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Abstract /Résumé

Trade Liberalisation and Product Mix Adjustments: Evidence from South African Firms

Theoretical and empirical studies on multi-product firms have shown that firms adjust their product mix in response to trade liberalisation. This paper uses the South African Revenue Service (SARS) and National Treasury (NT) firm-level panel to assess the response of South African firms to trade policy changes and demand shocks in destination markets between 2010 and 2016. This paper shows that South African multi-product manufacturers shift their exports towards their core products when competition intensifies in their export destinations and that these dynamics lead to productivity gains at the firm level. Also, trade liberalisation policies in the destination country positively affect the number of exported goods (extensive margin) as well as the average value of already exported products (intensive margin) for multi-product exporters, whereas restrictive measures negatively affect the extensive margin. Regarding trade policy measures, results suggest that tariff liberalisation only amplifies the adjustment of South African exporters if tariff cuts affect South African firms directly, while tariff cuts benefitting other foreign competitors mitigate within firm adjustments. By contrast, the reduction of Non-Tariff Measures (NTMs) always positively affects South African exporters.

This Working Paper relates to the 2020 OECD Economic Survey of South Africa.
(http://www.oecd.org/economy/south-africa-economic-snapshot/)

JEL classification: D24, F13, F14, F41, L11
Keywords: Multi-product firms, Productivity, Trade, South Africa.

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Libéralisation des échanges et ajustements de la gamme de produits : estimation sur données d'entreprises sud-africaines

Des études théoriques et empiriques sur les entreprises multi-produits ont montré que les entreprises ajustent leur gamme de produits en réponse à la libéralisation des échanges. Cet article utilise les données d'entreprises du service des revenus sud-africains (SRAS) et du Trésor National (NT) pour évaluer la réponse des entreprises sud-africaines entre 2010 et 2016 aux chocs de demande et aux réformes des politiques commerciales sur les marchés de destination. Cet article montre que les fabricants de plusieurs produits déplacent leurs exportations vers leurs produits de base lorsque la concurrence s'intensifie dans leurs destinations d'exportation et que cette dynamique entraîne des gains de productivité au niveau de l'entreprise. De plus, les politiques de libéralisation des échanges dans le pays de destination affectent positivement le nombre de produits exportés (marge extensive) ainsi que la valeur moyenne des produits déjà exportés (marge intensive) des exportateurs multi-produits, tandis que les mesures restrictives affectent négativement la marge extensive. Concernant les politiques commerciales, les résultats suggèrent que la libéralisation tarifaire ne fait qu'amplifier le mécanisme d'ajustement des exportateurs sud-africains si les réductions tarifaires affectent directement les entreprises sud-africaines, tandis que les réductions tarifaires bénéficiant à d'autres concurrents étrangers atténuent les ajustements au sein de l'entreprise. En revanche, la réduction des mesures non tarifaires (MNT) affecte toujours positivement les exportateurs sud-africains.

Ce Document de travail a trait à l'Étude économique de l'OCDE de l'Afrique du Sud, 2020
(http://www.oecd.org/fr/economie/afrique-du-sud-en-un-coup-d-oeil/)

Classification JEL : D24, F13, F14, F41, L11
Mots clés : entreprises multi-produits, Productivité, commerce, Afrique du Sud.

Table of contents

Tables

Figures

Trade Liberalisation and Product Mix Adjustments: Evidence from South African Firms

By Katharina Längle and Falilou Fall[1]

Introduction

Multi-product firms carry out a large share of today's world trade. As exporters on foreign markets, multi-product firms face exogenous shocks arising from steadily changing consumer demand and modifications of trade policies. Coping with such shocks represents a key determinant for firm performance.

Empirical as well as theoretical studies on multi-product firms show that firms address these challenges by adapting the product portfolio exported to their destination markets thus eventually benefitting from productivity gains at the aggregated firm level (Mayer et al., 2014, 2016, Bernard et al., 2011; Iacovone and Javorcik, 2010).

While existing studies predominantly focus on firm behavior of multi-product exporters in mature economies, to date, little evidence has been provided on how firms from countries at lower income levels adjust their market strategy in response to changing demand conditions at their export destination. Firms in emerging markets face different structure of costs, access to global value chains and non-tariff barriers that could induce different reactions to demand and trade policy shocks.

The present paper fills this research gap by investigating how South African multi-product exporters adjust their market strategy when they face demand and trade policy shocks at their destination. More precisely, this study focuses on tracing within-firm adjustments in the form of changes of the product portfolio following changing demand and thus competition conditions. Importantly, the analysis also considers the role of trade policies imposed by destination markets and investigates how within-firm adjustments are reinforced or mitigated by trade constraints and liberalisations.

1. Katharina Längle is from Paris School of Economics - Université Paris 1 Panthéon-Sorbonne. Falilou Fall is from the Economics Department OECD Economics Department, falilou.fall@oecd.org. This paper is part of the NT-SARS data project. The authors are grateful to the South African National Treasury for allowing us to work on its premises and for their technical support with the data panel. Special thanks to André Steenkamp for his excellent research assistance. Also, particular thanks go to Duncan Pieterse and Aalia Cassim from the National Treasury as well as to Amina Ebrahim, Junior Chiweza, Bjørn Bo Sørensen, Singita Rikhotso and Michael Kilumelume from UNU WIDER. The authors thank Lionel Fontagné for his inputs during this project. They would like to thank Mame Fatou Diagne, David Haugh and Vincent Koen (all ECO) and Julien Gourdon (TAD) for comments. Special thanks to Alexandra Guerrero and Sylvie Ricordeau for editorial assistance.

This paper is closely related to the empirical and theoretical approach of Mayer et al. (2016) who study the relationship between demand shocks, product mix adjustments and productivity for French exporters. However, the paper extends their model by including trade policy measures at the destination country, and by empirically evaluating to what extent these measures affect product mix adjustments of South African exporters. Moreover, the study adds to the literature on heterogeneous goods which are key in achieving productivity gains from within firm adjustments (Eckel and Neary, 2010, Eckel et al., 2015; Bernard et al., 2011; Arkolakis et al., 2016).

Focusing on South African firms is important for the research agenda for three reasons. First, it allows testing the validity of findings presented by Mayer et al. (2016) for a country at a lower income level. Second, as the largest economy of the Southern African region, South Africa is a driving force of economic development and regional integration. Thus, identifying the adjustment mechanisms of South African firms to demand shocks at their export destination is crucial to better understand the determinants of regional economic stability and resilience. Third, despite the strong competitive position of South Africa in the region, recent indicators showed that manufacturing accounts for only 12% of South African GDP similar to other large emerging markets except China.[2] Against the background of general concerns about the competitiveness of South African manufacturing exporters, it is of particular interest for policy makers to identify drivers of productivity (Rodrik, 2008).

Using the South African Revenue Service (SARS) and National Treasury (NT) firm-level panel for the timespan between 2010 and 2016, the paper shows that, despite a general economic downturn, South African manufacturing exporters, which face stronger competition at their destination, have shifted exports towards their core competencies and benefited from an increase in productivity. Importantly, taking into account the destination country's trade policy shows that trade margins of firms are sensitive to trade liberalisation and restriction. The paper shows theoretically, as well as empirically, that trade liberalisation measures at the destination lead to more pronounced reactions of the intensive and extensive margins, compared with a counterfactual situation without trade policy measures, and that these measures amplify the shift of the product mix towards better performing products. Conversely, trade restrictions reduce this adjustment mechanism. Regarding trade policy measures, the results suggest that tariff liberalisation only amplifies the adjustment mechanism of South African exporters if the tariff cuts affect South African firms directly, while tariff cuts benefitting to other foreign competitors reduce within firm adjustments. Unlike tariff measures, this study finds that the liberalisation of Non-Tariff Measures (NTMs) always positively affects South African exporters, suggesting the presence of positive spillovers from a decrease in NTMs.

Section 2 provides an overview of the related literature. Section 3 explains the underlying theoretical mechanism and outlines the theoretical implications of the inclusion of trade policy measures in this study. Subsequently, section 4 describes the empirical strategy and section 5 the data. Section 6 presents the results and section 7 concludes.

Literature review

Over the past decade, the empirical as well as theoretical literature on multi-product firms expanded rapidly. In general, studies focus on determinants of firm-specific product mix and export destination choice. While the presence of exporters in destinations with high access cost is primarily driven by the efficiency of exporters, the selection of firm-specific product-destination combinations also depends on performance of individual products (Chaney, 2008; Arkolakis et al., 2016; Eckel and Neary, 2010; Mayer et al., 2014, 2016).

A crucial empirical finding and important theoretical assumption is that products exported by a firm are heterogeneous with respect to their efficiency or quality (Arkolakis et al., 2016; Eckel and Neary, 2010;

2. In other BRICS countries, manufacturing contributed around 11% of GDP in Brazil, 12% in Russia, 15% in India and 29% in China (see World Bank (2019c), series: NV.IND.MANF.ZS).

Mayer et al., 2014, 2016; Eckel et al., 2015). Regarding efficiency, the production of additional products beyond the core competency of a firm is perceived as more costly and thus less efficient (Arkolakis et al., 2016; Eckel and Neary, 2010; Mayer et al., 2014, 2016). Accordingly, most studies assume that these efficiency and cost differences lead to a globally stable product hierarchy across destinations, so that firms enter a destination market with their most productive product before expanding the export scope down the efficiency ladder of products (Fontagné et al., 2018). However, this concept of a globally stable product hierarchy is challenged by the observation that the product mix of firms differs distinctly across destinations when the information that some products are not shipped to certain destinations is taken into account (Fontagné et al., 2018). Therefore, similarities between the product mix exported across destinations stem from product complementarities of goods rather than from a globally stable product hierarchy.

Regarding the joint selection of exported products and destinations, firms generally enter the export market with their most efficient product and expand their export portfolio along the efficiency ladder of goods. Given this selection of products and destinations, Eckel and Neary (2010) show that firms benefit from a productivity increase if they become "leaner and meaner" by adjusting the extensive margin of trade and concentrating on their core competency. Importantly, studies focusing on the development of the product mix at destinations over time provide proof that the product mix exported to a destination undergoes ongoing adjustments in response to shocks such as in the exchange rate, trade or competition (Chatterjee et al., 2013; Bernard et al., 2011; Mayer et al., 2014, 2016). Several empirical studies show that firms in Mexico, the US, Canada and France adjusted their export mix in response to NAFTA’s liberalisation of regional trade and trade liberalisation in Asia (Iacovone and Javorcik, 2010; Bernard et al., 2011; Baldwin and Gu, 2009, Bas and Bombarda, 2012). These adjustments included a reduction of the extensive margin (US) and plant size of exporters (Canada) as well as intense portfolio changes for product varieties at the firm level (Mexico).

As the SARS-NT firm level panel is relatively recent, the strand of literature using South African firm level data is small. So far, there is no study on within-firm adjustments of manufacturing exporters using the firm-level panel dataset. Nevertheless, there are studies on productivity and exporters. Regarding productivity, manufacturing subindustries experienced heterogeneous developments of total factor productivity between 2010 and 2013 (Kreuser and Newman, 2018). While productivity in industries including chemicals, core & refined petroleum and non-metallic mineral products grew by up to 10%, productivity of the leather, pharmaceutical and wood industries shrank by up to 3.5% between 2010 and 2011 (Kreuser and Newman, 2018). Besides this heterogeneity of productivity growth between industries, there also exists a pronounced heterogeneity within industries, which is mostly driven by large firms. Newman et al. (2019) identify significant misallocations of labour and capital that hamper manufacturing productivity growth.[3] With regard to dynamics among South African exporters, empirical work on the SARS-NT firm level panel confirmed common findings in the literature on exporters. South African exporters are larger, more capital intensive, pay higher wages and benefit from a productivity premium compared to their purely domestically operating competitors (Matthee et al., 2016; Edwards et al., 2016). In line with findings on exporters of other countries, a small number of multi-product and multi-destination firms explains the total export value (Matthee et al., 2016).

Theoretical background

The theoretical section is subdivided into two parts. First, the main features of the model of Mayer et al. (2016) are outlined to show that a positive demand shock in a destination leads to a shift of the product mix towards the best performing products of a firm. While subsection 3.1 highlights the main features of the model, a more detailed summary is in the Appendix. Second, the model is augmented to illustrate how

3. Policy measures explaining misallocation across firms include policies related to research and development incentives which allow for a tax deduction of 150% of expenditure for R&D or general depreciation allowances on movable capital equipment. For more details see Newman et al. (2019).

trade policy measures of the destination country affect the product mix of exporting firms and, in particular, South African exporters.

Product mix adjustments in response to demand shocks

Following the model of Mayer et al. (2016), the adjustment mechanism of the product mix in response to a positive demand shock is first outlined in a closed economy setting and later expanded to an open economy framework.

