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*Bee Yan Aw, Yi Lee, Hylke Vandenbussche*

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# Quantifying Consumer Taste in Trade: Evidence from the Food Industry

## Abstract

This paper develops an empirical model of consumer taste in twenty-nine Belgium food industries for the period from 1998-2005 to generate a “taste distance” measure of over 1,800 firm-product exports to 53 country destinations. We estimate consumer taste using a control function approach and perform a decomposition of export revenues of firm-products to establish the importance of representative consumer taste relative to quality and marginal cost in export success. We find substantial taste heterogeneity in food exports across destination countries. Overall, in the large majority of food exports, consumer taste is an important and separate demand determinant to explain export revenues. Depending on the product, taste for a product explains between 4-30% of export revenues. Thus, any taste shock due to events such as pandemics or climate change, may induce substantial changes in export profitability of firms.

JEL-Codes: F120, F140.

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

*Bee Yan Aw*
*The Pennsylvania State University*
*University Park / PA / USA*
*byr@psu.edu*

*Yi Lee*
*National Tsing Hua University*
*Hsinchu / Taiwan*
*ylee@mx.nthu.edu.tw*

*Hylke Vandenbussche**
*University of Leuven (KU Leuven) / Belgium*
*hylke.vandenbussche@kuleuven.be*

*corresponding author

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# 1 Introduction

Workhorse models in international trade and the price indices that they generate, typically assume demand for a variety to be identical across countries and do not include sources of international consumer heterogeneity. However, exporting a product to foreign countries can be challenging for firms especially when average consumer preferences in destination countries can be very different from those at home. While much progress has been made in recent years on the introduction of quality and firm-appeal as demand shifters,[1] what is missing in the literature thus far is the empirical identification of international taste differences that are clearly separated from other demand and cost shifters. Most existing models with taste effects, have introduced taste shifters at the level of the product and time, but without a country dimension. Recent theory on the efficiency of trade agreements has shown that a failure to recognize that consumers in different countries have different "collective preferences", may undermine the outcome of free trade agreements.[2]

The question we examine in this paper is, how important are international taste differences across countries for the same products and can we measure them at the level of the trade flow in micro-trade data? How does consumer taste differ from quality? How important is the international dimension in taste? Does taste vary mostly by country, by variety or over time?

Our first objective is to quantify the strength of consumer taste for every product and every destination in our data. A common practice in the current empirical trade literature to estimate taste is either to use the entire time-varying demand residual or to use product-country dummies. But the demand residual is typically quite large since it can include other demand and cost shifters. A dummies approach is also not ideal since it potentially confounds taste with other product-destination effects (local market competition, trade costs etc.). Moreover, it implicitly assumes that taste effects are time-invariant, which need not be the case.[3]

Consumer taste in a destination country is an unobservable in the export demand function. Thus, when not properly controlled for, it generates endogeneity issues when estimating the demand coefficients and results in biased estimates. To address the endogeneity problem, we estimate export demand equations using the control function approach in which a polynomial

[1]Crozet, Head and Mayer (2012) for French champaign; Chen and Juvenal (2016) for Argentinian wine; Roberts, Xu, Fan and Zhang (2018) for Chinese footwear; Hallak (2006), Khandelwal (2010); Hottman, Redding and Weinstein (2016), Kugler and Verhoogen (2011), Foster, Haltiwanger and Syverson (2016); Fan, Li and Yeaple (2018); Manova and Zhang (2012); Baldwin and Harrigan (2011).

[2]In Grossman, McCalman and Staiger's (2021) theory, consumers valuation for the same brand can differ across countries.

[3]De Sousa, Mayer and Sihra (2019) recently show that taste can change and converge over time with market integration.

function is defined over observables that proxy for the unobservable, taste.[4] This approach allows us to tease out the part of the demand residual in the export demand functions, that most likely corresponds with consumer taste. A control function is defined over at least two exogenous variables and is sufficiently flexible to capture non-linearities of the effect.

One of the exogenous variables in the control function comes from a new dataset containing ingredients of national food dishes by country. Countries that share similar food ingredients in their national dishes, are presumably more likely to have a similar taste in food products. For instance, the national dish of both Belgium and Ireland is a stew dish made with beef, beer and potatoes. Because of the overlap in ingredients, the taste distance between these two countries is likely to be small. This international comparison of food ingredients in national dishes generates a "taste distance" measure for all countries in our data.[5] This approach was inspired, amongst others, by the work of Dubois, Griffith and Nevo (2014) who also use detailed nutritional characteristics of foods to highlight the importance of international taste differences for consumption but for a very different research question than the one we examine here.[6] The second observable variable that we insert in the control function for taste is the global import share of the destination country. We show from theory that local taste for a Belgian product in a destination (a consumer preference parameter) is correlated with the observed global import shares (see Appendix A for this purpose).

Table 1 gives an example of taste indices using our approach for two countries (China and Japan) and two products (chocolate and beer). Horizontal comparisons of the taste indexes in the table yields cross-country "taste distance" for a given product. Vertical comparisons of the taste index allows us to make cross-product comparisons within each country. In our hypothetical example in Table 1, consumer taste in both China and Japan for beer is stronger than for chocolate. This quantification of consumer taste allows us to obtain a taste ranking and distance in both product space and geographical space.

To arrive at our consumer taste index for every trade flow, we estimate demand functions using annual quantities and prices of 1,802 firm-product exports of Belgian firms in twenty-nine different food industries exported to 53 destinations for the period 1998-2005. For this purpose we use Belgian firm level exports at the very disaggregate product level (HS8) to worldwide destinations. While we cannot reveal the name of these firms nor what they sell abroad and

[4]This approach is often used in the economics of education and other social sciences where latent variables often plague research designs. The use of a control function is one way to resolve the endogeneity problems.

[5]This measure is similar in spirit to Hofstede's (1980) "cultural distance" measured at the country-level which has often been used in the marketing literature.

[6]What people eat in their national dishes and their ingredients, is a strong indicator of taste overlap (Abbott Nutrition,"Ten Surprising Things that Affect Your Taste," August, 2017).

how much, we can use that wealth of information for research purposes. It is important to note that we do not have information on individual consumers in a country. Our data contains firm shipments of products to a country overall. Thus, every country in our data is a "representative" consumer as is common in most trade models. In contrast to the taste measure developed in Aw et al. (2018) where we relied heavily on functional forms derived from a structural model of export demand, the approach in this paper is more generic. We focus on empirically estimating fairly general export demand equation that corresponds with different families of models in international trade.

A closer examination of our taste measure reveals several important features. In looking at the variation in the taste index itself, we find that most of the variation in the taste index at firm-product level is across products within a country (56%) followed by cross-country variation (35%). We find the time variation of taste to be relatively small compared to the product or country variation.[7] The relatively large cross-country variation in the taste index suggests that differences in collective consumer preferences exist and are important in trade. In addition, we find that the correlation of our taste measure with product quality is low indicating that the two demand shifters are picking up different sources of demand heterogeneity. While product quality remains pretty stable, we find consumer taste for the same product to vary substantially across countries. We also find that the taste measure has a low correlation with marginal cost, suggesting that we have identified a source of variation in the data which does not overlap the cost dimension.

Both our data and our empirical methodology allow us to complement the existing literature in three different ways. First, most of the empirical work on demand shifters in trade is either done at the level of the firm, or for very specific products like wine, champagne or chocolates where additional product characteristics are present in the data.[8] While a firm-level demand shifter is a good starting point to explore the importance of demand heterogeneity across firms, it side-steps the product dimension within firms. Exporters tend to be multi-product firms and demand effects can vary substantially from one product to another and from one destination to another.[9] In this paper, we aim to contribute to the literature by using demand shifters at the level of firm-products and by country of destination.

