Switzerland's system of free trade agreements: Assessing the impact on imported goods

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In this paper, I estimate the aggregated ex-post effect of Switzerland's free trade agreements on the prospects for imported goods and quantify the implied consumer benefits. Applying a difference-in-difference approach to highly disaggregated import data, I find no effects on the quality and variety dimensions but a significant reduction of 8.41% in quality-adjusted prices. Using the share of imports in consumer expenditure, I calculate an average consumer price reduction of 1.43%. The price reduction implies a positive consumer gain. However, I perform a pre-trend test to validate the required parallel trend assumption and document a potential underestimation of the actual effect on consumer gains.

Key words: Switzerland, free trade agreements, imports
JEL codes: F1, F6

1 Introduction

Free trade is seen as an opportunity to mutually improve the welfare of the participating parties. Economic tenet predicts trade liberalization will positively influence imported products through channels such as reduced prices, improved quality and increased variety. Research on the potential welfare consequences of changes in specific import dimensions is limited, as most existing work focuses on the aggregated welfare gains from trade.

Free trade agreements (FTAs) are one of the main tools to reduce trade barriers. Since the 1990s, the proliferation of these agreements has led to a continuously growing network of FTAs across the world. The economic consequences of trade agreements are a central topic of research, and the evidence shows that FTAs increase bilateral trade flows between participating countries.

Switzerland is no exception to the international tendency to use FTAs as a central instrument in trade policy. During the last two decades, the country has established its own trade agreement system involving more than 30 individual FTAs. In 2018, over 80% of imported goods came from countries participating in an FTA. Consequently, the trade agreements have wide-ranging implications for Switzerland's economy.

1 This paper is based on my Master's thesis in the Department of Economics at the University of Zurich. I thank my adviser Ralph Ossa for his guidance, comments and support.

Most existing studies examining FTAs focus on either the effect of trade flows or on self-sustaining economies with substantial market power, such as the United States or the European Union. Switzerland, on the other hand, is a small open economy whose welfare and revenue depend strongly on bilateral trade. Providing evidence for the case of a trade-dependent economy is important, as there may be crucial implications for the gains from trade.

In this paper, I assess the effects of Switzerland's FTAs on import prices, while also controlling for effects on quality and changes in import variety. In order to do so, I apply the two-step method of Breinlich et al. (2016) to disaggregated import data that cover the time period from 1996 to 2019. First, I extract measures for the import characteristics from the trade data. Then, I use a difference-in difference (DiD) regression model to identify the effects of Switzerland's trade agreement system on the constructed measures of interest.

In contrast to studies on other FTA systems, I do not find a significant effect of the Swiss system on either import quality or variety changes. However, I observe a persistent negative effect on quality-adjusted import prices. The price adjustment indicates a positive welfare gain, as the improved market access and the reduction of trade costs might cause exporting firms in partner countries to reduce the prices of their exports.

In the last part of the paper, I quantify the price consequences for consumers and the implied welfare gains, by further following the approach of Breinlich et al. (2016) to obtain an import data set containing only final consumption goods. Combining the effects on import prices with data on consumer expenditure allows me to calibrate the influence on consumer prices. I find an average yearly consumer price reduction of 1.43%. Based on the consumer expenditure in 2017, this reduction corresponds to yearly consumer savings of CHF4.9 billion due to Switzerland's FTAs.

While the results illustrate the welfare benefits for Swiss consumers, I may underestimate the price reduction associated with the FTA system. In a pre-trend test, I find the partner countries to already be on a negative trend prior to the conclusion of the trade agreements. This test indicates a potential violation of the parallel trend assumption and points to a positive bias in the estimated price coefficient.

The remaining of this study proceeds as follows. Section 2 reviews the existing literature on the benefits of free trade. Section 3 outlines the empirical framework applied to the data described in Section 4. Section 5 reports on and discusses the baseline results. Section 6 describes the procedure to quantify the effect on consumer prices and summarizes the corresponding estimates. Finally, Section 7 concludes.

2 The benefits of free trade

This paper relates to a wide range of literature examining the merits of free trade. Within this broad picture, it mainly contributes to two major branches of research, namely, the evaluation of the welfare gains from free trade and the quantification of the effects of FTAs.

In Arkolakis et al. (2012), the aggregated welfare gains from trade are computed following a principle of sufficient statistics. The authors quantify the aggregated gains based on two statistics: the share of expenditure spent on domestic goods, and the elasticity of trade flows with respect to trade costs. Regardless of the underlying micro-level channels, they find relatively small gains across most countries. Ossa (2015) explores the potential of an aggregation bias of the formula used by Arkolakis et al. (2012). Taking into account the different emphasis of imports for an economy, he documents gains from trade that are more than three times larger. In his quantification, the effects for Switzerland are especially pronounced, as a move to autarky would reduce real income by more than 50%. Hepenstrick (2016) looks further into the particular case of Switzerland and calibrates an adapted version of the quantitative Ricardian model. He observes a relatively low importance for Switzerland's welfare of single trade partners, due to the abundance of other similar trading partners. When he looks at groups of countries such as the European Union, however, he finds large welfare effects.

Besides the research on the aggregated view, there is a broad range of studies on different micro-level channels. The literature can be broken down into three main contributors: variety changes, reduced markups and self-selection among firms. Broda and Weinstein (2006) measure the welfare benefit from an increase in import variety for the United States. They adapt the methodology first developed by Feenstra (1994) to identify the variety changes based on trade data and calculate the implied changes for an import price index. They find positive consumer gains, but the estimates may underestimate the real gains. Based on more detailed, market-based data from the automobile industry, Blonigen and Soderbery (2010) find even larger variety gains. Their work is an indicator of the importance of the granularity of the underlying data and how it affects the scope of variety gains. Mohler (2011) applies Broda and Weinstein's (2006) framework to Swiss data and finds consumer gains of a small magnitude. The main reasons stated for the dispensable effect are a low level of differentiation among Swiss imports and low growth in the set of new import varieties.

Feenstra and Weinstein (2017) study the gains from reduced markups in the case of the United States. They assess the effect on variety and prices by changing the commonly used assumption of constant elasticity of substitution (CES) to translog preferences, which allows for non-constant markups. Their estimates suggest a pro-competitive effect of globalization, which leads to consumer welfare gains. In particular, they find that half of the welfare gains associated by Broda and Weinstein (2006) with variety gains are due to reduced markups.

The third micro-level channel is the self-selection of the most productive firms engaged in trade. Trefler (2004) analyzes the concept of domestic productivity increases due to import competition. He examines the Canada–US FTA to measure productivity and employment effects within affected firms. The study successfully connects tariff cuts with significant efficiency and productivity adjustments, leading to strong welfare gains. In contrast, Hsieh et al. (2016) show that, in the case of the Canada–US FTA, domestic variety losses offset the domestic productivity increases. Further, productivity losses in foreign firms counteract the welfare gains from newly available foreign varieties. Their results suggest that Canada lost more from exiting domestic firms than it gained from foreign firms entering. Overall, however, there are still positive gains from the Canada–US FTA due to reduced import prices.

Besides the evaluation of welfare gains from trade, this paper also contributes to research exploring the economic consequences of FTAs. In particular, the effects on trade flows have been extensively reviewed and documented in recent years. Baier and Bergstrand (2007) were among the first to account for the non-random conclusion of trade agreements. They introduce fixed effects to the commonly used gravity equation to account for the endogeneity problem. Their estimation suggests much more pronounced effects on trade through FTAs than predicted with previous approaches. Within a ten-year time period, the establishment of an FTA can nearly double the trade volume between the affected countries. In a follow-up study, Baier and Bergstrand (2009) improve the approach with matching econometrics, and more robust estimates of the relationship between trade and FTAs are obtained. While most studies document positive ex-post effects on trade flows, in the specific case of Switzerland's trade agreements, Nussbaumer (2017) finds inconclusive evidence on the influence on aggregated trade.

More recently, consequences other than the effect on trade flows, such as the impact on welfare, have started to become the focus of research on trade agreements. The above-mentioned studies by Trefler (2004) and Hsieh et al. (2016), who investigate the gains from the Canada–US FTA, are common examples. Anderson and Yotov (2016) examine the global terms of trade effects of FTAs implemented in the 1990s using a gravity equation approach and panel data on manufacturing goods. They find both winners and losers, but an overall increase in efficiency in manufacturing trade of 0.9%. Bustos (2011) analyzes the MERCOSUR regional FTA and the effect on technology upgrading by Argentinian firms. She documents that firms facing higher tax reductions increase their investments and the rate of quality upgrading. Badinger (2008) provides reduced-form evidence of the welfare effects of FTAs. He proposes an instrument based on the probability of entering an FTA due to the geographical characteristics of the involved countries. The estimates indicate sizable effects of FTAs on per-capita income for a large sample of countries. Iacovone and Javorcik (2010) examine the North American Free Trade Agreement (NAFTA) and its relationship with the export quality of Mexican plants. They use a unique data set, incorporating both exports and domestic sales, to show that Mexican plants increased product quality in response to the improved access to US markets.

