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Importer price effects of tariffs in the context of preferential trade agreements

The case of poultry in South Africa

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Abstract: Using highly disaggregated customs-transaction-level data, we study the importer price effects of tariffs in the context of preferential trade agreements for South African imports of frozen bone-in chicken. We focus first on the firm-level impact of tariffs on import prices. Findings suggest no pass-through effect from changes in tariffs but our quantity analysis contradicts this, indicating adjustments consistent with higher landed prices. We reconcile this by considering the impact of the extensive margin with the inclusion of zero trade values and find that firms are less likely to trade with higher-tariff origins. Specifically, firms are less likely to continue importing higher-priced varieties from MFN origins in the context of higher most-favoured-nation tariffs. The findings emphasize the importance of varieties, defined as firm-origin combination, in import price analyses. We then move on to more aggregated analysis. After controlling for varieties, tariff pass-through to import prices is virtually complete (91 per cent). We find robust evidence that preference-partner countries take advantage of their tariff preference rent to increase prices. Lastly, we investigate the impact of other trade policy measures on importer prices. Restrictive trade measures such as anti-dumping, safeguards, and avian flu bans constrain imports effectively, through increasing prices of continuing varieties and the exit of varieties as they become prohibitively expensive. Liberalization events such as the US tariff rate quota have the opposite effect. These effects are large and more binding than most-favoured-nation tariffs—not surprising, as the other measures are more targeted and impose higher costs on specific foreign exporters and origins. Policy-makers should be cognisant of these dynamics when setting trade policy, particularly where structural impediments exist for local producers and when South African consumers' disposable income is increasingly constrained.

Key words: pass-through, preferential trade agreements, South Africa, imports, poultry

JEL classification: F13, F14, F15, L11

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1 Introduction

Trade policy involves trade-offs. While tariffs serve as an implicit subsidy to producers, they are a tax on consumers. The trade-off, however, depends closely on how domestic prices respond to tariffs. The theoretical literature in this regard is ambiguous. Traditional trade theory embodying assumptions of perfect competition and homogeneous goods dictates that for small countries like South Africa, tariffs are fully passed on to the domestic landed price of the imported good, meaning that consumers bear the full cost of the tariff. However, under imperfect competition models, incomplete pass-through of exchange rates, tariffs, and other trade policies can occur due to market power and mark-ups, among other factors (Berman et al. 2012; De Loecker et al. 2016; Devereux et al. 2017; Fajgelbaum and Khandelwal 2022).

The empirical literature also yields mixed outcomes, with the results sensitive to type of product, trade measure, and country of analysis. Feenstra (1989), for example, estimates that only 57 per cent of the tariffs imposed on Japanese imports were passed through to the landed domestic import price of US trucks, whereas the pass-through rate was 100 per cent for motorcycles.[1] In contrast, estimates of the response of US import prices to the 2018 increases in tariffs on imports from China find pass-through to be virtually complete (Amiti et al. 2019; Cavallo et al. 2021; Fajgelbaum et al. 2020; Fajgelbaum and Khandelwal 2022).

While the empirical literature is vast, there are two key areas that have not been well explored. First, preferential trading agreements (PTAs), conferred by bilateral/plurilateral trade agreements, create asymmetrical trading relationships between beneficiary members and non-member countries to said agreements. For example, South Africa has preferential trade agreements with the European Union (EU) and the Southern African Development Community (SADC), granting their exporters tariff-free access to the South African domestic market. As such, increases in the most-favoured-nation (MFN) tariff introduce a tariff preference rent between preferential and MFN tariffs, potentially allowing preference-partner exporters to increase their prices to capture some of the tariff rent (Chang and Winters 2002; Cirera 2014; Olarreaga and Özden 2005). This is an important consideration, as such behaviour amplifies the negative consumer price effect and effectively translates to a terms-of-trade loss.

Second, with heterogeneous firms and differentiated products, tariffs influence the firm and product composition of imports. Tariffs therefore affect consumer welfare through their impact on the varieties of imported products available to consumers, in addition to their impact on the import price. The exit of an imported variety in response to a tariff increase is akin to a rise in its price to a prohibitively high level at which consumers are no longer willing to purchase the product. Failure to account for the exit of this product leads to an underestimation of the price effect experienced by consumers. Feenstra (1994) develops a model to adjust for changes in the variety of products available. This approach has been applied in more recent literature by Amiti et al. (2019), Broda and Weinstein (2006), and Fajgelbaum et al. (2020), to identify the true price effects in response to tariff changes.

This paper uses the South African poultry industry, and in particular frozen bone-in chicken, as a case study to better understand how tariff policy affects import prices in the context of PTAs and differentiated products. There are three reasons for the focus on poultry. First, poultry products

[1] Imperfect tariff pass-through has also been found by Mallick and Marques (2008) and Marchand (2012) for India; Han et al. (2016) for China; Nicita (2009) for Mexico; and Irwin (2019) and Ludema and Yu (2016) for the US.

have been subjected to numerous trade policy measures (e.g. tariff, safeguard, and anti-dumping duty changes; avian flu bans; the USA tariff rate quota or TRQ) since the 2000s, particularly frozen bone-in chicken. Second, poultry products are relatively important items in the South African household consumer bundle, representing a large share of consumption particularly for poorer households, as most view it as one of the more affordable protein sources. As such, any price sensitivities towards trade policy changes will likely impact a large share of the population. Lastly, there is widespread concern and contestation around the inflationary impact of the trade measures on these products, and the subsequent impact on consumer welfare (SAPA 2022; Tshikalange 2022).[2]

To conduct the analysis, we draw on highly disaggregated customs-transaction-level data over the period 2009 to 2022 (National Treasury and UNU-WIDER 2022), accessed via a secure data facility at the National Treasury in Pretoria. The transaction data provide information on the price, quantity, and origin of every import transaction by firms at a highly disaggregated product level (the eight-digit level of the Harmonised System or HS). With these data, we are therefore able to track how importers respond to tariff changes in terms of price, quantity, and entry and exit.

We assess the impact of tariff measures on poultry imports and prices in several ways. The analysis focuses first on the firm-level impact of tariffs on import prices and import quantities. The firm-level estimates suggest that exporters from non-preference countries fully absorb MFN tariff increases in the form of lower export prices. In other words, the firm-level results suggest zero pass-through of tariffs to landed import prices. The results also indicate that exporters from preference countries do increase their prices marginally, by 0.21 per cent for every 1 per cent increase in MFN tariffs.

However, the estimates also reveal substantial downward adjustments in import quantities and firms in response to tariff increases along the extensive margin—a finding inconsistent with a zero landed import price effect from tariffs. We reconcile these differences by considering the impact of the extensive margin with the inclusion of zero trade values, and we find that firms are less likely to trade with origins experiencing higher tariffs. Specifically, we estimate that the probability of firm imports of frozen bone-in chicken from MFN countries decreased by 8.11 percentage points in response to the MFN tariff increase in October 2013. In response to higher MFN tariffs, firms are less likely to import from targeted countries, reducing the varieties available to South African consumers. Further analysis reveals that higher-priced varieties are less likely to continue being imported relative to lower-priced varieties.[3] This provides one explanation for the zero pass-through estimates—the pass-through estimates are biased downwards by the omission of relatively expensive varieties that exited in response to the higher tariffs.

The focus of the paper then shifts to an alternative approach to estimating pass-through that explicitly accounts for changes in product variety, namely the aggregate price index approach of Feenstra (1994). In this approach, the price of consumption is divided into two components: (i) changes in prices of continuing varieties, and (ii) an adjustment for the exit or entry of varieties. When the number of varieties falls, the exact price index calculated using price changes of continuing varieties is adjusted upwards to reflect the discontinuation of consumption of these products in response to the higher tariffs.

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[2] In August 2022, for example, Minister of Trade, Industry and Competition Ebrahim Patel deferred anti-dumping duties on chicken imported from Brazil, Denmark, Ireland, Poland, and Spain, citing the fight against food inflation and its effects on the poor (Arnoldi 2022).

[3] A 'variety' refers to a firm-origin combination for frozen bone-in chicken.

Using this approach, we show how increasingly restrictive trade measures have increased the price of consumption of frozen bone-in poultry cuts above what would be predicted on the basis of continuing varieties alone. After accounting for variety effects, price estimates reveal a near complete pass-through (91 per cent) of tariffs to import prices and robust evidence that preference partners are able to raise their prices, taking advantage of their tariff preference margins. We also analyse the effects of other restrictive trade measures, particularly anti-dumping and avian flu bans, which are found to reduce the number of varieties and increase prices to a greater extent than the MFN tariff changes, while liberalization events such as the US TRQ agreement in 2016 lead to entry of new varieties and lower average prices. Overall, we find that the variety effect can represent a dominant share of the price effect and is an important consideration in importer price analysis.

These results have several implications for trade policy. The multitude of trade restrictions imposed on poultry imports, particularly frozen bone-in chicken, affect consumer welfare along several channels. First, trade restrictions have raised the landed price of imported products from countries targeted by these restrictions. Second, these restrictions have led to the exit of varieties imported from targeted sources, reducing competition and putting additional upward pressure on prices. Both of these channels will have reduced consumer welfare. Third, there is robust evidence that preferential partners capture some of the rent from MFN tariff changes. This is exacerbated by structural problems domestically that constrain local producers' abilities to meet demand. When setting tariffs and other non-tariff measures, policy-makers need to be cognisant of these dynamics that influence both the effectiveness of trade policy and the welfare outcomes thereof.

The remainder of the paper is structured as follows. The next section provides a background on South African poultry imports. This is followed by an overview of the relevant theoretical and empirical literature. Section 4 provides a comprehensive description and summary of the data. Section 5 deals with the methodology and empirical results from the firm- and aggregate-level analyses. Section 6 concludes with a summary of the results, policy insights, limitations, and potential avenues for extension.

2 Background

Poultry imports into South Africa can be classified into eight main HS8 codes. These are presented in Table 1 along with their respective import quantity and value shares, as well as the MFN tariff changes for the period 2009–22. It is evident that frozen bone-in chicken (HS8 02071490) constitutes the bulk of all South African poultry imports, representing 55 per cent and 41 per cent of all import value and quantity, respectively. Frozen bone-in chicken has also been subjected to two MFN tariff changes in recent years. Prior to October 2013, MFN tariffs were 18 per cent, rising to 37 per cent in October 2013 and again to 62 per cent in March 2020 (ITAC 2020). Given the dominant import shares and susceptibility towards tariff events, this paper focuses on frozen bone-in chicken.[4]

[4] Mechanically deboned meat (02071210) represents the second-largest poultry import at 38 per cent and 23 per cent of imported quantities and value, respectively. However, there were no MFN tariff changes over the corresponding period of analysis to exploit. Other poultry imports represent very small shares and are not considered for this paper.

Table 1: Poultry product characteristics

HS8 Code	Description	Import share		MFN tariff change	
		Quantity	Value	Oct. 2013	March 2020
02071100	Fresh whole bird	0%	0%	No change	No change
02071210	Mechanically deboned meat	38%	23%	No change	No change
02071220	Frozen carcasses	3%	1%	27% to 31%	No change
02071290	Frozen whole bird	3%	3%	27% to 82%	No change
02071300	Fresh cuts and offal	0%	0%	No change	No change
02071410	Frozen boneless chicken	4%	9%	5% to 12%	12% to 42%
02071420	Frozen offal	10%	8%	27% to 30%	No change
02071490	Frozen bone-in chicken	41%	55%	18% to 37%	37% to 62%

Note: import shares represent average shares over the period 2009–22.

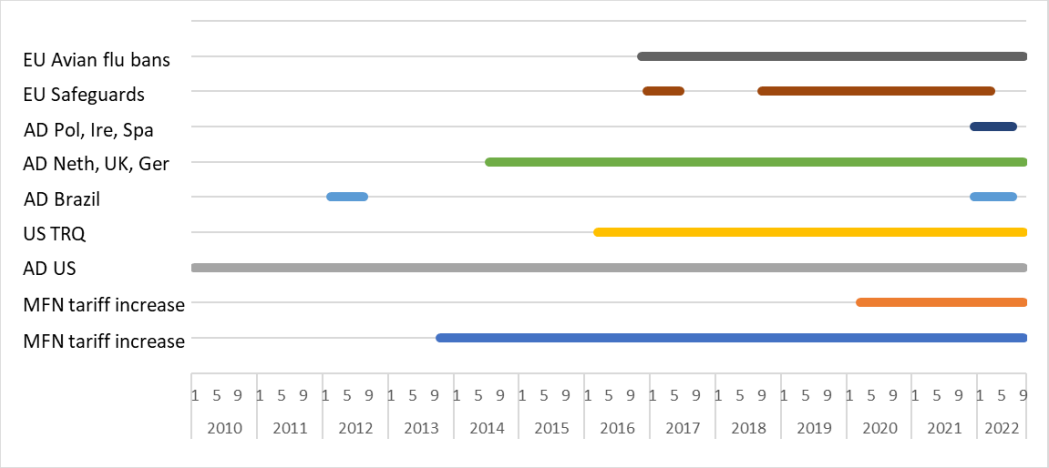
Source: HS8 and accompanying descriptions obtained from Schedules to the Customs and Excise Act, 1964 (SARS 2023); shares of import quantity and value obtained from authors' own calculations using customs-transaction-level data (National Treasury and UNU-WIDER 2022); MFN tariff changes obtained from various South African government gazettes and International Trade Administration Commission (ITAC) reports.

MFN tariffs are applied to all member countries of the WTO (World Trade Organization), although the WTO makes provisions for countries which participate in PTAs to be exempt from MFN tariffs provided they achieve greater liberalization. Notable PTAs from South Africa's perspective exist with the EU[5] and SADC countries.

In addition to MFN tariffs, frozen bone-in chicken imports have also been subjected to additional trade policy measures in the form of anti-dumping, safeguards, avian flu bans, and US TRQ. These measures are more targeted than MFN tariffs as they discriminate against specific importing countries/firms regardless of their preferential status (see Figure 1).

[5] South Africa and the EU have had a fully implemented free trade area in place since 2012, first in the form of the Trade Development and Cooperation Agreement (TDCA) which was subsequently replaced by the SADC–EU Economic Partnership Agreement (EPA).

Figure 1: Timeline of trade restrictions on chicken products, 2010–22



Note: see Appendix Table A1 for detailed breakdown.

Source: reproduced with permission from Edwards et al. (2022).

First, avian flu bans have been in place since November 2016 to combat the threat of the avian flu virus (H5N1) from the EU. These import bans have varied over time depending on evidence and testing of birds/chickens.[6] Second, provisional safeguard duties of 13.9 per cent were imposed on EU frozen bone-in chicken from 15 December 2016 to 3 July 2017. Final safeguard duties of 35.3 per cent were imposed on EU frozen bone-in chicken on 28 September 2018, with a phase-down over time to 30 per cent in March 2019, 25 per cent in March 2020, and 15 per cent from March 2021, with duties falling away from March 2022 (USDA 2018).