Second, existing work typically defines only one demand shifter labelled "firm-appeal". A single firm demand shifter side-steps the fact that quality and taste are two very different dimen-

[7] Atkin (2013) shows that habits from childhood result in persistent taste preferences during adulthood.

[8] Crozet et al. (2012), Chen and Juvenal (2016) and Jäkel (2019).

[9] Bernard, Redding and Schott (2011), Eckel and Neary (2010), Mayer, Melita and Ottaviano (2014), Bernard, Blanchard, Van Beveren and Vandenbussche (2019).

sions of demand that differ in ways that reflect differences in consumer income, cultural factors and consumer preferences resulting in differences in revenue productivity and profitability in the export market. The existence and magnitude of the different demand shifters is an empirical issue. Our objective therefore is to better distinguish and identify these two forms of demand shifters at the level of the firm-product.

Finally, existing methods in industrial economics on consumer heterogeneity such as random coefficient models - including discrete choice and nested logit - allow for heterogeneity in taste for specific product characteristics and have been applied in many settings, including automobiles, computers, radio station formats, cameras.[10] But the use of these models, and others - those using scanner data - usually requires detailed information on specific product characteristics typically not available in data on traded goods. While trade data typically does not contain details on product characteristics, its key advantage is that we can quantify the cross country heterogeneity of consumer preferences with a representative consumer of a country.

Our findings suggest that consumer taste is a key determinant of export performance. Depending on the product that is exported, consumer taste explains between 4-30% of the variation in export performance, and is about equally important to marginal cost.

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. Section 7 contains the summary and conclusion.

# 2 Empirical Methodology

## 2.1 A Control Function Approach

Following Heckman and Navarro (2004) and Heckman and Pinto (2022), we use a control function approach to proxy for the unobservable, consumer taste. In this section we give a general discussion of this approach and the core issues involved.

Consider the demand equation below, where we suppress subscripts for convenience,

$$Q = q[P, A, \epsilon] \tag{1}$$

[10] As in Berry, Levinsohn and Pakes (1995).

where $Q$ is observed output, $P$ is observed price and $A$ is an unobserved demand shifter such as consumer taste or other demand effects that jointly affects $P$ and $Q$ and $\epsilon$ is the remaining residual. The unobservable $A$ is a source of endogeneity. While $A$ cannot directly be observed, if it can be measured (potentially with error $\varepsilon_N$) by a function $f$ defined over $N$, an observed vector of variables, than $A$ can be teased out of the residual where it would otherwise end up. Formally, we write:

$$A = f(N, \varepsilon_N) \tag{2}$$

The functional form of $f(N, \varepsilon_N)$ is not known, and needs to be approximated by a non-parametric polynomial over the exogenous variables included in vector $N$ (control function).

Substituting equation (2) into equation (1) thus yields:

$$Q = q[P, f(N, \varepsilon_N), \epsilon] \tag{3}$$

$P$ needs to be instrumented given measurement error ($\varepsilon_N$) and the presence of other cost or demand shifters, such as transport costs, still present in $\epsilon$. This implies that the following equations hold.

$$E[\hat{P}, \varepsilon_N + \epsilon] = 0, \quad \text{and} \quad E[f(N, \varepsilon_N), \epsilon] = 0 \tag{4}$$

In the remainder of this paper, we estimate export demand equations from customs data at firm-product level where we observe export sales to a destination ($Q$), the f.o.b. export price of the trade flow ($P$) and distance, but we do not observe consumer taste in the destination nor the quality of a product. In the literature on demand shifters, consumer taste is referred to in as a horizontal demand shifter, while product quality is referred to as a vertical shifter of demand, suggesting that they affect sales in a different way (Di Comité et al. (2014)).

## 2.2 Identification Issues

Our empirical identification thus consists in specifying separate control functions for both consumer taste and quality over vectors of exogenous observables (section 2.3 and 2.4) and instrumenting for price (section 3). This approach then gives us taste and quality measures without biasing the price coefficient. The use of control functions allows us to tease out the unobservable demand shifters from the residual where they would otherwise end up, and to study their effect on trade flows.

Consider the following export demand equation where consumers in country $d$ have the following general demand function $q_{jidt}$ for product $i$ exported by firm $j$ in year $t$:

$$Q_{jidt} = q_{jidt}[P_{jidt}, Distance_d, \lambda(X')_{jidt}, \delta(Y')_{jidt}, \gamma_{it}, \epsilon_{jidt}] \tag{5}$$

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. $P_{jidt}$ is the price (f.o.b.) of product $i$ provided by firm $j$ exclusive of transport cost and distribution cost and Distance$_d$ varies by destination. Firm-level demand in a destination can thus vary due to the export price, the quality offered and the local taste. $\gamma_{it}$ represents a set of product-year fixed effects which controls for product market specific competition effects. We verify the results with an alternative specification where we drop Distance$_d$ and include product-country-year FE ($\gamma_{idt}$) controlling for destination market specific product characteristics including distance. Finally $\epsilon_{jidt}$ is the residual term. This residual ($\epsilon_{jidt}$) may still contain unobserved 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. To address this endogeneity problem, we need to instrument for firm-product prices (more details in section 3).

## 2.3 How Consumer Taste is Measured

To control for the unobservable consumer taste in equation (5), 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:

$$ln\lambda(X')_{jidt} = ln\lambda[WND_{jdt}, z_{idt}] \tag{6}$$

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 ($IM_{iBdt}$) over its total global imports of product $i$. That is,

$$z_{idt} = \frac{IM_{iBdt}}{\sum_{v \in W} IM_{idvt}}, \tag{7}$$

where $IM_{idvt}$ 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.

$WND_{jdt}$ is the weighted similarity index of national dishes (ND), which combines our customs data with a newly created data set that measures 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.[11] For our purposes, we only require the national dish overlap between Belgium and its trade partners. The details on how the index is constructed are reported in Appendix C. The similarity index of national dishes ($ND$) is destination ($d$) specific but is weighted by $s_{jdt}$, defined as the ratio of each firm $j$'s sales exported to country $d$ to firm $j$'s global exports in year $t$. Note that this weight is defined at the firm-level ($s_{jdt}$) to avoid potential endogeneity with the dependent variable which is defined at the firm-product destination level $q_{jidt}$. The use of the weight in the control function is necessary to ensure that we measure taste ($\lambda_{ijdt}$) 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.

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 global imports of product $i$ (see equation (7)). It is important to note that while $z_{idt}$ is clearly exogenous in the demand equation, these global import shares may not just reflect taste in the destination country but also quality and even distance. Therefore to further refine our $z$ variable, we regress $z$ on GDP per capita of the destination($d$) and country of origin($o$), Distance between countries of origin and destination as well as a rich set of fixed effects such as destination FE ($D_d$) and source country FE ($D_o$), product FE ($D_i$) and year FE ($D_t$):

$$z_{iodt} = \alpha_1 + \alpha_2 lnDistance_{od} + \alpha_3 lnGDPc_{ot} + \alpha_4 lnGDPc_{dt} + D_o + D_d + D_i + D_t + \varepsilon_{iodt} \tag{8}$$

[11] 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.

