The Micro-D classification: A new approach to identifying differentiated exports

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Abstract

It is common to assess the evolution of a country's export structure as a manifestation of the extent of progress or stagnation in its development process. Performing this exercise requires determining which features of exported products denote higher stages in that process. We argue that exports of *differentiated* products, especially when sold to developed countries, signal the acquisition of valuable knowledge that reflects development progress. We propose a new classification, denoted Micro-D, that by working at the finest aggregation level in customs nomenclatures allows for a more precise identification of differentiated products. Most saliently, using package size as a proxy for product differentiation this classification can identify differentiated food and beverage exports. Thus, it is especially – though not only – suited to capturing export upgrading in land-abundant developing countries. Applied to Argentina in 1998-2011, the Micro-D classification delivers a new picture about its sources of export upgrading during this period.

JEL Classification*: F10, F14, O14.*

Keywords: Differentiated products, exports, classification.

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1. Introduction

The evolution of a country's export structure is usually monitored to infer progress or stagnation in its development process. The inference is based on the notion that some products are more "desirable" than others, in the sense that they can be linked to higher development stages. This exercise requires taking a stand on which products are "desirable". Desirable products, for example, may require more sophisticated knowledge, generate knowledge externalities, and support higher wages. In this paper, we argue for product differentiation as the defining desirability criterion for a country's exports and we propose a new, more accurate, classification of differentiated products. We apply this new classification (denoted "Micro-D") to assess the evolution of Argentina's exports during 1998-2011.

Numerous efforts have been made to construct product classifications that capture a vertical dimension across products, in terms of technological complexity (Hartzichronoglou, 1997; Hidalgo *et al.*, 2009; Lall, 2000), order in which they start being exported (Feenstra and Rose, 1997), and development level of countries that export them (Hidalgo *et al.*, 2009). A similar but coarser exercise is often made in country-specific academic papers and policy reports that focus on rough indicators of export desirability such as whether exported products are "industrial" or "non-traditional" (Gabriele, 1997; Kouzmine, 2000; Von Hesse, 1994). Differentiated products need not be technologically complex or even industrial. However, the singular attributes that make their physical characteristics, design, brand image, or

service reliability unique in the market also allow them to fetch a higher price and reward higher wages. Thus, a country's ability to export differentiated products requires the acquisition of valuable capabilities (many anchored in market-based knowledge) that manifest development progress.

A renowned classification developed by Rauch (1999) distinguishes exports by degree of differentiation. However, this classification is defined at an aggregation level (4-digit SITC) that is too coarse to identify differentiated products because it lumps these products together with undifferentiated ones in broader categories. While these aggregation issues permeate all the classification, they are particularly prevalent in food and beverages, which are precisely good categories where product differentiation presents widely recognized export upgrading opportunities for land-abundant developing countries (such as many Latin American ones).

To address this shortcoming, we propose a new classification of differentiated products, denoted the Micro-Differentiated (Micro-D) classification. This classification is defined at the maximum (hence "Micro") level of disaggregation using information of product attributes described in the Argentine export nomenclature. Operating at the finest disaggregation level across all the nomenclature, the Micro-D classification achieves higher accuracy than the Rauch classification in the identification of differentiated products. Especially, it improves upon this classification in food and beverages by taking advantage of the fact that product positions at the

maximum disaggregation level in those sectors are distinguished by package size, which can be used as a proxy for product differentiation.

Before applying the Micro-D classification to the analysis of Argentine exports, we compare it with the Rauch classification. While discrepancies between the two involve only 16% of total export value, the differences are stark in some sectors. For example, while 18% of Food and Beverage exports are differentiated according to the Micro-D classification, only 6% are differentiated according to Rauch. By contrast, 35% of Metal exports are differentiated according to Rauch but only 11% are differentiated according to the Micro-D. A deeper look at which products generate the discrepancies support the better accuracy of our classification. In particular, products classified as differentiated by Rauch but not by the Micro-D tend to be standardized intermediate inputs, whereas products classified as differentiated by the Micro-D but not by Rauch are food and beverage products sold in small packages. To further assess the relative performance of these two classifications, we perform various tests. These include comparing export prices, the relationship between price and destination per-capita income, and price volatility between differentiated products and undifferentiated ones under each classification. Overall, these tests also support the better accuracy of the Micro-D classification.

Finally, we apply the Micro-D to the analysis of Argentine export growth in differentiated products between 1998 and 2011. We compare the results with those obtained using alternate classifications of "desirable" exports: (a) Manufactures of

Industrial Origin (MOI) as classified by Argentina's National Statistical Institute (INDEC); (b) medium-high and high technologically-intensive products as classified by Hartzichronoglou (1997); and (c) differentiated products as classified by Rauch. We focus on exports of desirable products to OECD countries, which we denote "upgraded" exports, as the metric for assessing virtue in export performance. Exports to developed countries signal the acquisition of diffusible knowledge which is critical for export development and future export growth (Artopoulos *et al.*, 2013).

The four classifications deliver very different results. First, under INDEC's classification upgraded export growth in Argentina during 1998-2011 was primarily driven by the institute's inclusion of precious metals (mainly unwrought gold) as MOI despite being commodities that only went through basic industrial processing. Second, under Hartzichronoglou (1997) and Rauch (1999) upgraded export growth was primarily driven by biodiesel, which although it is neither a technologically complex nor a differentiated good it is tagged as such by these two classifications due to aggregation with other products. By contrast, under the Micro-D the main contributors to growth in upgraded exports were differentiated food and beverages, which are products widely acknowledged to offer export upgrading opportunities in land-abundant countries. A country's ability to grab those opportunities manifests the acquisition of technological and market-based knowledge that can percolate through a broad range of other industries and generate future export growth. Thus, we think our proposed classification captures more accurately the relevant sources of export

progress providing a better guide for export promotion and productive development efforts.

The rest of the paper proceeds as follows. Section 2 justifies our methodological approach. Section 3 describes the main classification criteria used by the Micro-D. Section 4 compares the Micro-D and Rauch classifications. Section 5 applies the Micro-D to assess the recent evolution of Argentine exports. Section 6 concludes.

2. Differentiated vs industrial exports

It is customary to evaluate a developing country's productive performance over a certain time period by studying the dynamics of its export structure. In particular, increases in industrial exports have been prominently interpreted as a sign of productive development. This practice is supported by the traditional view of economic development as an industrialization process and is facilitated by the fact that national statistical institutes customarily report exports distinguishing industrial from primary products. However, increasing the weight of industry in total exports does not necessarily signal development progress. Some industrial activities (e.g., basic food processing) do not possess the desirable properties traditionally attributed to industry (e.g., they do not support higher wages, require sophisticated knowledge, or generate knowledge externalities) while, on the contrary, some non-industrial sectors (e.g., biotechnology, IT, audiovisual services) possess those properties.