Third, anti-dumping duties, which have been used extensively across import partners, of 224 rand (R) cents per kilogram (c/kg) were first imposed on the USA in 2001, leading the USA to completely exit the South African market (Cochrane et al. 2016; see Figure 2). These duties were further raised to 940c/kg in April 2012. Anti-dumping duties were also imposed on frozen bone-in chicken imports from the Netherlands (22.81 per cent), the United Kingdom (UK) (22.03 per cent), and Germany (73.33 per cent) in July 2014 (ITAC 2015).[7] These three EU countries represented 73 per cent of total imports of frozen bone-in chicken in 2013, according to the import data in National Treasury and UNU-WIDER (2022). More recently, in December 2021, additional provisional anti-dumping duties were imposed on selected frozen bone-in chicken products from EU countries Poland (up to 96.9 per cent), Ireland (158.42 per cent), Denmark (67.4 per cent), and Spain (up to 85.8 per cent). Brazil was also subject to provisional anti-dumping measures on frozen bone-in chicken, in December 2021 (up to 265.1 per cent) (ITAC 2021). The International Trade Administration Commission of South Africa (ITAC) made a final determination to impose anti-dumping duties in June 2022 (ITAC 2022); however, these were deferred by a year by the Minister of Trade, Industry and Competition Ebrahim Patel in August 2022 due to the potential inflationary implications of these duties on consumers (Arnoldi 2022). This moratorium lapsed without renewal in September 2023 (ITAC 2023a), meaning that these relief measures have since lapsed. However, ITAC announced in January 2024 that it would implement a short-term 25 per cent

[6] To date, countrywide bans remain on poultry products from several EU member states (European Commission 2023).

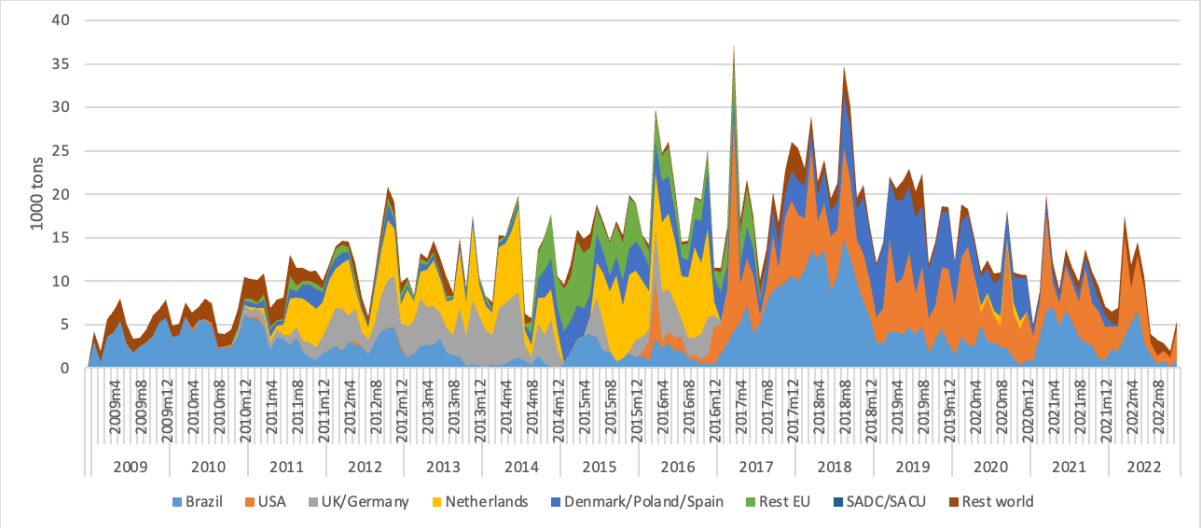
[7] These provisional duties were finalized in February 2015. The duty on Germany was increased from a 31.3 per cent prior anti-dumping duty on frozen bone-in chicken pieces sourced from that country.

rebate for frozen bone-in chicken imports, effectively reducing the MFN tariffs from 62 per cent to 37 per cent and providing some relief to consumers, albeit temporarily (ITAC 2023b).

Lastly, some relief was granted to US poultry importers in February 2016 during negotiations for the US extension of the African Growth and Opportunities Act (AGOA) of 2000, where South Africa was threatened with exclusion. A resolution was reached in the form of a TRQ to grant access for up to 65,000 tons of US frozen bone-in chicken at the MFN tariff of 37 per cent. Import quantities over this threshold would be subject to the same anti-dumping duty as before (940c/kg) (Cochrane et al. 2016). This resolution represents a liberalization event: it effectively removed the additional anti-dumping duties facing US importers, as at no point over the period of analysis did imports of USA frozen bone-in chicken exceed this threshold (see Figure 2).

The various trade measures have resulted in varied effects on frozen bone-in chicken imports over time. Figure 2 presents the monthly poultry import volume (in thousands of tons) trends for frozen bone-in chicken over the matching period of trade policy interventions. Import volumes are decomposed into key import partner groupings motivated by their import shares and specific targeted trade policies.

Figure 2: Monthly frozen bone-in chicken import volume, 2009–22



Source: authors' construction using National Treasury and UNU-WIDER (2022).

Three main trends can be observed. First, there is a large degree of volatility in the sources of frozen bone-in imports over time. Imports from Brazil and the rest of the world constituted the bulk of poultry imports between 2010 and 2012. However, since 2012, around the same time as the EU free trade agreement with the SADC, we observe a steep increase in poultry imports sourced from EU countries. This effect seems to be compounded in late 2013, corresponding to the increase in MFN tariffs. This has largely come at the expense of Brazil, which is not a member of South Africa PTAs.

Second, imports from the USA were practically non-existent prior to the TRQ implementation in 2016, pointing to the prohibitively binding anti-dumping trade policy measures applied prior to the agreement. Imports from the USA started to flow into South Africa again after the TRQ implementation, indicating a trade liberalization type of event.

Third, import volumes from the UK, Germany, and the Netherlands, first targeted by anti-dumping measures in 2014 and then restricted by avian flu bans from late 2016, show large variation. EU imports as a whole have shrunk significantly as a share of South African imports

since 2017 due to the combination of anti-dumping and safeguard measures and avian flu bans.[8] EU countries not as severely affected by avian flu bans early on (Denmark, Poland, Spain, and Ireland) experienced an increase in imports, suggesting some sort of substitution between EU imports.[9]

Two key takeaways from the above discussion are that (i) the increasingly restrictive trade policy measures have had a binding effect on the level of frozen bone-in imports, stifling import growth, as frozen bone-in chicken import volumes have returned to levels comparable to those at the beginning of 2009, after brief peaks in 2017/18; and (ii) the trends seem to present evidence of substitution, or at least changing varieties across origins as the geographical composition of imports changes in response to trade measures.

Within this lie large sources of heterogeneity which need to be unpacked. For example, not all importers embody the same characteristics or face the same trading conditions. The number of importing firms varies over time and across origin countries. Firms source different varieties of poultry imports in response to changes in trading conditions. Furthermore, there is a large degree of variation in firm size. These differences at the firm level lead to differences in prices which ultimately drive the fluctuations in import responses to trade policy measure changes as seen in Figure 2. Therefore, in order to better understand these trends and the importer price effects of trade policy changes, analysis is needed using disaggregated data (i.e. at the firm level).

3 Related literature

Traditional trade theory shows that in a market characterized by perfect competition with homogeneous goods, a tariff levied on an importer will result in a price increase by the full tariff amount—complete pass-through to imported prices, leading to a net welfare loss. This can be represented by the following simplified relationship:

$$P^D = P^* + t$$

where P^D represents the domestic price, P^* the international (world) price, and t the tariff or other trade policy measure. There are special circumstances where, if the importing country is large enough to influence world prices, the tariff pass-through may not be complete under perfect competition (Krugman et al. 2012: 225–26). For example, a tariff increase of R10 would increase domestic prices by less than R10. In such circumstances, the degree of pass-through is dependent on elasticities of demand and supply. A higher elasticity of demand would imply a lower degree of pass-through, as consumers can more easily switch products, whereas a more elastic supply curve would imply a higher degree of pass-through, as suppliers have greater choice of export destinations (Amiti et al. 2019). The net welfare effect is ambiguous under these circumstances.[10]

However, the assumptions of perfect competition and traditional trade theory are often unrealistic and rarely if ever manifest themselves, making any analysis much more complicated and uncertain. This study is concerned with three shortcomings.

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[8] Other major EU countries include Belgium, France, Germany, and Hungary.

[9] Denmark, Poland, and Spain have more recently also been restricted due to avian flu outbreak concerns. This has resulted in a further reduction in frozen bone-in chicken imports from EU (preference) countries.

[10] Net welfare is positive for sufficiently small tariffs but decreases as tariffs increase (Feenstra 2004).

First, traditional trade theory and related models could yield inaccurate predictions due to factors such as increasing returns to scale and network effects embodied in the new trade theory literature pioneered by Paul Krugman (1979) and others. In models of imperfect competition, where firm mark-ups and market power exist, foreign exporters have the ability to absorb some of the tariff increase by eating into their profits, thereby reducing the degree of pass-through to imported prices (De Loecker et al. 2016). Under perfect competition, South Africa would be classified as a 'small' country, implying perfect pass-through. However, consideration for imperfect market structures means that this is not clear and warrants investigation.

Existing studies find varied evidence of imperfect pass-through, across different types of products and countries, mostly using product-level data. Feenstra (1989) finds complete pass-through for motorcycle imports but incomplete (57 per cent) pass-through for trucks when using data on US imports of Japanese cars, trucks, and motorcycles. Hufbauer and Elliott (1994) conduct a comprehensive study on the costs of US protection and find large variation in price pass-through between products. For example, ball bearing imports exhibit almost perfect pass-through while dairy products have 74 per cent pass-through (Hufbauer and Elliott 1994: 28). Similarly, Irwin (2019) also finds incomplete pass-through when analysing US sugar import prices between 1890 and 1914. Studies have also been done for other countries, with Mallick and Marques (2008) and Marchand (2012) for India, Nicita (2009) for Mexico, and Han et al. (2016) for China all finding varied evidence of imperfect pass-through. More recent studies have used product-level data to investigate the pass-through effects of the US–China trade war, surprisingly finding near complete pass-through for US prices (Ahmad and Ahmad 2023; Amiti et al. 2019; Cavallo 2021; Fajgelbaum et al. 2020) as well as for China (Chang et al. 2021; Ma et al. 2021). Ludema and Yu (2016) is an exception in that they use more disaggregated firm-level transaction data to investigate the role that firm productivity and product quality play in determining the price responses to tariffs in the USA; they also find evidence of imperfect pass-through.

Relating to South Africa, Edwards et al. (2022) make use of product price data at the outlet level to investigate the tariff pass-through to consumer and import prices for poultry, frozen chips, and pasta. They find complete pass-through to prices (i.e. exporters do not reduce their prices at all in response to higher tariffs), although there is some evidence of incomplete pass-through in response to anti-dumping, safeguards, and the US TRQ related to the AGOA extension agreement (Edwards et al. 2022). We extend this analysis by using more disaggregated transaction-level data, additionally focusing on the cross-country heterogeneity between preference and MFN partners.

Second, traditional theory makes some restrictive assumptions regarding firms and origins—specifically, that firms and import origins are all homogeneous (perfect substitutes). Particularly relevant for our context, the traditional theory does not distinguish between preference and non-preference trading partners, as it assumes that all countries and firms are homogeneous and are equally affected by a tariff or other trade shock. This is concerning for two reasons. One, firms are highly heterogeneous, as is found in South Africa (Edwards et al. 2020; Matthee et al. 2018) and internationally (Bernard et al. 2018), and firm characteristics influence tariff pass-through. Two, given the proliferation of preferential trade agreements, adopting the 'traditional' approach would mask a great deal of heterogeneity associated with tariff and other trade policy changes. For example, a competing exporter who is exempt from a tariff increase could benefit from it due to the expanding preference margin. Depending on the market structure and local production capacity, said competing exporter could capture a greater share of the market via increased exports

and/or increasing prices through higher mark-ups (De Loecker et al. 2016). In the case of South Africa, this would mainly impact the country's trading relationships with the EU.[11]

Evidence of this dynamic has been found by Olarreaga and Özden (2005), who exploit the AGOA treaty of 2000 to analyse the impact of tariff preferences extended by the AGOA on the import prices of African-country apparel exporters. They find that average export prices increase by 6 per cent relative to MFN tariffs of 20 per cent. This translates to a pass-through of around 33 per cent to preference partners. In other words, preference-partner exporters capture additional gains due to the preferential conditions afforded to them by the AGOA. The paper also provides evidence of significant heterogeneity: exporters originating from smaller and poorer countries tend to capture a disproportionately lower share of tariff rents. Chang and Winters (2002) examine the effects of MERCOSUR, the Southern Common Market, on the pricing of non-member exports to Brazil. A key finding of this study is that non-member countries are significantly affected by regional integration schemes. More specifically, non-member countries reduced prices in response to the formation of MERCOSUR in 1991. Cirera (2014) uses a dataset containing product tariff preference utilization and non-utilization rates to conduct a natural experiment on the impact that EU trade preferences have on export prices. The key findings of the paper suggest that exporters obtain larger price margins under a preferential regime relative to MFN regimes, with pass-through coefficients ranging from 17 per cent to 28 per cent on average. Heterogeneity is found across products and size of preference margin, with differentiated products and those with a higher-tariff preference margin extracting higher rents. Synthesizing this literature, we expect to find that South Africa's preference partners capture some of the tariff preference rent that arises from MFN tariff increases. This share could be large if preferential-country importers represent a large share or domestic competition is low.

Third, traditional trade theory also assumes homogeneous products, but in reality there is large variation between and within products, even within narrowly defined, highly disaggregated product classifications (Schott 2004). Not factoring in varieties that fluctuate over time can lead to inaccurate estimations when it comes to price and welfare effects (Amiti et al. 2019; Feenstra 1994). On the price front, not accounting for changes in varieties leads to inconsistent price comparisons over time. On the welfare front, assuming that consumers extract utility from increased access to varieties, as is the case for new trade theory models, ignoring exiting varieties would lead to an underestimation of the negative welfare effects on consumers.

In sum, the existing empirical and theoretical literature points to large variation in importer price effects. Tariff pass-through effects not only vary significantly across countries and product categories, they also differ significantly across trade policy measures. Adding to the complexity is the consideration of across-country heterogeneity, where the presence of preferential trading arrangements can distort the level of pass-through between member and non-member countries, and of product varieties, which are important in evaluating the overall welfare implications of trade policy measures in new trade theory models. Most of the existing literature uses product-, industry-, or country-level data. To our knowledge, there are no studies that look at the micro-level firm dynamics behind tariff and other trade policy effects on import prices in South Africa, and only a few studies do so for other countries (e.g. Ludema and Yu 2016). In addition to our analysis of pass-through effects using highly disaggregated firm-level transaction data, the considerations of preferential trade agreements and product varieties are contributions that our paper makes to the existing literature.

[11] The SADC regions also represents a free trade region with South Africa. However, South Africa does not source a large volume of poultry imports from the SADC region.

4 Data and general descriptive statistics

To better understand the importer price (pass-through) effects, we utilize customs-transaction-level data (National Treasury and UNU-WIDER 2022). The data provide detailed monthly importer-level information over the period 2009–22. This includes information on import value (in South African rands), quantity by unit (kilograms, litres, number, etc.), origin (source of imports), product (at the eight-digit HS level), and time (monthly intervals). For the purposes of the empirical analysis and as mentioned previously, we restrict these data to frozen bone-in chicken pieces (HS02071490) while also conducting multiple rounds of data cleaning.[12]

The customs-transaction data are augmented by the inclusion of tariff and other trade policy data obtained from various sources, including South Africa government gazettes and various ITAC (2012, 2019, 2021, 2022) reports, European Commission (2023), USDA (2018), and the USDA report by Cochrane et al. (2016). Additional data are sourced from the Trade Map (ITC 2023), Centre d'Etudes Prospectives et d'Informations Internationales (CEPII 2023; see also Conte et al. 2022), World Bank (2023), and World Integrated Trade Solutions (WITS 2023) databases for international product prices, gravity model variables, and ISO3-level country codes and groupings, respectively.