By including destination FE, we also take out the distance effect that is potentially present in $z$. We call the residual of this equation $\hat{z}$ and use it to obtain the final import shares in each destination $d$, for products originating from Belgium. That is,

$$\hat{z}_{idt} = \varepsilon_{iBdt}$$

where $\hat{z}_{idt}$ is defined as the share of destination $d$'s imports of product $i$ from Belgium in the country's total imports of product $i$, purged from quality and distance effects.[12] We replace $z_{idt}$ with $\hat{z}_{idt}$ in equation (6) and use it as the second proxy variable in the control function for taste. The choice of $\hat{z}_{idt}$ can be rationalized from theoretical models such as those in Bernard et al. (2011) and Aw et al. (2018). In Appendix A, we provide a simplified CES demand model to show the relationship between the import share in destination $d$ and consumer taste. The fact that we use a CES specification for this purpose does not make our approach functional form dependent. It just shows that in a traditional trade model with broadly used demand preferences, the parameter on consumer taste for a product in a destination ($\lambda$), which is inherently unobservable, is positively correlated with the total import share of that product (observable $z$). While not shown here for brevity, this positive correlation is bound to hold in any type of model and suggests that $\hat{z}$ is a good variable to be included in the control function for taste.

A potential concern may be that exports can be highly concentrated in a small number of firms (see, e.g. Freund and Pierola (2015)). However, since the denominator of variable $z$ is the total world imports of product $i$ into a given destination $d$, the correlation of $z$ with any specific Belgian firm's export is likely to be negligible.

The control function for consumer taste $\lambda(X')_{jidt}$ will then be proxied by a polynomial in these two variables and is included in our demand function estimation together with product-destination-dummies $\gamma_{idt}$ to account for any other remaining factors affecting the product market.[13]

## 2.4 How Quality is Measured

Product quality is an another demand shifter that is unobservable in our data. We follow the literature to account for product quality in the demand estimation 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 et al.

[12] In the data, $\hat{z}_{idt}$ is estimated at the (HS6)product-country level.

[13] We use a polynomial of order two but a higher order polynomial of degree three does not affect results qualitatively.

(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 ($f_{jidt}$):

$$ln\delta(Y')_{jidt} = ln\delta[PIMP_{jt}, WGDP_{jit}, LGDP_{jidt}, f_{jidt}] \quad (9)$$

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 et al. (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.[14] 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 the weighted sum of GDP per capita across all countries($WGDP_{jit}$) that a firm-product pair is exported to.[15] Including $WGDP_{jit}$ in $\delta(Y')$ is based on 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 ($LGDP_{jidt}$) given that firms can vary their quality by destination and may offer higher quality to countries with higher local GDP per capita.[16]

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.[17]

[14]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 of good $z$ imported from country $o$ and $IMP_{jzot}$ is the import price of good $z$ coming from country $o$.

[15]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 $ji$.

[16]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 $d$.

[17]Again, we use a polynomial of order two and using higher order polynomials did not alter results much.

# 3 Demand and Cost Estimation

## 3.1 Demand Estimation

We estimate the demand function specified in equation (5) in a general form so that it corresponds with different families of trade models (log-linear and linear).[18] As such, our demand equation is estimated as:

$$\ln Q_{jidt} = \gamma_{idt} - \sigma_{id} \ln P_{jidt} + \ln\lambda(X^{'})_{jidt} + \ln\delta(Y^{'})_{jidt} + \epsilon_{jidt} \tag{10}$$

where $Q_{jidt}$ is the quantity of exports of product $i$ sold by firm $j$ to country $d$ in year $t$. $P_{jidt}$ is the f.o.b. price, $\ln\lambda(.)$ is consumer taste, $\ln\delta(.)$ is quality which all enter the demand function at the same level of disaggregation. The price elasticities of demand $\sigma_{id}$, vary across destination countries and product markets and $\gamma_{idt}$ represents a set of product-country-year fixed effects accounting for distance and pro-competitive effects in the destination market. $\epsilon_{jidt}$ accounts for any remaining unobserved demand shock correlated with price as well as a white noise. To ensure that the corr$(lnP_{jidt}, \epsilon_{jidt}) = 0$, we use the average export prices in other destinations $k$ (ln $P_{ji-dt}$) as the instrument for price (Hausman (1996)). Thus, in defining our instrument we take an average price for the same firm-product but exclude neighboring countries of the destination $d$. This is to ensure that $E(P_{jikt}\tau_{jidt}) = 0$.[19] It is well-known that the validity of the Hausman price instrument, depends on the absence of global shocks and pass-through in product prices. To verify this we engage in several diagnostic tests that confirm the use of the instrument. More details on this are provided in Appendix B.

Our instrument for price is the following:

$$lnPIV_{jidt} = \frac{1}{N_{jit}} \sum_{k \in S_{jit}, k \neq d} lnP_{jikt}, \tag{11}$$

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 except for country $d$ for the firm-product $ji$.

By using 2SLS, the estimation of the demand function in equation (10) 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 $ln\hat{\delta}_{jidt}$.

[18] CES trade models and quadratic utility models as in Melitz-Ottaviano (2008).

[19] 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.

The empirical counterparts to the control functions for taste and quality represented in equations (6) and (9) are constructed at the firm-product-country level quality index ($ln\delta_{jidt}$) and taste index ($ln\lambda_{jidt}$) as follows:

$$ln\hat{\lambda}_{jidt} = \sum_{l} \hat{\beta}_l X^l_{jidt} + \sum_{l}\sum_{m} \hat{\beta}_{lm}(X^l_{jidt} X^m_{jidt}) \tag{12}$$

where $l$ and $m$ include all variables in the control function of taste in Eq. (6) 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 equation (9).

## 3.2 Backing out Marginal Cost

We can now retrieve the demand parameters from estimating equation (10). In particular, we obtain the elasticity of demand ($\sigma$) 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.

$$P_{jidt}[1 - (1/\sigma_{id})] = MC_{jidt} \tag{13}$$

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. Product-destination-year ($idt$) specific transport and distribution costs are accounted for by the inclusion of $\gamma_{idt}$ in estimating equation (5). However, the firm-specific parts of transport and distribution costs are unobservables and still present in the residual of equation (5). Our instrumentation strategy and Hausman instrument on price, ensures that their presence in the residual does not contaminate the estimated coefficient on price, which is what matters for unbiased estimates of the demand elasticity. Since we back our cost from destination level prices using the demand elasticities' estimates, our estimates for marginal cost thus vary at the firm-product-destination level.

# 4 Data Description

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 flows.[20] 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).[21] 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

[20]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.

[21]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, Bernard and Vandenbussche (2012).

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 (ND) index obtained via LSA takes values lying between 1 (recipes are identical) and -1 (recipes are entirely different). More details on the methodology can be found in Appendix C.

In Table 2 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 ($\lambda_{jidt}$), the quality index ($\delta_{jidt}$) and the marginal cost index ($c_{jidt}$) which are all estimated at the same level of aggregation.

Table 3 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.[22]

Table 4 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.

This national dish (ND) index will be used as one of the proxy variables for consumer taste in food in the destination country. Ultimately we are interested to what extent the distance in consumer taste differs around the world and can explain exports in Belgian food products. Together with other proxy variables in the control function for consumer taste, the national dish index results in a taste index ($\lambda$) for every traded food product (see section 5.2).

# 5 Results on Parameters Estimates

From equations (10) and (13) we obtain demand parameters ($\hat{\sigma}$, $\hat{\lambda}$, $\hat{\delta}$) and cost parameters MC, respectively. Once we have these estimates in hand, the ultimate purpose is then to engage

[22]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.

in a decomposition of export revenues, in order to determine the relative importance of each of the estimated parameters in explaining export revenues (section 6.2).