Finally, Breinlich et al. (2016) examine the influence of the trade agreements concluded by the European Union on various import measures and their welfare consequences. They characterize the effect for both the United Kingdom and the European Union, and find a large influence on welfare through the import quality and price channels. The range of the effects varies depending on the specification and data sample, but in their baseline estimation they find quality increases of 23% for the United Kingdom and 24% for the European Union. They also attribute an import price reduction of 35% for the United Kingdom and 19% for the European Unionto the FTA system. Berlingieri et al. (2018) apply a similar approach, but they restrict the impact of an FTA to the five-year period after its conclusion. They find modest results ranging from 4–8% for quality and -6.4% for prices.

3 Empirical framework

The methodology I apply to quantify the impact of Switzerland's trade system on the import properties follows the two-step approach outlined in Breinlich et al. (2016). Section 3.1 describes the first step, in which I construct the measures for quality, quality-adjusted prices and variety changes based on disaggregated import data. Section 3.2 explains the second step, consisting of the difference-in-difference (DiD) identification strategy.

3.1 Construction of the import measures

The construction of different import characteristics is essential to identify potential welfare gains through changes in import dimension. I focus on separating the channels of quality increases, price reductions and variety improvements. Since the quality dimension is not directly observable, I follow a commonly used technique to segregate quality and quality-adjusted prices from trade data (KHANDELWAL, 2010; KHANDELWAL ET AL., 2013; HALLAK AND SCHOTT, 2011).

Before explaining the construction of the import characteristics, the term "variety" needs to be clarified, as its use varies widely across the literature. I define a variety as the pairing of a product line and its country of origin. I treat the same product lines from different countries as separate varieties, as they are likely to be perceived differently from a consumer's perspective. This definition allows the most precise measurement of variety changes, given the level of disaggregation of the data set.

Since I lack trade data at the firm level, I assume all firms in a country produce identical goods across the same product lines. This assumption implies a lower-end scope for the variety gains, compared to the case of a more optimal differentiation at the firm level. The measures for quality and quality-adjusted prices therefore represent the average of all firms within a country producing said product.

A standard proxy for the quality of imported goods in trade literature is unit values.[2] Since changes in unit values reflect fluctuations in both import price and quality, unit values are not suited to separating welfare gains implied by these channels. Instead, the unit values need to be further segregated to identify the effects of trade policy on either of the two channels.

To separate quality and prices, I start by specifying the CES import demand function of a variety:

$$x_{ojt} = \left(p_{ojt}/q_{ojt}\right)^{1-\sigma_j} P_{jt}^{\sigma_j - 1} E_{jt}, \tag{1}$$

where x_{ojt} is the value of a product line j, imported in year t from country of origin o. σ_j is the elasticity of substitution and is the margin of differentiation of a product line across different countries of origin.[3] Further, q_{ojt} represents the level of quality and p_{ojt} is the unit value. P_{jt} is the price index of the aggregated

2 A unit value is the value of a product divided by its quantity.

3 As an example, consumers are likely to perceive Italian coffee differently from German coffee. The demand elasticity of coffee will thus be low and the demand will depend less on quality or price.

varieties of a product line and E_{jt} is the consumer expenditure on the varieties of a product line.

To infer quality q_{ojt}, the natural logarithm of the demand function in Equation (1) is taken. Then, the equation can be rewritten as:

$$\ln x_{ojt} = \alpha_{jt} + (1 - \sigma_j) \ln p_{ojt} + \epsilon_{ojt}. \tag{2}$$

The notation of α_{jt} represents the aggregated price index and consumer expenditure, $\alpha_{jt} = (\sigma_j - 1) \ln P_{jt} + \ln E_{jt}$. The error term contains the desired quality level, $\epsilon_{ojt} = (\sigma_j - 1) \ln q_{ojt}$. The construction of the quality measure therefore requires the demand elasticity σ_j and the error term ϵ_{ojt} from the regression in Equation (2), as in:

$$\ln q_{ojt} = \frac{\epsilon_{ojt}}{(\sigma_j - 1)}. \tag{3}$$

Although I could estimate the regression in Equation (2) to obtain the demand elasticity, the estimated elasticity would be biased due to the two-way causality between quantity and price.

I obtain unbiased estimates of the demand elasticities by applying the approach first developed by FEENSTRA (1994) and further refined by BRODA and WEINSTEIN (2006). This methodology is the standard procedure in the trade literature for estimating demand elasticities based on trade data. It builds on the assumption that shocks to the demand and supply curves are uncorrelated at the variety level. Applying their methodology to panel data allows me to differentiate the demand and supply of a variety to a reference country and solve the endogeneity problem of the demand function. For more details on the methodology and descriptive statistics of the estimated elasticities, see Appendix A.

With the estimated elasticity of substitution $\hat{\sigma}_j$, I am able to construct the quality measure defined in Eq. (3). I obtain the predicted residuals by moving the price component to the left-hand side of Equation (2) and adding partner-fixed effects. This transformation leads to the following regression:

$$\ln x_{ojt} + (\hat{\sigma}_j - 1) \ln p_{ojt} = \alpha_{jt} + \alpha_o + \varepsilon_{ojt}, \tag{4}$$

which requires the predicted demand elasticities as well as data of quantities and prices. The partner-fixed effects α_o are added to account for time-invariant characteristics. The residuals ε_{ojt} contain the quality levels, which I compute as in Equation (3). I can then calculate quality-adjusted prices as $\ln p_{ojt} - \ln q_{ojt}$.

After obtaining measures for quality and quality-adjusted prices, changes in import variety are the final potential channel for changes in consumer welfare without an appropriate measure. Simply looking at the change in the number of varieties would not reflect the differing importance and value of new varieties for the consumer (Breinlich et al., 2016). Given this shortcoming, I prefer to use the lambda ratio first defined in Feenstra (1994) as an expenditure-based measure of variety changes.

The lambda ratio represents a trade-weighted measure of variety growth that reflects the importance of both new and disappearing varieties relative to total expenditure. Let I_{jt} be the total amount of varieties of a product line j in period t. Then, defining $I_j = I_{jt} \cap I_{jt-1}$ as the set of common varieties across periods t and t–1, the lambda ratio can be computed as:

$$\frac{\lambda_{jt}}{\lambda_{jt-1}} = \frac{\left(\sum_{o \in I_j} p_{ojt} x_{ojt}\right) / \left(\sum_{o \in I_{jt}} p_{ojt} x_{ojt}\right)}{\left(\sum_{o \in I_j} p_{ojt-1} x_{ojt-1}\right) / \left(\sum_{o \in I_{jt-1}} p_{ojt-1} x_{ojt-1}\right)}. \tag{5}$$

λ_{jt} represents the importance of new varieties. Varieties that are new additions in period t are included in the total set I_{jt} but not in the intersection I_j. Therefore, expenditure on new varieties lowers λjt and the whole ratio. The same logic applies to the denominator λ_{jt-1} but with exiting varieties. It captures the welfare loss of the disappearing varieties between period t–1 and period t. Exiting varieties will lower λ_{jt-1} and hence increase the lambda ratio. Taking expenditure on both appearing and disappearing varieties into account, the ratio is a measure that quantifies variety changes relative to a base year.

3.2 Identification strategy

I use the constructed measures for quality, quality-adjusted prices and variety changes to identify the welfare consequences of Swiss trade agreements. I follow the identification strategy of Breinlich et al. (2016), who use a DiD approach to estimate the average treatment effects. The regression model is specified as:

$$m_{ojt} = \alpha_{oj} + \alpha_t + \beta \, \text{FTA}_{ot} + \varepsilon_{ojt}, \tag{6}$$

where m_{ojt} stands for either one of the constructed measures. α_{oj} are origin-product fixed effects and α_t are time fixed effects. FTA_{ot} is an indicator variable, which takes the value of 1 if Switzerland and the country of origin have a trade agreement in place. ε_{ojt} is the error term. I estimate this regression model to obtain the treatment effect β of Switzerland's trade agreement system on the specified import dimension.

The FTA dummy captures market access effects outside of tariff reductions, which is the main advantage over tariff changes as a regressor (Berlingieri et al., 2018). Many recent trade agreements go beyond tariff reductions and tackle modern market access issues such as regulations on investments, e-commerce or intellectual property rights. Measuring the effect with a dummy variable includes the consequences of these thematics, which would otherwise be hard to measure based on import data. Using an FTA dummy, the model is therefore less likely to underestimate the welfare gains caused by new market access features.

The DiD approach compares the change in import characteristics from FTA partners to non-FTA partners. The treatment group comprises all imports that originate from an FTA partner country. The specified regression model compares these observations to the control group, which consists of imports from all other trading partners and the FTA partners before the implementation of the trade liberalization. This approach reduces concerns over omitted variable bias compared to a simple "before and after" estimation, as global trends can be eliminated.

More specifically, the regression model uses the nature of panel data to control for variables that differ across varieties but are constant over time (e.g., distance between countries) and variables which differ over time but are constant across varieties (e.g., global economic trends). As an example, increased globalization and innovations in transport are likely to reduce quality-adjusted prices across all countries over time, as the cost of transportation becomes smaller. The specified model in Equation (6) accounts for global trends with the inclusion of the time fixed effects α_t and therefore eliminates this potential positive bias.

The identification strategy also reduces concerns about two-way causality. FTAs should not be treated as an exogenous variable, as the probability of a trade agreement could be influenced by the variable of interest. For instance, looking at the quality of imports, Switzerland might prefer to conclude trade agreements with countries producing high-quality goods. In this scenario, a naive estimation approach would lead to an overestimation of the actual effect of trade agreements. The included variety fixed effects α_{oj} reduce the threat of bias by controlling for origin-product characteristics.