No direct pricing data are available from the dataset. Therefore, we construct a unit value proxy using the ratio of imported value and quantity, a common approach in the existing literature (e.g. Cirera 2014; Olarreaga and Özden 2005). Unit values are constructed both inclusive and exclusive of duties for our analysis. The unit value data are cleaned to remove outliers.[13] For the purposes of our econometric estimations and analysis, we are concerned mainly with the period 2012 to 2019.[14] First, 2012 represents the start of the EU–South Africa free trade area and this allows us to exploit the heterogeneous response to tariff and other trade measures. Second, despite data being available until end of 2022, the years from 2020 onwards are excluded due to the volatility and unpredictability of the COVID-19 pandemic.[15]

Table 2 presents aggregate characteristics for the final sample of frozen bone-in chicken imports post-cleaning for 2012 and 2019. The total import value of chicken in 2012 was R1,896.65 million, increasing to R2,998.41 million in 2019. A similar positive trend is observed for total number of firms and transactions, which increased from 43 and 212 to 105 and 253 respectively—a result of the influx of US importers after the 2016 TRQ implementation.[16] However, total number of origins decreased from 16 to 12 between 2012 and 2019, reflecting the avian flu bans and other increasingly restrictive trade measures implemented over this time period, especially on EU countries.

[12] The data appendix covers how this cleaning was done, in addition to other data manipulations used.

[13] Outliers were cleaned based on unit values, by removing the top and bottom 1% of unit value and unit value growth transactions. Transactions that fell above and below three standard deviations of the mean unit values were also excluded.

[14] Some descriptives utilize the full sample (2009–22) to provide a better sense of the broader trends.

[15] It will be difficult to accurately investigate the effect of the 2020 tariff increase, as this took place in March, coinciding with the outbreak of COVID-19 and subsequent strict lockdowns in South Africa.

[16] More than half of all firms (55) imported from the USA in 2019, a large increase from 2012, where no firms imported from the USA.

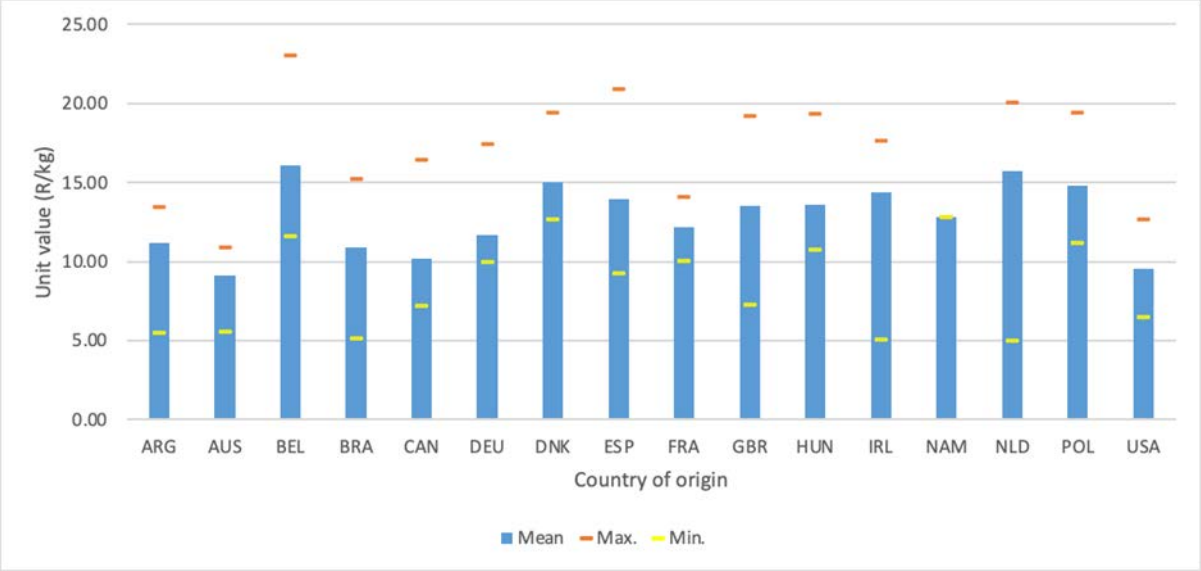
Table 2: Frozen bone-in chicken aggregate characteristics, 2012 and 2019

	2012	2019
Aggregate		
Total value (R million)	1896.65	2998.41
Total number of firms	43.00	105.00
Total number of transactions	212.00	253.00
Total number of origins	16.00	12,00

Source: authors' construction using National Treasury and UNU-WIDER (2022).

From the price (unit value) data we construct Figure 3, which presents the price variation for imports into South Africa for the 15 largest importing origins in 2016. Two key observations can be made here. First, there are large differences in the mean prices across origins. On average, import varieties from preference partners (EU countries) have higher import prices than those from non-preference countries (Brazil, USA, Argentina). Even within these preference groupings, large variation in prices exists. Second, there is also large price variation within countries, across firms, as evidenced by the varying deviations between the minimum and maximum import prices for each origin depicted in Figure 3. These observations imply that a large degree of heterogeneity exists even within a narrow, highly disaggregated product band such as frozen bone-in chicken, in line with findings by Schott (2004). It follows that both firm and origin country, in addition to preferential status, are important factors to consider when dealing with import price analyses. Additionally, the treatment of imports should be carefully evaluated, as imports, even within the same HS8 level of classification, can represent different varieties of the same product.

Figure 3: Frozen bone-in chicken price variation, 2016

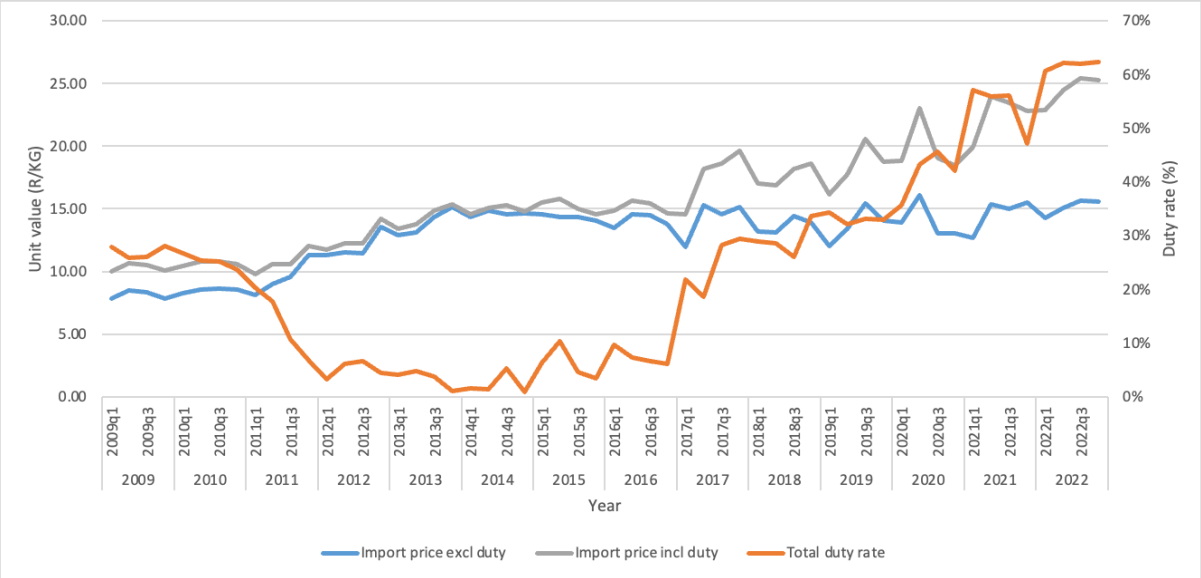


Source: authors' construction using National Treasury and UNU-WIDER (2022).

Figure 4 presents additional insights regarding import prices, specifically the potential association between import prices and tariffs and other trade measures, by looking at the unit value (price)

and collection rate data on dutiable import transactions.[17] The total duty rate, representing the cumulative duty inclusive of applied tariffs and anti-dumping and safeguard duties, initially dipped over the period 2011–15 to close to 0 per cent, driven in large part by the South Africa–EU PTA, then rose sharply to over 60 per cent in 2022. This rise corresponds to a period where anti-dumping and safeguard duties and avian flu bans were introduced, representing increasingly binding trade measures over time. Furthermore, the trends exhibited by the import price inclusive and exclusive of duties indicate some level of substitution. While the 2013 MFN tariff increase seemingly allowed importers and consumers to substitute away from MFN towards preference-partner varieties without incurring large changes in the import price, the increasingly restrictive trade measures imposed on these preference partners from late 2016 restricted this avenue of relief for consumers, hence the corresponding divergent trends in price inclusive and exclusive of duties shown in Figure 4. This period also corresponds to a period of reduced import quantities from EU countries, as seen in Figure 2. Many countries, including the UK, Germany, and the Netherlands, ceased exports to South Africa, suggesting a drop in varieties available.

Figure 4: Frozen bone-in chicken import price and collection rate, 2009–22



Note: unit value is computed by taking the import value in rands divided by import quantities measured in kilograms; total duty rate or collection rate is the total duties (applied tariff, anti-dumping and safeguard duties) paid by importers as a share of total import value.

Source: authors' construction using National Treasury and UNU-WIDER (2022).

4.1 Importer characteristics

To unpack the data at a more disaggregated level, Table 3 presents firm characteristics for frozen bone-in importers. The average firm size in terms of value decreased, almost halving between 2012 and 2019 (R44.11 to R28.56 million). This combined with the more than doubling in number of firms in Table 2 translates into a much lower number of transactions per firm, more than halving

[17] Dutiable transactions include CPC codes A1000, A1100, A1120, A1140, A1141, A1142, A1144, A1148, A1400, A1440, A1441, A1442, A1444, and A1448. E4000 (warehousing) transactions are excluded as duties are not charged on these transactions. Duties are charged only once goods exit the warehouse.

from 4.93 to 2.41, although each import transaction is of higher value (from R8.95 million to R11.85 million).[18]

Table 3: Frozen bone-in chicken firm characteristics, 2012 and 2019

	2012	2019
Firm		
Mean value per firm (R million)	44.11	28.56
Mean value per transaction (R million)	8.95	11.85
Mean number of transactions per firm	4.93	2.41
Share firms importing from preference partners	12%	8%
Share firms importing from non-preference partners	12%	55%
Share firms importing from preference and non-preference partners	77%	37%

Source: authors' construction using National Treasury and UNU-WIDER (2022).

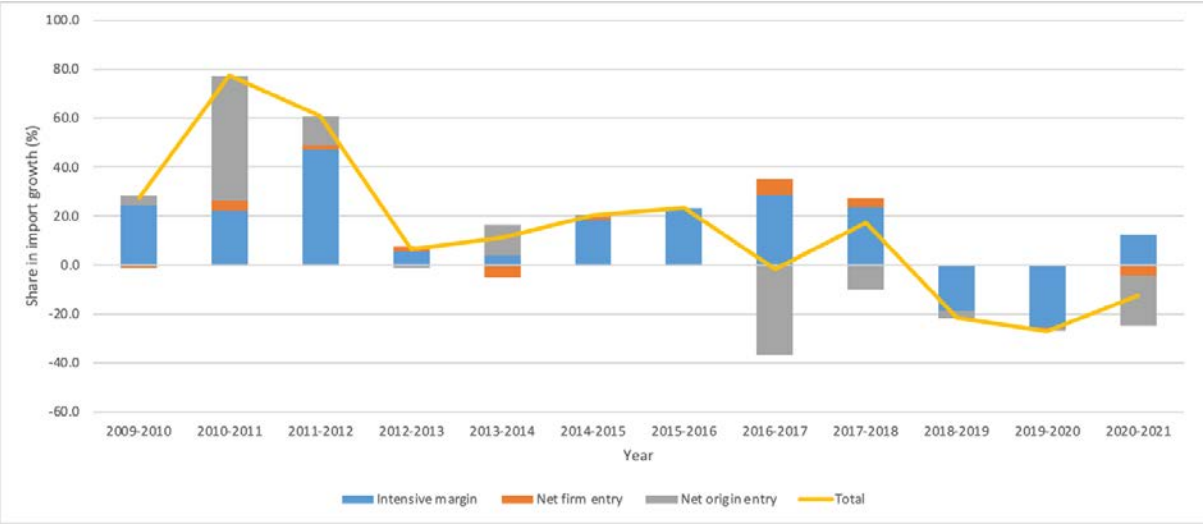
The shares of firms importing from preference and non-preference partners exhibit clear diverging trends. Originally representing an equal share in 2012 of 12 per cent each, the share of firms importing from preference partners shrinks to 8 per cent while the share importing from non-preference partners increases significantly to 55 per cent. Furthermore, the share of firms importing from both preference and non-preference partners represents just 37 per cent of all firms in 2019, in comparison with 77 per cent in 2012. This reinforces our earlier observation of increasingly restrictive trade measures dampening poultry imports particularly from EU (preference) countries while also presenting evidence of changing firm dynamics.

4.2 Importer dynamics

Investigating these changing firm dynamics further, Figure 5 presents a decomposition of aggregate import growth for frozen bone-in chicken. This is done by first aggregating the transaction data to the annual firm-origin level. Thereafter, import growth is decomposed into two broad margins: intensive and extensive. The intensive margin represents the share of import growth accounted for by continued imports by firms from existing origins, while the extensive margin represents the share of import growth accounted for by the entry and exit of firms (firm extensive margin)—net firm entry—and the entry and exit of continuing firms into and out of import origins or varieties (firm-origin extensive margin)—net origin entry.

[18] This suggests that the US importers entering post-2016 TRQ were on average smaller firms than existing importers from other countries.

Figure 5: Decomposition of import growth—intensive and extensive margins, 2010–21



Note: based on transaction data aggregated to the firm-origin-year level for frozen bone-in chicken; periods represent end-of-year periods, i.e. '2009–2010' refers to 2010 as it is the period from the end of 2009 to the end of 2010.

Source: authors' construction using National Treasury and UNU-WIDER (2022).

Two key features stand out from Figure 5. The first of these is the highly dominant intensive margin contribution (continuing firm-origin imports) to overall import growth, for both the positive (2010–18) and more recent negative (2019 onwards) growth periods. Second, the decomposition also illustrates the importance of the firm-origin extensive margin (net origin entry) or entry/exit of varieties in driving changes in poultry import growth in South Africa. Over the initial periods (2010–14) the net origin entry contributed positively towards import growth. This points towards a positive effect arising from the EU free trade agreement as well as potential substitution away from MFN varieties post the tariff increase in October 2013. This is in contrast to periods post-2016, where net origin contributes negatively to import growth—a consequence of the increasingly binding restrictions on EU countries restricting the imports of these varieties.