## 5.1 Elasticity of Demand

A first parameter of interest obtained from the demand specification in equation (10), is the elasticity of demand ($\sigma_{id}$). Figure 1 shows the distribution of the elasticities of demand that we obtain from our data. For demand elasticities greater than one, the average estimate obtained for $\sigma$ is 2.3, with the large majority of observations lying below a value of 4, and with relatively few estimates with a value higher than 4.[23]

These are reasonable estimates and in line with what others report in the literature. Note that the demand elasticities that we report here are obtained from a demand estimation that includes both demand shifters for both consumer taste and product quality, as shown in equation (10). These demand shifters are absorbing some variation in sales (which we will discuss below) that otherwise would be attributed to the demand elasticity. Without the inclusion of these additional demand shifters, an endogeneity bias is therefore likely to occur which would result in an upward bias on the demand elasticity estimates.

The estimated sigma's ($\hat{\sigma}$) from (10) together with the prices observed in the data ($P_{jidt}$), then allow us to back out the marginal cost as documented in equation (13), resulting in the cost index $\hat{MC}_{jidt}$ for every firm-product-country trade flow.

## 5.2 Taste Index Function

The next parameter of interest that we obtain from the demand specification in equation (10), is the taste index. Recall that in order to obtain estimates for $\hat{\lambda}$, we first need to estimate a polynomial function defined over two variables inserted into the demand equation: $\ln\hat{\lambda}_{jidt} = ln\lambda(WND_{jdt},\ \hat{z}_{idt})$. The results in Tables 6 and 7 come from the estimation of equation (10), but for expositional purposes in Table 6 we only report the coefficients on the taste variables and distance and suppress the coefficients on the quality variables which we focus on in Section 5.3.

In Table 6 we report the coefficients on the building block variables in the polynomial for taste in six different specifications. In columns (1) and (2) we report results on the importance of the national dish (ND) index and modified global import shares, $\hat{z}_{idt}$ and column (3) yields results for a second order polynomial over these variables with squares and interaction terms.

[23]In a small number of cases, the number of firms exporting the same product to the same destination in the same year, was insufficient to obtain reliable estimates on $\sigma$, which resulted in values below one which could not be used for further analysis.

Columns (4) and (5) repeats the same exercise using weighted national dish Index, $WND_{jdt}$ ($s_{jdt} \times ND_d$) in the polynomial with the firm-level weight, $s_{jdt}$. Specifications (1)-(5) include $Distance$ and product-year FE($\gamma_{it}$) while in specification (6) we drop distance and $\gamma_{it}$ and use product-country-year FE ($\gamma_{idt}$) instead.

Results on the control function suggest that both the ND index and the global market share are important in explaining the variations in firm-product level export sales across countries and thus are good proxy variables for consumer taste. In columns (1)-(3), we use the unweighted ND index, while columns (4) to (6) are based on the weighted national dish index. The results are robust to whether weights are used. In fact the taste indices arising from the two sets of specifications are highly correlated (0.96). Our taste index ($\ln\hat{\lambda}_{jidt}$) will come from column (6) since it includes the broadest set of product-destination-year FE which controls for local competition effects as well as distance effects.

## 5.3 Quality Index Function

The next parameter of interest from the demand specification in equation (10), is the quality index. In Table 7 we report the coefficients on only the quality variables. The first column of Table 7 reports coefficients on the quality variables as suggested in the literature as good proxies for quality. The results indicate that the Weighted GDP (WGDP), Local GDP (WLGDP), Import Prices (PIMP) and Market Share ($f_{jidt}$) are all significant variables in the demand equation. In column (2) of Table 7, we show the coefficients of a polynomial of order two in these variables, thus allowing for non linearities in the approximation of the unobservable quality and also include product-country-year dummies. In the last column of Table 7, we then check the robustness with respect to firm market share and we find the results not to be sensitive to its inclusion. The correlation of the quality index in columns (2) and (3) is 0.95. Our final quality index ($\ln\hat{\delta}_{jidt}$) estimates come from column (2), the specification with the broadest set of FE which controls for the distance to the destination market as well as a broader set of product-market characteristics specific to the destination such as market structure, local competition and other unobservables.

## 5.4 Taste versus Quality and Cost Indices

From equations (10) and (13) we obtain estimates of consumer taste, quality and cost at the level of the trade flow. This allows us to study the correlations of the two demand and cost indices and investigate their variance in the data.

The correlation matrix is shown in Table 8. All correlations appear to be low. In particular, consumer taste has a low correlation with product quality, confirming that these two demand shifters are picking up different sources of demand heterogeneity in the data.

The negative correlation between quality and marginal cost appears puzzling. However, to interpret this correctly, recall that our measure of marginal cost captures both productivity and the cost of producing quality, a relationship that we cannot disentangle. One way to address this issue is to perform a simple OLS regression of our measure of cost ($lnc_{jidt}$), on the quantity shipped ($lnQ_{jidt}$) and the quality ($ln\delta_{jidt}$). The coefficients in the regression are all statistically significant. The negative coefficient on quantity of -0.12 implies that low-cost (high-productivity) firms are likely to have larger shipments to the destination country. The positive coefficient on quality of 0.08, suggests that for a given level of output, higher quality goods in our data correlate positively with marginal cost, confirming what others have reported (Baldwin and Harrigan (2011)).

Next, we study the variance of each index to see which dimension the firm ($j$), the product ($i$) or the country ($d$) is most responsible for the variation in the observed data. Results for the consumer taste index are given in column (1) of Table 9. Taste varies mostly across products (within a country) accounting for 56% of the variation in the data. The country dimension of taste accounts for 35% (for the same product) and the firm dimension only represents 9% of the variation in the taste index.[24] This implies, for example, that when consumers abroad prefer purchasing Belgian chocolates over chocolates coming from other countries, they seem to care less about which firm-level Belgian brand of chocolates to buy.

Column (2) of Table 9 shows the results of the variance decomposition of quality index. These figures indicate that the main source of variation in the index comes from the firm and product-level dimensions explaining, respectively, 63% and 35% of the variance of the quality index. The country-dimension explains only 2% of the quality index variance. For the quality index, the firm dimension therefore seems very important and suggests that quality mainly varies by firm (brand) and much less by product or country. The extent to which firms vary the quality of their exports by export destination seems limited as the country variation appears to be small. Thus, the quality of Belgian chocolates varies much more across Belgian firms producing chocolates than the destination country of Belgian chocolate exports.

Results for the marginal cost index variance are shown in the last column of Table 9. We find that most of the variation in costs come from the firm dimension which explains around 55% and the product dimension explains around 38%. In contrast, the country-dimension accounts for about 7% of variation. Marginal cost thus seems to be primarily driven by the firm-product dimension and far less by the country where the product is shipped to. Variation of costs at

[24]The time variation is not included in Table 9 but is relatively small for all three parameters (around 1%). This does not mean that parameters do not move over time, but the variance coming from other dimensions is greater.

firm-product level is likely to reflect technology and in that sense, it is quite intuitive that this dimension explains most of the variation in cost. Thus, the cost of a bottle of beer varies across firms, largely reflecting firms' use of different technology but is otherwise the same regardless of where the bottle is shipped to.

# 6 The Importance of Consumer Taste

## 6.1 Consumer Taste and Latitude

A legitimate question to ask is whether our National Dish (ND) index 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 ND index 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 2.[25] We note that there is not much of a relationship with a correlation as low as -0.2. This low correlation suggests that our ND index is not likely to be picking up climate. National dish overlap between countries 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 be very different. 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 ND index is not that different (0.5). Figure 2 therefore offers convincing evidence to suggest that consumer taste does not seem to be driven much by latitude.