The DiD approach requires the treatment to be the only time-origin varying difference between the control and treatment group affecting the variables of interest. This "parallel trend assumption" implies that all systematic differences between control and treatment group can be attributed to the effect of FTAs. A potential violation of this constraint would be if agreements were more likely to be signed with countries that were expected to upgrade the quality of their exported goods in the near future. In this case, the estimation approach would result in an overestimation of the actual effect. Unfortunately, it is not possible to directly test whether the parallel trend assumption is satisfied due to the non-observability of the non-FTA counterfactual. Nevertheless, I perform a pre-trend test in Section 5.2.1, which helps to judge whether the assumption is likely to be correct.

4 Data

I apply the described methodology to highly disaggregated Swiss import data. Data on the value and quantity for each imported product are necessary to infer the defined import measures. Further, I need the implementation date of all trade agreements to construct the FTA dummy. Regarding the trade data, I use origin-specific data classified at the 6-digit level of the Harmonized System 1996 (henceforth referred to as HS1) goods classification. I choose this specific classification because there exist correspondence tables to a goods categorization system that is based on consumption baskets, which is required to quantify the effects on consumer prices.

The 6-digit level data are the most disaggregated data available and hence provide the most accurate information on the development of available varieties. The time period covered for the baseline results is 1996 to 2019. The data are from the United Nation's COMTRADE database, accessed through the World Bank's WITS interface. Additionally, the GDP per capita data used in a robustness check are available from the World Bank's World Development Indicators (World Bank 2019).

Switzerland is part of the European Free Trade Association (EFTA) and usually concludes FTAs within the EFTA framework. I obtain information on Switzerland's FTAs and the years they came into effect from the State Secretariat of Economic Affairs (SECO) and the EFTA.[4]

4 For the details regarding the implementation dates, see SECO (2018) and EFTA (2019).

Some European countries were party to existing individual free trade agreements before they joined the European Union. These trade agreements were abandoned in favor of the bilateral agreements with the European Union upon the integration of the partner country in the Union. For these countries, the date of the first agreement was taken as the starting point of the FTA cooperation with Switzerland. As an example, Croatia and Switzerland had an FTA in place from 2001 to 2013, when Croatia joined the European Union. In this case, I code the dummy variable to reflect the FTA between 2001 and 2019. For a complete overview of all trade agreements and signature dates, see Appendix B.

In Section 6, I calibrate the effects on consumer prices, which depend on data on yearly consumer expenditure sorted by purpose. Expenditure in Swiss francs is obtained from the Federal Statistical Office (FSO, 2019) and is converted to US dollars by applying a historical series of foreign exchange rates.

5 Results: Import measures

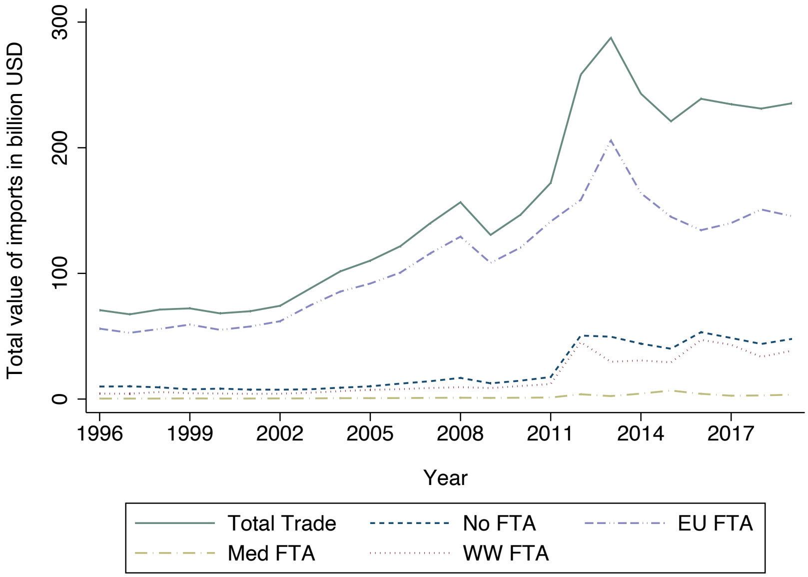
I start by presenting descriptive statistics of Switzerland's trade flows and the constructed import measures in Section 5.1. I then discuss the estimates of the baseline regression in Section 5.2. In Section 5.2.1, I perform robustness checks and examine the validity of the parallel trend assumption.

5.1 Descriptive statistics

Figure 1 plots the yearly value of goods imported by Switzerland in billions of US dollars. In addition to the aggregated trade flow, I segregate the FTAs into categories based on the trade partners' geographic location. To categorize the FTAs, I used the three groups defined by the SECO – "European", "Mediterranean" and "World Wide" – with the latter including countries such as China, Mexico and Canada.

Most of Switzerland's trade originates in the European area, particularly Germany, which accounted for 20% of total imports in 2016. The share of trade covered by European FTAs is consistently high throughout the observation period, but in most recent years there seems to be a shift towards intercontinental trade. In the "World Wide" and "No FTA" group, the growth in the period between 2011 and 2012 is remarkable. A closer look at the data reveals that this spike is due to imports from the United Arab Emirates and the United States. Since the FTA with the United Arab Emirates was implemented in 2014, it is unlikely that this period of growth is a reaction to a trade agreement.

Figure 1: Switzerland's imports, 1996–2019 (USD billions)



The quality and price properties are difficult to visualize, as the range of the measures depends on the product line. To allow a comparison, I compute relative scores for both measures per country, using Switzerlands' top 50 trade partners. Subsequently, I use the notation of quality-adjusted prices but the formulas are also applicable to the quality property. First, I take the time averages of the quality-adjusted prices per variety:

$$\bar{p}_{oj} = \frac{\sum_t^T \ln p_{ojt}}{T}. \tag{7}$$

Then, I normalize $\bar{p}_{oj}$ to be within the range of 0 and 100:

$$\tilde{p}_{oj} = \frac{\bar{p}_{oj} - \min(\bar{p}_{oj})}{\max(\bar{p}_{oj}) - \min(\bar{p}_{oj})} \cdot 100. \tag{8}$$

Finally, I compute the price scores for each country by taking the average of the normalized quality-adjusted prices $\tilde{p}_{oj}$ over all product lines for each country:

$$PS_o = \frac{\sum_j^{I'_o} \tilde{p}_{oj}}{I'_o}, \quad (9)$$

where I'_o is the total number of product lines exported by a country o.

Therefore, the price scores PS_o are the average price rankings of all products exported by a country, relative to the same product lines exported by other countries.[5]

Figure 2 plots the resulting price scores and GDP per capita in 2016. The figure shows a negative correlation between the relative price rankings and the GDP per capita of a country. The correlation suggests that more developed countries generally export lower-price goods, holding quality constant. The United States is the only country with no FTA in place with a score below 50. All other countries with low scores have concluded a trade agreement with Switzerland, suggesting there might be a correlation between trade agreements and lower quality-adjusted prices. Further, the exporters with the lowest rankings are mostly countries with high shares in Switzerland's total trade, namely, Germany, France, Italy, Austria and the United States. Those countries were all among Switzerland's most important trade partners in 2016 and had low price scores.

Figure 3 plots the calibrated quality scores against origin GDP per capita in 2016. Similar to the price scores, the figure indicates a correlation between GDP per capita and import quality. The countries with the highest quality scores are mainly European partners, with the exception of the United States and Japan. The top quality exporters are again countries with high shares in Switzerland's total trade. Exceptions are China and the United Arab Emirates, which had relatively low quality scores compared to their trade volumes.

5 For instance, if a country had a price score of 100, all its exported product lines would have the highest average quality-adjusted prices compared to the same product lines from different origins.

Figure 2: Average quality-adjusted price scores across all products and years by country plotted against GDP per capita for 2016

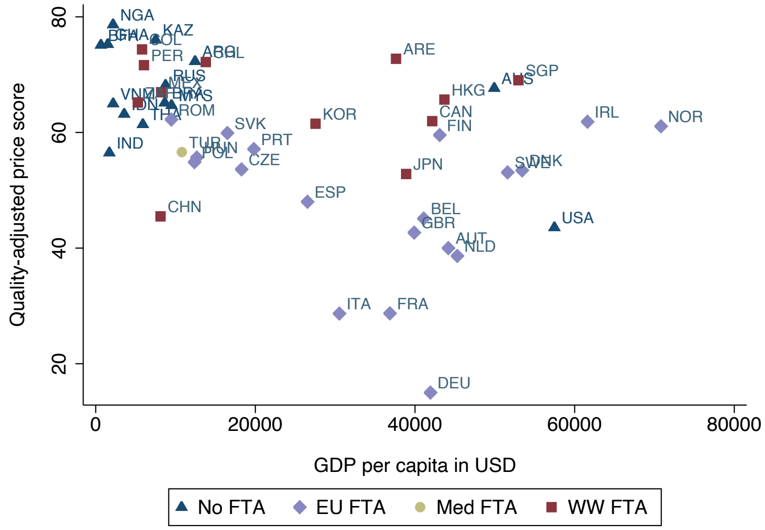


Figure 3: Average quality scores across all products and years by country plotted against GDP per capita in 2016.