On the demand side, it is assumed that there is additively separable utility over a continuum of imperfectly separable goods indexed by $i \in [0, M]$. From the utility maximisation problem of consumers, the inverse demand function per consumer can be derived $p(q_i) = u'(q_i)/\lambda$, which is associated with the curve of marginal revenue, $\phi(q_i) = u'(q_i + u''(q_i))/\lambda$. Importantly, λ serves as unique endogenous demand shifter so that an increase in λ leads to an inward shift of the residual demand curve which is qualitatively interpreted as an increase in competition. Given this framework of demand, it is possible to derive the elasticities of inverse demand and marginal revenue (in absolute terms), which capture the sensitivity of prices and marginal revenue in response to changes in quantities (Melitz, 2018):

$\epsilon_p = -p'(q_i)q_i/p(q_i)$ and $\epsilon_\phi = -\phi'(q_i)q_i/\phi(q_i)$

On the supply side, the model follows a monopolistically competitive market structure with one production factor, labour. To enter the market, firms pay a sunk cost, f^e and face fixed cost, *f*, as well as marginal cost, *v*. After having paid the entry cost, a firm possesses the exclusive blueprint to produce a core product with cost, *c*, plus a countable range of varieties, which cause additional costs beyond the marginal cost of the core product.[4]

The profit-maximisation condition, equalising marginal cost and marginal revenue, can be used to determine the profit maximising price, the optimal output per consumer as well as the elasticities of the performance measures of *output*, *revenue* and *profit* with respect to marginal cost, *v* and competition, λ, in terms of ϵ_p and ϵ_ϕ.

$$\begin{aligned} \varepsilon_{q,v} &= -\frac{1}{\varepsilon_\phi}, & \varepsilon_{q,\lambda} &= -\frac{1}{\varepsilon_\phi} \\ \varepsilon_{r,v} &= -\frac{1-\varepsilon_p}{\varepsilon_\phi}, & \varepsilon_{r,\lambda} &= -\frac{1-\varepsilon_p}{\varepsilon_\phi} - 1 \\ \varepsilon_{\pi,v} &= -\frac{1-\varepsilon_p}{\varepsilon_p}, & \varepsilon_{\pi,\lambda} &= -\frac{1}{\varepsilon_p} \end{aligned} \tag{1}$$

Accordingly, higher competition is associated with lower output, revenue and profit, while lower marginal cost is associated with higher output, revenue and profit.

In a *partial equilibrium*, there is a strictly binding budget constraint with a fixed number of firms in the short run:

$$\overline{N} = \{\sum_{m=0}^{\infty}[\int_0^{\hat{c}/z(m)} r(cz(m),\lambda)d\Gamma(c)]\} = 1.$$

4. It holds that v(m,c) = c z(m) with z(0) = 1 for the core competency indexed by 0 and z'(m) > 0.

Along with the zero profit condition, $\pi(\hat{v},\lambda)L^c = f$, this constraint determines endogenous equilibrium cutoffs, $\hat{v}$, and the competition level, λ.

Consequently, in case of a positive demand shock (increase in L), profits for all products increase and trigger higher cut-off levels. Thus, in the short run, when there is no free entry of firms, there is an increase in competition because of new varieties on the market. This increase in competition leads to a decline in output sales per consumer. How this decline in output per consumer translates into changes of the elasticity of output, revenue and profit is determined by the elasticities of inverse demand, ϵ_p, and marginal revenue, ϵ_ϕ, which in turn depend on particular assumptions on demand.

At this point, it is crucial that demand conditions follow **Marshall's second law of demand**. The assumption that Marshall's second law of demand holds true implies that the inverse price elasticity of demand increases with the quantity consumed. This specification implies I) $\epsilon_p'(q_i) > 0$ and II) $\epsilon_\phi'(q_i) > 0$ for $q_i \geq 0$. Both I) and II) are crucial determinants for the model implications with respect to the reallocation of profit, output and revenue towards better performing products. As stated above, the increase in competition in response to a positive demand shock leads to lower output sales per consumer. Given I) and II), it can be concluded that an increase in competition leads to a decline in elasticities, ϵ_p and ϵ_ϕ. Considering two products, 1 and 2, produced by a firm for which product 1 is a better performing product than product 2 (v1 < v2), this demand system leads to three important propositions for the performance measures expressed in equation 1.

Proposition 1: Regarding **operating profits**, $\pi(v_1,\lambda)/\pi(v_2,\lambda)$ increases as $|\epsilon_{\pi,v}|$ increases. As the latter only holds true if $\epsilon_p(q_i)$ *de*creases, I) can be seen as necessary and sufficient condition for the reallocation of operating profits towards better performing products in response to a positive demand shock.

Proposition 2: Regarding **output,** $q(v_1,\lambda)/q(v_2,\lambda)$ increases as $|\epsilon_{q,v}|$ increases. As the latter only holds true if $\epsilon_\phi(q_i)$ *de*creases, II) can be seen as necessary and sufficient condition for the reallocation of output towards better performing products in response to a positive demand shock.

Proposition 3: Regarding **revenue,** $r(v_1,\lambda)/r(v_2,\lambda)$ increases as $|\epsilon_{r,v}|$ increases. As the latter only holds true if $[1-\epsilon_p(q_i)]/\epsilon_\phi(q_i)$ *in*creases, II) can be seen as sufficient condition for the reallocation of revenue towards better performing products in response to a positive demand shock.

In an *open economy* with home country H (South Africa), a rest of the world, R, and a destination, D, the new zero profit cut-off condition and budget constraint change to

$$\pi(\tau_{lD}\hat{v}_{lD},\lambda_D) = f_{lD}, l \in \{H,R,D\} \tag{2}$$

And

$$\sum_{l=H,R,D} (\overline{N}_D = \{\sum_{m=0}^{\infty} [\int_0^{\hat{c}_{lD}/z_l(m)} r(\tau_{lD} c z_l(m),\lambda_D) d\Gamma_l(c)]\}) = 1. \tag{3}$$

It is assumed that exporting to D incurs fixed export cost, f_{lD}, as well as per-unit iceberg cost $\tau_{lD} > 1$.[5] Similar to the previous situation, the consumer budget constraint along with cutoff-profit conditions for H, R and D jointly determine the competition level, λ_D, and equilibrium cutoffs, $\hat{v}_{lD}$, for firm entry into D. Consequently, a positive demand shock in L_D^c leads to similar reallocation dynamics of output, profit and revenue as outlined before.

5. There are particular assumptions for domestic producers who face iceberg transport cost equal to 1 whereas unit iceberg cost are assumed to be greater than one for H and R.

Theoretical implication of trade policy interventions

This paper also aims at investigating how product mix adjustments are altered by trade policy measures at export destinations. Against this background, it is assumed that demand shocks at export destinations can be accompanied by liberalising and restricting trade policy measures affecting product mix adjustments of South African exporters.

The effect of trade policy measures at any destination market, *D*, can be explained based on equation 2. It is assumed that trade policy measures in *D* alter unit iceberg cost, τ_{lD}, and introduce γ to capture the impact of trade policy measures. In this context, *liberalising* trade policy measures are assumed to lower unit iceberg cost by a factor $\gamma_l < 1$ while *restrictive measures* are assumed to increase cost by a factor $\gamma_l > 1$. The resulting new short run consumer budget constraint augmented by trade policy can hence be expressed as follows:

$$\sum_{l=H,R,D}(\overline{N}_D = \{\sum_{m=0}^{\infty}[\int_0^{\hat{c}_{lD}/z_l(m)} r(\gamma_l \tau_{lD} c z_l(m), \lambda_D) d\Gamma_l(c)]\}) = 1 \qquad (4)$$

Recalling the general case of the short run scenario outlined in the previous subsection, higher demand triggers essentially two effects. First, higher demand leads to higher profits for all products and is thus affecting the intensive margin of trade. Second, as profits are higher, short-run equilibrium cut-offs increase and allow firms to sell more (previously unprofitable) varieties on the market and thus affect the extensive margin of trade. This effect is ultimately leading to an increase in competition. In the context of our model extension with trade policy measures at the destination country, these two effects are modified as follows.

Assuming that trade policy measures influence trade costs, a positive demand shock occurring along with trade liberalisation ($\gamma_l < 1$) leads to lower unit costs for firms exporting from country *l* to *D* compared to a counterfactual situation in which no liberalisation took place. There is hence a greater increase in profits per product and consequently a greater increase of equilibrium cut-offs. Competition is thus increasing beyond the scope of what would have happened in the counterfactual case without trade liberalisation. The opposite effect occurs if country *D* restricts trade for firms from country *l* ($\gamma_l > 1$). In this case, restricting policy measures trigger an increase in trade costs between *l* and *D* so that the entrance of new varieties on the market is lower than in the counterfactual situation without trade policy restrictions. Consequently, competition is increasing less.

Following this line of reasoning, the decline of output per consumer is more (less) pronounced if competition is increasing (decreasing) in response to trade liberalising (restricting) measures. Consequently, the decline of elasticities, ϵ_p and ϵ_ϕ, is stronger (weaker) so that the shift of operating profits, output and revenue towards core products is more (less) intensified compared to a situation without trade policy measures.

To further evaluate the effect of trade cost changes, three different measures are considered depending on the scope of countries affected in conjunction with the type of measure, NTMs or tariffs. A distinction of these measures allows deriving different implications with respect to the scope of affected countries as measures related to tariffs are targeting trade partners more precisely than NTMs, whereas there is a possibility of spill-overs due to the fact that third countries cannot be excluded from certain measures. Regarding the affected countries, measures jointly targeting South Africa as well as other countries (all), and measures that address South Africa (ZAF only) and other countries exclusively (RoW only) are considered separately.

Importantly, there is an ambiguous effect on trade costs if trade policy measures are exclusively addressing countries from the rest of the world. Regarding, for example, trade restrictions, policy measures only affecting the rest of the world can trigger three different implications for South African firms. First, as these restrictions only affect other countries than South Africa, the effect corresponds to a relative decline in trade costs in favour of South African firms. Second and in contrast to the previous argument, almost 50% of trade measures considered in our empirical framework comprise NTMs. As measures like restrictive border procedures or product standards are very likely to not only impact exporters from the rest of the world, there might be negative spillover effects that also negatively affect South African exporters. Third, even though restrictive measures imposed only against the rest of the world lead to a relative trade cost decline for South African exporters, there might be an increase of costs related to uncertainty, as it is unsure if measures against the rest of the world eventually affect South African firms through value chains or input factors[6]. Inversely, trade liberalisations only affecting the rest of the world do not necessarily imply a relative cost increase for South African firms for the same reasons. Therefore, the effects from positive demand shocks may further depend on the type of trade policy instrument, NTMs or tariffs that accompanies them.

Empirical strategy

The theoretical model's implications presented in the previous section are estimated with South African firm-level data in three steps. First and at the firm-industry-destination level, how positive demand shocks at a destination affect the product mix exported to this country is assessed and how the trade policy of the destination country modifies the relocation dynamics outlined in section 3.2. Second, whether firms tend to shift their portfolio towards their core products if competition at the destination increases along with trade measures at the destination is investigated. Third and at the aggregated firm level, to what extent destination-specific demand shocks affect the aggregated portfolio of exported goods is evaluated and how these dynamics ultimately affect productivity.

Measurement of destination-specific demand shocks

Regarding the first step of the empirical strategy, this section investigates how destination-specific demand shocks in conjunction with trade policy measures affect the extensive and intensive margins of exports. In line with Mayer et al. (2016), demand shocks at destinations are measured at three different levels of aggregation: the macro, sectoral and firm level.[7]

First and at the most aggregated macro level, this paper considers the level and change of GDP in the destination. Second, an industry-specific demand shock variable is calculated, which captures the level and development of imports from the rest of the world, *r*, to the destination country, *j*, within a four-digit ISIC industry, *s*. Finally, in a comparable manner, a firm-specific shock is calculated using total imports of products into destination *j*, which are exported by the considered firm. These three approaches can be expressed as below where *r* refers to the rest of the world and ω refers to a product included in the set of goods exported by the firm *i*, Ω_i. Moreover $trade_{i,j}$ represents a dummy variable equalling 1 if the firm i exports to country j.

$$Shock\_macro_{i,j} = GDP_j * trade_{i,j}$$

$$Shock\_sector_{i,j}^{s} = \sum_{r\in R} IM_{r,j}^{s} * trade_{i,j}$$

$$Shock\_firm_{i,j}^{s} = \sum_{\omega\in\Omega_i^s}\sum_{r\in R} IM_{r,j}^{\omega} * trade_{i,j}$$

6. As the paper studies empirical implications derived from a partial equilibrium model with effects occurring in the short run, global demand effects are disregarded.

7. Unless stated differently, the calculation of shocks and growth rates follows Mayer et al. (2016).

To capture the dynamics of these shocks, changes as mid-point growth rates are defined as:

$$\tilde{\Delta X}_t = (X_t - X_{t-1})/(0.5X_t + 0.5X_{t-1})$$

This method offers the advantage that it accurately captures changes when a shock switches from 0 to a positive number and is bound between +2 and -2. Moreover, shocks are calculated for all the destinations to which a South African firm is exporting between 2010 and 2016. This approach captures the information contained in the decision of a firm not to export to a destination at time, *t,* whereas it exported at *t-1*.

An important step to evaluate demand shocks along with trade cost shocks triggered by trade policy measures at an export destination is to explain how information on destination-specific trade policy changes are added. For this purpose, the analysis relies on country and product-specific information on trade policy measures from the Global Trade Alert database (GTA). Importantly, this database does include not only information on trade policy measures at the disaggregated product level but also categorises measures into trade liberalising and trade restricting measures.[8] Using the information on whether products imported into a destination fall under a liberalising or restricting trade policy measure allows the use of dummy variables which capture whether demand shocks in destination *j* are accompanied by a liberalising or restricting trade measure and if the measure are NTMs or tariffs.

As the information about trade policy measures at the detailed product level is available, one can capture trade cost shocks in conjunction with demand shocks at both the sectoral and firm level. In this context, trade liberalisation and restriction policies are separated by for instance classifying a demand shock in the wake of trade liberalisation if goods in this ISIC industry are only affected by a liberalising policy. This distinction allows us to capture the individual effect of liberalising and restricting trade policy measures without the risk of capturing the effect of interactions between the two measures.

