University of Nottingham
UK | CHINA | MALAYSIA

research paper series

Globalisation, Productivity and Technology Programme

Research Paper 2020/15

Consumer taste in trade

Bee Yan Aw, Yi Lee, and Hylke Vandenbussche

GEP

Consumer Taste in Trade*

Bee Yan Aw†[1], Yi Lee‡[2], and Hylke Vandenbussche§[3]

[1]The Pennsylvania State University

[2]National Tsing Hua University

[3]University of Leuven (KULeuven)

May 21, 2020

Abstract

This paper documents the importance of consumer taste for the food industry using firm-product level customs data by destination country. We identify consumer taste through the use of a control function approach and estimate it jointly with other demand parameters using a flexible demand specification. We find that, on average, consumer taste explains about as much of the variation in export revenue as marginal costs. The contribution of consumer tastes to export revenue variation ranges from 2% to 30% depending on product category in the food industry. Our results also show that consumer taste decreases in distance but this relationship is non-monotonic.

JEL Classification: F12, F14

Keywords: consumer taste, quality, productivity, exports, firm-product, food

*We especially thank Jonathan Eaton, Kala Krishna, Steven Redding, Mark Roberts, James Tybout, Stephen Yeaple, Lee Branstetter, Gabriel Felbermayr, Keith Head, Brian Kovak, Alessia Lo Turco, Giovani Peri, Saso Polanec, Stijn Van Ormelingen, Larry Qiu, Yoto Yotov, Daniel Xu and other seminar participants at Penn State, Hong Kong University (HKU), Jinan University and Carnegie-Mellon amongst others. We thank the National Bank of Belgium for customs data.

†byr@psu.edu

‡ylee@mx.nthu.edu.tw

§corresponding author: hylke.vandenbussche@kuleuven.be

1 Introduction

Recent papers in international trade document the importance of the demand side. In particular, Eaton et al. (2015) stress the importance of learning about demand for customer accumulation. Hottman et al. (2016) find that firm-appeal explains more than half of the variation in the product sales of firms. Foster et al. (2016) show that demand fundamentals explain more of the size gap between new and established firms than productivity does. However, missing in this literature is a better understanding of the various components on the demand side. In this paper, we fill this gap and dig deeper into the notion of firm appeal by analyzing the empirical importance of consumer taste in the export success of firms. For this purpose we use custom level data with more than hundred thousand observations of trade in food products exported by Belgian firms. We start by developing a new way to identify consumer taste. Next, we decompose export sales in order to assess the relative importance of consumer taste as a determinant of trade. And finally, we assess the role of consumer taste in a gravity context.

Over the past decade the importance of consumer taste is reflected in the rapidly rising marketing budgets of firms relative to productivity-enhancing expenditures.[1] A recent survey by Accenture of around 287 US manufacturing firms, indicated that 61% of firms responded that offshoring for efficiency reasons was no longer their priority. Instead, firms prefer to be closer to consumers to respond better to local tastes and taste heterogeneity.[2] An example of this is Nike, which has recently set up speed factories in the US to produce tailor-made sneakers to satisfy individual customer taste. Adidas has done the same in Germany.[3]

Studying consumer taste has important implications for a number of research questions related to traditional international trade, gravity and macro-models. Workhorse models in international trade and the price indices that they generate, typically assume demand to be identical across products and countries and do not include consumer heterogeneity. Our empirical finding that consumer taste is as important to export success as marginal costs suggests that a richer parameterization of demand preferences is warranted. Accounting for demand heterogeneity also leads to more concise price indices and cost of living indices.[4] Better price indices are desirable for

[1] https://cdn.static-economist.com/sites/default/files/images/print-edition/20150829$_{W}BC539.png$, *The Economist*.

[2] http://www.areadevelopment.com/BusinessGlobalization/4-20-2011/backshoring-us-manufacturing-labor-costs1266672.shtml

[3] https://www.forbes.com/sites/retailwire/2017/09/27/nike-can-make-you-custom-sneakers-in-under-an-hour/#29d2a8ce72f6

[4] Redding and Weinstein (2019) show the existence of a serious "taste shock bias" in traditional price indices, different from the already well-known quality bias. Without the use of taste-adjusted prices, the cost of living cannot be correctly assessed.

more accurate productivity measures since price indices are regularly used to deflate revenues.[5]

In the current gravity literature, distance is often used as a proxy for transport costs. In this paper we show that distance also in part reflects the decay of taste in space, suggesting the need to rethink what distance is really capturing in gravity models. Additionally, consumer taste, as a determinant of firm-level exporting, is likely to have a macroeconomic impact since aggregate exports are an important component of country-level GDP (Gabaix (2016); Giovanni and Levchenko (2012)). While the recent focus in macro models has been to incorporate heterogeneity on the supply side (Ghironi and Melitz (2005)), the inclusion of demand side heterogeneity may prove just as important as the driver of aggregate growth.

Finally, the importance of consumer taste also has implications for the research in industrial organization relating to the sources of firm growth. Recent papers by Head and Mayer (2014) and Mrazova and Neary (2017) incorporate the role of demand in explaining firm size distributions. However, demand heterogeneity in consumer taste has not been explored even though taste is very likely to affect firm size, through its effect on both domestic and export sales, and therefore firm size distributions.

In this paper we identify consumer taste for individual products shipped to different country destinations as a separate driver of export revenue for Belgian food manufacturing firms. The food industry is particularly relevant for this study because it is a key export industry and one in which consumer tastes are likely to play an important role. To identify consumer taste, we do not use a demand residuals approach since this would potentially confound taste with other unobservable demand and cost shifters. Instead we want to tease out the part of the demand residual that best captures the dimension of consumer heterogeneity related to taste differences across countries. For this purpose, we adopt a control function approach which has long been used in the productivity literature. We demonstrate its potential to identify unobserved consumer preferences on the demand side.

A control function requires at least two exogenous variables that are strongly correlated with consumer taste but uncorrelated with the demand residual in the demand function that we estimate at the level of firm-product trade flows from the customs data. To ensure exogeneity we complement our firm-product level exports with two independent data sets that reveal information about taste differences across countries. First, we turn to a novel data set that contains ingredients of individual country's national dishes. There is abundant evidence to suggest that what people eat in their national dishes and the ingredients they use, is a strong indicator of taste overlap.[6] Using a text recognition tool, we consider the overlap in national dish ingredients

[5] As shown by Foster et al. (2008) and more recently by Smeets and Warzynski (2013).

[6] Abbott Nutrition,"Ten Surprising Things that Affect Your Taste," August, 2017.

between Belgium and any destination country and take it as a bilateral indicator of how close or distant taste differences are between countries. We find only a weak relationship with distance from the equator in latitude, suggesting that our National dish indicator is not merely picking up climate conditions.

Second, in the control function for taste we also include firm-level and product-level global trade shares. For instance, we use COMTRADE product-level trade data to construct for each destination and each product an import share coming from Belgium, relative to imports from the rest of the world. This share is exogenous to any firm but captures the taste preference for Belgian products in the destination country.

Our approach to identify taste heterogeneity is different from the one in industrial economics and the random coefficient models - including nested logit. These models allow for heterogeneity in taste for specific product characteristics such as in Berry, Levinsohn and Pakes (1995) and have been applied in many settings, including automobiles, computers, radio station formats, cameras etc. But the use of these models usually requires detailed information on specific product characteristics typically not available in customs data on traded goods. Nested logit models rely heavily on functional form assumptions as shown by Anderson, Palma and Thisse (1992) and belong to the CES family. In our current approach we prefer not to take a stance on the underlying primitives of the model that generate the demand specification. We estimate a log-linear demand function and allow for pro-competitive effects and variable markups by product category. This corresponds well with different types of consumer preferences and model settings. We then tease out the part in the demand residual that is related to unobserved taste heterogeneity which are captured by proxies in the control function. Empirically we allow taste to vary over time, although we do not model taste dynamics. Our focus is on the cross-sectional taste differences in line with the finding of Atkin (2013) that taste is persistent over time and also corresponding to the notion that cultural traits are generally stable over time (Giuliano and Nunn (2019)).

The data used in our paper necessitates that a country is treated as a representative consumer, possibly hiding within-country heterogeneity across consumers. Our measure of consumer taste for each destination country therefore captures an average taste for every firm-product originating from Belgium. In that sense, our trade data prevents us from analyzing taste and cultural diversity within countries (Guiso, Sapienza and Zingales (2019)). Our data on physical goods trade confirm the results of recent studies using online trade (Elfenbein, Fisman and Mcmanus (2019)), showing that cultural similarity boosts trade. But where cultural similarity may still entail aspects of trust and cost of doing business, our measure of national dish ingredients offers a cleaner measure for consumer taste in the food industry.

In our paper, both consumer taste and quality are identified at the firm-product-destination level in our data. On the demand side we find at least three important and novel results. The first two results point to fundamental distinctions between consumer taste and quality in the data even though these two dimensions are often lumped together as demand-side factors in theory and empirically indistinguishable in the existing literature. First, based on our findings, the correlation between quality and taste is low, suggesting that these demand shifters can operate in opposite directions allowing outcomes such as a high taste for low quality goods or a low taste for high quality goods. Our results clearly show that these two demand shifters do not necessarily go in the same direction.[7] Second, while our consumer taste indicator mostly varies by country and product, our quality indicator varies mostly across firms. This finding has important implications for firms that are considering export entry and for policies regarding firm growth. For instance, if consumer tastes indeed varies primarily across destination countries, then for a firm that is seeking to grow in size, a policy of country diversification of its exports could be as important as the more traditional policy of product diversification.[8] Third, our results indicate that consumer taste for Belgian food products decays in space. We find an effect similar in spirit to the home bias effect whereby the demand for Belgian products is strongest in the nearby countries and is lower in more distant countries. However, consumer taste does not vary monotonically with distance. For example, we find taste in Australia to be closer to that in the UK and the US than to Asia. The correlation between distance and our indicator of consumer taste is around -0.5.

When we run a simple gravity model with taste included, the coefficient on the distance variable drops by more than 50%. Thus, without including a variable for taste in a gravity specification, its effect is in part picked up by the distance variable. Once we include taste, the role of distance in explaining trade flows reduces by half.

To asses the relative importance of consumer taste in explaining export success, we perform a decomposition of export revenue variation. Our results indicate that consumer taste is an important and independent source of variation in the trade data. On average, consumer taste explains about as much of the variation in exports as marginal costs.[9] Depending on the product category, consumer taste explains about 2-30% of actual export revenues. For example, consumer taste appears to be a very important driver of export success in sectors such as chocolates and

[7] For instance, Di Comité, Thisse and Vandenbussche (2014) model this distinction in demand shifters.

[8] We show that the variance of taste in our data is explained for 49% by the country dimension, for 43% by the product dimension and for 8% by the firm dimension (more details in Table 7).

[9] We know that the main contribution of the demand side lies at the intensive margin from the work of Roberts et al. (2018) who assess the role of firm-level demand heterogeneity in export participation. By conditioning on export participation we ignore fixed entry costs as a source of variation in trade decisions which was studied earlier by Aw et al. (2011).

ice-cream.

The remainder of the paper is structured as follows. Section 2 lays out the empirical identification strategy of consumer taste using the control function approach. In Section 3, we identify all the parameters from estimating the demand equation and we obtain marginal cost by backing it out from the price data. Section 4 describes the data. We report summary statistics on the demand and cost indicators in Section 5. In Section 6, we assess the relative importance of consumer taste in explaining firms' export revenues relative to other determinants such as quality and cost, distance, market size, income and competition effects and markups. We also examine the role of consumer taste on product-country level trade in a simplified gravity model. Section 7 contains the summary and conclusion.

2 General Demand Specification

2.1 Identification

We begin with a demand model in which we empirically identify the demand parameters and discuss the potential endogeneity issues. Consumers in country d have the following general demand function Q_{jidt} for product i exported by firm j in year t:

$$q_{jidt} = Q_{jidt}[p_{jidt}, \lambda(X')_{jidt}, \delta(Y')_{jidt}, \gamma_{idt}, \epsilon_{jidt}] \tag{1}$$

where q_{jidt} is the quantity of product i sold by firm j that is consumed in country d and year t, $\lambda(X')$ represents the control function for consumer taste and $\delta(Y')$ represents the control function for quality where X' and Y' are vectors of variables that proxy for taste and quality, respectively. Applying insights from Levinsohn and Petrin (2003), Olley and Pakes (1996) and others, we replace the unobservables $\lambda(.)$ and $\delta(.)$ with observables using polynomial functions to estimate the coefficients which are then used to predict indexes of taste and quality at the $jidt$ level.[10] p_{jidt} is the price (f.o.b.) of product i provided by firm j exclusive of transport cost and distribution cost. Firm-level demand in a destination can thus vary due to the export price, the quality offered and the local taste. γ_{idt} represents a set of product-country-year fixed effects. Given that our data are trade flows originating from Belgium, γ_{idt} captures product-

[10]By using a control function approach for consumer taste and product quality we avoid the endogeneity bias arising from correlation of these variables with the residual in the demand function. For instance, if not properly controlled for, taste will enter the residual of the demand function, rendering $E(p_{jidt}\epsilon_{jidt}) \neq 0$, affecting price as firms may set a higher price for products with a stronger taste. This would result in a misspecification of demand and biased coefficients.

country specific characteristics such as market size, market structure, distance and distribution costs in the destination country. Finally ϵ_{jidt} is the residual term. This residual (ϵ_{jidt}) may still contain unobservered demand and cost shifters such as trade costs at a more disaggregate firm-product level (such as transport, distribution costs and exchange rate fluctuations) and markups that could plague the identification of the demand parameters (γ_{idt} captures the variations at the product-country level). To address this endogeneity problem, we need to instrument for firm-product prices.

