	-0.023 ^b [0.011]
COMESA FTA	0.001 ^a [0.000]	0.001 ^a [0.000]	-0.005 [0.024]	0.001 ^a [0.000]	0.001 ^a [0.000]	-0.004 [0.024]
GDP growth	0.001 ^a [0.000]	0.001 ^a [0.000]	0.120 ^a [0.026]	0.001 ^a [0.000]	0.001 ^a [0.000]	0.120 ^a [0.026]
Product experience	0.011 ^a [0.000]	0.007 ^a [0.000]	0.022 ^a [0.007]	0.011 ^a [0.000]	0.008 ^a [0.000]	0.022 ^a [0.007]
Market penetration	0.005 ^a [0.000]	0.003 ^a [0.000]	0.035 ^a [0.004]	0.006 ^a [0.000]	0.004 ^a [0.000]	0.035 ^a [0.004]
Age=1			-0.184 ^a [0.007]			-0.185 ^a [0.007]
Age=2			-0.135 ^a [0.008]			-0.134 ^a [0.008]
Initial sales			0.018 ^a [0.001]			0.018 ^a [0.001]
Observations	13,866,936	13,269,336	40,758	13,441,894	12,861,596	40,710
R-squared	0.288	0.036	0.336	0.287	0.037	0.335
Product FE	Y	Y	Y	Y	Y	Y
Importer FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y

Note: Robust standard errors: ^a p<0.01; ^b p<0.05; ^c p<0.1.

Source: Authors' calculations.

This result confirms previous study that highlight the muted impact of integration on production trade in the region. Using value-added global value chain data from EORA over the 1990-2015 period, De Melo & Twum (2020) show that while EAC members successfully increased GVC participation over the past 25 years, this happened mostly with partners outside the EAC and predominantly outside of Africa. By 2015, only 1.7% of total gross exports within the EAC region were related to regional value chains compared to 3% in SADC and as much as 17.2% in ASEAN.

6.2. Traditional vs. non-traditional products

We turn our attention towards the potential of EAC for diversification into non-traditional export products – which is another key goal for the AfCFTA. We define traditional products as those that Rwanda has exported to the world at least three times during the 1996-2000 (when our panel starts).

In columns (4)-(6) of Table 1.9, we first find that the accession has a strong impact on the participation in the EAC market among traditional products, a 22.7 percentage point boost. The impact is also positive for non-traditional products, albeit much smaller at 5.2 percentage points. We observe similar results for entry, with both types of products benefiting from Rwanda's accession to the EAC but to a smaller extent for non-traditional products – 3.4 percentage points compared to 13.1 percentage points for traditional products.

We also find that trade agreement is associated with lower survival for non-traditional products, but we find no statistically significant impact on traditional products. This result complements previous literature on export survival of products with revealed comparative advantages (Nicita et al, 2013, Jaud et al 2011). For instance, Nicita et al (2013) find a significantly lower survival for products laying outside the comparative advantage frontier. The distance of products from exporting country's comparative advantage is defined by the difference between a product's factor intensity and the factor endowment of the exporting country.

7. Conclusions

This paper investigates the case of Rwanda's accession to the East African Community's (EAC) Customs Union in 2009/10. So far, little is known about the impact of existing regional trade agreements across the continent on the extensive margin of exports and diversification.

Rwanda's integration to the EAC provides an interesting case study to understand the implications of such trade agreements and draw some policy implications for the successful implementation of a continent-wide agreement. Indeed, the EAC shares the most similar features with the AfCFTA in term of depth and diversity of member countries and Rwanda, a landlocked country with a smaller domestic market base has a lot to gain from larger market accession, conditional on an adequate policy environment and cooperation between members. This medium-term assessment (covering Rwanda's export 10 years following accession) is also informative for setting expectation of Democratic Republic of the Congo's accession to the EAC in 2021.

Overall, our results show that joining the EAC helped diversify Rwanda' export basket to the EAC countries whilst increasing product churning. Our findings show that Rwanda's accession to the EAC boosted export participation to the bloc by 5.4 percentage points – a much larger effect than the relatively “shallower” COMESA FTA. The accession increased both entry and exit for Rwanda's export to the region. When focusing solely on tariff component, we find that the product lines that benefited from higher tariff reduction also experienced higher participation and entry rates but not survival. This is consistent with the view that regional cooperation in the EAC helped decrease the barrier to entry and uncertainty in exporting to the region – thereby reducing trade hysteresis.

The results suggest cautious optimism for using trade agreements to facilitate export diversification. They confirm the potentials of connecting regional markets for realising the continent's diversification. This is largely through encouraging export entry but offset by lower survival. Higher churning is not necessarily bad. The churning process may indicate a discovery process where exporters from Rwanda learn more about their competitiveness relative to the world market. However, to the extent that resilience has become an important policy objective following the COVID-19, the role of trade agreements in accelerating churning must be taken into account.

Similarly, the political ambition of creating regional production network through trade agreements may also need to be revisited. Our findings point to a stronger impact for trade in final consumption goods than in intermediate goods. Existing research have pointed to behind-the-border factors for explaining the limited trade in intermediates within the EAC (De Melo, Solleder and Sorgho, 2020). First, the often-observed lack of complementarities hinders trade integration: countries mostly export coffee and raw commodities and import intermediates and processed goods from outside the bloc. Second, they share similar factor of productions: high unit labour costs, weak governance, and limited support services for trade, whose weakness prevent the competitiveness of local economy in integrating and developing regional value chains. These issues call for further cooperation among countries in non-tariff areas of trade and beyond.

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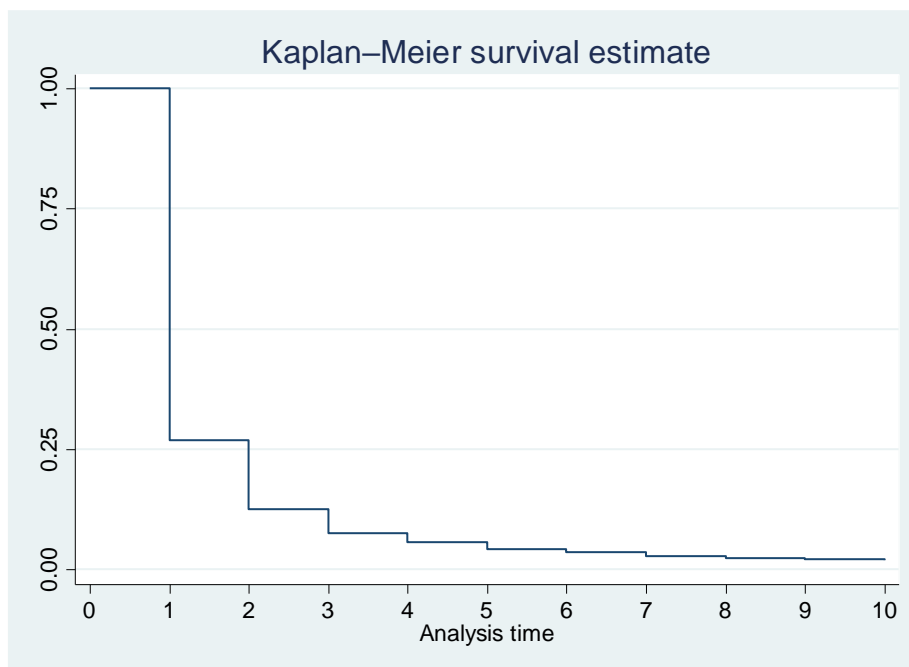
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Supplementary materials

Figure A.1.1. Kaplan-Meier survival estimate for Rwanda's export flows



Source: Authors' calculations.

Table A.1.1. Summary statistics on export relationship's survival

	Number of export relationship	% of observed export relationships	Exit before year 2	Exit before year 3	Survive beyond year 2
EAC	10 536	31.9%	73.6%	88.8%	11.2%
Kenya	3 673	11.1%	69.3%	85.5%	14.5%
Tanzania	2 011	6.1%	76.1%	90.8%	9.2%
Uganda	3 283	10.0%	73.7%	89.3%	10.7%
Non-EAC countries	1 569	4.8%	79.9%	92.7%	7.3%
Total	22 455	68.1%	74.6%	88.4%	11.6%

Note: Figures may not add up to 100% due to rounding.

Source: Authors' calculations.

Table A.1.2. Robustness check with alternative fixed effect specification 2

VARIABLES	(1) Participation	(2) Entry	(3) Survival	(4) Participation	(5) Entry	(6) Survival
EAC	0.055 ^a [0.001]	0.041 ^a [0.001]	-0.004 [0.027]			
EAC × Tariff cut				0.404 ^a [0.018]	0.279 ^a [0.019]	-0.106 [0.241]
Observations	13,864,611	13,269,335	18,369	13,957,924	13,356,562	20,903
R-squared	0.368	0.123	0.658	0.422	0.153	0.710
Product-Year FE	Y	Y	Y	Y	Y	Y
Product-Importer FE	Y	Y	Y	Y	Y	Y
Importer-Year FE				Y	Y	Y

Note: Several controls are suppressed from the table for brevity of presentation. All regressions include controls for COMESA FTA and GDP growth. Columns (1)-(3) also control for market penetration. Additionally, columns (3) and (6) also control for export relationship's age and initial sales. Robust standard errors: ^a p<0.01; ^b p<0.05; ^c p<0.1

Source: Authors' calculations.

Table A.1.3. Baseline setups with samples limited to developing-country destinations only.

VARIABLES	(1) Participation	(2) Entry	(3) Survival	(4) Participation	(5) Entry	(6) Survival
EAC _{jt}	0.053 ^a [0.001]	0.034 ^a [0.001]	-0.039 ^a [0.012]			
COMESA FTA _{jt}	0.000 ^a [0.000]	0.001 ^a [0.000]	-0.011 [0.026]			
EAC _{jt} *Tariff cut				0.401 ^a [0.018]	0.277 ^a [0.019]	-0.212 [0.284]
GDP growth _{jt,t+1}	0.000 ^a [0.000]	0.001 ^a [0.000]	0.124 ^a [0.029]			
Product experience _{kt}	0.011 ^a [0.000]	0.008 ^a [0.000]	0.030 ^a [0.008]			
Market penetration _{jt}	0.006 ^a [0.000]	0.004 ^a [0.000]	0.045 ^a [0.005]			
Age=1			-0.130 ^a [0.008]			0.196 ^a [0.021]
Age=2			-0.116 ^a [0.009]			0.076 ^a [0.020]
Initial sales			0.017 ^a [0.001]			0.014 ^a [0.005]
Observations	10,241,089	9,762,360	31,023	9,354,461	8,919,555	11,214
R-squared	0.312	0.042	0.350	0.453	0.174	0.741
Product FE	Y	Y	Y	Y	Y	Y
Importer FE	Y	Y	Y			
Year FE	Y	Y	Y			
Importer-Year FE				Y	Y	Y

Note: Robust standard errors: ^a p<0.01; ^b p<0.05; ^c p<0.1

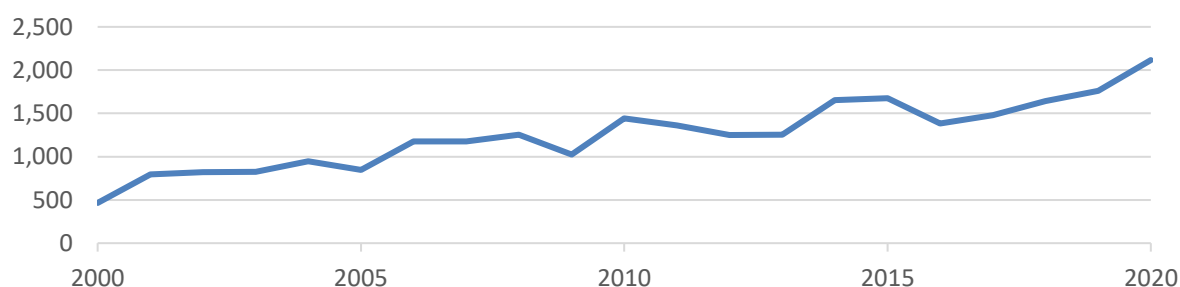
Source: Authors' calculations.

Chapter 2: Regulatory standards, trade margins and quality upgrading among Vietnamese exporters

1. Introduction

Understanding exporters’ response to public standards by importing countries is important in the current trade environment. The number of new notifications to the World Trade Organisation (WTO) regarding sanitary and phytosanitary (SPS) standards almost quadrupled from 2000 to 2019 (Figure 2.1). The COVID-19 pandemic further accelerated the use of such measures: over two thousand SPS notifications were submitted by WTO members in 2020, an all-time high. More than two-thirds of the regular notifications were related to food safety (WTO, 2021).

Figure 2.1. Number of new SPS notifications to the WTO from 2000-20



Source: Author’s calculations based on data from WTO (2021).

These standards matter for exporters from developing countries in particular. The application of SPS standards is most common for agri-food products, which constitute a large share of developing countries’ exports. For example, agri-food export (HS chapter 01-24) accounted for 14% of Africa’s total exports in 2017. Furthermore, as “standard-takers”, exporters from developing countries are more likely to face capacity issues in compliance when adapting to the (often higher) import standards imposed in high-income markets.

From a theoretical perspective, current literature suggests two opposing roles of import standards on international trade. One approach views standards as non-tariff barriers to trade. More stringent standards increase compliance cost for producers. It may impose additional fixed costs to improve production processes, adopt new quality control proce-

dures and/or obtain certifications. Variable costs may also incur through costlier transportation and lengthier border inspection. The possibility of border rejections due to food safety introduces additional uncertainty for exporters (Beestermöller et al., 2018).

The other approach views regulatory standards as catalyst for trade (Ponte & Ewert, 2009). Standards can induce trade through signalling. It is costly for consumers to individually verify the quality of each product in the market. The imposition of standards creates a signal of product quality to customers by ensuring a minimum level of quality. Furthermore, standards may force producers to upgrade their products to higher quality, which then enable them to increase prices and tap other market.

The presence of these two seemingly conflicting theoretical approaches thus calls for empirical investigation to evaluate the net trade effect of SPS measures. The literature has assessed the impact of standards on trade from three broad approaches. The first approach, popular in the Global Value Chain literature, often involves case studies that focuses on the responses of firms to a specific change in standards. The second approach in this literature analyses the impact of standards on bilateral trade among countries in a gravity model. The third and most recent strand of literature focuses on firm heterogeneity using firm-level custom registries.

This paper follows this latest strand of literature and exploit a new dataset to investigate the impact of SPS standards on agri-food exporters. The dataset covers the universe of agri-food exports at firm level recorded by the Vietnamese custom agency between 2005 and 2010. The application of more stringent standards is captured by a rich dataset on specific trade concerns (STCs) that governments raise at the WTO committee on SPS standards.

The paper first shows that the imposition of more stringent standards in the destination countries negatively affects the margins of trade among Vietnamese exporters. Exporters are less likely to participate and more likely to terminate serving a certain product-

destination when there is an active SPS-related specific trade concerns raised against this market. The magnitude of impact is comparable to that found in previous literature for exporters from France and Peru.

Second, exporters serving markets with more stringent standards also record higher product price (proxied by unit values) and quality. We estimate product quality at the firm–product–destination level by exploiting information on product prices and quantity exported following Khandelwal et al. (2013).

Third, the local production network matters for exporters’ response to stringent standards. Specifically, having more peers, exporters from the same region that serve the same product–destination, alleviates the negative impact of import standards on the extensive and intensive margins of trade. Furthermore, exporters with more peers are associated with higher product quality than those with fewer peers when they tap markets with more stringent standards.

This paper advances the literature on the trade impact of regulatory standards in three directions. First, this paper advances on the recent and relative thin approach of assessing firm-level responses to standards using custom registries. To my best knowledge, there have only been a handful of studies that follow this approach (Chen, Wilson and Otsuki, 2008; Reyes, 2011; Fontagné et al., 2015; Fontagné and Orefice, 2018; Fernandes et al., 2019; Curzi et al., 2021). However, most of this literature are based on the experience of exporters from high income countries.

The case of Vietnam is informative, especially for other developing countries, thanks to multiple reasons. Given the importance of agricultural export for Vietnam’s development pathway, its export-led development strategy has often been used as an example for other developing countries (Newman et al., 2016; Tarp, 2017). Furthermore, certain factors that affect firm’s response are systematically different between developing economies and developed ones. These factors could range from such as the limited availability and

diversity of high-quality inputs and the relatively larger scope for firms in developing countries to learn from exporting to each destination. For example, the unit rejection rate for food imports to the U.S. and E.U. market strongly correlate with the income level of the country of origin (Henson and Olale, 2011).

Second, the paper highlights the importance of local production network as a source of heterogeneity. Understanding the heterogeneity across exporters is an important advance compared to other gravity-based studies which analysed the impact on aggregate trade flows (Disdier et al., 2008; Tran et al., 2012). Existing research on standards and firm heterogeneity largely focus on the heterogeneity across firms with different sizes (as a proxy for productivity) and destination scope. By highlighting the importance of peer network, our findings echo the Global Value Chains literature that emphasises the role of local context for individual firm's response to import standards (e.g. Colen et al., 2012; Henson et al., 2011; Otsuki, 2011, Volpe-Martincus et al., 2010).

Third, the paper goes further to explore the relationship between regulatory standards and quality upgrading. This exploration helps go beyond the simple dichotomy of export survival and exit. Indeed, stopping a particular contract can be a good strategy if the firm is able to switch to other products with better long-term prospects. Exploiting detailed firm-level custom transactions, Stirbat et al. (2015) show that many Laotian exporters terminate an export contract to initiate new ones with higher level of economic complexity.

The dynamic of quality upgrading is particularly informative for policymaking. The process and determinants of quality upgrading is a critical component of economic upgrading (see Verhoogen, 2020 for a review). Increasing organisation and technological capability through upgrading holds the key to aggregate productivity improvement and long-run

development. Some authors argue that upgrading through exporting is even more important for long-run economic growth than exporting per se (see for example Hidalgo et al., 2007).

The remainder of the paper is organised as follows. Section 2 describes the data on Vietnamese exporters and data on Specific Trade Concerns related to SPS standards. It also highlights the Vietnam's economic context and the qualitative case studies on the experience of Vietnamese exporters in meeting import standards. Section 3 discusses the literature before presenting the empirical setup and results on the impact of standards on trade margins. Section 4 follows a similar structure to evaluate the impact of standards on product price and quality. Section 5 tests the robustness of these results. The final section concludes with a brief policy discussion in light of these findings.

2. Data & context

2.1. Data on Vietnamese exporters

The paper exploits a novel dataset based on transaction-level administrative records obtained from Vietnam's Customs Authority. To the best of our knowledge, this is the first paper that exploits transaction-level custom data for Vietnam. The dataset provides detailed information on import and export volume for each product line (classified according to the Harmonised System at 8 digit) and for each registered exporters in Vietnam between 2005 and 2010.²⁹

To verify the quality of the custom registry, we plot the aggregated export value for each subheading/importing country/year combination against the respective export value from COMTRADE database. The correlation of the two sets of values reaches 99.8% (see figure A1 in Annex 1). Furthermore, we apply several treatments to the data. First,

²⁹ While STC database is available until 2019, the encoded information on the concerned products is abnormally missing in many claims raised in the WTO database during the 2011-13 period (see Supplementary). Consequently, I limit the data for exporters until 2010.

we identify trade intermediaries from their legal names and filter them out of the sample.³⁰ Second, we remove 899 instances where firms are reported to export to Vietnam from Vietnam. These abnormal trade flows likely result from domestic firms selling to processing firms inside export processing zones, which is liable to export duty. Third, we exclude small transactions of less than USD 1 000 per firm-product-destination-year as they often indicate samples and trial products rather than substantial trade partnership.

The data is an unbalanced panel of 59 212 unique contracts, firm-destination-product (at HS 8-digit level) triads carried out by 5 718 different firms during 2006-10 period. Table 2.1 shows that the number of exporters increased from 2 409 firms in 2006 to 3 186 firms in 2010. At the same time, the number of HS 8-digit products exported by Vietnam declined. The number of destinations stayed relatively stable. The average and median number of products and destinations exported by each firm also remained relatively stable over this period (not shown in Table 2.1).

Table 2.1. Profile of Vietnamese exporters, 2006-10

	# of firms	# of products	# of destinations	Products per firm		Destinations per firm		Product × Destination per firm	
				Mean	Median	Mean	Median	Mean	Median
2006	2,409	1,651	200	12.2	8	12.8	7	34.4	18
2007	2,645	1,404	199	9.1	6	13.0	8	28.9	17
2008	2,800	1,192	207	9.5	6	14.8	9	33.4	18
2009	3,100	1,167	202	9.9	6	14.1	8	32.6	19
2010	3,186	1,121	201	10.1	5	13.5	7	32.3	18

Source: Author's calculations.

Considerable churning occurs as new firms entered, and incumbents dropped out of the custom registry. Looking at Vietnam's top 5 agri-food exports reveals considerable heterogeneity across sectors (Figure A.2.3). For example, the total number of shrimp and cashew nuts exporters have steadily increased, while the number of fish fillet exporters

³⁰ Businesses in Vietnam often have relatively self-explanatory names that could help identify import-export, logistics, and freight forwarding firms. Ahn et al. (2011) applied a similar method to identify intermediary exporters from China.

(mostly pangasius exporters) and coffee exporters remain relatively stable across years. The number of rice exporters increased until 2010 before dropping off afterward.

2.2. Data on standards

Data on SPS measures come the specific trade concerns (STC) database collected by the WTO. At the WTO's SPS committee, member countries can voice against SPS measures (in draft or in force) adopted by other WTO member countries. The discussion, also referred to as a "specific trade concern", would systematically specify the destination countries adopting the measure and the relevant product (typically at HS 4-digit level), among other information. The WTO secretariat then codifies this information based on the meeting records of the committee.

This dataset offers several advantages compared to other approaches of measuring trade barriers related to SPS. Preparing and presenting a concern is costly in term of time, effort and political capital for country representatives at the WTO. As a result, member countries often raise concerns only when the standards create considerable challenges for their exporters in practice. In contrast, *de jure*-based measure of trade restrictiveness or systematic assessment of existing legal frameworks cannot capture changes in enforcement or implementation. Regulations may come into effect without having actual impacts on trade due to the lack of implementation or the weak capacity to enforce.

