Agri-food importing firms amid a health crisis

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Abstract

This paper exploits daily customs transaction data on the universe of Swiss agri-food importing firms to assess the response of firms to a global shock. Estimating a linear model that regresses product-level import margins on daily COVID19 shocks and a host of fixed effects, we find that the pandemic had a substantial trade-reducing effect on imports. The trade effects were driven mainly by a reduction in the number of importing firms (i.e. 63% of the total effect), and much less by the number of products imported and the average import value per product per firm. We explore several sources of heterogeneity and show, among others, that larger and incumbent firms were affected more by the trade adjustments. Our results also reveal that the relative contribution of each import margin to the decline in aggregate imports depends on the level of data aggregation (i.e., daily, weekly or monthly). Finally, we validate and confirm main our findings by testing two mechanisms: (i) third-country supply-side effects using insights from structural gravity models and (ii) changes to consumer demand using consumer mobility, and retailer and consumer scanner data.

Keywords: Firms; Agricultural trade; COVID19; imports; Switzerland

JEL Classification: F14; Q17; Q18

1 Introduction

International trade in agricultural and food products has more than doubled in real terms since the early 1990s due to increased trade liberalisation and the spread of global value chains (Lim, 2021). Trade serves as a balancing mechanism for food demand and supply across the globe. It enables countries to meet parts of their food demand and macro-nutrient needs through imports (Traverso and Schiavo, 2020), and can act as a hedge against the risk of adverse shocks to domestic food supply (Dithmer and Abdulai, 2017; WTO, 2021). However, trade-related mobility of people, animals and goods can be a vector for disease transmission. This is even more crucial in agriculture where bio-security concerns are high. Thus agrifood trade can suffer from health shocks, which in a globalised world are exacerbated by inter-dependencies among economies and how fast the shocks can spread across borders (Distefano et al., 2018; Davis, Downs, and Gephart, 2021).

This century has seen many multi-country epidemics affecting the health of humans — e.g., SARS, MERS, Ebola — and animals — e.g., avian flu, mad cow disease, African swine fever (Anderson, 2022). These epidemics restructured agricultural trade, exposed the sector to tighter standards and regulations, and caused trade disruptions at the country-product level (Nicita, 2008). Yet, as these earlier epidemics were more local than global, importers could reallocate market shares to countries not affected by the crisis. This was not the case for the recent global SARS-CoV-2 virus (henceforth, COVID19) pandemic. Thus, the main objective of this paper is to provide a causal evidence of the reaction of agri-food importing firms to a global health crisis.[1] This is relevant because changes in firm performance may result from idiosyncratic shocks or from idiosyncratic reactions to common shocks affecting all firms. While the former channel has been analysed a great deal (e.g., Movchan, Shepotylo, and Vakhitov, 2020; Shepotylo et al., 2022), we have little evidence for the second channel (Bricongne et al., 2022).

In this paper, we exploit daily customs transaction data on the universe of Swiss agrifood importing firms to assess the impact of domestic COVID19 incidence rates on agrifood imports. First, we decompose daily product level imports into two extensive margins (i.e., the number of firms importing on a day and the number of unique HS8 digit products imported per day) and one intensive margin (i.e., the average import value per product per firm) following Bernard et al. (2007). We

[1] The global nature of the COVID19 shock meant that the agri-food sector faced severe challenges, some of which induced trade effects (OECD, 2020). Restrictions to movement created transport disruptions and delays. Ships and trucks were quarantined reducing ground fleets and increasing delivery times. Commercial flights, which also convey many high-value agricultural products, were cancelled. Social distancing orders reduced the number of import inspectors at borders and travel bans meant seasonal workers were unable to travel to production sites. These disruptions are especially detrimental given the perishable nature of agricultural and food products.

then estimate a linear model that regresses the different import margins on daily COVID19 shocks (which we measure as daily case counts), a variable capturing the policy response to the shock, tariffs and a host of fixed effects. Our identification assumption is that the COVID19 incidence rates are exogenous to the importing firms.

We find that the pandemic led to a reduction in agri-food imports. Specifically, a 10% increase in daily domestic COVID19 case counts decrease daily product-level imports by 3%. The negative effect is driven mostly by a decrease in the number of importing firms (i.e. 63% of the total effect), and comparatively less by the average import values per firm or the number of products imported. However, these average effects mask several sources of heterogeneity in the data set. At the sector level, we find that products further down the supply chains were affected more by the pandemic, with intermediate goods relatively more insulated. Both small and large importing firms were affected by the crisis. Yet, consistent with related evidence from French data (Bricongne et al., 2022), we find that the largest importing firms suffered more from the effect of the pandemic. We also find that the reduction in trade and the margins was driven mainly by incumbent firms.

To gain further insights into the factors driving our findings, we test two mechanisms. First, given the global nature of the pandemic, we expect third-country supply-side effects to be at play. Estimating structural gravity models on weekly firm-origin-product level imports, we show that the pandemic-related incidences in other countries led to a decline in Swiss firm-level imports. This also meant an increase in firm-product level import prices. Second, we test a consumer demand-side effect. The pandemic and its related measures affected consumer behaviour, e.g., by reducing food-away-from-home expenditures (Beckman and Countryman, 2021). Since firms and consumers usually interact, we expect a shock to consumer behaviour to affect firm behaviour. Hence, we test how the pandemic affected consumer demand using daily google mobility data (Aktay et al., 2020). We find a negative effect of the pandemic on visits to grocery shops and recreational centres which provides suggestive evidence of a decline in consumer demand. To confirm this suggestive evidence, we also use information from monthly consumer and retailer scanner data from Nielsen Schweiz (FOAG, 2021) and find that the pandemic indeed led to a decrease in consumer demand.

Our work contributes to the literature in several ways. First, we study the impact of the pandemic on trade using daily customs transaction firm-product-level data. A handful of existing studies have used monthly firm-level data from Colombia (Benguria, 2021), Portugal (Pimenta, Gouveia, and Amador, 2021), Kenya (Majune and Türkcan, 2022) and France (Bricongne et al., 2022; Lafrogne-Joussier, Martin, and Mejean, 2022; Brussevich, Papageorgiou, and Wibaux, 2022) to examine the impact of the COVID19 on trade and found negative effects. Our daily firm-product data is at a more dis-aggregated level than existing studies. This is relevant because the COVID19 incident rates occur daily which meant it was important to monitor the impact of the pandemic using high-frequency data. Our findings also support this data requirement; we show that the level of data aggregation matters for the findings. Regardless of the data frequency, the elasticity of imports to the pandemic remains negative and statistically significant. However, the relative contribution of each import margin to the decline in aggregate imports depends on the level of data aggregation.

Second, by examining the trade effects of the pandemic on a firm size — defined based on the number of employees — we enhance our understanding of the role of large firms in international trade and why they react more to common shocks than smaller firms. Di Giovanni, Levchenko, and Mejean (2020) show that the largest French firms are more sensitive to foreign shocks because they trade more while Bricongne et al. (2022) find that the top exporting French firms contributed disproportionately more to the trade collapse during the 2009 Great Financial Crisis and COVID19 pandemic because they exhibit a higher elasticity to foreign demand shocks. Given that existing evidence suggests that the virus spreads mainly between people in close contact, we test a potential mechanism linked to firm-level employment. Our findings show that firms that are large employers suffered more from the negative trade effects of the pandemic.

Finally, our paper contributes to the literature that assesses the resilience of agricultural trade to the pandemic. Existing studies are limited to the country level. Arita et al. (2022) offer an early empirical assessment of the trade effects of the pandemic, Engemann and Jafari (2022) provide a descriptive analysis of the changes in agri-trade values and Ahn and Steinbach (2022) assess the trade effects of temporary non-tariff measures introduced in response to the pandemic. However, the magnitude and channels of the agricultural trade effects of the pandemic at the firm level are not yet clear. This is important because while countries as an aggregate may have been affected relatively less than expected by the pandemic, this is not necessarily the case for firms. Early works on the pandemic (Bartik et al., 2020; Crane et al., 2022) find that firms closed temporarily or exited some markets completely during the first year of the pandemic. Thus, we provide the first analysis of the trade effect of the pandemic in the agricultural sector using detailed firm-product data.

The rest of the paper is structured as follows. Section 2 presents the data sources and stylized facts. We discuss the conceptual framework and outline the empirical strategy in Sections 3 and 4, respectively. We present and discuss the results in Section 5, followed by an analysis of the potential mechanisms driving the results in Section 6. In Section 7, we conduct robustness checks and offer conclusions in Section 9.

2 Data and stylized facts

2.1 Firm-level agriculture and food imports

Our analysis is based on Swiss firm-level customs transaction data covering the entire universe of agriculture and food importing firms (i.e., firms importing products within the HS01 to HS24 group) between 2019 and 2020. As a country with low food self-sufficiency ratio, and a net importer of agricultural products (Ferjani, Mann, and Zimmermann, 2018), Switzerland offers a good case to assess the reaction of agri-food importing firms to an economic or health crisis. For each import, the data records the day of the transaction, the product classification at the HS8 digit level, the country of origin, the import value in Swiss Francs (CHF), the import volume in kilograms (kg), the most-favoured nation (MFN) specific tariff applied in CHF/kg and the number of people employed by the firm. There are 39,535 unique firms importing 2,292 HS8 digit products from 196 different countries across the years. There are also some notable differences across the two years. Panel (a) of Table 1 provides a summary of selected variables for each year and for both years.

Panel (a) of Figure 1 provides an overview of the structure of Swiss agriculture and food imports in terms of values over the study period. They are dominated by beverages (HS22), fruits and nuts (HS08), coffee (HS09), food preparations (HS18, HS19, HS21) and vegetables (HS07). This distribution will help us understand any potential sector-specific effects that may be present in our empirical findings.