A good instrument for p_{jidt} should be highly correlated with the export price to destination d, but uncorrelated with the residual term. An instrument that potentially satisfies these conditions is an average price of the same firm-product (ji), but exported to distant destinations (Hausman (1996)). These destinations should not be in the proximity of country d because then the firm-product transport cost (τ_{jidt}) will be correlated between nearby countries. For this reason we define our instrument for price as the average price for the same firm-product that is at least 1000 km from destination d. This ensures that the instrumented price does not reflect firm-product transport costs to destination d. Put differently we ensure that our instrument is such that $E(p_{jikt}\tau_{jidt}) = 0$. For robustness, we also verify the results by using all prices for the same firm-product to all alternative destinations without imposing a distance restriction, as an instrument and the results are not sensitive to this change.[11][12] For the Hausman instrument to be valid, it is well known that this depends on the absence of global shocks in product prices. To verify this we run a diagnostic and check product-specific prices in all markets relative to the price in a fixed numeraire market. For this purpose we take France since it is an important destination for Belgian exports. We then take the ratio of product-year specific prices in all destinations other than France, relative to the price in France. We find that these relative prices are not very strongly correlated, suggesting that product prices are set independently across destinations. We also verify the standard deviations of the price ratios within the same CN8-product category across destinations for each year in the time period of our study and find them to be significantly different from zero confirming the absence of global shocks. More details are provided in Appendix A.

While our instrumentation strategy is one that has successfully been used in other papers, endogeneity could still be a problem if the pass-through rates of costs (exchange rates, markups or other) into prices systematically vary with the size of a firm in a destination market (Amiti et al.

[11] In an earlier paper Aw and Lee (2017) used the productivity of other firms selling the same product as an alternative instrument in the estimation of their demand equation. In the current paper we want to be more general and avoid the use of functional forms, which is why we turn to the Hausman (1996) price instrument.

[12] Fontagné, Martin and Orefice (2018) instrument export prices by firm-level electricity cost shocks, which is an alternative provided you have access to that type of data.

(2014), Atkinson and Burstein (2008)). This could potentially undermine our Hausman (1996) price instrumentation strategy because the price in another market would not be independent of the size effect. Whether a firm-product market share is positively correlated across markets is ultimately an empirical question. If being large means that pass-through rates are significantly lower than for products with small market shares, our instrumented price could still be correlated with the residual of equation (1).

For this purpose, we verify the bilateral correlations between firm-product ji's market size across destination markets. We find these to be very low and no higher than 0.2. Thus while a firm-product ji can have a large market share in one market, it may end up having a small market share in another market. This suggests that our instrument is still a good one, because the instrumented price is unlikely to be correlated with the residual, ϵ_{jidt}. Our instrument for price is the following:

$$lnPIV_{jidt} = \frac{1}{N_{jit}} \sum_{k \in S_{jit}, k \neq d} lnp_{jikt}, \tag{2}$$

where S_{jit} is the set of the remote countries that firm-product ji is exported to in year t and N_{jit} is the number of export destinations far from country d for the firm-product ji.

Empirically we estimate demand equation (1) such that it corresponds with several types of theory models. The linear specification below corresponds with a log-log specification of a model with representative consumer CES preferences model and monopolistic competition market structure, augmented with destination-specific effects. It also corresponds with a demand equation derived from quadratic utility consumer preferences with destination-specific pro-competitive effects (Melitz-Ottaviano (2008); Di Comité et al. (2014)). As such our empirical demand specification is fairly general and corresponds with different families of models in international trade :

$$\text{ln}q_{jidt} = \gamma_{idt} - \sigma_{id}\text{ln}p_{jidt} + \text{ln}\hat{\lambda}_{jidt} + \text{ln}\hat{\delta}_{jidt} + \epsilon_{jidt} \tag{3}$$

where q_{jidt} is the quantity of exports sold of product i that firm j sold to country d in year t. p_{jidt} is the f.o.b. price, $\text{ln}\lambda(.)$ is consumer taste, $\text{ln}\delta(.)$ is quality which all enter the demand function at the same level of disaggregation. The price elasticities of demand σ_{id}, vary across destination countries and product markets and γ_{idt} represents a set of product-country-year fixed effects accounting for distance and pro-competitive effects in the destination market. Both consumer taste and product quality are unobservables in the data. To obtain consistent estimates of $\text{ln}\hat{\lambda}_{jidt}$ and $\text{ln}\hat{\delta}_{jidt}$, a control function approach is used and described in the sections below. ϵ_{jidt} accounts for any remaining unobserved demand shock correlated with price as well as a white noise.

2.2 Control Function for Consumer Taste

We apply a control function approach to the estimation of demand for the purpose of teasing out the unobserved taste heterogeneity from the demand residual. We do this in a non-parametric way by specifying a polynomial in exogenous variables correlated with taste.[13] To control for the unobservable consumer taste in equation (3), we define $ln\hat{\lambda} = \lambda(X')$ where X' is a set of proxy variables that capture the taste of consumers in country d for variety ji. This control function for consumer taste is then embedded in the demand function and estimated jointly with other demand parameters. The variables, included in the control function for taste, capture consumer heterogeneity across countries and are represented as follows:

$$ln\lambda(X')_{jidt} = ln\lambda[WND_{jdt}, z_{idt}] \tag{4}$$

where WND_{jdt} is a weighted national dish index that reflects the similarity of food taste between the destination country d and Belgium measured by the overlap in national dish ingredients, and z_{idt} is the share of country d's import of product i from Belgium ($M_{id,BE,t}$) over its total import of product i:

$$z_{idt} = \frac{M_{id,BE,t}}{\sum_{v \in W} M_{idvt}}, \tag{5}$$

where M_{idvt} is country d's imports of product i from country v and W is the set of countries in the world that product i can be sourced from. This data is at the product-level and is collected from COMTRADE.

For WND_{jdt} we combine our customs data with a newly created data set that involves the similarity in ingredients of national dishes between the destination country and Belgium. To construct the data we follow the approach used by Kohler and Wunderlich (2019). They collect data on national dish ingredients to show how migration affects food trade.[14] For our purposes, we only require the national dish overlap between Belgium and its trade partners. First we

[13] Since we do not model dynamics over time, we do not face an inversion of monotonicity requirement in the estimation of our control function

[14] The authors find that the effect of migration on food trade decreases the more similar food taste are between migrants' country of origin and their host country.

identify the national dishes for each country and then trace the recipes and ingredients of each dish from publicly available data and websites.[15] We then use a text recognition tool to compare the similarity and overlap in dish ingredients. Latent Semantic Analysis (LSA) provides a useful way to measure the similarity in texts between national dishes.[16] We apply the LSA to construct a similarity index of national dishes between the destination country and Belgium. The details on how the index is constructed are reported in Appendix B.

The similarity index of national dishes (ND) is destination (d) specific but will be weighted by a firm-destination level weight, s_{jdt}. This weight is defined as the ratio of each firm j's sales exported to country d to firm j's global exports in year t. Moving the weight to the firm-level (s_{jdt}) reduces the potential endogeneity between q_{jidt} and a firm-product-weight defined at the level of the trade flow, s_{jidt}. The use of a firm-country weight in the control function is necessary to ensure that we measure taste (λ_{ijdt}) at the same level of aggregation as quality and marginal cost, which are defined in later sections. Measuring all parameters of interest at the same level of aggregation allows for greater comparability of our decomposition exercise where the purpose is to assess the contribution of each parameter to the variance of export revenues. For robustness, we also verify results where the weight is defined at the product-destination level, s_{idt} and our decomposition results do not change.

Besides the national dish indicator, the second variable in our control function for taste is z_{idt}, defined as the share of destination d's imports of product i from Belgium in the country d's total import of product i.[17] Using product-level COMTRADE data, this captures the taste preference in destination d for Belgian imports relative to imports from other countries for a specific product i. The choice of z_{idt} can be rationalized from theoretical models such as those in Bernard et al. (2011) and Aw et al. (2018). These papers develop structural models with CES consumer preferences on the demand side augmented with a product appeal weight in the Dixit-Stiglitz preferences which they argue captures taste similar to z. It can easily be shown with such an approach that consumer taste is a demand shifter, resulting in a larger fraction of imports from Belgium over a destination's total imports. The inclusion of z_{idt} in our empirical control function for taste thus stems directly from such a modelling approach and rationalizes z_{idt} as a proxy variable for consumer taste. In Appendix C, we provide a simplified CES demand model to show the relationship between the import share in destination d and consumer taste.

The control function for consumer taste $\lambda(X')_{jidt}$ will then be proxied by a polynomial in these two variables.[18] The resulting taste index then consists of (i) a weighted indicator (WND)

[15] https://www.foodpassport.com/ and https://nationalfoods.org/

[16] Landauer et al. (1998).

[17] In the data, z_{idt} is estimated at the (HS6)product-country level.

[18] We use a polynomial of order two. The use of a higher order polynomial of degree three does not affect our

that captures the bilateral consumer heterogeneity between Belgium and the destination country accounting for consumer preference across firms; (ii) the import share of Belgian products relative to imports from the rest of the world in the destination d which captures how much a destination d likes a specific product relative to other products (z_{idt}). Defined as such, this control function for taste is included in our demand function estimation together with product-country dummies γ_{idt} to account for other remaining factors such as distance, transport cost, market size, competition and income effects in the country of destination. The taste index resulting from our control function estimation can be compared for the same firm-product across destinations or for different firm-products within destinations. Alternatively, these taste indices can be aggregated at the level of the product group or the level of the country and are comparable across products and countries.

2.3 Control Function for Quality

We follow the literature to account for product quality in the demand specification by using a control function approach. In this literature, higher quality outputs have been shown to be positively correlated with input prices, income levels and market shares in a given destination country (Bastos, Silva and Verhoogen (2018); Khandelwal (2010), De Loecker et al. (2016)). The control function for quality $\delta(Y')_{jidt}$ is thus defined as a function of import prices ($PIMP_{jt}$), the weighted GDP per capita across destinations ($WGDP_{jit}$), the weighted local GDP per capita of the destination ($LGDP_{jidt}$) and the firm-product market share within the destination (f_{jidt}):

$$ln\delta(Y')_{jidt} = ln\delta[PIMP_{jt}, WGDP_{jit}, LGDP_{jidt}, f_{jidt}] \quad (6)$$

In the control function for quality, we include firm-level input prices since producing high-quality products generally requires high-quality inputs (Kugler and Verhoogen (2011), Bastos, Silva and Verhoogen (2018) and Fan et al. (2018)). For this purpose we construct a firm-level import price index ($PIMP_{jt}$) by calculating the weighted sum of import prices (unit values) of each imported product within a firm.[19] We normalize import prices of inputs by their (CN8)product mean to control for absolute price differences across products.

Since firms are likely to export high-quality products to high-income countries, we also include GDP per capita of the destination country (Schott (2004); Bils and Klenow (2001) and Hallak (2006)). Firms may export product i to several countries other than country d. Thus we use

results qualitatively.