Given that the GTA database also contains information on the target countries of trade policy measures, it is possible to distinguish if a measure directly affects South African firms or if the measure only targets other countries (rest of the world). To capture the effect on trade cost changes relative to competing firms from the rest of the world, three different categories of trade liberalisation are distinguished. Beside trade policy measures, which affect both South Africa and the rest of the world at the same time, the paper also includes those that either exclusively target South African firms or the rest of the world.

To only capture the effect from trade cost changes, it is important to control for macro shocks in our regressions. This specification is important as trade policy measures might be positively related to the business cycle of destination countries. In particular, trade restrictions would be more likely during an economic downturn, while liberalisations tend to occur during an economic upswing (Bagwell and Staiger, 2003). In that case, estimated coefficients of the trade cost shock variables would rather capture the effect of the macro shock of a country. The fact that policy measures of the GTA database are indeed positively related to the business cycle of the implementing country is shown in the Appendix.

Identification of product mix adjustments

Given the specification of these shocks, the first step of the identification strategy is to link the destination-specific extensive and intensive margins to demand and trade cost shocks at individual destinations. In total, this approach requires four different regressions of the two margins, along with shocks measured at the sectoral and firm level. For ease of presentation, two regressions for shocks measured at the sectoral and firm level, where *margin* represents the extensive or intensive margin are shown.

The variable $intervention_{j,\Phi}$ represents liberalising or restrictive measures imposed by country, *j*, against its trade partners captured in the set Φ (Φ= {H,R,H ∪ R). The $intervention_{j,\Phi}$ dummies in both equations differ according to the level of aggregation of shocks. While the exponent S implies that the measure

8. A more detailed explanation and a list of measures included in different categories is provided in the data section and the Appendix.

affects the industry of the firm *i*, $\omega_{i,j}$ implies that the measure affects a product, which is exported by the firm *i* to *j*. Given that this paper considers trade policy measures exclusively, $intervention^{s}_{j,\Phi}$ is more restrictive than $intervention^{\omega_{i,j}}_{j,\Phi}$ as it is more likely that there are two opposing measures for goods within an industry.

$$\begin{aligned}\tilde{\Delta Margin}^{s}_{i,j} &= \alpha \tilde{\Delta Shock\_macro}_{i,j} \\ &+\beta \tilde{\Delta Shock\_sector}^{s}_{i,j} \\ &+\gamma(\tilde{\Delta Shock\_sector}^{s}_{i,j} * intervention^{s}_{j,\Phi}) + \nu intervention^{s}_{j,\Phi} \\ &+\zeta t\_dummy + \mu^{s}\end{aligned}$$

$$\begin{aligned}\tilde{\Delta Margin}^{s}_{i,j} &= \alpha \tilde{\Delta Shock\_macro}_{i,j} \\ &+\beta \tilde{\Delta Shock\_firm}^{s}_{i,j} \\ &+\gamma(\tilde{\Delta Shock\_firm}^{s}_{i,j} * intervention^{\omega_{i,j}}_{j,\Phi}) + \nu intervention^{\omega_{i,j}}_{j,\Phi} \\ &+\zeta t\_dummy + \mu^{s}\end{aligned} \tag{5}$$

Moreover, to investigate the effect of different types of trade policy measures, equation 5 is extended by dummies equalling 1 if trade measures are either related to changes in tariffs or NTMs. These variables are added to the regression as triple interaction term between the trade shock variable, a dummy if there is a liberalising or restricting measure and a dummy for the instrument of the measure, Ψ, referring to NTMs or tariffs. The final regression equations can be expressed as follows.

$$\begin{aligned}\tilde{\Delta Margin}^{s}_{i,j} &= \alpha \tilde{\Delta Shock\_macro}_{i,j} \\ &+\beta \tilde{\Delta Shock\_sector}^{s}_{i,j} \\ &+\gamma(\tilde{\Delta Shock\_sector}^{s}_{i,j} * intervention^{s}_{j,\Phi}) + \nu intervention^{s}_{j,\Phi} \\ &+\eta(\tilde{\Delta Shock\_sector}^{s}_{i,j} * intervention^{s}_{j,\Phi} * \Psi^{s}_{j,\Phi}) + \theta \Psi^{s}_{j,\Phi} \\ &+\zeta t\_dummy + \mu^{s}\end{aligned}$$

$$\begin{aligned}\tilde{\Delta Margin}^{s}_{i,j} &= \alpha \tilde{\Delta Shock\_macro}_{i,j} \\ &+\beta \tilde{\Delta Shock\_firm}^{s}_{i,j} \\ &+\gamma\left(\tilde{\Delta Shock}_{firm^{s}_{i,j}} * intervention^{\omega_{i,j}}_{j,\Phi}\right) + \nu intervention^{\omega_{i,j}}_{j,\Phi} \\ &+\eta(\tilde{\Delta Shock\_firm}^{s}_{i,j} * intervention^{\omega_{i,j}}_{j,\Phi} * \Psi^{\omega_{i,j}}_{j,\Phi}) + \theta \Psi^{\omega_{i,j}}_{j,\Phi} \\ &+\zeta t\_dummy + \mu^{s}\end{aligned} \tag{6}$$

The second step of the identification strategy aims at investigating to what extent destination-specific demand shocks lead to a shift of the product vector towards a firm's core products. For that reason, it is necessary to identify a dependent variable that accurately captures the difference between destination-specific product vectors and a firm-wide vector of core products. Regarding the finding of Fontagné et al. (2018) that product vectors of firms differ widely across destinations when zeros are taken into account, the present paper slightly deviates from the prevailing approach to strictly rank products according to their productivity. Averaging destination-specific product vectors across both destinations and time allows not only to identify the relative productivity of individual products but also highlights product complementarities based on the information on which goods are frequently exported together. In this context, a core product vector of a firm is defined based on the respective average revenue shares of products, which a firm exports to all its destinations over time.

To capture the difference between the core- and destination-specific product vectors, it is necessary to rely on a measure that allows the inclusion of information on zero exports of a product to a destination. At this stage, the paper deviates from the empirical approach of Mayer et al. (2016) and follows Fontagné et al. (2018) by relying on the Bray-Curtis similarity index, which can be expressed as follows:

$$BC_{i,j} = 1 - \frac{\sum_p |s_{i,p} - s_{i,j,p}|}{\sum_p |s_{i,p} + s_{i,j,p}|} \quad (7)$$

In this expression, $s_{i,p}$ refers to entries of the core product vector, while $s_{i,j,p}$ refers to entries of a destination-specific product vector. This approach compares a core product vector, consisting of the respective revenue share of a product in a firm's overall product mix, with revenue shares of the same product in the portfolio of individual destinations. By definition, the fraction on the right-hand side equals zero if the product vector of destination *j* exactly coincides with the core product vector. Inversely, the right-hand side of equation 7 equals one if the core product vector and the destination-specific product vector show no similar pattern at all.

As the Bray-Curtis measure varies between 0 and 1, it is assumed that an increase of the indicator reflects a shift of a destination-specific product vector towards the core product vector, while a decline reflects a shift away from the core product vector of a firm. Thus, in order to assess to what extent destination-specific demand shocks and changes in trade costs lead to a shift of product vectors towards a firm's core product, the Bray-Curtis index is regressed on the same set of variables as presented in equations 5 and 6.

Assessment of productivity effects

As stated in the introduction, this paper aims at investigating the link between demand shocks at a destination, the adjustment of the product mix and the resulting productivity changes at the firm level. To assess the transmission of product mix adjustments driven by shocks at the disaggregated firm-industry-destination level in productivity gains at the more aggregated firm level, all variables are aggregated at the firm level. Consequently, variables aggregated at the firm level are used to regress firm level productivity on aggregated shocks. Productivity is defined as deflated value added per employee:

$$\Phi_i^s = \frac{VA_i/P^s}{L_i}.$$ [9]

It is crucial to find an appropriate aggregation that retains the information that a firm is no longer exporting to a destination. For this reason, the shocks are aggregated based on the average revenue share that a firm is earning in a certain industry and destination. To ensure that this measure is indeed capturing the information if a firm exports to a destination or not, revenue shares are calculated as depicted in the following equation, where the denominator comprises all destinations to which a firm is exporting in year t.[10]

9. Alternatively, it would have been possible to measure productivity as total factor productivity (TFP) following e.g. Levinsohn and Petrin (2003) and Ackerberg et al. (2006). Still, in view of the requirement that data should be available in sufficient quantity to obtain reliable TFP estimates and given our time constraint to work on the data, productivity is measured as deflated sales per employee.

10. If the average revenue shares of a firm are e.g. 0.5, 0.3 and 0.2 for destinations A, B and C respectively, the denominator varies over time if the firm exports to all destinations in t but drops destination C in t+1. Looking for example at destination A, the weight would be 0.5 in t and 0.625 in t+1.

$$weight_{i,j}^{s} = \frac{\overline{x}_{i,j}^{s}}{\sum_{j \in J_t} \overline{x}_{i,j}^{s}}$$

The aggregated shocks at the firm level in conjunction with the export intensity of individual firms lead to the following regression equation. As the firm-specific demand shock represents the most precise measure of the demand shock variable, only firm-specific demand shocks are kept in our further regressions on firm level productivity. Moreover, controls include the material used as well as capital per employee changes over time and weight trade shocks by the export intensity of firms.[11] As in equations 5 and 6, $intervention_{j,\Phi}$ refers to either liberalising or restrictive measures imposed by *j* against its trade partners captured under Φ. Ψ refers to the policy instrument, NTM or tariff changes, imposed by *j*. In contrast to previous specifications, variables are aggregated to the firm level using weights specified as outlined above.

$$\begin{aligned} \Delta log\phi_i &= \alpha\Delta(\widetilde{Shock\_macro}_{i,j} * EXintensity_i) \\ &+\beta\Delta(\widetilde{Shock\_firm} * EXintensity_i * intervention_{j,\Phi}^{\omega_{i,j}}) + vintervention_{j,\Phi}^{\omega_{i,j}} \\ &+\gamma\Delta(\widetilde{Shock\_firm} * EXintensity_i * intervention_{j,\Phi}^{\omega_{i,j}} * \Psi_{j,\Phi}^{\omega_{i,j}}) + \theta\Psi_{j,\Phi}^{\omega_{i,j}} \\ &+\zeta t\_dummy + \mu^i \end{aligned} \quad (8)$$

The South African firm level data

The principal data source is the South African Revenue Service (SARS) and National Treasury (NT) firm level panel (Pieterse et al., 2018). This panel is constructed from information on income taxes of registered firms, employee data from income tax certificates, value added tax data and customs transactions of traders.[12]

Most importantly, the basis of analysis is the raw customs data. Given the relatively small number of papers focusing on South African exporting firms and the fact that our analysis traces very granular dynamics at the firm-destination-product level, an important step is the cleaning strategy of the raw customs data. Important steps of the cleaning procedure include the harmonisation of HS6 product classifications, the distinction between retailers and manufacturers who produce as well as export their manufactured products and the definition of the main operating industry of a firm. Moreover, as the consideration of changes in the product mix requires looking at multi-product exporters by definition, only firms that export more than one product over time are kept. A more detailed description of the data cleaning strategy is available in the Appendix.

Eventually, one can trace portfolio adjustments of around 14,000 multi-product manufacturing exporters per year and link around 85% of firms in the restricted sample with data on productivity between 2010 and 2016.[13]

Table 1 provides an overview over the number of firms. However, there is a high number of firms organising their exports through agents. While declaration forms generally require agents to indicate the firm on whose behalf they are exporting, agents can also buy commodities from firms and export them on their own behalf.

11. The export intensity is calculated as $EXintensity_i = \frac{\sum_{j \in J} x_{i,j}}{Y}$ where *Y* represents total sales. Per definition, this measure should vary between 0 and 1. In cases in which the value was larger than 1, the export intensity was set to 1.

12. The analysis is based on panel data from May 2019 and a customs data extraction from December 2018.

13. It should be noted that here, years refer to *tax years* lagged by one year. Tax years run from the 1st of March to the last day of February of the following year (Pieterse et al., 2018). Our decision to lag tax years by one year is motivated by the fact that declarations of firms fall into the tax year in which the financial year of a firm ends. As around 80% of firms end their financial year in February, the main activity of firms lies in the previous year. Thus, to accurately link demand shocks based on calendar years with firm level dynamics, tax years are lagged by one year.

As these transactions cannot be linked back to firms, it is not possible to observe the entire set of exporting firms individually.

Table 1. Descriptive statistics: number of firms

Time	Number of total firms	Number of firms in sample	Number of firms matched with original panel	Matched value
2010	20 855	12 644	12 041	85%
2011	22 096	13 307	12 502	88%
2012	23 931	14 002	12 858	85%
2013	24 745	14 355	12 925	86%
2014	24 553	14 688	12 942	89%
2015	25 069	14 879	12 623	89%
2016	25 157	14 595	11 222	85%

Source: South Africa National Treasury-SARS data.

Regarding the number of exporters in Italy or France for the year 2007, 69,363 and 31,798 respectively, the total number of exporters is higher than what would have been expected based on GDP (Fontagné et al., 2018). Given that South African GDP corresponds to around 20% (15%) of Italian (French) GDP, the number of exporters is expected to range between only 5,000 and 14,000 exporters (World Bank, 2019a). This discrepancy can be explained by the fact that both Italy and France as members of the European Union have much higher thresholds to report exports to many of their intra-EU destinations than South Africa, where all products crossing the extra-SACU border need to be declared. Consequently, there are more small exporters in the South African panel than for France and Italy.