2.1.1 Firm structure

The firm-level data we use contains information on four firm groups defined based on the number of people employed by each firm. Panel (b) of Table 1 provides the distribution of the selected variables using data for both 2019 and 2020. As can be seen, 77% (30,319 out of 39,535) of the firms employ less than 10 people. Also, the number of countries that firms import from and the number of products they import decreases with increasing firm size. This is not surprising because the number of participating firms is also disproportionately skewed towards those with a smaller number of employees. The average and median import values and the number of product origins per firm are, however, increasing with increasing firm size.

A kernel density plot of the distribution of imports by firm size is presented in Panel (b) of Figure

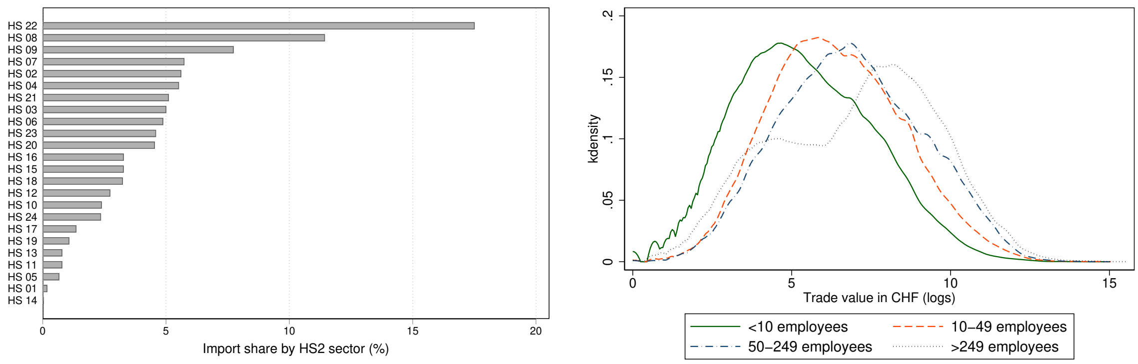
Table 1: Swiss agri-food firms and their importing characteristics

	Origins	Products	Firms	Import value		Origins/firm
				Mean	Median	
Panel a: distribution across years						
Year						
2019	190	2075	26857	5029	386	2
2020	189	2068	28893	5051	365	2
2020 & 2021	196	2292	39535	5041	375	2
Panel b: distribution based on firm structure						
Firm size						
< 10 employees	187	2059	30319	2063	156	2
10 – 49 employees	177	1827	6196	4962	520	3
50 – 249 employees	169	1754	2827	7091	813	4
> 249 employees	161	1690	1195	10000	1385	6

Notes: Origin is the number of countries the firms import from. Products is the number of imported HS8 products. Firms is the number of unique importing firms. Mean is the average import value. Median is the median import value. Origins/firm is the average number of countries a firm imports from. The mean and median values are in Swiss Francs (CHF). Panel b is based on data for both 2019 and 2020.

1. Despite their relatively smaller number (i.e., only 3% of the sample of importing firms), the large firms — i.e., those with > 249 employees — account for 43% of total imports. We see that firm structure, specifically, firm size (here measured by the number of employees), matters for imports. For Swiss agri-food exporting firms, a similar pattern is observed (Fiankor, 2022).

Figure 1: Imports by HS2 sector group and firm size



(a) Import values by HS2 sectors

(b) Imports by firm size

2.1.2 Decomposing Swiss imports into different margins

On aggregate, Swiss agricultural imports did not change much during the pandemic. To depict observed trade patterns prior to and during the pandemic, Panel (a) of Figure 2 shows weekly cumulative firm-level import values in Switzerland. We see that at the onset of 2020, agricultural import values hovered around 2019 values. This changed dramatically in mid-March when the pandemic reached Switzerland. While our focus here is on the agricultural sector, the dramatic drop in Swiss imports is also reported for all goods (Büchel et al., 2020). Nevertheless, import volumes surged again towards the end of the year.

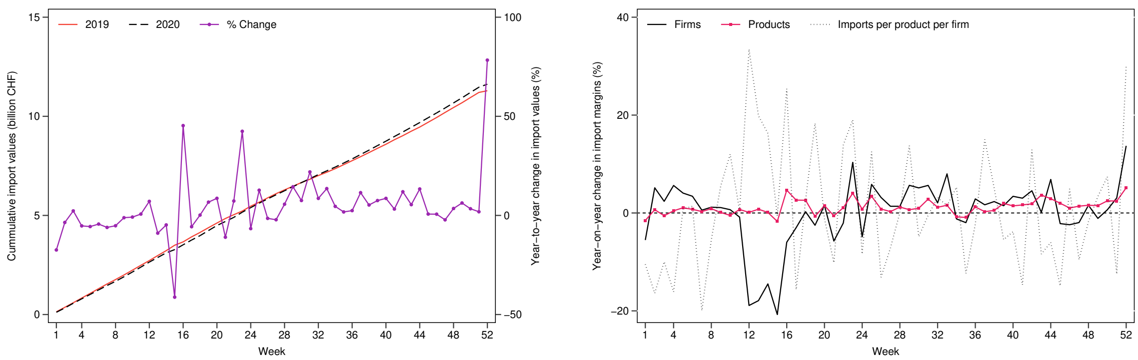
However, it is not enough to look only at the aggregate import levels since different margins of trade may respond differently to trade costs. To assess the different margins of trade adjustment, we follow Bernard et al. (2007) and express total Swiss imports of HS6 digit product p on day t summed across firms, HS8 digit products and origins (X_{pt}) into extensive and intensive margins as shown in equation (1):

$$X_{pt} = F_{pt} \times P_{pt} \times \bar{X}_{fpt} \tag{1}$$

where F_{pt} is the number of active importing firms, P_{pt} is the number of imported products and $\bar{X}_{fpt}$ is the import value per product per firm.

As an initial exploratory analysis, we depict year-on-year changes in the three trade margins (as generated from equation (1)) between 2019 and 2020 in Figure 2. We see variations over time. The number of products imported per firm remained rather stable over the course of the year. This was not the case for the number of importing firms which even though started the year higher than 2019 levels, dropped substantially within the initial stages of the pandemic before returning to pre-pandemic levels. The average import per product per firm was also very erratic over the course of the year. Our analysis assesses how daily COVID19 shocks influence the daily year-on-year changes that are observed here.

Figure 2: Decomposing Swiss imports into different margins of trade (2019 – 2020)



(a) Total imports

(b) Import margins

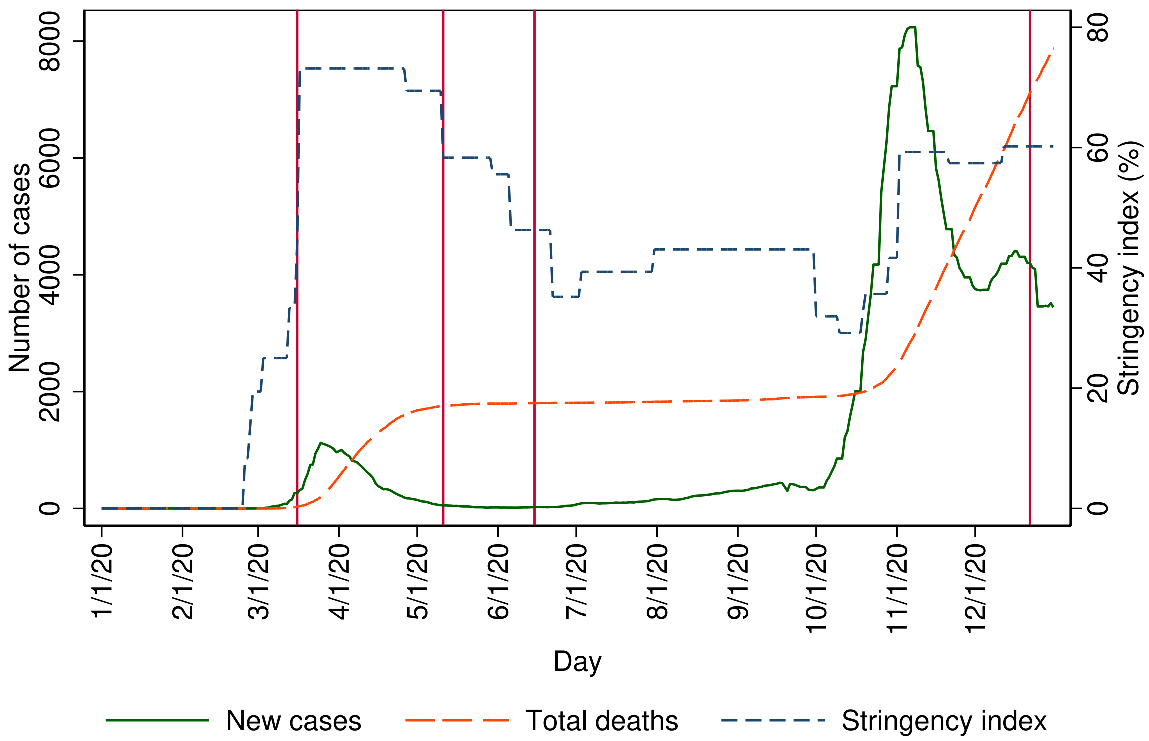
2.2 COVID19 incident rates in 2020

In Switzerland, the first case of COVID19 was confirmed on 25 February 2020 (Figure 3). On March 16, the Swiss government declared an "extraordinary situation" – putting the nation into a semi-lockdown. At this point, the authorities banned all private and public events and closed restaurants, bars, leisure facilities and shops. They only kept grocery stores and pharmacies open. Border checks and entry restrictions for non-eligible people were also introduced shortly after, while the federal authorities stopped processing new work permits and halted the issuing of visas. As the Covid cases kept increasing, Swiss borders were finally closed on 24 March 2020. 16 weeks later on 15 June, a substantial step toward normalisation was taken, lifting restrictions on people entering Switzerland from Schengen countries. However, as the nationwide lockdown restrictions were gradually eased, the cantons were able to impose their own restrictions. October 2020 saw a further rapid rise in new infections, in response to which the cantonal governments increasingly introduced more restrictive regulations. A second national lockdown was then introduced in December. Nevertheless, Swiss anti-COVID19 measures were less strict than other European countries with the Alpine state adopting a liberal implementation of mitigation measures (Moser, von Wyl, and Höglinger, 2021).