[19]Here $PIMP_{jt} = \sum_z \sum_o s_{jzot} \times IMP_{jzot}$ where s_{jzot} is the import share of firm j's total imports that come from good z imported from country o and IMP_{jzot} is the import price of good z coming from country o.

the weighted sum of GDP per capita across all countries($WGDP_{jit}$) that a firm-product pair is exported to.[20] Including $WGDP_{jit}$ in $\delta(Y')$ accounts for the idea that the higher the average GDP of all the countries that a firm export its product to, the higher the quality of the product. In addition, we also include the local GDP per capita of the destination, weighted by the firm-product market share ($LGDP_{jidt}$) to accounts for the idea that firms can vary their quality by destination and may offer higher quality to countries with higher local GDP per capita.[21]

Finally, we include firm-product market share within destination d (f_{jidt}) since within a destination, higher quality products can have higher market shares (Khandelwal (2010); De Loecker et al. (2016)). This control function is introduced in the demand function as a polynomial in all these variables, whose coefficients are simultaneously estimated with the other demand parameters.[22]

3 Estimation of Demand and Cost

3.1 Demand Estimation

We estimate the demand function:

$$\mathrm{ln}q_{jidt} = \gamma_{idt} - \sigma_{id}\mathrm{ln}p_{jidt} + \mathrm{ln}\lambda(X^{'})_{jidt} + \mathrm{ln}\delta(Y^{'})_{jidt} + \epsilon_{jidt} \tag{7}$$

To ensure that the corr(lnp_{jidt}, ϵ_{jidt}) = 0, we use the average export prices in other remote destinations k (ln p_{ji-dt}) as the instrument for price as shown in equation (7). We define remote countries based on the following criteria: (1) country k and country d do not share the same border; (2) country k and country d do not have a colonial history; (3) the distance between countries k and d is at least 1,000 km.

By using 2SLS, the estimation of the demand function in equation (7) allows us to empirically identify three important parameters e.g. the elasticity of demand $\hat{\sigma}_{id}$, the consumers' taste $ln\hat{\lambda}_{jidt}$ and the quality index $ln\hat{\delta}_{jidt}$.

The empirical counterparts to the control functions for taste and quality represented in equations (4) and (6) are constructed at the firm-product-country level quality index ($ln\delta_{jidt}$) and

[20]The weight that we use in $WGDP_{jit}$, is the sales share of a firm-product ji to country d in the total exports of firm-product ji.

[21]The weight that we use in $LGDP_{jidt}$, is the share of firm-product ji to country d over the total sales of product i aggregated across all Belgian exporting firms to country d.

[22]We used a polynomial of order two. Experimenting with higher order polynomials did not alter results much.

taste index ($ln\lambda_{jidt}$) as follows:

$$ln\hat{\lambda}_{jidt} = \sum_{l} \hat{\beta}_l X^l_{jidt} + \sum_{l}\sum_{m} \hat{\beta}_{lm}(X^l_{jidt} X^m_{jidt}) \tag{8}$$

where l and m include all variables in the control function of taste in Eq. (4) and

$$ln\hat{\delta}_{jidt} = \sum_{v} \hat{\beta}_v X^v_{jidt} + \sum_{v}\sum_{n} \hat{\beta}_{vn}(X^v_{jidt} X^n_{jidt})$$

where v and n include all variables in the control function of quality in Eq. (6).

3.2 Cost Estimation

We can now retrieve the demand parameters from estimating equation (7). In particular, we obtain the elasticity of demand (σ) as the regression coefficient on price ($\partial lnq_{ijdt}/\partial lnp_{ijdt}$) and use the optimal equilibrium pricing condition for profit maximization under monopolistic competition in every destination to back out the marginal cost from the prices without using any additional functional forms on the supply side.

$$p_{jidt}[1 - (1/\sigma_{id})] = MC_{jidt} \tag{9}$$

Since prices are f.o.b. export prices, our estimates of marginal cost are exclusive of transport and distribution cost but inclusive of the marginal cost of production which also includes costs related to vertical (quality) and horizontal (taste) product differentiation.[23] Our estimates for marginal cost thus vary at the firm-product-destination level since we back out cost from destination level prices.

4 Data Description and Documentation

Our trade data consist of Belgian customs data of manufacturing firms for the period 1998-2005 with information on firms exports in quantities and values by product and by destination and firm imports by product and country of origin. The Belgian trade data is from the National Bank of Belgium's (NBB) Trade Database, which covers the entire population of recorded trade

[23] Product-destination-year (idt) specific transport and distribution costs are accounted for by the inclusion of γ_{idt} in estimating equation (1). However, the firm-specific parts of transport and distribution costs are unobservables and still present in the residual of equation (1). But our instrumentation strategy, ensures that their presence in the residual does not contaminate the estimated coefficient on price.

flows.[24] The trade data are recorded at the firm-product-country-year level, i.e. they provide annual information on firm-level trade flows by 8-digit Combined Nomenclature (CN8) product and by country. Export prices and import prices are unit values which we obtain at the level of the trade flow, by dividing export values by quantities.

The period 1998-2005 has a congruent reporting threshold for firms to be considered as exporters over time. This threshold at the firm-product level was raised in 1998 from 104,115€ to 250,000€ but did not change until 2006. However, during the period of our analysis, the HS6 product classification was changed three times. To address the changes in product classifications over time, we concord the product codes along the lines of Bernard et al. (2019).[25] In doing so about 20% of export value in our data was lost, but this ensures that our data accounts for product code changes. In our analysis we focus on the food industry. Belgium exports a wide range of food products. This results in a sample of 1,802 firm-products in different food products (HS6) for which we can identify taste in every export destination.

We create a novel data set on national dish similarity between countries based on the overlap in their ingredients. Information on the ingredients were retrieved from public data and the websites foodpassport.com and nationalfoods.org. In the few cases where the recipes of national dishes were not available on either one of those two websites, online sources were used. For this paper we focus on the overlap in dish ingredients between Belgium and its trade partners. We use Latent semantic analysis (LSA) which is a text analysis tool for comparing and assessing the similarity of documents based on words used (for an excellent introduction see Landauer et al. (1998)). For our purposes, we compare the recipes of national dishes (documents) based on ingredients (words). First, we construct an ingredient-recipe matrix with a value of one (whenever an ingredient is used in a given recipe) or a zero (whenever an ingredient is not used in a given recipe). Second, LSA attributes a rank approximation to the ingredient-recipe matrix characterized by ones and zeros using singular-value decomposition (SVD). This results in a new approximated ingredient matrix with inferred frequencies of ingredients for each recipe. Intuitively, SVD infers how likely it is that ingredient A appears in national dish B. Third, based on the approximated matrix, one can calculate the cosine distance between national dishes to estimate their similarity. The National Dish Index obtained via LSA takes values lying between 1 (recipes are identical) and -1 (recipes are entirely different). More details on the methodology

[24] We exclude transactions that do not involve a "transfer of ownership with compensation". This means that we omit transaction flows such as re-exports, the return, replacement and repair of goods and transactions without compensation, e.g. government support, processing or repair transactions, etc.

[25] Instructions for concordance of trade classifications over time can be found here: https://www.sites.google.com/site/ilkevanbeveren/Concordances and is described in Van Beveren et al. (2012)

can be found in Appendix B.

In Table 1 we list the parameters that we identify in this paper and the level of aggregation at which they are measured empirically. This comprises the taste index (λ_{jidt}), the quality index (δ_{jidt}) and the marginal cost index (c_{jidt}) which are all estimated at the same level of aggregation.

Table 2 documents the broad product categories in our data and the broad geographical units of the destination countries. At the most disaggregate level our customs data consist of over 100,000 trade flows.[26]

Table 3 reports the similarity index of national dishes between the destination countries and Belgium. The first two columns presents the average indices of the similarity of national dishes by regions ranging between +1 and -1. On average, countries in Europe and North America are closer to Belgium in their national dishes. In contrast, National dishes in the Middle East and South Asia are very different from Belgian dishes. Columns 3 to 4 report the top seven countries with the highest similarity index in national dishes and the last two columns report the bottom seven countries with the lowest similarity indices. France, Ireland and Hungary have the highest similarity indices in their national dishes with Belgium while China, Norway and India have the lowest similarity indices relative to Belgium.

5 Parameter Estimates

5.1 Elasticity of Demand

From the estimation of the demand specification in equation (7), we obtain the elasticities of demand (σ_{id}). Table 4 documents the estimated average elasticities of demand (σ_{id}) that, for expositional purposes, we aggregate up to broad product categories. Average values range between 1.88 and 3.09 with standard deviations between 0.37 and 1.42. The inclusion of consumer taste and product quality as demand shifters when estimating (7), absorbs some of the variation that otherwise would be attributed to the demand elasticity. Without the inclusion of control functions for these additional demand shifters, an endogeneity bias would give rise to an upward bias on the demand elasticity estimates.

[26]Our data are at firm-product(CN8)-country level. The CN8 products included belong to the broader categories HS2 that range from HS2=15 which is Animal or Vegetable Fats and Oils to HS=22 which is Beverages, Spirits and Vinegar.

5.2 Taste versus Quality and Cost Indices

Averages of the estimated taste, quality and marginal cost indices by region (Table 5) indicate that consumer taste for exported Belgian products display substantial geographical variation while quality and cost appear to vary less by destination.[27]

Table 6 lists the correlation matrix between consumer taste, quality and marginal cost. The low correlation between marginal cost and taste suggests that our taste measure captures an inherently different source of variation in the data. The low correlation between quality and taste suggests that the two demand shifters are picking up different sources of demand heterogeneity. Thus, products can have low cost but high taste or high quality and low taste. These results suggest that theoretical models that propose a richer parameterization on the demand side are justified. A common assumption in the literature is that only highly productive firms (low cost firms) can produce high quality. However, once we empirically identify quality and marginal cost without imposing any prior relationship between them, as we do here, we do not find a strong correlation between them. A similar observation holds for models where firm appeal is considered to be the joint combination of taste and quality, suggesting that these demand shifters operate in the same direction. It is straightforward to verify this assumption with the measure for unobserved taste heterogeneity that we develop in this paper. Our findings indicate that high quality goods can have low taste and vice versa, indicating that taste and quality should be treated as two separate demand shifters.

At first sight, the negative correlation between quality and marginal cost, appears to be a counter-intuitive result. However, this can easily be understood by noting that our measure of marginal cost reflects both the inverse of productivity as well as the cost of producing quality. We cannot disentangle the productivity from the cost side without making specific functional form assumptions, which we want to avoid here. In order to establish a clean correlation between quality and marginal cost, we need to control for the level of output since high output in the data can come from high productivity (low MC) as well as high quality (corresponding to high MC). For this purpose we perform a simple OLS regression of our measure of marginal cost (lnc_{jidt}), as obtained from Eq. (9) on the quantity shipped (lnq_{jidt}) and the quality embedded ($ln\delta_{jidt}$). The coefficients on lnq_{jidt} and $ln\delta_{jidt}$ are -0.12 and 0.08, respectively. The positive coefficient on the quality index suggests that at any given level of output, higher quality goods in our data have a higher marginal cost, confirming what others have reported earlier (e.g. Baldwin and Harrigan (2011)). The negative coefficient on the quantity of exports reflects that low-cost (high-productivity) firms are likely to ship a large amount of goods to the destination country.

[27] The taste index takes on a negative value in some regions because the mean indices are expressed in logs.

In Table 7 we decompose the variance of each index that we identify from the data e.g. $ln\lambda_{jidt}$, $ln\delta_{jidt}$ and lnc_{jidt}. The first column shows that about 49% of the variation in the consumer taste index is explained by the country dimension, about 43% by the product dimension and only 8% by the firm dimension in the data. This suggests that consumer taste is a source of variation that is primarily driven by consumer heterogeneity across destinations and products. This also suggests that estimating consumer taste at product-country level, as in Aw, Lee and Vandenbussche (2018), would capture the bulk of the variance observed in consumer taste since taste varies mostly across countries and products but much less across firms.[28] Our results therefore suggest that while consumers abroad may have a large taste preference for Belgian chocolates over chocolates from anywhere else in the world, the taste difference between different brands of Belgian chocolates sold by different firms is relatively smaller.

The second column of Table 7 decomposes the variance of the quality index. This variance decomposition on the quality index $ln\delta_{jidt}$, shows that the main source of quality variation comes from the firm and product-level dimensions explaining respectively 66% and 31% of the variance of the quality index. The country-dimension explains only 3% of the quality index variance in our data. For quality we can therefore conclude that the firm dimension is very important and that quality mainly varies by firm and not as much by product or country. Table 7 also suggests that the extent to which firms vary the quality of their exports by export destination is rather limited. As far as product quality is conserved, consumers abroad have strong preferences over brands and brands tend to have a similar quality everywhere.

Finally in the last column, we show the decomposition of the variance of the marginal cost index. Most of the variation in costs come from the firm-and product-level which explains around 43% and 47%, respectively. In contrast, the country-dimension only accounts for about 10% of the overall cost variance. We thus conclude that marginal cost is driven primarily by firm-product-level technology rather than by the country that the product is exported to. Our results therefore suggest that the marginal production cost of a bottle of beer is pretty much the same no matter where the beer is exported to. The country-dimension in the marginal cost variance may reflect customization or quality cost differences when shipping products to different destinations, but these turn out to be small.

[28] Estimating taste with firm-product level trade as the dependent variable has the advantage that when using product-level trade shares in the control function does not generate endogeneity issues.