The firm extensive margin does not feature as prominently across time, with only a few instances where net firm entry is significantly represented on the graph. Instances of a notable firm extensive margin occur over the 2016–18 period, corresponding with the implementation of the US TRQ. Excluding the USA from importer dynamics (see Appendix Figure A1) results in a reduced relevance of the firm extensive margin.

This section has presented characteristics that highlight how firms (importers) and prices evolve over a period characterized by increasingly restrictive trade measures, and the significance that preference partners assume. First, the evidence presented thus far suggests that restrictive trade policies negatively impact not only import quantities but also prices (which increase). Second, restrictive trade measures also affect firms' trading relationship across origins. The targeted trade policy measures cause differing responses across firms and origins, chiefly between preference and MFN countries. Lastly, importer dynamics suggest that firm entry and exit from origins represents an important vector for overall import growth. This stresses the importance of considering import varieties, even within a narrowly defined product category like frozen bone-in chicken. We tackle these issues in the next section.

5 Methodology and results

For the purposes of our analysis, we aggregate the transaction-level data to quarterly intervals, which allows for greater continuity in firm-origin combinations over the period of analysis.[19] The analysis will be divided into two parts: We begin with firm-level analysis and then proceed to conduct more aggregate-level analysis to better identify the welfare effects of tariffs and other trade measures.

5.1 Firm-level analysis

In order to identify the importer price impact of tariffs, the following specifications are estimated at the firm/importer level:[20]

Equation 1:

$$\begin{aligned}\ln p_{fijt} = {} & \beta_1 \ln(1 + tarMFN_{it}) + \beta_2 \ln(1 + tarMFN_{it}) * DPref_j + \beta_3 DPref_j \\ & + \beta_4 \ln(1 + Safeguard_{ijt}) + \beta_5 \ln(1 + AD_{ijt}) + \beta_6 US\ TRQ_{ijt} \\ & + \beta_7 AvianBan_{jt} + Controls + \varepsilon_{fijt}\end{aligned}$$

Equation 2:

$$Controls = \alpha_t + \beta_1 \ln e_{jt} + \beta_2 \ln p^*_{ijt} + \beta_3 \ln GDP_{jt} + \mu_j + \mu_f$$

where p_{fijt} denotes the import price (in rands) proxied by the unit value (UV) for imported product i (frozen bone-in chicken) from country j at time t by importing firm f. The price here represents the free-on-board (FOB) landed price, which excludes any costs related to insurance or freight and import duties. $tarMFN_{it}$ denotes the MFN tariff rate which is applied to all WTO member countries. This variable varies by time t and by product i (frozen bone-in chicken).[21] MFN tariffs are waived for countries that are members of a PTA, as is the case with South Africa and the EU and SADC countries. $DPref_j$ allows us to distinguish between preference countries, taking a value of 1 for preference country origin (EU or SADC) and zero otherwise.

The β_1 coefficient on the $tarMFN_{it}$ term identifies the effect of MFN tariff changes on non-preference countries, while β_2 on the interaction between $tarMFN_{it}$and $DPref_j$ allows us to identify the difference between preference and non-preference country responses to MFN tariff changes. Therefore, the sum of β_1 and β_2 represents the total MFN tariff effect on preference countries. Guided by theory and existing empirical literature, our expectation is that β_1 will range between -1 and 0, indicating imperfect pass-through. A significant coefficient close to or equal to -1 implies no pass-through to imported prices. In this scenario, foreign exporters fully absorb the

[19] The mean import value is R179.69 million per monthly period/interval, R535.87 million per quarterly period/interval. The mean number of firms and transactions increases from 13.50 to 40.27 and from 71.47 to 112.73 respectively when comparing data at monthly and quarterly intervals.

[20] Specifications are estimated linearly via high-dimensional fixed effects using the Stata user-written package reghdfe by Correia (2014) unless otherwise stated.

[21] MFN tariffs are reported as ad valorem rates and are included as $(1 + tarMFN_{it})$ in the regression analyses as displayed in the equations. Subsequent discussions around changes in MFN tariffs refer to changes in $(1 + tarMFN_{it})$. This also applies to $Safeguard_{ijt}$ and anti-dumping duties (AD_{ijt}) interpretations as these are also ad valorem rates.

tariff increase. Tariff pass-through increases as the coefficient approaches zero ($\beta_1 \rightarrow 0$), where tariff changes are fully passed on to the import price. Conversely, we expect a positive β_2 coefficient as preference partners are not subject to MFN tariff changes. The total effect on preference partners ($\beta_1 + \beta_2$) reflects any positive spillover effects arising from an increase in MFN tariffs. A positive significant coefficient suggests that preference-country importers are able to exploit the increase in the tariff preference margin arising from higher MFN tariffs, passing these on to South African consumers while capturing a greater share of rent.

The specification also controls for other trade measures that were implemented over the time period of analysis, as these represent separate and significant trade policy events and, as such, are expected to affect the import price to varying degrees. There is some literature that confirms symmetry between pass-through of exchange rate and tariff changes (Feenstra 1989). However, more recent literature, particularly pertaining to trade policy measures, has found contrary evidence (Nizovtsev and Skiba 2019).[22]

$Safeguard_{ijt}$ and AD_{ijt} represent ad valorem rates and allow us to control for safeguard and anti-dumping duties respectively, both of which were imposed on EU imports. Our expectations here are consistent with that of β_1 in terms of expecting incomplete pass-through.[23]

$US\ TRQ_{ijt}$ is a dummy variable which is unity from when imports from the USA were subject to the TRQ in 2016, a trade liberalization event where anti-dumping duties were removed on imports below the 65,000 tons threshold; $AvianBan_{jt}$ is a dummy variable indicating whether a country is subject to legislation banning the import of frozen bone-in chicken.[24] The removal of anti-dumping measures on US imports is expected to have applied downward pressure on import prices ($\beta_6 < 0$), as with avian flu bans ($\beta_7 < 0$) which reduce the varieties available to consumers.

Additional controls are presented in Equation 2 and include the bilateral exchange rate, e_{jt},[25] GDP (GDP_{jt}), international prices (p^*_{ijt}),[26] and combinations of fixed effects covering firm (μ_f), origin (μ_j), and time (α_t) dimensions. The inclusion of various fixed effects helps to control for unobservable firm and importer time-invariant and time-varying factors.

[22] Nizovtsev and Skiba (2019) identify varying effects arising from different trade policy measures.

[23] Although there is evidence in the literature to suggest that anti-dumping measures have a greater than full pass-through effect in some instances (Blonigen and Haynes 2002; Nizotsev and Skiba 2019; Sandkamp 2020).

[24] Over the period of the sample, this is concentrated among European countries, namely the Netherlands, Spain, Poland, Belgium, France, Denmark, and Sweden.

[25] An increase in the exchange rate represents a depreciation of the South African rand relative to the foreign currency. We expect a weaker currency to translate into higher import prices, although the level of pass-through is ambiguous. Existing literature has found varied exchange rate pass-through effects.

[26] One concern is regarding the contribution of international prices to the variation in South Africa poultry import prices, which we expect to be positively correlated. We collect monthly HS6-level export data for frozen chicken (HS020714) from Trade Map (ITC 2023) at the bilateral level for South Africa's top 15 import origins. The export data is parsed into exports to South Africa and exports to the rest of the world, which is used as our proxy for international frozen chicken prices (see Appendix Figure A2). It can be observed that South Africa's import price moves largely with our international price proxy for frozen chicken. Interestingly, the South Africa import price lies below the international price, suggesting that there may be some effect from the various trade policy measures.

In conjunction with the price analysis, we also identify the quantity responses in Equation 3 using the natural log of quantity in millions as our dependent variable—$\ln(qmill_{fijt})$. All other variables remain unaffected. Controls are as specified in Equation 2.

Equation 3:

$$\begin{aligned}\ln qmill_{fijt} = {} & \beta_1 \ln(1 + tarMFN_{it}) + \beta_2 \ln(1 + tarMFN_{it}) * DPref_j + \beta_3 DPref_j \\ & + \beta_4 \ln(1 + Safeguard_{ijt}) + \beta_5 \ln(1 + AD_{ijt}) + \beta_6 US\ TRQ_{ijt} \\ & + \beta_7 AvianBan_{jt} + Controls + \varepsilon_{fijt}\end{aligned}$$

We expect there to be an inverse relationship between the price and quantity responses—an increase in prices should correspond with a decrease in imported quantities. From Equation 1, imperfect pass-through for MFN tariffs ($-1 < \beta_1 < 0$) should translate into a negative quantity response from MFN countries as consumers reduce demand in face of higher import prices. Therefore, we expect β_1 to be negative in Equation 3. This quantity response becomes stronger as the importer price pass-through increases ($\beta_1 \to 0$ in Equation 1). Relating this more broadly to trade policy measures, more restrictive trade policy measures (MFN tariff increase, anti-dumping duties, safeguards, and avian flu bans) are expected to have decreased the quantity imported while liberalization events (US TRQ) are expected to have increased the demand for imports.

Table 4 reports results obtained from regression Equation 1 and Equation 3. Starting with the importer price results in column 1, we find that the signs of the coefficients are largely in line with expectations. Specifically, an increase in MFN tariffs corresponds to a reduction in import prices from MFN countries. A 1 per cent increase in MFN tariffs reduces the import price from MFN countries by approximately 1.09 per cent while leading to an additional positive and significant marginal change for preference partners of 1.35 per cent. The overall preference effect is a price increase of 0.21 per cent when estimating the MFN tariff effect on only the subsample of preference countries. Applying this to the 2013 October MFN tariff change (increase from 18 per cent to 37 per cent) for frozen bone-in chicken translates to a 15.02 per cent decrease in prices for MFN countries and a 3.18 per cent increase in prices for preference countries.[27] Coefficients are all highly significant at the 1 per cent level.

[27] $(e^{(\ln\left(\frac{1.37}{1.18}\right)*\beta} - 1) * 100$

Table 4: Pass-through on South Africa chicken import prices

Variables	(1) Ln(Unit Value)	(2) Ln(Quantity)	(3) PPML Quantity
ln(1+tarMFN)	−1.090**	−4.247**	−9.701**
	(0.139)	(0.949)	(1.259)
Dpref*ln(1+tarMFN)	1.353**	4.927**	10.593**
	(0.115)	(0.788)	(1.115)
ln(1+safeguard)	−0.859**	−1.309**	−1.386**
	(0.053)	(0.366)	(0.399)
ln(1+AD)	−0.253**	−2.739**	−5.961**
	(0.047)	(0.322)	(0.433)
US TRQ	−0.216**	1.114**	3.263**
	(0.059)	(0.404)	(0.382)
Avian Ban	−0.089**	−1.188**	−4.115**
	(0.022)	(0.153)	(0.332)
ln(Ex Rate)	−0.012	−0.082	−0.048
	(0.017)	(0.115)	(0.168)
ln(GDP)	0.082*	0.288	0.006
	(0.041)	(0.277)	(0.407)
ln(P int)	0.089**	−0.409*	−0.764**
	(0.023)	(0.160)	(0.219)
Constant	0.773	-6.261	2.046
	(0.827)	(5.653)	(8.457)
Observations	4,177	4,177	23,232
R-squared	0.568	0.412	

Note: all estimates at the firm-origin-time level for frozen bone-in chicken; fixed effects included for firms, origin, and time (year and quarter); columns 1 and 2 present estimation results for dependent variables' log of unit value in rands and log of quantity in millions, using reghdfe (Correia 2014); column 3 uses ppmlhdfe (Correia 2019) for quantity in millions to account for zero trade values; standard errors reported in parenthesis with significance levels indicated as follows: ** p<0.01, * p<0.05, + p<0.1.

Source: authors' construction based on National Treasury and UNU-WIDER (2022).

Other protectionist trade measures (safeguards, anti-dumping duties, and avian flu bans) have the expected negative coefficients, also indicating some absorptive capacity among exporters in response to more restrictive trade policy measures, particularly safeguard duties, where foreign exporters absorb almost 86 per cent of changes. However, domestic consumers bear the majority of the costs arising from anti-dumping duties. The US TRQ liberalization event exhibits a significant negative effect. The coefficient suggests that it led to a 19.42 per cent reduction in import prices.[28] This is in line with the descriptives presented earlier, as US imports represent

[28] $100(e^{\beta} - 1)$

relatively cheaper varieties.[29] Avian flu bans also have a negative effect on import prices of 8.52 per cent.

Controls for GDP and international price variables exhibit positive and significant coefficients, although the sensitivity is not very strong—a 1 per cent increase in the international price of frozen chicken and GDP leads to a 0.089 per cent and 0.082 per cent increase in the landed price of chicken imports, respectively. Interestingly, changes in the exchange rate do not seem to affect import prices. This could be a result of foreign exporters targeting price stability in their export markets (Cirera 2014; Edwards and Hlatshwayo 2020).

Columns 2 and 3 estimate the quantity responses from Equation 3. The results indicate that there are strong and significant quantity responses to changes in MFN tariffs—frozen bone-in chicken imports from MFN countries decrease significantly by approximately 4.25 per cent in response to a 1 per cent increase in tariffs. This is significantly different to import responses from preference origins, which exhibit a positive and significant marginal effect. Overall, the preference-country response ($\beta_1 + \beta_2$) to the MFN tariff change in 2013 is positive, suggesting substitution between MFN and preference countries in line with our earlier discussions. However, this response is not statistically significantly different from zero. Nonetheless, the quantity results contradict the price pass-through results of the preceding column. If exporters absorb the full tariff change, standard economic theory would suggest a limited quantity response, as the final imported price facing importers/consumers does not change. A reduction in import quantities would be consistent with imperfect or full pass-through of tariffs. Other restrictive trade measures such as safeguards and anti-dumping duties decrease import quantities by 1.31 per cent and 2.73 per cent respectively for every 1 per cent increase.

To further investigate this inconsistency, we also present results on aggregate firms and quantities at the country level (see Appendix Table A2). The results indicate that the number of firms serving MFN countries decreases in response to higher MFN tariffs, a finding that extends to the other restrictive trade measures, while the number of firms importing from the USA increases significantly due to the US TRQ. The aggregate quantity results reveal a similar trend. The responses for preference countries remain insignificant.

One possible explanation for this can be gleaned from the Poisson pseudo-maximum likelihood (PPML) results in column 3 which account for zero trade values (Santos Silva and Tenreyro 2006). The effects of tariffs and other trade measures are amplified by the inclusion of zero trade values, while still being highly significant. A 1 per cent rise in MFN tariffs now corresponds with a 9.71 per cent decrease in the quantity imported. In the case of safeguards and anti-dumping duties, import quantities are reduced by 1.39 per cent and 5.96 per cent respectively when accounting for zero trade values. Avian flu bans have a similarly negative impact on import quantities across both specifications while the US TRQ liberalization event significantly increases import quantities. Both are significantly amplified when accounting for zero trade values.[30]

This points to the importance of considering not only those varieties that continue (intensive margin) but also those that enter and exit (extensive margin). Furthermore, not accounting for

[29] Among South Africa's major import origins, the USA has the lowest average price of frozen bone-in chicken (see Figure 3).