## 6.2 The Decomposition of Export Revenues

In this section, we decompose export revenues into their demand and cost indices that we derived above to assess their relative importance for export performance. Based on the estimated demand function (Eq. (5)) and the firm's optimal price (Eq. (13)), firm $j$'s export revenue of

[25] 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).

product $i$ in country $d$ can be decomposed as follow:

$$\begin{aligned} lnr_{jidt} &= lnP_{jidt} + lnQ_{jidt} \\ &= \gamma_{idt} + (1-\sigma_{id})lnP_{jidt} + ln\widehat{\lambda}_{jidt} + ln\widehat{\delta}_{jidt} + \epsilon_{jidt} \\ &= \underbrace{\gamma_{idt} + (1-\sigma_{id})ln(\frac{\sigma_{id}}{\sigma_{id}-1})}_{M_{idt}} + (1-\sigma_{id})lnc_{jidt} + ln\widehat{\lambda}_{jidt} + ln\widehat{\delta}_{jidt} + \epsilon_{jidt} \end{aligned} \tag{14}$$

Equation (14) decomposes firm-product-destination-year sales into marginal cost of production ($lnc_{jidt}$), firm-product-destination quality ($ln\hat{\delta}_{jidt}$), firm-product-destination consumer taste ($ln\hat{\lambda}_{jidt}$), and a Market Effect ($M_{idt}$) which captures all other components such as market size and competition, markups and distance effects and finally a residual ($\epsilon_{jidt}$).

Following Hottman et al. (2016), we regress each component on the right-hand side of equation (14) on $lnr_{jidt}$ to get its individual contribution to total export revenues. This is given in Equations (15a) to (15e).

$$M_{idt} = \beta_M lnr_{jidt} + \varepsilon^M_{jidt} \tag{15a}$$

$$ln\hat{\lambda}_{jidt} = \beta_\lambda lnr_{jidt} + \varepsilon^\lambda_{jidt} \tag{15b}$$

$$ln\hat{\delta}_{jidt} = \beta_\delta lnr_{jidt} + \varepsilon^\delta_{jidt} \tag{15c}$$

$$(1-\sigma_{id})lnc_{jidt} = \beta_c lnr_{jidt} + \varepsilon^c_{jidt} \tag{15d}$$

$$\epsilon_{jidt} = \beta_R lnr_{jidt} + \varepsilon^R_{jidt} \tag{15e}$$

Each of the $\beta$ coefficients in Equations (15a) to (15e) can now be interpreted as the "percentage variation of the revenue explained by the indicator". The $\beta$ coefficients thus give us an indication of the relative importance of destination specific taste, versus quality and cost as well as other factors affecting firm level export revenues.

### 6.2.1 Decomposition of Actual Export Revenues

Empirical findings of the decomposition of actual export revenues are reported in Table 10. In columns (2) and (3) of Table 10 we use two alternative measure of consumer taste based on the control function approach. The first taste index is the unweighted national dish indicator and the second taste index is the weighted national dish indictor where the weight $s_{jdt}$ is defined as the ratio of the firm-sales to destination $d$, relative to the global sales of the same firm $j$. Both specifications are based on a polynomial of order two. Our results on the importance of taste in explaining export revenues are not sensitive to whether we use the unweighted or weighted taste index as our measure of consumer taste. In both cases, the taste index is significant and explains about 15% of the variation in export revenue. As a baseline, we report the results where the entire residual is treated as a measure of consumer taste, a common practice in the literature. This amounts to using $\beta_R$ as a proxy for taste instead of using $\beta_\lambda$, our taste indices shown in Column (1). Unsurprisingly, since the residual is picking up other demand and cost shifters in addition to taste, $\beta_R$ explains 36% of the actual variation in export revenue, an unrealistically high number.

Turning to the other indices in our decomposition, the results on quality and marginal cost are quite stable in columns (1) to (3). Quality explains about 26% of export revenues and marginal cost explains between 17% to 20%. Thus, marginal cost explains about as much of export revenue variation than taste.

In the last two columns of Table 10, we check for sensitivity of the results. First, the use of firm market share ($f_{jidt}$) to proxy for the quality index could raise a potential endogeneity concern. We thus remove this variable when estimating the quality index. The decomposition results, reported in column (4), are not sensitive to this change.[26] Secondly, we address the potential endogeneity of using firm-destination level, $s_{idt}$ (where $i$ is defined at the CN8 level) as the weight in the national dish indicator to proxy for the taste index. We construct an alternative taste index where we now define the weight at the product-destination level rather than the firm destination level.[27] Results are shown in column (5) and indicate little change. The taste index is again significant and now explains about 13% while leaving the other variables in the decomposition relatively unchanged.[28]

In sum, the results in Table 10 show that consumer taste is important in explaining export revenues in the food industry in every specification and its magnitude is similar in magnitude to that of marginal cost.

Other variables in the decomposition are mainly used as controls for distance, market size, markups or income effects in the regressions. The Market Effect term ($M_{idt}$) in the decomposition comprises of product-destination dummies that control for many effects including that of distance, destination market competition and markups corresponding to the elasticity of demand as shown in equation (14). In Table 10 we show that this Market Effect ($M_{idt}$) accounts for about 3-20% of the variation in firm-product-country export revenues depending on the specification and the set of fixed effects included.

[26]When we drop Market share ($f_{jidt}$) from the polynomial on quality variables, the quality index in the decomposition only drops by 2%.

[27]This does not mean that $\gamma_{idt}$ drops from the demand equation since $\gamma$ is at the HS4 level of aggregation.

[28]In Aw et al. (2018), consumer taste was proxied by product-country dummies and picked up more of the variation in the decomposition.

The coefficient on the residual component is about 33%.[29] This residual includes many 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.

In Appendix Table C-2 we show decomposition results for each of the twenty-nine HS4 product category. For each HS4 food product group we run a decomposition similar to the one in specification (3) in Table 10 which corresponds with a quality and taste index coming from column (6) of Table 6 and column (2) of Table 7. For every industry where we have a sufficient number of observations to perform the decomposition, the results generates sensible coefficients.[30] Table C-2 shows that the importance of the consumer taste index varies significantly depending on the product category and ranges between 4-30%. In some industries consumer taste appears to be much more important than what the average coefficient in Table 10 suggests. For example in the product group Belgian Ice cream (2105), consumer taste explains 24% of the export revenues, compared to 30% and 3% attributed to quality and marginal costs, respectively. Another example is the product group Margarines (1517) where taste explains about 31% 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) findings 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.

### 6.2.2 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 10, we can calculate the relative importance of taste on the predicted export revenues, disregarding the residual variation (1-33% = 67%). Decomposition results on consumer taste now accounts for 22% (15%/67%) of the export success, while 22% (15%/67%) is explained by marginal cost. Taste and quality

[29] 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.

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

together explain the bulk of the predicted revenues e.g. 61% ((15% + 26%)/67%).

## 6.3 Robustness Checks

### 6.3.1 Balanced Panel Results

Thus far, we have used all observations in our data set. Since not every product is exported to every destination, the composition of Belgian export products differs across destination countries. Is it possible that selection effects are at work in driving the resulting composition?

To verify whether results are affected by selection effects, we perform a decomposition of export revenues on a balanced panel where we only include in our regressions every firm-product that is present in every destination. Results are shown in Table 11. The coefficients on the decomposition do not change much and results for the balanced panel are similar to the ones in Table 10 even though the number of observations drops substantially. When the taste index is obtained with a control function approach (cols. (2)-(5)), taste continues to feature as an important determinant (13-17%) in the decomposition of export revenues.

### 6.3.2 Age of the Firm

We next examine whether our results on consumer taste are picking up 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). The coefficient on log(age) indicates 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 3 which clearly shows the strong correlation between the two measures.