6 The Importance of Consumer Taste

6.1 Consumer Taste and Distance

In Figure 1 we aggregate our measure of consumer taste up to the country-level and then plot the average taste for Belgian food products for each destination in the world on a map. The taste index is normalized between zero and one as indicated in the legend to the Figure 1. Darker colors reflect a higher level of the destination-specific taste index. The world map clearly indicates how consumer taste evolves in space. Not surprisingly, taste for Belgian exported products is typically strongest close to home, in nearby Western European countries. The map also shows that distance is not the only driving force underlying consumer taste. Taste for Belgian products is also strong in countries very far away from Belgium such as the U.S., Canada and Australia. The correlation between consumer taste and distance from Belgium in our data, is negative and approximately -0.5. This suggests that with a doubling of distance, taste falls by about half. The scatter plot in Figure 2 between λ_{jidt} and distance (both in logs), shows this negative relationship.

But Figure 1 also clearly indicates that consumer taste for Belgian products does not vary monotonically with distance. Given that product-country fixed effects are separately included in the demand equation (7) to control for bilateral distance at the product market-level, the taste index which is simultaneously identified, is likely to be picking up another source of variation. The non-monotonicity of consumer taste with distance suggests that, in addition to geographical distance between the importing and exporting countries, consumer taste also plays an important role in explaining trade flows between countries.[29]

6.2 Consumer Taste and Latitude

But what if our National dish indicator is just picking up climate or geography? What if consumers develop a taste for what can be grown locally which may depend on weather conditions and climate? To check whether our National dish indicator is picking up climate, for each country in our data, we plot the relationship between National Dish similarity to Belgium and the distance from the equator expressed in latitude, as shown in Figure 3.[30] We note that there is not much of a relationship with a correlation as low as -0.2. This low correlation suggests that our National Dish indicator is not likely to be picking up climate. National dish overlap between countries

[29] Eaton and Kortum (2002) already show that geography plays an important role in determining trade flows among countries.

[30] For every country we take the difference in latitude compared to Belgium (latitude 50.5). For example, the latitude of Netherlands is 52.1 and the latitude of Italy is 41.9. The distance in latitude between Netherlands and Belgium is therefore 1.6 (52.1-50.5) and the distance in latitude between Italy and Belgium is 8.6 (50.5-41.9)

seems to be driven by other conditions than distance from the equator. Even when countries have a very similar latitude relative to Belgium, their national dish ingredients can differ quite a lot. For example the UK (GB) has a similar latitude to Belgium but has a low similarity in National dish ingredients (0.09). Similarly, Norway has a relatively similar latitude to Belgium but a very low similarity in National dish ingredients (-0.06). Brazil, on the other hand has a very different latitude to Belgium (distance in latitude is 36.3) but the National Dish index is not that different (0.5).

6.3 The Example of Chocolates

At this point we present an external validation of our taste measure. For this purpose we turn to chocolates which is one of the very few products where the HS8 product classification offers an outside validity test. Since cocao is the main and most expensive ingredient in chocolates, dark chocolate is generally regarded as higher quality than milk chocolate. In every destination where chocolates are sold in our data, using our methodology, we find that high-end dark chocolates with a cocao content exceeding 30% (HS:18062010) has a higher quality index than the low-end milk chocolate with a much lower cocao content (18062030). Marginal cost for dark chocolates is found to be significantly higher than for milk chocolates.

In terms of taste, based on our method we consistently find stronger taste for the sweeter low-end milk chocolate (HS:18062030) than for more bitter high-end dark chocolate. These results correspond quite well with industry reports on the chocolate market. Milk chocolate typically holds the largest market share but dark chocolate is known to be more expensive and to have health benefits.[31]

Unfortunately, chocolate is one of the few if not the only product category where the HS product classification offers guidance on quality and taste of products. This is exactly the reason why measures like ours can offer a solution since for many other traded products, consumer taste and quality indicators are missing or non-existant. By applying our approach we can generate measures for these unobservable demand shifters that would otherwise be very difficult to obtain for most products. With our new measure for consumer taste, we can construct taste indices for hundreds of products and thousands of observations in our data.

[31] https://www.grandviewresearch.com/industry-analysis/chocolate-market

6.4 The Decomposition of Export Revenues

Finally, based on the joint demand and supply parameters we perform a decomposition of export revenues to assess the importance of taste in explaining firms' export revenues relative to other demand and cost drivers. Our decomposition is in the spirit of Hottman et al. (2016), but whereas they pursue it at the firm-level, our decomposition is at the firm-product-country level. The coefficients arising from the decomposition can be interpreted as the percentage variation in export revenues that is explained by each particular indicator including consumer taste.

Based on the estimated demand function (Eq. (3)) and the firm's optimal price (Eq. (9)), firm j's export revenue of product i in country d can be expressed as:

$$\begin{aligned} lnr_{jidt} &= lnp_{jidt} + lnq_{jidt} \\ &= \gamma_{idt} + (1-\sigma_{id})lnp_{jidt} + ln\widehat{\lambda}_{jidt} + ln\widehat{\delta}_{jidt} + \epsilon_{jidt} \\ &= \underbrace{\gamma_{idt} + (1-\sigma_{id})ln(\frac{\sigma_{id}}{\sigma_{id}-1})}_{M_{idt}} + (1-\sigma_{id})lnc_{jidt} + ln\widehat{\lambda}_{jidt} + ln\widehat{\delta}_{jidt} + \epsilon_{jidt} \end{aligned} \tag{10}$$

Equation (10) shows how export sales revenue at firm-product-country level can be decomposed into its separate components: the variation of market size and market competition, including markup variations and distance effects (a Market Effect, M_{idt}), firm-product-destination costs of production (lnc_{jidt}), firm-product-destination quality ($ln\hat{\delta}_{jidt}$), firm-product-destination consumer taste ($ln\hat{\lambda}_{jidt}$) and a residual (ϵ_{jidt}).

Following Hottman et al. (2016), we regress each component of the right-hand side of equation (10) on lnr_{jidt} to get the contribution of each component of firm-product-destination export revenue on total export revenues. This is given in Equations (11a) to (11e).

$$M_{idt} = \beta_M lnr_{jidt} + \varepsilon^M_{jidt} \tag{11a}$$

$$ln\hat{\lambda_{jidt}} = \beta_\lambda lnr_{jidt} + \varepsilon^\lambda_{jidt} \tag{11b}$$

$$ln\hat{\delta_{jidt}} = \beta_\delta lnr_{jidt} + \varepsilon^\delta_{jidt} \tag{11c}$$

$$(1-\sigma_{id})lnc_{jidt} = \beta_c lnr_{jidt} + \varepsilon^c_{jidt} \tag{11d}$$

$$\epsilon_{jidt} = \beta_R lnr_{jidt} + \varepsilon^R_{jidt} \tag{11e}$$

Each of the β coefficients in Equations (11a) to (11e) can now be interpreted as the "percentage variation of the revenue explained by the indicator". As such the β coefficients can directly be compared with each other.

6.4.1 Decomposition of Actual Export Revenues

Empirical findings of the decomposition are reported in Table 8. In the first column we show the decomposition results where we consider consumer taste to come from a residuals approach e.g. the dependent variable in equation (11b) comes from estimating the demand in equation (7) but without using a control function for taste. With the entire residual as our measure of taste, the taste parameter, β_λ, explains 45% of the actual variation in export revenues. This seems unrealistically high, especially compared to the other relevant parameters such as quality and cost which explain respectively 24% and 15% of the variation. A residuals approach to consumer taste therefore does not appear to be realistic.

Next, in column (2) of Table 8 we use a measure of consumer taste from the incorporation of a control function for taste in the estimation of the demand equation. The control function for taste consists of the weighted national dish indicator where the weight is the initial firm-product global sales fraction $s_{jid(t=0)}$ and of the variable z_{idt} which is country d's import share of Belgian product i relative to country d's total world imports of product i. The firm-product global sales fraction in column (2) is defined as the ratio of the firm-product exports to destination d, relative to the global sales of the same firm-product ji, taken in the initial year of the data t=0. The decomposition result on consumer taste, given by β_λ, now amounts to 14%, while the decomposition results on quality and cost are similar to those obtained in column (1). By teasing out the part of the demand residual which we believe to correspond most with consumer heterogeneity in consumer taste, we obtain a measure of taste that, in terms of magnitude, is about equally important as marginal cost as a driver of export success.

Despite taking the initial value of $s_{jid(t=0)}$ the problem of endogeneity could arise if the $s_{jidt)}$ in the control function is strongly correlated over time. Therefore we run an alternative specification where we weigh the national dish indicator at the firm-level instead. Moving the weight to the firm-level reduces the potential correlation between the dependent variable q_{jidt} and the firm-level weight, s_{jdt}. The decomposition results with a firm-level global sales share are shown in column (3) and are relatively similar to those in column (2) and do not alter the decomposition results.[32]

For robustness, we also verify results where the weight is defined at the product-destination level, s_{idt}. With product-destination weights s_{idt}, product i is defined at the CN8 level. The product-country-year dummies γ_{idt} in the demand function already account for more aggregate shocks at the HS4 level of product i. Firm level shocks may then still affect q_{jidt} but not s_{idt}.

[32] A remaining concern could be that firm-level shocks affect trade flows of firm-products. But the correlation in the data between a change in q_{jidt} and a change in s_{jdt} is low at around 0.18, suggesting that there are no unobservable shocks that shift both in the same direction. This increases our confidence in using the firm-level global sales weights as our preferred specification.

Results with product-destination weights are shown in column (4) and are again qualitatively similar to the ones in column (2) suggesting that the endogeneity of the weight is not at play. Decomposition results are stable across specifications and the importance of consumer taste in explaining export revenue is not affected by the level of aggregation of the weighting scheme that we used in the control function for consumer taste.[33] In sum, the results reported in Table 8 shows that consumer taste is important in explaining export revenues in the food industry in every specification and its magnitude is about equally to that of marginal cost.

Other variables in the decomposition are mainly there as controls e.g. to make sure that our indices on taste, quality and cost are not picking up any distance effects, market size, markup or income effects that can also differ by destination and product. The Market Effect term (M_{idt}) in the decomposition entails product-destination dummies that control for distance effects, destination market competition effects and markups corresponding to the elasticity of demand as shown in Eq. (10). From Table 8 we see that this Market Effect (M_{idt}) accounts for about 9-17% of the variation in firm-product-country export revenues depending on the specification. In this paper our main focus lies on the demand versus cost of production determinants.[34]

The coefficient on the residual component is about 37%.[35] This residual may contain additional but unobservable cost and demand drivers such as distribution costs, firm-specific transport costs or remaining demand variation at the more disaggregated bar code level of products that we cannot control for. This residual component is still substantial, but what is important for our purposes is that whatever is left in the residual does not contaminate our measure of consumer taste, quality and cost. The instrumentation strategy that we pursued in estimating the demand parameters and the use of the control functions offer us exogenous measures of taste, quality and cost at the level of the trade flow.

We should note that the regression coefficients obtained in the decomposition address the question of "how much the variation in (predicted) export sales is explained by each component of the decomposition". Decomposition results thus show that when firm-products within the same product-destination differ in their sales, it is mainly because they differ in quality e.g. export revenue differences between firm-products are mainly explained by quality differences. Based on Table 7 we find that quality does not vary much by country, therefore most of the

[33] In Aw et al. (2018), consumer taste was proxied by product-country dummies and picked up more of the variation in the decomposition. Here we have a cleaner way of measuring consumer taste and find smaller coefficients in the decomposition results.

[34] Under the current approach we cannot compare the importance of consumer taste relative to say transport costs. But in future that could clearly be an interesting avenue to pursue.

[35] Goodness-of-fit measures in firm-level panel data are typically very low, especially at the level of disaggregation that we consider in the data.

quality variation comes from the across-firm variation. In contrast, the variations of consumer taste mainly come from consumer heterogeneity across countries where geographical difference accounts for around half of the variations of consumer taste.

In Appendix Table C-1 we show decomposition results for each of the thirty-four HS4 product category. For each HS4 food product group we run a decomposition similar to the one in specification (3) in Table 8. For every industry where we have a sufficient number of observations to perform the decomposition, the results generates sensible coefficients.[36] Table C-1 shows that the importance of the consumer taste index varies significantly depending on the product category and ranges between 2-30%. In some industries consumer taste appears to be much more important than what the average coefficient in Table 8 suggests. For example in the product group Belgian Ice cream (2105), consumer taste explains 27% of the export revenues, compared to 24% and 7% attributed to quality and marginal costs, respectively. Another example is the product group Margarines (1517) where taste explains about 29% of the variation. Overall, in the large majority of food product groups, consumer taste together with quality explain more of the variation in export revenues than marginal cost. These results largely confirm Hottman et al. (2016) who found that firm-appeal explains more than half of the variation in the sales of barcoded products. These results are also in line with Aw et al. (2018) where a functional form approach was used to derive structural parameters on consumer taste, quality and cost. Their conclusion, based on a wider range of industries, also pointed to the demand side being more important than the cost side in the decomposition of export revenues.