[30] This is not surprising given that US imports were practically non-existent prior to the US TRQ, while avian flu bans represent a 'terminating' restriction where all imports from targeted countries have to cease.

zero trade values ignores a significant portion of data and omits key information.[31] The importer price analysis in column 1 of Table 4 considers only the firm intensive margin and ignores entry and exit of varieties over time. To explore the significance of the extensive margin more directly, we identify the response of varieties as in Equation 4 for MFN and preference-country subsamples separately.[32]

Equation 4:

$$Dtrade_{fijt} = \beta_1 \ln(1 + tarMFN_{it}) + \beta_2 \ln(1 + tarMFN_{it}) * DPref_j + \beta_3 DPref_j + \beta_4 \ln(1 + Safeguard_{ijt}) + \beta_5 \ln(1 + AD_{ijt}) + \beta_6 US\ TRQ_{ijt} + \beta_7 AvianBan_{jt} + Controls + \varepsilon_{fijt}\ for\ DPref_j \in 0.1$$

where $Dtrade_{fijt}$ is equal to 1 when a firm f imports product i (frozen bone-in chicken) from country j at time t.[33] All other variables are maintained as before. Therefore, the specified model measures the extent to which the probability of a firm trading with a country changes in response to the various trade policy measures. We expect more restrictive trade measures to reduce the probability of trading and liberalization events to increase the probability of a firm trading with affected origin(s). For example, an increase in MFN tariffs leads to increased costs of trading with MFN origins, leading to a lower chance of firms trading with these origins, reducing the number of MFN varieties, and vice versa.

The results of Equation 4 are presented in Table 5. Columns 1 and 2 present the results for the MFN ($DPref_j \in 0$) and preference ($DPref_j \in 1$) subsamples respectively. The October 2013 MFN tariff increase from 18 per cent to 37 per cent reduces the probability of firms trading with MFN countries by 8.11 percentage points.[34] Conversely, the negative MFN effect corresponds with an increase in the probability of firms trading with preference origins by 4.64 percentage points.[35] These results, although different from the importer price results obtained in column 1 of Table 4, confirm the firm-level quantity results and aggregate results where the aggregate import quantity and number of firms decrease from MFN countries. This implies that there is some price effect on importers/consumers in South Africa. Additionally, the opposite effects on the probability of trading with MFN and preference countries provide evidence of a substitution effect, although this is not as clear in the earlier firm-level analysis.

[31] The number of observations inclusive of zero trade values rises to 21,232 from 4,177.

[32] We separate the full sample into two subsamples (MFN and preference) for these estimations, as the probabilities and changes across samples are not easily additive/comparable.

[33] This is essentially a dummy variable that is unity for a variety being traded/imported in time t. Recall that a variety refers to a firm-origin combination for frozen bone-in chicken.

[34] $\left(\ln\left(\frac{1.37}{1.18}\right) * \beta\right) * 100$

[35] These effects are significant when compared with the average share of firm-origin combinations (varieties) over the period of analysis (12.86%), affecting 63.06% and 36.08% of these varieties respectively.

Table 5: Extensive margin, 2012–19

	(1)	(2)	(3)	(4)
		Dtrade		
Variables	MFN	Pref.	MFN	Pref.
ln(1+tarMFN)	−0.543**	0.311**	−0.144	0.742**
	(0.071)	(0.081)	(0.427)	(0.259)
Lag mean price			0.287*	0.029
			(0.128)	(0.073)
Lag mean price*ln(1+tarMFN)			−1.025*	−0.188
			(0.428)	(0.252)
US TRQ	0.089**		0.551**	
	(0.013)		(0.196)	
ln(1+safeguard)		−0.179**		−0.322+
		(0.045)		(0.167)
ln(1+AD)		−0.931**		−1.257**
		(0.035)		(0.105)
Avian ban		−0.331**		−0.611**
		(0.011)		(0.045)
ln(Ex Rate)	−0.082**	−0.240**	−0.153**	−0.318*
	(0.014)	(0.047)	(0.055)	(0.128)
ln(GDP)	0.304**	−0.098**	0.700**	−0.112
	(0.040)	(0.037)	(0.177)	(0.111)
ln(P Int)	−0.083**	0.043+	−0.294*	0.076
	(0.030)	(0.025)	(0.139)	(0.072)
Year	0.037**	0.050**	0.048**	0.045**
	(0.002)	(0.004)	(0.011)	(0.012)
Observations	11,616	14,048	1,507	2,621
R-squared	0.283	0.277	0.242	0.268

Note: all estimates at the firm-origin-time level for frozen bone-in chicken; fixed effects included for firms, origin, and time (quarter); dependent variable across all specifications (Dtrade) takes on a value of unity if a firm imports frozen bone-in chicken from country j at time t and zero otherwise; columns 1 and 3 present results for MFN subsample while columns 2 and 4 present results for preference subsample; standard errors reported in parenthesis with significance levels indicated as follows: ** p<0.01, * p<0.05, + p<0.1.

Source: authors' construction based on National Treasury and UNU-WIDER (2022).

The probability responses to other restrictive trade measures (anti-dumping, safeguards, and avian flu bans) are consistent with our expectations, exhibiting negative and significant effects, while the US TRQ liberalization event boosts the probability of firm imports from the USA.

To investigate the extensive margin dynamic further, columns 3 and 4 present estimations to discern the relationship between prices and the probability of trading. More specifically, we include a dummy variable that equals unity if the lagged import price value exceeds the mean (lag mean price), along with its interaction with MFN tariffs (Lag mean price*ln(1+tarMFN)), as a covariate in Equation 4. The expectation is that higher-priced varieties, determined by import prices above the mean threshold, in the previous period will have a negative relationship with the probability of trading in the current period when facing higher MFN tariffs. In other words, more expensive varieties, as determined by the mean threshold, are expected to have a lower probability of continuing relative to lower-priced varieties from MFN countries, in response to higher MFN tariffs. The results in column 3 confirm our expectations. Intuitively this makes sense—higher tariffs increase costs, which leads to a lower probability of these varieties continuing. The coefficients on our other covariates are robust across specifications.

Overall, the results across Table 4 and Table 5 suggest that in studying importer price effects, it is not sufficient to focus only on the intensive margin. Economic shocks (trade policy measures in our case) lead to entry and exit of firms and varieties, as seen in Figure 5 and confirmed in our firm-level analysis above. Ignoring extensive margin adjustments can distort pass-through effects, leading to an underestimation of the degree to which prices are passed on to importers and subsequently the impact on consumer welfare (Feenstra 1994).

We now shift to an alternative approach to estimating the importer price and welfare effect that explicitly accounts for changes in varieties, namely the price index approach of Feenstra (1994).

5.2 Aggregate-level analysis

Feenstra (1994) provides a framework to adjust for variety changes over time to estimate the price index and income elasticities of US consumers more accurately. This allows one to more accurately evaluate the price and welfare implications arising from economic shocks. Feenstra's (1994) framework builds on a standard constant elasticity of supply (CES) unit-cost function and the associated exact price index of Sato (1976) and Vartia (1976):

Equation 5:

$$P_{exact} = \prod_{i \in I} \left({}^{p_{i,t}}/_{p_{i,t-1}} \right)^{w_{i,t}(I)}$$

where $w_{i,t}(I)$ is the weight factor representing the ratio of the cost shares ($s_{i,t}(I) = {}^{p_{i,t}x_{i,t}}/_{\sum_{i \in I} p_{i,t}x_{i,t}}$) in a hypothetical two-period model:

Equation 6:

$$w_{i,t}(I) = \frac{{}^{s_{i,t}(I) - s_{i,t-1}(I)}/_{lns_{i,t}(I) - lns_{i,t-1}(I)}}{\sum_{i \in I} {}^{s_{i,t}(I) - s_{i,t-1}(I)}/_{lns_{i,t}(I) - lns_{i,t-1}(I)}}$$

The exact price index of Sato (1976) and Vartia (1976) allows one to deal with compositional shifts over time. This can be thought of as the 'common-goods' component which captures the price effects of overlapping varieties over the two time periods (Amiti et al. 2019). Feenstra (1994) extends the exact price index by utilizing an adjustment factor $\theta = (\lambda_t / \lambda_{t-1})^{1/(\sigma-1)}$.

Equation 7:

$$\lambda_r = \sum_{i \in I} p_{i,r} x_{i,r} \Big/ \sum_{i \in I_r} p_{i,r} x_{i,r}$$

for $r = t-1;\ t$, which allows one to account for variety changes over time, conditional on a subset of overlapping varieties over the two time periods (Feenstra 1994). Specifically, the ratio represents the share of expenditure by consumers in period t on a goods set I relative to the entire goods set $I_t (I \in I_t)$. The variety-adjusted price index proposed by Feenstra (1994) is presented in Equation 8.

Equation 8:

$$P_{v\_adj} = \prod_{i \in I} (p_{i,t} / p_{i,t-1})^{w_{i,t(I)}} * \theta$$

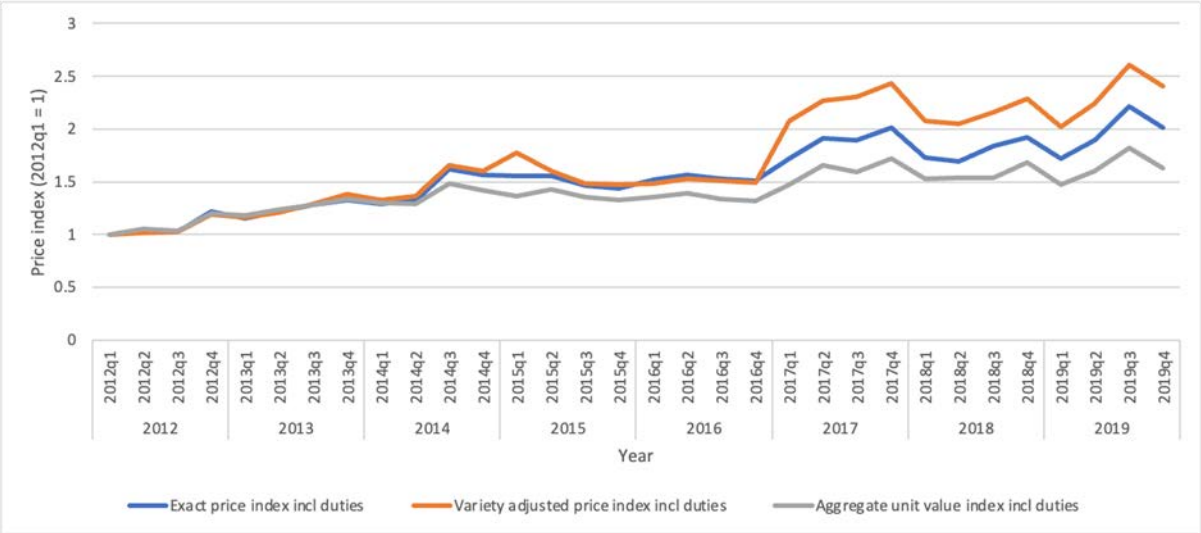
Following from this, an increase in the number of varieties consumed in period t relative to $t-1$ would reduce the variety-adjusted price index (P_{v_adj}), while a decrease in the number of varieties would increase P_{v_adj}. An intuitive way of thinking about this is that the price rises so much that it becomes prohibitively expensive for consumers, leading to disappearing varieties (Feenstra 1994). The extent to which the variety-adjusted price index increases (decreases) is dependent on two key variables. The first is the share of expenditure on the disappearing (new) varieties: the greater the share new varieties represent in consumers' expenditure share, the further P_{v_adj} falls. Therefore, P_{v_adj} could increase even if there is a net increase in total varieties, if exiting varieties represent a large share of expenditure. The second variable is the elasticity of substitution (σ).

Feenstra (1994) applies the adjustment mechanisms to six manufactured products imported into the USA from 1964 to 1987 and finds that previously estimated income elasticities for these US imported products were overestimated due to the failure to account for changing varieties over time, particularly imports from developing countries. Broda and Weinstein (2006) extend Feenstra's (1994) analysis by applying the 'Feenstra Index' to highly disaggregated data at the product level to estimate exact aggregate price indexes and welfare calculations at the national level for the period 1972–2001. Overall, Broda and Weinstein (2006) find that the growth of varieties is significant for the US economy and ignoring changes in varieties overestimates the true aggregate price effect by around 28 per cent for the full period. This has implications for the consumer price index (CPI), as using unadjusted price index measures will lead to significant biases. These biases can be misconstrued to be welfare negative, whereas in reality the higher unadjusted prices represent a higher premium that consumers are willing to pay for different varieties (Broda and Weinstein 2006).

More recently, Amiti et al. (2019) and Fajgelbaum et al. (2020) also utilize the 'Feenstra Index' approach to analyse the effects of the 2018 trade war between the USA and China. Both papers find evidence of complete pass-through of tariff increases to consumer prices. When variety is taken into account, the effects of these tariffs on prices is larger than what the unadjusted prices would suggest, due to the prohibitive effects of higher tariffs leading to exiting varieties (Amiti et al. 2019).

We follow Feenstra's (1994) approach and construct cumulative-level price indexes, initially assuming an elasticity of substitution of 4.[36] Figure 6 illustrates the three indexes for the full (aggregated) sample where all origin countries are aggregated together for frozen bone-in chicken imports. The exact price index is constructed as in Equation 5, the variety-adjusted exact price index constructed as in Equation 8, and the aggregate unit value index constructed as the mean aggregate unit value. All three indexes are indexed to 2012 quarter 1 (2012q1), the start of our analysis period and inclusive of all duties,[37] as this captures the prices paid by importers.[38] Periods where the aggregate unit value index lies below the exact price index correspond to periods where importers, and by extension consumers, purchase lower-priced import bundles (composition effect). Periods where the exact price index lies above the variety-adjusted exact price index correspond to periods where importers purchase a greater variety of imports (variety effect).

Figure 6: Aggregated cumulative price index trends, 2012–19 (2012q1 = 1)



Note: data aggregated to the quarterly level where all origin countries are aggregated for frozen bone-in chicken; cumulative price index calculated as the product of prior quarter price index (indexed to 1 in 2012q1) and price ratio in current quarter.

Source: authors' construction using National Treasury and UNU-WIDER (2022).

A few key observations can be made from Figure 6. First, the three indexes largely move together until 2014. Post-2014, the exact price index and variety-adjusted price index diverge from the aggregate index. The diverging trends lend legitimacy to our earlier claims that looking at price alone yields inaccurate results and emphasizes the need to consider the extensive margin (varieties). Second, the exact price index lies strictly above the aggregate price index. This indicates a compositional effect whereby consumers are buying lower-priced goods in their import bundles.