In addition, the STC dataset also covers a broad range of sector and type of measures. Countries raised concerns over a variety of agri-food products ranging from meat to diary produce and edible fruit and nuts (see Table 3 in Fontagné et al. [2015]). They cover a range of measurement from requirements on packaging to excessive restrictions of pesticide residuals.

This is an important advantage given a large literature show that the effect of standards on trade depends on the sectors and types of measures involved (de Melo et al., 2014; Shepherd & Wilson, 2013; Beghin et al., 2015). Studies based on product-specific

measures of standards such as the level of maximum pesticide residue allowed (Fernandes et al., 2019) may suffer from limited external validity to other products. To put this into perspective, pesticide residuals accounted for only 6.3% of all rejections for agri-food imports to the European Union during the 2002-10 period (UNIDO, 2015).

In this paper, a product-destination (also known as a variety in the literature) is coded to be affected by more stringent SPS standards when one or more country has unresolved concern(s) regarding such product against this destination country. The majority of concerns are raised at the product heading level (HS 4-digit), followed by chapter level ((HS 2-digit) and a handful at subheading level (HS 6-digit level). I assign these concerns to all products (HS 8-digit) falling under the respective categories. Measures imposed by EU countries are assigned to cover each of the EU member countries at the time of notification.

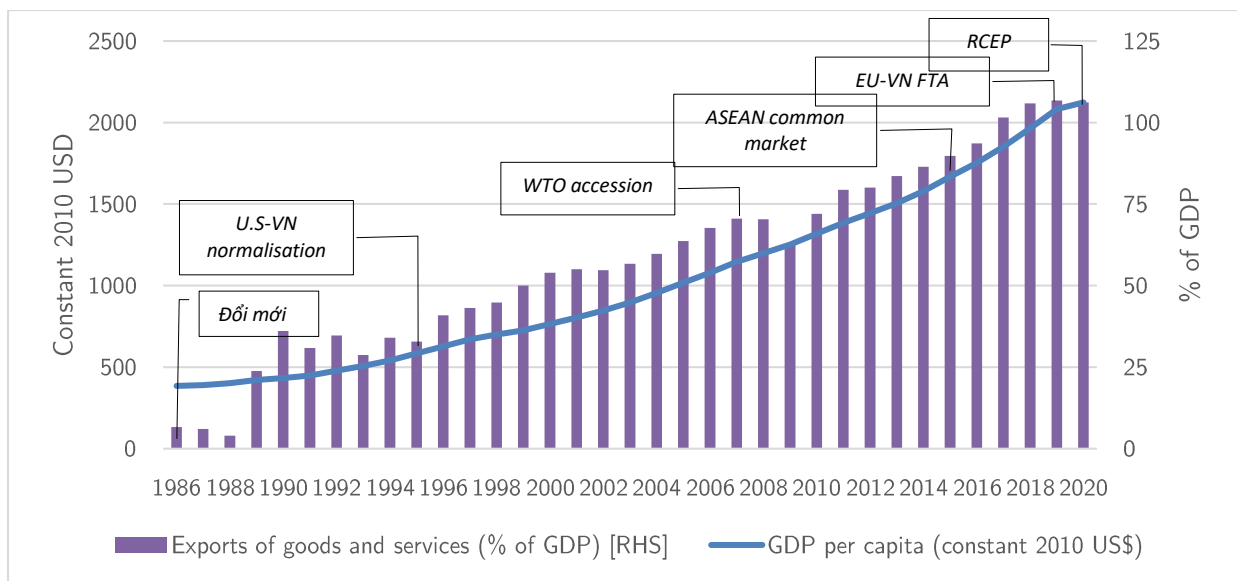
2.3. The economic context in Vietnam

Vietnam has made remarkable progress in terms of development in the past decades. Since *Đổi Mới* (reform policy) in December 1986, the country has replaced its centrally planned economy with a market-oriented economic system where private enterprise is allowed and in fact actively encouraged by the state. Policy making is also decentralised towards a larger role for provincial governments, which are organised around 3 mega-regions (North, Central and Southern region) and 8 regions. GDP per capita has grown more than five-fold in this period, from USD 390 (in 2010 price) to USD 2 123 (see Figure 2.2). Extreme poverty rate (share of population living with USD 1.90 a day, 2011 PPP) dropped from 52.3% in 1992 to 1.8% in 2018.

A key pillar of this new development model is export-push to transform the domestic economy, inspired by the success stories of the Asian tigers. Following *Đổi Mới*, a series of trade agreements liberalised Vietnam's trade with major markets and culminated in its accession to the WTO in 2007. Since then, the country has continued to strengthen

its relationship with other countries through deeper economic partnership agreements, most recently the EU-Vietnam FTA and the signing of the Regional Comprehensive Partnership in Hanoi, in 2019 and 2020 respectively. The importance of the export sector in the economy has grown in the last three decades: exports of goods and services as a share of GDP grew from 7% in 1986 to 106% in 2020 (Figure 2.2).

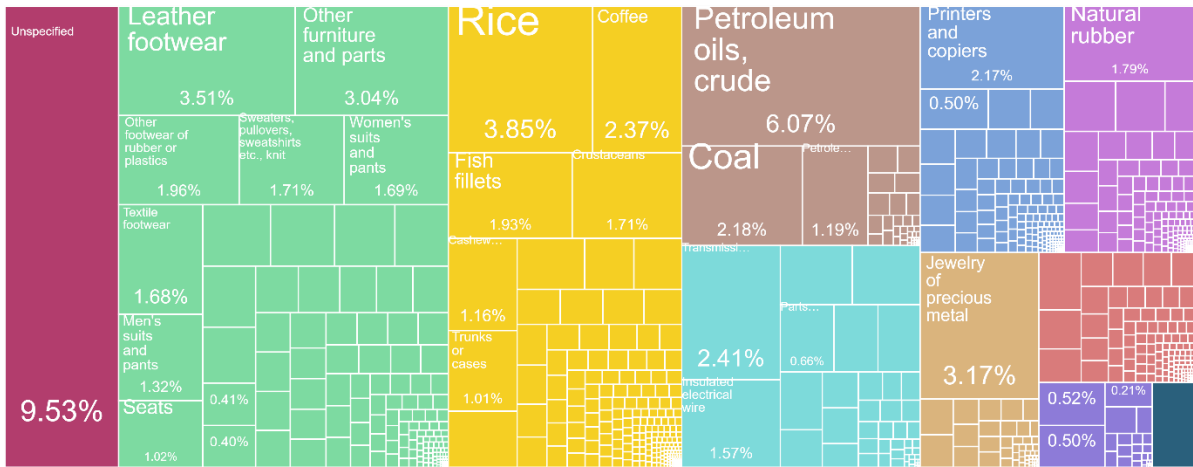
Figure 2.2. Vietnam’s economic and export growth



Source: Author’s calculations based on data from World Bank (2021) *World Development Indicator*.

The development of the agri-food sector, especially for export, is an important contributor to this export growth. By 2010 (end of the studied period in this paper), agricultural exports amounted to USD 15.4 billion, or 20% of total export. This share has since declined thanks to the expansion of other export products such as textile, garments and more recently electronics. However, as the agri-food economy still provides the main source of livelihood for over 30% of the population, agri-food exports remain an important source for inclusive growth. Main products include rice, coffee, fish and fishery products (notably shrimps and pangasius) and cashew nuts (see Figure 2.3). Such development plays a key role for poverty reduction and overall development in Vietnam (McCaig, 2011).

Figure 2.3. Composition of Vietnam's export, 2010



Source: Atlas of Economic Complexity

Compliance with import SPS standards is a major challenge for the agri-food sector in Vietnam. In 2002-10, Vietnam ranked among the ten countries with the highest rate of import rejections for agri-food products in the US (6th), EU (9th), Japanese (1st) and Australian (10th) market (UNIDO-IDE-JETRO, 2013: Table 5.1). For Vietnamese exports to the EU, veterinary drugs residues and bacterial contamination were the most common reasons for rejections, respectively accounting for 27% and 23% of all rejections. Contaminations in upstream production, detections of heavy metals and hygienic conditions in various stages of the supply chain were also common causes for rejection.

Meeting import standards entails a large cost for Vietnamese exporters. Fish and fishery products faced the highest number of rejections, reflecting both the size of these products in Vietnam's export basket and the prevalence of SPS measures in the sector globally. A case study of the pangasius and shrimp export sector in Vietnam shows that exporters (typically processors) have to pay the high cost of obtaining and maintaining different certifications to meet the specific requirements for each import market (UNIDO-IDE-JETRO, 2013). Processors also report that the fickle and last-minute changes in regulation and testing procedures pose additional challenges for exporters to plan and adapt.

In addition, increased testing and controls at shipping ports drive up the storage and inventory cost.

Furthermore, exporters' ability to control product quality also depend on factors outside their boundaries. Processors usually source raw products either from contracted farms or by from traders and wholesalers who collect from smallholder, grow-out farmers. Applying changes to production process will require the processors to work closely with contracted farmers to give guidance, monitor quality and even provide training. Incentivising grow-out farmers to adopt new techniques often proves difficult. In some sectors, high demands by food safety, quality and sustainability standards have driven an ongoing process of consolidation and vertical integration (Bush et al., 2015; Khiem et al., 2010). However, vertical integration is not always possible due to various constraints, especially with access to land and disease control (Tran et al., 2013).

3. Impact of standards on trade margins

This paper most closely relates to this latest literature on standards and firm heterogeneity. While differing in their geographic coverage and the measures of standards, these empirical papers converge that more stringent and divergent public standards can hinder trade. Fontagné et al. (2015) find that the introduction of more stringent SPS measures can discourage the presence of exporters in SPS-imposing foreign markets. Building on the same dataset of French exporters, Fontagné and Orefice (2018) show that technical barriers to trade (proxied by concerns at the WTO TBT committee) have a similar effect on French exporters. Reyes (2011) finds that the harmonisation of product standards in the European Union increases exports by U.S. firms to the EU. By reducing the cost for serving multiple EU destinations, the change in standards induces higher firm entry. Analysing U.S. import refusals, Grundke and Moser (2019) find that the enforcement of product standards was enforced more strictly by the U.S. during the global financial crisis as a form of hidden protectionism.

These papers often focus on how the cost of standards compliance affect the extensive and intensive margins of trade. They build on the theoretical foundation of heterogeneous firm framework following Melitz (2003). The higher compliance cost can make exporting unprofitable for existing exporters, especially those with lower productivity. They would drop out from serving such product-destination and thus the rate of exporter exit increases. The impact on the intensive margin, i.e. firm's export sales, is more ambiguous and depends on the type of cost involved and other market parameters such as the elasticity of substitution (Chaney, 2008).

These studies also show important heterogeneity due to firm-specific characteristics. Most of them focus on the differential responses across firm size (e.g. Fontagné et al. [2015]; Curzi et al. [2021]). Larger firms, proxied by total export sales in a given year, are often associated with higher productivity that help them absorb the additional compliance cost. In addition, larger exporters could spread the lumpy cost of investment across more sales. This reduces per-unit costs of compliance, similar to the role of marketing cost in Arkolakis (2010). Sharing this focus on marginal cost of production, Fontagné and Orefice (2018) show that the lower cost of switching across destinations enable multi-destinations exporters from France to reallocate their sales out of destinations that impose more stringent standards.

However, this literature has largely overlooked the importance of local production network on firm heterogeneity. An exception is Fernandes et al. (2019). They find that having more exporters from the same country that serve a particular product-destination market can increase the survival of exporters in that same market when the requirements over pesticide residuals become stricter. They posit that meeting the more stringent standards may require specific know-how and management technology that firms, especially those in developing countries, may not be aware of. Thanks to close proximity, firms can share information and learn about these practices – similar to a “social learning” mechanism.

This line of reasoning can find support in the recent trade literature that emphasises the role of the local production network in facilitating knowledge transfer and learning. Bisztray et al. (2018) show that peers learning can permeate through both managerial and spatial networks of exporters. Using data for Hungarian firms, they show that having a neighbour which has imported from a particular country more than doubles the probability of starting to import from that country. This effect is stronger the closer the proximity between the two firms.

Other studies points to the role of financial market in propagating information across industrial networks. Analysing export transactions of African exporters, Cadot et al. (2013) suggested that having many firms serving an export market creates a positive signal on profitability. Once financial intermediaries such as banks learn more about the potential profitability of serving an export market, they are more likely to extend credits such as trade finance and loans for firms to invest in meeting the new standards. Jaud et al (2015) find that the deepening of domestic financial market strengthens the survival rates of export relationship.

Empirical evidence from the broader trade literature confirms the importance of external factors in exporters' dynamics. Matching custom data on imports to the United States with the geographic location of Bangladeshi exporters, Kamal and Sundaram (2016) suggest that spatial proximity can facilitate matching between exporters and importers. When a Bangladeshi firm first export to the U.S., they are more likely to sell to a U.S. importer that already bought from other exporters in the same neighbourhood. Similarly, Arguello et al. (2020) find the presence of size of exporter agglomeration in Colombian municipalities and states is associated with longer duration of export flow at the firm-product-destination level.

A critical mass of producers and suppliers can help reduce the cost of compliance through cost-sharing – an idea often emphasised in economic geography. Having a critical mass

of potential users provides the scale necessary for quality infrastructure such as metrology and laboratory to emerge. The proximity also cuts down the travel cost involved in the physical inspection, testing and certification of products. For example, most exporters of frozen pangasius and shrimp from Vietnam have in-house labs to test for chemical residue levels in procured inputs and in final products ready for shipping. For shipments to countries with stringent requirements such as Japan, processors may carry out more accurate tests on antibiotic level at external laboratories – which are available in sufficiently large clusters of exporters.

However, agglomeration may also have adverse effects on the performance of each producer. First, firms face more competition for non-tradable inputs such as land or intermediate inputs with inelastic supply in domestic market. This is particularly relevant in the context of Vietnam during this period where trade input liberalisation did not progress as fast. Second, the spatial agglomeration of firms can increase the likelihood of cross-plant contamination of diseases and toxicities. This problem is particularly severe for aquaculture products such as shrimp farming. Third, import countries may increase border inspections, product detention and rejection for all exporters from the same countries if they detect repeated offenses from a few producers – thus creating a negative spill-over for all producers in the sector.

3.1. Setup

The paper analyses the export dynamics at the firm-product-destination level (also referred to as export contracts). The main model takes the following form:

$$y_{fjkt} = \beta_1 \text{SPS}_{jkt} + \beta_2 \text{SPS}_{jkt} \times \text{Peers}_{fjk,t-1} + \beta_3 \text{Peers}_{fjk,t-1} + \beta_4 \log(1 + \text{tariff}_{fjkt}) + \mathbf{X}_{fjk,t-1} + \Phi_f + \Phi_{jt} + \Phi_{kt} + \varepsilon_{fjkt} \quad (1)$$

where y_{fjkt} refers to the dynamics of firm f in exporting product k (HS 8-digit) to destination j in year t . For our analysis on trade margins, the dependent variable represents:

- i. the extensive margin of export: a dummy for export participation that indicate if the particular firm export to a given product-destination variety in a given year,
- ii. export exit: a dummy indicating whether a firm ceases to export to a given product-destination variety in a given year after having done so in the previous year, and
- iii. the intensive margin of export: the export sale value (specified in logs) conditional on exporting.

The main independent variable SPS_{jkt} is a binary variable that takes the value of 1 if there is at least one unresolved specific trade concern regarding the application of SPS for product k maintained by country j in year t .

To evaluate the importance of external environment, the $Peers_{fjk,t-1}$ variable captures the (lag) density of local production network. Following the literature, we define $Peers_{fjk,t-1}$ as the (log) number of firms (excluding firm f) from the same region that exported product k to country j in in the previous year. The interaction term between this variable and SPS standards helps estimate the heterogeneous impacts of stringent standards across different external environment.

The model further controls explicitly for several (lag) dynamic factors that may determine trade margins. First, countries may seek to employ more non-tariff barriers as a way to avoid erecting tariff barriers. We thus control for import tariff expressed as ad-valorem equivalent at HS-6 digit level, provided by ITC/CEPII MacMap portal. Second, we control for the total export sales (in log) by firm f across all products and all destinations in the previous year. We also account for the heterogeneous response to SPS across firm size by including the interaction term between size and product standards. Third, in the regression on exit rate we also control for contract weight, defined as the share of the contract in the firm's overall export sales. In the framework of Iacovone and Javorcik (2010) where the core products of multi-product firms are more resilient than

the periphery ones, we expect that contracts that account for a larger share of sales are less likely to be terminated.

A battery of stringent fixed effects helps to account for omitted variable bias. The firm fixed effect (Φ_f) controls for firm's static characteristics such as firms' average productivity levels and ownership. The inclusion of destination-year fixed effect (Φ_{jt}) controls for time-varying factors such as transport costs, business cycles, demand shocks from the importers, and the geographic orientation of Vietnamese exports (Head and Meyer, 2014; Fontagné and Orefice, 2018). This is particularly important as our period of study covers the global financial crisis in late 2000s, whose impact on exporters vary strongly across destinations via demand shocks (Bricongne et al., 2011). Finally, the product-year fixed effect (Φ_{kt}) accounts for the product-specific characteristics and their evolution over time such as the global governance of the sector, the substitutability of products as well as changes in global demand pattern for this product.

The set of firms in each regression vary slightly for each outcome. The regressions on the intensive margin include all active contracts in the current year. The regressions on exit include all contracts that were active in the previous year ($t-1$). For the regressions on export participation, we follow Fernandes et al. (2019) in filling in all the year during the 2006-10 period for each firm-product-destination triad that was active at least once during this period. This approach differs from other trade literature that would create a square matrix for all possible combinations of firm, product, destination and year. This latter approach would result in a dataset consisting of predominantly zero trade flows. Furthermore, it is arguably unrealistic to expect that each firm could serve all possible

destination-product combination. Lastly, it would be computationally difficult to estimate the balanced panel with almost 20 billion observations.³¹

3.2. Results

Columns (1)-(3) of Table 2.2 estimate the baseline effect of stringent standards on export margins. We find that the imposition of a SPS measure reduces the probability that a certain firm will serve a particular product-destination market by 1.1 percentage point on average. Stringent standards also increase the exit rate of Vietnamese exporters in that particular product-market destination by 1.7 percentage points on averages. They reflect the difficulty for Vietnamese exporters in entering and surviving in markets with higher standards and confirmed previous qualitative evidence.

These findings are consistent with previous studies on STC and firms' extensive margins in another context. For comparison, Fontagné et al. (2015: Table 5, Column 2) find that the presence of a specific trade concern over SPS increases the probability of French firms exiting the affected market by 1.7 percentage point. On average, we do not find a statistically significant impact of SPS measures on sales (conditional on exporting).

³¹ Results regarding the extensive margin remain qualitatively similar when we square the matrix over the destination dimension, i.e. we expand the dataset to every destination-year possible for each active firm-product combination.

Table 2.2. Impact of SPS on extensive margin, exit rate and intensive margin

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Ext.	Exit	Int.	Ext.	Exit	Int.	Ext.	Exit	Int.
	margin		margin	margin		margin	margin		margin
SPS	-0.011 ^b	0.017 ^b	-0.041	-0.014 ^a	0.035 ^a	-0.078 ^b	-0.013 ^c	0.026	-0.192 ^a
	[0.005]	[0.008]	[0.035]	[0.004]	[0.009]	[0.032]	[0.007]	[0.035]	[0.052]
SPS × Peers				0.007 ^b	-0.014 ^a	0.037 ^b	0.007 ^b	-0.015 ^a	0.034 ^b
				[0.003]	[0.004]	[0.016]	[0.003]	[0.004]	[0.016]
Peers				0.067 ^a	-0.080 ^a	0.494 ^a	0.064 ^a	-0.079 ^a	0.493 ^a
				[0.002]	[0.003]	[0.009]	[0.002]	[0.003]	[0.009]
SPS × Size							-0.000	0.001	0.008 ^a
							[0.001]	[0.002]	[0.003]
Size							0.014 ^a	-0.066 ^a	0.017 ^a
							[0.000]	[0.003]	[0.002]
Observations	393605	104854	113443	393605	104854	113443	393605	104854	113443
R ²	0.186	0.297	0.514	0.195	0.307	0.541	0.205	0.311	0.542

Note: All regressions include firm, destination-year, and product-year fixed effects. For brevity, additional controls omitted from the table include contract weight (only for regressions on exit) and import tariffs. Standard errors, clustered at destination-HS 2 digit-year level, are presented in brackets ^a p<0.01, ^b p<0.05, ^c p<0.1.

Source: Author's calculations.

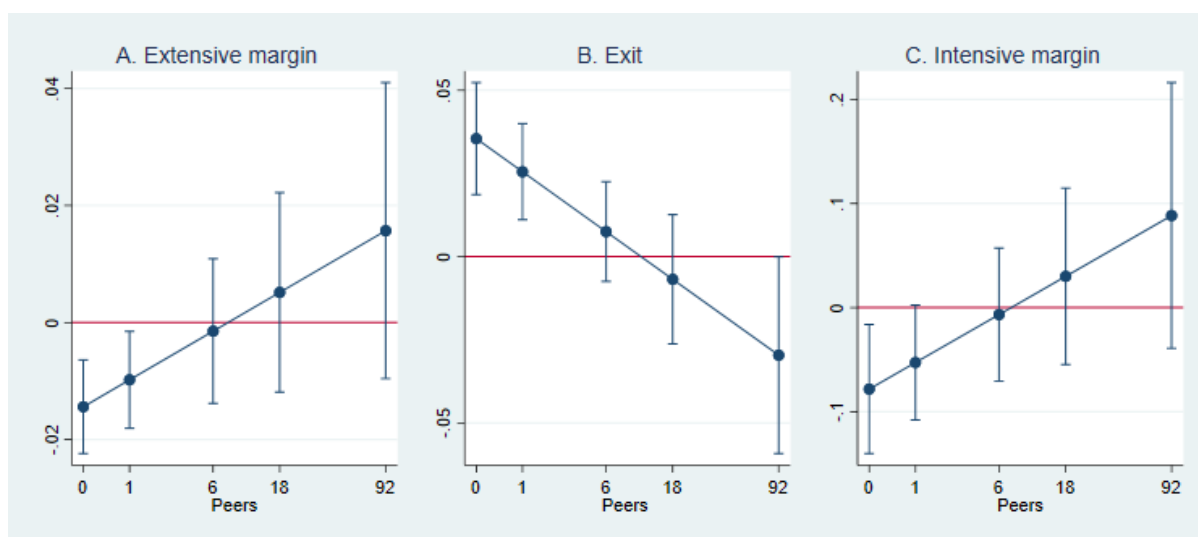
Columns (4)-(7) assess the heterogeneous response with respect to the prevalence of neighbouring exporters in the same product-destination market. Across the different trade margins, we first observe that firms having more peers tend to perform better than firms with fewer peers. Everything else being equal, they are more likely to participate in a certain product-destination market and sell higher values conditional on exporting. Exporters with more peers in their regions are also less likely to terminate existing export relationship.