A finer approach focuses on the technological intensity of a country's export basket. Underlying this approach is the widespread notion that economic development is associated with a country's ability to produce and export technologically complex products. To capture those exports, Hartzichronoglou (1997) and Lall (2000) developed two alternate export classifications according to products' technological intensity which have been widely used in empirical studies and country reports to assess export performance (Aggarwal, 2002; Bahar *et al.*, 2013; Jarreau *et al.*, 2012; Moreira, 2007; Poncet *et al.*, 2013; Srcholec, 2007; Stehrer *et al.*, 2009).

Although technologically complex products are often differentiated, differentiated products may have the desirable properties attributed to industrial or complex products without necessarily being technologically complex. In fact, widely recognized export upgrading opportunities for land-abundant developing countries (such as many Latin American ones) involve differentiated products that use standard technology. These countries cannot compete in costs with other low-income countries in most undifferentiated low-technology products while they do not possess the technological capabilities to compete with high-income countries in differentiated high-technology products. However, their abundant natural resources provides them a competitive potential in differentiated products, which despite not being technologically complex can command high prices and reward high wages due to their quality, design, traceability, brand reputation, and customization.

In their Argentine cases of export emergence, Artopoulos *et al.* (2011, 2013) point to foreign market knowledge as a key constraint that prevents developing-country firms from exporting differentiated products to developed countries. Only based on this knowledge do firms adopt a set of business practices which are crucial for reaching these foreign markets but differ drastically from those prevailing in their domestic market. They need to adapt product designs to foreign demand idiosyncrasies, upgrade quality, conform to foreign distributors' way of doing business, and engage them to be a source of information about the evolution of foreign demand.[1] Thus, growth in differentiated exports to developed countries manifests the acquisition of this knowledge and the adoption of this new set of business practices.

A country's export composition not only reveals its productive capability at a given point in time but also, as suggested by Lall (2000) for technologically-intensive export structures, it may predict future export growth: "[…technology intensive structures offer better prospects for future growth because their products tend to grow faster in trade: they tend to be highly income elastic, create new demand, and substitute faster for older products]". Since differentiated products are also highly income elastic, create new demand, and substitute faster for older products, we can argue as well that export structures intensive in differentiated products may also predict future export growth.

[1] This evidence is consistent with Molina and Muendler (2013) and Mion and Opromolla (2014) who show that firms are more likely to export if they hire workers and managers with previous work experience at exporting firms. González and Hallak (2013, 2016) argue that insertion in global value chains oriented to non-mass segments of developed-country markets imposes less stringent but nonetheless qualitatively similar requirements on the foreign market knowledge firms need to acquire.

Moreover, growth in differentiated exports to developed countries can be viewed as a predictor of further export growth since the knowledge and practices required to export them, once acquired by some firms, may diffuse throughout the economy.

3. The Micro-D classification of differentiated products

In order to assess a country's export growth in differentiated products, we need to be able to identify those products in export statistics. Currently, the Rauch (1999) classification is the only available option to perform this task (Castro, 2014; Manova *et al.*, 2012; Bastos *et al.*, 2010; Hummels *et al.*, 2005; Nunn, 2007). This classification divides goods into three categories: (a) homogeneous, commercialized in international organized exchange markets; (b) referenced-priced, with reference prices displayed in specialized publications; and (c) differentiated, which are all remaining products. This categorization is performed at an aggregation level (4-digit SITC) that is sometimes too broad. This problem is particularly prevalent in categories that include agricultural-based products. For example, 4-digit SITC category 1121: "Wine of fresh grapes", classified by Rauch as "referenced priced", lumps together grape must, a scantily differentiated good that has historically accounted for most Argentine wine exports, with boxes of bottled fine wine, a differentiated product that currently makes for the bulk of those exports. Since achieving higher value added through differentiation in agricultural-based products has long been recognized as a promising avenue for export upgrading in developing countries, this shortcoming in the classification can obscure key facts in the evolution of these countries' exports. At a much finer aggregation level,

customs nomenclatures specify product attributes that can serve as good proxies for differentiation. To exploit this information, our proposed classification resorts to Argentina's HS-based 12-digit Sistema Informático María (SIM).

To construct our proposed classification, we use products' stage of elaboration as a broad guide to infer differentiation. We take advantage of the HS structure, which organizes the universe of products mostly by their main primary material, usually starting with codes for the material in primary forms, continuing with codes for transformations of the primary material into intermediate inputs, and finishing with codes for final products obtained from the material's further processing. For example, codes 3901 to 3914 in HS Chapter 39 ("Plastics and articles thereof") include different primary forms of polymers and other plastics (e.g. HS 3903 "Polymers of styrene, in primary forms"), codes 3915 to 3921 include plastic intermediates (e.g. HS 3919 "Self-adhesive plates, sheets, film, foil, tape, strip and other flat shapes, of plastics, whether or not in rolls"), and codes 3922 to 3926 include plastic final products (e.g. HS 3924 "Tableware, kitchenware, other household articles and hygienic or toilet articles, of plastics").

At one end of the production chain, we classify products in primary forms as undifferentiated (U) because their essential attributes are homogeneous conditional on standard specifications. At the other end, we classify final products and capital goods as differentiated (D) because they are typically distinguished by their design, quality, brand, customization, technical performance, reliability, after-sale service, or

packaging. Thus, primary forms of agricultural products, minerals, chemicals, metals, plastics, rubber, leather, textiles, glass, stone, wood, and paper are U, while manufactures made from these materials are D if they are final or capital goods. [2]

As opposed to primary, final, and capital goods, products at intermediate stages of elaboration pose harder classification challenges. In the case of products other than food and beverages, we rely on the technical advice of sectoral experts who pointed us to product attributes described in the nomenclature that can serve as indicators of product differentiation.[3] Specifically, we first asked each sectoral expert to describe the sector's value chain and then asked him/her to determine the degree of standardization and codification of products in the chain. In particular, the expert was asked to identify relevant attributes that would determine whether products could be distinguished among its various suppliers. Once this conceptual exercise was concluded, we invited the technical expert to mark differentiated products in the export nomenclature.