An overview of the distribution of multi-product exporters and the number of destinations they serve over all years from 2010 to 2016 is given in Table 2.

Table 2. Descriptive statistics: distribution of multi-product firms

		Number of products						
		1	2	3	4-9	10+	50+	Total
Number of destinations	1	2 183	2 588	1 046	1 519	420	9	7 765
	2	237	1 904	1 450	2 238	531	5	6 365
	3	42	211	457	1 516	496	10	2 732
	4-9	46	184	187	1 752	1 724	40	3 933
	10+	9	42	53	187	515	50	856
	50+	0	0	1	2	4	0	7
Total		2 517	4 929	3 194	7 214	3 690	114	21 658

Source: South Africa National Treasury-SARS data.

Table 2 shows a comparably high concentration of exporters on one and two products exported to fewer than ten destinations. While French and Italian firms export on average 12–13 products to around 15 different destinations (in 2007), smaller numbers for South African firms can be partially explained by the lower income level of the country in general, as well as the geographic location (Fontagné et al., 2018). Regarding the former, there are less so-called "superstar" firms in smaller economies that have the capacity to export many products to a wide range of destinations.

Moreover, as argued before, by being a member of the EU, firms in Italy and France enjoy easier access to many destinations within and outside of the EU. For South Africa, exporting outside of the SACU area means shipping mainly overseas thus implying a higher barrier for exporters. Consequently, as also reflected in the data, many small South African firms temporarily become exporters and change their export status across years.

Data to construct firm-specific shocks is mainly sourced from three databases. First, to calculate the most aggregated destination-specific demand shock, current GDP data is taken from the World Bank.[14] Second, to calculate destination-specific demand shocks on both the industry and firm level, detailed trade data on bilateral HS6 product flows is taken from the CEPII-Baci database.

Third, in order to capture the circumstance when trade flows are associated with trade cost shocks, additional information on trade liberalising and restricting policy measures is taken from the Global Trade Alert (GTA) database (Evenett and Fritz, 2019).[15] Besides tariff changes, this database lists Non-Tariff Measures (NTMs) and lines up with the Multi-Agency Support Team (MAST) chapters aiming at uniquely classifying NTMs (Evenett and Fritz, 2019). Regarding the distribution of measures between 2010 and 2016, around 53% affect import tariffs, and around 43% are non-tariff ones.[16] In this context, authors of the GTA database also provide an evaluation of measures. Accordingly, they distinguish three categories: i) measures which *almost certainly discriminate* against foreign commercial interests, ii) measures which are *likely to involve discrimination* against foreign commercial interests and iii) measures which *liberalise* on a non-discriminatory basis or improve the transparency of relevant policies. For the sake of simplicity i) and ii) are grouped together as trade restricting measures while category iii) represents trade liberalising ones. Examples of trade liberalising measures include duty-free import quotas on certain products or temporary elimination of value added tax on imports of goods. Examples of trade restricting measures include state aid for specific firms or quotas on certain products. Importantly, only trade policy measures are considered that directly discriminate or liberalise against imports whereas measures addressing exports, measures without MAST chapter classification or missing information on the product scope are disregarded. To account for the fact that subsidies might have an ambiguous effect on trade flows, measures classified as trade restricting subsidies are excluded from the sample.

The paper only considers demand shocks beyond the Southern African Customs Union (SACU). Because, first and related to the data availability, there is no trade data at the bilateral product level from UN COMTRADE for Swaziland for the years 2010, 2011 as well as 2012 and no data from the same source for Lesotho for 2016. Second and important for the identification strategy is the argument of exogeneity of demand shocks. As South Africa represents the largest economy in SACU, it is not only providing most of the member countries' imports but also has a strong influence on GDP developments in the region.[17] Consequently, demand shocks can no longer be seen as exogenous shocks but are very likely to be closely correlated with domestic economic developments. To avoid endogeneity, this study focuses on extra-SACU dynamics.

14. As not all destinations appear in this dataset, missing GDP data for Mayotte, Martinique, Guadeloupe, French Guyana and la Réunion are taken from Insee for the years 2010 until 2015. To calculate values for 2016, data is extrapolated using growth rates between 2015 and 2016 from Eurostat. There are in total 10 destinations for which no GDP data is available neither from the World Bank nor from respective national sources. As these countries are rather small islands and account for only around 3,000 shipments out of more than 4,000,000 they are dropped from the sample. These destinations are: Anguilla, the Cocos Islands, the Cook Islands, the Christmas Islands, the Falkland Islands, the Norfolk Islands, Niue, Saint Helena, Tokelau and US minor outlying islands.

15. For measures to be listed in the GTA database and to distinguish GTA measures from mere announcements of intent, listed state measures need to fulfil seven different criteria. These criteria include i.a. that measures listed in the GTA database are unilateral actions, that measures lead to a meaningful change and that they trigger a credible action. Other criteria are that measures must pass a relative treatment test (2), that measures lack a higher motive (5), that measures are listed along with other measures which were covered within the same announcement (6) and that they must have been announced/ implemented after November 1st 2008 (7) (Evenett and Fritz, 2019).

16. Numbers based on author's calculations distinguishing Intervention types including "Import tariffs" and NTMs. It should be noted that these numbers are based on the original dataset and not on the restricted sample only affecting South Africa.

17. An overview of the evolution of GDP for SACU members Botswana, Lesotho, Namibia, South Africa and Swaziland is provided in the Appendix.

Results

The presentation of results is divided into three parts. Section 6.1 considers to what extent trade margins respond to demand shocks and trade policy changes at export destinations. Section 6.2 focuses on shifts of destination-specific product vectors in response to demand and trade policy shocks while section 6.3 presents the link between these shocks and aggregated firm level productivity.

Adjustment of trade margins in response to demand shocks

This section shows results on the sensitivity of export margins in response to demand shocks in conjunction with trade policy measures at the destination as presented in equations 5 and 6. Table 3 reports individual regression results of demand shocks at different levels of aggregation and their effect on the extensive and intensive margin of trade at the *firm-industry-destination* level. Interaction terms between demand shock variables and trade policy measures at the destination as described in section 4.1 are added in columns 2,3,5,6,8,9,11 and 12 respectively. While columns 1 to 6 consider changes in the extensive margin, adjustments of the intensive margin are in columns 7 to 12. For clarity and simplicity of presentation, estimates of dummy variables without interactions and standard errors are not shown.

A glance at both the extensive and intensive margin of trade shows that firms are sensitive to demand shocks at their destination regardless the shocks' level of aggregation, confirming the model implications of Mayer et al. (2016) for South African exporters. In this context, demand shocks measured as changes in import competition at the sectoral as well as firm level are positively related to trade margins at high levels of statistical significance. With respect to the magnitude of demand shocks, estimated coefficients indicate that adjustments of the extensive and intensive margin are most affected by the firm-specific shock.

Regarding the role of trade policy measures at the destination and their effect on trade margins of firms, the results show the product mix adjustment of firms is dependent on whether there are trade liberalising or restrictive measures implemented by the destination country. With respect to the extensive margin of trade, results in column 2 show that firms tend to increase the number of exported products if their respective destination is implementing trade liberalising policies. Importantly, these liberalisations -when measured at the sectoral level- are only significant when the destination country targets South Africa directly.

Inversely, if the destination country imposes trade-restricting measures the positive effect of a demand shock is mitigated. Regarding trade restrictions, which are directly targeting South Africa, the extensive margin is even shrinking (+0.0015 to - 0.0024). Moreover, the beneficial impact of positive demand shocks is reduced by trade restrictive measures imposed by the destination against all trade partners. Column 3 shows regression results of equation 6 with additional information on the precise type of trade policy measures. The coefficients indicate that the extensive margin of South African exporters is increasing less if the positive demand shock at the destination is accompanied by tariff increases for all partner countries. They also show that the extensive margin even shrinks if the positive demand shock is accompanied by trade restricting NTMs and tariff increases exclusively addressed to South African exporters (+0.0015 - 0.0010, +0.0015 -0.0035, +0.0015 -0.0025).

Table 3. Adjustment of trade margins in response to demand and trade cost shocks

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Δln EM	Δln EM	Δln EM	Δln EM	Δln EM	Δln EM	Δln IM	Δln IM	Δln IM	Δln IM	Δln IM	Δln IM
ΔS_{macro}	0.0031***	0.0032***	0.0032***	0.0035***	0.0035***	0.0035***	0.0959***	0.0984***	0.0988***	0.1002***	0.1010***	0.1009***
ΔS_i	0.0014***	0.0015***	0.0015***				0.0376***	0.0374***	0.0379***			
ΔS_i*L.ZA		0.0026*	0.0027					0.0304	-0.023			
ΔS_i*L.ZA *ntm			-0.001						0.1625			
ΔS_i*L.ZA *tariff			-0.0001						0.0554**			
ΔS_i *L.all		-.0007	-.0008					0.0203	0.0373			
ΔS_i*L.all *ntm			0.0005						0.0251			
ΔS_i*L.all *tariff			0.0002						-0.029**			
ΔS_i *L.RoW		-.0007	-.0005					-0.010	0.0015			
ΔS_i*L.RoW*ntm			0.0009*						0.0266			
ΔS_i*L.RoW*tariff			-.0004						-.0158**			
ΔS_i *R.ZA		-0.002***	-.0001					-0.005	0.0241			
ΔS_i*R.ZA *ntm			-0.003***						-0.027			
ΔS_i*R.ZA *tariff			-0.002***						-0.034**			
ΔS_i *R.all		-0.001*	-.0008					-0.011	-0.003			
ΔS_i*R.all *ntm			0.0006						-0.001			
ΔS_i*R.all *tariff			-0.001**						-0.014			
ΔS_i*R.RoW		-.0005	-.0003					-.0123	-.0097			
ΔS_i*R.RoW*ntm			0.0001						-.0041			
ΔS_i*R.RoW*tariff			-.0004						-.0058			
ΔS_f				0.0025***	0.0025***	0.0025***				0.1034***	0.097***	0.098***
ΔS_f *L.ZA					0.0133**	-.0007					0.020	0.219
ΔS_f*L.ZA *ntm						-0.026						0.367
ΔS_f*L.ZA *tariff						0.0148						-0.208

ΔSf *L.all					0.0028	-.0005					0.205 ***	0.220 **
ΔSf*L.all *ntm						0.0147*						0.145
ΔSf*L.all *tariff						0.0048						-.0307
ΔSf*L.RoW					-.0026	-0.004 *					0.108 *	0.163 **
ΔSf*L.RoW* ntm						0.0062						0.253 **
ΔSf*L.RoW* tariff						0.0018						-0.092 *
ΔSf *R.ZA					-0.010	0.0099					0.135	0.235
ΔSf*R.ZA *ntm						-0.066						-0.068
ΔSf*R.ZA *tariff						-0.020						-0.116
ΔSf *R.all					-0.005 **	-.0002					-0.061	-0.035
ΔSf*R.all *ntm						0.0055						0.042
ΔSf*R.all *tariff						-0.010 **						-0.073
ΔSf*R.RoW					-0.001	0.0005					-.0005	-.0060
ΔSf*R.RoW *ntm						0.0009						0.008
ΔSf*R.RoW *tariff						-0.002						-0.005

Note: All regressions include time dummies and industry (4-digit ISIC) fixed effects. S_i and S_f refer to demand shocks measured at the industry and firm level respectively. L and R refer to liberalising and restricting trade policy measures. Standard errors in parentheses clustered at the level of the destination country for shocks at the macro level (column 1), clustered at the industry-destination level for shocks measured at the industry level (columns 1–3, 7–9) and clustered at the firm-destination level for shocks at the firm level (columns 4–5,10–12).*** p<0.1, ** p<0.05, * p<0.01. Estimations based on 4,333,340 observations (time/firms/industries/all destinations between 2010 and 2016).

Comparing the estimation of trade cost shocks measured at the sectoral level with shocks measured at the firm level in columns 3 and 6, it can be seen that coefficients are slightly bigger in magnitude when measured at the firm level. Accordingly, the positive effect of a demand increase is bigger when trade liberalisation measures are directly affecting South African firms, while restricting measures negatively affect the extensive margin when they are imposed against South Africa and other countries.

Regarding the nature of trade policy measures, column 6 shows that the positive effect on the extensive margin of South African exporters is confirmed if improvements of NTMs are implemented by the destination country. In contrast to this finding, the positive effects turn negative if the destination country increases tariffs against South Africa and other trade partners. These findings are in line with the theoretical model laid out in section 3. Accordingly, trade liberalisations (restrictions) are lowering (raising) trade costs for South African exporters, allowing them to expand (restrain the set of products exported to these destinations.

With respect to the *intensive margin* of trade, results in column 8 show that there is no significant effect from trade cost changes when these changes are calculated at the sectoral level. Still, when considering the different nature of shocks, it turns out that the intensive margin of South African exporters increases when positive demand shocks at the destination are accompanied by declining tariffs, which are exclusively granted to South Africa. In contrast to this result, the effect of a positive demand shock is reduced if South African exporters exclusively experience an increase in tariffs at their export destination.