# 7 Summary and Conclusion

This paper is a first attempt to estimate consumer taste heterogeneity across destinations using micro-level trade data from Belgium. In contrast to the industrial organization literature where often detailed data on product characteristics exist on narrowly defined products, this is not always the case in trade. Trade data typically hold a large number of observations, but involve very different types of products but without much details. The purpose here was to estimate consumer taste for a wide range of exported products and without any knowledge on the product characteristics involved. For this, we adopt an approach where we proxy consumer taste for Belgian products through a polynomial function defined over observables that proxy for the unobservable consumer taste.

The new evidence that we collect through the use of our taste index has the potential to generate a wealth of new insights. For example, our evidence documents the existence of substantial heterogeneity in taste for the same firm-product across countries and across firms within a destination. With our consumer taste measure in hand we show that taste is a separate demand shifter, not identified before and an important determinant to explain export performance of firms.

This paper provides evidence of consumer heterogeneity across countries which suggests that consumer preferences around the world differ. The existence of "collective preferences" can have major implications for the construction of Free Trade agreements. For example, Grossman et al. (2021) recently argues that heterogeneous taste across countries can result in regulatory dissonance and facilitate protection as it can give rise to diverging product standards across countries which undermines the efficiency of trade agreements. While a lot more research on international taste differences is required, the evidence that we present, confirms the existence of local tastes.

Another area where our findings may generate new insights and be important is the construction of better price indices and ensuing welfare effects of trade. New trade agreements typically result in trade with new trade partners and can involve trade in varieties that have a different taste than the existing varieties. Not accounting for these taste differences may bias price indices and the measured welfare effects of trade agreements. Therefore in addition to the well-known quality bias, international price indices may also suffer from a taste bias.

Another clear area where taste differences may matter a lot is the export entry models. Thus far, the role of productivity is already well-understood and how it affects export entry into new destinations, but the role of demand drivers such as local taste is still unexplored. When a firm decides on the next destination to export its product to, it would be interesting to see to what extent local taste plays a role in that decision, not just on the entry side but also on the exit side. Can the strength of local consumer taste be a mitigating factor to overcome low productivity and high production costs? Can consumer taste have an impact on firm survival in an export market? All these questions offer interesting avenues for future research and can generate additional insights into the drivers of export entry.

And finally, our findings can also be very relevant for analyzing taste shocks induced by pandemics, climate change or other shocks that potentially alter collective preferences for specific products. The panel data that we use in this paper have a relatively short time span and the time variation in consumer taste that we find was small. However, it is clear that in datasets with longer time fluctuations, especially with the occurrence of large shocks due to trade policy or other, taste shifts can be identified with the method we used here. For instance, it is expected that the global pandemic may result in preferences shifting in favour of domestically produced products and away from imported varieties which is an interesting avenue for future research.

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Table 1: A Hypothetical Example of taste Distance

| Quantification of local taste | Consumer Taste Index in year t | | |
|---|---|---|---|
| | in China | in Japan | Taste Distance across Countries |
| Export of Belgian chocolates | 3 | 5 | 2 |
| Export of Belgian beer brand | 12 | 9 | 3 |
| Taste Distance across Products | 9 | 4 | |

Table 2: Level of Estimated Parameters

| Parameters | Variables | Level of Analysis |
|---|---|---|
| $\sigma_{idt}$ | Demand Elasticities | (HS4)Product-Country |
| $\lambda_{jidt}$ | Taste Index | Firm-(CN8)Product-Country-Year |
| $\delta_{jidt}$ | 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 ($\sigma$) at the (HS6)product-country level. However, estimating $\sigma$ at the (HS6)product-country level results in a large number of inelastic demand estimates ($\sigma < 1$) probably due to a small number of observations within a (HS6)product-country market. Therefore, we estimate the demand elasticity at the (HS4)product-country level.

Table 3: 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 4: 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: 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 5: Average Demand Elasticities by (HS2)Sectors

| HS2 Industries | Mean($\sigma$) | S.D.($\sigma$) | Number of (HS4)Product-Country Pairs |
|---|---|---|---|
| 15 | 3.050 | 1.433 | 26 |
| 16 | 2.287 | 1.385 | 18 |
| 17 | 2.005 | 0.787 | 24 |
| 18 | 1.524 | 0.398 | 19 |
| 19 | 1.950 | 0.639 | 27 |
| 20 | 2.888 | 1.409 | 51 |
| 21 | 2.121 | 0.868 | 36 |
| 22 | 1.914 | 0.994 | 24 |

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 6: Demand Estimation Results of Control function for Taste Effects

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| ln(Distance) | -0.4742*** | -0.3451*** | -0.3580*** | -0.2393*** | -0.1602*** | |
| | (0.015) | (0.015) | (0.015) | (0.015) | (0.015) | |
| National Dish | 0.4496*** | 0.2199*** | -1.1996*** | | | |
| index (ND) | (0.071) | (0.068) | (0.200) | | | |
| Import Share($\hat{z}$) | | 4.2849*** | 7.8855*** | 3.9802*** | 6.8400*** | 8.6550*** |
| | | (0.100) | (0.260) | (0.097) | (0.174) | (0.220) |
| $(ND)^2$ | | | 1.7307*** | | | |
| | | | (0.258) | | | |
| $(\hat{z})^2$ | | | -8.9290*** | | -7.5885*** | -10.0858*** |
| | | | (0.374) | | (0.361) | (0.443) |
| $ND \times \hat{z}$ | | | 0.1973 | | | |
| | | | (0.447) | | | |
| Weighted ND | | | | 5.0066*** | 13.0103*** | 10.7756*** |
| | | | | (0.180) | (0.369) | (0.425) |
| (Weighted ND)$^2$ | | | | | -19.3634*** | -16.0612*** |
| | | | | | (0.846) | (0.863) |
| Weighted ND $\times\hat{z}$ | | | | | 0.5540 | 4.5160*** |
| | | | | | (0.871) | (0.936) |
| Constant | 7.8109*** | 6.9667*** | 7.2048*** | 6.1412*** | 5.3536*** | 4.3539*** |
| | (0.386) | (0.376) | (0.367) | (0.375) | (0.365) | (0.349) |
| $\ln\hat{\delta}$ | Yes | Yes | Yes | Yes | Yes | Yes |
| Product-Year FE | Yes | Yes | Yes | Yes | Yes | No |
| Product-Country -Year FE | No | No | No | No | No | Yes |
| Observations | 41,922 | 41,922 | 41,922 | 41,922 | 41,922 | 41,922 |
| R-squared | 0.554 | 0.578 | 0.590 | 0.597 | 0.617 | 0.681 |

Note: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 7: Demand Estimation Results of Control function for Quality

| | (1) | (2) | (3) |
|---|---|---|---|
| Weightd GDP all destination | 0.3734*** | 1.7014*** | 1.1865*** |
| (WGDP) | (0.043) | (0.249) | (0.253) |
| Weigthed local GDP | 0.5638*** | 0.0865 | 3.3174*** |
| (WLGDP) | (0.048) | (0.300) | (0.165) |
| Import Prices | 0.0979*** | 0.3826 | 0.4057 |
| (PIMP) | (0.034) | (0.252) | (0.261) |
| Market share | 2.3111*** | 15.4894*** | |
| | (0.136) | (0.688) | |
| $(\text{WGDP})^2$ | | -0.2535*** | -0.2020*** |
| | | (0.045) | (0.046) |
| $(\text{WLGDP})^2$ | | -0.0223 | -1.1358*** |
| | | (0.044) | (0.014) |
| $(\text{PIMP})^2$ | | -0.0252 | -0.0320 |
| | | (0.020) | (0.020) |
| $(\text{Market share})^2$ | | -7.3051*** | |
| | | (0.421) | |
| PIMP $\times$ WLGDP | | -0.0547 | 0.0158 |
| | | (0.113) | (0.037) |
| PIMP $\times$ WGDP | | -0.1105 | -0.1193 |
| | | (0.076) | (0.079) |
| WGDP $\times$ WLGDP | | 0.7351*** | 0.3848*** |
| | | (0.084) | (0.051) |
| PIMP $\times$ Market Share | | 0.1383 | |
| | | (0.344) | |
| WGDP $\times$ Market share | | -2.1596*** | |
| | | (0.191) | |
| WLGDP $\times$ Market share | | -2.0094*** | |
| | | (0.233) | |
| Constant | 6.3675*** | 4.3539*** | 5.5389*** |
| | (0.140) | (0.349) | (0.348) |
| $\ln \hat{\lambda}$ | Yes | Yes | Yes |
| Product-Country-Year FE | Yes | Yes | Yes |
| Observations | 41,922 | 41,922 | 41,922 |
| R-squared | 0.584 | 0.681 | 0.667 |