The presence of a dense industrial network also helps mitigate the impacts of stringent standards on trade margins. Specifically, the coefficients of the interaction term between SPS standards and peer network suggest that having more peers attenuate the negative impacts of standards on the extensive margins. For example, among firms that manage to export to STC-affected markets, those with more peers tend to export more than those with fewer peers. When facing stringent standards, firms with more peers are also less likely to exit than those with fewer peers. Furthermore, we find differentiated impacts of standards on the intensive margins across different external environment. These results

suggest a spill-over effect across the industrial network that help firms to better response to import standards. They are consistent with findings from Fernandes et al. (2019) who also found that the survival likelihood vis-à-vis more stringent standards improves with the number of peers.

Similarly, Figure 2.4 visualises the predicted average marginal effects of stringent standards across different size of peer networks. It highlights the particularly damaging impact of stringent standards towards pioneer firms, those who export to destination-product markets that no other exporter from its region participates. These firms are less likely to participate and more likely to exit when facing SPS. In contrast, having more peers reduce the likelihood of firm terminating the export contract. The predicted result suggests that the median firm with just one other peer from the same region are not affected by SPS measures in term of exit likelihood. Conditional on exporting, SPS standards are associated with lower export values for “pioneer exporters”. However, as the number of peers increase, this negative effect dissipates. Taken together, these results highlight the importance of dissecting the impact of regulatory standards beyond firm averages.

Figure 2.4. Average marginal effects of SPS concerns on trade margins



Note: Linear projections based on results from columns (4)-(6) in Table 2.2. The x-axis label indicates the number of peers at different moment: 0 (min), 1 (median), 6 (75th percentile), 18 (90th percentile), 27 (95th percentile) and 92 (max).

Source: Author’s calculations.

We further control for firm size and its interaction with the SPS variable. As discussed previously, a number of studies have pointed out the importance role of firm's total export sales on its trade margins and its response to stringent standards. Even when controlling for these dynamic firm characteristics, we still find a heterogeneous impact of standards imposition across different external environment. In columns (7)-(9) of Table 2.2, the direction and magnitude for the differentiated impacts of stringent standards across different peer networks remain largely consistent with our previous findings. This result underlines the importance of fostering a vibrant export environment in addition to firm's internal characteristics (such as size).

4. Impact of standards on product quality

Despite its importance, the impact of standards on quality upgrading remains underdiscussed among the recent heterogeneous firm literature. Exporters of higher quality products often receive have higher revenue, sell to a broader number of destination markets and pay higher wages (e.g., Verhoogen, 2008, Crozet et al., 2012, Manova and Zhang, 2012). Recent trade literature emphasises vertical differentiation as a key driver for success in exporting (Amiti and Khandelwal, 2013) and longer-run development (Khandelwal, 2010; Hallak and Schott, 2011). In the agri-food sector, quality is particularly important due to the high gap in quality between local and export market (Swinnen and Vandeplass, 2011; Beghin et al., 2015). Past research suggests that trade policy such as with the removal of import quotas (Manova and Yu, 2016) and liberalisation of input trade (Bas and Strauss-Kahn, 2015) play an important role in this process.

Standards can indirectly improve quality level by weeding out the low-quality producers. Notably, Gaigné and Larue (2016) develop a theoretical model of heterogeneous firms with vertical differentiation and perfect information. As more stringent standards weed out (domestic and foreign) firms producing low-quality varieties, higher-quality firms

capture a larger market share. The exit of some producers also reduces competition for inputs and other factors of production for the surviving producers.

Self-sorting by product quality is also the key mechanism for behind Gagné et al. (2021). Through a process of adverse selection, the enforcement of quality standards and the costly investment in quality signalling would drive out low-quality firms. Firms selling high quality products are less likely to be bound and affected by increased quality demand – thus they are more likely to enter and less likely to terminate exporting following more stringent measures.

Some studies suggest that standards can also directly induce quality upgrading. A large GVC literature suggests higher standards in foreign markets force the complying firms to substantially upgrade their products, processes and capability (Ponte & Ewert, 2009; Tokatli, 2013; Yeung & Coe, 2015). Exploiting EU’s policy changes on lighter’s standard as a natural experiment, Hu and Lin (2016) find that the more stringent standards increase the quality of China’s lighters exported to EU markets. In Senegal, the tightening of the European Union’s quality standards on fruits and vegetables led to a change in the structure of Senegal’s export supply chain (Maertens and Swinnen, 2009). The value chain moved from smallholder contract farming to vertically integrated estate production with more sophisticated production processes and formal employment.

The presence of peers may also affect quality upgrading through cost-sharing, matching and learning (Duranton and Puga, 2004). A sufficient mass of producers provides the scale necessary for critical market infrastructure such as cold chain storage and transportation. It also attracts a dense network of suppliers and skills also enable firms to better mix and match when attempting to innovate. Empirical studies have shown that having access to quality inputs and skills are critical to quality upgrading (Bas and Paunov, 2021). The variety of ideas and actors also facilitates cross-exchange of knowledge and information that is conducive to innovation.

In the presence of large peer network, higher import standards may also induce firms to upgrade their quality in order to avoid price competition. As firms producing lower quality goods are more likely to exit, higher standards increase the average quality level in the destination market (Asprilla et al., 2019). Consequently, the gap between high-quality producers and the rest of active producers closes down. In a model where firms compete on both price and quality (such as Ronnen [1991]), these high-quality producers may respond by investing and upgrading their output quality in order to avoid price competition that yields lower mark-up. This incentive applies even towards high quality producers who would have met the higher standards already.

Previous studies also suggest the importance of local production environment on upgrading in agri-food markets. Reviewing four selected aquacultures value chains in Bangladesh, China, Thailand and Vietnam, Ponte et al. (2014) note that the upgrading trajectories of production farms and processors depend on the strength of domestic regulatory framework and public sector support. From a broader perspective, Bas and Paunov (2018) find evidence that local business environment matter for firm's innovation activities.

4.1. Setup

To evaluate the impact of import standards on product price and quality, we extend the analysis in equation (1) where the dependent variable now represents:

- i. product price conditional on exporting, expressed in log of unit value (the ratio between product export value and export quantity),
- ii. quality for each firm-product conditional on exporting, and
- iii. quality-adjusted price, i.e. the difference between firm-level (log) price and (log) product quality.

To estimate product quality at the firm-product level, we rely on the methodology of Khandelwal et al. (2013). This method does not require data on domestic production at

the firm level, a critical advantage in our application. The basic intuition is that at the same price, the demand for higher quality products will be stronger. Assuming a constant elasticity to scale (CES) utility function, product quality captures any attribute that shifts the product demand. Under this framework, we can infer product quality as a residual from estimating the following regression with OLS:

$$\log(\text{Quantity}_{fjkt}) + \sigma \times \log(\text{Price}_{fjkt}) = \alpha_k + \alpha_{jt} + \eta_{fjkt} \quad (2)$$

where Quantity_{fjkt} and Price_{fjkt} represent the trade quantity and f.o.b unit value, respectively. The product fixed effect α_k accounts for any product-specific characteristics, especially as prices and quantities are not necessarily comparable across products. We can then infer a measure of product quality, λ_{fkt} , from the residual term η_{fjkt} of this regression. Specifically, quality λ_{fkt} can be estimated as $\lambda_{fkt} = \eta_{fjkt}/(\sigma - 1)$, where σ refers to the elasticity of substitution across variety.³² Following the literature, we filter out extreme outliers by removing observations with the top and bottom 1% of unit values and those with the top and bottom 5% of quality.

4.2. Results

We now turn to present the results concerning exporters' price and quality strategy.

The result in column (1) of Table 2.3 suggests that the price (unit value) rises on average when a new SPS measure is introduced. There are broadly three potential explanations for such increase. First, assuming SPS measures are non-discriminatory, they could impose additional compliance cost for all producers. In such case, an increase in price could reflect the higher cost of producing and trading being passed on to customers. Second, new SPS measures could raise the barrier to exporter entry. This lower level of competition creates rents in the form of higher price for incumbent exporters and domestic

³² For the baseline model, we assume elasticity of substitution of 4 following Melitz and Redding (2013). The results are also qualitatively similar when we assume different value of elasticity of substitution (at 10) and when we use product-specific elasticities from Broda et al. (2006). Results are available upon request.

producers (Shapiro, 1983; Leland, 1979). Third, such rents could also incentivise producers to upgrade their products. The higher price thus could reflect the higher product quality.

In columns (2)-(3), we find evidence that on average, the imposition of more stringent standards is associated with higher product quality. However, standards are not associated with a higher level of quality-adjusted price. Taken together, these results suggest that on average, the increase in price is largely driven by higher product quality. In contrast, the role of mark-up from the new competition landscape appears more limited, as evidenced by the fact that the impact on quality-adjusted price has a small magnitude and is not statistically different from zero.

Qualitative evidence corroborates this finding. Khiem et al. (2010) suggest that in response to higher international food safety standards, producers in the shrimp and pangasius export sector in Vietnam have managed to increase intrinsic product qualities such as colour, appearance, size, and absence of chemical residues. They did so by investing in improving their water management system, feed, chemicals and the matching of standards. However, several interviewed exporters reported to receive similar or even lower prices, which does not justify the additional compliance costs sometimes.

These results are also in line with comparable literature in other contexts. Adopting similar approach, Curzi et al. (2020) report that stringent SPS standards would lead to higher prices and quality for Peruvian agri-food exports, but they do not affect quality-adjusted prices. They also find evidence that the effect depends on the scope for quality differentiation in the specific product market. For products with a longer quality ladder, i.e. there is larger variance in quality, the effect of standards is stronger. Similarly, using custom registries data from China, Doan and Zhang (2022) find that stringent technical barriers to trade induce higher quality and price but not quality-adjusted price for Chinese exports.

Table 2.3. Impact of SPS measures on product quality and price

	(1)	(2)	(3)	(4)	(5)	(6)
	Price	Quality	Quality-adj. price	Price	Quality	Quality-adj. price
SPS	0.051 ^a	0.045 ^a	0.006	0.035 ^b	0.011	0.024 ^b
	[0.011]	[0.017]	[0.013]	[0.015]	[0.018]	[0.012]
SPS * Peers (NUTS2)				0.012 ^b	0.026 ^a	-0.014 ^b
				[0.006]	[0.008]	[0.006]
Peers (NUTS2)				-0.025 ^a	0.122 ^a	-0.147 ^a
				[0.004]	[0.005]	[0.004]
ln(1+tariff)	-0.032	-0.063 ^c	0.030	-0.037	-0.025	-0.012
	[0.023]	[0.037]	[0.024]	[0.023]	[0.037]	[0.024]
Observations	109123	109123	109123	109123	109123	109123
R^2	0.918	0.488	0.947	0.918	0.493	0.948

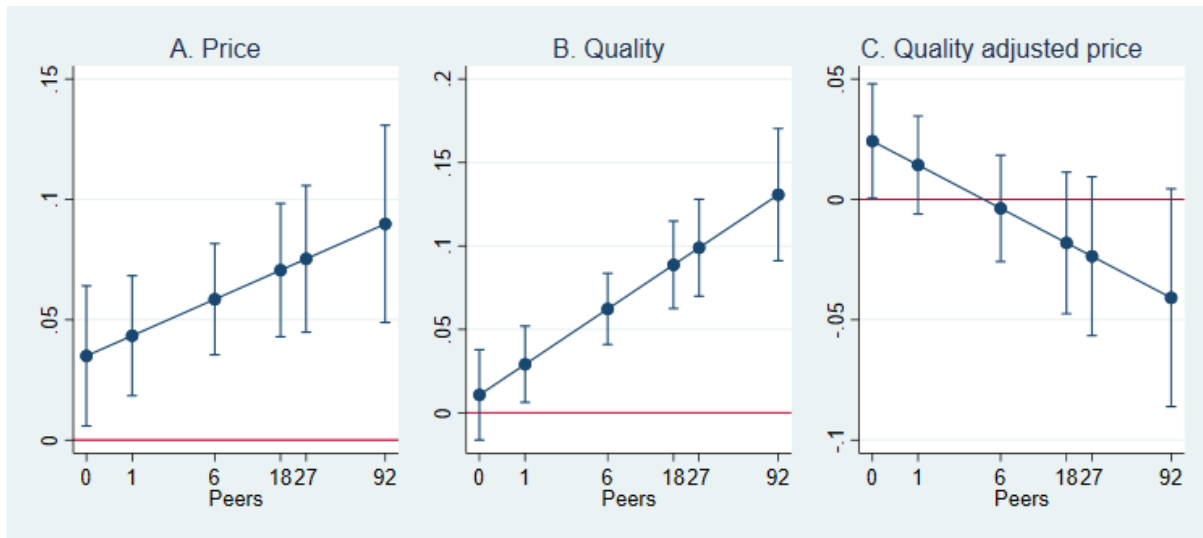
Note: All regressions include firm, destination-year and product-year fixed effects. Additional controls omitted from the table include import tariff. Robust standard errors in brackets ^a $p < 0.01$, ^b $p < 0.05$, ^c $p < 0.1$.

Source: Author's calculations.

Columns (4)-(6) of Table 2.3 analyse the heterogeneity of impact across production environment. Overall, we find that stringent standards are not associated with higher product quality among the export pioneers, those that serve a product-market without similar neighbours. However, firms in standard-affected markets are more likely to sell higher quality products when there more peers in their region. Panel B of Figure 2.5 further visualise this difference.

These findings are consistent with existing theories. The presence of peers can induce quality upgrading either through reducing the firm-specific cost of such investment or through the increased pressure to upgrade and avoid price competition. At the same time, those pioneer exporters can increase product price thanks to lower level of competition from other exporters. These results remain broadly consistent when we control for exporter size (see Table A.2.1), confirming that importance of peers network and, more broadly, external factors.

Figure 2.5. Average marginal effects of SPS concerns on pricing and quality



Note: Linear projections based on results from columns (4)–(6) in Table 2.3. The x-axis label indicates the number of peers at different moment of the distribution: 0 (min), 1 (median), 6 (75th percentile), 18 (90th percentile), and 92 (max).

Source: Author's calculations.

5. Robustness

Reverse causality is a particular concern when using the WTO Specific Trade Concerns data as a source of policy shock. Reverse causality could arise when the destination's government imposes a SPS measure in response to competition from specific Vietnamese exporters (which then leads Vietnam raising a concern at the SPS Committee of the WTO).

Compared to previous studies such as Fontagné et al. (2015) and Fontagné and Orefice (2018) that focus on French exporters, reverse causality may be less of an issue in our context. Vietnam did not raise any concern and only supported one concern at the WTO Specific Trade Concerns committee during the period studied. The limited involvement of Vietnam at the committee reflects its limited capacity to pursue cases, especially in the immediate period following its accession to the WTO, and its preference for settling disputes bilaterally. This behaviour is typical for lower-income countries as documented in Fontagné et al. (2015). Furthermore, compared to French exporters, Vietnamese exporters are typically much smaller with limited market power. Similar, the Vietnamese

government generally does not have the political capital to influence policymaking in foreign countries. Keeping this in mind, we test the results against reverse causality by lagging the import standard variable by one year. Arguably, the imposition of standards in the previous year is exogenous to firms' export performance in the current year. The results are qualitatively similar and presented in Table A.2.2.

We further test the results against alternative specification of covariates to ensure robustness vis-à-vis omitted variable bias. A particular feature of our data is that a large number of firm-product-destination triads appear only once in the panel. This feature reflects the difficulty of Vietnamese exporters in adapting and surviving in the international market. These triads will drop out of the regression as singletons if we apply stringent sets of fixed effects such as firm and product (HS 2-digit)-destination-year combination (as in Fontagné and Orefice [2018]), or firm-product-destination and year combination. With these constraints in mind, we test the robustness of results against a combination of firm, product trend, destination trend and product-destination fixed effects. The results, presented in Supplementary Table A.2.3, are broadly similar in direction.

We further evaluate the longer-term impact of SPS standards by focusing on alternative definitions of export exit. Specifically, we consider a contract to be discontinued when the firm does not continue the contract at all in the next 2 or 3 years. Supplementary Table A.2.4 present the results. The results are qualitatively similar and reinforce the robustness of the main findings. They suggest that SPS has a permanent impact that forces exporters to exit from serving the trade flow completely rather than taking a hiatus to invest in meeting the new standard.

Lastly, our methodology may underestimate the impact of stringent standards due to measurement issues. First, due to delays in communication between private producers, national governments and representatives of member countries at the WTO, countries

may raise concerns at the SPS committee at considerable delays after the actual imposition of more stringent standards in practice. Given the inclusion of various trend fixed effects in the model, it is possible our SPS variable may only capture the impact of measures implemented years before. At the same time, member countries may raise concerns against draft legislation. As such, addressing the anticipation or attenuation bias is difficult through the use of lagging or leading import standard variables.

Second, the STC measure captures the impact of raised concerns on exporters in a third country (not Vietnam). This analysis implicitly assumes that stringent SPS measures would affect exporters from all countries and not only those who explicitly raised concerns. While this assumption is consistent with the non-discriminatory rules of the WTO and of public standards (which apply to both public and private firms), it may underestimate the severity of SPS measures for Vietnamese exporters. In such case, one would expect a stronger impact for issues more directly applicable to Vietnamese exports. Given these caveats, the estimated impact of SPS imposition is likely to be a lower-bound for the actual effect.

6. Conclusions

This paper provides new empirical findings on the impact of SPS measures on the dynamics of exporters using a novel dataset from customs transactions in Vietnam. Despite hundreds of studies and its importance for policymaking, the debate remains inconclusive on the role of quality standards in hindering and catalysing trade (see Santeramo and Lamonaca [2019] for a recent meta-analysis). This issue becomes ever more pressing with the increased use of quality measures before and during the COVID-19 crisis. The case of Vietnam is informative given the importance of agri-food sector behind its export growth, and the relative similarity of context between Vietnam and other developing countries.

The paper shows that the imposition of more stringent standards in the destination countries negatively affects the margins of trade among Vietnamese exporters. Facing more stringent standards in a certain product-destination, exporters are less likely to participate and more likely to terminate serving this market. This finding confirms the difficulty for exporters from Vietnam in meeting international import standards. Analysis based on imports into U.S. market suggests that the unit rejection rate for agri-food exports from Vietnam averaged 25.4% during the 2006-08 period. This rate is higher than average of 6.2% for exporters from OECD countries, 18.8% for exporters from lower-middle income country and 20.9% among exporters from low-income countries (Henson and Olale, 2011).

At the same time, the study also finds evidence of import standards as a catalyst for economic upgrading. Exporters serving markets with more stringent standards record higher product price and quality. Interestingly, imposition of such standards is not associated with higher quality-adjusted price, alleviating concerns that weaker competition may be the main force driving higher prices.

Despite this encouraging result, it remains to be seen whether such improvement brings material and long-term benefits to exporters and the local communities at large. For example, Krauss and Krishnan (2021) provide evidence that that adoption of international sustainability standards can help cocoa farmers in Nicaragua to generate and maintain business ties with lead multinationals. In spite of their successful integration, the farmers actually received lower profits and the soil conditions deteriorate which led to longer term downgrading.

Third, the local production network matters for exporters' response to stringent standards. Specifically, having more exporters from the same region that serve the same product-destination helps alleviate the negative impact of import standards on the extensive and intensive margins of trade. When facing more stringent standards, exporters with

more peers are also associated with higher product quality than those with fewer peers. This positive spill-over effect across firms implies a role for policymakers to encourage agglomeration of exporters through export entrepreneurship in order to navigate the increasingly hostile trade environment.

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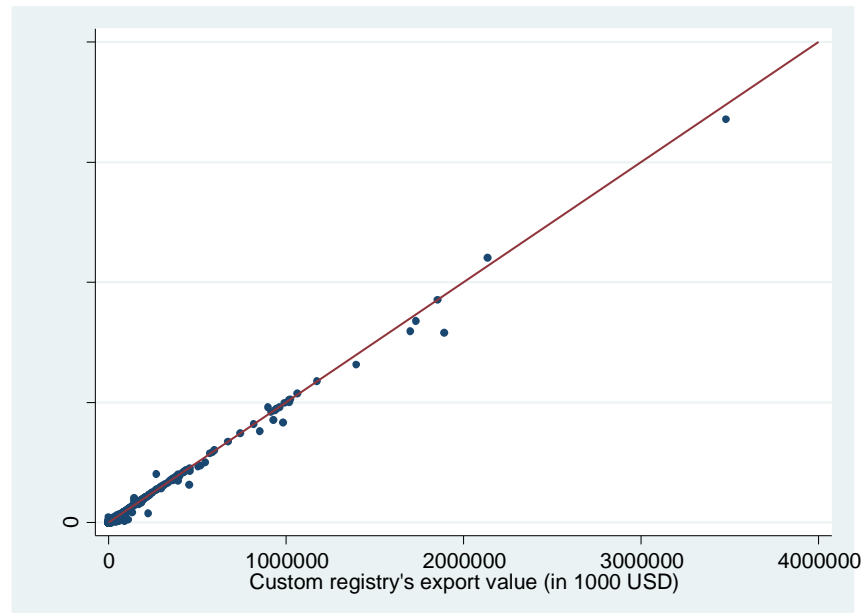
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Supplementary materials

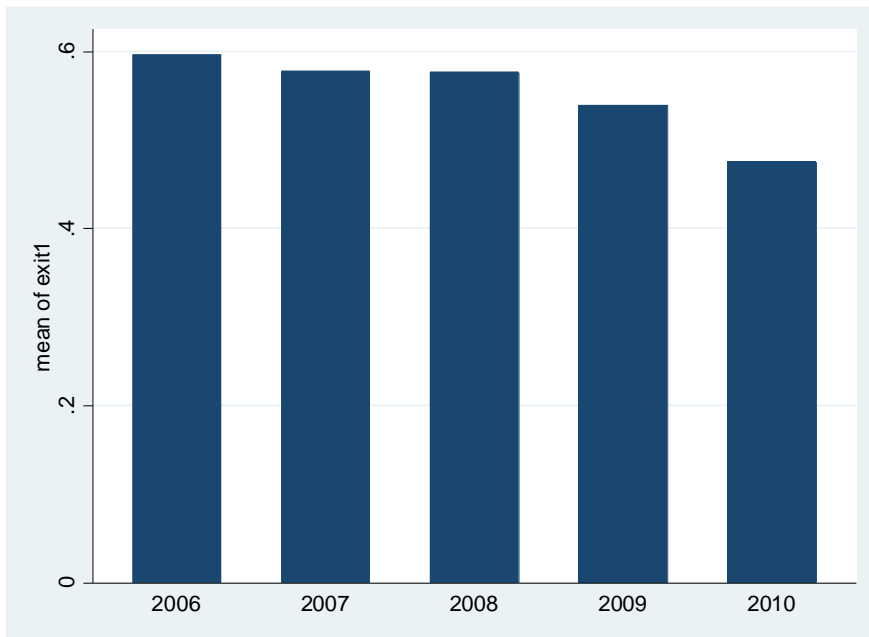
Figure A.2.1. Scatterplot of export value of each product subheading-destination-year combination, custom registry vs. COMTRADE data



Note: Red line indicates equity.