Identifying differentiated products in the case of agricultural, food, and beverage goods (HS1 to HS24) is largely facilitated by the fact that Argentina's export nomenclature

[2] Although we follow our own criteria to determine whether goods are primary, final, or capital, we check consistency with the UN Broad Economic Classification (BEC). Since we work at a finer level than this classification, which maps 6-digit HS codes into broad economic categories, on occasions we can classify products more accurately. The main differences are concentrated in food and beverages (e.g. we consider yoghurt sold in small packages as a final product whereas it is classified as primary by BEC). Differences are almost nil in the remaining products. For example, the Micro-D classifies as U 98% of BEC's primary fuels and primary industrial supplies, while it classifies as D 99% of BEC's consumption goods and 100% of BEC's capital goods and transport equipment. Rauch (1999) also classifies most primary products as U and most final and capital products as D

[3] Most of the consulted experts are sectoral analysts at the Argentine Ministry of Production.

distinguishes these products by package size.[4] Products in small packages tend to be at their last processing stage before final consumption and thus possess a variety of differentiated attributes. Products exported in bulk or in larger containers are likely to be undifferentiated goods in primary forms or at intermediate stages of elaboration. Thus, following the general criterion we classify products in small packages as D while those exported in bulk or in larger containers are U.[5] A special case arises in the case of final products sold in small packages, like some unprocessed produce, that are ready for retail sale even though they do not present a high degree of processing. The fact that these products are sold in small packages ready for retail sale indicates the presence of attributes like brand identification or quality that differentiate the product and ultimately translates into additional value added. Here, the high degree of elaboration does not stem from various processing stages but from the care and control of the production process required to obtain the desired product features.[6] Due to the central role played by information at a disaggregated level in our classification, we call it the "Micro-Differentiated (Micro-D)" classification. Appendix A provides a detailed description of the classification criteria while the full classification database in Stata

[4] Starting in 1998, the Argentine government discriminates food and beverages by package size in the export nomenclature in an effort to promote higher value added through higher tax rebates to exports shipped in small packages.

[5] The package size used as a threshold varies across products depending on the product characteristics and on the level of detail provided by the SIM nomenclature. For example, fruit exports are counted as D if they are traded in containers below 20 kilograms while meat exports are D if they are traded in containers below 5 kilograms.

[6] Even though the package size criterion is mainly applied in food and beverages, we also apply it to other products when information is available. Examples of non-agricultural products classified as D when sold in small packages are fertilizers (HS 310510) and paper and paperboard of a kind used as a base for photo-sensitive, heat-sensitive, or electro-sensitive paper or paperboard (HS 480220).

and in pdf formats are available as an online appendix at the journal's and authors' websites.

Although the Argentine SIM is based on the HS, which is harmonized across countries up to the 6-digit level, it discriminates food products by package size only at the 12-digit level. This implies that the Micro-D classification is not directly applicable to other countries' exports. For this reason, our proposed classification follows transparent guiding criteria to ensure easy adaptation to other customs nomenclatures. In this regard, we hope this paper will influence future efforts in customs data collection oriented towards capturing product differentiation.

In addition, we have also constructed a 6-digit version of our classification (the "6-digit Micro-D") by classifying as D 6-digit HS categories with more than 50% of Argentina's export value during 2007-2011 accounted for by differentiated 12-digit positions.[7] Although this version of the Micro-D classification is based on the specific composition of Argentina's differentiated exports, it may be a useful tool for researchers in other countries studying export upgrading through differentiation.[8]

[7] We thank a referee for this suggestion. A Stata file with the 6-digit Micro-D is provided on the authors' and journal's websites, together with the share of differentiated exports in each 6-digit code.
[8] In fact, excluding Food and Beverages, the correlation between the Micro-D and the 6-digit Micro-D is 0.97. The relevant differences take place in those two sectors, where the correlation is 0.45. Overall, the correlation between the Micro-D and the 6-digit Micro-D is 0.93.

4. Comparing differentiated-product classifications: Rauch versus Micro-D

In this section, we compare the Micro-D and Rauch classifications and assess their relative performance in the identification of differentiated goods. We use Argentine export data from INDEC, by product (HS 12-digit), destination and year.

Table 1 divides all 12-digit SIM positions according to their "differentiation condition", i.e. whether they are classified as D only by Rauch (liberal classification), only by Micro-D, by neither of the two, or by both classifications.[9] Then it calculates, for each of twelve product groups (see details in online Appendix B), the percentage value of Argentine exports between 2007 and 2011 under each differentiation condition.

The two classifications accord in 84% of exports (64% U, 20% D). They coincide in classifying as U agricultural commodities such as wheat, maize, and soybean oil, as well as mineral products such as precious metals and fuels. They also coincide in classifying as D transport vehicles and machines. By contrast, they do not coincide in the remaining 16% of exports (8% only Rauch and 8% only Micro-D). Substantial differences take place in specific sectors. On the one hand, a large fraction of only-Rauch D exports are present in Textile, Leather and Hides, where only Rauch classifies tanned and prepared leather as D, as well as in Chemicals, Plastics and Rubber, and Metals. On the other hand, 16% of Food and Beverages exports are classified as D

[9] In the Rauch classification, we compute as U homogenous and reference-priced products.

only by the Micro-D versus 4% classified as D only by Rauch. This fact exhibits the main advantage of the Micro-D classification. By identifying items sold in small packages it captures differentiation upgrade in goods traditionally derided as "primary" or "commodities".[10]

Table 1: Differences between Rauch and Micro-D classifications, by product group. 2007-2011.

Group of products	Rauch: U Micro-D: U	Rauch: D Micro-D: U	Rauch: U Micro-D: D	Rauch: D Micro-D: D	Exports (US$ bn)
Food and Beverages	78%	4%	16%	2%	24.8
Other agricultural products	94%	2%	4%	0%	10.0
Vehicles	0%	0%	0%	100%	7.0
Fuels	99%	1%	0%	0%	5.7
Chemicals	23%	32%	2%	43%	4.3
Metals	62%	28%	4%	7%	4.2
Machinery	0%	0%	1%	99%	2.9
Textiles, Leather and Hides	22%	60%	3%	15%	1.7
Plastics and Rubber	51%	21%	0%	28%	1.7
Precious metals	89%	0%	2%	9%	1.7
Paper and Paperboard	35%	0%	25%	40%	0.7
Other industrial products	9%	0%	1%	90%	0.4
Total	**64%**	**8%**	**8%**	**20%**	**65.3**

Table 2 takes a deeper look at the discrepancies between Rauch and the Micro-D. Within only-Rauch D exports (left hand side), the most important items are seamless tubes (Metals), biodiesel (Chemicals), hides, and leather (Textiles, Leather and Hides). Although seamless steel tubes and biodiesel are capital intensive products, their main

[10] A large percentage of only Micro-D exports in paper products is mainly explained by exports of impregnated paper and paper boxes, which are products that generally indude customized features.

features are standard and their prices are easily found in specialized sites and publications. Hides and leather exported by Argentina display little scope for differentiation since they have only gone through basic processing.

Table 2: Main differences between Rauch and Micro-D. 2007-2011.