We access the data on COVID19 indicators from an online database maintained by the Johns Hopkins University.[2] In Figure 3, we depict the COVID incident rates in Switzerland in 2020. We observe varying stringency of COVID19 policy measures (depicted by the stringency index) and variations in case counts. The stringency index is a composite measure based on nine response indicators (i.e., school closures, workplace closures, cancellation of public events, restrictions on public gatherings, closures of public transport, stay-at-home requirements, public information campaigns, restrictions on internal movements, and international travel controls) re-scaled to a value from 0 – 100. A higher score indicates a stricter policy response. Stricter COVID19 policy measures do not necessarily correspond with the number of COVID19 cases. In other words, a relatively low number of COVID19 cases might cause strict policy measures such as a total lockdown of the economy, whereas rather lax COVID19 measures were imposed when a high number of COVID19 cases was observed. Depending on what objective they sort to achieve — e.g., worried about available hospital beds — policymakers could tighten or relax their containment measures.

[2] https://github.com/CSSEGISandData/COVID19

Figure 3: Swiss daily COVID19 incident rates in 2020



Notes: This graph also depicts key timelines in Switzerland. The four vertical lines show from left to right (i) the first lockdown on 16/03/2020, (ii) the end of first lockdown on 11/05/2020, (iii) the border opening on 15/06/2020 and (iv) the beginning of a second lockdown on 22/12/2020. Higher values of the stringency index indicate more stringent policy measures.

3 Conceptual framework

The conceptual framework of our paper is grounded on recent trade theories with heterogeneous firms (Melitz, 2003; Chaney, 2008). We use the main predictions of the model presented in Chaney (2008) as a framework for how we expect the pandemic to affect agri-food imports.

The pandemic affected macro-level domestic income directly and indirectly. First, the pandemic directly reduced investment (Andersson et al., 2022) and likely reduced food demand due to shock to consumer demand and employment (OECD, 2020).[3] Early insights from CGE models showed that the negative impacts of the pandemic on the GDP of many countries from agriculture arise due to reduced food-away-from-home expenditures (Beckman and Countryman, 2021). Second, the various policy measures implemented by Switzerland to prevent the spread of COVID19 could also indirectly affect domestic income via reduced investment and lower demand. Uncertainty in-

[3]For example, importing firms could halt or postpone their importing activities due to the uncertainty created by the pandemic, and prevent the spread of COVID19 among their workers. Demand could also reduce because more people fell sick (and die) and, some consumers may have postponed their consumption.

duced by shocks reduces the appetite of firms to invest. Investment into fixed and variable costs of importing is no exception. This implies that demand for imported agri-food products is likely to reduce due to the reduction in domestic demand. However, both the pandemic and related policy measures could also decrease the domestic production of agri-food products, which can increase foreign demand for these products, for a given level of demand. Therefore the effect of the pandemic on agri-food imports depends on the relative magnitude of these opposing forces and is, thus, an empirical question.

COVID19 and related travel restrictions are more likely to account for a substantial increase in trade costs because they have disrupted freight transport, and supply of services, among others (WTO, 2020). An increase in trade costs is likely to reduce the import volume of current importers and also increase the productivity level needed to import. Firms will import a given variety of agri-food products if the expected profits derived from selling them cover at least their cost of importing. This implies only the most productive incumbent firms are likely to import while only the productive new firms will enter the import market. This would likely affect the number of importing firms and also the number of products they import. Also, the productivity of workers could be affected if more workers fall sick and isolate themselves. For instance, there were reported cases of outbreaks in many work settings: 15 EU/EEA countries and the UK reported 1,376 clusters of COVID19 in occupational settings which occurred between March and early July 2020 resulting in 18,170 cases and 166 deaths. The food packaging and processing sector ranked third in the settings with the most reported cases with 153 clusters and 3,856 cases (ECDC, 2020).

In many exporting countries, agricultural and food production faced significant bottlenecks due to the pandemic and containment measures imposed by governments. For example, acute shortages of seasonal labour and disruptions to input markets due to mobility restrictions such as border closures and lockdowns affected agriculture directly by reducing yields (OECD, 2020). Many countries also introduced food export restrictions following the market uncertainties triggered by the pandemic (Laborde, Mamun, and Parent, 2020). With increasing COVID19 case counts many countries introduced export-restricting non-tariff measures (Ahn and Steinbach, 2022). These and many other supply-side factors in major agricultural-producing countries reduced the volume of products available for export and increased export prices. The consequences for importing countries depend very much on their net trade positions. Net importing countries will suffer the effects of these supply shortages relatively more than other countries.

4 Empirical strategy

Our benchmark model analyses the effect of daily variations in Swiss-specific COVID19 shocks on Swiss aggregate agri-food imports, extensive margin (the number of active importing firms and the number of imported products) and the intensive margin (import value per product per firm). This allows us to understand how the different margins adjusted and by how much to the pandemic. To that end, we estimate a linear model wherein we regress aggregate import, and each of the three margins defined in equation (1) on lags of daily COVID19 shocks, a measure of the stringency of policy response to the pandemic on the day of imports, most-favoured-nation tariffs and a set of product and week-year fixed effects. Our benchmark estimation equation is the following:

$$\ln X_{pt} = \beta_0 + \beta_1 \ln \text{Covid}_{t-5} + \beta_2 \text{Stringency index}_t + \beta_3 \ln(1 + \text{Tariff}_{pt}) + \theta_p + \lambda_w + \varepsilon_{pt} \quad (2)$$

where X is one of the measures defined in equation (1). Our variable of interest is Covid, which is measured as the number of confirmed deaths reported on day t in Switzerland. While the COVID19 related case count is an intuitive proxy for the direct effect of the pandemic, lock-downs of various stringency are implemented in reaction to the shock. As a result, we also control for the stringency of policy measures introduced to control the spread of the virus using the contemporaneous Stringency index_t measure. The inclusion of both COVID19 related case count and the stringency of policy measures in the same regression model allows us to capture the pure effect of the pandemic via the case count variable. The variable Tariff_{pt} is the product-specific most-favoured-nation tariff imposed on imports at time t. Summary statistics on all the variables used in the regression are presented in Table A1 in the Appendix.

We also include a set of fixed effects to limit concerns about omitted variables. In particular, we include product fixed effects, θ_p, to account for all observable and observable time-invariant products and importing firm characteristics, and time (week-year) fixed effects, λ_w, to account for all common global shocks, seasonality and Switzerland specific country-level time-varying variables that could affect trade. We cluster the error terms at the product level.

The identification assumption is that the COVID19 pandemic is an exogenous shock to the firms because it was sudden and affected all firms. Our identification strategy, therefore, exploits variations in daily COVID19 incident rates as a predictor of daily product-level imports i.e the identification relies on variation in daily import growth of the same product with varying degrees of COVID severity, while accounting for product-level and weekly common shocks. We estimate equation (2) using ordinary least squares (OLS).

5 Results

5.1 Decomposing the trade effect of the crisis

Table 2 reports our benchmark results. The dependent variable in the first column is the total imports value, while that of the next three columns are the number of firms, number of products and the average imports per product per firm, respectively. The sum of the coefficients across the last three columns should equal that of the first column.

In column (1), we observe that the COVID19 shock had a negative effect on Swiss imports. Specifically, a 10 percent increase in the number of COVID19-related deaths in Switzerland reduced Swiss product level imports by 2.8%. Splitting the total import value into the different trade margins shows that the COVID19-induced trade shock worked mostly through a reduction in the number of importing firms, i.e., approximately 63% of the total effect. A 10% increase in daily COVID19-related deaths reduced the number of importing firms by 1.7%, the number of imported product varieties by 0.3% and the average import value per product per firm by 0.7%. For an economy experiencing COVID19, the economic contraction resulting from domestic pandemic containment policies — such as restrictions on mobility and social distancing was expected to lead to a large contraction in demand. It is also possible that the firms reduced their investment in response to the shock, while more workers fell sick, which likely affected their productivity. These factors coupled with many others, such as delayed delivery times, increased freight costs, COVID19 shocks and restrictions in the origin countries likely contributed to the decline in imports. We examine some of these channels in details in Section 6.

Focusing on the other control variables, we see that the stringency index — which proxies the policy response to the shock — has a positive but negligible effect on imports. This is not surprising as the factors that constitute the measure of the stringency index affected consumers more directly than firms. Specific tariffs reduce the values of imports but increase the number of products imported.

Table 2: OLS estimates of the effect of COVID19 on Swiss firm-level import margins

	Total imports X_{pt}	Firms F_{pt}	Products P_{pt}	Imports/product/firm $\bar{X}_{fpt}$
	(1)	(2)	(3)	(4)
Log Covid$_{t-5}$	-0.276^{***}	-0.174^{***}	-0.031^{***}	-0.071^{**}
	(0.039)	(0.015)	(0.006)	(0.032)
Stringency index$_t$	0.011^{***}	0.006^{***}	0.001^{***}	0.005^{***}
	(0.002)	(0.001)	(0.000)	(0.001)
Log Tariff$_{pt}$	-0.224^{***}	0.035	0.130^{***}	-0.389^{***}
	(0.069)	(0.037)	(0.018)	(0.031)
Product FE	Yes	Yes	Yes	Yes
Week-year FE	Yes	Yes	Yes	Yes
N	223680	223680	223680	223680
adj. R^2	0.521	0.566	0.754	0.521

Notes: Data are in daily frequency. The dependent variable in column (1) is total Swiss imports — summed across all firms, HS8 digit products and origin countries — of product p on day t. F_{pt} is the number of active importing firms on day t, P_{pt} is the number of products imported on day t and $\bar{X}_{fpt}$ is the import value per product per firm on day t. All models are estimated using ordinary least squares. p values are in parentheses. ***, ** and * denote significance at 1%, 5% and 10% respectively. Intercepts included but not reported.