6.4.2 Decomposition of Predicted Export Revenues

Thus far we considered the actual export revenues in the decomposition. However, in many instances in the literature, decomposition results are reported on the predicted export revenues thereby disregarding the residuals. Based on specification (3) in Table 8, we can calculate the relative importance of taste on the predicted export revenues, disregarding the residual variation (1-37% = 63%). Decomposition results on consumer taste now accounts for 25% ((16%)/63%) of the export success, while 22% (14%/(63%) is explained by marginal cost. Taste and quality together explain the large majority of the predicted revenues e.g. 65% ((16% + 25%)/63%).

[36] In a few industries we have very few observations, which can result in negative coefficients

6.5 Robustness Checks

6.5.1 Balanced Panel Results

Thus far, we have used all observations in our data set. But the question that can be raised is whether there are selection effects at work. Not every product is exported to every destination therefore the composition of Belgian export products differs across destination countries.

To verify whether results are affected by selection effects, we now perform a decomposition of export revenues on a balanced panel where we require every firm-product to be present in every destination. Results are shown in Table 9. The coefficients on the decomposition do not change much and results for the balanced panel are similar to the ones in Table 8 even though the number of observations drops substantially. When the taste index is obtained with a control function approach (cols. 2-3), taste continues to feature as an important determinant (13-15%) in the decomposition of export revenues. Consumer taste together with quality still explain the largest fraction of data variation in export revenue. The low values on the marginal cost coefficients in the balanced panel can be ascribed to the fact that Belgian chocolates (1806), which are shipped almost everywhere and determine the outcome of the balanced panel, are typically products for which cost differences between firm-products are low. Based on a decomposition on the predicted revenues shown in column (4), firm-appeal (taste and quality) now explains 82% ((15% + 30%)/55%) which is large majority of the variation and thus the main determinant of export revenues for food products.

6.5.2 Age of the Firm

We next examine whether our results on consumer taste are picking up the age of the firm e.g. how long a firm-product has been present in a destination market. In order to define a firm-product age, we first drop the firm-product-destination combinations that appear in the first year of our panel since we have no information on how long they have been in the destination market.

Next, we run an OLS regression of our taste measure on ln(age). This results in a low correlation of 0.17. The correlation of our taste variable in the models with and without the age variable is around 0.99 implying that the ranking of our earlier taste index does not change much when controlling for the firm-product age in the demand function estimation. This is illustrated in Figure 4 which clearly shows the strong correlation between the two measures.

6.6 The Gravity of Consumer Taste

Now that we have found a new way to quantify consumer taste several new research questions can be raised or old ones re-opened. For one, how important is consumer taste in explaining the gravity of exports? In Table 10 we show the results of a simple gravity model where we regress export revenues at the (HS6)product-country level in our data on a gravity specification that includes distance to and GDP of the destination. For every gravity regression shown in Table 10 we report the coefficients resulting from a standardization of the variables,[37] such that coefficients can usefully be compared across variables independent of the units in which they are expressed. In column (1), we start by regressing product-destination-year export revenues on the $lnGDP_{dt}$ of the destination and the distance to the destination ($lnDIST_d$) and find both to be highly significant as we would expect. In column (2) we add local market effects, by inserting product (HS4)-destination-year dummies into the regression. But to prevent distance from dropping from the regression when we simultaneously insert these dummies, we retrieve the market effect from the demand estimation ($ln\hat{\gamma}_{idt}$) and insert it in the gravity specification to control for the local market effect. Next, in column (3) of Table 10, we augment the gravity specification with the quality index ($ln\hat{\delta}_{idt}$), which originates from the estimation of the demand equation (7).[38] Column (3) clearly shows that accounting for the quality of trade flows is an important determinant of exports, but adding the quality index does not affect much the regression coefficients of the typical gravity variables GDP and distance.

But in column (4), adding the taste index ($ln\hat{\lambda}_{idt}$), reduces the importance of the distance variable significantly. This finding continues to hold in the extended gravity model augmented with the taste and quality index as shown in column (5). More importantly, columns (4) and (5) clearly show that in a gravity specification augmented with a control for consumer taste, the coefficient on distance drops by more than 50%. This suggests that without explicitly accounting for consumer taste, distance is picking up an important part of the taste heterogeneity between countries. An additional finding is that when regressing export revenues on both quality and taste, we now find that the marginal effect of a one unit increase in the taste index affects export revenues more than a marginal increase in the quality index.[39]

[37]Standardization here means subtracting the average value and dividing by the standard deviation.

[38]The original quality index at the level of $ln\hat{\delta}_{jidt}$ was aggregated to product-country $ln\hat{\delta}_{idt}$ in the gravity regressions. To obtain a measure of product-destination quality we aggregated over firms using market shares of firm-products in the country of destination as the weights in the aggregation.

[39]The stronger effect of taste on export revenue does not contradict the decomposition results obtained earlier. The interpretation of the role played by taste in a gravity model is different. The results here suggest that for those firms that want to raise their export revenue and have to choose between raising their taste by one unit or raising their quality (supposing that equal cost), they would go for the former since taste contributes more to export revenues.

7 Summary and Conclusion

The importance of quality and consumer taste is evident in the recent literature. The failure to specifically account for demand factors can lead to inaccurate price indices and thus biased productivity measures (Foster, Haltiwanger and Syverson (2008)) and a "taste" bias in cost of living measures (Redding and Weinstein (2019)). In this paper, we fill this gap in the literature by offering a method to measure consumer taste and assess its importance in the international trade context.

We first develop an empirical strategy to identify consumer taste using international firm-product trade data to estimate a general log-linear demand specification. In order to tease out the part of the demand residual that captures unobserved consumer taste heterogeneity, we use a control function approach using amongst others, data on national dish ingredients across countries as our taste measure.

Next, we perform a decomposition of export revenues to assess the importance of consumer taste relative to product quality and costs in explaining export success. We find consumer taste to be an important and independent source of variation in the trade data. On average, consumer taste explains about as much of the variation in exports as marginal costs. Our findings indicate that taste is a fundamentally different source of heterogeneity than quality even though, in the extant literature, the two dimensions are often lumped together as firm-appeal. In our model, quality and taste together explain the majority of the variation in the data, independent of the product category.

And finally, we assess the importance of taste in a gravity model where the coefficient on distance falls by 50% when our measure of consumer taste is added to the gravity specification. We also find that consumer taste decays in space with a clear home bias observed in the pattern of consumer taste. However, the decay of taste in space is not monotonic, with a correlation between taste and distance of around -0.5.

The national dish indicator used in this paper, offers an exogenous taste measure for food products. In Aw et al. (2019), we experimented with indicators such as cultural distance, common spoken language, common nationality and common religion in the control function for taste. While these variables can potentially capture consumer taste heterogeneity across countries, they may also include aspects of trade costs. Nevertheless, the results obtained using these proxies largely confirm the findings of this paper.

Obvious candidates for which taste measures can also be developed, are trade in fashion items, textiles, leather and apparel or cultural export products such as movies and TV series. Trade in cars and consumer electronics could also be subject to country-level consumer taste differences.

The approach that we advocate in this paper e.g. the use of a control function approach to measure taste, is easy to replicate and provides measures of taste for every trade flow in the data at any level of aggregation. The approach also allows for an identification of quality and marginal cost at the same level of aggregation. In this paper we offer a way to quantify and track consumer taste changes over time which can be used to identify shifts in taste patterns across countries. Global shocks such as pandemics can alter consumer taste patterns which can be identified using our method. In this paper we do not exploit the time dimension in our taste measure, but future research may well be directed to identify taste shocks related to pandemics such as COVID-19.

References

[1] Amiti, Mary, Oleg Itskhoki and Jozef Konings (2014) "Importers, Exporters, and Exchnage Rate Disconnect," *American Economic Review, 104(7), pp. 1942-1978.*

[2] Anderson S., J. Thisse and A. de Palma and J. Thisse (1992) *Discrete Choice of Product Differentiation, MIT press.*

[3] Atkeson, Andrew and Ariel Tomás Burstein (2008) "Pricing-to-Market, Trade Costs, and International Relative Prices," *American Economic Review, 98(5), pp. 1998-2031.*

[4] Atkin, David (2013), "Trade, Tastes and Nutrition in India", *American Economic Review, 103(5), pp. 1629-1663.*

[5] Aw, Bee-Yan, Mark Roberts and Daniel Yi Xu (2011) "R&D investment, Exporting, and Productivity Dynamics", *American Economic Review, 101(4), pp. 1312-1344.*

[6] Aw, Bee-Yan and Yi Lee (2017) "Demand, Costs and Product Scope in the Export Market", *European Economic Review, 100, pp. 28-49.*

[7] Aw, Bee-Yan, Yi Lee, and Hylke Vandenbussche (2018) "Decomposing Firm-Product Appeal: How Importance is Consumer Taste?" *National Bank of Belgium, Working Paper, no. 337.*

[8] Aw, Bee-Yan, Yi Lee, and Hylke Vandenbussche (2019) "The Importance of Consumer Taste in Trade" *Centre for Economic Policy Research, Discussion Paper, no. 13614.*

[9] Baldwin, Richard and James Harrigan (2011) "Zeros, Quality and Space: Trade Theory and Trade Evidence", *American Economic Journal: Microeconomics, 3(2), pp. 60-88.*

[10] Bastos, Paulo, Joana Silva and Eric Verhoogen (2018) "Export Destinations and Input Prices," *American Economic Review, 108(2), pp. 353-392.*

[11] Bernard, Andrew, Stephen Redding and Peter Schott (2011) "Multi-product Firms and Trade Liberalization," *Quarterly Journal of Economics, 126(3), pp. 1271-1318.*

[12] Bernard, Andrew, Emily Blanchard, Ilke Van Beveren, and Hylke Vandenbussche (2019) "Carry-along Trade", *Review of Economic Studies, 86(2), pp.526-563.*

[13] Berry, Steven, James Levinsohn and Ariel Pakes (1995) "Automobile Prices in Market Equilibrium", *Econometrica, 63(4), pp. 841-890.*

[14] Bils, Mark and Peter Klenow (2001) "Quantifying Quality Growth", *American Economic Review, 91(4), pp. 1006-1030.*

[15] De Loecker, Jan, Pinelopi Goldberg, Amit Khandelwal and Nina Pavcnik (2016) "Prices, Markups and Trade Reforms", *Econometrica, 84(2), pp. 445-510.*

[16] Di Comité, Francesco, Jacques-François Thisse and Hylke Vandenbussche (2014) "Verti-zontal Differentiation in Export Markets", *Journal of International Economics, 93, pp. 50-66.*

[17] Eaton, Jonathan and Samuel Kortum (2002) "Technology, Geography, and Trade" *Econometrica, 70(5), pp. 1741-1779.*

[18] Eaton, Jonathan, Marcela Eslava, David Jinkins, C.J. Krizan, and James Tybout (2015) "A Search and Learning Model of Export Dynamics", *Meeting Papers 1535, Society for Economic Dynamics.*

[19] Elfenbein, Daniel W., Raymond Fisman and Brain McManus (2019) "The Impact of Socio-economic and Cultural Differences on Online Trade" *NBER wprking paper, no.26197.*

[20] Fan, Haichao, Yao Amber Li and Stephen Yeaple (2018) "On the Relationship Between Quality and Productivity: Evidence from Chinas Accession to the WTO," *Journal of International Economics, 110(1), pp. 28-49.*

[21] Fontagé, Lionel, Phillipe Martin, and Gianluca Orefice (2018) "The International Elasticity Puzzle is Worse Than You Think,", *Journal of International Economics, 115, pp. 115-129.*

[22] Foster, Lucia, John Haltiwanger and Chad Syverson (2008) "Reallocation, Firm Turnover, and Efficiency: Selection on Productivity or Profitability?", *American Economic Review 98 (1), pp. 394-425.*

[23] Foster, Lucia, John Haltiwanger and Chad Syverson (2016) "The Slow Growth of New Plants: Learning about Demand?", *Economica, 83(329), pp. 91-129.*

[24] Gabaix, Xavier (2016) "Power Laws in Economics: An Introduction", *Journal of Economic Perspectives, 30(1), pp. 185-206.*

[25] Ghironi, Fabio and Marc Melitz (2005) "International Trade and Macroeconomic Dynamics with Heterogeneous Firms", *Quarterly Journal of Economics, 120, pp. 865-915.*

[26] Giovanni, Julian and Andrei Levchenko (2012) "Country Size, International Trade, and Aggregate Fluctuations in Granular Economies", *Journal of Political Economy 120(6), pp. 1083-1132.*