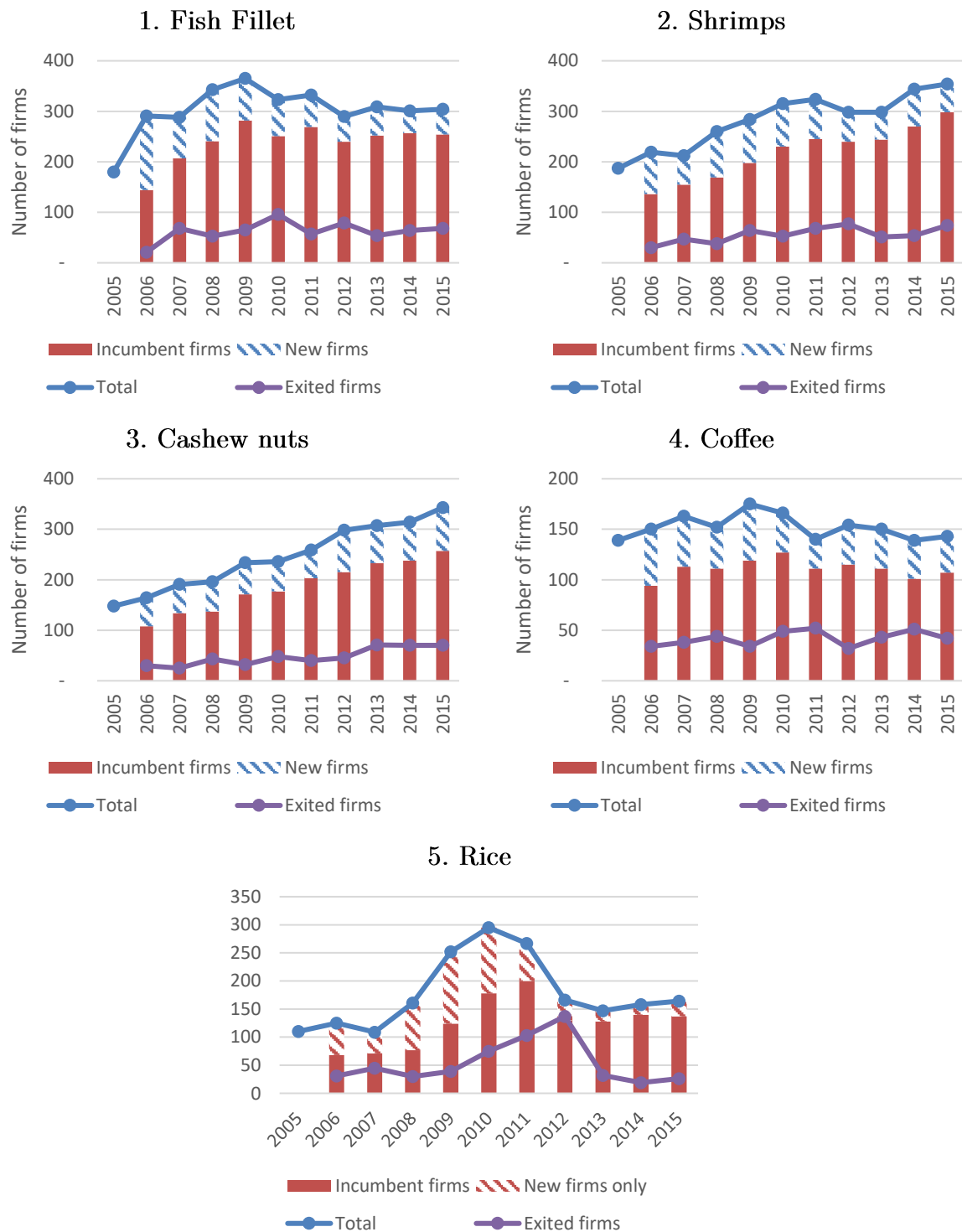
Source: Author's calculations.

Figure A.2.2. Crude exit rate, 2006-15



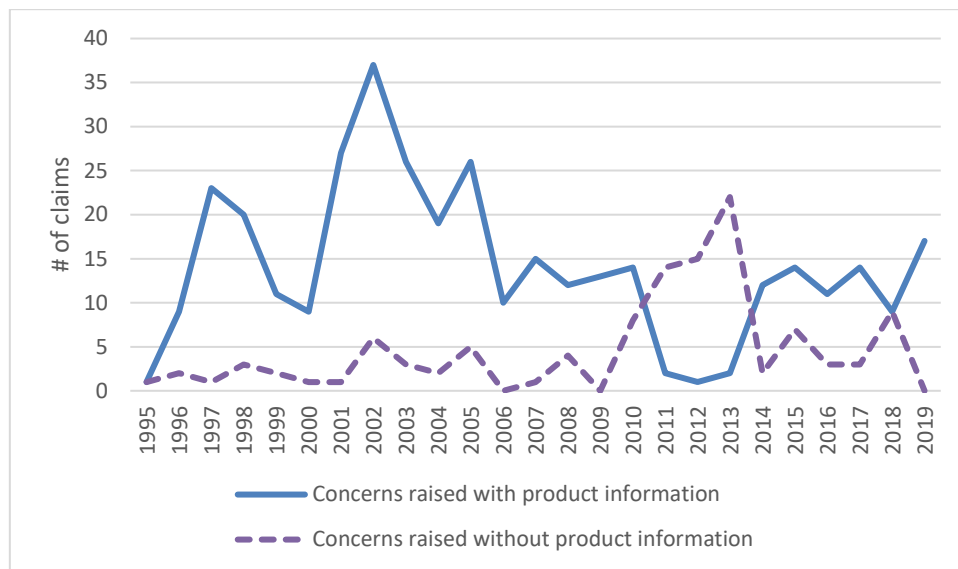
Source: Author's calculations.

Figure A.2.3. Number of firms in the five most popular export products: total, incumbent, new and exited firms



Source: Author's calculations.

Figure A.2.4. Prevalence of SPS concerns in the WTO Trade Concern database
with and without product information



Source: Author's calculations.

Table A.2.1. Impact of import standards on product price and quality controlling
for exporter size

VARIABLES	(1) Price	(2) Quality	(3) Quality-adj. price
SPS	0.083 ^a [0.024]	0.057 ^b [0.028]	0.026 [0.020]
SPS × Peers	0.009 [0.006]	0.018 ^b [0.008]	-0.008 [0.006]
Peers	-0.023 ^a [0.005]	0.122 ^a [0.006]	-0.146 ^a [0.004]
SPS × Size	-0.004 ^b [0.001]	-0.002 [0.002]	-0.001 [0.001]
Size	-0.002 ^c [0.001]	0.005 ^a [0.001]	-0.007 ^a [0.001]
ln(1+tariff)	-0.015 [0.025]	-0.009 [0.037]	-0.006 [0.023]
Observations	86,298	86,298	86,298
R-squared	0.916	0.506	0.946

Source: Author's calculations.

Table A.2.2. Regression results using lagged SPS measure

A. Trade margins

	(1)	(2)	(3)	(4)	(5)	(6)
	x	x	Inv	Inv	Exit	Exit
SPS (lag)	-0.009 ^c [0.005]	-0.010 ^a [0.004]	-0.016 [0.040]	-0.026 [0.035]	0.013 [0.009]	0.025 ^a [0.009]
SPS (lag) × Peers		0.006 ^b [0.003]		0.023 [0.017]		-0.011 ^a [0.004]
Peers		0.069 ^a [0.002]		0.486 ^a [0.010]		-0.081 ^a [0.003]
ln(1+tariff)	-0.041 ^a [0.008]	-0.023 ^a [0.007]	-0.101 [0.066]	0.064 [0.066]	0.076 ^a [0.015]	0.050 ^a [0.015]
Constant	0.265 ^a [0.002]	0.210 ^a [0.002]	11.043 ^a [0.013]	10.468 ^a [0.015]	0.594 ^a [0.003]	0.700 ^a [0.005]
Observations	356425	356425	89699	89699	82094	82094
R ²	0.184	0.194	0.513	0.538	0.308	0.318

Note: All regressions include firm, destination-year and product (HS 8-digit)-year fixed effects. Robust standard errors, clustered at destination-product section (HS 4-digit)-year level, are presented in brackets. ^a p<0.01, ^b p<0.05, ^c p<0.1.

B. Product price and quality

	(1)	(2)	(3)	(4)	(5)	(6)
	Price	Price	Quality	Quality	Quality-adj. price	Quality-adj. price
SPS (lag)	0.046 ^a [0.013]	0.042 ^b [0.017]	0.046 ^b [0.018]	0.030 [0.020]	-0.000 [0.014]	0.012 [0.013]
SPS (lag) × Peers		0.003 [0.007]		0.014 [0.009]		-0.011 ^c [0.006]
Peers (NUTS2)		-0.022 ^a [0.005]		0.123 ^a [0.006]		-0.145 ^a [0.004]
ln(1+tariff)	-0.010 [0.025]	-0.015 [0.025]	-0.044 [0.037]	-0.009 [0.037]	0.034 [0.023]	-0.007 [0.023]
Observations	86298	86298	86298	86298	86298	86298
R ²	0.916	0.916	0.501	0.505	0.944	0.946

Note: All regressions include firm, destination-year and product (HS 8-digit)-year fixed effects. Robust standard errors, clustered at destination-product section (HS 4-digit)-year level, are presented in brackets. ^a p<0.01, ^b p<0.05, ^c p<0.1.

Source: Author's calculations.

Table A.2.3. Regression results using alternative fixed effect specifications

A. Trade margins

	(1)	(2)	(3)	(4)	(5)	(6)
	Ext. margin	Exit	Int. margin	Ext. margin	Exit	Int. margin
SPS	-0.020 ^b	0.016	0.038	-0.022 ^b	0.034	0.058
	[0.010]	[0.018]	[0.038]	[0.010]	[0.021]	[0.044]
SPS × Peers (NUTS2)				0.001	-0.011 ^c	-0.013
				[0.004]	[0.006]	[0.015]
Peers (NUTS2)				0.037 ^a	-0.011 ^b	0.251 ^a
				[0.002]	[0.004]	[0.011]
Observations	393605	98258	107271	393605	98258	107271
R^2	0.224	0.378	0.625	0.226	0.378	0.628

Note: All regressions include firm, destination-product, destination-year and product chapter-year fixed effects. Robust standard errors, clustered at destination- product section (HS 4-digit)-year level, are presented in brackets. ^a p<0.01, ^b p<0.05, ^c p<0.1.

B. Product price and quality

	(1)	(2)	(3)	(4)	(5)	(6)
	Price	Quality	Quality-adj. price	Price	Quality	Quality-adj. price
SPS	-0.013	-0.009	-0.004	-0.017	-0.014	-0.003
	[0.020]	[0.020]	[0.010]	[0.023]	[0.023]	[0.012]
SPS × Peers (NUTS2)				0.003	0.004	-0.001
				[0.007]	[0.008]	[0.005]
Peers (NUTS2)				-0.006	0.036 ^a	-0.043 ^a
				[0.005]	[0.006]	[0.004]
ln(1+tariff)	0.006	-0.040	0.046	0.005	-0.038	0.043
	[0.077]	[0.094]	[0.050]	[0.077]	[0.094]	[0.050]
Observations	102945	102945	102945	102945	102945	102945
R^2	0.940	0.597	0.959	0.940	0.598	0.960

Note: All regressions include firm, destination-product, destination-year and product chapter-year fixed effects. Robust standard errors, clustered at destination- product section (HS 4-digit)-year level, are presented in brackets. ^a p<0.01, ^b p<0.05, ^c p<0.1.

Source: Author's calculations.

Table A.2.4. Impact of SPS standards on long-term survival

	Exit (2 years definition)			Exit (3 years definition)		
	(1)	(2)	(3)	(4)	(5)	(6)
SPS	0.017 ^b	0.033 ^a	0.014	0.015 ^b	0.031 ^a	-0.001
	[0.008]	[0.008]	[0.034]	[0.007]	[0.008]	[0.034]
SPS × Peers (NUTS2)		-0.013 ^a	-0.014 ^a		-0.013 ^a	-0.014 ^a
		[0.004]	[0.004]		[0.004]	[0.004]
Peers (NUTS2)		-0.080 ^a	-0.079 ^a		-0.079 ^a	-0.078 ^a
		[0.003]	[0.003]		[0.003]	[0.003]
SPS × Size			0.001			0.002
			[0.002]			[0.002]
Size			-0.060 ^a			-0.058 ^a
			[0.003]			[0.003]
Observations	104854	104854	104854	104854	104854	104854
R^2	0.318	0.328	0.332	0.331	0.340	0.343

Note: The dependent variable for the regressions in column2 (1)-(3) is a dummy that takes the value of 1 if the contract is discontinue in the next 2 years, i.e. the firm does not export to that product-destination combination in t nor $t+1$. Similarly, the dependent variable for the regressions in columns (4)-(6) indicate whether firm discontinue the contract for the next 3 years. All regressions include firm, destination-year and product chapter-year fixed effects. Robust standard errors, clustered at destination- product section (HS 4-digit)-year level, are presented in brackets. ^a $p < 0.01$, ^b $p < 0.05$, ^c $p < 0.1$.

Source: Author's calculations.

Chapter 3: Does the internet matter for export concentration?

1. Introduction

Export sales increasingly concentrate among the largest firms. Mayer and Ottaviano (2007) find that the top 1% of firms account for 77% of manufacturing exports in Hungary, 59% in Germany, 53% in Norway, 48% in Belgium, 44% in France, 42% in the United Kingdom and 32% in Italy. Export “superstars” such as Samsung in Vietnam and Intel in Costa Rica also dominate developing countries’ export basket and growth. Freund and Pierola (2015) analysed custom transaction data from 32 (mostly developing) countries to show that the top 5 firms account for 30% of non-oil exports. In a follow up study, they find that these superstars account for almost half of export growth as well (Freund and Pierola, 2020). After reviewing existing literature, they also conclude that the causes behind this rising concentration remain an open question for research.

Understanding the drivers of export concentration is critical from both academic and policy perspectives. Recent studies demonstrate the non-negligible consequence of these “superstars” on aggregate economic behaviour and volatility (Gabaix, 2011; Di Giovanni, Levchenko, and Mejean, 2014; Carvalho and Grassi, 2019), comparative advantage (Gaubert and Itskhoki, 2021), mark-ups (De Loecker and Eeckhout, 2020), decline in labour share (Autor et al., 2020) and inequality (Gans et al., 2019). The heterogeneity of firms is also central to estimating trade elasticities and the gains from trade (Arkolakis, Costinot & Rodríguez-Claire, 2012). In the context of COVID-19, understanding firm-concentration becomes an important policy objective in order to avoid excessive exposure to idiosyncratic shocks from a few firms and to avoid supply chain bottlenecks.

This paper provides empirical evidence suggesting that the global expansion of the internet contributes to the rising concentration of goods export among the top exporters. To our knowledge, this paper is the first to explicitly assess the link between communication technologies and export concentration in international trade. After describing the

data in section 2, section 3 and 4 will apply panel econometric techniques to firm-level customs registries from 11 developing countries to show that:

- First, the spread of the internet steepens the slope of the log-log ranks-sales relationship among exporters in each origin-destination pair. This shift implies a concentrating distribution of export sales toward the top exporters.
- Second, incumbent export superstars are more likely to retain their status in an environment with better internet. The main specification suggests that doubling internet adoption would boost the chance for the incumbent top exporter to retain its position by 22.7% and improve the likelihood that the incumbent top 5% of exporters would remain in the top 5% by 11.7%. This increase suggests an “entrenchment” effect where the internet reduces churning at the top.

These results are robust to a series of sensitivity checks for the concentration measures, various stringent sets of fixed effects, as well as alternative samples of data. These findings also hold when we use international internet bandwidth as an instrumental variable for Internet adoption to address concerns of endogeneity.

The idea that internet adoption may increase export concentration is not immediately intuitive. Past research on the effect of the internet on international trade has often emphasised its role in cutting trade cost, especially in reducing the fixed cost of searching and matching between partners (Freund and Weinhold [2002] and [2004]). Under a heterogeneous firm model such as Chaney (2008), a reduction in fixed cost would typically lead to an increase in the number of exporters by inducing new entry. However, the shape of the Pareto distribution that describes the heterogeneity of export sales does not change when the productivity cut-off for exporting drops.

Section 5 reconciles these findings from the lens of information frictions. In a nutshell, connectivity can alter the level of competition faced by exporters by exposing each importer to many more potential exporters. As buyers can now easily find substitutes,

demand becomes more elastic to prices – an argument dating back to Hirschman’s first rule of derived demand. Importers are now more likely to source from sellers with the lowest production cost. High-productivity exporters are thus better placed than low-productivity ones to boost their sales from this heightened visibility and expand their market share. Consequently, the expansion of the Internet is expected to increase export concentration among the superstars.

In an extension of our empirical models, we find evidence confirming the importance of information frictions as a key channel for the relationship between Internet adoption and export concentration. We find that the impact of the internet on export concentration is stronger for exports of differentiated goods than for exports of homogenous goods. Trading of differentiated goods is typically more information intensive where sellers and buyers need more communication to convey various product specifications and characteristics. In contrast, information frictions are less constraining for homogeneous goods that trade on commodity trading platforms or use referenced prices.

Such results do not refute the possibility of alternative mechanisms. For example, the spread of internet connectivity may also affect firm heterogeneity through channels such as productivity, access to inputs and organisation capital. However, our main results remain robust even when controlling for various supply- and demand-side factors.

This paper complements the growing sets of research on information frictions in international trade. Exporters could face information frictions related to the costly monitoring of market prices across destinations (Allen, 2014; Steinwender, 2018), the limited awareness of potential partners (Akerman et al., 2022), the lack of information on the credibility of buyers (Araujo et al., 2016), and the lack of knowledge on demand condition (Dickstein & Morales, 2018). Importers also face frictions due to the lack of awareness

about potential suppliers (Lenoir, Martin & Méjean, 2022), the cost of processing information (Dasgupta & Mondria, 2018), and the lack of information on the credibility of sellers on online platform (Chen & Wu, 2020).

These papers highlight the distinct role of informational frictions that cannot be captured as part of the fixed trade cost. Past research in the aforementioned cross-country strand often assumes that the induced cost from frictions is already factored in the transaction as buyers and sellers agree on a common price and quantity. In reality, firms often do not find out about the quality (and profitability) of the match until after the trade has started, sometimes much later when disagreement occurs. This problem is arguably more severe in the context of international trade and developing countries, where buyers and sellers are far away from each other and the infrastructure for information flow and traditional marketing is underdeveloped.

The paper also relates to the literature on exporter heterogeneity. It first provides a multi-country perspective to the empirical literature that often dissect the anatomy and distribution of bilateral export sales from a single source country such as Head et al. (2014) and Nigai (2017).

This paper also complements the research on understanding the sources of heterogeneity. Partly due to the lack of data, this literature often focused on either supply-side factors such as productivity, product scope, quality or demand-side factors such as final consumer preferences and firm-specific demand shocks. The matching of buyers and sellers have largely been overlooked in this discourse. An exception is Bernard et al. (2022), whose findings confirm our conjecture on the role of matching frictions in sales heterogeneity. They use firm-to-firm sales data for Belgium to demonstrate that the number of customers accounts for 51% of firm sale dispersion. In contrast, firm's ability to obtain large market shares across its customers only account for 18% of dispersion.

Last but not least, the paper also adds to the growing literature on market concentration in the digital economy that has been documented in other fields. For example, recent research in industrial organisation highlights the winner-takes-all (so called “tipping”) feature of the digital economy (see Tirole [2020] for a review). On innovation, Paunov et al. (2019) find that patent applications in the digital economy are more concentrated in the top cities than patent applications in other sectors. The top 1% of cities in OECD countries account for 42.5% of patent applications in communication and technology fields. For comparison, the top 1% of cities account for 15.1% of patent applications in activities related to consumer goods.

Section 6 concludes by summarising the key results and briefly discussing their implications for policymakers.

2. Data

2.1. Data on exporters

This paper relies on information on firm’s non-oil export transactions collected from national custom agencies and published in the WB Exporter Dynamic Database (EDD) (Fernandes, Freund & Pierola, 2016). To the best of our knowledge, this dataset is currently the largest publicly available database on firm-level export dynamics in term of coverage for developing country. The public database exists in two main variants: an aggregated dataset of firm dynamics that is available for 65 countries (EDD v1.0), and a smaller subset of firm-level microdata for 11 countries (EDD v2.0). This paper employs the EDD v2.0 dataset. In this variant, the export sales from each firm are disaggregated by year, destination and product at HS 6-digit level.³³ For the purpose of this paper, we aggregate the data at firm-destination-year level for most applications.

³³ The database only concerns the universe of non-oil exports from formal firms registered by custom agencies. It does not capture data on informal trader or unrecorded exports by formal firms, which may constitute an important part of cross-border trade in developing country.

The dataset covers a broad set of developing countries that span across geographic regions and income brackets. The coverage includes both low-income countries such as Malawi, Burkina, and Yemen as well as middle-income countries such as Mexico, Bulgaria, Peru, and Uruguay. We also have both coastal and landlocked countries.