Rauch: D - Micro-D: U		**Rauch: U - Micro-D: D**	
Product	**Exports (US$ mil.)**	**Product**	**Exports (US$ mil.)**
Seamless steel tubes	1131	Meat of bovine animals, fresh or chilled (less than 5kg)	648
Biodiesel	1077	Wine of fresh grapes (less than 2 liters)	633
Tanned or crust hides and skins of bovine	638	Apples, pears and quinces (less than 20 kg)	495
Leather further prepared after tanning or crusting, of bovine	239	Citrus fruits (less than 20kg)	364
Frozen fish, excluding fish fillets (higher than 1 kg)	202	Meat of bovine animals, frozen (less than 5 kg)	273
Malt, whether or not toasted (in bulk)	201	Cheese and curd (less than 5kg)	154
Polymers of ethylene, primary forms	170	Meat of poultry (less than 15kg)	147
Essential oils	135	Other prepared or preserved meat (less than 5kg)	135
Other vegetables prepared or preserved (higher than 2.5kg)	94	Grapes (less than 20kg)	118
Petroleum coke	72	Potatoes (less than 2,5kg)	118

The right hand side of Table 2 details products classified as D by the Micro-D but not by Rauch. A striking fact is that all ten of the largest items in this list are either food or beverages. While these export items are often sold primarily in bulk, a significant volume is sold in small packages as a differentiated product. Additionally, the list shows

that differentiation upgrade is not confined to a single product but is achieved across a large number of food and beverage categories.

We perform three exercises to assess the relative ability of the Rauch and Micro-D classifications to identify differentiated exports.[11] First, a product that has achieved a higher degree of differentiation is expected to face a lower demand elasticity. Thus, conditional on costs, the firm will charge a higher price. To check this prediction, we compare products' unit values according to their differentiation condition (only Rauch, only Micro-D, Both, None). This is done by regressing the (log) unit value of each product (12-digit SIM) on a set of dummies for each condition (the constant corresponds to None), together with fixed effects at the 2-digit level (column 1) and at the 4-digit level (column 2), both interacted with year and unit of measurement (e.g. kilos, liters, units, etc) fixed effects.[12,13]

The results are shown in Table 3. Not surprisingly, all products classified as D by at least one classification display higher prices than U products. In all three cases, the average unit value is substantially higher than the benchmark case captured by the constant (not reported). Also, products classified as D by both classifications have the highest prices. A notable finding is that products classified as D only by the Micro-D

[11] We thank a referee for suggesting these exercises.
[12] In the particular case of food and beverages, export quantities are generally expressed in "kilos" and "liters", respectively, rather than in "units".
[13] We cannot include fixed effects at finer aggregation levels. The 6-digit HS concords with the 4-digit SITC, which is the aggregation level used by Rauch to classify products. Thus, including fixed effects at this aggregation level would remove all useful variation for this exercise.

display statistically-significant higher prices than products classified as D only by Rauch – the difference is stronger when we include 2-digit fixed effects. This finding suggests that the Micro-D can identify differentiated products more accurately than the Rauch classification.

Table 3: Price level estimations

	Price (ln)	Price (ln)
Both	0.8376***	0.4554***
	(0.1388)	(0.0747)
Only Micro-D	0.6045***	0.2772***
	(0.1360)	(0.0351)
Only Rauch	0.4212***	0.2096***
	(0.1035)	(0.0662)
2-digit HS-Unit-Year FE	Y	N
4-digit HS-Unit-Year FE	N	Y
Observations	67,801	67,801
R^2	0.5314	0.7213

Clustered standard errors by 2-digit HS-year in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

There is a strong caveat to this result. Since stage of production is a key classification criterion in the Micro-D, and since differentiated products tend to be in their final processing stages, they would mechanically have higher production costs, and hence, prices. To avoid this potential problem, we look at price variation across destinations *for the same product*. In particular, we expect that a differentiated product's price (12-digit SIM unit value) will increase systematically with destination per-capita income. Differentiated products have a broader scope of variation in quality, brand recognition, and consumer loyalty which, via impact on costs and mark-ups, should be reflected in

systematic price variation with income.[14] Undifferentiated products, by contrast, have standardized attributes and higher demand elasticities.

In Table 4, we regress the product's (log) price on the destination per-capita income and on the interaction of this variable with differentiation-condition dummies, controlling for year-unit-product (12-digit SIM) fixed effects. As expected, prices are on average higher for products exported to higher-income countries. Also, as expected, the positive relationship between destination income and price is stronger for products classified as D by at least one classification. Among those, D products only under the Micro-D are those that display the strongest relationship with income even compared to D products under both classifications. We view this result as evidence that the Micro-D classification can identify differentiated products more accurately than Rauch (1999).[15]

[14] See, for example, Berry et al., 1995; Goldberg, 1995, Hausmann et al., 1994 and Petrin, 2002.
[15] We find similar results for these two exercises when we use the 6-digit Micro-D classification instead of the Micro-D (see online Appendix C). These results suggest that the coarser classification still identifies differentiated goods more accurately.

Table 4: Export price and destination country income

	Price (ln)
GDP pc (ln)	0.0232***
	(0.0042)
Rauch*GDP pc (ln)	0.0205**
	(0.0087)
Micro-D*GDP pc (ln)	0.0446***
	(0.0071)
Both*GDP pc (ln)	0.0248***
	(0.0051)
12-digit SIM-Unit-Year FE	Y
Observations	436,907
R^2	0.8326

Source: Authors' estimations based on INDEC and World Bank. Clustered standard errors by 12-digit SIM-year in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Finally, we analyze export price volatility by differentiation condition. Since differentiated products command higher mark-ups, their price in foreign markets can absorb more variation in costs – e.g., due to exchange rate movements – than commodities. Thus, we would expect that differentiated product prices are more stable over time. In order to assess export price volatility, we compute the coefficient of variation of each 12-digit SIM export unit value in each destination over the period 2002-2011 and regress it on a set of dummies for each differentiation condition, alternatively including destination combined with unit of measurement and 2-digit and 4-digit fixed effects (columns 1 and 3). Since some products are not exported every

year, we perform an alternate regression using products exported every year (columns 2 and 4).[16]

Table 5: Price volatility

	(1) All products	(2) Continuous products	(3) All products	(4) Continuous products
Only Rauch	0.0692***	0.0634***	0.0339**	0.0597
	(0.0083)	(0.0216)	(0.0156)	(0.0710)
Only Micro-D	0.0401***	0.0380*	-0.0049	-0.0122
	(0.0077)	(0.0208)	(0.0079)	(0.0398)
Both	0.0980***	0.0649***	-0.0208	-0.0378
	(0.0075)	(0.0183)	(0.0175)	(0.0803)
2-digit HS-Unit-Dest. FE	Y	Y	N	N
4-digit HS-Unit-Dest FE	N	N	Y	Y
Observations	157,328	16,404	157,328	16,404
R^2	0.2033	0.2940	0.3893	0.5606