Moreover, the positive effect of a demand increase at the destination is mitigated if tariff reductions are granted to both South Africa and other trade partners or to other trade partners exclusively. The latter finding can be explained based on the theoretical intuition outlined in section 3.2. Accordingly, a decline in tariffs, which only favours competitors from other countries, leads to higher relative trade costs for South African firms at the destination market, thus mitigating the positive effect from a demand increase for South African exporters.

The finding that tariff reductions granted to South Africa and other trade partners mitigate the positive effect of a demand increase at the destination can be explained by the changing degree of competition triggered by tariff reductions. Consequently, a reduction of tariffs for all trade partners is leading to tougher competition at the destination market so that the intensive margin of South African exporters does not increase to the extent as in the counterfactual situation in which the positive demand shock occurs without a tariff decline.

Considering shocks measured at the firm level in columns 11 and 12, trade liberalisation measures, which are targeting all non-domestic firms as well as firms from the rest of the world exclusively, tend to confirm the beneficial effect from positive demand shocks on the intensive margin. Column 12 shows that the latter result can be interpreted as the effect of positive spillovers of a liberalisation of NTMs. This finding is in line with the theoretical intuition of section 3.2, suggesting that NTM liberalisations granted to the rest of the world exclusively are also benefiting South African exporters at the destination country through positive spillovers. Similar to the argument made in the case of demand shocks measured at the industry level, the finding of a negative effect from tariff reductions exclusively granted to the rest of the world can be explained by increasing relative trade costs for South African exporters.

These findings indicate that the extensive and intensive margin of exports are sensitive to demand shocks and that this sensitivity is magnified by trade policy measures of the destination country. In order to investigate how these destination-specific shocks affect the adjustments of the firm-specific product mix, equation 8 is estimated. For this purpose, the paper first considers the development of the Bray-Curtis measure in response to demand shocks at the destination and then interact trade shock variables with trade policy dummies.

Product mix adjustments in response to demand shocks

Table 4 presents estimations for the statistical link between demand shocks and the Bray-Curtis measure. As outlined in subsection 4.2, an increase in the Bray-Curtis measure reflects a shift of the destination-specific product vector towards a firm's core product vector, while a decrease in the Bray-Curtis measure reflects a shift away.

Regarding regressions without additional variables on trade policy measures, positive demand shocks do trigger a shift in product vectors towards the core product vector of firms. Regression results in columns 1 and 4 confirm the implications of the model of Mayer et al. (2016). Thus, positive demand shocks measured at both the industry and firm level trigger a shift of the product mix towards the core product vector of a firm. Considering the effect of positive demand shocks in conjunction with trade policy measures, estimations show that trade cost changes are affecting the extent to which firms adjust their product mix in response to demand shocks.

The interaction term in column 2 between the trade shock variable and a dummy for a trade liberalising measure, which affects all countries, indicates that liberalisation measures are further amplifying the adjustment of the product mix at both the industry and firm level. Accordingly, with an increase in competition, there is a decline in output per consumer. As explained in section 3.2, the assumption of Marshall's second law of demand implies a decline in elasticities $\epsilon_p(q_i)$ and $\epsilon_\phi(q_i)$ when there is a decline in output per consumer. Thus, the reallocation dynamics of operating profits, output and revenue towards core products are more pronounced if demand shocks are accompanied by trade liberalisation measures.

Besides the impact from trade liberalisation measures, there is an inverse effect when demand shocks are accompanied by a trade restriction. As indicated by the negative and significant coefficients of the interactions between the trade shock variable and the dummy for restrictions against the rest of the world exclusively and all countries (including South Africa), firms tend to shift their product vector less towards their core vector if the destination imposes trade restrictions. This finding is in line with the theoretical background. As trade restrictive measures represent an impediment for competition, the output per consumer is not shrinking to the extent it would have without trade measures. Following the theoretical reasoning, the decline of elasticities $\epsilon_p(q_i)$ and $\epsilon_\phi(q_i)$ is not as pronounced as in the counterfactual case without trade measures so that the adjustment of the shift of operating profits, output and revenue towards core products occurs to a smaller degree.

Focusing on the role of different types of trade liberalisation and restrictions as NTMs or tariff changes, results in column 3 show that South African firms tend to shift their export product mix more towards their core product vector if the demand shock is accompanied by a tariff reduction that is exclusively addressing South African exporters. Similar to the previous explanation, this result can be interpreted as an increase in competition through additional South African varieties at the destination thus magnifying the shift of the product mix towards the core product vector.

In contrast to this result, tariff reductions granted to all countries mitigates the shift of the export product mix of South African firms towards their respective core product vectors. At first glance, this finding is in conflict with the underlying theoretical mechanism outlined in section 3.2. Generally, lower tariffs for all importers into the destination should further spur competition so that there is less output per consumer, that is, in turn, leading to a decline of elasticities $\epsilon_p(q_i)$ as well as $\epsilon_\phi(q_i)$ and ultimately leads to a reallocation of operating profits, output and revenue towards the core product vector. This result can be explained in conjunction with findings regarding trade margins of South African exporters. As indicated by the results in Table 3 on the intensive trade margin, South African exporters further decrease exports of products when demand shocks at the destination are accompanied by tariff reductions targeting all importers. Related to this finding, results in column 3 of Table 4 suggest that the shift towards the core product vector is mitigated by the fact that South African firms decrease sales of their core products when tariff reductions at the destination target both South African firms and other competitors.

Considering estimation results of shocks measured at the firm-specific level in columns 4 to 6, results confirm that positive demand shocks occurring along with trade liberalisations for all partner countries magnify the shift of the product mix towards the respective core product vector of a firm. South African firms shift their product mix towards their core product vectors when they face a demand shock at their export destination in conjunction with NTM liberalisations (column 5 and 6). Given the fact that NTM liberalisations might facilitate trade at the destination for all importers, it fosters competition at the destination thus triggering a stronger reallocation of operating profits, output and revenue towards the core product vector compared to a situation without a liberalisation of NTMs.

In contrast to these effects, the shift of the product vector towards core products is mitigated if positive demand shocks occur along with tariff reductions for all trade partners or the rest of the world exclusively. As argued before, these findings are in conflict with the theoretical mechanism as tariff reductions should foster competition and hence the reallocation of products towards the core product vector rather than mitigating the product shift. Still, in line with findings concerning trade margins, tariff reductions in favour of the rest of the world lower the intensive margin of South African firms, which might be an explanation for the less pronounced shift of the product vector towards core products compared to a counterfactual situation without any trade policy measure at the destination.

Table 4. Product mix adjustments in response to demand and trade cost shocks

	(1)	(2)	(3)	(4)	(5)	(6)
	ΔBray-Curtis	ΔBray-Curtis	ΔBray-Curtis	ΔBray-Curtis	ΔBray-Curtis	ΔBray-Curtis
ΔSmacro	0.0292**	0.0291**	0.0290**	0.0298**	0.0298**	0.0299**
ΔSi	0.0084***	0.0086***	0.0087***			
ΔSi *L.ZA		0.0066	-0.0049			
ΔSi *L.ZA*ntm			-0.0055			
ΔSi *L.ZA*tariff			0.0120**			
ΔSi *L.all		0.0072***	0.0116***			
ΔSi *L.all*ntm			0.0047			
ΔSi *L.all*tariff			-0.0072**			
ΔSi *L.RoW		-0.0051	-0.0018			
ΔSi *L.RoW*ntm			0.0012			
ΔSi *L.RoW*tariff			-0.0039			
ΔSi *R.ZA		0.0018	-0.0012			
ΔSi *R.ZA*ntm			-0.0065			
ΔSi *R.ZA*tariff			0.0038			
ΔSi *R.all		-0.0078**	-0.0069			
ΔSi *R.all*ntm			-0.0003			
ΔSi *R.all*tariff			-0.0017			
ΔSi *R.RoW		-0.0049*	-0.0050*			
ΔSi *R.RoW*ntm			-0.0009			
ΔSi *R.RoW*tariff			-0.0001			
ΔSf				0.0246***	0.0235***	0.0238***
ΔSf *L.ZA					0.0136	0.0550
ΔSf *L.ZA*ntm						0.1856***
ΔSf *L.ZA*tariff						-0.0438
ΔSf *L.all					0.0628***	0.0822***
ΔSf *L.all*ntm						0.0657
ΔSf *L.all*tariff						-0.0371*
ΔSf *L.RoW					0.0030	0.0284
ΔSf *L.RoW*ntm						0.0612**
ΔSf *L.RoW*tariff						-0.0373**
ΔSf *R.ZA					0.0354	0.1021***
ΔSf *R.ZA*ntm						-0.0047
ΔSf *R.ZA*tariff						-0.0756
ΔSf *R.all					-0.0149	0.0021
ΔSf *R.all*ntm						-0.0083
ΔSf *R.all*tariff						-0.0267
ΔSf *R.RoW					-0.0037	-0.0087
ΔSf *R.RoW*ntm						0.0084
ΔSf *R.RoW*tariff						0.0038
Observations	4,596,069	4,596,069	4,596,069	4,596,069	4,596,069	4,596,069
FE	yes	yes	yes	yes	yes	yes
Year-Dummies	yes	yes	yes	yes	yes	yes
Cluster	yes	yes	yes	yes	yes	yes

Note: All regressions include time and firm-destination-industry (4-digit ISIC) fixed effects. Standard errors in parentheses clustered at the level of the destination country.*** p<0.1, ** p<0.05, * p<0.01. Estimations based on 4,596,069 observations (time/firms/industries for all destinations between 2010 and 2016).

As outlined in the introduction, the dynamics identified in this section suggest important *within*-firm adjustments towards a more efficient allocation of production factors. To assess how these *within*-firm adjustments translate into productivity changes at the aggregated firm level, the subsequent section considers the link between demand as well as trade policy shocks, within-firm adjustments and firm productivity.

Effects on aggregated firm productivity

The evaluation of *within*-firm adjustments and their effect on firm level productivity is based on equation 8. Thus, firm level productivity changes are regressed on aggregated demand and trade cost shocks measured at the firm level, as well as controls for material use and capital per employee.[18] As the firm-specific demand shock represents the most precise measure of our shock variable, only firm-specific demand shocks are considered in our further regressions on firm level productivity. Firm level productivity is measured as deflated value added per employee and demand shock variables are weighted by the firm's export intensity. Results are shown in table 5.[19]

As expected in this specification, capital and material use are linked positively and significantly with firm-level productivity. Moreover, the overall demand shock variable is positively and significantly related to a productivity increase, confirming the theoretical implication of Mayer et al. (2016).

Our extension of the model to consider demand shocks at the destination in conjunction with trade policy measures shows mixed results. The positive estimate of the interaction between the demand shock at the destination and the dummy for NTM restrictions against all countries implies a productivity increase for South African exporters. This finding is in conflict with the mechanism outlined in section 3.2 as stricter NTMs hinder competition and hence the within-firm adjustment to shift production capacities to the core products and should thus not lead to a productivity increase. Still, this variable is only significant at the 10% level so that this result might also be caused by interactions of different aggregated trade measures at the firm level.

Looking at the estimations for interaction term between demand shock variables and tariff changes affecting foreign competitors at the destination, results indicate that the positive effect of the demand shock is reinforced for South African exporters if tariff increases are implemented against the rest of the world. For South African firms, tariff increases for the rest of the world imply a reduction in relative trade costs so that South African exporters can expand their product portfolio, that is, there is more competition in the market due to an increasing number of South African varieties on the market of the destination country. Given the theoretical reasoning, this increase in competition leads to a shift towards the core product vector of a firm and ultimately leads to higher productivity.

18. To demonstrate that the result of a positive and significant link between the demand shock measured at the firm level and the Bray-Curtis measure is still maintained at the aggregated level, the regression of equation 5 (with the Bray-Curtis measure as dependent variable) is performed at the aggregated firm level. Even though estimates of demand shocks measured at the macro and sectoral level are at odds with previous findings, the demand shock measured at the most precise firm level is confirmed.

19. As a robustness check a simple regression including demand and trade cost shocks has been implemented based on data of single product firms. Estimation results are not significant regardless of the precise specification of the regression. Results are provided in the Appendix.

Table 5. Productivity changes in response to demand and trade cost shocks

	(1)	(2)
	Δ log productivity	Δ log productivity
Δ Shockmacro		-0.0098**
		(0.004)
Δ log Capital p. Empl.	0.0755***	0.0754***
	(0.006)	(0.006)
Δ log Material	0.1980***	0.1976***
	(0.015)	(0.015)
Δ Shockfirm	0.0076***	0.0107***
	(0.003)	(0.003)
Δ Shockfirm*lib.	0.0014	0.0026
	(0.004)	(0.005)
Δ Shockfirm*lib.ZA*ntm		0.0233
		(0.078)
Δ Shockfirm*lib.all*ntm		-0.0059
		(0.015)
Δ Shockfirm*lib.RoW*ntm		-0.0111
		(0.014)
Δ Shockfirm*lib.ZA*tariff		0.0047
		(0.008)
Δ Shockfirm*lib.all*tariff		-0.0063
		(0.009)
Δ Shockfirm*lib.RoW*tariff		0.0118*
		(0.007)
Δ Shockfirm*restr.	-0.0047	-0.0050
	(0.003)	(0.004)
Δ Shockfirm*restr.ZA*ntm		-0.0106
		(0.036)
Δ Shockfirm*restr.all*ntm		0.0160*
		(0.009)
Δ Shockfirm*restr.RoW*ntm		-0.0121*
		(0.007)
Δ Shockfirm*restr.ZA*tariff		0.0040
		(0.011)
Δ Shockfirm*restr.all*tariff		-0.0168**
		(0.007)
Δ Shockfirm*restr.RoW*tariff		0.0137**
		(0.006)

Note: All regressions include industry-year dummies and firm fixed effects. Standard errors clustered at the firm level in parentheses.*** p<0.1, ** p<0.05, * p<0.01. Estimations based on 35,777 observations.