5.2 Sector-specific effects

The HS2 sector-specific findings are reported in Table 3. We find that all import sectors had at least one trade margin affected negatively by the pandemic, with most having to adjust along multiple import margins. The exceptions were cereals (grain handling and processing are highly automated and less labour intensive), live animals (probably seem to have adapted more easily probably due to experience gained from past experiences like the BSE), cocoa and products of the milling industry. This observation is largely in line with the 2020 FAO Food Outlook (FAO, 2020). Oilcrops experienced a COVID19-related stagnation in terms of demand by the food and non-food sectors and sugar consumption declined due to COVID19-related lockdown and containment measures. The pace of production expansion across all meat sectors were moderated by pandemic-related disruptions to production processes and output restraints. The fruits and vegetables sectors were among the most affected during the pandemic as their production is highly labour-intensive and their perishable nature requires efficient logistics and transportation. The general observation, however, is that products further down the supply chains, i.e., closest to the final consumer, were affected more by the pandemic, with intermediate goods relatively more insulated.

Table 3: HS2 sector specific effects of COVID19 on import margins

2 digit HS group	X_{pt}	F_{pt}	P_{pt}	$\bar{X}_{fpt}$	N
HS01: Animals, live	0.661	0.429**	−0.055	0.287	1139
HS02: Meat	−0.066	−0.215***	−0.011	0.161	10763
HS03: Fish and crustaceans	0.049	−0.026	−0.003	0.078	26596
HS04: Dairy produce	0.321	−0.034	−0.114***	0.469**	7858
HS05: Animal products, nes	0.222	−0.179	−0.034	0.435**	2193
HS06: Trees and other plants	−0.630***	−0.508***	−0.038	−0.084	8492
HS07: Vegetables	−0.489***	−0.403***	−0.120***	0.034	26580
HS08: Fruits and nuts	−0.580***	−0.357***	−0.013	−0.210**	26240
HS09: Coffee, tea, mate, spices	−0.308*	−0.077	−0.003	−0.228*	11688
HS10: Cereals	−0.253	0.041	0.038	−0.331	3702
HS11: Products of the milling industry	−0.123	−0.079	−0.026	−0.017	7698
HS12: Oil seeds	−0.332	−0.191***	−0.047**	−0.095	9321
HS13: Lac; natural gums, resins	−0.127	−0.090	0.044	−0.081	2116
HS14: Vegetable plaiting materials	0.165	−0.014	0.006	0.173	1299
HS15: Animal, vegetable fats and oils	−0.485***	−0.074*	−0.030	−0.382**	9527
HS16: Meat, fish; preparations	−0.315***	−0.132***	−0.006	−0.177	11619
HS17: Sugars and sugar confectionery	−0.800***	−0.173*	−0.110*	−0.518*	5044
HS18: Cocoa and cocoa preparations	0.369**	−0.004	0.025	0.348**	3467
HS19: Preparations of cereals	0.005	−0.127**	−0.061**	0.193	7367
HS20: Preparations of vegetables, fruits	−0.196	−0.049	0.034	−0.182	16548
HS21: Miscellaneous edible preparations	−0.492	−0.204*	−0.048	−0.239	7540
HS22: Beverages, spirits, vinegar	−0.463***	−0.268***	0.025	−0.220*	9941
HS23: Residues of food industry	−0.392***	−0.211***	−0.068	−0.114	4429
HS24: Tobacco	−0.027	0.038	−0.019**	−0.046	2513

Notes: Data are in daily frequency. All models are estimated using ordinary least squares. ***, ** and * denote significance at 1%, 5% and 10% respectively. Intercepts included but not reported. X_{pt} is total Swiss imports — summed across all firms, HS8 digit products and origin countries — of product p on day t. F_{pt} is the number of active importing firms on day t, P_{pt} is the number of products imported on day t and $\bar{X}_{fpt}$ is the import value per product per firm on day t. All other controls are included but not reported for brevity. p values are not reported because of space.

5.3 Which firms were more affected by the crisis?

5.3.1 Firm size

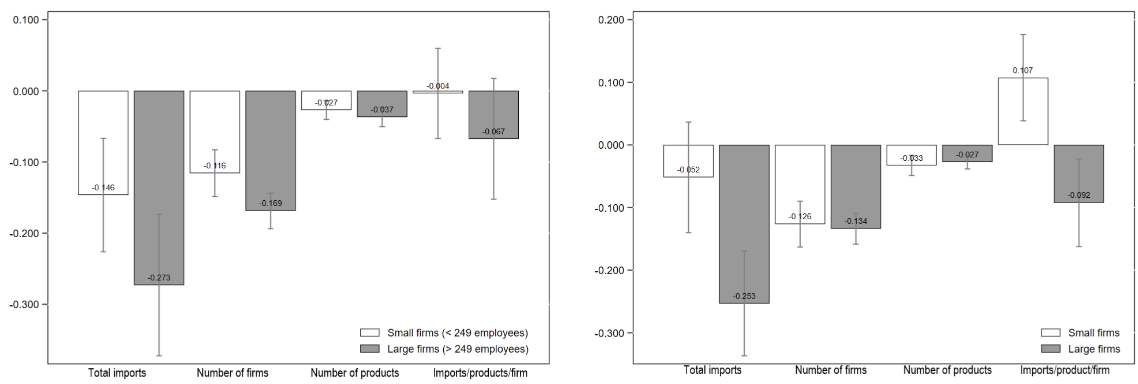
There remains considerable debate in the theoretical and empirical literature about the differences in the cyclical dynamics of firms by size — which is a measure of productivity (Fort et al., 2013). The trade literature has also established a clear consensus between firms' trade potentials and their productivity (Mayer and Ottaviano, 2008; Bernard et al., 2012). In light of these papers, we assess how the COVID shock affected firms based on their size.

Our first measure of firm size is based on the distributions in Figure 1. We define two groups of firms: (i) small — those with less than 240 employees — and (ii) large — those with more than 240 employees — firms.[4] Figure 4 summarizes the results of this analysis. We find that The

[4] If we alternatively define four groups of firms: those with (i) <10 employees, (ii) 10 – 49 employees, (iii) 50–249 employees and (iv) > 240 employees, we find that in all cases larger firms were more affected by the COVID19 shock than smaller ones. The exception is with firm sizes 3 (i.e., 50–249) where in three out of the four cases there were no statistically significant effects. See Figure A1 in the Appendix.

COVID19 shock affected both large and small firms. This finding confirms that Swiss firms were not prepared to deal with this type of shock, regardless of their size. However, we also see that larger firms suffered more from the effects of the pandemic (Panel a of Figure 4). A possible reason for this is that firms with higher numbers of employees are more likely to work in close physical proximity to other people and thus more exposed to and at higher risk of COVID19. Before we take this evidence as conclusive, it is possible that some large firms with a high number of employees may have importing activities forming only a small part of their business activities. This does not appear to be the situation in our case as the firm group employing the most employees also accounts for 46% of overall imports. Nonetheless, we also define firm size based on import activity; precisely total import values in 2019 (Figure 4b). We define firms with a total import value in 2019 above the median import value of 3,292,961 CHF as large firms.[5] Otherwise they are defined as small. The disproportionately large effect for larger firms is also here confirmed. Overall, our finding confirms recent evidence that points towards a larger negative overreaction of importing and exporting firms to economic shocks that affect all firms within an economy (Bricongne et al., 2022; Di Giovanni, Levchenko, and Mejean, 2020).

Figure 4: Heterogeneity across firm size



(a) Firm size defined by number of employees (b) Firm size defined by import volumes

Notes: The results presented in these graphs are based on two different samples of small and large firms . In essence, we calculate the total imports and the three import margins for each firm size grouping. The coefficient estimates that are plotted here are then retrieved from regressions of equation 2 on the two samples of small and large firms.

5.3.2 Incumbent and new firms

We also assess the differential impact of the pandemic on incumbent and new importing firms. The trade literature emphasise that entrants are relatively small compared to incumbents in terms of their

[5]The maximum total import value by a firm was 876 million CHF

trade value and thus contribute less to aggregate trade (Eaton et al., 2008; Lederman, Rodríguez-Clare, and Xu, 2011; Fernandes, Lederman, and Gutierrez-Rocha, 2013). Assessing this source of heterogeneity is important in understanding the reaction of these firm types to the COVID19 pandemic. We define incumbents as firms that imported at least one product in both 2019 and 2020 while new importing firms (i.e., entrants) as firms that did not import any product in 2019 but imported at least one product in 2020.

The results are presented in Table 4. For incumbent firms (Columns 1 – 4), a statistically significant negative effect of the pandemic on imports and the margins is observed, while for entrants (columns 5 – 8), the effect is either statistically insignificant or small in economic magnitude. This suggests that the negative effects of the COVID19 shock on the imports and the three margins were largely driven by incumbent firms. A likely explanation for this is that incumbent firms command a larger market share and thus suffered the impact of the exogenous shock more as argued by the existing literature (e.g., Di Giovanni, Levchenko, and Mejean, 2020).[6] It is also possible that the new importing firms entered the market after observing the shock and thus were more prepared to cope with the shock than the incumbent firms.

Table 4: OLS estimates of the effect of COVID19 on import margins (Incumbents vs Entrants)

	Incumbents				Entrants			
	X_{pt} (1)	F_{pt} (2)	P_{pt} (3)	$\bar{X}_{fpt}$ (4)	X_{pt} (5)	F_{pt} (6)	P_{pt} (7)	$\bar{X}_{fpt}$ (8)
Log Covid$_{t-5}$	-0.296^{***}	-0.186^{***}	-0.035^{***}	-0.075^{**}	-0.102	-0.002	-0.032^{*}	-0.068
	(0.042)	(0.016)	(0.007)	(0.035)	(0.135)	(0.029)	(0.017)	(0.129)
Stringency index$_t$	0.010^{***}	0.006^{***}	0.001^{***}	0.003^{**}	0.011^{*}	0.001	0.001	0.009
	(0.002)	(0.001)	(0.000)	(0.001)	(0.006)	(0.001)	(0.001)	(0.005)
Log Tariff$_{pt}$	-0.218^{***}	0.027	0.124^{***}	-0.370^{***}	-0.202^{***}	0.035^{**}	0.028^{***}	-0.265^{***}
	(0.073)	(0.039)	(0.019)	(0.032)	(0.070)	(0.014)	(0.009)	(0.069)
Product FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Week-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	199486	199486	199486	199486	11225	11225	11225	11225
adj. R^2	0.524	0.563	0.747	0.529	0.322	0.395	0.468	0.330

Notes: Data are in daily frequency. All models are estimated using ordinary least squares. ***, ** and * denote significance at 1%, 5% and 10% respectively. Intercepts included but not reported. X_{pt} is total Swiss imports — summed across all firms, HS8 digit products and origin countries — of product p on day t. F_{pt} is the number of active importing firms on day t, P_{pt} is the number of products imported on day t and $\bar{X}_{fpt}$ is the import value per product per firm on day t. Incumbents are firms that imported in both 2019 and 2020. Entrants are firms that imported in 2020 but not in 2019. Control variables include product-specific most-favored-nation tariff and the stringency index.