Clustered standard errors by 2-digit HS-destination in parentheses. Dependent variable: Price variation coefficient.
*** p<0.01, ** p<0.05, * p<0.1

Table 5 displays the results. Controlling for 2-digit fixed effects, the price of D products (either classified by Rauch, Micro-D or Both) is significantly more volatile than the price of U products. A potential reason for this finding is that differentiated products have shorter product cycles, leading to innovation and variation in product characteristics over time, which increase price variability. In addition, even a 12-digit position consists of a variety of items with different features, quality, and prices. Hence, its unit value is determined by the particular composition of these varieties,

[16] Since identification here relies on time-series variation, we exploit a longer time period available in our dataset (using previous years would involve dealing with heavy concordance issues). The results of Tables 3 and 4 are almost unchanged if we instead use the sample period 2002-2011.

which changes every year. The composition of undifferentiated positions, by contrast, is more homogenous, which helps stabilize these products' prices. When we control for 4-digit fixed effects (the highest possible disaggregation level for product fixed effects), the results are more in line with our conjecture: differentiated goods by both classifications and only by the Micro-D present lower price volatility over time than undifferentiated goods, although the difference is not statistically significant.

5. Assessing the evolution of Argentine exports

In this section, we apply the Micro-D classification to analyze the evolution of Argentine exports during 1998-2011. Those years mark the peaks of two macroeconomic cycles. The first peak is at the height of the Convertibility regime that ruled the country between 1991 and 2001. The second is at the height of the post-Convertibility regime. After 2011, the Argentine government embarked on an unabated turn toward a commercial policy of generalized protection that imposed discretionary authorization requirements on all import shipments. Analyzing the consequences of this policy turn on Argentina's exports is left for future research.

We also compare the results applying the Micro-D to Argentina's exports with those obtained using alternative classifications. Specifically, we assess the evolution of "desirable" export products under four alternatives. First, based on the classification used by Argentina's official statistical institute (INDEC) we consider as desirable those

products included in the category "Manufactures of Industrial Origin" (MOI).[17] Second, based on the most widely used product classification by technological content (TC) (Hartzichronoglou, 1997) we consider as desirable "High Intensity" and "Medium-High Intensity" products. Third, under both Rauch and Micro-D desirable products are those classified as "Differentiated" (D).[18]

As argued in section 2, differentiated exports to high-income countries are more likely to manifest the acquisition of diffusible knowledge than differentiated exports to other destinations. In particular, differentiated exports to neighboring countries and to low-income countries do not necessarily require the capability to adapt products and business practices to foreign market needs. Thus, it is relevant to focus on desirable exports to developed countries. We refer to those as "upgraded" exports to distinguish them from desirable exports to all destinations. More specifically, upgraded exports are desirable exports shipped to any of the 23 OECD members in 1990 (this set excludes more recent members such as Mexico, Korea or Chile).[19]

Figure 1 displays the growth rate of desirable and upgraded exports according to each classification between the 1998-1999 average and the 2010-2011 average.[20]

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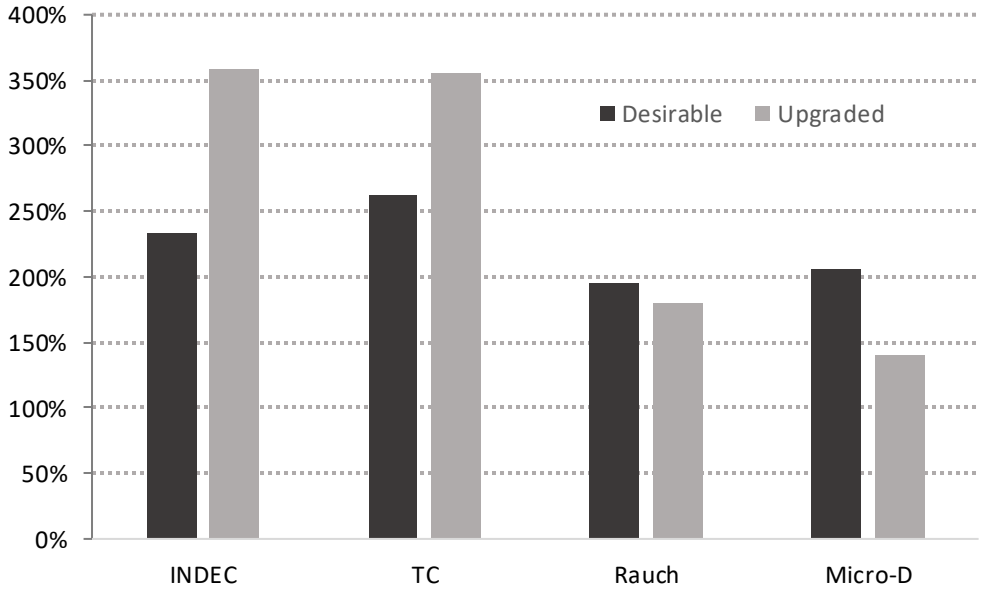
[17] INDEC classifies products in four categories: Primary Products, Manufactures of Agricultural Origin (MOA), Manufactures of Industrial Origin (MOI), and Fuels and Energy. It is customary to regard MOI as the virtuous category both in the press and in the academic literature.

[18] We exclude used products from the analysis. These exports are particularly relevant in airplanes where used items account for 99% of airplane exports from Argentina.

[19] In all four classifications, upgraded exports account for a small share of desirable exports, namely 27%, 19%, 20% and 19% of the 2010-2011 desirable export average under INDEC, TC, Rauch, and Micro-D, respectively.

[20] We use two-year averages to smooth out idiosyncratic variation in the extreme years.