Moreover, a decline in tariffs granted to the rest of the world exclusively tends to magnify the positive effect of a demand shock. Even though this variable was not statistically significant at the less aggregated firm-industry-destination level, it can be argued theoretically that this trade policy measure spurs competition thus also reinforcing the adjustment mechanism highlighted before.

By contrast to trade liberalisation measures, trade restrictive measures mitigate the positive effect from demand shocks. In this context, interactions between the demand shock variable and dummies for restrictive NTMs and tariff increases against all countries negatively influence firm level productivity. Following the theoretical reasoning, these measures impose an impediment for competition thus limiting the product mix adjustment of firms and thus the within-firm reallocation of factors.

Conclusion

This paper aimed at investigating the link between demand shocks at export destinations and the product mix and productivity of South African multi-product exporters between 2010 and 2016. In particular, the role of trade liberalisations and restrictions as amplifiers for positive demand shocks in export destinations is investigated.

The findings suggest that South African manufacturing exporters who experienced a positive demand shock at their export destination were benefiting from a slight productivity increase by shifting their export product mix towards their core product vector. At the disaggregated firm-industry-destination level, how trade policy measures at the export destination alter the underlying adjustment dynamics is analysed.

For this purpose, the study builds on the model of Mayer et al. (2016) and shows theoretically and empirically that South African firms benefit from trade liberalisation measures at their export destinations. A positive effect is identified on both the extensive and intensive margin when there is a positive demand shock accompanied by trade liberalisations at the destination vis-à-vis South Africa and other countries. Against this background, it is shown that such trade shocks trigger a shift of the product mix of firms towards their core products. Conversely, trade restrictions tend to negatively affect the extensive margin of South African manufacturing exporters and reduce the adjustment of the product mix towards a firm’s core products.

In addition, the liberalisation of tariffs is reinforcing within-firm adjustments only if they are directly addressed to South African exporters. By contrast, the paper finds that a decline in NTMs magnifies the effect from positive demand shocks at trade margins thus highlighting positive spillover effects of NTM liberalisations.

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Annex

A. Detailed Summary of Mayer et al. (2016)

Following the model structure of Mayer et al. (2016), the adjustment mechanism of the product mix in response to a positive demand shock is first outlined in a closed economy setting and later expanded to an open economy framework.

Closed Economy

On the demand side, there is additively separable utility over a continuum of imperfectly substitutable goods indexed by $i \in [0, M]$. The respective utility maximisation problem of consumers hence reads:

$$max \int_0^M u(q_i) di s.t. \int_0^M p_i q_i di = 1$$

With sub-utility $u(q_i) \geq 0$ and $q_i = 0$ as well as $u'(q_i) > 0$ and $u''s(q_i) \geq 0$.

The inverse residual demand function per consumer is given by the first order condition of the utility maximisation problem.

$$p(q_i) = \frac{u'(q_i)}{\lambda} \quad \text{(A.1)}$$

Importantly, $\lambda = \int_0^M u'(q_i) q_i di > 0$ is the marginal utility of income and serves as unique endogenous aggregate demand shifter. Accordingly, a higher λ is shifting residual demand curves inwards and thus represents an increase in competition for a fixed level of market demand L^c. Moreover, the residual demand implies the following curve of marginal revenue.

$$\phi(q_i) = \frac{u'(q_i + u''(q_i))}{\lambda} \quad \textit{(A.2)}$$

Based on equations 1 and 2, it is possible to derive the elasticities of inverse demand and marginal revenue denoted in absolute values:

$$\epsilon_p = -p'(q_i)q_i/p(q_i) \; and \, \epsilon_\phi = -\phi'(q_i)q_i/\phi(q_i)$$

These elasticities capture the sensitivity of prices as well as marginal revenue in response to changes in quantities (Melitz, 2018).

On the supply side, there is a monopolistically competitive market structure. The only production factor is labour, which also serves as numeraire. Firms are either single- or multi-product producers and supply a countable number of products. Each product is supplied by a single firm and technology exhibits increasing returns to scale with fixed cost *f* and constant marginal cost of production *v* per product. To enter the market, firms pay a sunk cost f^e. After having paid the fixed entry cost, firms draw the marginal cost for their core product *c,* which gives producers the exclusive blueprint to produce their core product plus a countable range of additional products indexed by *m*. In line with the previously mentioned heterogeneity of product efficiency within firms, it is assumed that the production of varieties beyond the core competency of a firm triggers additional cost. Consequently, it holds that $v(m, c) = cz(m)$ with z(0) = 1 for the core competency indexed by 0 and $z'(m) > 0$.

In this setting, the profit maximisation problem of a firm given the marginal cost *v* for its product and competition level λ equalises marginal revenue and marginal cost. This optimisation leads to an optimal output per consumer $q(v,\lambda)$ along with a profit-maximising price consisting of the marginal cost plus a markup: $p(q(v,\lambda)) = \mu(q(v,\lambda))v$ where $\mu(q_i) = 1/(1-\epsilon_p(q_i))$. The resulting performance measures (on the product level) for total product level sales and net profits hence read:

$L^c r(v,\lambda) = L^c[p(q(v,\lambda))q(v,\lambda)]$ and $L^c\pi(v,\lambda) = L^c[(p(v,\lambda)-v)q(v,\lambda)-f]$.

By using the first order condition, which equalises marginal revenue and marginal cost, together with the expression of marginal revenue and the markup, it is possible to express the elasticities of all product level performance measures in terms of the elasticity of demand and the elasticity of marginal revenue. Thus the elasticity of output, revenue and profit with respect to marginal cost v and competition λ read as follows.

$$\begin{aligned} \varepsilon_{q,v} &= -\frac{1}{\varepsilon_\phi}, & \varepsilon_{q,\lambda} &= -\frac{1}{\varepsilon_\phi} \\ \varepsilon_{r,v} &= -\frac{1-\varepsilon_p}{\varepsilon_\phi}, & \varepsilon_{r,\lambda} &= -\frac{1-\varepsilon_p}{\varepsilon_\phi} - 1 \\ \varepsilon_{\pi,v} &= -\frac{1-\varepsilon_p}{\varepsilon_p}, & \varepsilon_{\pi,\lambda} &= -\frac{1}{\varepsilon_p} \end{aligned} \tag{A.3}$$

Given these elasticities, higher competition is associated with lower output, revenue and profit while lower marginal costs are associated with higher output, revenue and profit. For a non-negative net profit, there is a unique cutoff cost level $\hat{v}$ resulting from the following equation.

$$\pi(\hat{v},\lambda)L^c = f \tag{A.4}$$

Thus, products with lower marginal cost than the cutoff will be produced. A firm with $c \le \hat{c}$ hence produces $M(c) = max\{m|cz(m) \le \hat{v}\}$ additional varieties.

Partial Equilibrium

To obtain both equilibrium cutoffs, $\hat{v} = \hat{c}$, and the relevant competition level λ, the model can be considered in the long run as well as in the short run. In the following, the short-run equilibrium is derived. Mayer et al. (2016) show the long-run equilibrium.

Regarding the short-run equilibrium, the profit cutoff of equation 4 is strictly binding so that all firms with marginal cost below the cutoff produce the core competency and stay in the market while other firms exit.

Consumers decide on how to distribute their income over all varieties available. This leads to the following budget constraint which is used along with the cutoff conditions of equation 4 to determine the endogenous equilibrium cutoffs $\hat{v} = \hat{c}$ and the competition level λ.

$$\overline{N} = \{\sum_{m=0}^{\infty}[\int_0^{\hat{c}/z(m)} r(cz(m),\lambda)d\Gamma(c)]\} = 1 \tag{A.5}$$

To demonstrate the effect of a positive demand shock, it is necessary to consider equation 4.

Accordingly, an increase in demand L^c leads to an increase in competition λ: profits for all products increase along with demand leading to an increase in the cutoffs $\hat{v} = \hat{c}$. Consequently, in the short run, competition increases because of new varieties on the market. This increase in competition leads to a decline in output sales per consumer. How this decline in output per consumer translates into changes of the elasticity of output, revenue and profit is determined by the elasticity of inverse demand, ϵ_p, and marginal revenue, ϵ_ϕ, which in turn depends on particular assumptions on demand.

At this point, it is crucial to assume that demand conditions follow Marshall's second law of demand.

The assumption that Marshall's second law of demand holds implies that the inverse price elasticity of demand increases with the quantity consumed.

This specification triggers I) $\epsilon_p'(q_i) > 0$ and II) $\epsilon_\phi'(q_i) > 0$ for $q_i \geq 0$.

Both I) and II) are crucial determinants for the model implications with respect to the reallocation of profit, output and revenue towards better performing products. To outline these dynamics, the model considers two products 1 and 2 produced by a firm for which it holds that product 1 is a better performing product than product 2 ($v_1 < v_2$). As stated before, the increase in competition in response to a positive demand shock leads to lower output sales per consumer. Given I) and II), it can be concluded that an increase in competition leads to a decline in elasticities, ϵ_p and ϵ_ϕ. These dynamics trigger three important implications for the elasticities of firm performance indicators depicted in equation 3.

Implication 1: Regarding **operating profits**, $\pi(v_1, \lambda)/\pi(v_2, \lambda)$ increases as $|\epsilon_{\pi,v}|$ increases. As the latter only holds true if $\epsilon_p(q_i)$ *de*creases, I) can be seen as necessary and sufficient condition for the reallocation of operating profits towards better performing products in response to a positive demand shock.

Implication 2: Regarding **output**, $q(v_1, \lambda)/q(v_2, \lambda)$ increases as $|\epsilon_{q,v}|$ increases. As the latter only holds true if $\epsilon_\phi(q_i)$ *de*creases, II) can be seen as necessary and sufficient condition for the reallocation of output towards better performing products in response to a positive demand shock.

Implication 3: Regarding **revenues**, $r(v_1, \lambda)/r(v_2, \lambda)$ increases as $|\epsilon_{r,v}|$ increases. As the latter only holds true if $[1 - \epsilon_p(q_i)]/\epsilon_\phi(q_i)$ *in*creases, II) can be seen as sufficient condition for the reallocation of revenue towards better performing products in response to a positive demand shock.

Open Economy

In the open economy setting, there are three countries home (H, South Africa), a rest of the world (R) and a destination country D indexed by $l \in \{H, R, D\}$. It is assumed that exporting to D incurs fixed export cost f_{lD} as well as per-unit iceberg cost $\tau_{lD} > 1$ with particular assumptions for domestic producers who face $\tau_{DD} = 1$ and $f_{DD} < f_{lD}$. Product ladder cost, entry cost and the distribution of core competencies can vary arbitrarily across countries. Model implications regarding the optimal output, operating profit and revenue functions presented under the closed economy setting also apply to the open economic framework. For firms to be able to operate on the market of the destination country D, there are three new zero profit cutoffs:

$$\pi(\tau_{lD}\hat{v}_{lD}, \lambda_D) = f_{lD}, l \in \{H, R, D\} \tag{A.6}$$

Consequently and in line with the implication of the closed economy, products from l with $v \leq \hat{v}_{lD}$ are sold in D. If marginal cost of the core competency is above the cutoff, a firm is not present in export market D ($c \leq \hat{c}_{lD} = \hat{v}_{lD}$).

Similar to the short run scenario in the closed-economy framework, consumers in D split their income across both imported and domestically produced goods. The budget constraint hence reads:

$$\sum_{l=H,R,D} (\overline{N}_D = \{\sum_{m=0}^{\infty} [\int_0^{\hat{c}_{lD}/z_l(m)} r(\tau_{lD} c z_l(m), \lambda_D) d\Gamma_l(c)]\}) = 1 \tag{A.7}$$

Thus, the consumer budget constraint along with cutoff-profit conditions for countries H, R and D jointly determine the competition level as well as the equilibrium cutoffs for firm entry into D. Like in the closed economy case, an increase in demand L_D^c leads to an increase in competition λ_D so that all reallocation dynamics of output, profit and revenue also apply in the setting of the open economy.