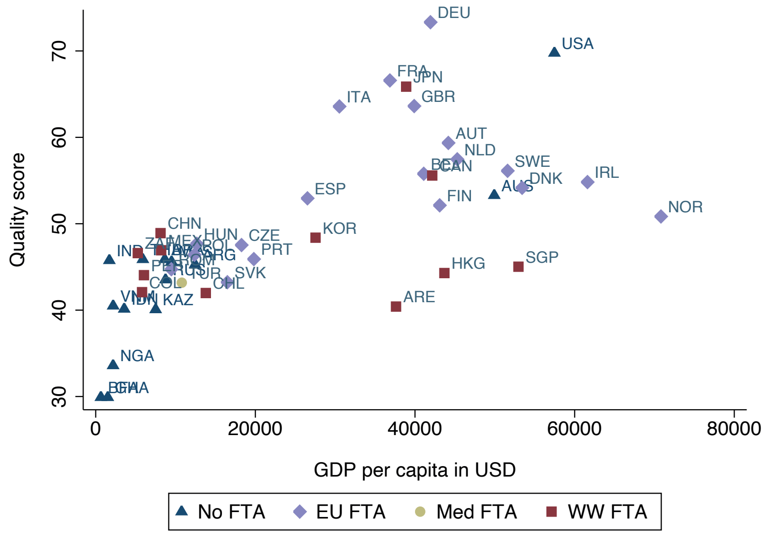
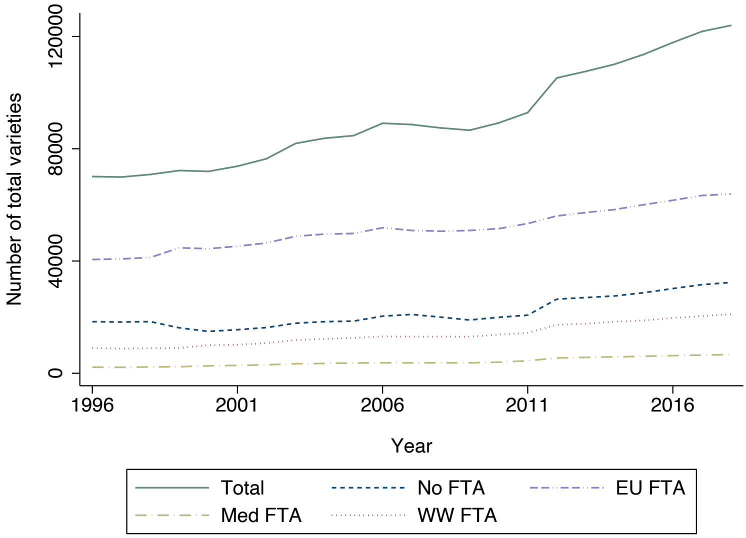


Figure 4 illustrates the development of the total number of imported varieties over the sample period. In 1996, the total number of imported varieties was 70,122. By 2019, the number of varieties had almost doubled to 125,203, showing a constant growth over the examined sample period. The generally high level of varieties stems from both the highly segregated trade data and the inclusive definition of a variety. I define a variety as the pairing of an origin country and a product line, which means that the same product lines coming from different origin countries count as different varieties. Combined with the trade data, which are segregated at the 6-digit level, this results in the pictured high number of varieties.

Figure 4: Number of imported varieties, 1996–2019



The absence of any extraordinary increases within the FTA groups is notable. This observation hints at a lack of influence on consumer gains through the channel of variety gains. If trade agreements did influence the extensive margin of trade (i.e., the number of exporting firms and goods), I would expect to see spikes in the years that trade agreements were concluded.

5.2 Effects on import measures

Table 1 presents the results of the basic regression specified in Equation (6) with the three different import properties as dependent variables.

Table 1: Estimates of the aggregated effects of the FTA system on quality-adjusted prices, quality and variety changes, 1996–2019

	(1) Quality-adjusted price	**(2) Quality**	**(3) Variety**
FTA_{ot}	-0.0878*** (0.0058)	0.0078 (0.0074)	-0.0033 (0.0145)
Origin-product FE, α_{oj}	Yes	Yes	Yes
Time FE, α_t	Yes	Yes	Yes
N	2,214,240	2,214,240	2,156,720
R^2	0.0227	0.0000	0.0000

Notes: This table summarizes the estimates of the baseline regression with the dependent variable specified in the top row. Column (1) and (2) report the coefficients of the regressions with the constructed measures for quality and quality-adjusted prices as the LHS variable. In column (3) the variable of interest is the measure for variety change $\lambda_{jt}/\lambda_{jt-1}$. The LHS variables in column (1) and (2) are in natural logarithms. The explanatory variable FTA_{ot} is an indicator variable which equals 1 if an FTA was in place at the time. Additionally, the RHS of the regression contains year and origin-product fixed effects. Robust standard errors, clustered at the product line level, are reported in brackets. *** indicates statistical significance at the 1% confidence level.

Column (1) reports the estimated coefficient with quality-adjusted import prices as the measure of interest. I find an average effect of -8.41%[6] on quality-adjusted import prices associated with Switzerland's FTA system. The coefficient is statistically significant at the 1% confidence level. Columns (2) and (3) present the estimates with quality and the measure of variety as the dependent variables. The FTA coefficient is not statistically different from zero for either one of these, indicating that there is no traceable ex-post effect of FTAs on import quality or variety over the study period. The definition of the lambda ratio is the reason for the lower number of observations of the specification in column (3). The calibration of the ratio requires data for two consecutive periods. Therefore,

6 The percentage is calculated as $\exp(\beta) - 1$.

I cannot calculate the ratio for the first period of the sample, explaining the lower number of observations.

The reported negative price effect is in line with common trade theory, and is likely to be a consequence of the reduction in import tariffs and the improved market access. The elimination of import tariffs leads to a reduction in trade costs for the affected product, which in return is reflected in a reduced price. Additionally, the trade agreement dummy captures effects which go beyond the elimination of import customs. The coefficient reflects price changes arising from all market access improvements in the FTAs. From the perspective of foreign firms, exporting is an investment decision which implies costs. The sunk costs of the investment decision are only worthwhile if the firm expects safe market access. Since an FTA represents guaranteed access to the Swiss market, the conclusion of a trade agreement might lead to an increase in competition for foreign firms that already export. Since most real-world markets are imperfect, the additional competition should lead to price reductions, holding quality constant.

The price coefficient is also in accordance with existing evidence. An example of how tariffs can affect consumer welfare is examined by Amiti et al. (2019), who look at the introduction of various new tariffs by the United States in 2018 and find increases in the unit values of affected products ranging from 10% to 30%. There is also evidence of welfare gains due to tariff elimination related to FTAs and under the exclusion of the quality property. Berlingieri et al. (2018) find a reduction in import prices due to the EU FTA system. Using a similar empirical approach, they find a negative effect on import prices of 6.4%.

The similarity of the magnitude of the reduction documented here and that for the EU case in Berlingieri et al. (2018) is notable. The size of the effect is to some extent surprising, as Switzerland is a country with historically low import tariffs. As an example, in 2006 the simple average of the most-favorable nation (MFN) customs for non-agricultural goods was only 2.1% in Switzerland, while it was 3.9% for the European Union (WTO, 2019).

There are many potential explanations for why I observe a reduction of similar magnitude, despite Switzerland's low level of import barriers. First, the share of trade covered by FTAs is substantially higher for Switzerland compared to the European Union. In 2018, only 29% of EU imports were affected by a preferential trade agreement (European Commission, 2019). For comparison, Swiss FTAs covered over 80% of total imports in 2018. The wide range of trade covered by FTAs might leverage the effect, as the reported coefficient represents the effect of all trade agreements. Second, while Switzerland has low import customs on average, there are specific categories of goods with high import customs. For example, in 2006 customs on clothing averaged 6.4% (WTO, 2006). The effect of FTAs might therefore be driven by categories of goods for which the import tariffs outside of trade agreements are substantially higher. This is in line with the categorical results for consumption goods reported in Section 6. Overall, the wide scope of trade affected by Switzerland's FTA system and the high custom barriers for some product categories are potential explanations for the magnitude of the observed price effects.

The statistically insignificant coefficient in the import quality regression is of particular interest, as it contradicts most existing evidence on this subject. Research on acts of trade liberalization tends to find quality upgrading in the export sector of less-developed partners. For example, Iacovone and Javorcik (2010) examine the behavior of export plants after the integration of Mexico into NAFTA. Mexican plants which considered exporting to the US market increased the quality of their products to match the higher quality demands of US customers. There is also evidence of quality upgrading based not on firm-level data but on trade data. Berlingieri et al. (2018) find quality increases of 4–8% attributed to the EU FTA system. In a heterogeneity analysis of the aggregated effect, they show that the quality upgrading is especially pronounced for products exported to high-income EU members. Following the literature, I would therefore expect to also find a positive influence on import quality of Switzerland's FTAs.

However, my results suggest that Switzerland's system of trade agreements is not associated with any form of import quality upgrading. One potential explanation might be the high share of developed countries in the origin of imported goods. Most of Switzerland's import volume covered by FTAs comes from other high-income countries, such as Germany or the United Kingdom. These exporters are likely to already produce high-quality goods, as they face similar quality demands in their domestic markets. Improved access to the Swiss market would therefore not lead to quality upgrades but to price adjustments, as competition in the partner country's export sectors increases with the reduction of export costs. The significant reduction in prices supports this home-market hypothesis.