Third, the variety-adjusted exact price index line shows large fluctuations over time. There does seem to be some reduction, albeit not very conclusive, in varieties around October 2013 when MFN tariffs increased. However, more noticeable is the massive spike and sustained higher level of the variety-adjusted price index from 2016 onwards. This spike coincides with the multitude of restrictive trade measures imposed on EU (preference) countries since late 2016. This, together with the already higher MFN tariffs imposed from October 2013 on MFN countries, puts added

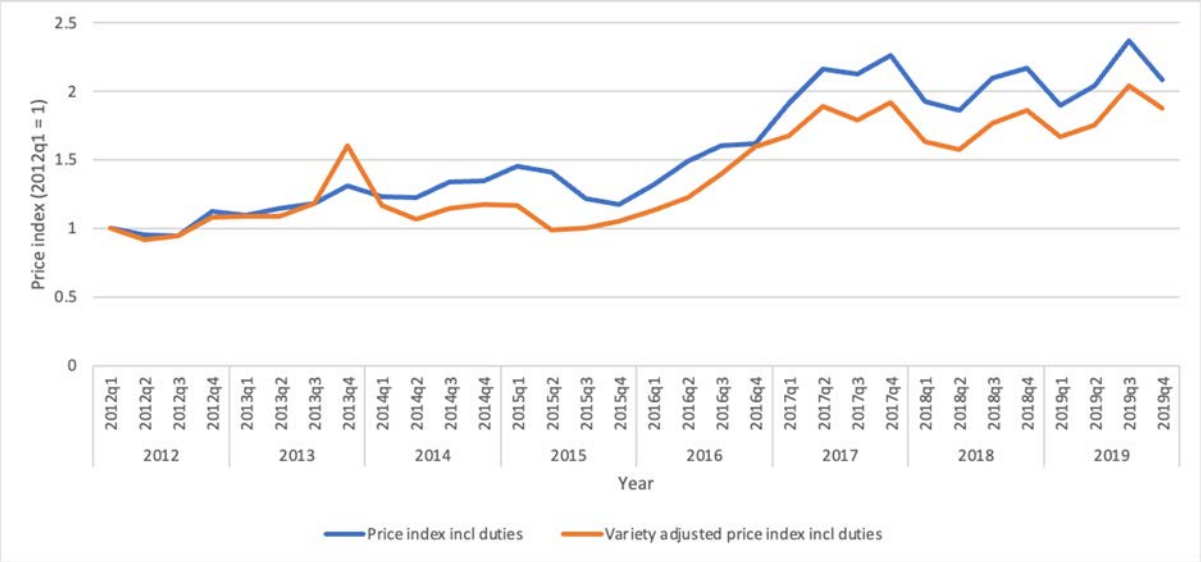
[36] The sensitivity of our results to the elasticity of substitution is tested later (see Section 5.3).

[37] All duties include applied tariffs, anti-dumping duties, and safeguard duties.

[38] This is the same approach adopted by Amiti et al. (2019).

pressure on importers and consumers. Not only did they face higher MFN tariffs, but in 2016 they also faced new higher barriers to importing from preference countries. These restrictions reinforce each other, creating increasingly binding constraints, thus forcing varieties to disappear. Fourth, the period between 2015 and 2016 coincides with the US TRQ liberalization event which leads to lower average prices, as evidenced by the downward trajectory of the variety-adjusted price index. The variety effect over this period, however, is not so clear. To better understand the separate contributions towards the aggregate price indexes, particularly relating to changes in variety, we present Figure 7, Figure 8, and Figure 9 for separately aggregated subsamples relating to MFN countries excluding the USA, USA, and preference partners, respectively. These three groups represent the key import origins targeted by South African trade policy over our period of analysis.

Figure 7: MFN sample excluding USA—cumulative price index trends, 2012–19 (2012q1 = 1)



Note: data aggregated to the country group level—USA, MFN excluding USA, and preference-country groups for frozen bone-in chicken; cumulative price index calculated as the product of prior quarter price index (indexed to 1 in 2012q1) and price ratio in current quarter.

Source: authors' construction using National Treasury and UNU-WIDER (2022).

Starting with Figure 7, which looks at the subsample of MFN countries excluding the USA, we now see a noticeable spike in the variety-adjusted price index coinciding with the increase of MFN tariffs in October 2013. This indicates a reduction in varieties imported from MFN countries. However, this seems to be temporary, as the variety-adjusted index declines below the exact price index from 2014 onwards.

Figure 8: USA cumulative price index trends, 2012–19 (2012q1 = 1)

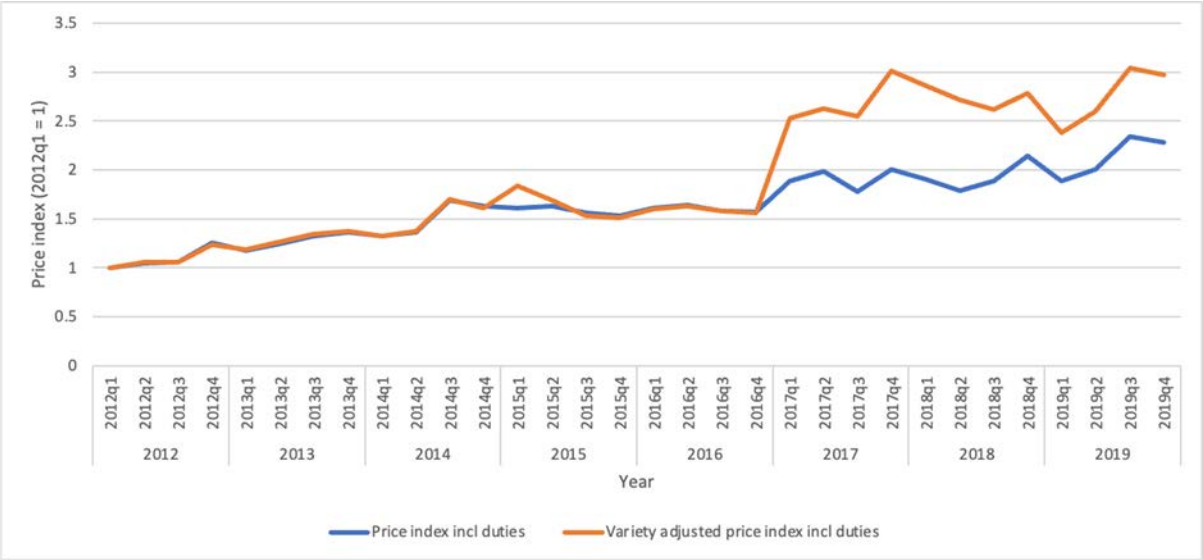
Note: data aggregated to the country group level—USA, MFN excluding USA, and preference-country groups for frozen bone-in chicken; cumulative price index calculated as the product of prior quarter price index (indexed to 1 in 2012q1) and price ratio in current quarter.

Source: authors' construction using National Treasury and UNU-WIDER (2022).

Figure 8 presents the price index trends for only the USA. Index trends are unity prior to 2016, as previous anti-dumping duties were prohibitively binding, leading to no imports from the USA. Given that the USA was subject to a liberalization event, unlike with the other restrictive trade policies implemented against MFN and preference partners, it is unsurprising to see an increase in varieties commencing in 2016 when the US TRQ was implemented.

For preference countries, in Figure 9, the price index trends are quite stable until the end of 2016, when there is a noticeable decrease in the number of varieties, as evidenced by the significant increase in the variety-adjusted price index above the exact price index. This once again reinforces our earlier findings that the compounding protectionist trade policy measures imposed on the EU were highly restrictive, leading to disappearing varieties. Interestingly, comparing this period with those of Figure 7 and Figure 8, varieties increased from MFN countries (including from the USA), suggesting that there is some substitution effect. The period corresponding with the MFN tariff increase in October 2013 does show some minor increase in varieties and evidence of substitution, although this effect is hardly noticeable in Figure 9. This is not very surprising considering that the firm-level responses presented earlier yielded changes that were not statistically significant.

Figure 9: Preference sample cumulative price index trends, 2012–19 (2012q1 = 1)



Note: data aggregated to the country group level—USA, MFN excluding USA, and preference-country groups for frozen bone-in chicken; cumulative price index is calculated as the product of prior quarter price index (indexed to 1 in 2012q1) and price ratio in current quarter.

Source: authors' construction using National Treasury and UNU-WIDER (2022).

To provide more concrete evidence of these dynamics, we estimate Equation 9 to empirically test for the presence of any statistically significant relationship among tariffs, other trade measures, and the various prices indexes.

Equation 9:

$$\begin{aligned}\ln\left(Price\ Index_{igt}\right) &= \alpha_t + \beta_1 \ln(1 + tarMFN_{it}) + \beta_2 \ln(1 + tarMFN_{it}) * DPref_g \\ &+ \beta_3 DPref_g + \beta_4 \ln\left(1 + Safeguard_{igt}\right) + \beta_5 \ln\left(1 + AD_{igt}\right) \\ &+ \beta_6 US\ TRQ_{igt} + \beta_7 AvianBan_{gt} + \beta_8 \ln e_{gt} + \beta_9 \ln p^*_{igt} + \mu_j + \mu_f \\ &+ \varepsilon_{figt}\end{aligned}$$

$Price\ Index_{igt}$ represents the exact price index, the variety-adjusted price index, or the aggregate unit value index inclusive of all duties[39] for product i (frozen bone-in) from country group g at time t. For our estimations, origin countries are aggregated to two country groups, MFN and preference countries.[40] Given that we are using duty-inclusive prices in our specifications, we now expect the β_1 coefficient to range between 0 and 1.[41] β_2, representing the marginal impact of preference partners, is still expected to be positive. We also identify the variety-specific effect by using only the variety bias ($Variety_{igt}$) component as the dependent variable, where $Variety_{igt}$ is constructed by taking the difference between the exact price index and the variety-adjusted price

[39] All duties include applied tariffs, safeguards, and anti-dumping duties.

[40] The relatively small size of the sample of firms that import frozen bone-in chicken limits the level of aggregation we can use for our price index analysis to the country group level.

[41] Results for price indexes exclusive of duties are presented in Appendix Table A3. Excluding duties essentially reduces the coefficients by unity.

index.[42] Our expectation is that there will be a negative relationship between tariff increases and the variety effect for MFN countries. A positive value for variety indicates that a greater variety of frozen bone-in chicken is being imported, a negative value that less variety is being imported. Additionally, this enables us to decompose the final variety-adjusted price index effect into a continuing variety (intensive margin) effect and an entry/exit (extensive margin) variety effect as was done in Amiti et al. (2019). Results from Equation 9 estimations are reported in Table 6. Column 1 reports the results from Equation 9 with the aggregate unit value index, followed by the exact price and variety-adjusted price index specifications in columns 2 and 3 respectively. Column 4 presents results from the variety-specific estimation.

Table 6: Price index analysis, 2012–19

	(1)	(2)	(3)	(4)
Variables	Ln(Aggregate UV Index)	Ln(Exact Price Index)	Ln(Variety-Adjusted Price Index)	Ln(Variety)
ln(1+tarMFN)	0.112	0.392	0.912+	-0.521
	(0.483)	(0.361)	(0.485)	(0.349)
Dpref*ln(1+tarMFN)	0.773	−0.056	0.193	−0.249
	(0.506)	(0.378)	(0.508)	(0.365)
ln(1+safeguard)	0.220	0.430*	0.442+	−0.012
	(0.229)	(0.171)	(0.230)	(0.165)
ln(1+AD)	1.515*	1.264**	2.411**	−1.147*
	(0.621)	(0.464)	(0.624)	(0.449)
US TRQ	−0.080	0.283*	−0.327+	0.610**
	(0.181)	(0.135)	(0.182)	(0.131)
Avian Ban	−0.031	0.047	0.618**	−0.571**
	(0.110)	(0.082)	(0.110)	(0.079)
ln(Ex Rate)	−0.631+	−0.539+	−0.540	0.000
	(0.369)	(0.276)	(0.370)	(0.266)
ln(P int)	0.814*	0.767**	0.638+	0.128
	(0.338)	(0.252)	(0.339)	(0.244)
Constant	1.655*	−0.781	−0.721	-0.060
	(0.719)	(0.537)	(0.721)	(0.519)
Observations	64	64	64	64
R-squared	0.826	0.951	0.967	0.970

Note: all estimates at the country group (MFN and preference)-time level for frozen bone-in chicken; fixed effects included for country group and time (year and quarter); columns 1–3 dependent variable is log of duty-inclusive price indexes; column 4 presents results for log of variety, constructed as the difference between log of exact price index and variety-adjusted price indexes; results assume elasticity of substitution value equal to 4; standard errors reported in parentheses; ** p<0.01, * p<0.05, + p<0.1.

Source: authors' construction based on National Treasury and UNU-WIDER (2022).

[42] ln (Exact $Price\ Index_{igt}$) − ln (Variety Adjusted $Price\ Index_{igt}$).

Columns 1 and 2 present very similar results and levels of significance across all covariates. The non-significance of coefficients relating to $\ln(1 + tarMFN_{it})$ and $\ln(1 + tarMFN_{it}) * DPref_g$ means that we cannot meaningfully conclude any significant responses different from zero. A zero coefficient suggests no change in duty-inclusive import prices. In other words, foreign exporters fully absorb the tariff change for MFN countries, in line with our firm-level findings in Table 4, column 1, while preference countries maintain their prices as they are not subject to MFN tariffs.

However, after adjusting for varieties in column 3, we find a significant effect for $\ln(1 + tarMFN_{it})$, providing evidence of tariff pass-through to import prices. The magnitude indicates that for every 1 per cent increase in MFN tariffs, the import price inclusive of duties will increase by approximately 0.91 per cent, an almost complete pass-through of tariffs to importers and consumers, thus reducing their welfare. Breaking this down, not only does a 1 per cent increase in MFN tariffs raise the tariff-inclusive price of continuing varieties by 0.39 per cent, but the increase in tariffs also raises the import price indexes by an additional 0.52 per cent, as some varieties become prohibitively expensive because of the higher tariffs. Ignoring the entry and exit of varieties would thus result in an underestimation of importer price effects by more than half (57.13 per cent).[43] Relating this to the MFN increase in October 2013, this would have translated into a total price increase of approximately 14.59 per cent. However, a limitation here is the weak significance of the coefficients.

The non-significance of the interaction term (β_2) coefficient suggests that preference-country price response does not differ significantly from that of MFN countries. This would imply that preference countries hike their prices in response to MFN tariff increases, thus taking advantage of their higher tariff preference margin and capturing a greater share of rents, in line with literature by Chang and Winters (2002), Cirera (2014), and Olarreaga and Özden (2005). However, given the low level of significance, further checks need to be conducted for robustness (see Section 5.3).

Other restrictive trade measures also present some interesting findings largely in line with our expectations. Of note is the greater-than-unity (2.41 per cent) and significant anti-dumping coefficient. This is more pronounced than the earlier firm-level results, amplified by variety adjustments, and it supports the findings by Blonigen and Haynes (2002), Nizovtsev and Skiba (2019), and Sandkamp (2020) who find anti-dumping duties to have the most pronounced response in importer price—at times greater than unity—relative to other trade policy measures. Ignoring the entry and exit of varieties relating to anti-dumping duties would underestimate the importer price effects by almost half (47.57 per cent). The liberalization event brought about by the US TRQ leads to an increase in varieties, which has a dominating effect while reducing average import prices by 27.89 per cent. The avian flu bans and safeguard duties, as expected, lead to a reduction in varieties, although this finding lacks meaningful significance in the case of safeguards. Avian flu bans in particular have a prohibitively binding effect, increasing prices by 85.52 per cent. These effects suggest that these other trade measures are more binding on importers and consumers than MFN tariff changes.

International prices are positively correlated with our import price, which is to be expected, while the exchange rate has no significant impact on import prices once varieties have been accounted for. This is in line with our findings earlier at the firm level.