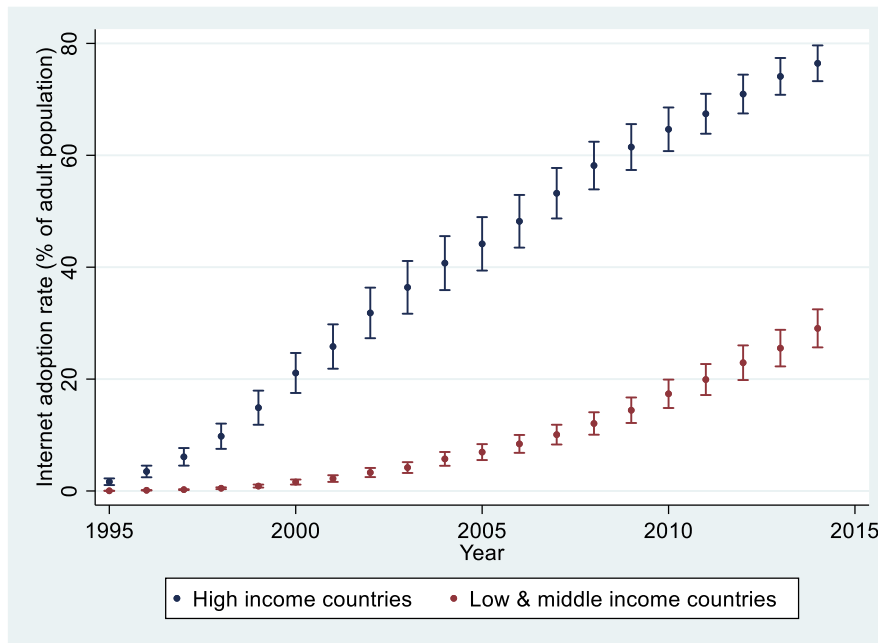
Table A.3.1 summarises data coverage by country. While there is significant variation across countries, the dataset mostly covers the late 2000s period.

2.2. Data on internet use

I use the percentage of internet users in the adult population for each country to proxy for firms' use of the internet to search for partners. This measure is commonly used among the cross-country literature to measure the impact of internet use on international trade. The annual data for each country come from World Bank's World Development Indicators.

During the period when the exporter data is available, access to internet increases significantly all across the world (Figure 3.1). The share of internet users globally increased six-fold from 7% in 2000 to 43% in 2015, according to data from the International Telecommunication Union (ITU). Internet use in the context of developing countries during this period mostly pertains to basic internet application such as e-mail, low-cost internet-enabled voice call and websites. Nonetheless, a large discussion during this period emphasised the role of the internet as a game-changer for the international trade. Some author went as far as declaring "death to distance" and that the internet makes the world "flat" (Freidman, 2005).

Figure 3.1. Internet connection by country, 1995-2015



Source: Author's calculations based on data from International Telecommunication Union.

Unlike past cross-country literature which often treated internet measures of origin and destination countries separately, we argue that the utilisation of internet for cross-border trade needs to be a joint function of internet adoption at both origin and destination countries. As discussed in the literature review, the internet can help both exporters and importers to address informational frictions in search. This entails the ability to codify information (creating a website, digitizing product specifications and listing) and processing information (ability to use internet search, use of platform, etc.).

At the same time, the use of internet for searching and matching is more likely to be driven by internet adoption in the weaker node of the supply chain for any country pair in the trade. For example, any improvement in online communication between the U.S. and Malawi is more likely to be driven by improvements in internet use in Malawi, where only 14% of the population has access to the internet, rather than changes in internet use in the U.S., where over 86% of the population use the internet.³⁴ Following Lopéz-

³⁴ Osgano and Tan (2016) show that the impact of internet access on export flow is highest when countries have similar penetration rate – a pattern they refer to as “assortive matching”.

González and Ferenc (2018), we define our main variable, the bilateral internet adoption rate, as the pairwise minimum of internet usage for each pair of origin country i and destination country j in year t :

$$Internet_{ijt} = \min \{Internet_{it}, Internet_{jt}\}$$

3. The Internet and distribution of exporter sales

This section evaluates if internet adoption leads to more concentrated distribution of firm-level export sales in each country pair. This empirical exercise faces three important considerations: (i) which distribution to approximate sales; (ii) which method to estimate such distribution; and (iii) how to account for firm-specific characteristics.

For the first question, the current heterogeneous firm trade literature has often used either Pareto or lognormal distribution to approximate the heterogeneity of export sales. The canonical firm-heterogeneity models following Melitz (2003) and Chaney (2008) assume a Pareto distribution of productivity. This is partly thanks to its attractiveness for model tractability, but also backed up by a number of empirical investigations (such as Axtell [2001], di Giovanni and Levchenko [2012], Arkolakis [2016]). Export sales to a specific destination emerge endogenously in these models, and they also follow a Pareto distribution.

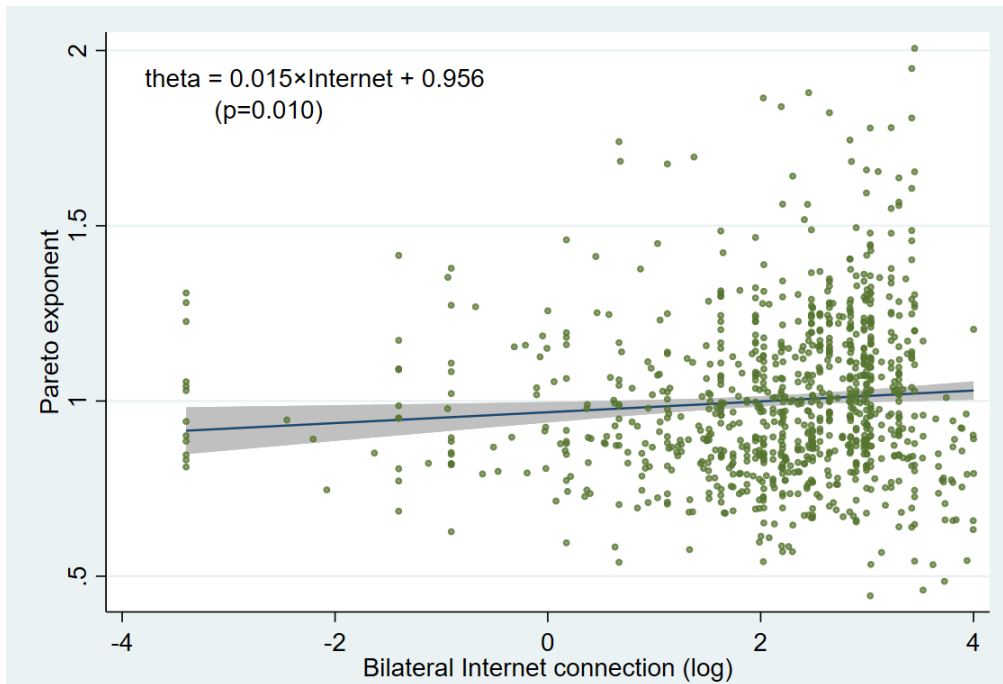
Some authors such as Head et al. [2014] and Fernandes et al. [2022] question this Pareto assumption. They suggest that the lognormal distribution is a superior fit for the entire distribution of export sales. Using the domestic and foreign sales of French firms Nigai (2017) reconcile the two contrasting views to suggest that the choice of distribution type should depend on the quantile interested. He finds that Pareto distribution provides better estimate for the top of the distribution. In contrast, lognormal proves more capable for the rest of the support.

In this paper, the focus on export superstars lends itself to a Pareto-type estimation. At the same time, there remains uncertainty over the exact threshold over the distribution support where Pareto law is more relevant. Consequently, it would be important to carry out careful sensitivity analyses with different cut-offs of top exporters, a common practice in the literature.

In our application, the main interest lies in estimating the Pareto exponent (also known as shape parameter) that governs heterogeneity of such Pareto distribution. Among the most commonly used methods is to the log-log rank-size regression. This method has been used in various applications, including in international trade literature (Helpman, Melitz and Yeaple, 2004). Another closely related method is to use the quantile-quantile (QQ) estimator to exploit the theoretical relationship between empirical quantiles of the sorted log sales data and the empirical quantiles (Head, Mayer and Thoenig, 2014). Outside the international trade literature, maximum likelihood approaches such as those suggested by Malik (1970) are also popular to fit different types of Pareto distribution.

As a simple stylised fact, Figure 3.2 plots the Pareto exponents (estimated separately on export sales distribution in each origin-destination-year triad) against bilateral internet adoption level. The plot suggests that better internet connectivity correlates with higher Pareto exponent, suggesting more concentrated sales distribution.

Figure 3.2. Internet and heterogeneity of export sales distribution



Note: Pareto exponent for export sales distribution is estimated using QQ estimator as suggested in Head, Mayer and Thoenig (2014). The sample is restricted to in each origin-destination-year triad with at least 200 exporters. *Source:* Author's calculations.

However, such aggregate-level investigation would overlook the various cross-destination spillovers within firms that would bias the analysis. The margins of firm participation in each market are interdependent and complementary (Bernard et al., 2018). For example, exporters in one market may find it less costly to export the same products to nearby markets thanks to the acquired knowledge of the local culture and consumer preferences. Other firm idiosyncrasies may also affect firm's export sales across different markets. In profiling export superstars in nine developing countries, Freund & Pierola (2020) document that the majority of superstars are multi-national enterprises that simultaneously serve multiple destination. Thanks to their international connection, FDI firms may also have better information on market entrance and demand shifters than those owned by domestic firms.

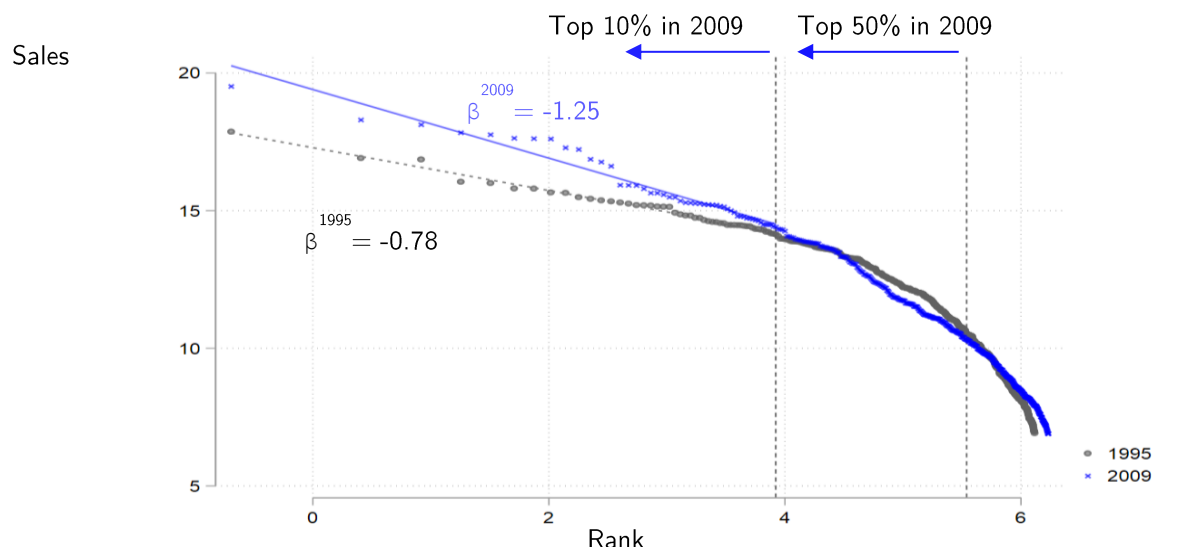
The log-log ranks-sizes regression appears most relevant for our analysis given these considerations. Compared to the more sophisticated methods, it offers both its simplicity and robustness after a simple adjustment (Gabaix & Ibragimov, 2011). This approach

also allows for inclusion of high-dimensional fixed effects that helps account for various idiosyncratic effects. This is a considerable advantage compared to methods based on maximum likelihood estimations (which cannot incorporate these fixed effects). In addition, the flexibility to use the alternative specification of log-log sizes-ranks enables us to make meaningful economic interpretation regarding the effect of internet expansion on average sales itself.

For example, Figure 3.3 visualises the log-log sale-rank relationship among Peruvian exporters to Germany. We capture two moments: in the first year where data is available (1995) and in the last year (2009).³⁵ As the data series for 2009 expands further rightward than the data series for 1995, it suggests that there are more Peruvian exporters in the German market in 2009 than in 1995. The figure also shows a linear relationship between export sales and ranks, especially at the top 10% of the distribution. We can trace the exponent of this relationship by regressing log sales on log rank for the top 10% of exporters in each year. The slope for 2009 (β^{2009}) is steeper than the slope for 1995 (β^{1995}), suggesting that the exponent of the top 10% of sales distribution increased during this period. This shift would imply an increased concentration at the top of the distribution.

³⁵ This choice is motivated by that fact that customs data from Peru has the longest uninterrupted panel series among the countries in the EDD dataset. Germany was the most popular destination among Peruvian exporters during this period.

Figure 3.3. Distribution of sales among Peruvian exporters to Germany, 1995-2009



Source: Author's calculations.

If internet adoption has a positive impact on the Pareto exponent κ of export sales distribution (in other words, it reduces the coefficient β of log-rank in equation (1)), the result would imply a more concentrated distribution. The rest of this section 3 will evaluate *Hypothesis 1* formulated as below:

Hypothesis 1 Higher internet adoption rate leads to an increase in the exponent of the export sales distribution for a given country-pair.

3.1. Empirical setup

We start with a log-log size-rank regression, a variant of the more commonly used classic log-log rank-size. Gabaix & Ibragimov (2011) show that this approach shares asymptotic properties equivalent to the traditional setup. They also suggest shifting rank variable by a factor of $\frac{1}{2}$ to ensure consistency in small samples. These modifications lead to the following setup:

$$\log(\text{Sale}_{fijt}) = \alpha + \beta \log(\text{Rank}_{fijt} - \frac{1}{2}) \quad (1)$$

where $Sales_{fijt}$ represents the total export sales from firm f of country i to country j in year t .³⁶ $Rank_{fijt}$ represents the rank in term of sales by firm f among the exporters from i to j in year t . Due to the negative correlation between the descending rank and sales level, β takes on a negative value. The absolute value of this slope (β) approximates the Pareto exponent κ (also called the shape parameter $\tilde{\theta}$ in some literature).

To separate out the effect of internet adoption, we augment equation (1) with the bilateral internet adoption rates $Internet_{ijt}$ defined in Section 2.2, and its interaction with firm ranks:

$$\begin{aligned} \log(\text{Sale}_{fijt}) = & \beta_1 \log(\text{Rank}_{fijt} - \frac{1}{2}) + \beta_2 \log(\text{Rank}_{fijt} - \frac{1}{2}) \times \log(\text{Internet}_{ijt}) \quad (2) \\ & + \beta_3 \log(\text{Internet}_{ijt}) + \Phi_f + \Phi_{it} + \Phi_{jt} + \Phi_{ij} + \varepsilon_{fijt} \end{aligned}$$

Our main coefficient of interest is that of the interaction term between log rank and internet adoption β_2 . This interaction term indicates the impact of internet adoption on the slope of the log-log sale-rank relationship (the exponent parameter). A negative coefficient β_2 would imply that with stronger internet adoption rates, the (negative) slope of the sale-rank relationship becomes steeper. In this case, internet adoption facilitates a more concentrated distribution of export sales. The coefficient β_3 of the internet adoption variable captures the impact of internet adoption on average sales level.

The firm fixed effect helps account for idiosyncratic behaviours of firms that may affect sales such as their ownership and main industry of activities. The linear trends for origin and destination countries account for multilateral resistances, overall demand and supply trends, as well as other macroeconomic shocks in these countries. The origin-destination country pairs account for the trade cost between countries such as distance, borders, religion, common language and colonial history.

³⁶ For simplicity, the notation for origin country is suppressed whenever we refer to a specific firm. In EDD database, firm identifications are anonymised in each country, therefore we cannot observe if the same multinational may appear in multiple country datasets. We thus assume any firms from different countries are different from each other.

Table 3.1 displays summary statistics for the resulting dataset. In total, we observe 1 051 095 observations from 232 528 different exporters. There are 1 725 country pairs which form 10 963 origin-destination-year flows. In each flow, there are up to 28 997 exporters. The bilateral internet adoption rate stands at 13% for the median observation, ranging from 0.001% to 54.7%. In the regressions, we will express this variable as log of percentage points.

Table 3.1. Summary statistics for log-log sale-rank regressions

VARIABLES	(1) N	(2) mean	(3) sd	(4) p50	(5) min	(6) max
Sales _{ijt} (in thousand USD)	1051095	1871	64421	36	1	30203306
Internet _{ijt} (%)	1051095	13	10	12	0	55
Rank _{ijt}	1051095	2886	6034	349	1	28997
Number of exporters _{ijt}	1051095	5771	10044	861	1	28997

Source: Author's calculations.

3.2. Results

Table 3.2 first estimates the exponent of the sale-rank distribution for the top 10% of exporters in each flow by estimating equation (1). In column (1), the Pareto exponent (the absolute value for the coefficient of log-rank variable) of 0.915 conforms to previous estimates of the exponent at around 1 (albeit with a large standard error).

Column (2) presents the key result by estimating equation (2) for the top 10% of exporters and confirms *Hypothesis 1*. The coefficient for the interaction term between internet adoption and log-rank is negative and statistically significant at the 1% level. This result suggests that the internet reduces the negative slope of the log-log sale-rank relationship (hence increasing the exponent) – suggesting a more skewed sales distribution toward the top. To put this in perspective, the coefficient of log-rank suggests that there's a 55.5% difference in sales between the biggest exporters and 2nd biggest exporters for

a country pair with median level of internet adoption (12%). Doubling the internet adoption rate would widen this gap by 1.5 percentage points to 57.0%, *ceteris paribus*.³⁷ While the increase may not seem substantial, the bilateral internet adoption rate doubled every 1.7 year on average during the studied period.

The Internet has a positive and significant impact on sales of all exporters in the top 10%. This result is consistent with previous studies. For example, Fernandes et al. (2019) find that internet roll out increases the average export intensity of Chinese manufacturers in the same province. One standard deviation increase in internet penetration rate increases the sales for a certain exporter in an industry with the average intensity of internet use by 8.5%, *ceteris paribus*.

Table 3.2. The effect of internet on log rank-log sale relationship

VARIABLES	Top 10% (1)	Top 10% (2)	Top 50% (3)	Top 50% (4)	Full sample (5)	Full sample (6)
Rank	-0.915 ^a [0.011]	-0.849 ^a [0.013]	-1.377 ^a [0.016]	-1.283 ^a [0.014]	-1.852 ^a [0.020]	-1.725 ^a [0.016]
Rank × Internet		-0.030 ^a [0.005]		-0.044 ^a [0.006]		-0.059 ^a [0.007]
Internet		0.227 ^a [0.076]		0.261 ^a [0.076]		0.366 ^a [0.083]
Observations	99,707	99,646	491,747	491,453	958,780	958,158
R-squared	0.958	0.958	0.946	0.946	0.920	0.921

Note: All regressions include origin and destination linear trends, country pair and firm fixed effects. Robust standard errors clustered at origin-destination-year level are reported in brackets: ^a p<0.01; ^b p<0.05; ^c p<0.1. *Source:* Author's calculations.

The slope of the log-log sale-rank relationship can be highly dependent on the quantile of export sales analysed (see Figure 3.3 for an example and Nigai [2017] for a detailed discussion).³⁸ As a sensitivity analysis, the rest of the table repeats the same exercise for

³⁷ Results in column (2) suggest that for bilateral flow with bilateral internet adoption rate at 12%, the difference in sales between the first-ranked and the second-ranked firm is $\exp(-0.849 \times \log 1 - \frac{1}{2} - \log 2 - \frac{1}{2} - 0.030 \times \log 1 - \frac{1}{2} - \log 2 - \frac{1}{2} \times \log 12) - 1 = 55.5\%$. When the internet adoption rate doubles to 24%, the difference in sales is predicted as $\exp(-0.849 \times \log 1 - \frac{1}{2} - \log 2 - \frac{1}{2} - 0.030 \times \log 1 - \frac{1}{2} - \log 2 - \frac{1}{2} \times \log 24) - 1 = 57.0\%$.

³⁸ The deviation from power law at the tail-end of the distribution could reflect the fact that we do not observe firms' domestic sales.

a larger sample of the top 50% exporters and for the full sample of all exporters. In both cases, the general slope of rank-sale relationship steepens as the sample expands, highlighting the heavy tail characteristics of exporter distribution. This is also found in other studies such as Eaton et al. (2011) and di Giovanni et al. (2011). The main results hold qualitatively. They suggest that concentration occurs across the whole distribution of exporters, and not just among exporters at the very top, thus confirming *Hypothesis 1*.

3.3. Robustness

Our identification strategy relies on the temporal variation in bilateral internet adoption. In previous cross-country literature that exploit variations in country-level internet adoption rates, reverse causality is a serious concern because earnings from exports can fuel investment in internet infrastructure and facilitate adoption. Arguably reverse causality is less likely to be a serious concern for this paper as it analyses export sales at the firm level. The export performance of one firm is unlikely to affect directly the internet adoption rate of the whole population in either origin or destination country, due to the high fixed cost of setting up internet infrastructure.

Nonetheless, we test the robustness of the results against reverse causality through two tests. In the first test, we use the one-year lag of bilateral internet adoption rates as the main policy variable. Internet use in the previous year is arguably exogenous to contemporary export performance and helps avoid simultaneity bias. The results, presented in Panel A of Table A.3.2, are qualitatively and quantitatively similar to those found in Table 3.2, thus confirming the main results.

The second test uses internet speed as an instrumental variable for internet adoption. We use data on international Internet bandwidth per Internet user provided by the International Telecom Union. Similar to the internet use variable, country-level internet speeds are transformed into a bilateral indicator of internet speed as the lower speed of

each country pair. The rationale is that the slower node is more likely to create bottlenecks in information flow between these two countries. Because the annual data series have only been collected since 2000, the number of observations dropped.

Existing evidence suggests that internet speed is a key determinant of internet usage across countries. In many developing countries, the issue of internet speed ranks among the top barriers to internet adoption. In a survey of households in seven African countries, 15% of respondents cited the speed of internet as a limiting factor to internet use (Gillwald & Mothobi, 2019). In most countries, international Internet bandwidth is driven by investment and improvement in submarine cables and cross-border Internet Exchange Points for landlocked countries.³⁹ The expansion of this backbone network is also known as the first-mile challenge in internet adoption. A number of recent economic papers have used the roll-out and reliability of the backbone network as a proxy for internet use such as Hort and Poulsen (2019) and Cariolle (2021).