5.4 Does the level of data aggregation matter?

The COVID19 pandemic has required monitoring economic activity in real time, a feature that usual data could not provide. Our daily firm-level import data offers a level of data aggregation that is of a

[6] In our sample, the average import value per product per entrants is about 75% that of incumbents in 2020.

higher frequency than any from existing works. As a result, we estimate our models by aggregating our daily import data to weekly and monthly levels. The aim is to see how the higher aggregated levels influence our findings. For the COVID19 related variables, we use simple means to bring them from the daily to weekly or monthly levels. The results are presented in Table 5. Overall, we still see the trade reducing effects of the pandemic. However, the relative contribution of each margin to the decline in aggregate imports also depends on the level of data aggregation.

Table 5: OLS estimates of the effect of COVID19 on firm-level imports: different levels of data aggregation

	Weekly data				Monthly data			
	X_{kt} (1)	F_{kt} (2)	P_{kt} (3)	$\bar{X}_{fkt}$ (4)	X_{kt} (5)	F_{kt} (6)	P_{kt} (7)	$\bar{X}_{fkt}$ (8)
Log Covid$_{t-1}$	-0.030^{***}	-0.011^{***}	0.000	-0.020^{***}	-0.009^{**}	0.003^{*}	0.001	-0.012^{***}
	(0.007)	(0.002)	(0.001)	(0.006)	(0.004)	(0.001)	(0.001)	(0.003)
Stringency index$_t$	0.002^{***}	−0.000	−0.000	0.002^{***}	0.003^{***}	0.001^{**}	0.000	0.002^{***}
	(0.001)	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)
Log Tariff$_{pt}$	-0.369^{***}	−0.051	0.161^{***}	-0.479^{***}	-0.455^{***}	−0.049	0.148^{***}	-0.553^{***}
	(0.079)	(0.032)	(0.019)	(0.048)	(0.121)	(0.043)	(0.025)	(0.076)
Product FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month-year FE	Yes	Yes	Yes	Yes	No	No	No	No
Year FE	No	No	No	No	Yes	Yes	Yes	Yes
N	70808	70808	70808	70808	16872	16872	16872	16872
adj. R^2	0.841	0.932	0.931	0.778	0.906	0.959	0.953	0.859

Notes: Data in columns (1) – (4) are at weekly frequency. Data in columns (1) – (4) are at monthly frequency. All models are estimated using ordinary least squares. ***, ** and * denote significance at 1%, 5% and 10% respectively. Intercepts included but not reported. X_{pt} is total Swiss imports — summed across all firms, HS8 digit products and origin countries — of product p on day t. F_{pt} is the number of active importing firms on day t, P_{pt} is the number of products imported on day t and $\bar{X}_{fpt}$ is the import value per product per firm on day t. Control variables include product-specific most-favored-nation tariff and the stringency index.

6 Mechanisms

Our findings thus far confirm product-level impacts of the pandemic on import demand. Given that this was a global pandemic, it also affected other countries that export to Switzerland. The direct effect of the pandemic on consumers could also be a factor. As such, in this section, we explore some of the possible mechanisms that could explain the negative trade effects we see in Section 5. First, we assess how shocks to other countries affected Swiss firm-level import volumes and prices. We then assess how the pandemic affected Swiss consumer behavior.

6.1 Third-country effects

Here, we estimate the effect of partner countries' COVID19 shocks on firm-product-level imports. We measure the dependent variable as the weekly[7] import value and quantity of HS8-digit product p between firm f and origin country o (i.e., X_{fpot}) and estimate a structural gravity model using OLS and Poisson Pseudo-Maximum Likelihood Estimator (PPML). Our OLS estimation equation takes the following form[8]:

$$\ln X_{fpot} = \beta_0 + \beta_1 \ln \text{Covid}_{ot-1} + \beta_2 \text{Stringency index}_{ot-1} + \alpha_{fpm} + \alpha_{opm} + \varepsilon_{fpot} \tag{3}$$

where Covid_{ot-1} is the one-week lag of COVID19-related deaths per million inhabitants in origin country o, in week t. Stringency index_{ot} measures the policy environment in the exporting country on the day t. α_{fpm} and α_{opm} are firm-product-month and origin-product-month fixed effects which control for the theoretical multilateral resistance terms (Anderson and Van Wincoop, 2003).[9] The inclusion of α_{fpm} means that we exploit the within-firm-product variation in our data set. α_{fpm} also accounts for all firm-specific effects. Because there is no importing country variation in our dataset, α_{fpm} also accounts for COVID19 incidence and stringency levels in Switzerland.[10] α_{opm} accounts for all observable and unobservable variables that vary along that dimension, e.g., product-specific custom tariffs, but also traditional gravity variables such as GDP, distance, contiguity, and language. The error term, ε_{fpot}, is clustered at the firm-product-origin level. Summary statistics on the variables used in this part of the analysis are presented in Table A2.

The results of the structural gravity estimations are presented in Table 6. Governmental COVID19 policy measures of foreign countries indeed impacted Swiss firm-level imports.[11] In particular, a ten percent increase in the COVID death count per million inhabitants decreases Swiss import values by about four percent. From the supply side, the sudden halt in production following strict lock downs

[7] For the gravity model estimations we aggregate the data set to the weekly level to allow for the most likely scenario that firms are not importing from a particular origin country every day.

[8] We run the PPML estimations on the same sample as the one for the OLS regressions. Squaring the firm-product-origin-week-year trade data set to include zeroes results in too many observations. The estimation equation for the PPML is the following:

$$X_{fpot} = \exp\left[\beta_0 + \beta_1 \ln \text{Covid}_{ot-1} + \beta_2 \text{Stringency index}_{ot-1} + \alpha_{fpm} + \alpha_{opm}\right] + \varepsilon_{fpot}$$

[9] Ideally, the multilateral resistance terms should vary at the weekly level. However, defining them at this level will not allow us to identify the COVID shock which we in this step define at the weekly level.

[10] This is not a problem in our case, as we already identify the Swiss specific COVID effect in Section 5. In our case, a gravity specification that attempts to identify COVID19 shocks in the single importing country case will require that we drop the firm-level fixed effects. We believe doing this will weaken our identification strategy as our inward multilateral resistance terms will in that case not be defined correctly.

[11] The EU is the biggest supply of Swiss imports. To assess how the third-country effects from the EU affected Swiss imports we interact the COVID19 variable with an EU dummy. We find that the being a member of the EU did not moderate the effects of the pandemic.

and outright closings of establishments would also imply a contraction in the exports of trading partners or equivalently the bilateral imports of trading partners.

Table 6: The effect of COVID19 in other countries on Swiss firm-level import values and prices

	Import values in CHF		Import prices in CHF/kg		
	(1)	(2)	(3)	(4)	(5)
Log Covid$_{t-1}$	-0.014^{***}	-0.035^{***}	0.005^{***}	0.005^{***}	0.003^{*}
	(0.005)	(0.013)	(0.002)	(0.002)	(0.002)
Stringency Index$_t$	0.000^{**}	0.002^{***}	-0.000^{**}	-0.000	-0.000
	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)
High value product				0.763^{***}	0.754^{***}
				(0.007)	(0.008)
Log Covid$_{t-1}$ × High value product					0.005^{***}
					(0.001)
Firm-product-month FE	Yes	Yes	Yes	Yes	Yes
Origin-product-month FE	Yes	Yes	Yes	Yes	Yes
N	1111926	1111926	1049615	1049615	1049615
Estimator	OLS	PPML	OLS	OLS	OLS

Notes: Data are in weekly frequency. The dependent variable in columns (1) – (2) are the import values of firm f of HS8 digit product p from origin country o in week t of years 2019 and 2020. The dependent variable in columns (3) – (5) are the prices of imports — measured as CIF unit values — of firm f of HS8 digit product p from origin country o in week t of years 2019 and 2020. p values are in parentheses. ***, ** and * denote significance at 1%, 5% and 10% respectively. Intercepts included but not reported. We define high-value (low-value) as products that have a value-to-weight ratio higher (lower) than the median across all products in our sample.

We also assess how COVID19 shocks in partner countries affected firm-product-level import prices. Using data on import values in CHF and import volumes in kg, we calculate unit values in CHF/kg as a proxy for import prices. Empirically, we estimate a linear model akin to equation (3) but replace the dependent variable variable with the price of imports of firm f of HS8 digit product p from origin country o in week t (i.e., UV_{fpot}). The results are presented in columns (3) – (5) of Table 6. A 10 percent increase in the case count per million inhabitants increased firm-product level import prices by 0.05 percent. However, it is possible that price effects vary across product quality groups. Following Szewerniak, Xu, and Dall'erba (2019), we define high-value (low-value) as products that have a value-to-weight ratio higher (lower) than the median across all products in our sample. In column (4), we introduce a control for high-value products. We see that high-value products are sold at high prices. We interact the control for high-value products with the COVID shock in column (5) and find that the price effect is more pronounced for products of higher quality. This can be explained by the perishable and time-sensitive nature of high-value-to-weight products (usually consumables such as fruits, vegetables, meat, flowers) vis-à-vis low-value-to-weight products (usually commodities such as cocoa, coffee, wheat). Furthermore, high-value agri-food products are usually transported as air cargo on commercial flights. The substantial drop in commercial flights induced by the pandemic increased the cost of air transportation and distribution.