[27] Giuliano, Paola and Nathan Nunn (2019) "Understanding Cultural Persistence and Change" *Harvard University working paper, February.*

[28] Guiso, Luigi, Paola Sapienza and Luigi Zingales (2019) "Does Culture affect Economic Outcomes?" *Journal of Economic Perspectives, 20(2), pp. 23-48.*

[29] Hallak, Juan Carlos (2006) "Product Quality and the Direction of Trade", *Journal of international Economics, 68(1), pp. 238-265.*

[30] Hausman, Jerry A. (1996) "Valuation of New Goods under Perfect and Imperfect Competition," *The Economics of New Goods, edited by Timothy F. Bresnahan and Robert J. Gordon, pp. 207 - 248.*

[31] Head, Keith and Thierry Mayer (2014) "Welfare and Trade without Pareto," *American Economic Review, 104(5), pp. 310-316.*

[32] Hottman, Colin, Stephen Redding and David Weinstein (2016) "Quantifying the sources of Firm Heterogeneity", *The Quarterly Journal of Economics, 131(3), pp. 1291-1364.*

[33] Khandelwal, Amit (2010) "The Long and Short (of) Quality Ladders", *Review of Econmic Studies, 77(4), pp. 1450-1476.*

[34] Kohler, Andreas and Anne Wunderlich (2019) "How Migrants' Food Tastes Shape International Agro-Food Trade," *Manuscript*

[35] Kugler, Maurice and Eric Verhoogen (2011) "Prices, Plant Size, and Product Quality", *Review of Economic Studies, 79, pp. 307-339.*

[36] Landauer, Thomas, Peter W. Foltz, and Darrell Laham (1998) "An Introducetion to Latent Semantic Analysis," *Discourse Processes, 25(2-3), pp. 259-284.*

[37] Levinsohn, James and Amil Petrin (2003) "Estimating Production Functions Using Inputs to Control for Unobservable", *Review of Economic Studies, 70, pp. 317-341.*

[38] Melitz, Marc and G. Ottaviano (2008) "Market Size, Trade and Productivity" *Review of Economic Studies, 75, pp.295-316.*

[39] Mrazova, Monica and Peter Neary (2017), "Not so Demanding: Demand Structure and Firm Behavior," *American Economic Review, 107(12), pp. 3835-3874.*

[40] Olley, Steven and Ariel Pakes (1996) "The Dynamics of Productivity in the Telecommunications Equipment Industry" *Econometrica, 64(6), pp. 1263-1297.*

[41] Redding, Stephen and David Weinstein (2019) "Measuring Aggregate Price Indexes with Taste Shocks: Theory and Evidence for CES preferences" *NBER working paper, no.22479.*

[42] Roberts, Mark, Daniel Yi Xu, Xiaoyan Fan and Shengxing Zhang (2018) "The Role of Firm Factors in Demand, Cost, and Export Market Selection for Chinese Footwear Producers", *Review of Economic Studies, 85, pp. 2429-2461.*

[43] Schott, Peter (2004) "Across-Product versus Within-Product Specialization in International Trade", *Quarterly Journal of Economics, 119(2), pp. 647-678.*

[44] Smeets, Valerie and Frederic Warzynski (2013) "Estimating Productivity with Multi-product Firms, Pricing Heterogeneity and the Role of International Trade," *Journal of International Economics, 90(2), pp. 237-244.*

[45] Van Beveren, Ilke, Andrew Bernard and Hylke Vandenbussche (2012) "Concording Trade and Production Data Over Time", *NBER Working Paper 18604.*

Table 1: Level of Estimated Parameters

Parameters	Variables	Level of Analysis
σ_{idt}	Demand Elasticities	(HS4)Product-Country
λ_{jidt}	Taste Index	Firm-(CN8)Product-Country-Year
δ_{jidt}	Quality Index	Firm-(CN8)Product-Country-Year
c_{jidt}	Marginal costs Index	Firm-(CN8)Product-Country-Year

Note: From the data we can also identify the elasticity of demand (σ) at the (HS6)product-country level. However, estimating σ at the (HS6)product-country level results in a large number of inelastic demand estimates ($\sigma < 1$). Therefore, our preferred level for the demand elasticity is at the (HS4)product-country level.

Table 2: Number of Observations by (HS2)Industries and Regions

	15	16	17	18	19	20	21	22	Total
AU	65	1	174	507	75	84	85	108	1,099
EA	360	78	706	1,945	337	605	558	675	5,264
EE	1,283	662	1,137	2,482	1,193	1,367	1,562	1,203	10,889
ME	522	139	787	1,816	579	1,156	664	524	6,187
NA	41	36	406	1,018	208	443	205	377	2,734
SA	49	8	81	181	57	52	89	120	637
SAM	311	74	327	1,002	282	506	319	395	3,216
SSA	321	64	443	376	337	395	471	448	2,855
WE	4,990	11,273	7,294	11,046	7,719	10,073	8,972	6,234	67,601
Total	7,942	12,335	11,355	20,373	10,787	14,681	12,925	10,084	100,482

Notes: Regions: AU: Australia and New Zealand, EA: East Asia, EE: East Europe, ME: Middle East, NA: North America, SA: South Asia, SAM: South America, SSA: Sub-Saharan Africa , WE: Western Europe.
(HS2)Industries: 15: Animal or Vegetable Fats and Oils, 16: Meat, Fish or Crustaceans, 17: Sugars and Sugar Confectionery, 18: Cocoa and Cocoa Preparations, 19: Preparations of Cereals, Flour, Starch or Milk, 20: Preparations of Vegetables, Fruit, Nuts, 21: Miscellaneous Edible Preparations, 22: Beverages, Spirits and Vinegar.

Table 3: Average Bilateral Indices on Similarity in National Dish between Belgium and Destinations

Similarity in National Dishes					
		Top Seven Countries		Bottom Seven Countries	
Region	Index	Country	Index	Country	Index
AU	0.1502	France	0.7596	China	-0.0669
EA	0.2081	Ireland	0.7423	Norway	-0.0638
EE	0.4020	Hungary	0.7297	India	-0.0566
ME	-0.0353	Argentina	0.6264	Turkey	-0.0353
NA	0.5647	Portugal	0.5714	Korea	-0.0120
SA	-0.0566	U.S.A.	0.5654	New Zealand	0.0040
SAM	0.3678	Canada	0.5634	Peru	0.0569
SSA	0.3997				
WE	0.3851				

Notes: ND: Similarity in National Dishes. The similarity measure based on LSA takes values lying between 1 (recipes are identical) and -1 (recipes are entirely different). Regions: AU: Australia and New Zealand, EA: East Asia, EE: East Europe, ME: Middle East, NA: North America, SA: South Asia, SAM: South America, SSA: Sub-Saharan Africa ,WE: Western Europe.
The similarity in National Dishes (ND) is based on public information on national dishes and their ingredients https://www.foodpassport.com/ and https://nationalfoods.org/. Details on the construction of the national dish indicator can be found in Appendix B.

Table 4: Average Demand Elasticities by (HS2)Sectors

HS2 Industries	Mean(σ)	S.D.(σ)	Number of (HS4)Product-Country Pairs
15	3.0957	1.2838	24
16	2.2733	1.4236	18
17	2.0799	0.7683	23
18	1.4330	0.3705	16
19	1.8770	0.6499	29
20	2.9737	1.3741	49
21	2.0759	0.8249	35
22	1.9430	1.0012	23

Notes: The estimated demand elasticities are averaged over product categories and regional blocs.
(HS2)Industries: 15: Animal or Vegetable Fats and Oils, 16: Meat, Fish or Crustaceans, 17: Sugars and Sugar Confectionery, 18: Cocoa and Cocoa Preparations, 19: Preparations of Cereals, Flour, Starch or Milk, 20: Preparations of Vegetables, Fruit, Nuts, 21: Miscellaneous Edible Preparations, 22: Beverages, Spirits and Vinegar.

Table 5: Summary Statistics of Demand and Cost Indices

Region	Quality Index ($ln\hat{\delta}$)	Taste Index ($ln\hat{\lambda}$)	MC Index ($ln\hat{c}$)
AU	4.2784	0.4286	-1.6121
EA	3.9891	0.6910	-1.2814
EE	4.1254	0.6897	-1.1785
ME	4.0105	0.8693	-1.4870
NA	3.7953	0.7420	-1.6173
SA	4.6292	0.0607	-0.5600
SAM	4.4220	0.8313	-0.7671
SSA	3.7471	2.1486	-0.7556
WE	3.8428	1.5944	-1.0288
S.D.	1.4601	1.2006	1.2897

Note: Regions: AU: Australia and New Zealand, EA: East Asia, EE: East Europe, ME: Middle East, NA: North America, SA: South Asia, SAM: South America , SSA: Sub-Saharan Africa, WE: Western Europe.
When estimating the demand function, we lose 52% of total number of observations due to the following criteria: (1) dropping outliers in lnp (6% of total number of observations are lost); (2) dropping observations without information on the proxy variables of tastes index and IV for prices (38% of total number of observations are lost); (3) dropping (HS4)Product-country markets whenever the number of Belgium firms exporting are fewer than twenty (7% of total number of observations are lost). After all lost observations, the sample for the demand function estimation still captures 70% of total export value in the Belgium Food Industry.

Table 6: Correlation Matrix of Quality, Tastes and MC indices

	Quality Index ($ln\hat{\delta}$)	Taste Index ($ln\hat{\lambda}$)	MC Index ($ln\hat{c}$)
Quality Index ($ln\hat{\delta}$)	1		
Taste Index ($ln\hat{\lambda}$)	-0.0925	1	
MC Index ($ln\hat{c}$)	-0.0722	-0.0255	1

Table 7: Variance Decomposition of Indices

Variation in:	Taste Index	Quality Index	MC Index
Firm	8%	66%	43%
Product	43%	31%	47%
Country	49%	3%	10%
	100%	100%	100%

Notes: We decompose the variance of the taste (quality and cost) index into three components: (1) Variance across firms within the same (HS6) Product-Country market; (2) Variance across (HS6) Products within the same country; (3) Variance across countries. The decomposition of the variance of the taste index is defined as $\sum_{jid}(ln\lambda_{jidt}-ln\lambda_t)^2 = \sum_{jid}(ln\lambda_{jidt}-ln\lambda_{idt})^2 + \sum_{jid}(ln\lambda_{idt}-ln\lambda_{dt})^2 + \sum_{jid}(ln\lambda_{dt}-ln\lambda_t)^2 + 2\sum_{jid}(ln\lambda_{jidt}-ln\lambda_{idt})(ln\lambda_{idt}-ln\lambda_{dt}) + 2\sum_{jid}(ln\lambda_{jidt}-ln\lambda_{idt})(ln\lambda_{dt}-ln\lambda_t) + 2\sum_{jid}(ln\lambda_{idt}-ln\lambda_{dt})(ln\lambda_{dt}-ln\lambda_t)$. The first term represents the variance across firms, the second term represents the variance across products, and the third term represents the variance across countries. The last three terms represent the covariances of the indices.
The covariance terms are empirically negligible so we do not report them here.

Table 8: Decomposition of Firm-Product Export Revenues

	(1)	(2)	(3)	(4)
β_λ (Tastes)	0.45	0.14	0.16	0.14
	(.002)***	(.002)***	(.002)***	(.002)***
β_δ (Quality)	0.24	0.24	0.25	0.26
	(.002)***	(.003)***	(.003)***	(.003)***
β_c (MC)	0.15	0.13	0.14	0.13
	(.003)***	(.003)***	(.003)***	(.000)***
β_M (Market Competition)	0.17	0.11	0.09	0.09
	(.003)***	(.003)***	(.003)***	(.003)***
β_R (Demand Residuals)		0.37	0.37	0.38
		(.003)***	(.003)***	(.003)***
Observations	39,001	31,265	32,239	32,034

See Equations Equations (11a) to (11e) for the regression equations.
Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
Notes: In Column (1) we treat the demand residuals as the taste index so that the contribution of taste index and demand residuals are combined in the contribution of taste index. Columns (2)-(4) reflect the use of a control function for taste but with different proxy variables. In specification (2) the weight for the nation dish index is given by the initial fraction of firm-(CN8)Product sales in the destination country. In specification (3) we use the fraction of firm-level sales in the destination country as the weight for the national dish index instead. In specification (4) we use the fraction of product-level sales in the destination country as the weight for the national dish index instead.