The exclusion restriction of IV model requires that internet speed has an impact on firms' export sales only through internet adoption and without other confounding factors. Being an infrastructural index, internet speed is unlikely to causally affect the sales or shipment of physical goods in ways than through promoting internet use and application.

While any ICT investments are clearly not randomly allocated but affected by various factors such as local macroeconomic conditions and institutional settings, several examples suggest that such concerns are alleviated in the case of backbone network in developing countries. For example, the Dot Com bubble in the latter half of 1990s in the U.S. helped generate an abundance of financial resources to develop Internet infrastructure in many developing countries such as India. Many of these investments are speculative in

³⁹ Satellite-based internet transmission remains limited to very few users in high income countries, and

nature with limited connection to their actual use case.⁴⁰ For many small countries, their International bandwidth is largely driven by the connection through undersea internet cables whose main purpose is to link other major economic hubs together.

Table 3.3 reports the effect of the internet on log-log sale-rank relationship using this instrumental variable approach. The internet bandwidth and its interaction with rank variable are the two instruments for internet adoption and its interaction with sales rank, making the estimates just-identified. Panel A presents the results from the first stage of the 2SLS procedures across the three samples of firms. Across all six columns, the Sanderson-Windmeijer F-statistics range from 1 458 to 4 130, alleviating the concerns over weak instruments (Sanderson & Windmeijer, 2016). The first column reports that a 10% increase in bandwidth increases internet adoption rate by 4.96%. The interaction of internet bandwidth with sale rank also has a statistically significant relationship in explaining the variation of the interaction term between internet use and sale rank.

Panel B of Table 3.3 reports the results from the second stage of the 2SLS procedure. The second stage results confirm that higher internet adoption increases the exponent of the sales distribution. Internet adoption also has a positive and statistically significant relationship with average sales of firm in each serving destination. These results broadly confirm the impact of internet on export concentration, as reported in Table 3.2.

⁴⁰ While one can argue that the dot com bubble is also source of confounding factors that affect international trade, the limited spill-overs from the dot com burst to the real economy suggests that such concern may not be a crucial factor.

Table 3.3. Internet & log-log sale-rank relationship, instrumental variable approach

A. First stage

	Top 10%		Top 50%		Full sample	
	(1)	(2)	(3)	(4)	(5)	(6)
	Internet	Rank×Internet	Internet	Rank×Internet	Internet	Rank×Internet
Bandwidth	0.496 ^a (0.022)	-0.067 (0.085)	0.511 ^a (0.036)	0.026 (0.199)	0.522 ^a (0.042)	0.089 (0.261)
Rank × Bandwidth	-0.018 (0.011)	0.436 ^a (0.049)	-0.016 (0.010)	0.415 ^a (0.061)	-0.016 (0.010)	0.406 ^a (0.067)
Rank	0.200 ^b (0.082)	-0.348 (0.347)	0.180 ^b (0.076)	-0.113 (0.441)	0.179 ^b (0.075)	-0.006 (0.482)
N	101449	101449	501629	501629	1003194	1003194
SW F-stat	3847	1458	4100	1688	4130	1761
KP F-stat	1287	1287	855	855	762	762

B. Second stage

VARIABLES	Top 10%	Top 50%	Full sample
	(1)	(2)	(3)
	Sales	Sales	Sales
Rank	-0.908 ^a [0.029]	-1.296 ^a [0.033]	-1.682 ^a [0.039]
Rank × Internet	-0.004 [0.011]	-0.037 ^a [0.011]	-0.076 ^a [0.014]
Internet	1.157 ^b [0.545]	1.219 ^a [0.428]	1.360 ^a [0.426]
Observations	95,638	471,107	917,903
R-squared	0.779	0.854	0.811

Note: SW F-stat refers to Sanderson-Windmeijer F-statistics. KP F-stat refers to Kleibergen-Paap Wald F statistic. All regressions include origin and destination linear trends, country pair and firm fixed effects. Robust standard errors, clustered at origin-destination-year level, are reported in brackets: ^a p<0.01; ^b p<0.05; ^c p<0.1.

Source: Author's calculations.

Table 3.4 tests the robustness of this *Hypothesis 1* against several alternative specifications. To conserve space, it focuses the analysis on the top 10% of exporters. Results for the top 50% and the whole sample are qualitatively similar and available upon request.

To account for different confounding factors, we first evaluate the robustness of the baseline model against alternative sets of fixed effects (FEs). First, we replace the firm-specific FEs with firm-destination FEs. Using detailed data on exports by Danish man-

ufacturers, Munch and Nguyen (2014) find that firm–destination specifics (such as demand shocks and firm–destination specific cost shocks) account for 55% of variation in firm-level export sales within a product-destination market.⁴¹

Second, we include the more stringent origin-destination-year Fes. These fixed effects accounts for overall demand and supply trends, as well as other evolution in bilateral trade cost between the two countries (such as trade policy, logistics and migrant networks). Their inclusion absorbs the internet variable that varies at the country pair-year level.

A potential issue with our definition of bilateral internet adoption is that when one country has persistently lower internet adoption rate than its partner, the variation in bilateral internet use could be exclusively driven by changes in adoption rate in this country, rather than reflect the changes in both countries.

To test against this issue, we split the sample into two groups depending on whether the exporter country has higher initial adoption rate than the importer country. In column (3), we limit the sample only to country pairs where the origin country had lower internet penetration rate at the first year when exporter data is available (t_0). In this situation, bilateral internet connection, defined as the pairwise minima value, would largely be driven by variations in internet penetration in exporting country. Inversely, column (4) exploits a subsample of country pairs where the destination country had lower internet penetration rate at the first year where exporter data is available (t_0).

In both situations, the results remain qualitatively similar. The coefficients for the interaction term between ranks and internet adoption indicate a strengthening effect of the internet on the exponent of sales distribution. This result confirms *Hypothesis 1*. Inter-

⁴¹ In contrast, firm-specific effects (such as productivity, quality, or economies of scale) account for 45% of sales variation.

estingly the effect of internet use on sales differs across the two specifications. This divergence is consistent with findings from Cariolle, de Melo and Imbruno (2022) who report a diverging impact of internet adoption for exporters from high-income countries (who often have higher internet adoption rates) and exporters from lower-income countries (who often have lower internet adoption rates).

Table 3.4. Effect of internet on rank-sale exponent among the top 10%, covariates and sample robustness

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Covariate robustness		Internet _{t0} <	Internet _{t0} ≥	Internet	N≥100	Existing
VARIABLES	Sales	Sales	Internet _{t0}	Internet _{t0}	as %	Sales	pairs
			Sales	Sales	Sales	Sales	Sales
Rank	-0.802 ^a	-0.861 ^a	-0.780 ^a	-0.901 ^a	-0.893 ^a	-0.870 ^a	-0.851 ^a
	[0.020]	[0.013]	[0.012]	[0.018]	[0.014]	[0.015]	[0.013]
Rank × Internet	-0.026 ^a	-0.032 ^a	-0.029 ^a	-0.019 ^a		-0.035 ^a	-0.030 ^a
	[0.005]	[0.005]	[0.006]	[0.006]		[0.005]	[0.005]
Internet	0.270 ^a		-0.413 ^c	-0.128		0.378 ^a	0.247 ^a
	[0.081]		[0.220]	[0.249]		[0.113]	[0.078]
Rank × Internet (%)					-0.002 ^a		
					[0.001]		
Internet (%)					0.004		
					[0.004]		
Observations	88,597	97,218	25,960	72,198	99,707	86,545	98,896
R-squared	0.977	0.971	0.946	0.963	0.958	0.974	0.959
<i>Fixed effects</i>							
Origin-Year	Y		Y	Y	Y	Y	Y
Dest.-Year	Y		Y	Y	Y	Y	Y
Firm-Dest.	Y						
Origin-Dest.-Year		Y					
Firm		Y	Y	Y	Y	Y	Y
Origin-Dest.			Y	Y	Y	Y	Y

Note: Robust standard errors clustered at origin-destination-year level are reported in brackets: ^a p<0.01; ^b p<0.05; ^c p<0.1.

Source: Author's calculations.

Finally, we evaluate the base models against alternative variable construction and samples. In column (5), we further test the sensitiveness of the result using internet as a percentage (rather than log specified). Column (6) evaluate the equation (2) using only flows where there are at least 100 exporters. This subsample ensures that the top 10%

include at least 10 firms. Columns (7) addresses concerns over selection by keeping only flows that are already active in the first year when customs data is available for each of the 11 developing countries in the EDD 2.0 dataset. This approach excludes new destinations that exporters from these 11 countries only exported more recently, as these new destinations could be a consequence of internet adoption. All these regressions using alternative subsample of observations confirm the main results to support *Hypothesis 1*.

Annex Table A.3.3 replicates the analysis using harmonic number to proximate rank. In particular, let $H(k)$ denotes the k th harmonic number: $H(k) = \sum_{x=1}^k \frac{1}{x}$ for $k \geq 1$. Let $H(0)=0$. For each flow (origin-destination-year triad), the $\log(\text{Rank}_{ijt}^{-1/2})$ in equation (1) and (2) now turns into $H(\text{Rank}_{ijt} - 1)$. Gabaix and Ibragimov (2011) suggests this approach as a better estimation of the tail estimate for small samples, albeit at a loss of simplicity and visual traction. The results confirm the robustness of the results against this alternative construction of the rank variable.

4. The Internet and entrenchment of export superstars

Conceptually, measures of concentration can follow two approaches using static measures and dynamic measures. Static measures aggregate information of each underlying distribution into composite indicators for comparing across countries and time. Dynamic measures focus on the movements and changes of a particular segment, quantile or group of firms across time.

Section 4 provides evidence that that the concentration of export sales in each origin-destination flow increases with better internet. This view of export concentration constitutes only the static aspect of export reliance. The concentration of exports among a few

firms in a given year may not necessarily imply a reliance on the superstars if the composition of firms that make up this top group changes frequently, i.e. there is high churning.

In contrast, an “entrenchment” of the top exporters who retain their dominance from one year to another would suggest sustained concentration over time and raise concerns for policymakers. This is an important point stressed by the statistical analysis from Freund and Pierola (2020). They find that 71% of the top-five exporters in a given year already featured in the top 1% of exporters five years previously.

From a conceptual basis, complementing the static view of concentration with the dynamics of export superstars would enable us to have a holistic understanding of concentration. Each measure embeds, explicitly or implicitly, value judgement about the relative importance of individuals along the distribution. The choice of measurement can have a direct impact on the design, result and inference of empirical analysis. Therefore, the literature on measuring concentration in other economic fields such as income inequality (Deaton, 2005, Milanović, 2012) and management (Brynjolfsson, Hu, and Smith, 2010) recommends using multiple complementary methods.

This section aims to understand the entrenchment of export superstars in the Internet era. Particularly, it evaluates if incumbent superstars are more likely to retain their top positions from one year to another as internet adoption expands thanks to the internet environment. This dynamic measure complements the static view of exporter concentration in section 4. It resembles in spirit the measurements of social mobility in the income inequality literature. The section tests *Hypothesis 2* as follows:

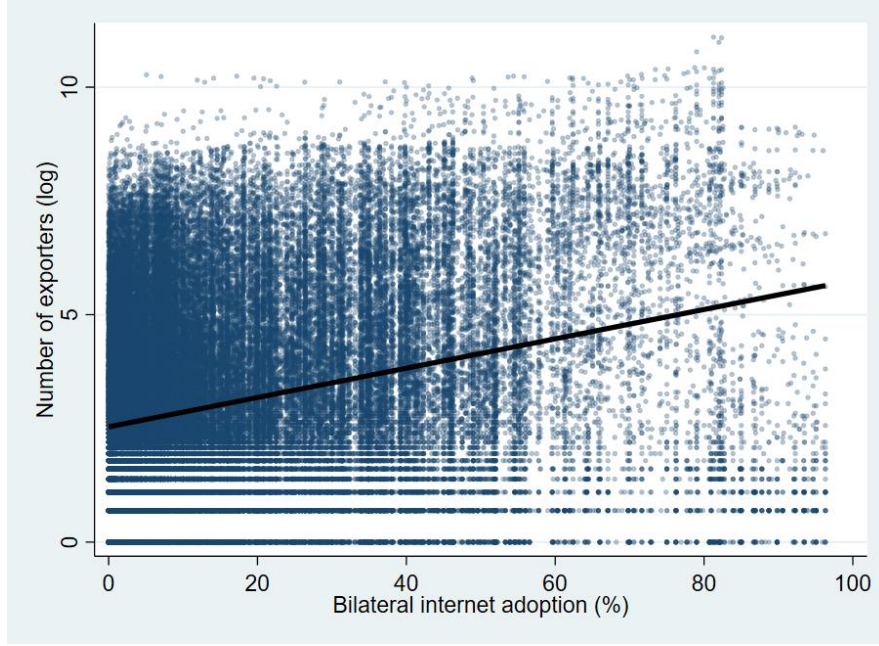
Hypothesis 2 Superstar exporters in each country-pair are more likely to retain their superstar status when the internet adoption rate is higher.

A challenge to this empirical exercise is the changing number of exporters. Across all country pairs in our panel, the number of exporters in each flow increases with internet adoption rate (Figure 3.4). Empirically, Cariolle, de Melo and Imbruno (2022) found that the deployment of telecommunications submarine cable is associated with an increase in the number of exporters from high income countries but a decrease in the number of exporters from lower income countries.

The definition of “superstars” is sensitive to this compositional change. When the number of exporters increases, exporters outside the top quantile (e.g. the top 5% and top 10% of exporters) in the previous year can now attain the superstar status simply thanks to the numerical increase in the size of the top quantile. In contrast, ordinal-rank definition (e.g. top one or top five firms) can be distorted in flows with few exporters. Exporters outside the top five can now feature in this group when those in the top 5 exit the market, everything else being equal.

Evaluating *Hypothesis 2* thus requires using both the ordinal and relative definitions of superstars. Indeed, the related management literature has extensively documented how different definitions of superstars can lead to contradicting results on concentration level (see Brynjolfsson, Hu, and Smith [2010] for a review). To address this concern, we will assess the model one-by-one using both the relative rank (top 5% and top 10%) and the ordinal rank of superstars (top 1, top 2 and top 5 of exporters) – a similar approach to Freund and Pierola (2020).

Figure 3.4. Number of exporters per country-pair increases with internet adoption



Source: Author's elaboration based on World Bank's EDD database v1.0 (including 65 countries).

4.1. Empirical setup

This section evaluates *Hypothesis 2* by testing if incumbent superstars are more likely to retain their top positions from one year to another (the “entrenchment effect”) thanks to higher internet use. The baseline model takes the following form:

$$\begin{aligned}
 \text{Prob}(Superstar_{fijt} = 1) & & (3) \\
 &= \beta_1 Superstar_{fij,t-1} + \beta_2 Superstar_{fij,t-1} \times \log(Internet_{ijt}) \\
 &+ \beta_3 \log(Internet_{ijt}) + Z_{fijt} + \varepsilon_{fijt}
 \end{aligned}$$

where $Superstar_{fijt}$ is a dichotomous variable indicating whether or not firm f ranks among the top exporters in term of total sales from country i to country j in year t . $Superstar_{fijt-1}$ represents the firm's superstar status in the preceding year.⁴² To address the concerns over the definition of superstars (as discussed in section 4), we will assess

⁴² Firms that export in year $t-1$ but not in t (exiter) will be denoted as non-superstar in year t ($Superstar_{fijt}=0$). New entrants (export in year t but not in $t-1$) will be denoted as non-superstars in year $t-1$ ($Superstar_{fijt-1}=0$).

the model one-by-one using both the relative rank (top 5% and top 10% of exporters) and the ordinal rank of superstars (top 1, top 2 and top 5 of exporters).

The main coefficient of interest is the interaction term (β_2) between exporter's (lag) superstar status and internet adoption. A positive and statistically significant coefficient would confirm *Hypothesis 2* as it suggests that internet connectivity increases the likelihood of top exporters retaining their superstar status from $t-1$ to t .

Z_{fijt} denotes a series of fixed effects to account for omitted variable bias. Similar to section 4, we control for country-pair, linear trends for origin and destination and firm-specific fixed effect. In this setup, the firm-level fixed effect controls for unobserved time-invariant characteristics such as the average level of productivity and ownership structure (which is unlikely to change given the short panel for most of the countries).

The origin-trend fixed effects capture any shocks to the local economy that may have asymmetric impacts among producers and affect the possibility for any exporters to feature in the “superstar” category. For example, distortions in the domestic economy can reduce misallocate resources away from the most productive firms (Hsieh and Klenow, 2009). Using an expanded version of the Exporter Dynamic Database, Freund, Margarida and Pierolla (2016) find that the dynamics of exporters also depend on the stage of development in the origin country. For example, the importance of the top 5% in total export values increases with total export sales. Similarly, the destination-year fixed effects account for various demand-side factors that affect heterogeneity such as the level of competition in the economy, changing consumer demands and preference for quality as well as unilateral opening of domestic markets.

In addition, we include product fixed effect to account for industry-specific factors such as the capital intensity or the structure of the industry in which each firm operates. Products are identified as the most important product heading (HS 4-digit) in the firm's

export basket to each destination in a given year. Because the product category for each exporter can vary by each destination, it reflects the comparative advantage of the exporter compared to local firms in each importing country. As this product category can also vary across year, it helps capture changes in the exporter's product orientation over time.

Table A.3.4 provides a summary of the variables used in these regressions on superstars.

4.2. Results

Table 3.5 presents the results from estimating equation (3) for different definitions of superstars. Due to the large number of fixed effects employed and computational constraints, we estimate the model with OLS. This approach also helps avoid the incidence parameter problem that hinders non-linear estimators such as probit or logit in the context of short panel.

In column (1), we first observe that in an environment without internet connectivity, the top 5% exporter in the previous year has 36.9-percentage point (pp) higher chance of featuring in the top 5% this year, compared to other exporters. This is consistent with previous findings from Freund and Pierola (2020), who report that in 32 countries where firm-panel data is available, 71% of top five firms were already in the top 1% of exporters five years earlier.

We also find that the internet also has a negative and statistically significant impact on the likelihood that any given firm (independent of its previous performance) feature in the top 5% of a country-pair flow. This is likely to reflect the fact that there are more firms exporting in a connected environment. By encouraging entry and exit, the internet

inflates the sample of firms for consideration in each country-pair-year triad by including both current and recently exited exporters.⁴³

The positive and statistically significant coefficient of the interaction term between superstar status and internet penetration suggests that the internet helps top exporters retain their status. Everything else being equal, doubling the internet penetration rate boosts the probability that the top 5% exporters will retain their ranks by an additional 4.3pp (=0.052-0.009), representing a 11.7% increase in their chance of retaining the top spots. This result suggests that the internet environment is conducive to “entrenchment” where superstar exporters are more likely to maintain their dominance over time – thus confirming *Hypothesis 2*.

Table 3.5. Effect of internet on export superstars’ persistence

Superstar definition →	Relative rank		Ordinal rank		
	(1) Top 5%	(2) Top 10%	(3) Top 1	(4) Top 2	(5) Top 5
Superstar (lag)	0.369 ^a [0.013]	0.392 ^a [0.011]	0.132 ^a [0.010]	0.082 ^a [0.009]	0.046 ^a [0.009]
Superstar (lag) × Internet	0.052 ^a [0.005]	0.039 ^a [0.004]	0.036 ^a [0.004]	0.052 ^a [0.004]	0.065 ^a [0.003]
Internet	-0.009 ^b [0.005]	-0.009 ^c [0.005]	-0.006 ^c [0.004]	-0.007 [0.005]	0.001 [0.007]
Observations	1,285,471	1,285,471	1,285,471	1,285,471	1,285,471
R-squared	0.466	0.486	0.291	0.340	0.399

Note: All regressions include country-pair, origin and destination linear trends, firm and product fixed effects. Robust standard errors clustered at origin-destination-year level are reported in brackets: ^a p<0.01; ^b p<0.05; ^c p<0.1.

Source: Author’s calculations.

Column (2) follows a similar strategy with superstars defined as those in the top 10% of sales. Exporters in the top 10% of sales in the previous years have 39.2pp higher likelihood to feature in the top 10% again this year, compared to those not previously in the

⁴³ Analysis similar to those done for Figure 3.4 suggests that Internet adoption rates correlate positively with both the number of exiting firms (those who export in t-1 but not in t) and the share of exiting firms in total exporters.

top 10%. In an environment where internet adoption doubles, this likelihood is boosted by 3.0pp, equivalent to a boost of 7.7%.

Columns (3)-(5) evaluate *Hypothesis 2* using ordinal-rank definitions of superstars (the top one, the top two, and the top five exporters in an origin-destination-year triad). Column (3) for example presents the estimation of equation (3) with superstars defined as the single top exporter. The top exporter in the previous year has 13.2-percentage point higher chance of retaining this status, compared to other exporters. Doubling of internet adoption rate boosts the probability that the top exporter will retain its top position from one year to another by 3.0pp, representing an 22.7% increase in their chance of retaining the top spots. The results for the top 2 and top 5 exporters are qualitatively similar, where doubling internet penetration rate would lead to a boost of 54.9% and 143.5% respectively in the chances that these superstars retain their dominance. These results demonstrate that *Hypothesis 2* is robust against the alternative definitions of superstars.

4.3. Robustness

Similar to section 3.3, this section evaluates the robustness of *Hypothesis 2* against an instrumental variable approach, a series of stringent fixed effects and alternative samples of data. Each test will use consecutively both relative rank definitions and ordinal rank definitions of superstars. To conserve space, we only report the results for the top 5% and top 1 exporters in certain tests. Results using other definitions of superstars are qualitatively similar and available upon request.

In this analysis, reverse causality can occur where an incumbent superstar creates pressure on the local government to invest in internet infrastructure to facilitate their trading. However, existing experience suggests that the typical response is to concentrate their investment in spatially-targeted industrial clusters. Such investments would have

little impact on the rate of internet access among the majority of the population who typically live outside these zones. Indeed, the lack of linkage between many industrial zones and the general economy has often been criticised in numerous policy evaluation. Nonetheless, we replicate the baseline regressions in 4.2 with lagged internet. Panel B of Table A.3.2 presents the results which confirm our findings.