B. Overview of Trade Interventions in the Global Trade Alert Database

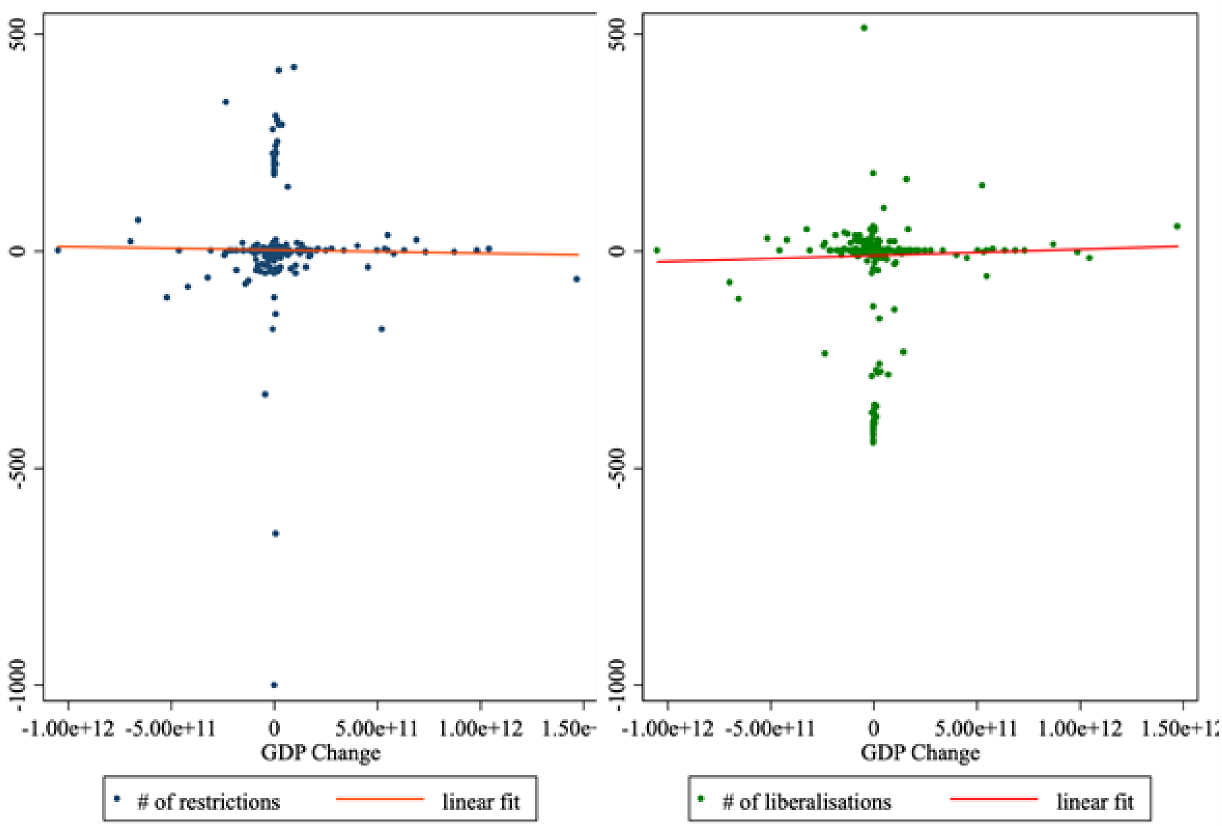
Table 6. Examples of Trade Interventions in the Global Trade Alert Database

GTA Evaluation	Intervention Type	Countries
Amber	Anti-dumping	Brazil
Amber	Capital injection/equity stakes	Denmark/Norway/Sweden
Amber	Consumption subsidy	Japan
Amber	Control on personal transactions	Russia:
Amber	Controls on credit operations	Austria
Amber	FDI: Entry and ownership rule	Mexico
Amber	FDI: Financial incentive	Vietnam
Amber	FDI: Treatment and operations	France
Amber	Import ban	USA
Amber	Import licensing requirement	Malaysia
Amber	Import monitoring	USA
Amber	Import quota	EC
Amber	Import tariff	EC
Amber	Intellectual property protection	Indonesia
Amber	Interest payment subsidy	Russia
Amber	Internal taxation of imports	Indonesia
Amber	Local labour	USA
Amber	FDI: Financial incentive	Vietnam
Amber	Local operations	France
Amber	Local sourcing	Australia
Amber	Localisation incentive	Australia
Amber	Price stabilisation	Brazil
Amber	Production subsidy	Russia
Amber	Public procur. localisation	USA
Amber	Public procur. preference margin	UK
Amber	Sanitary/phytosanitary measure	Republic of Korea
Amber	Technical barrier to trade	India
Green	Anti-dumping	South Africa
Green	Anti-subsidy	Canada
Green	Capital injection/ equity stakes	Romania
Green	FDI: Entry and ownership rule	Turkey
Green	FDI: Financial incentive	Japan
Green	FDI: Treatment/operations	Indonesia
Green	Financial assist. in foreign market	Japan
Green	Financial grant	Costa Rica

Source: Global Trade Alert Database (Evenett and Fritz, 2019).

C. Correlation between GDP Changes and the Number of Trade Interventions

Figure 1. Correlation between the change of GDP and the number of trade policy interventions



Source: World Bank (2019b); the Global Trade Alert Database (Evenett and Fritz, 2019).

D. Data Cleaning Strategy

In order to trace firms for which adjustments of the product mix can be matched with information on sales and employment, only active firms in the customs raw dataset are kept. Active firms are defined as firms which have sales as well as labour cost and are non-dormant between 2010 and 2017.

All unclassified shipments and re-exports are dropped from our sample. To only observe exports of products, which are actually produced by South African firms, two criteria are set:

- First, values lower than 500 euros per month are dropped.
- Second, manufacturing exporters are separated from retailers by looking at the different industries across which a firm is exporting. Accordingly, the 21 HS sections firms across which firms are exporting are considered. To assume that exported goods are indeed manufactured by the indicated exporting firm, only those firms are kept which are exporting across only certain HS sections. To account for the fact that exports in one HS section are not necessarily excluding exports in a related HS section, some sections are merged.

The complete list of joint HS sections is given below.

Table 7. Summary of HS sections

Original HS section	Description	Adjusted HS section
1	live animals/ products	1
2	vegetabkle products	1
3	animal/vegetable oil, fats, waxes	1
4	prep. food/ beverages/tobacco	1
5	mineral products	5
6	chemicals/ allied industries	6
7	plastics	7
8	hides/ skins	8
9	woods	9
10	pulp of wood	9
11	textiles	8
12	footwear/ headgear	8
13	art. stones	13
14	pearls/ imitation of juwelery, stones	14
15	base metals, articles of steel/ iron	15
16	machinery, mechanical appliances	15
17	vehicles, aircraft	15
18	optical, photographic, clocks, watches	15
19	arms and amunition	19
20	manufacturing misc.	15
21	works of art collectors	21

Source: Authors' presentation based on information on HS sections from UN Comtrade (2019).

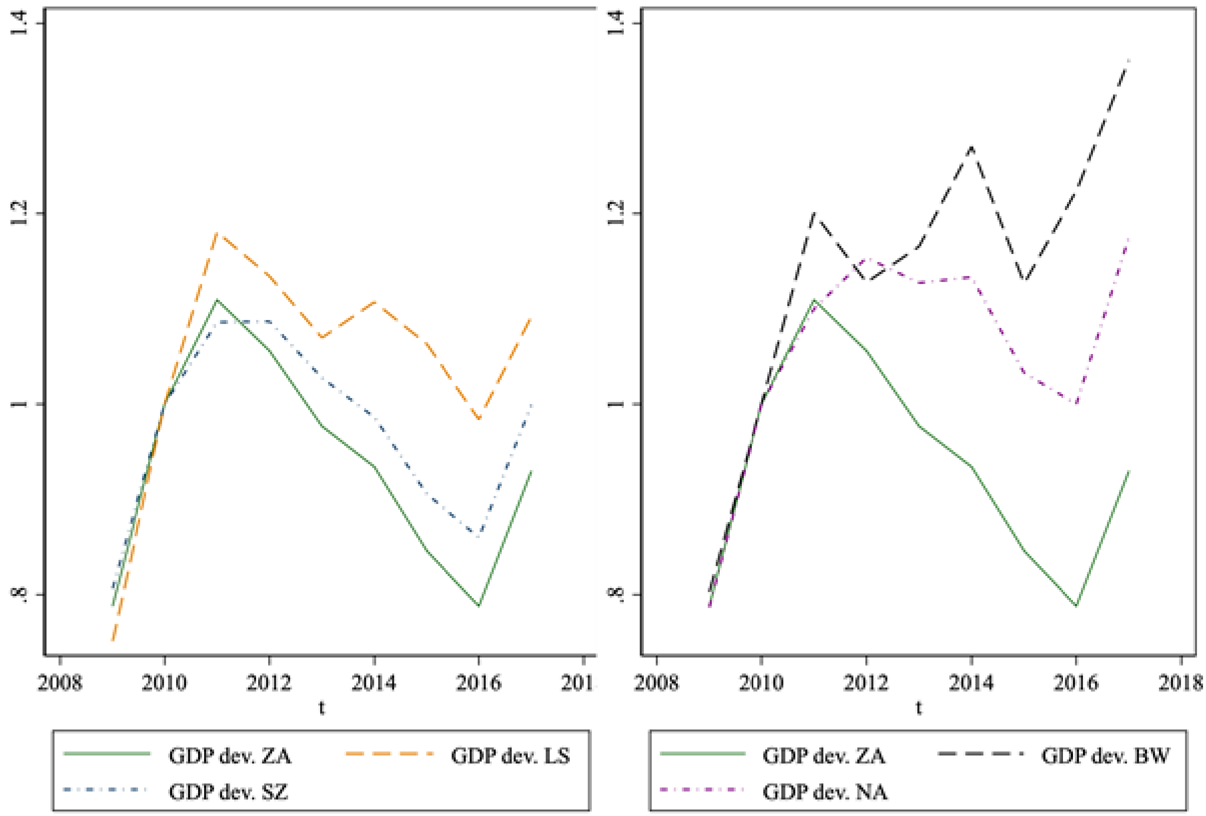
To ensure a consistent classification of remaining HS6 products all HS codes are transformed in HS6 revision 2007.

Given that the consideration of firm-specific product vectors requires to precisely track the exports of individual products over time, products are dropped in cases for which the original HS code corresponds to more than one HS code of revision 2007.

As industry codes were initially in conflict with the set of products exported by firms when we first accessed the database, the industry of a firm is based on the industry of the product with the highest revenue share in the export product mix over time. This procedure finally allows us to trace dynamics at the firm-industry-destination level with 4-digit ISIC industries (revision 3).

E. Evolution of GDP of SACU members

Figure 2. Development of GDP of SACU members



Note: This graph shows the development of GDP (constant 2010 USD) for SACU members (index 2010 =1).
Source: World Bank (2019a), series NY.GDP.MKTP.KD.

F. Detailed regression tables

Table 8. Adjustment of trade margins in response to demand and trade shocks (all estimates – industry level shock)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	ΔEM	ΔEM	ΔEM	ΔEM	ΔIM	ΔIM	ΔIM	ΔIM
ΔShmacro	0.0038**	0.0031***	0.0032***	0.0032***	0.1157**	0.0959***	0.0984***	0.0988***
ΔShisic		0.0014***	0.0015***	0.0015***		0.0376***	0.0374***	0.0379***
lib.ZAisic			-0.0011**	-0.0023*			-0.0152	-0.0091
lib.ZA∗Shisic			0.0026*	0.0027			0.0304	-0.0234
lib.ntmZAisic				-0.0002				0.0104
lib.ntm.ZA*ΔShisic				-0.0011				0.1625
lib.tariffZAisic				0.0013				-0.0070
lib.tariff.ZAisic				-0.0001				0.0554**
lib.allisic			0.0001	0.0001			0.0002	0.0001
lib.all*ΔShisic			-0.0007	-0.0008			0.0203	0.0373
lib.ntm.all*isic				-0.0000				-0.0144*
lib.ntm.all*ΔShisic				0.0005				0.0251
lib.tariff.all*isic				0.0000				-0.0012
lib.tariff.all*ΔShisic				0.0002				-0.0292**
lib.RoWisic			0.0001	-0.0001			0.0081**	-0.0011
lib.RoW*ΔShisic			-0.0007	-0.0005			-0.0104	0.0015
lib.ntm.RoWisic				-0.0002				-0.0142**
lib.ntm.RoW*ΔShisic				0.0009*				0.0266
lib.tariff.RoWisic				0.0003**				0.0108***
lib.tariff.RoW*ΔShisic				-0.0004				-0.0158**
restr.ZAisic			-.0013***	-0.0016			-0.027***	-0.0230
restr.ZA*ΔShisic			-0.002***	-0.0001			-0.0059	0.0241
restr.ntm.ZAShisic				-0.0004				-0.0024
restr.ntm.ZA*ΔShisic				-0.003***				-0.0276
restr.tariffZAisic				0.0003				-0.0059
restr.tariffZA*ΔShisic				-0.002***				-0.0343**
restr.allisic			-0.0001	0.0001			-0.0108**	-0.0034
restr.all*ΔShisic			-0.0013*	-0.0008			-0.0113	-0.0037
restr.ntm.allisic				-0.0003*				-0.0077*
restr.ntm.all*ΔShisic				0.0006				-0.0013
restr.tariff.allisic				-0.0002				-0.0092
restr.tariff.all*ΔShisic				-0.0010**				-0.0143
restr.RoWisic			-0.0001	-0.0004**			-0.0019	-0.0080**
restr.RoW*ΔShisic			-0.0005	-0.0003			-0.0123	-0.0097
restr.ntm.RoWisic				0.0001				-0.0020
restr.ntm.RoW*ΔShisic				0.0001				-0.0041
restr.tariff.RoWisic				0.0004***				0.0073**
restr.tariffRoW*ΔShisic				-0.0004				-0.0058
FE	ind.	ind.	ind.	ind.	ind.	ind.	ind.	ind.
Year-Dummies	yes	yes	yes	yes	yes	yes	yes	yes
Cluster	yes	yes	yes	yes	yes	yes	yes	yes

Note: All regressions include time dummies and industry (4-digit ISIC) fixed effects. Standard errors in parentheses clustered at the level of the destination country for shocks at the macro level (column 1) and clustered at the industry-destination level for shocks measured at the industry level.*** p<0.1, ** p<0.05, * p<0.01. Estimations based on 4,333,340 observations (time/firms/industries/all destinations between 2010 and 2016).