Table 9: Decomposition of Firm-Product Revenues (Balanced Panel)

	(1)	(2)	(3)	(4)
β_λ (Tastes)	0.49	0.13	0.15	0.27
	(.008)***	(.007)***	(.007)***	
β_δ (Quality)	0.30	0.32	0.30	0.55
	(.008)***	(.010)***	(.008)***	
β_c (MC)	0.04	0.02	0.02	0.04
	(.006)***	(.004)***	(.004)***	
β_M (Market Competition)	0.14	0.08	0.08	0.14
	(.008)***	(.007)***	(.006)***	
β_R (Demand Residuals)		0.45	0.45	
		(.010)***	(.009)***	
Observations	3,009	1,978	2,540	2,540

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
Notes: Specification (1) treat the demand residuals as the taste index so that the contribution of taste index and demand residuals are combined in the contribution of taste index. Specifications (2)-(3) use a control function to construct the taste index but with different proxy variables. Specification (2) uses the initial fraction of firm-(CN8)Product sales in the destination country as the weight for the national dish index. Specification (3) uses the fraction of firm- sales in the destination country as the weight instead. Specification (4) reports the contribution of each variable to the predicted export revenue.

Table 10: Simplified Gravity Model

	(1)	(2)	(3)	(4)	(5)
$\ln(\text{GDP})_{dt}$	0.3552	0.2807	0.2907	0.1756	0.1827
	(0.007)***	(0.007)***	(0.007)***	(0.007)***	(0.006)***
$\ln(\text{DIST})_d$	-0.2934	-0.3048	-0.3369	-0.0943	-0.1215
	(0.007)***	(0.007)***	(0.007)***	(0.007)***	(0.007)***
$ln\hat{\gamma}_{HS4,dt}$		0.2235	0.2655	0.2531	0.2987
(Market effect)		(0.008)***	(0.008)***	(0.008)***	(0.007)***
$ln\hat{\delta}_{idt}$			0.2463		0.2613
(Quality Index)			(0.006)***		(0.005)***
$ln\hat{\lambda}_{idt}$				0.4308	0.4449
(Taste Index)				(0.007)***	(0.007)***
Constant	-0.0418	-0.0371	-0.0313	-0.0391	-0.0331
	(0.017)**	(0.017)**	(0.016)**	(0.015)***	(0.014)**
Year	yes	yes	yes	yes	yes
(HS6)Product FE	yes	yes	yes	yes	yes
Observations	16,793	16,793	16,793	16,793	16,793
R-squared	0.365	0.391	0.448	0.500	0.564

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Notes: $ln(\hat{\gamma}_{HS4,dt})$ capture the market effect that is estimated from the demand function. (HS6)Product-country level quality index ($ln\hat{\delta}_{idt}$) is constructed by $ln\hat{\delta}_{idt} = \sum_{j\in\Omega_{idt}} w_{jidt} ln\hat{\delta}_{jidt}$, where w_{jidt} is the share of firm j's export sales of product i over total Belgian export of product i to destination country d. $ln\hat{\lambda}_{idt}$ is the (HS6)Product-country level taste index that we used in column (4) of Table 8.

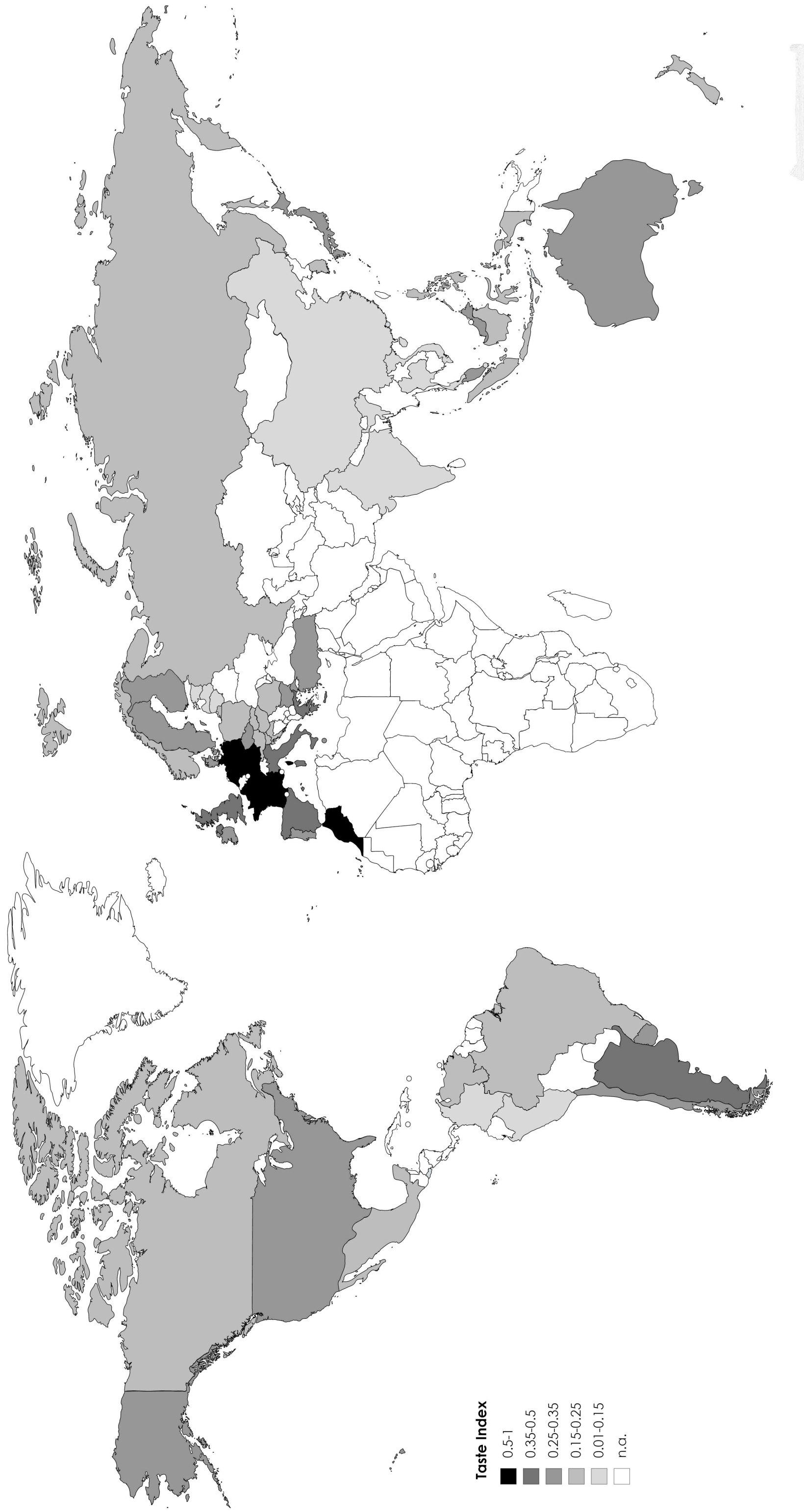

Figure 1: Taste for Belgian Food Exports

Note: Darker color indicates stronger taste for Belgian export products.

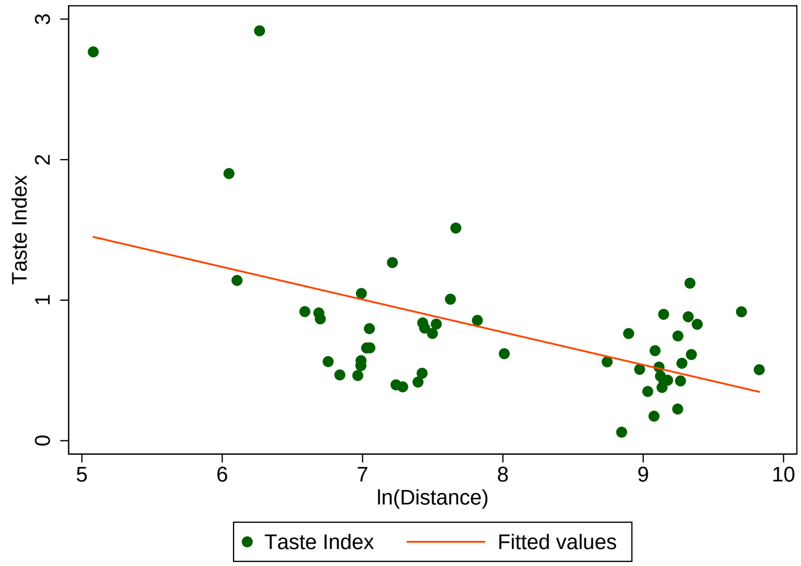

Figure 2: Relationship between Average Taste and Distance to Belgium, by Destination

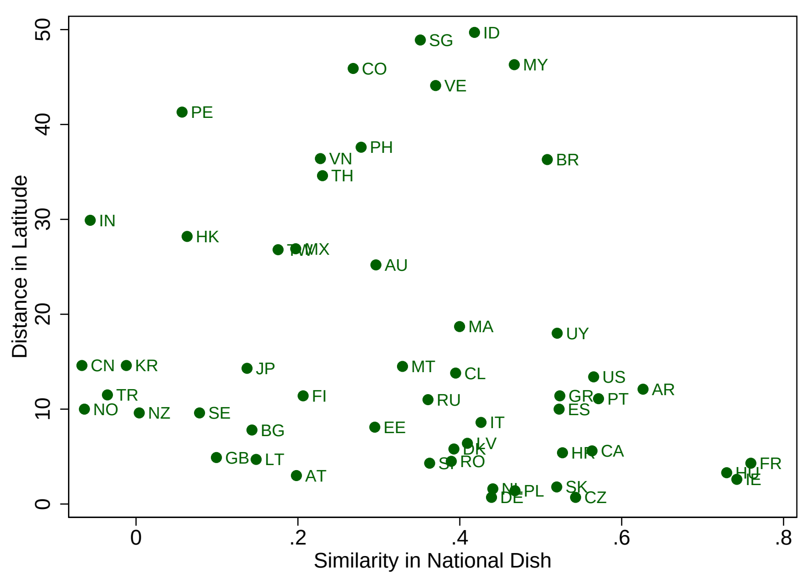

Figure 3: Relationship between *Similarity of National Dish Index* and *Latitude Distance to Belgium*, by Destination

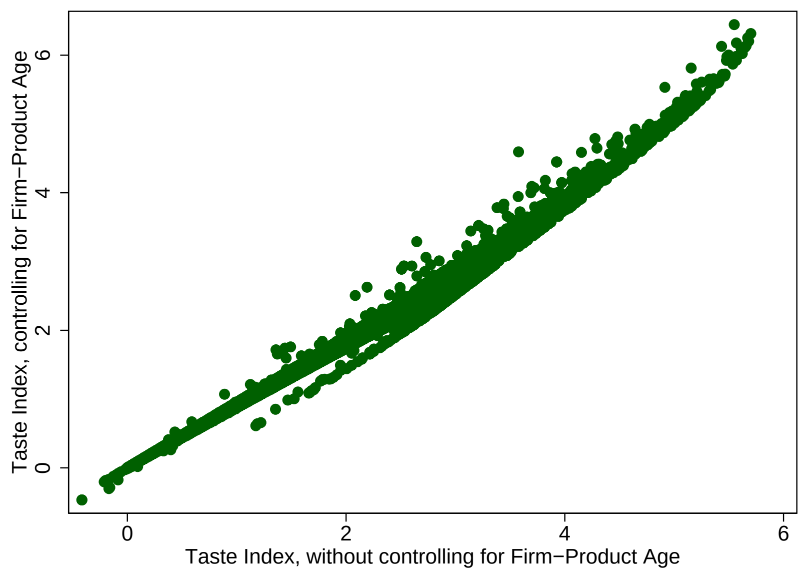

Figure 4: Taste with and without Controlling for Firm-Product Age

Appendix A

The Hausman instrument is only valid in the absence of product-level global shocks. For this purpose we compare the product-level prices across destinations. We first calculate average prices across firms selling the same (CN8)poduct to each country to construct a product-country level price. We pick France as the reference country and calculate the price ratio of each product-country's price over the price in France. We then calculate the changes in price ratios from years t to $(t+1)$. That is,

$$PR_{idt} = \frac{P_{idt}}{P_{i,France,t}} \tag{A.1}$$

$$\Delta PR_{idt} = PR_{id(t+1)} - PR_{idt} \tag{A.2}$$

where P_{idt} is the average prices of product i that Belgian firms export to destination country d in year t and $P_{i,France,t}$ is the average prices of product i that Belgian firms export to France in year t. PR_{idt} is the price ratio of product i that Belgian firms export to country d relative to France and ΔPR_{idt} is the changes in price ratios from years t to $(t+1)$.

In the presence of product-specific global shocks, we would expect the changes in price ratios (ΔPR_{idt}) to be the same across destinations. For this purpose we calculate the standard deviation (S.D.) of the price ratios within the same (CN8)product category across destinations every year. Results ares shown below. We find the standard deviation of the price ratios to be significantly different from zero. Based on these results, we confirm that there is no global shock on product prices.