In the variety regression, the dependent variable is the lambda ratio. Due to the initial assumption that Switzerland's high dependence on trade might be an indicator of high variety gains through FTAs, I would expect to find a positive effect on welfare. Since the lambda ratio is an inverse measure for welfare, this would be reflected in a negative coefficient. A reduction in the lambda ratio would imply that the expenditure spent on entering varieties compared to expenditure spent on exiting varieties was larger.

The insignificant effect in the variety regression contradicts this expectation. However, it is not an uncommon result for Switzerland in empirical research. Mohler (2011) finds low variety gains in his analysis of Switzerland's trade flows. There are many potential explanations for the insignificant effect regarding import variety. The first is Switzerland's already high degree of openness at the beginning of the sample period. The country's Impex ratio,[7] a common measure of an economy's openness, was 79% in 1996. This ranks fairly highly among developed countries. For comparison, in 1996 the Impex ratios for the United Kingdom and the United States were 51% and 22%, respectively. Besides the high degree of openness, there is also the shortcoming of not separating goods at the firm level. As described in Section 3.1, this limitation implies a lower-end measure of variety changes. A third potential reason is the low differentiation in Swiss imports, as mentioned by Mohler (2011).

As a final note on the baseline results, I want to point out that the welfare benefits are only a low-end measure of the overall potential gains. The estimated effects are the direct benefits through changes in import prices and do not account for any changes within the domestic industry. Potential channels of indirect consumer benefit include improved access to intermediate goods and additional competition for domestic goods. Both might affect the quality and prices of domestically produced goods.

5.2.1 Robustness checks

In this section, I perform three robustness checks to shed light on potential shortcomings of the methodology and the validity of the reported results. First, I look into the required parallel trend assumption. Second, I investigate potential bias from the exclusion of GDP. Finally, in the third test, I look at the robustness of the baseline results with regards to changes in the control group.

The parallel trend assumption requires the FTA partners to hypothetically have the same development in the variables of interest as non-FTA countries in the absence of the FTA treatment. Since it is impossible to observe FTA partners without implemented trade agreements, I cannot directly test the assumption. However, the results can be verified to some extent by assessing the trends leading up to FTAs. If the two groups followed the same trends prior to the signing of the agreements, it is more likely that the identified effects are caused by the trade agreements and not by other time-origin changing factors.

7 Imports and exports as a percentage of total GDP; the following numbers are based on data from the World Bank.

I apply the placebo test described in BERLINGIERI ET AL. (2018) to look for any systematically different pre-trends between the treatment and control group. I estimate the baseline DiD regression for each import measure with a modified FTA dummy. I replace the original indicator variable with a different dummy variable that takes the value of 1 if the observation is within a five-year period prior to the actual conclusion of a trade agreement. The new dummy variable therefore indicates whether an FTA was implemented within the near future and measures different pre-trends.

Table 2 presents the estimated results of the placebo test. If there are no different developments influencing the dimensions of imports from countries about to enter into a trade agreement, then the coefficients should be statistically insignificant.

Table 2: Estimates of the pre-trend regression with quality-adjusted prices, quality and variety changes as dependent variables, 1996–2019

	(1) Quality-adjusted price	**(2) Quality**	**(3) Variety**
$FTA_{ot+5} - FTA_{ot}$	-0.0287*** (0.0041)	-0.0021 (0.0063)	-0.0391 (0.0349)
Origin-product FE, α_{oj}	Yes	Yes	Yes
Time FE, α_t	Yes	Yes	Yes
N	2,214,240	2,214,240	2,156,720
R^2	0.0177	0.0000	0.0000

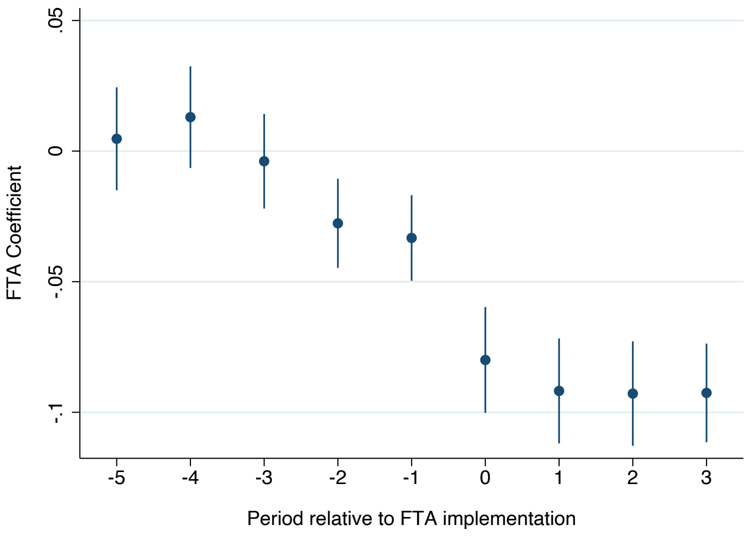
Notes: This table presents the estimates of the pre-trend test with the dependent variable specified in the top row. The LHS variables in column (1) and (2) variables are in natural logarithms. The explanatory variable $FTA_{ot+5} - FTA_{ot}$ is an indicator variable which equals 1 if an FTA with country of origin o was implemented within five years from period t. The regression contains year and origin-product fixed effects. Robust standard errors, clustered at the product line level, are reported in brackets. *** indicates statistical significance at the 1% confidence level.

While the coefficients for quality and variety are indeed insignificant, I find a significant negative pre-trend for the quality-adjusted prices of imported goods. The coefficient suggests that prices of goods imported from upcoming partner countries prior to the implementation of an FTA were already on a decreasing gradient compared to the control group. The measured pre-trend indicates a potential underestimation of the negative effect in the baseline regression for quality-adjusted prices.

Additionally, I visually inspect the parallel trend assumption in Figure 5. The figure plots the development of the average treatment effect over the time periods close to the FTA implementations. The pictured observations are the point estimate of a regression similar to the baseline model in Equation (6). For each relative time period before and after the treatment, I add a dummy variable indicating whether a trade agreement was in place or not. This new set of dummy variables replaces the aggregated FTA dummy in the baseline estimation. The resulting coefficients for each period are less powerful, as the model only compares observations in the same relative time period. However, the individual coefficients can help to find potential pre-trends, as I would expect the treatment effects to be close to zero for the periods prior to the conclusion of the trade agreements.

Figure 5 shows the coefficients for the periods close to the implementation of a trade agreement together with the 5% confidence intervals. The variable of interest in the underlying model are the quality-adjusted prices. The time period zero represents the implementation period of the trade agreements. The figure illustrates that, in the two years prior to implementation, the trade agreements already had a price-reducing effect. Therefore, the visual inspection fortifies the suspected negative pre-trend, suggesting a violation of the parallel trend analysis.

Figure 5: Treatment effect on quality-adjusted prices against the time period relative to the implementation of trade agreements



The negative pre-trend might be a consequence of the fixed FTA definition. The implementation of an FTA also influences the period before the conclusion, as the negotiations prior to the conclusion are likely to have an effect on anticipating firms' investment decisions. If firms expect improved market access provided by the conclusion of an FTA, then the observed pre-trend and the implied consumer benefit could be a positive spillover of the anticipation of the trade agreement.

The second robustness check adds GDP as an additional control variable. The empirical approach does not account for factors varying across time and country of origin. If they have an influence on the measure of interest and the conclusion of trade agreements, there might be potential omitted variable bias.

The previously presented descriptive statistics show the tendency for origin GDP and the dimensions of imported goods to correlate. The trade literature also documents a positive relationship between quality and origin GDP (Schott, 2004; Feenstra and Romalis, 2014). Further, Baier and Bergstrand (2004) evaluate the determinants of FTAs and find that countries are more likely to conclude trade agreements if they share a similar level of GDP. Since it is a time-origin varying variable, the DiD approach may attribute the effect of GDP on prices and quality to the trade agreement system.

However, GDP is not necessary a bias concern as trade agreements are also supposed to affect the GDP of a partner country through the improved export opportunities (Trefler, 2004). Therefore, controlling for GDP might eliminate the passive effect of trade agreements on prices and quality through GDP.

Table 3 summarizes the estimates of the baseline regression, extended with a control variable containing the natural logarithm of GDP per capita. I find a reduced negative effect on quality-adjusted prices and a significant negative effect on quality. The effect on variety changes is still statistically insignificant. As expected, the coefficient for the origin country's GDP per capita is negative for quality-adjusted prices and positive for quality. The number of observations is smaller than in the baseline results because the data for the year 2019 were dropped due to missing GDP figures.

While the dampened results are in line with the above reasoning of the passive effect of GDP, the negative effect on quality also contradicts the predictions of common trade models. Nevertheless, there exists evidence of quality reductions in response to trade liberalization. Specifically, Harrigan and Barrows (2009) present the case of quality downgrading as a result of the liberalization of import quota limitations. They look at the end of the Multi Fiber Agreement, which regulated global trade in apparel and textiles industry through quota limitations.