6.2 Changes in consumer demand

The COVID19 pandemic constituted both a demand and a supply shock. National COVID19 policy measures such as a total lockdown of the economy, an obligation to work from home or isolation of infected persons also affected consumer behaviour. During the first lockdown in Switzerland, all stores, restaurants, bars, schools, entertainment and leisure establishments were closed. Furthermore, the closed borders with the European Union prevented the cross-border shopping tourism behaviour of Swiss consumers (Ritzel et al., 2022). Since consumers and firms interact with each other (e.g., increasing consumer demand leads firms to increase production and/or imports, and marketing activities of firms cause a change in consumer demand), we test the impact of the pandemic on consumer behaviour. We test this mechanism using consumer mobility data and consumer purchase data.

First, we use daily data on mobility sourced from Google's COVID19 community mobility reports (Aktay et al., 2020). The data tracks changes in the observed pattern in daily mobility across a different classifications of places relative to a baseline. The baseline is the median value from the 5-week period between January 3rd to February 6th 2020. We use Cantonal mobility trends from two categories of places that consumers regularly visit, i.e., (i) grocery and (ii) retail & recreation.[12] Grocery is defined as the daily trend in visits to grocery markets, food warehouses, farmers markets, specialty food shops, drug stores, and pharmacies compared to a baseline. Retail & recreation is defined as the daily trend in visits to restaurants, cafes, shopping centres, theme parks, museums, libraries, and movie theatres compared to a baseline. The results are shown in Table 7. The pandemic led to drop in the mobility patterns to grocery stores and retail and recreation centres. This provides suggestive evidence that the pandemic led to a drop in consumer demand. Even though, the pandemic led to an increase in online grocery shopping, it was not enough to replace all food-away-from-home expenditures at restaurants, school and office canteens or demand from firms who used these products as intermediate inputs.

We also test the effect of the pandemic on consumer demand using Nielsen Schweiz homescan and retailer scanner data set (FOAG, 2021). This data set draws on two data sources: a consumer panel and a retail scanner panel. The consumer panel covers data on monthly purchase quantities and costs of 4,000 Swiss households from channels such as traditional retailers, direct farm sales, butcheries and bakeries. In the retail scanner panel, all products scanned on the conveyors at retailers participating in the panel are recorded. This includes all the players in the Swiss stationary retail

[12]Cantons are territorial divisions within the Swiss confederation. There is currently 26 Cantons in Switzerland

trade but excludes the two German discounters Aldi and Lidl. Demand quantities for both organic and conventional food products are available on a monthly basis, and cover four basic product categories: meat, milk products, vegetables, and fruits. The combined retail/consumer panel provides the most precise sales and turnover figures for the Swiss retail sector (FOAG, 2021). We regress COVID19 shocks on quantity demand and identify a negative and statistically significant relationship. This finding support existing evidence from Switzerland: using debit card transaction data, Pleninger, Streicher, and Sturm (2022) show that consumption decreased with increasing infections.

Table 7: OLS estimates of the effect of COVID19 on consumer demand

	Consumer mobility		Consumer demand			
	Grocery (1)	Retail & Recreation (2)	Vegetables (3)	Fruits (4)	Meat (5)	Milk products (6)
Log Covid$_{t-h}$	-7.197^{***}	-4.853^{***}	-0.059^{***}	0.067	-0.034^{***}	-0.021^{***}
	(1.062)	(0.617)	(0.007)	(0.053)	(0.005)	(0.003)
Stringency index$_t$	0.215^{***}	-0.585^{***}	0.008^{***}	0.005	0.008^{***}	0.005^{***}
	(0.021)	(0.028)	(0.001)	(0.005)	(0.001)	(0.001)
Observation	5411	5411	1104	937	1356	782
adj. R^2	0.178	0.829	0.879	0.507	0.958	0.982

Notes: The data on consumer mobility are in daily frequency and at the canton level while the data on consumer demand are in monthly frequency and the country level. Grocery is the daily change in visits to places like grocery markets, food warehouses, farmers markets, specialty food shops, drug stores, and pharmacies compared to a baseline day. Retail & Recreation is the daily change in visits to places like restaurants, cafes, shopping centres, theme parks, museums, libraries, and movie theatres compared to a baseline day. The baseline day is the median value from the 5-week period between January 3rd to February 6th 2020. Columns 1 and 2 controls for the interaction between 2019 Canton level variables(population and GDP growth) and a linear time trend, canton and week-year fixed effects. Columns (3) – (6) include product and week-year fixed effects. For columns (1) to (2) the lag length $h = 5$ days. For columns (3) to (6) the lag length $h = 1$ month. p values are in parentheses. ***, ** and * denote significance at 1%, 5% and 10% respectively. Intercepts included but not reported.

7 Robustness Checks

This section contains a series of sensitivity checks to examine the robustness of the results obtained in Section 5. First, in our benchmark models, we measure the COVID19 shock as the number of confirmed deaths on a day. To see if the result is sensitive to the definition of COVID19 shock, we use three other proxies: (a) total COVID19 cases on day t, (b) new COVID19 deaths on day t, and (c) new COVID19 cases on day t. The results are presented in the Tables A3, A4, and A5 respectively. As can be seen, the results are similar to those presented in section 5. Thus, the choice of proxy for COVID19 shock does not appear to be driving our findings. We also check whether accounting for time-varying factors in the origin country alters the main findings of the paper. Specifically, we define the trade margins in equation 2 at the product-origin-time level instead of the product-time level. This allows us to flexibly control for the origin country's time-varying factors – including their daily domestic COVID19 cases with origin-time fixed effects. The results as presented in Table A6 are in line with the main findings.

8 Policy implications

Our findings have policy implications for the resilience of agricultural trade to current and future global shocks, especially those that affect all countries simultaneously. First, the agricultural and food sector is highly integrated into the global economy, and thus not immune to global shocks. As a result, the sector faced several challenges during the recent SARS-CoV-2 virus pandemic. As our findings show, some of these challenges induced substantial trade-reducing effects at the firm level. Our work corroborates the early country-level findings of Arita et al. (2022), but also highlights the importance of considering the effects at more micro-levels to understand the resilience of the sector to shocks. Since our findings show that the trade-reducing effects of the pandemic operated mainly through a reduction in the number of importing firms, policies aimed at import promotion such as financial support, and lowering import restrictions/barriers could help cushion the impact on firms.

Second, agriculture accounts for a comparatively small share of the global economy but remains central to the lives of a great many people (Alston and Pardey, 2014). Thus shocks that lead to reductions in production, or disruptions to supply chains have implications for food security. In particular, these shocks threaten the role of global food trade as a balancing mechanism for food demand and supply across the world. As we observed at the initial stages of the pandemic, unforeseen shocks to the global economy can lead to autarky reactions from many countries, which will further dampen the goal of globalisation.

9 Conclusion

This paper assesses the resilience of agricultural imports to the COVID19 pandemic using daily firm-level import data on the universe of Swiss importing firms between 2019 and 2020. We extend the international trade literature by contributing one of the first set of studies that exploit firm-product level trade data of very high frequency, specifically on a daily basis. We also assess the reaction of large and small firms to the crisis. Furthermore, global agricultural trade has been described as resilient to the impacts of the COVID19 pandemic. However, the size and channels of its quantitative impacts at the firm level are not yet clear. We extend the agricultural trade literature by offering the first firm-level evidence to that effect.

Our benchmark models exploit variations in daily Covid incident rates to explain changes in daily firm-product level imports while controlling for the policy environment on the day, MFN tariffs and a host of product and week-year fixed effects. We find that the pandemic led to a reduction in firm-level imports at the product level. The reduction was driven more by a decrease in the number of importing firms and less by the average imports per product per firm and even less so the number of products imported. Swiss agri-food importing firms, regardless of their sizes, were generally not prepared to deal with the exogenous Covid shock. Both small and large firms — defined here based on the number of employees – were affected by the crisis. These large firms form only about 3% of the sample of importing firms, yet account for 43% of total imports. But larger firms suffered more from the negative effects. The drop in the number of importing firms was mainly driven by incumbent firms — i.e., firms that imported pre- and post-pandemic. This supports our finding that larger firms were more affected by the pandemic as incumbents usually also control a larger share of the market. At the sector level, we see that products closest to the final consumer were affected more by the pandemic, with intermediate goods relatively more insulated. We also show that the level of data aggregation matters for the findings. The elasticity of imports to the pandemic becomes smaller in magnitude as we move to more aggregate data levels. The relative contribution of each margin to the decline in aggregate imports also depends on the level of data aggregation.

We also test different mechanisms that may drive the negative effects we find for firm-level imports. First, third-country supply-side effects were present. Estimating structural gravity models, we show that the pandemic-related closures in origin countries drove the drop in Swiss firm-level imports. This also meant an increase in firm-product level import prices which were higher for products of high value-to-weight ratios compared to products with low value-to-weight ratios. Second, we test how the pandemic affected consumer demand since this has the potential to influence firm behaviour, and vice versa. Using daily google mobility data, we find negative effects of the pandemic on visits to grocery shops and recreational centres which provides suggestive evidence of a decline in consumer demand. To confirm this suggestive evidence, we also use information from monthly consumer and retailer scanner data and find that the pandemic indeed led to a decrease in consumer demand.

References

Ahn, S., and S. Steinbach. 2022. "The impact of COVID-19 trade measures on agricultural and food trade." *Applied Economic Perspectives and Policy* n/a.

Aktay, A., S. Bavadekar, G. Cossoul, J. Davis, D. Desfontaines, A. Fabrikant, E. Gabrilovich, K. Gadepalli, B. Gipson, M. Guevara, et al. 2020. "Google COVID-19 community mobility reports: anonymization process description (version 1.1)." *arXiv preprint arXiv:2004.04145*, pp. .