We further test against using endogeneity by using international internet bandwidth and its interaction with the lagged superstar status as instrumental variables. For brevity, we present the first stage results in Supplementary Table A.3.5. For both the Internet adoption variable and its interaction with superstar status, The Sanderson-Windmeijer F-statistics in the first stage regressions range from 79 to 4 737 – alleviating the concerns over weak instruments in this setup.

Table 3.6 presents the results from the instrumental approach for the second stage of the two-step process. We find that that Internet adoption helps superstars, defined by their ordinal rank, to retain their status. While the coefficients for the interaction term between internet adoption and superstar remain positive for the relative rank definitions of superstars, these estimates are no longer statistically significant.

Table 3.6. Effect of internet on superstars, IV approach

Superstar definition →	Relative rank		Ordinal rank		
	(1) Top 5%	(2) Top 10%	(3) Top 1	(4) Top 2	(5) Top 5
Superstar (lag)	0.461 ^a [0.024]	0.462 ^a [0.020]	0.154 ^a [0.016]	0.118 ^a [0.014]	0.096 ^a [0.014]
Superstar (lag) × Internet	0.012 [0.009]	0.010 [0.008]	0.020 ^b [0.008]	0.029 ^a [0.007]	0.036 ^a [0.006]
Internet	-0.019 [0.022]	-0.024 [0.026]	0.000 [0.015]	0.013 [0.023]	-0.004 [0.036]
Observations	1,226,696	1,226,696	1,226,696	1,226,696	1,226,696
R-squared	0.238	0.235	0.040	0.036	0.037
SW F-stat Internet	79	80	80	80	80
SW F-stat Superstar × Internet	603	586	4737	4577	3989

Note: The table reports Sanderson-Windmeijer F-statistics for first stage regressions for $Internet_{ijt}$ and $Superstar(lag) \times Internet_{ijt}$ being the endogeneous regressors. All regressions include country-pair, origin and destination linear trends, firm and product fixed effects. Robust standard errors clustered at origin-destination-year level are reported in brackets: ^a $p < 0.01$; ^b $p < 0.05$; ^c $p < 0.1$.

Source: Author's calculations.

Table 3.7 tests the sensitivity of the results against alternative sets of fixed effects. The regression in column (1) includes destination-product to account for the diversity of product market in each destination country, such as taste and demand for quality. Column (2) includes origin-destination-year trends to further control for the evolution of trade costs between a country pair. Indeed, several studies have pointed out the importance of connectivity and communication technologies on bilateral trade cost and the so-called “distance puzzle” in international trade. Superstars are defined as the top 5% exporters in term of sales in these specifications.

Columns (3)-(4) repeat the exercise for an ordinal-rank definition of superstar, specifically the largest exporters. Note that the number of observations vary slightly across different specifications due to dropping of singleton observations. Across all specifications, we find that that connectivity strengthens the dominance of export superstars across years.

Table 3.7. Effect of internet on superstars, alternative fixed effects

VARIABLES	(1) Top 5%	(2) Top 5%	(3) Top 1	(4) Top 1
Superstar (lag)	0.299 ^a [0.016]	0.399 ^a [0.013]	-0.003 [0.011]	0.187 ^a [0.011]
Superstar (lag) × Internet	0.051 ^a [0.006]	0.044 ^a [0.005]	0.041 ^a [0.005]	0.029 ^a [0.005]
Internet	-0.003 [0.005]		-0.001 [0.004]	
Observations	1,278,212	1,283,835	1,278,212	1,283,835
R-squared	0.509	0.474	0.396	0.281
<i>Fixed effects</i>				
Origin-Destination	Y		Y	
Origin-Year	Y		Y	
Destination-Year	Y		Y	
Origin-Destination-Year		Y		Y
Firm	Y	Y	Y	Y
Product		Y		Y
Product-Destination	Y		Y	

Note: Robust standard errors clustered at origin-destination-year level are reported in brackets: ^a $p < 0.01$; ^b $p < 0.05$; ^c $p < 0.1$.

Source: Author's calculations.

Table 3.8 evaluates the robustness of the results against alternative samples. In column (1)-(2), we limit the sample only to country pairs where the origin country had higher internet penetration rate in the first year where exporter data is available for each exporting country (t_0). In this situation, changes in the bilateral internet connection, defined as the pairwise minima values, would largely be driven by variations in internet penetration in the importing country. Inversely, columns (3)-(4) limit the subsample to country pairs where the destination country had lower internet penetration rate initially. In each subsample, we evaluate equation (3) based on a relative-rank definition (top 5%) and an ordinal-rank definition (top 1) of superstars. The results remain qualitatively similar in all cases.

Table 3.8. Effect of internet on superstars, with alternative samples

VARIABLES	Internet _{it0} ≥ Internet _{jt0}		Internet _{it0} < Internet _{jt0}		Flows with 100+ exporters		Four-year performance	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Top5%	Top 1	Top5%	Top 1	Top5%	Top 1	Top5%	Top 1
Superstar (lag)	0.269 ^a [0.014]	0.093 ^a [0.013]	0.422 ^a [0.020]	0.112 ^a [0.017]	0.527 ^a [0.014]	0.412 ^a [0.028]		
Superstar (lag) × Internet	0.065 ^a [0.006]	0.031 ^a [0.006]	0.031 ^a [0.007]	0.046 ^a [0.007]	0.014 ^b [0.005]	0.008 [0.011]		
Internet	0.003 [0.017]	0.033 ^b [0.015]	0.001 [0.009]	0.001 [0.006]	-0.000 [0.003]	0.000 [0.000]		
Superstar (4y lag)							0.382 ^a [0.041]	0.317 ^a [0.039]
Superstar (4y lag) × Internet							0.097 ^a [0.017]	0.019 [0.018]
Observations	302,744	302,744	977,446	977,446	1,138,781	1,138,781	95,883	95,883
R-squared	0.420	0.347	0.500	0.288	0.537	0.323	0.576	0.413

Note: All regressions include country-pair, origin and destination linear trends, firm and product fixed effects. Robust standard errors, clustered at origin-destination-year level, are reported in brackets: ^a p<0.01; ^b p<0.05; ^c p<0.1.

Source: Author's calculations.

Columns (5)-(6) of Table 3.8 test whether our results are affected by the over-representation of flows with too few firms that arithmetically places more importance on small firms. In this case, we restrict the sample to flows with at least 100 exporters. For both relative-rank and ordinal rank definition of superstars, the main results hold with a positive (and statistically significant) effect of internet on entrenchment.

A selection problem may bias our estimation as the internet may induce specific types of firms to enter and exit the export market. On the one hand, the internet could attract new non-exporters to experiment with exporting. These firms typically have low productivity level, high churning rate and overall limited probability to feature at the top. Their presence in the control group of non-superstars thus inflates the “entrenchment” effect of the superstars.

On the other hand, internet may have also induced the emergence of export superstars by facilitating off-shoring investment from the Global North to developing countries.

Fjort (2017) shows that the adoption of communication technology increases the probability of outsourcing and offshoring among U.S. manufacturing firms. Freund and Pierola (2020) document multiple instances where new firms - which did not feature in the sample five years earlier - start exporting with a very high amount (in monetary values). These are often foreign-owned firms and many of them grow to be in the top five group within two years. The emergence of these internet-driven born-to-be superstars may create downward bias on the effect of internet on superstar's "entrenchment".

To account for firm selection, columns (7) and (8) focus on the long-run dominance of the "original" superstars - those who already attained this status in the first year that exporter data are available in the EDD 2.0 dataset.⁴⁴ Furthermore, we focus on their export performance 4 years later instead of tracking the dynamics of exporters in the following year. The choice of 4 year is driven by the length of panel data for exporters from Yemen, which is only available for 2008-12 period. Overall, results presented in columns (7)-(8) largely confirm *Hypothesis 2* whereby we find that increasing internet adoption rate would boost for these "original" superstars to feature in the top ranks 4-year later.

5. Mechanisms

So far, the majority of papers evaluating the impact of the Internet on international trade focus on aggregate trade flows in a cross-country analysis. They often exploit the difference in internet rollout across country, region, and time dimension to estimate the impact of internet on trade in a gravity model. The pioneer work by Freund and Weinhold (2002) finds that a 10-percent increase in the share of internet users in the partner countries leads to an 1.7-percentage-point boost to service trade with the U.S. For trade

⁴⁴ For the case of Peru where data is available from 1995, we focus on export superstar in year 2000 to ensure consistency in time period with other countries. Internet adoption rate in Peru barely increased from 0.003% in 1995 to 1.952% in 1999, but exploded rapidly afterward, from 3.076% in 2000 to reach 14.1% in 2004 and 31.4% in 2009.

in goods, Freund and Weinhold (2004) find that a 10-percentage point increase in the growth of web hosts in a country leads to about a 0.2-percentage point increase in export growth.

This cross-country strand of literature often emphasises the role of internet communication in reducing the fixed cost of searching and matching. Online websites, e-commerce platforms and social media reduce the cost for firms in reaching out to distant trading partners, obtaining market information, and coordinating with buyers and suppliers. When calculating the ex-ante profitability of exporting, firms are assumed to perfectly observe the different costs and know all the potential partners. If the expected benefit outweighs the expected cost, they will then pay the fixed cost, including the fixed cost of searching and matching with importers, to start trading. These papers often focus on aggregate trade flows, and thus they overlook the heterogeneity of firms.

Nonetheless when extending to the heterogeneous firm model, a reduction in fixed cost is unlikely to lead to export concentration. Reducing the fixed cost to start trading will shift the productivity cut-off and induce new and less-productive firms to enter exporting. While this change may affect the definition of superstars, it will not change the heterogeneity of sales distribution. Most of the literature following the canonical Melitz (2003) assumes Pareto distribution of firm's productivity with a location parameter (α) and a shape parameter (θ). With an exogeneous constant elasticity of substitution σ and monopolistic competition, export sales to each destination will also be Pareto distributed with the shape parameter of sales $\theta = \frac{\theta}{\sigma-1}$. In such case, a reduction in fixed cost will not affect the heterogeneity of export sales.

In contrast to these theoretical predictions, section 3 and 4 have established that internet connectivity increases the concentration of bilateral export sales among firms and helps export superstars retain their dominance. To reconcile these findings with the hetero-

genous firm framework, the rest of this section will discuss the potential role of information frictions in explaining these empirical regularities before exploring other channels.

5.1. Information friction and sales concentration

Our findings could be explained through the lens of information matching frictions. Connectivity helps expand the choice set of potential partners for each exporter and importer – which increases the competition level. The heightened competition makes it easier to find substitutes and makes demand more elastic, following Marshall’s first rule of derived demand. Akerman, Leuven & Mostag (2022) formalise this argument in a model of with variable elasticity of demand. They find that expansion of broadband internet to a region makes export sales more sensitive to prices, and hence the difference in trade costs across destination. Extending this argument, we would expect export sales to also become more sensitive to production cost, with high-productivity firms getting a higher share of total sales. As a consequence, the provision of information through Internet communication can lead to export sales concentration towards high-productivity firms, who are typically the large sellers already.

That high-productivity firms gain disproportionately higher sales thanks to information provision is also a key insight from Lenoir, Martin & Méjean (2022). In their Ricardian model, search frictions mean that a buyer is drawn against a random number of heterogeneous producers from each origin country – from whom she chooses the lowest-cost suppliers. Higher search friction is more penalising for high productivity firms because they are much more likely to win sales from the new, expanded set of potential buyers. In contrast, the change can be detrimental for low-productivity sellers because they are less likely to become the lowest-cost producers when there are more competitors for each buyer. Conversely, being exposed to fewer customers is not as penalising as the likelihood of not winning the sale is higher for them. As a result, internet connectivity increases

the allocation of sales towards high-productivity sellers who are much more likely to win sales from the improved visibility.

The role of communication technologies on reducing information frictions in trade has been the focus for an active line of research. By exploiting spatial variation in mobile phone coverage in the Philippines, Allen (2014) demonstrates that information frictions account for half of the observed price dispersion in agricultural trade among the islands in the country. Steinwender (2018) shows that the transatlantic telegraph connection in the 19th century enhanced the flow of information on cotton markets between the U.S. and the U.K market. The reduction in information frictions led to a lower level of price dispersal, as well as larger and more volatile trade flows. Dasgupta and Mondria (2018) are more explicit about the role of internet connection on alleviating informational frictions. They assume the inverse of the maximum internet bandwidth between two countries as a proxy for the cost of information processing.

If information friction is the relevant mechanism, we would expect the impact of internet adoption on export concentration to be more pronounced for trading of information-intensive goods. For example, buyers typically need more communication to find the right sellers of differentiated products, and to convey various product specifications and characteristics. In contrast, the use of commodity trading platform and referenced price for homogeneous goods trade facilitates the process of searching and matching between buyers and sellers (Rauch, 1999). In this case, we expect the impact of the internet on sales concentration to be stronger for differentiated goods export than for homogenous goods.

Previous literature has documented the stronger impact of connectivity for trade of differentiated goods. Akerman, Leuven & Mostag (2022) find stronger effects of broadband adoption on the demand elasticity of differentiated goods as compared to homogeneous goods. In a similar vein, Osgano and Tang (2016) jointly estimate the impact of internet

adoption for bilateral trade flows in the two types of goods using the seemingly unrelated regression (SUR) methodology. They find that the higher adoption of Internet in the exporter countries increases exports of differentiated goods but reduces exports of homogeneous goods.

Juhász and Steinwender (2019) further categorise differentiated goods by the *codifiability* of product specification. Exploiting the reduction in communication time thanks to the gradual spread of global telegraph network, they show that enhanced communication would have the largest effect on trade of the most codifiable product and the smallest effect on non-codifiable products – emphasizing the heterogeneity effect of information provisions across traded goods.

As an extension of *Hypothesis 1*, we will first test if the impact of internet expansion has differential impacts on the Pareto exponent κ of export sales distribution among the two types of goods. We first identify homogenous goods as those traded on organised exchanges and those with reference prices using Rauch’s classification (1999). The rest of products are identified as differentiated goods where sellers and buyers need more communication to convey information on product specifications and characteristics. For each type of goods, we aggregate firms’ export sales in this category to each destination and recalculate the sale ranking accordingly. A firm-destination-year combination will receive separately two rankings for each type of goods in the same market if exporting both homogeneous and differentiated goods.

To evaluate *Hypothesis 3a*, we extent equation (2) as follows:

$$\begin{aligned}
\log(\text{Sale}_{fijt}) = & \beta_1 \log(\text{Rank}_{fijt} - \frac{1}{2}) + \beta_2 \log(\text{Rank}_{fijt} - \frac{1}{2}) \times \log(\text{Internet}_{ijt}) \\
& + \beta_3 \log(\text{Rank}_{fijt} - \frac{1}{2}) \times \log(\text{Internet}_{ijt}) \times \text{Differentiated goods} \\
& + \beta_4 \log(\text{Internet}_{ijt}) + \beta_5 \text{Differentiated goods} \\
& + \beta_6 \log(\text{Rank}_{fijt} - \frac{1}{2}) \times \text{Differentiated goods} \\
& + \beta_7 \log(\text{Internet}_{ijt}) \times \text{Differentiated goods} \\
& + \Phi_f + \Phi_{it} + \Phi_{jt} + \Phi_{ij} + \varepsilon_{fijt}
\end{aligned} \tag{2}$$

where *Differentiated goods* is a dummy variable that obtains the value of 1 for export sales of differentiated goods and 0 otherwise.

The main coefficient of interest is that of the three-way interaction term (β_3) between rank, internet adoption and differentiated goods dummy. It indicates the differential impact of connectivity on the Pareto exponent between differentiated and homogeneous goods. Other controls and interaction terms involving *Differentiated goods* help account for the structural difference in the distribution of sales between these two types of goods.

Panel A of Table 3.9 consecutively presents the estimation results of equation (4) for the top 10%, the top 50% and the full sample. In the first two estimations, we do not report a statistically significant different regarding the impact of connectivity on the exponent. In the third estimation, we find negative and statistically significant coefficient for the three-way interaction term between rank, internet adoption and goods type, which would suggest stronger impact of connectivity on sales heterogeneity for differentiated goods, thus supporting our conjecture.

Similarly, if informational friction is the salient channel, we would expect that higher internet adoption rate boosts the likelihood for superstar exporters to retain their status by a larger amount among exporters of differentiated goods than among exporters of homogeneous goods. We augment equation (3) with a dummy for differentiated goods, its interactions with the internet and the (lag) superstar variable, and its three-way interaction term with (lag) superstar and internet variable. Our main interest lies with the coefficient of this three-way interaction term.

Panel B of Table 3.9 presents the results for this exercise using various definitions of superstars. We find that impact of internet adoption on superstar dominance is stronger for differentiated goods when using ordinal rank definition. However, we do not find a significant difference in the impact between differentiated and homogeneous goods when considering relative rank definition.

Table 3.9. The impact of Internet on export concentration, by type of goods

Panel A. Effect on log-log ranks-sales relationship

VARIABLES	(1)	(2)	(3)
	Sales	Sales	Sales
Rank	-0.982 ^a [0.059]	-1.384 ^a [0.035]	-1.843 ^a [0.017]
Rank × Internet	-0.048 ^a [0.018]	-0.043 ^a [0.012]	-0.047 ^a [0.009]
Rank × Internet × Differentiated goods	0.029 [0.020]	-0.011 [0.009]	-0.036 ^a [0.011]
Internet	0.402 ^a [0.099]	0.420 ^a [0.127]	0.426 ^a [0.151]
Observations	98,729	489,668	960,650
R-squared	0.939	0.927	0.902
Sample	Top 10%	Top 50%	Full sample

Note: All regressions include country-pair, origin and destination linear trends and firm fixed effects. A dummy for differentiated goods, and its interactions with the internet variable and export ranks were also included in the regressions but omitted from the table for brevity. Robust standard errors clustered at origin-destination-year level are reported in brackets: ^a p<0.01; ^b p<0.05; ^c p<0.1.

Panel B. Effect on superstar's persistence

Superstar definition →	Relative rank		Ordinal rank		
	(1)	(2)	(3)	(4)	(5)
	Top 5%	Top 10%	Top 1	Top 2	Top 5
Superstar (lag)	0.376 ^a [0.011]	0.420 ^a [0.009]	0.315 ^a [0.010]	0.335 ^a [0.008]	0.379 ^a [0.007]
Superstar (lag) × Internet	0.040 ^a [0.005]	0.029 ^a [0.004]	0.015 ^a [0.004]	0.013 ^a [0.003]	0.013 ^a [0.003]
Superstar (lag) × Internet × Differentiated	-0.001 [0.004]	-0.002 [0.004]	0.013 ^b [0.005]	0.009 ^b [0.004]	0.004 [0.003]
Observations	1,057,224	1,057,224	1,057,224	1,057,224	1,057,224
R-squared	0.484	0.511	0.330	0.370	0.430

Note: All regressions include country-pair, origin and destination linear trends, firm and product fixed effects. Additional controls, omitted from table for brevity, include internet adoption, a dummy for differentiated goods and its interaction terms with internet adoption and with superstar status. Robust standard errors clustered at origin-destination-year level are reported in brackets: ^a p<0.01; ^b p<0.05; ^c p<0.1.

For robustness, we estimate equation (2) and (3) individually for exports of each type of goods. Comparing the results between the two types of goods in Panel A of Table A.3.6 shows that the magnitude of impact is higher for differentiated goods than for homogeneous goods. In Panel B, the coefficient of the interaction term between internet and superstar status is higher in the sample of differentiated goods than in the sample of homogeneous goods for both definitions of superstars (top 5% and top 1 exporters). These results support the conjecture that the impact of internet on export concentration is more pronounced for differentiated goods than for homogeneous goods.

5.2. Other channels

The spread of internet connectivity and the broader diffusion of information and communication technologies may also affect heterogeneity through supply-side factors such as productivity, access to inputs and organisation capital. Such technologies can induce technological adoption that shape firms' productivity and characteristics through changes in the use of tangible inputs such as intermediate materials and machineries and intangible inputs such as management, organisational practice and support services (see Hjort and Tian [2022] for a recent summary of this literature). For example, Malgouyres et al (2021) find that broadband expansion across French cities increases firm-level imports by approximately 25%. Other studies document the positive impact of connectivity on productivity through deeper financial market (D'Andrea and Limodio, 2019), and intensified product and process innovation (Houngbonon et al., 2021).

Connectivity may introduce further bias that exacerbates productivity dispersion in the economy. First, the Internet may induce induced changes in the optimal input mix with higher importance for intangible inputs over tangible inputs. This shift may disproportionately favour firms already endowed with higher productivity such as those with higher share of high skilled labour (Akerman et al., 2015), urban-based (Tian, 2019) and ICT-based activities such as finance (Hjort & Poulsen, 2019). Lower coordination cost

in the supply chains also facilitates production fragmentation and induce existing high-productivity firms to reallocate to developing countries. Fjort (2017) shows that adoption of communication technology increases the probability of outsourcing and offshoring among U.S. manufacturing firms.

The lumpy cost of internet adoption may create a “digital divide” that widens the productivity gap. Digital skills, organisation capability and financial requirements may create barriers to adoption of Internet application even when such investment is technologically feasible and economically viable. This problem is particularly severe in environments with a limited supply of high skills and underdeveloped financial markets – such as those in developing countries. Cariolle, de Melo, and Imbruno (2022) formalise this in a heterogeneous firm model where only a few high-productivity firms in developing countries are able to exploit digital technology and increase their productivity when given access to the Internet. In contrast, low-productivity firms, unable to take advantage of the new technology, fall further behind – thus widening the productivity gap.

Whilst not refuting the possibility of alternative mechanisms, our empirical results corroborate the importance of information frictions as a key channel to explain our results. The firm-specific fixed effects capture the average productivity of each firm across the periods. It controls for other critical firm characteristics such as foreign-owned enterprises, who may have relocated to the origin country thanks to easier coordination of international production networks. The inclusion of origin- and destination-trend fixed effects also capture systemic changes to the various supply- and demand-side factors that may affect firm heterogeneity. To further address concerns over the uneven adoption of Internet technologies across firms, we further add firm-trend fixed effects to the two models which helps capture the evolution in firms’ productivity, (overall) quality as well as product scope. Annex Table A.3.7 presents the result and confirm the robustness of the main results against the inclusion of these stringent controls.