While Switzerland did not impose any quantitative restriction under this particular agreement (SILBERSTON, 1990), the elimination of quotas cannot be ruled out as the potential driver behind the reported neg ative effect on quality. A conclusive statement requires in-depth analysis of the individual trade agreements, which would go beyond the scope of this robustness check.

Table 3: Estimates of the aggregated effects of the FTA system on the import dimensions with GDP per capita as additional control variable, 1996–2018

	(1) Quality-adjusted price	**(2) Quality**	**(3) Variety**
FTA_{ot}	-0.0520*** (0.0058)	-0.0175** (0.0079)	-0.0038 (0.0176)
l_GDPpc_{ot}	-0.2722*** (0.0093)	0.3061*** (0.0087)	-0.0737 (0.0766)
Origin-product FE, α_{oj}	Yes	Yes	Yes
Time FE, α_t	Yes	Yes	Yes
N	1,967,992	1,967,992	1,917,457
R^2	0.0209	0.0494	0.0000

Notes: This table presents the estimates of the baseline regression with additionally controlling for the effect of GDP and the dependent variable specified in the top row. The LHS variables in column (1) and (2) variables are in natural logarithms. The explanatory variable FTA_{ot} is an indicator variable which equals 1 if an FTA was in place at the time. The RHS of the regression contains year and origin-product fixed effects, as well as the natural logarithm of GDP per capita. Robust standard errors, clustered at the product level, are reported in brackets. *** indicates statistical significance at the 1% confidence level. ** signals statistical significance at the 5% confidence level.

In the final robustness check, I exclude all data points for FTA partners prior to the implementation of the trade agreement from the control group. In the baseline regression, the control group also included imported products from countries which would be treated in the future. For example, imports from Croatia are in the control group if they are imported prior to 2001, and in the treatment group afterwards. To see how the inclusion of FTA partners in the control group influences the baseline results, I estimate the model without goods from FTA partners in the control group.

Table 4: Estimates of the aggregated effects of the FTA system on the import dimensions, excluding FTA partner countries from the control group, 1996–2019

	(1) **Quality-adjusted price**	(2) **Quality**	(3) **Variety**
FTA_{ot}	-0.1353*** (0.0212)	0.0396 (0.0253)	0.0428 (0.0275)
Origin-product FE, α_{oj}	Yes	Yes	Yes
Time FE, α_t	Yes	Yes	Yes
N	1,517,794	1,517,794	1,483,275
R^2	0.0213	0.0000	0.0000

Notes: This table presents the estimates of the baseline regression. All imports from FTA partner countries, prior to the implementation of the trade agreement, have been excluded from the control group. The LHS variables in column (1) and (2) variables are in natural logarithms. The explanatory variable FTA_{ot} is an indicator variable which equals 1 if an FTA was in place at the time. The RHS of the regression contains year and origin-product fixed effects. Robust standard errors, clustered at the product level, are reported in brackets. *** indicates statistical significance at the 1% confidence level.

Table 4 shows the results of the baseline regression with the altered control group. The effects on quality and variety are still insignificant. The reduction in quality-adjusted prices increases to 12.65%. If the development of the import characteristic is only compared between FTA partners and non-FTA partners, I find an overestimation of the price effect. This suggests that price developments in FTA partner countries prior to the implementation were on a positive trend. The overestimation shows the importance of including and accounting for imports by future FTA partners.

6 Results: Consumer prices

The reported reduction in import prices represents a channel for consumer welfare gain, but it does not quantify the price effects faced directly by consumers. A translation from the import price effect to the consumer price impact will allow me to calibrate the direct savings for consumers associated with Switzerland's FTAs.

Proceeding with the approach of Breinlich et al. (2016), I map the HS1 classified data to a product classification that is based on the baskets of a consumer price index (CPI). After this transformation, the underlying data set will only contain imports used for final consumption (the original set also included intermediate goods in the analysis). I estimate the quality-adjusted import price changes for each sub-index category separately. Combining each price coefficient with the annual import share in the respective CPI sub-index expenditure results in yearly price changes for each category. Ultimately, I will aggregate these annual changes in consumer prices by sub-indices to obtain the overall price effect faced by consumers.

Breinlich et al. (2016) determine two assumptions that need to be fulfilled to identify valid consumer price changes with this approach. First, it requires that wholesalers do not change their markups in response to changes in the quality-adjusted import price. Second, the change in quality-adjusted prices of imported consumption goods does not affect the price component of domestically produced consumption goods. I argue that the second condition is unlikely to hold, as a reduction of the import prices increases the competition and price pressure for similar domestically produced goods. The calibrated consumer price change will therefore not reflect the potential downward adjustment of prices of domestic consumption goods induced by the additional import competition.

The mapping of the HS1 data to a classification allows me to allocate and link product lines to different expenditure baskets. For this purpose, I use the Classification of Individual Consumption According to Purpose (COICOP), which was developed by the United Nations Statistic Division. COICOP contains twelve different categories at the highest level, of which ten are relevant for import products.[8]

Since there is no direct correspondence table available, I transfer the data in an intermediate step to "Central Product Classification, version 10" (CPCv10). From the CPCv10 categorized data set, the goods are mapped to the COICOP categories. The relevant correspondence tables are available from the UN Statistics Division (UNSD, 2019).

In the mapping process, not all goods classified in the HS1 are matched with a COICOP category. This discrepancy reflects the existence of intermediate goods in the original data, which are not part of consumer expenditure. There are also goods mapped into multiple COICOP groups. The final COICOP classified data

8 The categories which had no products allocated were "Education" and "Restaurants and Hotels".

set contains around 40% fewer unique observations compared to the initial HS1 data set.

Table 5 reports the results for all three measures based on the COICOP data set and allows a direct comparison to the baseline results. The used dataset contains only observations imported prior to 2018, as the data will be combined with consumer expenditure data, which were only available up to 2017. Unlike the analysis in Section 5, the estimates are based on final consumption goods only. The coefficients for quality and variety are still insignificant. The reduction of quality-adjusted prices has changed magnitude, shrinking by 4.02 percentage points to 4.39%. Therefore, a substantial part of the welfare gains through quality-adjusted prices reflects gains from the cheaper access to intermediate goods.

Table 5: Estimates of the aggregated effects of the FTA system on the import dimensions, based on COICOP data, 1996–2017

	(1) Quality-adjusted price	**(2) Quality**	**(3) Variety**
FTA_{ot}	-0.0449*** (0.0066)	0.0012 (0.0086)	0.0046 (0.0042)
Origin-product FE, α_{oj}	Yes	Yes	Yes
Time FE, α_t	Yes	Yes	Yes
N	1,279,070	1,279,070	1,242,433
R^2	0.0239	0.0000	0.0001

Notes: This table summarizes the estimates of the baseline regression based on a consumption goods data set with the dependent variable specified in the top row. The LHS variables in column (1) and (2) variables are in natural logarithms. The explanatory variable FTA_{ot} is an indicator variable which equals 1 if an FTA was in place at the time. Additionally, the RHS of the regression contains year and origin-product fixed effects. Robust standard errors, clustered at the product line level, are reported in brackets. *** indicates statistical significance at the 1% confidence level.

The price change in column (1) indicates a reduction in consumer prices but it does not account for the importance of different consumption categories. For example, in 2016 Swiss consumers spent around CHF12 billion on footwear and clothing, and CHF56 billion on health products. Since I mapped the data set to different COICOP categories, it is possible to weight the individual category effect based on the category's share in total expenditure. The result is an average consumer price change based on the relative importance of the category.

I obtain the individual COICOP category import price effect by estimating the baseline regression based on data samples containing only goods of the respective COICOP categories. The FTA coefficient for each sample and the corresponding robust standard errors are presented in column (3) and (4) of Table 6. Based on the import price changes, the effect on consumer prices of each sub-index, ΔCP_{ct}, is calculated by expanding the coefficients with the expenditure and import shares for each category:

$$\begin{aligned}\Delta CP_{ct} &= [\exp(\beta_c) - 1] \cdot \text{FTA Import Share}_{ct} \cdot \text{Trade Share}_{ct}, \\ &= [\exp(\beta_c) - 1] \cdot \frac{\text{FTA Imports}_{ct}}{\text{Total Imports}_{ct}} \cdot \frac{\text{Total Imports}_{ct}}{\text{Consumer Expenditure}_{ct}},\end{aligned} \tag{10}$$

where c represents the COICOP category.

As an example of this process, I compute the FTA induced consumer price change for COICOP group "03 Clothing and footwear" in 2016 as follows. The estimated FTA coefficient is –0.0860, indicating an average quality-adjusted price effect of exp(–0.0860) – 1 = –8.24%. The share of trade covered by FTAs in total clothing and footwear imports was 79.8%.

The share of imports in the total clothing and footwear expenditure in 2016 was 70%. The consumer price change for group 03 in 2016 is then computed as –8.24% · 79.8% · 70% = –4.6%. The reported price changes in column (6) of Table 6 correspond to the average over time of these yearly price effects.

Finally, I quantify the overall effect by weighting each category's effect by the average share in total expenditure. The result is an aggregated consumer price reduction due to FTAs of 1.43%, presented at the bottom of Table 6. The total number of observations is not identical to the number reported in Table 5, as some HS classified products are ultimately mapped into multiple COICOP categories.