Overall, our results present evidence of the important role that varieties play in identifying the effects on importer prices and welfare of not only tariffs but also other trade policy measures. Not

[43] $0.521/0.912 = 0.571271929 * 100 = 57.13\%$.

only do trade measures have a pass-through effect on the import price of continuing varieties, but disappearing varieties also contribute to the overall welfare effect on importers and consumers, as these become prohibitively expensive to continue. In particular, our results indicate highly significant negative effects of anti-dumping duties and avian flu bans that are more binding than the MFN tariff effect. This seems logical, as these trade policy measures are often more targeted to specific origins and foreign exporters, resulting in binding constraints on these importers and consumers relative to the broader, less specific MFN tariffs, the results of which are less convincing in our estimations but still nonetheless point to a reduction in welfare due to higher prices from both MFN and preference countries. This also works in reverse. The positive effects arising from the US TRQ liberalization event emphasize the positive welfare effects that can arise when a country adopts a more 'liberal' approach to trade policy, with benefits arising from entry of new varieties and lower average prices.

5.3 Robustness

Numerous robustness checks were done for our analysis. First, specifications were tested for robustness to the exclusion of warehousing import classifications (Customs Procedure Code/CPC E4000). Warehousing transactions falling under CPC code E4000 are imports that do not immediately enter the domestic market for consumption. This creates complexities, as the customs-transaction-level data do not provide information that allows one to track each consignment. Therefore, we are unable to determine with accuracy when a specific consignment of warehoused goods is subsequently released from the warehouse. These results are presented in Appendix Table A4; they indicate with high levels of significance that tariff pass-through to importer prices is complete after controlling for varieties. Additionally, import varieties decrease in response to restrictive trade measures and increase in response to liberalization events, as expected. If anything, the results suggest more aggressive negative adjustments in response to the MFN tariff increase in October 2013.

Second, we test the sensitivity of our results to different elasticity-of-substitution parameterizations. We re-estimate Equation 9, presenting results for elasticity-of-substitution (sigma) values equal to 2 and 8 respectively. These results can be found in Appendix Tables A5 and A6. Once again, the results largely hold their significance across estimation results. Even though the MFN tariff effect on MFN countries loses significance for the sigma $(\sigma) = 8$ specification, the preference response is robust, reinforcing our earlier finding that preference partners take advantage of their tariff preference rent.

Overall, the variety effect is negatively affected by higher elasticity-of-substitution parameterizations (i.e., higher elasticity-of-substitution values dampen the negative variety response to higher tariffs). This is logical—more substitutable varieties are less affected by restrictions, as importers and consumers can more easily switch between varieties without incurring large costs.

Notably, the effects on anti-dumping, safeguards, avian flu bans, and the US TRQ liberalization event remain robust and largely highly significant across all robustness checks, both with the exclusion of warehousing transactions and the various elasticity-of-substitution parameterizations. This reinforces our earlier findings that these more targeted trade policy measures are more binding and effective at restricting imports from specific origins. Although some trade policy measures may be necessary from the perspective of needing to protect consumer health from diseases such as avian flu, this can be dangerous if applied recklessly and maintained longer than is necessary due to their welfare-negative implications.

6 Conclusions

This paper used the South African poultry industry and in particular frozen bone-in chicken as a case study to better understand how tariff policy affects import prices in the context of preferential trade agreements. Using highly disaggregated customs-transaction-level data (National Treasury and UNU-WIDER 2022) over the period 2012 to 2019, we assessed the impact of MFN tariffs and other trade measures on frozen bone-in chicken imports.

Focusing first on the firm-level impact of tariffs on import prices and import quantities, our results suggest that exporters from MFN countries fully absorb MFN tariff increases in the form of lower export prices while preference partners increase prices marginally (by 0.21 per cent). However, our results reveal significant quantity and firm adjustments in response to the MFN tariff increase. A 1 per cent increase in the MFN tariff reduces the quantity imported by approximately 4.25 per cent, rising to 9.70 per cent once zero trade values are accounted for. Furthermore, we estimate that the probability of firm imports of frozen bone-in chicken from MFN countries decreased by approximately 8.11 percentage points in response to the MFN tariff increase from 18 per cent to 37 per cent in October 2013. In response to higher MFN tariffs, firms are less likely to import from MFN countries, reducing the imported varieties available to South African consumers. A more thorough investigation revealed that imports of higher-priced varieties are less likely to continue in response to higher MFN tariffs, which provides a key link between prices and the extensive margin. Therefore, failure to account for extensive-margin adjustments (changing varieties) will lead to an underestimation of the importer price effects.

Given the active extensive margin and accompanying downward bias, the analysis then shifted to the more aggregated price index approach pioneered by Feenstra (1994), which adjusts for changing varieties. The results here showed that increasingly restrictive trade measures in the form of higher tariffs, anti-dumping, safeguards, and avian flu bans have increased the price of consumption of frozen bone-in chicken above what would be predicted on the basis of continuing varieties alone. First, the price estimates now reveal an almost complete pass-through of tariffs to import prices (91 per cent) after varieties are controlled for, with varieties accounting for more than half of the effect (57.13 per cent), although these results are not very significant. Nonetheless, there is robust evidence of preference partners raising their import prices, thus taking advantage of their tariff preference margin to capture larger rents. Although PTAs have the potential to generate some relief for consumers by shielding importers from tariffs, this does not seem to have happened, as our findings suggest an increase in their mark-ups instead. Thus, higher MFN tariffs do not seem to be very effective in achieving their objectives, instead acting to grant PTA exporters greater protection.

Second, other trade policy measures also exhibit strong influences on importer prices after accounting for varieties, particularly anti-dumping and avian flu bans, resulting in price increases of 2.41 per cent for every 1 per cent increase in anti-dumping duties and 85.52 per cent in response to avian flu bans. These restrictive trade measures constrain import varieties, accounting for 47.57 per cent and 92.39 per cent of the overall negative importer price effect, respectively. On the other hand, the US TRQ liberalization event shows a large positive effect, reducing prices by around 27.89 per cent, driven predominantly by new varieties. This shows the positive welfare effects that can arise if governments and policy-makers allow for greater competition. These other trade policies seem to be more binding and result in larger responses (both negative and positive) from importers and consumers. This is not surprising given that these policies are often more targeted to specific origins and foreign exporters (safeguards, anti-dumping, and avian flu bans on a selection of EU countries and US TRQ on the US only) than MFN tariffs.

6.1 Policy implications

The results of the study suggest that the multitude of trade restrictions imposed on frozen bone-in chicken has hampered imports and reduced consumer welfare. First, there is a complete pass-through of higher tariffs to import prices after accounting for varieties for MFN countries. This is welfare negative.

Second, the non-tariff trade policy measures, namely anti-dumping duties and avian flu bans, result in an unambiguous reduction in varieties imported by importers and consumers, compounding the negative welfare effects. These negative welfare effects are large and significant, indicating the binding nature of the effect that these trade policy measures can have on imports from targeted origins.

Third, the presence of PTAs reduces the effectiveness of trade policy tools such as tariffs. PTAs create tariff preference margins that preference partners can exploit when tariffs increase. This is particularly prevalent when local producers do not have capacity to meet the increased demand generated by more restrictive trade barriers. Unfortunately, structural limitations in South Africa such as load-shedding constrain domestic producers' ability to meet domestic poultry demand even under protectionist policy measures. Further, one of the criticisms of the poultry masterplan is that it has not adequately addressed the structural constraints faced by the South African poultry industry (i.e., high input costs[44] and market access[45]) which also prevent the domestic industry from competing in export markets. While the masterplan acknowledges these issues, implementation has lagged, resulting in further reliance on tariffs and other trade measures. This potentially allows greater scope for preference partners to extract additional rents through higher prices, as is found in our results. In such scenarios not only does the government not receive tariff revenue, but consumers also have to pay higher prices for imports from PTA partners, resulting in a reduction in welfare.

Complicating matters further, the recent outbreak of avian flu in South Africa is a further hindrance to the poultry sector. This, combined with the lapse in the moratorium on anti-dumping measures by Minister Ebrahim Patel in September 2023, will only increase the cost burden on importers and consumers, although the recent short-term 25 per cent rebate on frozen bone-in chicken will provide some relief (ITAC 2023b), albeit temporary.

Fourth, the positive response of importers and consumers to the US TRQ liberalization event provides further insights into the binding nature of trade policies that are very targeted. The removal of such trade policies leads to entry of varieties and reduction in prices. While some trade policy measures may be necessary for the protection of human life (e.g. diseases such as avian flu), policy-makers should be wary of maintaining these policies for longer than is necessary, as they cause distortions in the market, with negative welfare consequences.

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[44] Feed costs account for about 70 per cent of total costs (Ravindran 2010). Considering that input costs are critical to the poultry industry's competitiveness, the animal feed strategy needs to be prioritized to fast-track interventions in the feed value chain, particularly the soybean industry. This should be reinforced by the strategic approach of identifying regional opportunities in the soybean industry. It is acknowledged that a recent shift in the domestic grain industry towards planting soybean meant that South Africa became a net exporter of soybeans in 2023. This will likely be associated with an easing of domestic soybean prices, which will alleviate some of the price pressure on animal feeds.

[45] Currently, South African poultry producers are not eligible for poultry exports to the EU. To alleviate such regulatory constraints, issues of sanitary and phytosanitary (SPS) certification need to be resolved expediently to improve market access for South African poultry meat products (Slater 2022).

The findings of this paper show the importance of coordination of industrial, trade, and competition policy. The fact that tariff and other trade policy changes lead to reductions in varieties reduces competition in the industry, allowing for higher prices. Makgetla (2021) states that economists agree that tariffs are justifiable where they can promote economic diversification or support local producers over short-term difficulties; however, it is difficult to support tariffs and other restrictive trade policy measures that maintain higher prices to protect inefficient local producers. As such, tariffs and other protectionist trade measures should be implemented with a view that local producers will ultimately become globally competitive.

In recent years, there has been an increase in the use of trade protection measures. However, as this paper shows, these policies can have unintended consequences, especially when protection is used while the structural constraints faced by an industry are not addressed. This is true for the South African poultry industry, which has struggled with competition issues, failures in agricultural policy, and an inability to address market access requirements. Thus, further protection without addressing structural constraints results in inflationary pressures on consumers.

Trade policy measures targeting poultry products needs to be cognisant of these dynamics that influence both the effectiveness of trade policy and the welfare outcomes thereof. This is particularly relevant in an environment where the South African consumer—for whom chicken represents a large share of their expenditure and major source of protein, particularly among poorer individuals/households—is increasingly constrained in their disposable income. Trade policy measures, particularly those targeting specific origins, should not be implemented for longer than is necessary.

6.2 Limitations and future work

A limitation of the study is the limited number of observations, particularly for the aggregate price index estimations. Unfortunately, the COVID-19 pandemic precluded us from conducting effective analysis on periods from 2020 onwards. Future research could extend the time period of analysis as more data become available for more recent years, as well as extending this analysis to cover other product categories that have been subject to trade policy interventions.

An additional extension for this study would be to investigate the elasticity-of-substitution parameterization in more depth. This study has assumed an elasticity-of-substitution value of 4 as our base case for our aggregate analysis, showing the robustness of results to different parameterizations. However, a more systematic derivation of this parameter would allow for a more comprehensive interrogation of the dynamics.

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Appendix A: Figures and tables

Table A1: Poultry products and timeline of trade policy interventions

HS	**02071220**	**02071290**	**02071410**	**02071420**	**02071490**
Product	Frozen carcasses	Frozen whole bird	Frozen boneless cuts	Frozen offal	Frozen bone-in cuts
Tariff measure and date of implementation					
5-Jul-00			AD on US imports (224c/kg to 725c/kg)	AD on US imports (224c/kg to 725c/kg)	AD on US imports (224c/kg to 725c/kg)
10-Feb-12		Provisional AD Brazil (62.93%)	Provisional AD Brazil (6.26%-46.59)		
5-Apr-12			AD on USA raised from 224c/kg to 940c/kg	AD on USA raised from 224c/kg to 940c/kg	AD on USA raised from 224c/kg to 940c/kg
10-Aug-12		Provisional AD on Brazil lapses	Provisional AD on Brazil lapses		Provisional AD Brazil lapses
30-Sep-13	MFN Tariff increase (27% to 31%)	MFN tariff increase (27% to 82%)	MFN tariff increase (5% to 12%)	MFN tariff increase (27% to 30%)	MFN tariff increase (220c/kg (18%) to 37%)
4 July 2014—2 Jan 2015					Provisional anti-dumping duties on Netherlands (22.81%), UK (22.03%), and Germany (31.3 to 73.33%)
27-Feb-15					Final anti-dumping duties on Netherlands (3.86% to 22.81%), UK (12.07% to 30.99%), and Germany (31.3 to 73.33%)
End Feb 2016					US TRQ arrangement: Rebate of USA AD on 65 000 tons
Nov-16	Avian flu ban, Netherlands				
15-Dec-16					Prov[isional] safeguard on EU (13.9%)
3-Jul-17					Prov safeguard removed
Mar-17	Avian flu ban, France, Germany, Hungary, Israel, Netherlands, Poland, Spain, United Kingdom				
20-Jun-17	Avian flu ban, Belgium				
2-Jun-17	Avian flu ban, Zimbabwe				

28-Sep-18			Final Safeguard on EU (35.3%)
Sep-18	Avian flu ban lifted Poland and Spain		
12-Mar-19			Safeguard reduced (30%)
11-Feb-20	Avian flu ban lifted, Netherlands		
Late 2019	Avan flu ban reimposed Poland		
12-Mar-20			Safeguard reduced (25%)
Oct-20	As of Oct 2020, 4 Member States pending reinstatement for export of poultry meat to South Africa (Belgium, France, Hungary and Poland)		
13-Mar-20		MFN Tariff increase from 12% to 42%	MFN tariff increase from 37% to 62%)
2-Nov-20	Avian flu ban Netherlands (SPS)		
18-Nov-20	Avian flu ban Denmark (SPS)		
3-Dec-20	Avian flu ban Sweden		
Jan-21	All EU member states banned		
12-Mar-21			Safeguard reduced (15%)
Apr-21			Increase US Quota to 71290 tons
Sep-2021, Autumn 2021	September 2021 HPAI free status restored for FI, BE, FR, HU, IE, PL but again lost by autumn 2021 new outbreaks of HPAI		
17-Dec-21			Provisional anti-dumping duties on selected bone-in chicken products from Poland (up to 96.9%), Brazil (up to 265.1%), Ireland (158.42%) and Spain (up to 26%)
Mar-22	Countrywide Avian flu bans on 14 EU members maintained		
Aug-22			Delay in implementation of final anti-dumping duties on Poland, Spain, Brazil and Ireland

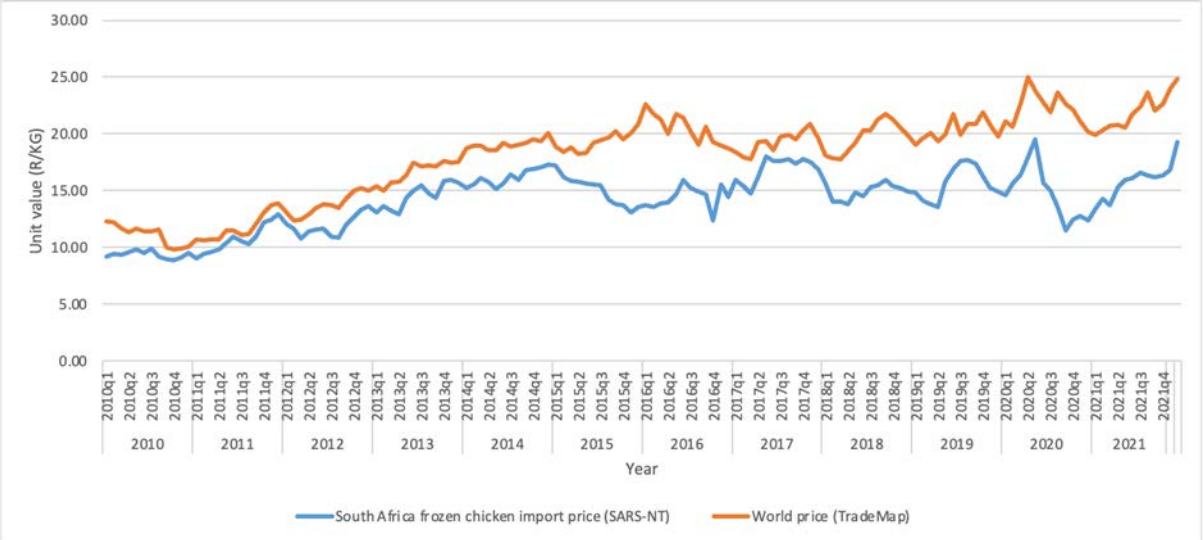
Source: reproduced with permission from Edwards et al. (2022).