Alston, J.M., and P.G. Pardey. 2014. "Agriculture in the global economy." *Journal of Economic Perspectives* 28(1):121–46.

Anderson, J.E., and E. Van Wincoop. 2003. "Gravity with gravitas: A solution to the border puzzle." *American economic review* 93:170–192.

Anderson, K. 2022. "Agriculture in a more uncertain global trade environment." *Agricultural Economics* 53:563–579.

Andersson, M., C. Di Stefano, Y. Sun, and F. Vinci. 2022. "The recovery in business investment–drivers, opportunities, challenges and risks." *Economic Bulletin Articles* 5.

Arita, S., J. Grant, S. Sydow, and J. Beckman. 2022. "Has global agricultural trade been resilient under coronavirus (COVID-19)? Findings from an econometric assessment of 2020." *Food Policy* 107:102204.

Bartik, A.W., M. Bertrand, Z. Cullen, E.L. Glaeser, M. Luca, and C. Stanton. 2020. "The impact of COVID-19 on small business outcomes and expectations." *Proceedings of the national academy of sciences* 117:17656–17666.

Beckman, J., and A.M. Countryman. 2021. "The importance of agriculture in the economy: impacts from COVID-19." *American Journal of Agricultural Economics* 103:1595–1611.

Benguria, F. 2021. "The 2020 trade collapse: Exporters amid the pandemic." *Economics Letters* 205:109961.

Bernard, A.B., J.B. Jensen, S.J. Redding, and P.K. Schott. 2012. "The empirics of firm heterogeneity and international trade." *Annual Review of Economics* 4:283–313.

—. 2007. "Firms in international trade." *Journal of Economic perspectives* 21:105–130.

Bricongne, J.C., J. Carluccio, L.G. Fontagné, G. Gaulier, and S. Stumpner. 2022. "From Macro to Micro: Large Exporters Coping with Common Shocks." Working paper, CESifo Working Paper.

Brussevich, M., C. Papageorgiou, and P. Wibaux. 2022. "Trade and the COVID-19 Pandemic: Lessons from French Firms." Working paper, IMF Working Paper.

Büchel, K., S. Legge, V. Pochon, and P. Wegmüller. 2020. "Swiss trade during the COVID-19 pandemic: an early appraisal." *Swiss Journal of Economics and Statistics* 156:1–15.

Chaney, T. 2008. "Distorted gravity: the intensive and extensive margins of international trade." *American Economic Review* 98:1707–21.

Crane, L.D., R.A. Decker, A. Flaaen, A. Hamins-Puertolas, and C. Kurz. 2022. "Business exit during the COVID-19 pandemic: Non-traditional measures in historical context." *Journal of Macroeconomics* 72:103419.

Davis, K.F., S. Downs, and J.A. Gephart. 2021. "Towards food supply chain resilience to environmental shocks." *Nature Food* 2:54–65.

Di Giovanni, J., A.A. Levchenko, and I. Mejean. 2020. "Foreign shocks as granular fluctuations." Working paper, National Bureau of Economic Research.

Distefano, T., F. Laio, L. Ridolfi, and S. Schiavo. 2018. "Shock transmission in the international food trade network." *PloS one* 13:e0200639.

Dithmer, J., and A. Abdulai. 2017. "Does trade openness contribute to food security? A dynamic panel analysis." *Food Policy* 69:218–230.

Eaton, J., M. Eslava, M. Kugler, and J. Tybout. 2008. "Export dynamics in colombia: Transactions level evidence." *Borradores de Economía; No. 522*, pp. .

ECDC. 2020. "Updated rapid risk assessment from ECDC on coronavirus disease (COVID-19) pandemic in the EU/EEA and the UK: resurgence of cases." *Eurosurveillance* 25:2008131.

Engemann, H., and Y. Jafari. 2022. "COVID-19 and changes in global agri-food trade." *Q Open* 2.

FAO. 2020. *Food Outlook - Biannual Report on Global Food Markets*.

Ferjani, A., S. Mann, and A. Zimmermann. 2018. "An evaluation of Swiss agriculture's contribution to food security with decision support system for food security strategy." *British Food Journal* 120:2116–2128.

Fernandes, A.M., D. Lederman, and M. Gutierrez-Rocha. 2013. "Export entrepreneurship and trade structure in Latin America during good and bad times." *World Bank Policy Research Working Paper*, pp. .

Fiankor, D.D.D. 2022. “Distance to destination and export price variation within agri-food firms.” *European Review of Agricultural Economics*, pp. .

FOAG. 2021. *Infographic: Expenditure on food in the Swiss retail sector*.

Fort, T.C., J. Haltiwanger, R.S. Jarmin, and J. Miranda. 2013. “How firms respond to business cycles: The role of firm age and firm size.” *IMF Economic Review* 61:520–559.

Laborde, D., A. Mamun, and M. Parent. 2020. “COVID-19 Food Trade Policy Tracker [Dataset].”

Lafrogne-Joussier, R., J. Martin, and I. Mejean. 2022. “Supply shocks in supply chains: Evidence from the early lockdown in China.” *IMF Economic Review*, pp. 1–46.

Lederman, D., A. Rodríguez-Clare, and D.Y. Xu. 2011. “Entrepreneurship and the extensive margin in export growth: A microeconomic accounting of Costa Rica’s export growth during 1997-2007.” *The World Bank Economic Review* 25:543–561.

Lim, S. 2021. “Global agricultural value chains and structural transformation.” Working paper, National Bureau of Economic Research.

Majune, S.K., and K. Türkcan. 2022. “COVID-19 vs. GFC: A firm-level trade margins analysis using Kenyan data.” Working paper, WTO Staff Working Paper.

Mayer, T., and G.I. Ottaviano. 2008. “The happy few: The internationalisation of european firms.” *Intereconomics* 43:135–148.

Melitz, M.J. 2003. “The impact of trade on intra-industry reallocations and aggregate industry productivity.” *econometrica* 71:1695–1725.

Moser, A., V. von Wyl, and M. Höglinger. 2021. “Health and social behaviour through pandemic phases in Switzerland: Regional time-trends of the COVID-19 Social Monitor panel study.” *PloS one* 16:e0256253.

Movchan, V., O. Shepotylo, and V. Vakhitov. 2020. “Non-tariff measures, quality and exporting: evidence from microdata in food processing in Ukraine.” *European Review of Agricultural Economics* 47:719–751.

Nicita, A. 2008. “Avian influenza and the poultry trade.” Working paper, World Bank Policy Research Working Papers.

OECD. 2020. *Preliminary Report: Evaluation of the Impact of the Coronavirus (COVID-19) on Fruit and Vegetables Trade*.

Pimenta, A.C., C.M. Gouveia, and J. Amador. 2021. "Covid-19, lockdowns and international trade: Evidence from firm-level data." Working paper, Bank of Portugal Working Papers.

Pleninger, R., S. Streicher, and J.E. Sturm. 2022. "Do COVID-19 containment measures work? Evidence from Switzerland." *Swiss Journal of Economics and Statistics* 158:1–24.

Ritzel, C., J. Ammann, G. Mack, and N. El Benni. 2022. "Determinants of the decision to build up excessive food stocks in the COVID-19 crisis." *Appetite*, pp. 106089.

Shepotylo, O., V. Vakhitov, V. Movchan, and M. Panga. 2022. "Non-tariff measures and productivity of Ukrainian food-processing firms." *Journal of Agricultural Economics* 73:234–256.

Szewerniak, W.W., Y. Xu, and S. Dall'erba. 2019. "The effects of diesel price on regional trade in the USA." *Journal of Economic Geography* 19:1099–1118.

Traverso, S., and S. Schiavo. 2020. "Fair trade or trade fair? International food trade and cross-border macronutrient flows." *World Development* 132:104976.

WTO. 2020. *Trade costs in the time of global pandemic*. World Trade Organisation.

—. 2021. "World Trade Report. Economic Resilience and Trade." Working paper, World Trade Organization, Geneva.

Appendix

Table A1: Summary statistics on data used in baseline estimations

Variable	Mean	SD	Min	Max	N
Covid deaths	950.56	1560.7	0	7873	338050
Stringency index	21.04	26.25	0	73.15	338050
Number of firms	9.85	14.96	1	259	338050
Number of products	1.72	1.61	1	28	338050
Total imports	67772.31	222982.02	1	7457590	338050
Imports/product/firm	6117.57	27192.45	0.75	3324300	338050
MFN tariff	69.92	201.25	0	2304	338050

Table A2: Summary statistics on data used in the gravity model

Variable	Mean	SD	Min	Max	N
Stringency index	27.65	33.09	0	100	2760415
Covid deaths per million	140.94	267.02	0	2772.95	2760415
MFN tariff	70.69	195.48	0	3140	2760415
Trade value (CHF)	7655.17	41406.71	1	5463777	2760415
Trade volume (kg)	4521.54	76376.91	0	32959200	2760415
Unit values (CHF/kg)	10.44	16.59	0.21	167.50	2643899

Table A3: The effect of COVID19 on Swiss firm-level import margins

	Total imports X_{kt}	Firms F_{kt}	Products P_{kt}	Imports/product/firm $\bar{X}_{fkt}$
	(1)	(2)	(3)	(4)
Log Total cases$_{t-5}$	-0.104^{***}	-0.073^{***}	-0.012^{***}	-0.019
	(0.027)	(0.009)	(0.004)	(0.023)
Stringency index$_t$	0.008^{***}	0.004^{***}	0.001^{***}	0.004^{***}
	(0.001)	(0.000)	(0.000)	(0.001)
Log Tariff$_{pt}$	-0.224^{***}	0.035	0.130^{***}	-0.389^{***}
	(0.069)	(0.037)	(0.018)	(0.031)
Product FE	Yes	Yes	Yes	Yes
Week-year FE	Yes	Yes	Yes	Yes
N	223680	223680	223680	223680
adj. R^2	0.521	0.566	0.754	0.521