The calculated consumer price reduction is a measure of the direct consumer benefit from Switzerland's trade policy. To put the effect in perspective, total consumer expenditure in 2017 was CHF348 billion. Based on this expenditure, the average price effect of -1.43% implies yearly savings of around CHF4.9 billion for Swiss consumers.

Table 6 Predictions of the consumer price changes by COICOP category, 1996–2017

(1) COICOP category #	**(2) Category name**	**(3) β_c**	**(4) S.E.**	**(5) N**	**(6) Price change**
01	Food and non-alcoholic beverages	-0.0042	0.0154	166,053	-0.00%
02	Alcoholic beverages, tobacco and narcotics	-0.0034	0.0353	42,020	-0.12%
03	Clothing and footwear	-0.0860***	0.0121	310,549	-4.92%
04	Housing, water, electricity, gas and other fuels	-0.0625***	0.0235	89,656	-0.43%
05	Furnishings, household equipment and routine household maintenance	-0.0503***	0.0121	364,771	-7.64%
06	Health	-0.1036**	0.0435	40,797	-0.25%
07	Transport	-0.0391*	0.0214	159,083	-2.19%
08	Communication	0.0717	0.0512	14,173	1.92%
09	Recreation and culture	-0.0510***	0.0141	302,234	-5.92%
12	Miscellaneous goods and services	-0.0482***	0.0159	127,570	-0.55%
Total	*All categories pooled by expenditure*			*1,616,905*	*-1.43%*

Notes: This table summarizes the estimated import price changes and the average consumer price effects per COICOP category. Column (1) and (2) identify the CPI category. Column (3) and (4) present the estimated coefficient and its standard error for each category. The standard errors are robust and clustered at the product line level. Column (5) reports the number of observation in each category. Column (6) contains the average of the annual price effects over all years, calculated as in Eq. (7). *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

The magnitude of the effects on consumer prices is quite large compared to a similar study for Switzerland. Müller et al. (2017) examine the potential effects of an unilateral elimination of all remaining Swiss import customs on industry goods.[9] They compute a multi-country general equilibrium model to predict effects on GDP and other variables, such as the consumer price level, and estimate a potential reduction of 0.1% in consumer prices due to the elimination of the remaining import tariffs.

While the approaches are not directly comparable, as Müller et al. (2017) use a different methodology and set-up, the difference in magnitude is still noteworthy. The sizable difference might be explained by the large amount of trade that is covered by trade agreements and therefore already tariff-free. Therefore, the disparity of the effects highlights how beneficial the tariff eliminations through trade agreements have already been. Also, the greater benefits in my regression approach are consistent with the rationale for an FTA dummy, as it captures not only the cutback on customs but also multiple improvements to market access processed in trade agreements.

As mentioned in the baseline results, the estimated price reduction may be driven by some specific products which have high tariffs outside of FTAs. The underlying category effects in Table 5 support this hypothesis. For example, in the high-tariff group "03 Clothing and footwear", I report a consumer price reduction of 4.92%. Other categories with strong effects on consumer prices are "05 Furnishings, household equipment and routine household maintenance", with a price reduction of 7.64%, and "09 Recreation and culture", with a reduction of 5.92%.

Overall, the point estimates in the categories range from -7.64% up to even slightly positive effects. The positive price changes are computed based on FTA coefficients that are not statistically significant. The reduction of the sample size likely leads to non-significant results for some groups. For the group "01 Food and non-alcoholic beverages", I even expect an insignificant result, as Switzerland has exceptionally high import barriers in the agriculture sector that are mostly unaffected by the majority of trade agreements.

9 Industry goods include also all non-agricultural consumption goods.

7 Conclusion

In this paper, I use a DiD approach to provide evidence on the aggregated effects of Switzerland's FTAs on imported goods and the welfare consequences for consumers. I focus on the changes in quality-adjusted prices while also checking for welfare effects in import quality and variety. Even though Switzerland is a country with low import customs to begin with, I find a substantial price reduction due to the system of trade agreements. Holding quality constant, the import price reduction is 8.41%, indicating a positive welfare gain. Contrary to the existing evidence on the effects of FTA systems, I do not find significant effects on either quality or variety.

I then quantify the price implications directly faced by consumers. After limiting the data set to only final consumption goods, I find a reduction in consumer prices of approximately 1.43%. This price adjustment corresponds to yearly savings of CHF4.9 billion due to Switzerland's FTA system, based on expenditure from 2017. These savings come solely from the reduced prices of imported consumption goods and do not take into account effects on domestically produced consumption goods through additional import competition.

The results should be interpreted with care, as I document a potential violation of the parallel trend assumption. I estimate a negative pre-trend for prices within the treatment group of FTA partner countries, which indicates a potential bias of the price reduction and the associated welfare benefits. Even though I document a positive welfare effect through reduced import prices, the consequences of Switzerland's trade agreements are not entirely clear yet and require further investigation.

References

Amiti, Mary, Stephen J. Redding and David E. Weinstein (2019), The impact of the 2018 tariffs on prices and welfare, *Journal of Economic Perspectives* 33 (4), pp. 187–210.

Anderson, James E. and Yoto V. Yotov (2016), Terms of trade and global efficiency effects of free trade agreements, 1990–2002, *Journal of International Economics* 99, pp. 279–298.

Arkolakis, Costas, Arnaud Costinot and Andrés Rodríguez-Clare (2012), New trade models, same old gains?, *The American Economic Review* 102 (1), pp. 94–130.

Badinger, Harald (2008), *Trade policy and productivity*, European Economic Review 52 (5), pp. 867–891.

Baier, Scott L. and Jeffrey H. Bergstrand (2004), Economic determinants of free trade agreements, *Journal of International Economics* 64 (1), pp. 29–63.

Baier, Scott L. and Jeffrey H. Bergstrand (2007), Do free trade agreements actually increase members' international trade? *Journal of International Economics* 71 (1), pp. 72–95.

Baier, Scott L. and Jeffrey H. Bergstrand (2009), Estimating the effects of free trade agreements on international trade flows using matching econometrics, *Journal of International Economics* 77 (1), pp. 63–76.

Berlingieri, Giuseppe (2009), *Variety growth, welfare gains and the fall of the iron curtain*, Technical Report, London School of Economics.

Berlingieri, Giuseppe, Holger Breinlich and Swati Dhingra (2018), The impact of trade agreements on consumer welfare – evidence from the EU common external trade policy, *Journal of the European Economic Association* 16 (6), pp. 1881–1928.

Blonigen, Bruch A. and Anson Soderbery (2010), Measuring the benefits of foreign product variety with an accurate variety set, *Journal of International Economics* 82 (2), pp. 168–180.

Breinlich, Holger, Swati Dhingra and Gianmarco I.P. Ottaviano (2016), *How have EU's trade agreements impacted consumers?,* Technical Report, Centre for Economic Performance, London School of Economics and Political Science.

Broda, Christian and David E. Weinstein (2006), Globalization and the gains from variety, *The Quarterly Journal of Economics* 121 (2), pp. 541–585.

Bustos, Paula (2011). Trade liberalization, exports, and technology upgrading: Evidence on the impact of MERCOSUR on Argentinian firms, *The American Economic Review* 101 (1), pp. 304–40.

EFTA – European Free Trade Association (2019), Chronology of EFTA's free trade agreements, joint declarations on cooperation, free trade negotiations and exploratory processes, Ref. 14-124805 (https://www.efta.int/sites/default/files/documents/free-trade/chronology-of-fta-process.pdf).

European Commission (2019), *2019 report on implementation of EU free trade agreements*, Brussels.

Feenstra, Robert C. (1994), New product varieties and the measurement of international prices, *The American Economic Review* 84 (1), pp. 157–177.

Feenstra, Robert C. (2010), *Product variety and the gains from international trade*, MIT Press.

Feenstra, Robert C. and John Romalis (2014), International prices and endogenous quality, *The Quarterly Journal of Economics* 129 (2), pp. 477–527.

Feenstra, Robert C. and David E. Weinstein (2017), Globalization, markups, and US welfare, *Journal of Political Economy* 125 (4), pp. 1040–1074.

FSO – Federal Statistical Office (2019), Households final national consumption expenditure by purpose (www.bfs.admin.ch/bfs/en/home/statistics/national-economy/national-accounts/investment-consumption-expendidure.assetdetail.9546447.html).

Hallak, Julian C. and Peter K. Schott (2011), Estimating cross-country differences in product quality, *The Quarterly Journal of Economics* 126 (1), pp. 417–474.

Harrigan, James and *Geoffrey Barrows* (2009), Testing the theory of trade policy: Evidence from the abrupt end of the Multifiber Arrangement, *The Review of Economics and Statistics* 91(2), pp. 282–294.

Hepenstrick, Christian (2016), The sources and magnitudes of Switzerland's gains from trade, *Swiss Journal of Economics and Statistics* 152 (1), pp. 1–21.

Hsieh, Chang-Tai, Nicholas Li, Ralph Ossa and Mu-Jeung Yang (2016), *Accounting for the new gains from trade liberalization*, Technical Report, National Bureau of Economic Research.

Iacovone, Leonardo and Beata S. Javorcik (2010), Multi-product exporters: Product churning, uncertainty and export discoveries, *The Economic Journal* 120 (544), pp. 481–499.

Khandelwal, Amit K. (2010), The long and short (of) quality ladders, *The Review of Economic Studies* 77 (4), pp. 1450–1476.