Note: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 8: 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 ($ln\hat{\lambda}$) | -0.146 | 1 | |
| MC Index ($ln\hat{c}$) | -0.114 | -0.026 | 1 |

Table 9: Variance Decomposition of Indices

| Variation in: | Taste Index | Quality Index | MC Index |
|---|---|---|---|
| Firm | 9% | 63% | 55% |
| Product | 56% | 35% | 38% |
| Country | 35% | 2% | 7% |
| | 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 10: Decomposition of Firm-Product Export Revenues

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| $\beta_\lambda$ (Tastes) | | 0.15 | 0.15 | 0.15 | 0.13 |
| | | (.002)*** | (.003)*** | (.002)*** | (.002)*** |
| $\beta_\delta$ (Quality) | 0.27 | 0.25 | 0.26 | 0.24 | 0.25 |
| | (.003)*** | (.002)*** | (.003)*** | (.003)*** | (.003)*** |
| $\beta_c$ (MC) | 0.17 | 0.20 | 0.15 | 0.16 | 0.16 |
| | (.003)*** | (.003)*** | (.003)*** | (.003)*** | (.003)*** |
| $\beta_M$ (Market Competition) | 0.20 | 0.03 | 0.11 | 0.11 | 0.11 |
| | (.003)*** | (.002)*** | (.003)*** | (.003)*** | (.003)*** |
| $\beta_R$ (Demand Residuals) | 0.36 | 0.37 | 0.33 | 0.34 | 0.35 |
| | (.003)*** | (.003)*** | (.003)*** | (.003)*** | (.003)*** |
| Observations | 32,245 | 30,830 | 32,027 | 32,119 | 31,757 |

See Equations Equations (15a) to (15e) 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 reflects the contribution of demand residuals. Columns (2)-(5) reflect the use of a control function for taste but with different specifications. In column (2), National dish index(ND) and the import share($\hat{z}$) are proxied for consumer tastes and the product-year dummy variables are included to control for market competition (column (3) in Table 6). In column (3), the weighted national dish index(WND) and $\hat{z}$ are the proxy variables for taste index and the product-country-year dummy variables are included to control for market competition (column (6) in Table 6). In column (4), the proxy variables of tastes are the same as in column (3) but firm market share are excluded from the proxy variables of quality index (column (3) in Table 7). In column (5), the proxy variables for taste and quality indices are the same as column (3) but we use the fraction of product-level sales in the destination country as the weight for the national dish index instead.

Table 11: Decomposition of Firm-Product Revenues (Balanced Panel)

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| $\beta_\lambda$ (Tastes) | | 0.17 | 0.16 | 0.15 | 0.13 |
| | | (.006)*** | (.006)*** | (.007)*** | (.007)*** |
| $\beta_\delta$ (Quality) | 0.32 | 0.27 | 0.32 | 0.31 | 0.33 |
| | (.009)*** | (.009)*** | (.009)*** | (.008)*** | (.009)*** |
| $\beta_c$ (MC) | 0.04 | 0.09 | 0.03 | 0.04 | 0.03 |
| | (.006)*** | (.005)*** | (.004)*** | (.004)*** | (.004)*** |
| $\beta_M$ (Market Competition) | 0.17 | 0.03 | 0.08 | 0.06 | 0.07 |
| | (.008)*** | (.002)*** | (.005)*** | (.005)*** | (.005)*** |
| $\beta_R$ (Demand Residuals) | 0.47 | 0.44 | 0.41 | 0.44 | 0.44 |
| | (.009)*** | (.009)*** | (.009)*** | (.009)*** | (.009)*** |
| Observations | 2,669 | 2,234 | 2,669 | 2,647 | 2,635 |

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 reflects the contribution of demand residuals. Columns (2)-(5) reflect the use of a control function for taste but with different specifications. In column (2), National dish index(ND) and the import share($\hat{z}$) are proxied for consumer tastes and the product-year dummy variables are included to control for market competition (column (3) in Table 6). In column (3), the weighted national dish index(WND) and $\hat{z}$ are the proxy variables for taste index and the product-country-year dummy variables are included to control for market competition (column (6) in Table 6). In column (4), the proxy variables of tastes are the same as in column (3) but firm market share are excluded from the proxy variables of quality index (column (3) in Table 7). In column (5), the proxy variables for taste and quality indices are the same as column (3) but we use the fraction of product-level sales in the destination country as the weight for the national dish index instead.

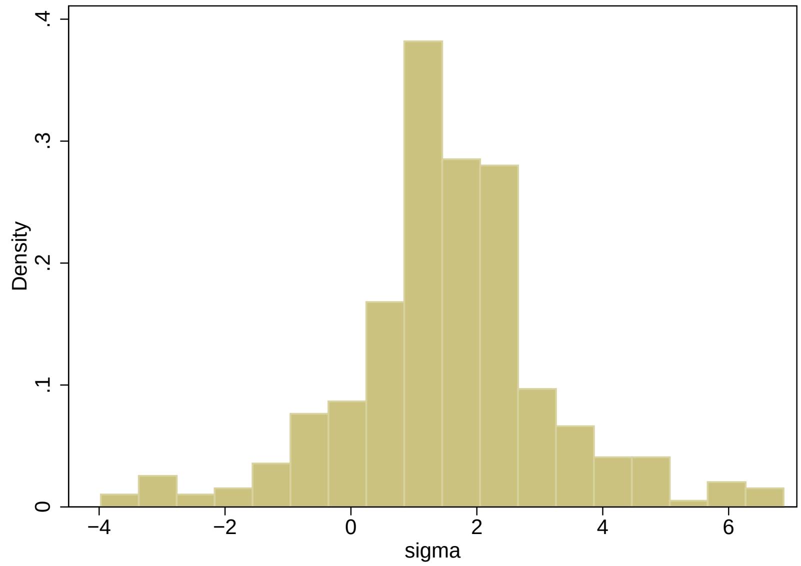


Figure 1: Distribution of Estimated Demand Elasticities

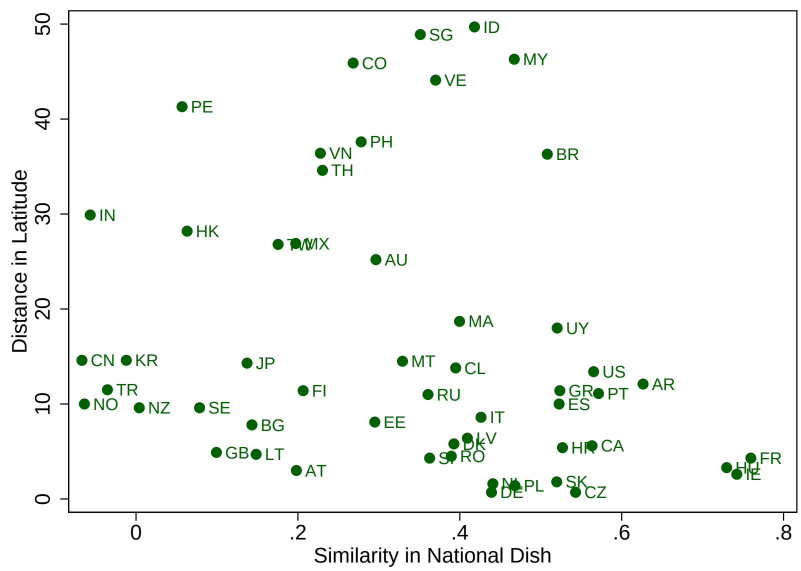


Figure 2: Relationship between *Similarity of National Dish Index* and *Latitude Distance to Belgium*, by Destination