Figure 1: Desirable and upgraded exports' growth rate. 1998-9/2010-1

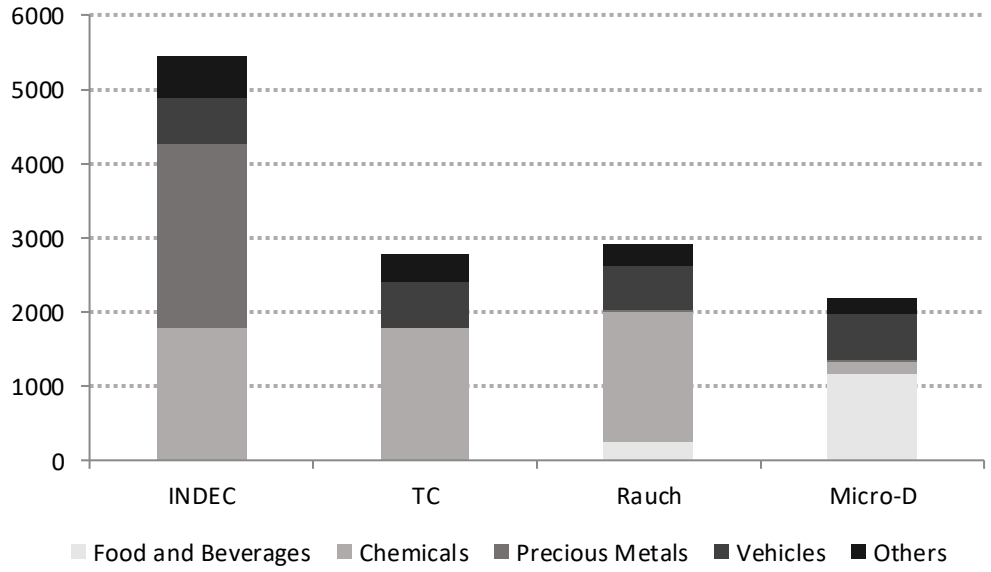


All four classifications deliver similar growth rates for desirable exports. The growth rate is highest when desirable exports are computed using the TC classification (262%) while it is lowest when they are computed using Rauch (196%). However, when we focus on upgraded exports, differences in growth rates become larger. In particular, upgraded exports identified according to differentiation (Rauch and the Micro-D) deliver substantially lower growth rates than upgraded exports singled out by the other two classifications (INDEC and TC).

In order to understand why the classifications yield so different results, we divide products in the same twelve groups used in section 4 and identify which are responsible for the main differences. It is now more convenient to look at absolute growth rather than at growth rates. Figure 2 decomposes absolute growth in upgraded exports by

product group according to each classification. Under INDEC's classification, the main growth contributor is Precious Metals, which is mainly unwrought gold.[21] The other three classifications instead rightly leave Precious Metals out of the desirable set; the TC classification does not consider these products desirable because they are not technologically intensive while the other two classifications do not consider them desirable due to their low degree of differentiation.

Figure 2: Contribution to absolute upgraded export growth (US$ billions). OECD. 1998-9/2010-1



Second, the TC and Rauch classifications surprisingly deliver similar results in terms of export growth's sectoral composition. In both cases, the most important

[21] INDEC classifies unwrought gold as a manufacture because after its extraction, and before it is exported, the crude mineral goes through basic chemical and casting processes to obtain the gold ingot.

contributor is Chemicals, driven almost exclusively by biodiesel exports. This product is basically a commodity obtained from further processing of soybean oil.

Under the Micro-D classification, growth in upgraded exports is more modest. Upgraded exports grew by 2.2 billion dollars under the Micro-D whereas they grew by 2.8 and 2.9 billion dollars under the TC and Rauch classifications, respectively. Most importantly, substantial differences arise in growth composition. Two elements stand out. On the one hand, while under the TC and Rauch classifications Chemicals is the most important growth component accounting for 65% and 60% of total growth, respectively, this sector's contribution to upgraded growth under the Micro-D is only 7% since this classification rightly considers biodiesel to be an undifferentiated product.

Under the Micro-D, on the other hand, Food and Beverages is the most important contributor to upgraded growth. This category accounts for 54% of total growth in upgraded exports, whereas it only accounts for 9% and 0% of upgraded growth under the Rauch and TC classifications, respectively. While the Micro-D classification can single out differentiated food and beverage items in small packages, the Rauch classification can only identify as differentiated specific food categories (e.g. frozen fish, malt, and malt extract). In the case of the TC classification, the neglect is more

dramatic as this classification does not include any food or beverage item in its two upper technological-content categories.[22]

In order to delve deeper into the differences in upgraded export growth between Rauch and the Micro-D, we list in Table 6 the most salient departing items. On the left panel, the table shows that vehicles and vehicle parts are the most important export growth items within those considered upgraded under both classifications. Other important items are hormones, pumps for liquids, and inlet valves. On the center panel, those products with the highest export growth classified as upgraded by Rauch but not by the Micro-D are biodiesel, seamless steel tubes, peanuts, essential oils, and petroleum coke. These are products that have standard features and thus are not differentiated. On the right panel, top-growth upgraded items by the Micro-D but not by Rauch are all either food or beverages. This list includes wine, bovine meat, citrus, apples, and other fruits exported in small packages. These products are correctly classified as D since their shipment in small packages manifest the possession of differentiated attributes.

[22] The remaining large upgraded growth component is Vehicles whose exports are unanimously classified as desirable. Qualitatively, similar differences across classifications arise when we perform this exercise considering exports to all destinations. Although vehicle exports become the main desirable export item under all four classifications – due to the large amount of Argentine vehicle exports to Brazil – the sectoral composition of export growth is qualitatively unchanged.

Table 6: Upgraded exports with highest absolute export growth (US$ billions). 1998/9-2010/1.

Rauch: D - Micro-D: D		Rauch: D - Micro-D: U		Rauch: U - Micro-D: D	
Description	Growth	Description	Growth	Description	Growth
Motor vehicles (for transport of goods)	555	Biodiesel	1503	Wine of fresh grapes (less than 2 liters)	472
Parts of vehicles	85	Seamless steel tubes	277	Meat of bovine animals, fresh or chilled (less than 5 kg)	243
Hormones	56	Peanuts (higher than 2.5 kg)	226	Other fruits (less than 2.5 kg)	105
Pumps for liquids	33	Essential oils	88	Citrus fruit (less than 16 kg)	91
Inlet valves	33	Petroleum coke	34	Apples (less than 2.5 kg)	45
Subtotal (top five) Rauch:		2890	Total Rauch:	2930	
Subtotal (top five) Micro-D:		1718	Total Micro-D:	2177	

Adding value through differentiation in food and beverage items sold to high-income countries is a relevant manifestation of productive transformation in land-abundant developing countries. However, the TC classification neglects this type of transformation by focusing on technological content while the Rauch classification does not capture it due to insufficient disaggregation. By looking at package size in disaggregated export statistics as an indicator of product differentiation in food and beverage products, the Micro-D classification is better suited to identify export upgrading in land-abundant countries.

Improving upon the seminal contribution of Rauch (1999) is crucial for reaching a more accurate assessment of the evolution of Argentine differentiated exports to

developed countries. Based on an inaccurate classification of biodiesel as a differentiated product, under the Rauch classification we would conclude that chemical products were the main contributor to upgraded exports during the period 1998-2011. By contrast, under the Micro-D classification we conclude that the major contributor to this type of exports was food and beverages sold in small packages. This result supports an assessment of the sources of recent export upgrading in Argentina which might point to very different policy recommendations.