Table 9. Adjustment of trade margins in response to demand and trade cost shocks (All estimates –firm level shock)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	ΔEM	ΔEM	ΔEM	ΔEM	ΔIM	ΔIM	ΔIM	ΔIM
ΔShmacro	0.0038**	0.0035***	0.0035***	0.0035***	0.1157**	0.1002***	0.1010***	0.1009***
ΔShfirm		0.0025***	0.0025***	0.0025***		0.1034***	0.0977***	0.0987***
lib.ZAfirm			-0.0049*	-0.0044			-0.0088	0.1926
lib.ZA∗Shfirm			0.0133**	-0.0007			0.0202	0.2194
lib.ntm.ZAfirm				-0.0407				-0.3090
lib.ntm.ZA*ΔShfirm				-0.0268				0.3678
lib.tariff.ZAfirm				-0.0006				-0.2081
lib.tariff.ZAfirm				0.0148				-0.2086
lib.RoWfirm			-0.0005	0.0005			0.0179	0.0260
lib.RoW*ΔShfirm			-0.0026	-0.0042*			0.1084*	0.1634**
lib.ntm.RoWfirm				-0.0002				-0.0353
lib.ntm.RoW*ΔShfirm				0.0062				0.2532**
lib.tariff.RoWfirm				-0.0013				-0.0082
lib.tariff.RoW*ΔShfirm				0.0018				-0.0924*
lib.allfirm			-0.0001	0.0012			0.0197	-0.0105
lib.all*ΔShfirm			0.0028	-0.0005			0.2057***	0.2203**
lib.ntm.all*firm				0.0007				0.0798*
lib.ntm.all*ΔShfirm				0.0147*				0.1452
lib.tariff.all*firm				-0.0019				0.0303
lib.tariff.all*ΔShfirm				0.0048				-0.0307
restr.ZAfirm			-0.009***	-0.0058			-0.119***	0.0220
restr.ZA*ΔShfirm			-0.0100	0.0099			0.1352	0.2354
restr.ntm.ZAShfirm				-0.0094				-0.1068
restr.ntm.ZA*ΔShfirm				-0.0663				-0.0681
restr.tariff.ZAfirm				-0.0042				-0.1559*
restr.tariff.ZA*ΔShfirm				-0.0207				-0.1160
restr.allfirm			-0.0012	-0.0004			-0.0433**	-0.0067
restr.all*ΔShfirm			-0.0057**	-0.0002			-0.0619	-0.0356
restr.ntm.allfirm				-0.005***				-0.0568*
restr.ntm.all*ΔShfirm				0.0055				0.0420
restr.tariff.allfirm				0.0003				-0.0391
restr.tariff.all*ΔShfirm				-0.0102**				-0.0739
restr.RoWfirm			-0.0002	0.0012			0.0105	0.0045
restr.RoW*ΔShfirm			-0.0011	0.0005			-0.0005	-0.0060
restr.ntm.RoWfirm				-0.0013				-0.0176
restr.ntm.RoW*ΔShfirm				0.0009				0.0088
restr.tariff.RoWfirm				-0.0016				0.0137
restr.tariffRoW*ΔShfirm				-0.0025				-0.0055
FE	ind.	ind.	ind.	ind.	ind.	ind.	ind.	ind.
Year-Dummies	yes	yes	yes	yes	yes	yes	yes	yes
Cluster	yes	yes	yes	yes	yes	yes	yes	yes

Note: All regressions include time dummies and industry (4-digit ISIC) fixed effects. Standard errors in parentheses clustered at the level of the destination country for shocks at the macro level (column 1) and clustered at the firm-destination level for shocks at the firm level.*** $p<0.1$, ** $p<0.05$, * $p<0.01$. Estimations based on 4,333,340 observations (time/firms/industries/all destinations between 2010 and 2016).

Table 10. Product mix adjustments in response to demand and trade cost shocks (All estimates – industry level shock)

	(1)	(2)	(3)	(4)
	ΔBray-Curtis	ΔBray-Curtis	ΔBray-Curtis	ΔBray-Curtis
ΔShmacro	0.0337**	0.0292**	0.0291**	0.0290**
ΔShisic		0.0084***	0.0086***	0.0087***
lib.ZAisic			-0.0221	-0.0246*
lib.ZA∗Shisic			0.0066	-0.0049
lib.ntmZAisic				0.3044***
lib.ntm.ZA*ΔShisic				-0.0055
lib.tariffZAisic				-0.0004
lib.tariff.ZAisic				0.0120**
lib.allisic			-0.0139	-0.0155
lib.all*ΔShisic			0.0072***	0.0116***
lib.ntm.all*isic				-0.0046
lib.ntm.all*ΔShisic				0.0047
lib.tariff.all*isic				0.0019
lib.tariff.all*ΔShisic				-0.0072**
lib.RoWisic			0.0166*	0.0154*
lib.RoW*ΔShisic			-0.0051	-0.0018
lib.ntm.RoWisic				0.0093
lib.ntm.RoW*ΔShisic				0.0012
lib.tariff.RoWisic				0.0000
lib.tariff.RoW*ΔShisic				-0.0039
restr.ZAisic			-0.0170	0.0197
restr.ZA*ΔShisic			0.0018	-0.0012
restr.ntm.ZAShisic				-0.0045
restr.ntm.ZA*ΔShisic				-0.0065
restr.tariffZAisic				-0.0393
restr.tariffZA*ΔShisic				0.0038
restr.allisic			0.0157	0.0183*
restr.all*ΔShisic			-0.0078**	-0.0069
restr.ntm.allisic				-0.0041
restr.ntm.all*ΔShisic				-0.0003
restr.tariff.allisic				-0.0069
restr.tariff.all*ΔShisic				-0.0017
restr.RoWisic			0.0035	0.0037
restr.RoW*ΔShisic			-0.0049*	-0.0050*
restr.ntm.RoWisic				-0.0012
restr.ntm.RoW*ΔShisic				-0.0009
restr.tariff.RoWisic				-0.0027
restr.tariff.RoW*ΔShisic				-0.0001
FE	yes	yes	yes	yes
Year-Dummies	yes	yes	yes	yes
Cluster	yes	yes	yes	yes

Note: All regressions include time and firm-destination-industry (4-digit ISIC) fixed effects. Standard errors in parentheses clustered at the level of the destination country.*** p<0.1, ** p<0.05, * p<0.01. Estimations based on 4,596,069 observations (time/firms/industries for all destinations between 2010 and 2016).

Table 11. Product mix adjustments in response to demand and trade cost shocks (All estimates – firm level shock)

	(1)	(2)	(3)	(4)
	ΔBray-Curtis	ΔBray-Curtis	ΔBray-Curtis	ΔBray-Curtis
ΔShmacro	0.0337**	0.0298**	0.0298**	0.0299**
ΔShfirm		0.0246***	0.0235***	0.0238***
lib.ZAfirm			0.0093	-0.2779***
lib.ZA∗Shfirm			0.0136	0.0550
lib.ntm.ZAfirm				1.8105***
lib.ntm.ZA*ΔShfirm				0.1856***
lib.tariff.ZAfirm				0.2819**
lib.tariff.ZAfirm				-0.0438
lib.allfirm			-0.1401**	-0.2008**
lib.all*ΔShfirm			0.0628***	0.0822***
lib.ntm.all*firm				-0.0400
lib.ntm.all*ΔShfirm				0.0657
lib.tariff.all*firm				0.1404*
lib.tariff.all*ΔShfirm				-0.0371*
lib.RoWfirm			0.0838*	0.0634
lib.RoW*ΔShfirm			0.0030	0.0284
lib.ntm.RoWfirm				-0.1254*
lib.ntm.RoW*ΔShfirm				0.0612**
lib.tariff.RoWfirm				0.0364
lib.tariff.RoW*ΔShfirm				-0.0373**
restr.ZAfirm			0.0189	-0.1724
restr.ZA*ΔShfirm			0.0354	0.1021***
restr.ntm.ZAShfirm				-0.4315***
restr.ntm.ZA*ΔShfirm				-0.0047
restr.tariff.ZAfirm				0.2218
restr.tariff.ZA*ΔShfirm				-0.0756
restr.allfirm			-0.0219	-0.0477
restr.all*ΔShfirm			-0.0149	0.0021
restr.ntm.allfirm				-0.0073
restr.ntm.all*ΔShfirm				-0.0083
restr.tariff.allfirm				0.0348
restr.tariff.all*ΔShfirm				-0.0267
restr.RoWfirm			0.0087	0.0193
restr.RoW*ΔShfirm			-0.0037	-0.0087
restr.ntm.RoWfirm				-0.0010
restr.ntm.RoW*ΔShfirm				0.0084
restr.tariff.RoWfirm				-0.0301
restr.tariff.RoW*ΔShfirm				0.0038
FE	yes	yes	yes	yes
Year-Dummies	yes	yes	yes	yes
Cluster	yes	yes	yes	yes

Note: All regressions include time and firm-destination-industry (4-digit ISIC) fixed effects. Standard errors in parentheses clustered at the level of the destination country.*** p<0.1, ** p<0.05, * p<0.01. Estimations based on 4,596,069 observations (time/firms/industries for all destinations between 2010 and 2016).

G. Product Mix Adjustments at the Aggregated Firm Level

Results in this table are not as clear as on the disaggregated level. While the finding of a positive link between the firm-specific demand shock variable and the average skewness of product vectors towards core products is stable across all different specifications, aggregated demand shocks measured at the industry level and as GDP changes switch signs compared to coefficients obtained at the disaggregated level. Moreover, interaction terms between demand shocks and dummies for liberalising and restricting trade policy interventions show ambiguous results at the aggregated level. These results can be explained by mainly three facts.

First, at the firm-level, there is a lack of control possibilities for firm-industry-destination characteristics which might be key in explaining shifts away and towards the core product vector regardless demand developments at the destination. In this sense, there might be e.g. a shift away from core products in a destination within an industry due to changes in the destination specific market strategy of the firm.

Second, as outlined in section 4, attention is paid to carefully disentangle demand shocks which, occur in the wake of trade liberalising policies from demand shocks occurring in the wake of trade restricting interventions. This distinction is crucial to capture effects of different policies individually without the risk to blur results by ambiguous interactions of both policy types. While this distinction is possible at the disaggregated level, it is not evident to what extent aggregated policy shocks affect product mix dynamics in one direction or the other.

Third, effects of trade cost changes might not be strong enough to be visible at the aggregated firm level. As identified in tables 3 and 4, trade cost changes serve as an amplifier of positive demand shocks. Although these effects are statistically significant at the disaggregated firm-industry-destination level, it turns out that they are too small in magnitude to affect adjustments of the aggregated product mix of firms.

Table 12. Product mix adjustments at the aggregated firm level

	(1)	(2)	(3)	(4)	(5)	(6)
	Bray-Curtis	ΔBray-Curtis	ΔBray-Curtis	Bray-Curtis	ΔBray-Curtis	ΔBray-Curtis
ln GDP	-0.0058***			-0.0064***		
ln total Shock $_{firm}$	0.0174***			0.0167***		
ln total Shock $_{isic}$	-0.0088***			-0.0084***		
ln liberal. x Shock $_{firm}$				0.0020***		
ln restr. x Shock $_{firm}$				0.0017***		
ln liberal. x Shock $_{isic}$				-0.0015***		
ln restr. x Shock $_{isic}$				0.0003		
ΔGDP		-0.0719***	-0.0669***		-0.0784***	-0.0735***
Δtotal Shock $_{firm}$		0.0949***	0.0940***		0.0893***	0.0879***
Δtotal Shock $_{isic}$		0.0130	0.0090		0.0130	0.0087
Δliberal. x Shock $_{firm}$					0.0285***	0.0328***
Δrestr. x Shock $_{firm}$					0.0241***	0.0258***
Δliberal. x Shock $_{isic}$					0.0313***	0.0338***
Δrestr. x Shock $_{isic}$					0.0347***	0.0390***
Observations	79,065	68,116	73,000	79,065	68,116	73,000
R-squared	0.513	0.156	0.013	0.514	0.164	0.024
FE	firm	firm	firm	firm	firm	firm
Year-Dummies	no	no	no	no	no	no
Cluster	firm	firm	firm	firm	firm	firm

Note: All regressions include firm fixed effects. Standard errors in parentheses clustered at the firm level. *** p<0.01, **p<0.05 and * p<0.1.

H. Robustness Check: Replicating Table 5 for single Product Firms

Table 13. Replication of Table 5 for single product firms

	(1)	(2)	(3)
	ln prod	*Δ* prod	*Δ* prod
log Shock $_{firm}$	0.0189		
log Shock $_{firm}$* lib.	-0.0103		
log Shock $_{firm}$* restr.	-0.0068		
log Capital p. employee	0.0644***		
log Material	0.1243***		
Δ Shock $_{firm}$*		-0.0056	-0.0106
Δ Shock $_{firm}$* lib.		0.0212	0.0236
Δ Shock $_{firm}$* restr.		0.0003	-0.0015
Δ Capital p. Employee		0.0672***	0.0694***
Δ Material		0.1239***	0.1315***
Observations	5,589	4,089	4,644
R-squared	0.830	0.299	0.137
FE	yes	yes	yes
Year-Dummies	yes	yes	yes
Cluster	yes	yes	yes

Note: *** $p<0.01$, ** $p<0.05$, * $p<0.1$. FE refers to firm fixed effects. Standard errors are clustered at the level of the firm.