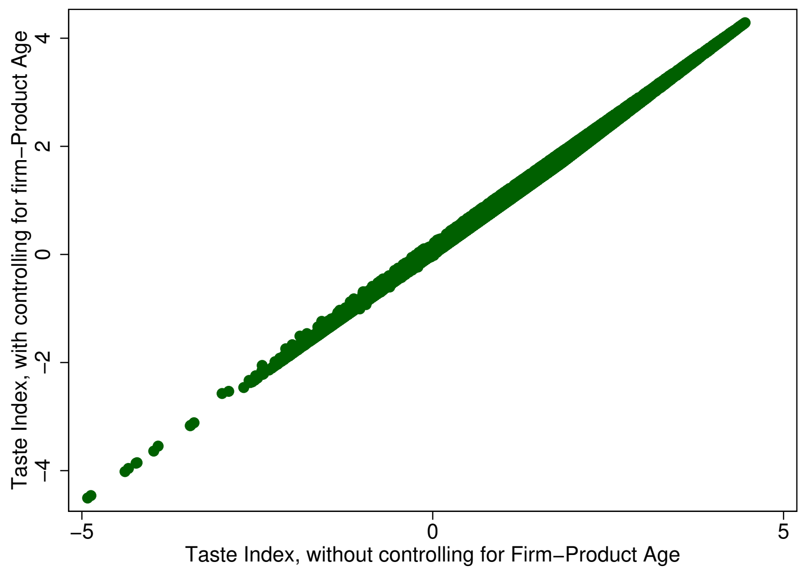


Figure 3: Taste with and without Controlling for Firm-Product Age

# Appendix A

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:

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

where $\lambda_{jisd}$ represents the taste of consumers in country $d$ for product $i$ that firm $j$ exported from country $s$.[31] $Q_{jisd}$ is the quantity of firm-product pair $ji$ exported from country $s$ to country $d$. $\Omega_{sd}$ is the set of products that are exported from country $s$ to country $d$, $\Omega_{isd}$ is the set of firms in country $s$ that exported product $i$ to country $d$.

The CES utility results in the following demand function:

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

here $E_d$ is the total expenditure in country $d$ and $\sigma$ 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 $\tau_{sd}$ 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:

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

Consumer taste $\lambda_{jisd}$ 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

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

$d$ can then be expressed as follows:

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

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:

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

Based on equation (A.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 $i$.

# Appendix B

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)product 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,

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

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

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 $\Delta PR_{idt}$ 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 ($\Delta PR_{idt}$) 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 B-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 |

While our instrumentation strategy for price 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, Itskhoji and Konings (2014), Atkenson 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 (5).

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, $\epsilon_{jidt}$.

# Appendix C

Here we illustrate how we construct a bilateral indicator of closeness in national dishes' ingredients between any two countries. First we identify the national dishes for each country and then trace the recipes and ingredients of each dish from publicly available data and websites.[32] 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.[33][34]

Table C-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.

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

[33] Landauer, Foltz and Laham (1998). 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 C-1.

[34] Table C-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.

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

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 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 $d_2$.

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

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.

Table C-2: Decomposition of Export Revenue, by (HS4)Products

| (HS4)Sector | $\beta_\lambda$ | $\beta_\delta$ | $\beta_c$ | $\beta_M$ | $\beta_R$ | no.(observations) |
|---|---|---|---|---|---|---|
| 1507 | 0.15 | 0.29 | 0.20 | 0.15* | 0.21 | 50 |
| 1511 | 0.24 | 0.49 | -0.14 | 0.42 | -0.01* | 45 |
| 1515 | 0.16 | 0.45 | 0.16 | 0.12 | 0.11 | 214 |
| 1516 | 0.21 | 0.41 | 0.04 | 0.14 | 0.20 | 265 |
| 1517 | 0.31 | 0.31 | 0.06 | 0.18 | 0.14 | 1,160 |
| 1601 | 0.08 | 0.35 | 0.05 | 0.26 | 0.26 | 390 |
| 1602 | 0.19 | 0.30 | 0.09 | 0.12 | 0.30 | 2,804 |
| 1604 | 0.13 | 0.25 | 0.13 | 0.20 | 0.29 | 116 |
| 1605 | 0.11 | 0.34 | 0.43 | -0.04* | 0.16 | 20 |
| 1701 | 0.12 | 0.31 | 0.08 | 0.19 | 0.30 | 470 |
| 1702 | 0.16 | 0.34 | 0.09 | 0.09 | 0.32 | 665 |
| 1704 | 0.09 | 0.24 | 0.3 | 0.08 | 0.29 | 3,187 |
| 1806 | 0.17 | 0.21 | 0.02 | 0.09 | 0.51 | 9,678 |
| 1901 | 0.04 | 0.45 | 0.05 | 0.26 | 0.20 | 209 |
| 1902 | 0.12 | 0.38 | 0.10 | 0.10 | 0.30 | 526 |
| 1904 | -0.05* | 0.38 | 0.12 | 0.25 | 0.30 | 67 |
| 1905 | 0.10 | 0.27 | 0.13 | 0.11 | 0.39 | 1,736 |
| 2004 | 0.16 | 0.27 | 0.25 | 0.05 | 0.27 | 1,741 |
| 2005 | 0.18 | 0.36 | 0.15 | 0.13 | 0.18 | 611 |
| 2007 | 0.18 | 0.21 | 0.17 | 0.15 | 0.29 | 1,293 |
| 2008 | 0.10 | 0.35 | 0.06 | 0.16 | 0.33 | 1,097 |
| 2009 | 0.04* | 0.44 | 0.03 | 0.13 | 0.36 | 193 |
| 2102 | 0.25 | 0.46 | 0.09 | 0.23 | -0.03* | 83 |
| 2103 | 0.15 | 0.36 | 0.04 | 0.03 | 0.42 | 741 |
| 2104 | 0.13 | 0.35 | 0.07* | 0.18 | 0.27 | 60 |
| 2105 | 0.24 | 0.3 | 0.03 | 0.12 | 0.31 | 681 |
| 2106 | 0.07 | 0.29 | 0.06 | 0.15 | 0.43 | 2,717 |
| 2203 | 0.08 | 0.47 | 0.05 | 0.13 | 0.27 | 709 |
| 2208 | 0.08 | 0.22 | 0.05 | 0.16 | 0.49 | 393 |

Notes:* Insignificant at 10%.

Table C-3: (HS4)Product Definition

| HS4 | Definition |
|---|---|
| 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 |
| 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, mollusca 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; homogenized composite food preparations |
| 2105 | Ice cream and other edible ice; whether or not containing cocoa |
| 2106 | Food preparations not elsewhere specified or included |
| 2203 | Beer made from malt |
| 2208 | Ethyl alcohol, undenatured; of an alcoholic strength by volume of less than 80% volume; spirits, liqueurs and other spirituous beverages |