6. Conclusions

This paper argues that product differentiation is the best criterion to identify desirable exports and proposes a new classification of differentiated products that builds upon the seminal work of Rauch (1999). By working at a very fine aggregation level, the Micro-D classification allows for a more accurate identification of differentiated products. Applied to Argentina's exports during 1998-2011, the Micro-D classification delivers a very different view about the sources of Argentine export upgrading. While according to the Rauch classification it largely consisted of chemicals (basically biodiesel), according to the Micro-D classification it consisted of differentiated food and beverages. This new result induces a different interpretation of the recent Argentine export performance that has implications for the optimal choice of international insertion policies.

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Appendix A: Detailed description of the Micro-D classification

We first mention some database adjustments we have implemented. First, the HS classification was modified twice during our sample period (HS 1996 to HS 2002, then to HS 2007). Since some product codes were changed, we had to work on the correspondence between these nomenclatures and on the trade flows assigned to each code in order to guarantee consistency over time. At the authors' websites, in addition to providing a Stata file and a pdf file with the SIM 2007 full classification database (Micro-D.dta) and description (Micro-D full description.pdf), we also provide a Stata file (Combined SIM for Micro-D.dta) with the classification applied to all SIM codes during the 1998-2011 period.

Another issue that arose was that some trade flows in 1998 and 1999, which were supposed to be registered based on the corresponding HS 1996 nomenclature, were instead registered using the previous, HS 1988/92, nomenclature. Since the newer HS 1996 had finer codes which were grouped together in the HS 1988/1992, several differentiated and undifferentiated products were bundled together in the same codes under the older nomenclature. This problem was particularly important for meat and fruit products, because the HS 1988/92 did not yet distinguish products according to their package size. To deal with this issue, we assigned the same D/U shares observed in 2000 at the 8-digit level and destination group level to exports reported under these troublesome codes in 1998 and 1999.

Now we proceed to describing in detail the Micro-D classification. The main criteria have been discussed in section 3. In particular, primary products are undifferentiated (U), final products and capital goods are differentiated (D) and intermediate products are classified case by case as U or D based on their specific attributes. Here, we discuss the application of these broad criteria to set of goods.

- *Agricultural products, food, and beverages (HS 01-24):* Products in this category are classified for the most part according to their package size. Food and beverages exported in small packages are considered D, whereas those exported in bulk are classified as U. This follows the general rule of classification according to degree of elaboration. On the one hand, processed consumer goods (e.g., dulce de leche, candy, champagne, pasta, etc.) are classified as D. On the other hand, for unprocessed or partially processed animal and vegetable products such as meat, fish, dairy, produce, fruit, cereals, and their derivatives, which constitute the vast majority of products in these chapters, we identify whether they have reached their last stage of elaboration by looking at the size of the containers they are exported in. They are classified as U if they are exported in bulk, and as D if they are exported in containers ready for retail sale.
- *Minerals products (HS 25-27):* All products in these three chapters are classified as U because all are primary products.
- *Products of the chemical or allied industries (HS 28-38):* Following the general rule, products in these chapters are classified according to their degree of elaboration. In the case of intermediate products, they are D when the production process

(purification protocols and synthesis process) and way of distribution (e.g., refrigeration package) determine their effectiveness. All remaining intermediate products are U. In particular:

- *Inorganic and organic chemicals* (HS 28-29): Primary products (e.g., fluorine, carbon, and hydrocarbons) are U. Among intermediate items, there is a group of D products (e.g., hormones, vitamins, and antibiotics) where the purification protocols and way of distribution are important for subsequent performance and a group of U products (e.g., inorganic acids and oxides, alcohols, and phenols) with standard characteristics and less relevant purification protocols.
- *Pharmaceutical products* (HS 30): All intermediate and final products are classified as D. Intermediate items are D because the specific synthesis process followed to produce them determines their effectiveness.
- *Fertilizers* (HS 31): They are classified according to their package size.
- *Tanning, dyeing extracts, pigments, and other coloring matter* (HS 32): Primary products (e.g., tanning substances and dyeing extracts) are U. Among intermediate products, there are both D products (prepared pigments, paints, varnishes, and driers), customized to market niches, and U products (coloring matters) with standardized features.
- *Essential oils, perfumery, cosmetic, and toilet preparations* (HS 33): Intermediate products (essential oils and odoriferous substances) are U because they present standardized features. Final goods are D (e.g., perfumes, make-ups, and preparations for hair use).

- *Soap, organic surface-active agents, washing preparations and prepared waxes* (HS 34): All products are classified as D because they are final products.
- *Albuminoidal substances; modified starches; glues; enzymes* (HS 35): All intermediate and final products are classified as D. Intermediate items are D because the specific purification protocols and production processes followed to obtain them determine their performance.
- *Explosives; pyrotechnic products; matches; pyrophoric alloys* (HS 36): Intermediate products (e.g., propellant powders and prepared explosives) are U because they contain standard features. Final goods (e.g., safety fuses, fireworks, and matches) are D.
- *Photographic or cinematographic goods* (HS 37): All products are D because they are final products.
- *Miscellaneous chemical products* (HS 38): Primary forms (e.g., artificial graphite, activated carbon, and tall oil) are U. A group of intermediate commodity chemicals (e.g., rosin and resin acids, turpentine, mixed alkylbenzenes, fatty acids, and biodiesel) are classified as U because there is little scope for differentiation given the chemical composition. Another group of intermediate specialty chemicals (e.g., agrochemicals, finishing agents, prepared rubber accelerators, and diagnostic or laboratory reagents) are D because their synthesis process and purification protocols determine their performance.

- *Plastics and rubber products* (HS 39-40): Primary forms such as polymers, cellulose, silicone, and natural or synthetic rubber, and some semi-manufactures such as

monofilaments, tubes, and floor coverings are classified as U. Manufactures made from these primary inputs are D (pneumatic tires are a prominent example).

- *Hides, skin, and leather* (HS 41-43): Primary forms such as raw and tanned hides, skins, and furskins, are U. Most intermediate products (e.g., dressed furskins and leather) are U because they present standard features. The exceptions are chamois and patent leather which contain differentiated attributes. Articles of leather, apparel, and artificial fur are D because they are final products.
- *Wood, cork, and manufactures of straw* (HS 44-46):
  - *Wood and wood articles* (HS 44): Primary forms of wood (such as fuel wood, wood wool, wood sawn, fiberboard of wood, and densified wood) are U. Wooden frames for paintings, packing boxes, tools, and other articles of wood are D.
  - *Cork and articles of cork* (HS 45): Natural and agglomerated cork (primary forms) are U. Their articles (final products) are D.
  - *Manufactures of straw* (HS 46): All products are D because they are final products.
- *Pulp of wood, paper and paperboard, and articles thereof* (HS 47-49):
  - *Pulp of wood* (HS 47): All products are U because they are primary products.
  - *Paper and paperboard* (HS 48): Intermediate products are divided between those with standardized features (e.g., newsprint in rolls, toilet or facial tissue stock, uncoated kraft paper and paperboard, paper and paperboard corrugated, and filter paper and paperboards), which are U, and those with customized features (paper and paperboard coated, impregnated, covered, or printed; envelopes and letter cards, toilet paper, cartons, boxes, cases, bags, and paper and paperboard labels),

which are D. Uncoated or coated paper and paperboard and cigarette paper with kaolin are D only when they are conditioned for retail sale.