Khandelwal, Amit K., Peter K. Schott and Shang-Jin Wei (2013), Trade liberalization and embedded institutional reform: evidence from Chinese exporters, *The American Economic Review* 103 (6), pp. 2169–2195.

Mohler, Lukas (2011), Variety gains from trade in Switzerland, *Swiss Journal of Economics and Statistics* 147 (1), pp. 45–70.

Müller, André, Tobias Schoch, Sarina Steinmann, Christoph Böhringer and Edward Balistreri (2017), *Volkswirtschaftliche Auswirkungen unilateraler Importerleichterungen der Schweiz*, Staatssekretariat für Wirtschaft SECO.

Nussbaumer, Timothy (2017), A study case on the caveats in the measurement of FTAs effect on trade: Switzerland's free trade agreements, *Aussenwirtschaft* 68 (1), pp. 139–167.

Ossa, Ralph (2015), Why trade matters after all, *Journal of International Economics* 97 (2), pp. 266–277.

Schott, Peter K. (2004), Across-product versus within-product specialization in international trade, *The Quarterly Journal of Economics* 119 (2), pp. 647–678.

SECO – State Secretariat for Economic Affairs (2018), List of Free Trade Agreements of Switzerland (www.seco.admin.ch/seco/en/home/Aussenwirtschaftspolitik_Wirtschaftliche_Zusammenarbeit/Wirtschaftsbeziehungen/Freihandelsabkommen.html).

Silberston, Aubrey (1990), Textile markets and the Multi Fibre Arrangement, in *Competition and Markets*, Springer, pp. 63–76.

Trefler, Daniel (2004), The long and short of the Canada-US free trade agreement, *The American Economic Review* 94 (4), pp. 870–895.

UNSD – United Nations Statistics Division (2019), Classification on Economic Statistics (https://unstats.un.org/unsd/classifications/econ/).

World Bank (2019), DataBank, World Development Indicators (https://databank.worldbank.org/reports.aspx?source=2&series=NY.GDP.PCAP.CD&country=#).

WTO – World Trade Organization (2006), *World Tariff Profiles 2006*, World Trade Organization.

WTO (2019), World Trade Organization Data Portal (https://data.wto.org/).

Appendix A: Estimation of the demand elasticities

This appendix provides a summary of the applied method to estimate demand elasticities based on trade data. The methodology was pioneered by FEENSTRA (1994) and advanced by BRODA and WEINSTEIN (2006). The section is based on BERLINGIERI (2009) and FEENSTRA (2010), who explain and summarize the procedure.

Starting by defining the set I_{jt} as the set of all varieties of product line j in period t, the expenditure share s_{ojt} of a variety is:

$$s_{ojt} = \frac{p_{ojt}x_{ojt}}{\sum_{o\in I_{jt}} p_{ojt}x_{ojt}}. \tag{11}$$

Then, the demand equation from Equation (2) can be rewritten in terms of expenditure shares and changes over time:

$$\Delta \ln s_{ojt} = \Theta_{jt} - (\sigma_j - 1)\Delta \ln p_{ojt} + \Delta\epsilon_{ojt}, \tag{12}$$

where Θ_{jt} represents product-time varying effects, Δ are changes from period t–1 to t and ϵ_{ojt} contains all unobserved random effects. Due to the two-way causality problem between prices and expenditure shares, estimating the demand elasticity directly from this equation would lead to a biased result. To solve this problem, a supply equation in differences over time is introduced:

$$\Delta \ln p_{ojt} = \omega_j \Delta \ln x_{ojt} + \Delta\varepsilon_{ojt}, \tag{13}$$

where ω_j is the inverse supply elasticity and ε_{ojt} is the random error of the supply equation. Since the demand equation uses expenditure shares, I combine Equations (11) and (13) to eliminate quantities from the supply curve:

$$\Delta p_{ojt} = \psi_{jt} + \frac{\omega_j}{1+\omega_j}\Delta \ln s_{ojt} + \Delta\delta_{ojt}, \tag{14}$$

where $\psi_{jt} = \frac{\omega_j}{1+\omega_i} \cdot \sum_{o\in I_{jt}} p_{ojt}x_{ojt}$ and $\Delta\delta_{ojt} = \frac{\Delta\varepsilon_{ojt}}{1+\omega_j}$.

To proceed further, the identification strategy relies on the assumption:

$$\mathrm{E}\left(\epsilon_{ojt}\delta_{ojt}\right) = 0. \tag{15}$$

The assumption implies uncorrelated supply and demand error terms at the variety level. It allows me to eliminate the time fixed effects by differentiating Equations (12) and (14) to some reference country k:

$$\Delta^k \ln s_{ojt} = -(\sigma_j - 1)\Delta^k \ln p_{ojt} + \epsilon^k_{ojt}, \tag{16}$$

$$\Delta^k \ln p_{ojt} = \frac{\omega_j}{1+\omega_j}\Delta^k \ln s_{ojt} + \delta^k_{ojt}, \tag{17}$$

where the superscript k indicates a differentiation of the affected variable to a reference country. Then, Equation (17) can be rewritten as:

$$(1-\rho_j)\Delta^k \ln p_{ojt} = \frac{\rho_j}{\sigma_j - 1}\Delta^k \ln s_{ojt} + \delta^k_{ojt}, \tag{18}$$

where $\rho_j = \omega_j(\sigma_j - 1)/(1 + \omega_j\sigma_j)$. Multiplying Equation (16) by Equation (18), the estimation equation is obtained:

$$(\Delta^k \ln p_{ojt})^2 = \theta_1(\Delta^k \ln s_{ojt})^2 + \theta_2(\Delta^k \ln s_{ojt})(\Delta^k \ln p_{ojt}) + u_{ojt}, \tag{19}$$

Where:

$$\theta_1 = \frac{\rho_j}{(1-\rho_j)(\sigma_j-1)^2},$$
$$\theta_2 = \frac{2\rho_j - 1}{(1-\rho_j)(\sigma_j-1)},$$
$$u_{ojt} = \frac{\epsilon^k_{ojt}\delta^k_{ojt}}{(1-\rho_j)(\sigma_j-1)}.$$

After averaging Equation (19) over time, the demand elasticity σ_j can be consistently estimated by weighted least squares.

Note that the differentiation with respect to the reference country in Equations (16) and (17) requires that each product line has at least one country exporting it in every observation period. In my data set, this condition is not fulfilled for around 20% of the data defined at the 6-digit level. As Berlingieri (2009) describes, this leaves the option of either dropping the data or estimating the elasticity at a lower level of disaggregation. Since the affected data are of a significant size, dropping them might result in the loss of valuable information. Therefore, elasticities estimated at the 4-digit level were used in the case of no available reference country at the 6-digit level. If a variety still did not fulfill the condition to perform the differentiation at the 4-digit level, the corresponding observations were dropped. This approach resulted in a loss of only around 4% of the original data.

For the implementation of the procedure, I followed FEENSTRA (2010), who provides applicable code in the Appendix of his book. With this methodology, it is possible to obtain negative elasticities for some goods. In these cases, I also follow the approach of FEENSTRA (2010) and perform a grid search to obtain a positive value. Table 7 shows summary statistics of the estimated demand elasticities for all product lines. These are similar to the statistics reported in other studies that estimate demand elasticities based on Swiss trade data (MOHLER, 2011). It is not uncommon to see some large outliers with this approach, explaining the relative high mean.

Table 7: Summary statistics of the estimated demand elasticities

Observations	4,807
Mean	21.09
Std. deviation	608.96
Median	4.25
Min	1.2
Max	42,100.9

Appendix B: Free trade agreements

Table 8 Overview of Switzerland's FTA partners and the date of conclusion, grouped by geographic location

Partner country	Year	Partner country	Year	Partner country	Year
European					
Norway	1966	Finland	1966	Austria	1966
Denmark	1966	Portugal	1966	Sweden	1966
United Kingdom	1966	Iceland	1970	Belgium	1973
France	1973	Germany	1973	Italy	1973
Netherlands	1973	Ireland	1973	Spain	1979
Greece	1981	Czech Republic	1992	Poland	1992
Slovak Republic	1992	Romania	1992	Hungary	1993
Bulgaria	1993	Estonia	1995	Latvia	1995
Lithuania	1995	Slovenia	1995	Faroe Islands	1995
Croatia	2001	Macedonia	2002	Cyprus	2004
Malta	2004	Albania	2010	Serbia	2010
Ukraine	2012	Montenegro	2012	Bosnia-Herzegovina	2015
Georgia	2018				
Mediterranean					
Turkey	1992	Israel	1993	Palestinian Authority	1999
Morocco	1999	Jordan	2002	Tunisia	2006
Lebanon	2007	Egypt	2008		
World Wide					
Mexico	2001	Singapore	2003	Chile	2004
Republic of Korea	2006	South Africa	2008	Botswana	2008
Lesotho	2008	Namibia	2008	Swaziland	2008
Canada	2009	Japan	2009	Colombia	2011
Peru	2011	Hong Kong, China	2012	Bahrain	2014
Kuwait	2014	Oman	2014	Qatar	2014
Saudi Arabia	2014	Honduras	2014	China	2014
Panama	2014	Costa Rica	2014	Guatemala	2014
United Arab Emirates	2014	Philippines	2018		