6. Conclusions

This paper is the first to suggest that the global expansion of the Internet has contributed to rising export concentration. It employs firm-level custom registries from 11 developing countries in the 2000s to present empirical evidence that:

- First, internet adoption steepens the slope of the log-log sale-rank relationship in each origin-destination pair, implying a concentrating distribution of exporters' sales toward a few top firms.
- Second, incumbent export superstars are more likely to retain their status in an environment with better connectivity. Doubling the bilateral internet adoption rate would boost the chance for the incumbent top exporter to remain at the top by 22.7%. It would also improve the likelihood that the incumbent top 5% would remain in this position by 11.7%. These results suggest an entrenchment effect where the internet reduces firm churning at the very top of the sale distribution.

These results are robust to various tests using an instrumental variable approach, different definition of concentration and superstars, a series of stringent fixed effects, as well as alternative samples of data.

One potential channel to explain these empirical regularities is through the lens of information friction. Internet connectivity can allow exporters and importers to expand their network and thus intensify competition that each exporters face. This shift leads to higher cost-sensitivity among importers that disproportionately favour sales by high productivity firms. Indeed, the paper shows that the impact of the internet on export concentration is stronger among exports of differentiated goods than on exports of homogenous goods, for which information friction is less salient.

This concentration of export sales in the internet era has important implications for policymakers in developing countries. Many countries, especially developing ones, are

focusing on the rapid expansion of the internet and digital transformation in general to expand their competitiveness and trade performance in general. Understand the dynamics of competition in the digital age can help policymakers better design their export strategy. Furthermore, as the spread of internet continues to expand across all countries, policymakers also need to pay attention to the link between exporter concentration and its consequence on domestic economy.

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Supplementary materials

Table A.3.1. Coverage of Exporter Dynamic Database 2.0

Origin country	Region	First year	Last year
Albania	Europe	2004	2012
Burkina Faso	Africa	2005	2010
Bulgaria	Europe	2001	2006
Guatemala	LAC	2003	2010
Jordan	Asia	2003	2010
Mexico	LAC	2000	2007
Malawi	Africa	2004	2009
Peru	LAC	1993	2009
Senegal	Africa	2000	2010
Uruguay	LAC	2001	2012
Yemen	Asia	2008	2012

Table A.3.2. Log-log rank-sale regressions with lagged internet

Panel A. Impact on log-log sales-rank regressions

VARIABLES	(1) Top 10%	(2) Top 50%	(3) Full sample
Rank	-0.863 ^a [0.016]	-1.300 ^a [0.017]	-1.746 ^a [0.020]
Rank × Internet (lag)	-0.027 ^a [0.005]	-0.041 ^a [0.007]	-0.056 ^a [0.008]
Internet (lag)	0.192 ^a [0.070]	0.295 ^a [0.067]	0.393 ^a [0.074]
Observations	98,975	488,114	951,477
R-squared	0.958	0.946	0.921

Note: All regressions include origin and destination linear trends and country pair fixed effects. Robust standard errors clustered at origin-destination-year level are reported in brackets: ^a p<0.01; ^b p<0.05; ^c p<0.1.

Panel B. Impact on superstar persistence

VARIABLES	(1) Top 5%	(2) Top 10%	(3) Top 1	(4) Top 2	(5) Top 5
Superstar (lag)	0.400 ^a [0.011]	0.417 ^a [0.009]	0.149 ^a [0.008]	0.110 ^a [0.007]	0.088 ^a [0.007]
Superstar (lag) × Internet (lag)	0.043 ^a [0.004]	0.032 ^a [0.004]	0.028 ^a [0.004]	0.039 ^a [0.003]	0.047 ^a [0.003]
Internet (lag)	-0.002 ^b [0.001]	-0.001 [0.002]	-0.003 ^a [0.001]	-0.006 ^a [0.001]	-0.012 ^a [0.002]
Observations	1,277,913	1,277,913	1,277,913	1,277,913	1,277,913
R-squared	0.463	0.485	0.283	0.328	0.384

Note: All regressions include country-pair, origin and destination linear trends, firm and product fixed effects. Robust standard errors clustered at origin-destination-year level are reported in brackets: ^a p<0.01; ^b p<0.05; ^c p<0.1.

Source: Author's calculations.

Table A.3.3. Log-log rank-sale regressions with rank variable as harmonic number

VARIABLES	(1) Top 10%	(2) Top 10%	(3) Top 50%	(4) Top 50%	(5) Full sample	(6) Full sample
Rank	-2.674 ^a [0.031]	-2.543 ^a [0.049]	-4.819 ^a [0.035]	-4.615 ^a [0.058]	-6.461 ^a [0.037]	-6.206 ^a [0.061]
Rank × Internet		-0.063 ^a [0.021]		-0.098 ^a [0.024]		-0.123 ^a [0.026]
Internet		0.258 ^b [0.106]		0.163 ^c [0.094]		0.116 [0.085]
Observations	91,187	91,187	455,803	455,803	911,552	911,552
R-squared	0.595	0.595	0.207	0.207	0.067	0.067

Source: Author's calculations.

Table A.3.4. Summary statistics for main variables used in regressions on superstar persistence

VARIABLES	(1) N	(2) mean	(3) SD	(4) median	(5) min	(6) max
Top 1	1358518	0.008	0.088	0.000	0.000	1.000
Top 2	1358518	0.014	0.118	0.000	0.000	1.000
Top 5	1358518	0.029	0.168	0.000	0.000	1.000
Top 5%	1358518	0.039	0.192	0.000	0.000	1.000
Top 10%	1358518	0.074	0.261	0.000	0.000	1.000
Internet (log)	1358518	2.270	1.121	2.488	-10.953	4.001

Source: Author's calculations.

Table A.3.5. Impact on superstar persistence, first stage regression using IV approach

	Top 5%		Top 10%		Top 1		Top 2		Top 5	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Internet	Superstar _{t-1} × Internet	Internet	Superstar _{t-1} × Internet	Internet	Superstar _{t-1} × Internet	Internet	Superstar _{t-1} × Internet	Internet	Superstar _{t-1} × Internet
Bandwidth	0.034 ^a (0.004)	-0.016 ^a (0.001)	0.034 ^a (0.004)	-0.029 ^a (0.002)	0.034 ^a (0.004)	-0.006 ^a (0.001)	0.034 ^a (0.004)	-0.009 ^a (0.001)	0.034 ^a (0.004)	-0.015 ^a (0.002)
Superstar _{t-1} × Bandwidth	-0.000 (0.000)	0.397 ^a (0.016)	0.000 (0.000)	0.385 ^a (0.016)	-0.001 (0.001)	0.511 ^a (0.007)	-0.001 (0.001)	0.498 ^a (0.007)	-0.001 (0.001)	0.477 ^a (0.008)
Superstar _{t-1}	-0.000 (0.001)	-0.394 ^a (0.125)	-0.001 (0.001)	-0.275 ^b (0.126)	0.002 (0.005)	-1.678 ^a (0.055)	0.005 (0.005)	-1.529 ^a (0.055)	0.003 (0.004)	-1.289 ^a (0.057)
N	1226696	1226696	1226696	1226696	1226696	1226696	1226696	1226696	1226696	1226696
SW F-stat	79	603	80	586	80	4737	80	4577	80	3989

Note: SW F-stat refers to Sanderson-Windmeijer F-statistics. All regressions include country-pair, origin and destination linear trends, firm and product fixed effects. Robust standard errors clustered at origin-destination-year level are reported in brackets: ^a p<0.01; ^b p<0.05; ^c p<0.

Source: Author's calculations.

Table A.3.6. The differential impact of Internet adoption on export concentration, split sample regressions

Panel A. Impact on log-log rank-sale relationship

VARIABLES	Differentiated goods			Homogeneous goods		
	(1)	(2)	(3)	(4)	(5)	(6)
	Top 10%	Top 50%	Full sample	Top 10%	Top 50%	Full sample
Rank	-0.859 ^a [0.005]	-1.313 ^a [0.003]	-1.774 ^a [0.003]	-0.907 ^a [0.008]	-1.293 ^a [0.004]	-1.832 ^a [0.004]
Rank × Internet	-0.037 ^a [0.002]	-0.069 ^a [0.001]	-0.091 ^a [0.001]	-0.021 ^a [0.003]	-0.031 ^a [0.001]	-0.051 ^a [0.001]
Internet	0.208 ^a [0.012]	0.398 ^a [0.007]	0.575 ^a [0.007]	0.146 ^a [0.019]	0.160 ^a [0.009]	0.267 ^a [0.009]
Observations	80,535	398,143	796,473	36,498	178,037	356,258
R-squared	0.937	0.885	0.856	0.863	0.877	0.829

Note: All regressions include country-pair, origin and destination linear trends and firm fixed effects. Robust standard errors clustered at origin-destination-year level are reported in brackets: ^a p<0.01; ^b p<0.05; ^c p<0.1.

Panel B. Impact on superstar persistence

Superstar definition →	(1)	(2)	(3)	(4)
	Differentiated goods	Homogeneous goods	Differentiated goods	Homogeneous goods
	Top 5% _{ijt}	Top 5% _{ijt}	Top 1 _{ijt}	Top 1 _{ijt}
Superstar (lag)	0.177 ^a [0.028]	0.141 ^a [0.034]	-0.062 [0.041]	0.097 ^b [0.042]
Superstar (lag) × Internet	0.057 ^a [0.005]	0.044 ^a [0.006]	0.045 ^a [0.008]	0.022 ^a [0.008]
Internet	-0.006 ^a [0.001]	-0.009 ^a [0.002]	-0.005 ^a [0.001]	-0.007 ^a [0.001]
Observations	943,661	413,001	943,661	413,001
R-squared	0.462	0.415	0.263	0.317

Note: All regressions include country-pair, origin and destination linear trends, firm and main-product fixed effects. Robust standard errors clustered at origin-destination-year level are reported in brackets: ^a p<0.01; ^b p<0.05; ^c p<0.1.

Source: Author's calculations.

Table A.3.7. Robustness check with inclusion of firm-year fixed effects

Panel A. Impact on log-log sale-rank regressions

VARIABLES	(1)	(2)	(3)
	Top 10%	Top 50%	Full sample
Rank	-0.847 ^a [0.011]	-1.253 ^a [0.010]	-1.725 ^a [0.016]
Rank × Internet	-0.026 ^a [0.005]	-0.040 ^a [0.005]	-0.059 ^a [0.007]
Internet	0.169 ^b [0.085]	0.243 ^a [0.070]	0.366 ^a [0.083]
Observations	65,576	352,429	958,158
R-squared	0.950	0.943	0.921

Note: All regressions include origin and destination linear trends, country pair and firm-year fixed effects. Robust standard errors clustered at origin-destination-year level are reported in brackets: ^a p<0.01; ^b p<0.05; ^c p<0.1.

Panel B. Impact on superstar persistence

VARIABLES	(1)	(2)	(3)	(4)	(5)
	Top 5%	Top 10%	Top 1	Top 2	Top 5
Superstar (lag)	0.395 ^a [0.011]	0.427 ^a [0.009]	0.175 ^a [0.010]	0.128 ^a [0.009]	0.101 ^a [0.009]
Superstar (lag) × Internet	0.064 ^a [0.005]	0.053 ^a [0.004]	0.037 ^a [0.004]	0.053 ^a [0.004]	0.067 ^a [0.004]
Internet	-0.016 ^a [0.006]	-0.017 ^a [0.007]	-0.008 ^c [0.004]	-0.013 ^b [0.006]	-0.010 [0.008]
Observations	909,627	909,627	909,627	909,627	909,627
R-squared	0.507	0.533	0.353	0.400	0.456

Note: All regressions include origin and destination linear trends, country pair, product and firm-year fixed effects. Robust standard errors clustered at origin-destination-year level are reported in brackets: ^a p<0.01; ^b p<0.05; ^c p<0.1.

Source: Author's calculations.

General conclusions

Findings

This Ph.D. thesis investigates how the megatrends in global trade environment affect the export resilience for developing countries. Its three papers take turn to evaluate the impacts of regionalism, protectionism and digitalisation on the behaviours of exporters from an empirical perspective.

The first chapter studies the impact of Rwanda's accession to the East African Community's Customs Union in 2009/10 on Rwanda's diversification dynamics. By applying various panel econometric techniques to bilateral trade flows, we find that the accession increased Rwanda's export participation to the bloc by 5.4 percentage point (pp). For comparison, joining the COMESA FTA boosted Rwanda's export participation by 0.1pp. This expansion in participation was driven by new export relationships and offset by higher churning (lower survival). Tariff reduction and cooperation over non-tariff aspects played important but slightly different roles on export dynamics. We also find considerable heterogeneity of impacts across products. These results offer insights on the potential of regional trade agreements in diversifying the product mix of African exporters. This is critical towards informing the ongoing process of the African Continental Free Trade Area.

The second chapter provides new empirical evidence on how exporters respond to public standards imposed by destination countries. It exploits a novel dataset based on firm-level custom registry from Vietnam. We find evidence that more stringent standards in a product-destination market negatively affect Vietnamese exporters' extensive margins. Stringent standards are also associated with higher product prices and quality for exporters. These findings help balance the view of import standards for exporters from

developing countries as non-tariff barriers and as catalysts for upgrading. The local production networks, measured by the presence of other exporters in the region that serve the same market, matter for firm's response to SPS standards. Understanding such heterogeneity will be important for policymakers to optimise their export strategy in an increasingly hostile trade environment.

The third chapter presents empirical evidence that the expansion of the internet plays a role behind the rising level of export concentration. To my best knowledge, this is the first attempt to make a technological explanation for the "export superstars" phenomenon. Using firm-level customs transaction data from 11 developing countries, I first document that the spread of internet adoption is associated with more concentrated export sales among top exporters. Second, incumbent superstars are also more likely to retain their status thanks to better internet, creating a self-reinforcing cycle of rising concentration. For both findings, the impact is stronger for exports of information-intensive differentiated goods than for exports of homogeneous goods – suggesting the role of informational frictions in explaining the results.

Taken together, these findings emphasise that policy makers need to better understand the consequences of the changing global trade environment. These megatrends may fundamentally affect the export patterns of developing countries in the future: the type of goods and trade partners, the type of firms that export and their share in aggregate sales, the duration and scale of export relationships, as well as the benefits countries derive from exporting activities. In this process, they will inevitably create losers and winners. Export-oriented development strategies thus need to reassess the impacts of existing measures in the new context and update their policy toolkits to this new reality.

Limitations

By drawing from past events in order to search for causal evidence, these papers may not be the perfect indication of the future. For example, the third chapter documents the impact of the Internet during an earlier stage of digitalisation. This period (mid-2000s) predates the explosion of internet platforms such as eBay or Alibaba for international cross-border sales, as well as the widespread adoption of more advanced digital applications such as block chains-enabled trade finance and additive manufacturing. Recent work by Chen and Wu (2020)⁴⁵ suggest that the incidence of superstars may be even more prevalent on e-commerce platform. Using transaction data of cross-border T-shirt exports by Chinese firms on Alibaba platform, they show that sales are even more concentrated among the top 1% and top 5% of exporters (in term of sales) than the concentration level observed in Chinese custom registries.⁴⁶

Furthermore, the chapters have only managed to assess each of the megatrend from a narrow angle. For example, the second chapter focuses on the use of public standards. In practice, private standards promoted by lead firms and NGOs are proliferating to promote social, environmental concerns. Due to their voluntary nature, their interactions with public standards can create complex responses among firms (Gaigné and Larue, 2016). For instance, while Curzi et al. (2020) find a negative impact of public standards on the margins of Peruvian agri-food exporters, Schuster and Maertens (2015) find that certification to private standards has no impact neither the extensive nor the intensive margin of Peruvian asparagus exporters. Further research along these dimensions would

⁴⁵ Chen, M. X., & Wu, M. (2020). The value of reputation in trade: Evidence from Alibaba. *Review of Economics and Statistics*, 1-45.

⁴⁶ They attribute this to the informational frictions faced by importers when buying on e-commerce platforms. Because importers do not directly observe the quality of exporters, they pay a premium for firms with good reputation based on the seller rating mechanism provided by Alibaba.

be critical in order to comprehensively analyse the impact of quality standards on exporters.

Similarly, the third chapter focuses on the impact of the internet at the top of the sales distribution while overlooking its impact at the bottom of the distribution. The management literature has long documented the simultaneous incidence of “superstars” and the “long tail” on internet sale channel. By reducing the cost of production and distribution on the supply side, and by changing consumer behaviours through search technologies, personalised recommendation and social networks, the internet enables a mass of niche producers to develop by enhancing their access to market – leading to a “long tail” in a rank-size distribution (see Brynjolfsson, Hu, and Smith [2010]⁴⁷ for a review). This impact is particularly important for developing countries where micro, small and medium enterprises account for the majority of firms.

Last but not least, the reliance on data from official custom registries prevents all three papers from analysing other important flows outside of formal goods trade. Clearly, the thesis overlooks the role of trade in services. Such flows have become ever more important, especially with the rapid acceleration of the digital economy and the overall “servicification” of global value chains, whereby manufacturing functions are increasingly segmented and outsourced across borders (Miroudot & Cadestin, 2017).⁴⁸ Similarly, the issue of market concentration for digitally-deliverable service trade where suppliers may face quasi-zero marginal cost remains untouched in this thesis.

Just as informality is an important feature of many developing economies, informal cross-border trade also characterises many South-South trade corridors. Anecdotal estimates

⁴⁷ Brynjolfsson, E., Hu, Y., & Smith, M. D. (2010). Long tails vs. superstars: The effect of information technology on product variety and sales concentration patterns. *Information Systems Research*, 21(4), 736-747.

⁴⁸ Miroudot, S., & Cadestin, C. (2017). Services in global value chains: From inputs to value-creating activities. *OECD Trade Policy Papers*, No. 197, OECD Publishing, Paris.

from Vietnam suggest that 60% of Vietnam’s fruits and vegetable exports to China were conducted via informal cross-border trade transactions (Vietnam Investment Review, 2018).⁴⁹ The interaction between informal trade and public policy such as import standards could be complex and currently understudied. For example, evidence from informal cross border trade in Benin suggests that standards, such as sanitary and phyto-sanitary regulations and technical barriers to trade (such as labelling requirements), play an important role in pushing traders to informality to avoid compliance cost (Bensassi et al., 2019).⁵⁰ Further research in this direction would be an important complement.

Avenues for further research

While the three chapters have treated each megatrend separately, the intersections of digitalisation, protectionism and regionalism can prove fertile area for research. In particular, the cross-border flow of data is an important research area that lies at the heart of these megatrends. The seamless flow of data is instrumental to the functioning of digital-enabled production and trade. Whereas data localisation and data protection policy may serve legitimate policy goals such as privacy and cybersecurity, they may also increase compliance cost and distort market structure. At the same time, the stagnant progress of the WTO Joint Statement Initiative on electronic commerce has led like-minded countries to adopt a “regional” approach such as the Digital Economy Partnership Agreement between Chile, New Zealand and Singapore.

More work could be done to strengthen our understanding and inform policymaking in this area. So far, existing information on data policy often captures *de jure*-based

⁴⁹ Vietnam Investment Review (2018). Firms aim to boost official farm exports to China.

⁵⁰ Bensassi, S., Jarreau, J., & Mitaritonna, C. (2019). Regional integration and informal trade in Africa: Evidence from Benin’s borders. *Journal of African Economies*, 28(1), 89-118.

measures that may not reflect the true level of enforcement and restrictiveness. For example, Van der Marel & Ferracane (2021)⁵¹ find that the rising prevalence of data policy, measured by the mere presence of such policy, is negatively associated with the international flows of services, especially for the data-intensive ones. Most analyses also remain at the cross-country level and largely for high income countries.

In addition, a deeper understanding of firm's heterogeneous responses to these megatrends would also be helpful. While the second chapter highlights the critical role of external environment, the specific channels of impact remain elusive. Does peer effect occur through peer learning such as direct exchange of information or through cross-firm labour mobility? What is the role of local markets for skills, intermediate input and support services? Do local governments matter? These questions have been assessed largely from qualitative works while rigorous quantitative evidence remains scarce, especially in the context of developing countries.

Some of these questions could potentially be addressed by extending the database from Vietnamese custom registries. In this thesis, I have only worked with the dataset at an aggregated level. Yet, the original data can be disaggregated down to each custom form with details on the type and exact moment of transactions. Through the tax code, I managed to link approximately 70% of firms to the Vietnam Enterprise Survey 2005-15. This firm-level survey includes a wealth of other information on labour force structure, capital, sales, and ownership. Separately, I have also been able to match the addresses of most firms to their GPS coordinates – which enable exploration into the location-specific factors. I was not able to exploit these features in this thesis. Time and mental space have always been scarce resources throughout this whole Ph.D. process. This thesis

⁵¹ Van der Marel, E., & Ferracane, M. F. (2021). Do data policy restrictions inhibit trade in services?. *Review of World Economics*, 157(4), 727-776.

is not an end, but merely a beginning to a new chapter of my career where I look forward to continuing this line of research.

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RÉSUMÉ

Cette thèse étudie comment les mégatendances émergentes affectant le commerce international influent sur la résilience des exportations des pays en développement. Chacun des trois chapitres se concentre sur une mégatendance spécifique : régionalisme, protectionnisme et numérisation. Ils évaluent empiriquement les impacts sur les différentes dimensions de la résilience des exportations - notamment la concentration des entreprises, la diversification des produits et la durabilité des relations commerciales. Ils couvrent également un large éventail de contextes géographiques et adoptent un mélange de perspectives macro et micro. Tout en contribuant aux recherches académiques, cette thèse aide à informer les décideurs politiques des pays en développement dans la conception de leur stratégie de développement, en particulier dans l'adaptation des politiques de promotion des exportations au nouvel environnement mondial.

MOTS CLÉS

commerce international, régionalisme, protectionnisme, numérisation, économie global

ABSTRACT

This thesis investigates how emerging megatrends in global trade environment affect the resilience of exports from developing countries. Each of the three chapters zooms into a specific megatrend: regionalism, protectionism and digitalisation. They empirically evaluate the impacts on the different dimensions of export resilience – including firm concentration, product diversification and survivals. They also cover a broad range of geographic context and adopt a mix of macro- and micro- perspectives. Whilst adding to the academic discourses, this thesis helps inform developing countries' policymakers in designing their development strategy, especially in adapting export promotion policies to the new environment.

KEYWORDS

International trade, regionalism, protectionism, digitalisation, global economy