Table A-1: Distribution of the Standard Deviations of Changes in Price Ratios across the Export Destinations, by Products

Percentile	S.D. of Changes in Price Ratios
5%	0.05
25%	0.16
50%	0.27
75%	0.44
95%	0.91
S.D.	0.38

Appendix B

Here we illustrate how we construct a bilateral indicator of closeness in national dishes' ingredients between any two countries. We apply the Latent Semantic Analysis (LSA) introduced in Landauer et al. (1998) to construct the correlation between two text documents. Suppose the ingredients of the national dishes for several countries are shown in Table B-1.[40]

Table B-1: Ingredients of National Dishes, by Country

Country	National Dishes	Ingredients of National Dishes
Belgium(BE)	Carbonada Flamandes	Beef, garlic, onion, flour, salt
U.S.(US)	Hamburger	Flour, beef, garlic, onion, cheese, salt
Singapore(SG)	Hainanese Chicken Rice	Rice, garlic, onion, chicken, cucumber, salt
Japan(JP)	Ramen	Chicken, sesame oil, soy sauce

We apply Latent Semantic Analysis (LSA) to construct an index reflecting the similarity in national dishes between any two country pair. The first step of LSA is to construct a matrix (A) where each row represents each ingredient shown in any country's national dishes and each column represents a country. Each cell is equal to 0 or 1 to indicate whether this ingredient is used in the country's national dish.

$$A = \begin{array}{l} \\ Beef \\ Garlic \\ Onion \\ Flour \\ Salt \\ Cheese \\ Rice \\ Chicken \\ Cucumber \\ Sesameoil \\ Soysauce \end{array} \begin{array}{c} \begin{matrix} BE & US & SG & JP \end{matrix} \\ \begin{pmatrix} 1 & 1 & 0 & 0 \\ 1 & 1 & 1 & 0 \\ 1 & 1 & 1 & 0 \\ 1 & 1 & 0 & 0 \\ 1 & 1 & 1 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 1 & 1 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 \end{pmatrix} \end{array}$$

The second step of LSA is to reweigh each cell entry in the matrix A by a function that expresses the importance of the ingredient across all national dishes. For example, salt frequently

[40] Table B-1 is just an example for illustrative purposes. In reality every dish consists of far more ingredients but we just limit ourselves to list a few here.

appears in many national dishes while cucumber is not such a frequently-used ingredient. Therefore, two national dishes that both use salt do not necessarily reflect the same type of similarity than two dishes using cucumbers. Therefore, LSA gives a smaller weight to frequently-used ingredients such as salt. The correlation between any two columns in matrix A, reflects the similarity of ingredients used in any two country's dishes. However, given that each national dish uses a lot of different ingredients, matrix A is bound to have a lot zeros (ingredient that are not used in every dish) and only few positive cell entries (ingredients used). Simply calculating the correlation or Manhattan distance between any two columns is therefore not very useful. LSA applies the so-called Singular Value Decomposition (SVD) to solve this problem. SVD is a form of factor analysis which transforms matrix A into another matrix $\tilde{A}$ with a smaller dimension and fewer zeros. Matrix $\tilde{A}$ infers how likely it is for an ingredient-factor f_x to be used in the national dish of a country d_c. The final step in LSA is to calculate the cosine similarity among the ingredient-factors between two countries d_1 and d_2.

$$cosinesim_{d_1,d_2} = \frac{\sum_{x=1}^{N}(f_x^{d_1} \cdot f_x^{d_2})}{\sqrt{\sum_{x=1}^{N} f_x^{d_1}} \cdot \sqrt{\sum_{x=1}^{N} f_x^{d_2}}} \tag{B.1}$$

The cosine similarity in the ingredient-factors of national dishes between country d and Belgium is the similarity index in national dishes between any country d and Belgium.

Appendix C

In this section, we provide a theoretical argument for inserting (z_{idt}) as an additional variable in the control function for taste. We develop a simplified CES demand model also used by Aw et al. (2018), to show the relationship between consumer tastes and the import share of Belgian products over the total imports in the destination country (z_{idt}). Suppose the utility function for a representative consumer in country d is:

$$U_d = \Big[\sum_{j \in \Omega_{isd}} \sum_{i \in \Omega_{sd}} \big(\lambda_{jisd} q_{jisd} \big)^{\rho} \Big]^{\frac{1}{\rho}} \tag{C.1}$$

where λ_{jisd} represents the taste of consumers in country d for product i that firm j exported from country s.[41] q_{jisd} is the quantity of firm-product pair ji exported from country s to country d. Ω_{sd} is the set of products that are exported from country s to country d, Ω_{isd} is the set of firms in country s that exported product i to country d.

The CES utility results in the following demand function:

$$q_{jisd} = \lambda_{jisd} p_{jisd} E_d P_d^{1-\sigma}, \;\; P_d = \Big[\sum_{j \in \Omega_{isd}} \sum_{i \in \Omega_{sd}} \big(\frac{p_{jisd}}{\lambda_{jisd}} \big)^{1-\sigma} \Big]^{\frac{1}{\sigma-1}}, \;\; \sigma = \frac{1}{1-\rho} \tag{C.2}$$

here E_d is the total expenditure in country d and σ is the elasticity of demand.

Assume that firm j in country s has the marginal cost of producing product i equal to wage cost in country s divided by the productivity $\frac{W_s}{\omega_{jis}}$ and faces the a trade cost τ_{sd} to export goods to country d. Based on the CES demand function and the monopolistic competition market structure, the firm's optimal price in country d is $p_{jisd} = \frac{\sigma}{\sigma-1} \tau_{sd} \frac{W_s}{\omega_{jis}}$ and the sales revenue of firm-product pair-ji in country d are given by:

$$r_{jisd} = (W_s \tau_{sd})^{1-\sigma} E_d P_d^{1-\sigma} \omega_{jis}^{\sigma-1} \lambda_{jisd}^{\sigma-1} \tag{C.3}$$

Consumer taste λ_{jisd} can be decomposed into two parts: a product-country specific part $\tilde{\lambda}_{isd}$ which represents the local consumers' average taste for product i imported from country s, and a firm-product pair -ji specific part $\tilde{\lambda}_{jisd}$ that represents the deviation of taste for firm-product pair-ji from the average taste index. The total imports of product i from country s in country

[41] In this simplified model, we just focus on consumer taste and ignore product quality.

d can then be expressed as follows:

$$\begin{aligned} IM_{isd} &= \sum_{j\in\Omega_{isd}} r_{jisd} = E_d P_d^{1-\sigma}(W_s\tau_{sd})^{1-\sigma} \sum_{j\in\Omega_{isd}} \omega_{jis}^{\sigma-1}\lambda_{jisd}^{\sigma-1} \\ &= E_d P_d^{1-\sigma}(W_s\tau_{sd})^{1-\sigma}\tilde{\lambda}_{isd}^{\sigma-1} \underbrace{\sum_{j\in\Omega_{isd}} \omega_{jis}^{\sigma-1}\tilde{\lambda}_{jisd}^{\sigma-1}}_{\varphi_{isd}} = E_d P_d^{1-\sigma}(W_s\tau_{sd})^{1-\sigma}\tilde{\lambda}_{isd}^{\sigma-1}\varphi_{isd} \end{aligned} \tag{C.4}$$

The total value of imports of good i in country d (IM_{id}) and the import share of product i from country s (z_{isd}) can then be written as:

$$\begin{aligned} IM_{id} &= E_d P_d^{1-\sigma} \overbrace{\sum_s (W_s\tau_{sd})^{1-\sigma}\tilde{\lambda}_{isd}^{\sigma-1}\varphi_{isd}}^{X_d} \\ z_{isd} &= \frac{IM_{isd}}{IM_{id}} = \frac{(W_s\tau_{sd})^{1-\sigma}\tilde{\lambda}_{isd}^{\sigma-1}\varphi_{isd}}{X_d} \end{aligned} \tag{C.5}$$

Based on equation (C.5), the fraction of country d's import of product i from country s over the total imports of product i in country d (z_{isd}) is a function of the average consumer taste of product i imported from country s, $\tilde{\lambda}_{isd}$. We thus show that the fraction of country d's imports of product i from Belgium over the total imports of product i in country d, z_{idt}, can be used as a proxy variable for the taste index of consumers in country d for Belgian product i.

Table C-1: Decomposition of Export Revenue, by (HS4)Products

(HS4)Sector	β_λ	β_δ	β_c	β_M	β_R	no.(observations)
1501	0.27	0.59	0.12	0.09*	-0.08*	18
1507	0.19	0.26	0.20	0.18	0.17	51
1511	0.30	0.48	-0.13	0.36	-0.01*	45
1515	0.17	0.44	0.12	0.14	0.13	249
1516	0.22	0.37	0.06	0.05*	0.30	187
1517	0.29	0.30	0.06	0.18	0.17	1176
1518	-0.03*	0.74	-0.02*	0.003*	0.30	18
1601	0.10	0.33	0.04	0.2	0.33	401
1602	0.19	0.29	0.06	0.09	0.38	2897
1604	0.18	0.25	0.15	0.16	0.27	117
1605	0.08*	0.32	0.44	-0.03*	0.21	22
1701	0.14	0.29	0.08	0.14	0.34	484
1702	0.14	0.32	0.08	0.06	0.41	700
1704	0.10	0.22	0.26	0.08	0.34	3401
1806	0.17	0.20	0.01	0.07	0.55	9350
1901	0.03	0.48	0.05	0.23	0.21	195
1902	0.12	0.34	0.09	0.09	0.35	576
1904	-0.04*	0.38	0.11	0.03	0.32	70
1905	0.12	0.25	0.10	0.09	0.44	1833
2004	0.17	0.26	0.25	0.13	0.29	1746
2005	0.19	0.33	0.14	0.13	0.26	722
2007	0.19	0.20	0.18	0.11	0.30	1340
2008	0.10	0.31	0.05	0.23	0.41	963
2009	0.06	0.42	0.02	0.11	0.40	197
2102	0.24	0.44	0.06	0.23	0.03*	83
2103	0.15	0.33	0.03	0.01*	0.48	761
2104	0.03*	0.37	-0.01*	0.22	0.39	33
2105	0.27	0.29	0.03	0.09	0.31	685
2106	0.09	0.28	0.06	0.11	0.46	2797
2201	0.002*	0.69	0.05	0.49	-0.22	17
2202	0.02	0.63	0.26*	0.21*	-0.13*	16
2203	0.06	0.46	0.05	0.14	0.29	712
2206	-0.006	1.18	-0.01*	0.07*	-0.23	19
2208	0.08	0.19	0.05	0.13	0.56	358

Notes:* Insignificant at 10%.
There are three sectors (1511, 2201, 2206) with significant negative coefficients due to a few number of observations.

Table C-2: (HS4)Product Definition

HS4	Definition
1501	Pig fat (including lard) and poultry fat
1507	Soya-bean oil and its fractions
1511	Palm oil and its fractions
1515	Fixed vegetable fats and oils (including jojoba oil) and their fractions
1516	Animal or vegetable fats and oils and their fractions
1517	Margarine; edible mixtures or preparations of animal or vegetable fats or oils
1518	Animal or vegetable fats, oils, fractions, modified in any way
1601	Sausages and similar products of meat, meat offal or blood
1602	Prepared or preserved meat, meat offal or blood
1604	Prepared or preserved fish; caviar and caviar substitutes prepared from fish eggs
1605	Crustaceans, molluscs and other aquatic invertebrates, prepared or preserved
1701	Cane or beet sugar and chemically pure sucrose, in solid form
1702	Sugars, sugar syrups, artificial honey, caramel
1704	Sugar confectionery (including white chocolate), not containing cocoa
1806	Chocolate and other food preparations containing cocoa
1901	Malt extract; flour/starch/malt extract products, no cocoa (or less than 40% by weight)
1902	Pasta
1904	Prepared foods obtained by swelling or roasting cereals or cereal product
1905	Bread, pastry, cakes, biscuits, other bakers' wares
2004	Vegetables preparations (frozen)
2005	Vegetables preparations(not frozen)
2007	Jams, fruit jellies, marmalade
2008	Fruit, nuts and other edible parts of plants
2009	Fruit juices (including grape must) and vegetable juices
2102	Yeasts (active or inactive); prepared baking powders
2103	Sauces and preparations therefor
2104	Soups and broths and preparations therefor; homogenised composite food preparations
2105	Ice cream and other edible ice; whether or not containing cocoa
2106	Food preparations not elsewhere specified or included
2201	Waters, including natural or artificial mineral waters and aerated waters, not containing added sugar
2202	Waters, including mineral and aerated waters, containing added sugar or sweetening matter, flavoured
2203	Beer made from malt
2206	Fruit, vegetables, nuts, fruit-peel and other parts of plants, preserved by sugar (drained, glace or crystallised)
2208	Ethyl alcohol, undenatured; of an alcoholic strength by volume of less than 80% volume; spirits, liqueurs and other spirituous beverages