Figure A1: Decomposition of import growth excluding the USA, 2010–21

Note: data aggregated to annual firm-origin level for frozen bone-in chicken; intensive margin represents share of import growth accounted for by continuing imports by firms from existing origins; net firm entry represents share of import growth accounted for by entry and exit of firms (firm extensive margin; net origin entry represents share of import growth accounted for by entry and exit of varieties (firm-origin extensive margin); periods represent end-of-year periods, e.g. 2010–11 refers to 2011 as it is the period from the end of 2010 to the end of 2011.

Source: authors' construction using National Treasury and UNU-WIDER (2022).

Figure A2: Trade Map and customs-transaction-level unit value data, 2010–21



Note: frozen chicken SA import price is calculated as the average of the prices of frozen boneless, frozen offal, and frozen bone-in from (National Treasury and UNU-WIDER 2022); world price is compiled from Trade Map (ITC 2023) by taking the export price (unit value) of HS020714 to the rest of the world (world ex-SA) from the 15 largest exporting countries to South Africa: Argentina, Belgium, Brazil, Canada, Denmark, France, Germany, Hungary, Ireland, Netherlands, Poland, Spain, Thailand, UK, and the USA.

Source: authors' construction using Trade Map (ITC 2023) and customs-transaction-level data (National Treasury and UNU-WIDER 2022).

Table A2: Aggregate firms and quantity, 2012–19

	(1)	(2)
	Aggregate firms	Aggregate quantity
Variables	Ln(firms)	Ln(qmill)
ln(1+tarMFN)	−7.632**	−14.256**
	(1.479)	(2.723)
Dpref*ln(1+tarMFN)	8.335**	13.758**
	(1.210)	(2.228)
ln(1+safeguard)	−1.282+	−3.237**
	(0.675)	(1.242)
ln(1+AD)	−4.616**	−6.819**
	(0.446)	(0.820)
US TRQ	3.015**	3.838**
	(0.404)	(0.744)
Avian Ban	−1.987**	−4.222**
	(0.187)	(0.344)
ln(Ex Rate)	−0.124	0.170
	(0.194)	(0.357)
ln(GDP)	−0.260	−0.542
	(0.465)	(0.855)
ln(P int)	0.595*	0.692
	(0.278)	(0.512)
Constant	6.756	11.111
	(9.275)	(17.073)
Observations	340	340
R-squared	0.709	0.797

Note: all estimates aggregated at the country-time level for frozen bone-in chicken; fixed effects for origin and time (year and quarter) included; dependent variables are log of firm count (number of firms) and log of quantity in millions for columns 1 and 2 respectively; standard errors reported in parentheses; ** p<0.01, * p<0.05, + p<0.1.

Source: authors' construction based on National Treasury and UNU-WIDER (2022).

Table A3: Price index analysis (sigma = 4, excluding duties), 2012–19

Variables	(1) Ln(Aggregate UV Index)	(2) Ln(Exact Price Index)	(3) Ln(Variety-Adjusted Price Index)	(4) Ln(Variety)
ln(1+tarMFN)	−0.903+	−0.623+	−0.100	−0.523
	(0.483)	(0.359)	(0.476)	(0.340)
Dpref*ln(1+tarMFN)	1.916**	0.968*	1.193*	−0.225
	(0.506)	(0.376)	(0.498)	(0.356)
ln(1+safeguard)	−0.576*	−0.576**	−0.591*	0.015
	(0.229)	(0.170)	(0.226)	(0.161)
ln(1+AD)	0.422	−0.847+	0.144	−0.992*
	(0.621)	(0.462)	(0.612)	(0.437)
US TRQ	0.010	0.271+	−0.352+	0.623**
	(0.181)	(0.135)	(0.179)	(0.128)
Avian Ban	0.185+	0.045	0.587**	−0.542**
	(0.110)	(0.082)	(0.108)	(0.077)
ln(Ex Rate)	−0.879*	−0.573*	−0.539	−0.034
	(0.369)	(0.274)	(0.364)	(0.260)
ln(P int)	0.965**	0.757**	0.603+	0.154
	(0.338)	(0.251)	(0.333)	(0.238)
Constant	1.745*	−0.583	−0.522	−0.060
	(0.719)	(0.534)	(0.708)	(0.506)
Observations	64	64	64	64
R-squared	0.880	0.886	0.938	0.969

Note: all estimates at country group (MFN and preference)-time level for frozen bone-in chicken; fixed effects included for country group and time (year and quarter); columns 1–3 dependent variable is log of duty-exclusive price indexes; column 4 presents results for log of variety, constructed as the difference between log of exact price index and variety-adjusted price indexes; results assume elasticity of substitution value equal to 4; standard errors reported in parentheses; ** p<0.01, * p<0.05, + p<0.1.

Source: authors' construction based on National Treasury and UNU-WIDER (2022).

Table A4: Price index analysis (sigma = 4, no warehousing—E4000s), 2012–19

Variables	(1) Ln(Aggregate UV Index)	(2) Ln(Exact Price Index)	(3) Ln(Variety-Adjusted Price Index)	(4) Ln(Variety)
ln(1+tarMFN)	0.085	0.082	2.698**	−2.617**
	(0.545)	(0.382)	(0.547)	(0.472)
Dpref*ln(1+tarMFN)	0.919	0.272	−1.734**	2.006**
	(0.571)	(0.400)	(0.572)	(0.494)
ln(1+safeguard)	0.179	0.549**	0.694*	−0.145
	(0.259)	(0.182)	(0.260)	(0.224)
ln(1+AD)	1.569*	1.205*	2.677**	−1.472*
	(0.703)	(0.493)	(0.705)	(0.608)
US TRQ	−0.061	0.175	−1.164**	1.339**
	(0.211)	(0.148)	(0.212)	(0.183)
Avian Ban	-0.079	0.112	0.793**	-0.681**
	(0.124)	(0.087)	(0.124)	(0.107)
ln(Ex Rate)	−0.702	−0.428	−0.373	−0.055
	(0.422)	(0.296)	(0.423)	(0.365)
ln(P int)	0.823*	0.653*	0.485	0.169
	(0.385)	(0.270)	(0.386)	(0.333)
Constant	1.769*	−0.703	−0.840	0.137
	(0.813)	(0.571)	(0.816)	(0.704)
Observations	64	64	64	64
R-squared	0.796	0.940	0.968	0.959

Note: all estimates at country group (MFN and preference)-time level for frozen bone-in chicken; fixed effects included for country group and time (year and quarter); columns 1–3 dependent variable is log of duty-inclusive price indexes; column 4 presents results for log of variety, constructed as the difference between log of exact price index and variety-adjusted price indexes; results assume elasticity of substitution value equal to 4 and exclude warehousing transactions (E4000s); standard errors reported in parentheses; ** p<0.01, * p<0.05, + p<0.1.

Source: authors' construction based on National Treasury and UNU-WIDER (2022).

Table A5: Price index analysis (sigma = 2, including duties), 2012–19

Variables	(1) Ln(Aggregate UV Index)	(2) Ln(Exact Price Index)	(3) Ln(Variety-Adjusted Price Index)	(4) Ln(Variety)
ln(1+tarMFN)	0.112	0.392	1.953+	−1.562
	(0.483)	(0.361)	(1.084)	(1.047)
Dpref*ln(1+tarMFN)	0.773	−0.056	0.691	−0.746
	(0.506)	(0.378)	(1.135)	(1.095)
ln(1+safeguard)	0.220	0.430*	0.467	−0.037
	(0.229)	(0.171)	(0.514)	(0.496)
ln(1+AD)	1.515*	1.264**	4.706**	−3.442*
	(0.621)	(0.464)	(1.394)	(1.346)
US TRQ	−0.080	0.283*	−1.546**	1.829**
	(0.181)	(0.135)	(0.407)	(0.393)
Avian Ban	−0.031	0.047	1.760**	−1.714**
	(0.110)	(0.082)	(0.246)	(0.238)
ln(Ex Rate)	−0.631+	−0.539+	−0.541	0.001
	(0.369)	(0.276)	(0.828)	(0.799)
ln(P int)	0.814*	0.767**	0.382	0.385
	(0.338)	(0.252)	(0.758)	(0.732)
Constant	1.655*	−0.781	−0.601	−0.180
	(0.719)	(0.537)	(1.612)	(1.556)
Observations	64	64	64	64
R-squared	0.826	0.951	0.971	0.970

Note: all estimates at the country group (MFN and preference)-time level for frozen bone-in chicken; fixed effects included for country group and time (year and quarter); columns 1–3 dependent variable is log of duty-inclusive price indexes; column 4 presents results for log of variety, constructed as the difference between log of exact price index and variety-adjusted price indexes; results assume elasticity of substitution value equal to 2; standard errors reported in parentheses; ** p<0.01, * p<0.05, + p<0.1.

Source: authors' construction based on National Treasury and UNU-WIDER (2022).

Table A6: Price index analysis (sigma = 8, including duties), 2012–19

Variables	(1) Ln(Aggregate UV Index)	(2) Ln(Exact Price Index)	(3) Ln(Variety-Adjusted Price Index)	(4) Ln(Variety)
ln(1+tarMFN)	0.112	0.392	0.615	−0.223
	(0.483)	(0.361)	(0.381)	(0.150)
Dpref*ln(1+tarMFN)	0.773	−0.056	0.051	−0.107
	(0.506)	(0.378)	(0.399)	(0.156)
ln(1+safeguard)	0.220	0.430*	0.435*	−0.005
	(0.229)	(0.171)	(0.181)	(0.071)
ln(1+AD)	1.515*	1.264**	1.756**	−0.492*
	(0.621)	(0.464)	(0.490)	(0.192)
US TRQ	−0.080	0.283*	0.022	0.261**
	(0.181)	(0.135)	(0.143)	(0.056)
Avian Ban	−0.031	0.047	0.291**	−0.245**
	(0.110)	(0.082)	(0.087)	(0.034)
ln(Ex Rate)	−0.631+	−0.539+	−0.540+	0.000
	(0.369)	(0.276)	(0.291)	(0.114)
ln(P int)	0.814*	0.767**	0.712*	0.055
	(0.338)	(0.252)	(0.267)	(0.105)
Constant	1.655*	−0.781	−0.755	−0.026
	(0.719)	(0.537)	(0.567)	(0.222)
Observations	64	64	64	64
R-squared	0.826	0.951	0.959	0.970

Note: all estimates at the country group (MFN and preference)-time level for frozen bone-in chicken; fixed effects included for country group and time (year and quarter); columns 1–3 dependent variable is log of duty-inclusive price indexes; column 4 presents results for log of variety, constructed as the difference between log of exact price index and variety-adjusted price indexes; results assume elasticity of substitution value equal to 8; standard errors reported in parentheses; ** p<0.01, * p<0.05, + p<0.1.

Source: authors' construction based on National Treasury and UNU-WIDER (2022).

Appendix B: Data

This data appendix is created as per UNU-WIDER requirements for users of the National Treasury Secure Data Facility (NT-SDF).

Data access

The data used for this research were accessed from the NT-SDF under a non-disclosure agreement. All output was checked so as not to reveal any sensitive information regarding individual firms. The results and discussions of this research do not constitute formal statistics, nor do they represent the views of the NT,SARS or UNU-WIDER.

Data used were National Treasury and UNU-WIDER (2022): customs-transaction-level (Version e5_v1) annual import data (ccd_'year'_Imports_e5_v1) from 2009 to 2022. Microsoft Excel was used to export, format, and present data for the write-up.

Software

Stata 17 was used for the majority of the analysis. User-written programmes for Stata used include reghdfe (Correia 2014) and ppmlhdfe (Correia et al. 2019).

Variables

Variables used from the raw transaction-level (Version e5_v1) data include: countryoforiginnamee countryoforigin, countryofdestination, cust_refno, calendaryear, procedurecategorycode, requestedprocedurecode, previousprocedurecode, tariff, monthlongname, statisticalunit, totaldutyamt, sch12aamt, sch12bamt, sch13camt, sch13damt, sch15aamt, sch15bamt, sch1p1mt, sch2p1amt, sch2p2amt, sa_trade_dummy, statisticalquantity, customsvalue.

CPC codes were created using procedurecategorycode, requestedprodcedurecode, and previousprocedurecode. Unit values were created using the customsvalue and statisticalquantity variables.

Cleaning and sample notes

Non-trade transactions are excluded from the sample, on the basis that our analysis focuses on trade (imports). This was done by filtering the data by the SA_trade_dummy variable in the transaction-level data, keeping only those observations where the dummy variable is unity. The dataset was further restricted to only HS8 products broadly falling under the 0207 HS4-level heading for poultry. Certain HS8 subcategories of chicken were then combined to ensure consistency in classification across time periods. For example, products falling under HS7 code 0207149, such as whole bird cut in half, leg quarters, wings, breasts, thighs, and drumsticks, were collapsed under the common HS8 code (02071490) representing the final sample of frozen bone-in chicken pieces.

We augment the customs-transactional data with various external datasets. This includes data on bilateral exchange rates obtained from the World Bank (2023), iso3 codes for import origin countries, gravity model variables such as GDP from CEPII (2023), and monthly export trade data for HS6 level poultry products from South Africa's 15 largest poultry imports obtained from Trade Map (ITC 2023). This monthly export data were used to construct the international price (P int) variable. Various sources, such as government gazettes and ITAC (2012, 2019, 2021, 2022) reports, European Commission (2023), USDA (2018), and the USDA report by Cochrane et al. (2016),

were consulted to construct the various trade policy measures (the tarMFN, Safeguard, Anti-dumping, US Quota, and Avian Ban variables).

Outliers were cleaned based on unit values, by removing the top and bottom percentile of unit value and unit value growth transactions. Additionally, transactions that fall above and below 3 standard deviations of mean unit values are excluded.

The sample period for our econometric analysis is restricted to the period post-2012 when the EU was afforded preferential trade with South Africa. This allows us to exploit the heterogeneity in responses of preference versus non-preference partner country imports. Years from 2020 onwards are also excluded from our empirical analysis as these contain a lot of noise related to the COVID-19 pandemic. However, the full sample (2009–22) is used to present descriptive statistics and trends.

These notes outline the key steps of the data cleaning and construction process. However, this is not a comprehensive discussion. For more detailed information, users should consult our Stata do-files which are available at the NT-SDF.