Notes: Data are in daily frequency. The dependent variable in column (1) is total Swiss imports — summed across all firms, HS8 digit products and origin countries — of product p on day t. F_{pt} is the number of active importing firms on day t, P_{pt} is the number of products imported on day t and $\bar{X}_{fpt}$ is the import value per product per firm on day t.All models are estimated using ordinary least squares. p values are in parentheses. ***, ** and * denote significance at 1%, 5% and 10% respectively. Intercepts included but not reporte

Table A4: The effect of COVID19 on Swiss firm-level import margins

	Total imports X_{kt}	Firms F_{kt}	Products P_{kt}	Imports/product/firm $\bar{X}_{fkt}$
	(1)	(2)	(3)	(4)
Log New death$_{t-5}$	−0.113***	−0.075***	−0.014***	−0.024**
	(0.015)	(0.006)	(0.002)	(0.011)
Stringency index$_t$	0.008***	0.004***	0.001***	0.004***
	(0.001)	(0.000)	(0.000)	(0.001)
Log Tariff$_{pt}$	−0.225***	0.035	0.130***	−0.390***
	(0.069)	(0.037)	(0.018)	(0.031)
N	223680	223680	223680	223680
adj. R^2	0.521	0.566	0.754	0.521

Notes: Data are in daily frequency. The dependent variable in column (1) is total Swiss imports — summed across all firms, HS8 digit products and origin countries — of product p on day t. F_{pt} is the number of active importing firms on day t, P_{pt} is the number of products imported on day t and $\bar{X}_{fpt}$ is the import value per product per firm on day t. All models are estimated using ordinary least squares. p values are in parentheses. ***, ** and * denote significance at 1%, 5% and 10% respectively. Intercepts included but not reported.

Table A5: The effect of COVID19 on Swiss firm-level import margins

	Total imports X_{kt}	Firms F_{kt}	Products P_{kt}	Imports/product/firm $\bar{X}_{fkt}$
	(1)	(2)	(3)	(4)
Log New cases$_{t-5}$	−0.028***	−0.015***	−0.003***	−0.010***
	(0.004)	(0.002)	(0.001)	(0.003)
Stringency index$_t$	0.005***	0.002***	0.000*	0.003**
	(0.001)	(0.000)	(0.000)	(0.001)
Log Tariff$_{pt}$	−0.224***	0.035	0.130***	−0.389***
N	223680	223680	223680	223680
adj. R^2	0.521	0.566	0.754	0.521

Notes: Data are in daily frequency. The dependent variable in column (1) is total Swiss imports — summed across all firms, HS8 digit products and origin countries — of product p on day t. F_{pt} is the number of active importing firms on day t, P_{pt} is the number of products imported on day t and $\bar{X}_{fpt}$ is the import value per product per firm on day t. All models are estimated using ordinary least squares. p values are in parentheses. ***, ** and * denote significance at 1%, 5% and 10% respectively. Intercepts included but not reporte

Table A6: The effect of COVID19 on Swiss firm-level import margins

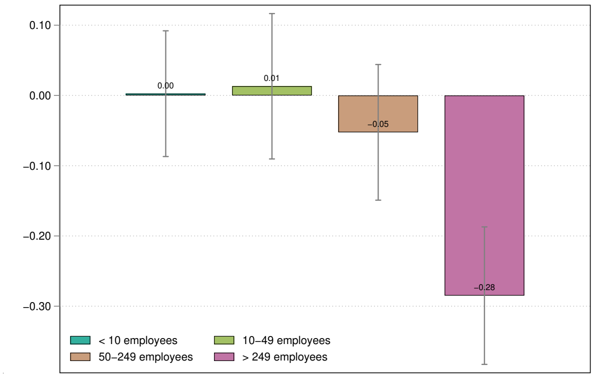
	Total imports X_{pt}	Firms F_{pt}	Products P_{pt}	Imports/product/firm $\bar{X}_{fpt}$
	(1)	(2)	(3)	(4)
Log Covid$_{t-5}$	-0.110^{***}	-0.098^{***}	-0.024^{***}	0.012
	(0.024)	(0.008)	(0.004)	(0.020)
Stringency index$_t$	0.005^{***}	0.003^{***}	0.000^{***}	0.002^{**}
	(0.001)	(0.000)	(0.000)	(0.001)
Log Tariff$_{kt}$	-0.163^{***}	0.002	0.077^{***}	-0.242^{***}
	(0.031)	(0.015)	(0.010)	(0.018)
Product FE	Yes	Yes	Yes	Yes
Origin-week-year FE	Yes	Yes	Yes	Yes
Week-year FE	Yes	Yes	Yes	Yes
N	595261	595261	595261	595261
adj. R^2	0.337	0.335	0.456	0.357

Notes: Data are in daily frequency. The dependent variable here is measured at the product-origin-time level. All models are estimated using ordinary least squares. p values are in parentheses. ***, ** and * denote significance at 1%, 5% and 10% respectively. Intercepts included but not reported.

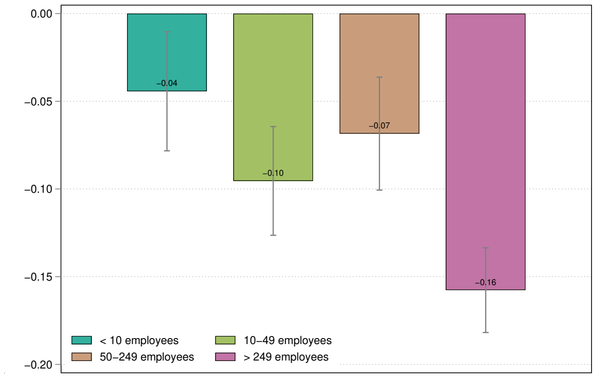
Table A7: List of product-origin countries

Afghanistan, Albania, Algeria, Andorra, Angola, Anguilla, Antigua and Barbuda, Argentina, Armenia, Aruba, Australia, Austria, Azerbaijan, Bahamas, The, Bahrain, Bangladesh, Barbados, Belarus, Belgium, Belize, Benin, Bermuda, Bolivia, Bosnia and Herzegovina, Brazil, British Virgin Islands, Brunei, Bulgaria, Burkina Faso, Burundi, Cambodia, Cameroon, Canada, Cape Verde, Cayman Islands, Central African Republic, Chad, Chile, China, Colombia, Congo, Dem. Rep., Congo, Rep., Costa Rica, Cote d'Ivoire, Croatia, Cuba, Cyprus, Czech Republic, Denmark, Djibouti, Dominican Republic, Ecuador, Egypt, Arab Rep., El Salvador, Equatorial Guinea, Eritrea, Estonia, Ethiopia (excludes Eritrea), Faeroe Islands, Fiji, Finland, France, French Guiana, French Polynesia, Gabon, Georgia, Germany, Ghana, Gibraltar, Greece, Greenland, Guadeloupe, Guatemala, Guinea, Haiti, Honduras, Hong Kong, China, Hungary, Iceland, India, Indonesia, Iran, Islamic Rep., Iraq, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kazakhstan, Kenya, Korea, Dem. Rep., Korea, Rep., Kuwait, Kyrgyz Republic, Lao PDR, Latvia, Lebanon, Libya, Lithuania, Luxembourg, Macao, Macedonia, FYR, Madagascar, Malawi, Malaysia, Maldives, Mali, Malta, Martinique, Mauritania, Mauritius, Mexico, Moldova, Mongolia, Morocco, Mozambique, Myanmar, Namibia, Nepal, Netherlands, New Caledonia, New Zealand, Nicaragua, Niger, Nigeria, Norway, Oman, Pakistan, Palestine, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Portugal, Qatar, Reunion, Romania, Russian Federation, Rwanda, Samoa, San Marino, Saudi Arabia, Senegal, Seychelles, Sierra Leone, Singapore, Slovak Republic, Slovenia, Somalia, South Africa, Spain, Sri Lanka, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Sudan, Swaziland, Sweden, Syrian Arab Republic, Taiwan, Tajikistan, Tanzania, Thailand, Togo, Trinidad and Tobago, Tunisia, Turkey, Turkmenistan, Turks and Caicos Isl., Uganda, Ukraine, United Arab Emirates, United Kingdom, United States, Uruguay, Uzbekistan, Vanuatu, Venezuela, Vietnam, Yemen, Rep., Zambia, Zimbabwe

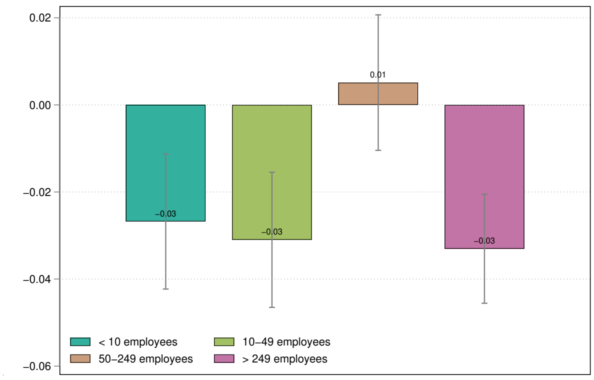
Figure A1: Heterogeneity across four different firm sizes



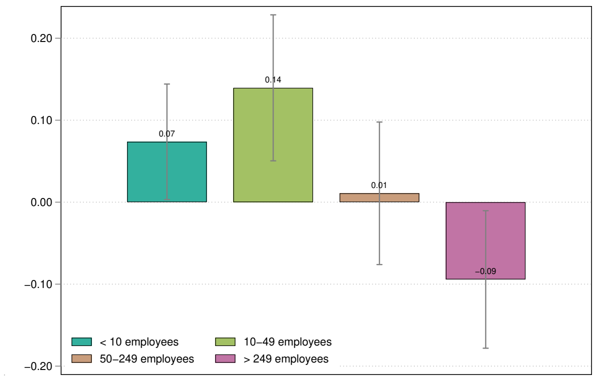
(a) Total import value



(b) Number of firms



(c) Number of products



(d) Average imports per product per firm

Notes: The bars from left to right are as follows: (i) total imports (ii) number of firms (iii) number of products and (iv) imports per product per firm.