- *Printed books, newspaper, and pictures* (HS 49): All products are D because they are final products.

- *Textiles and textile products* (HS 50-67):
  - *Textiles* (HS 50-56): Primary forms of each material (e.g., silk, wool, and cotton) are U. Among intermediate products, woven fabrics of cotton and synthetic fibers are in general U because they contain standardized characteristics, except for printed woven fabrics (classified as D) which are differentiated by their designs. Woven fabrics of other textile fibers (e.g. silk, wool, and flax) are D because they are typically customized to market needs. Yarns are U because they contain standardized characteristics (within a textile fiber).
  - *Textile articles* (HS 57-63): Intermediate products (e.g., special woven fabrics, impregnated, coated or laminated textile fabrics, and knitted fabrics) are in general D because they tend to be differentiated by their brand or design. The exceptions are unbleached and dyed knitted fabrics of cotton and synthetic fibers, which are U because their features are standard. Final products (carpets and articles of apparel and clothing) are D.
  - *Footwear, umbrellas and prepared feathers* (HS 64-67): All products are D because they are final products.

- *Articles of stone, ceramic and glass* (HS 68-70): All products are D because they are final products.

- *Base and precious metals products* (HS 71-83): Products in these chapters are classified according to their degree of elaboration and their differentiated attributes:
  - *Natural or cultured pearls, precious or semi-precious stones, and precious metals (HS 71):* Primary forms (unwrought metals and pearls, diamonds, and precious stones not worked) are U. Final products (articles of jewelry and articles of goldsmiths' or silversmiths' ware) are D.
  - *Iron and steel* (HS 72): Steel and stainless steel products (primary forms and intermediate products) are U because conditional on observable characteristics (e.g., thickness, diameter) their attributes are standard. Primary forms of alloy steel are U. Other alloy steel products are D because they are differentiated by the specific combination of metals they contain.
  - *Articles of iron and steel* (HS 73): Sheet pilling, railway construction material, tubes, pipes, and hollow profiles are U because conditional on observable characteristics their attributes are standard. Other intermediate products (e.g., containers, screws, bolts, nuts, and springs) are D because they are customized to market needs. Final products (e.g., tables and other household articles, sanitary ware, and stoves) are D.
  - *Copper, aluminum, other metals, and articles thereof* (HS 74-81): Primary forms (unwrought base metals and powders) are U. Bars, plates, sheets, and tubes of these metals are also U because they consist of standard features. Other intermediate products (e.g., reservoirs) and final products (e.g., tables and kitchen articles) are D.

- *Tools, implements, cutlery, spoons, forks, and miscellaneous articles of base metals* (HS 82-83): All intermediate and final products are classified as D because they have customized characteristics.

- *Machinery and appliances; vehicles and transport equipment* (HS 84-89): All products are D. They include capital goods (e.g., electro-mechanical domestic appliances, nuclear reactors, and turbines), specialized intermediate products (e.g., parts of vehicles), and final products (e.g., vehicles and aircrafts).
- *Miscellaneous manufactured articles and works of art* (HS 94-97): All products are classified as D because they are either final products (e.g., furniture, musical instruments, arms, toys, and photographic instruments) or specialized intermediate products (e.g., parts of these products). Collections and antiques are the only exceptions because, despite being differentiated, they are not reproducible.

Appendix B: Construction of product groups

This appendix describes the composition of product groups used in Table 2 and in Figure 1. These groups are constructed based on the 2-digit codes of the Harmonized System (HS), as detailed in Table B.1.

Table B.1.: Correspondence between product groups and 2-digits HS codes.

Product Groups	2-digit HS codes
Food and Beverages	02, 03*, 04, 07, 08, 09*, 10, 11, 12, 15, 16, 17, 18, 19, 20, 21, 22
Other Agric. Products	01, 03*, 05, 06, 09*, 13, 14, 23, 24, 25*, 26*, 31*, 35, 40*, 44*, 45, 46, 99*
Textiles	41, 42, 43, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64
Chemicals	28, 29, 30, 31* 32, 33, 34, 36, 37, 38
Plastic and Rubber	39, 40*
Paper	26*, 47, 48, 49
Precious Metals	68, 69, 70, 71
Metals	72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83
Machinery	84, 85, 88*, 89
Vehicles	86, 87, 88*
Other Industrial Products	25*, 44*, 65, 66, 67, 90, 91, 92, 93, 94, 95, 96, 97, 99*
Fuels	27, 99*

2-digits HS codes followed by * are not fully included in the product group.

90% of 2-digit HS codes are fully included in a single product group. There are nine exceptions, as discussed below:

- 03 – Fish and crustaceans: all items are included in Food and Beverages, except for pacific salmon which is included in Other Agricultural Products.

- 09 – Coffee, tea, mate and spices: all items are included in Food and Beverages, except for coffee not roasted which is included in Other Agricultural Products.

- 25 – Salt, sulphur, earth and stone, lime and cement: all items are included in Other Agricultural Products, except for quicklime and portland cement which is included in Other Industrial Products.

- 26 – Ores, slag and ash: copper ores are included in Metals. Other minerals are included in Other Agricultural Products. Roasted iron pyrites and slags are included in Other Industrial Products.

- 31 – Fertilizers: animal and vegetable fertilizers are included in Other Agricultural Products. The remaining items are included in Chemicals.

- 40 – Rubber and articles thereof: natural rubber is included in Other Agricultural Products. All remaining items are included in Plastic and Rubber.

- 44 – Wood and articles of wood: primary forms of wood are included in Other Agricultural Products. Products that display some kind of elaboration are included in Other Industrial Products.

- 88 – Aircraft, spacecraft: spacecraft and multiengine airplanes are included in Vehicles. All remaining items are included in Machinery.

- 99 – Others: supplies of fuels and lubricants to ships and aircraft are included in Fuels. Other supplies to ships and aircraft and simplified exports are included in Other Agricultural Products. All other products are included in Other Industrial Products.

Appendix C: The 6-digit Micro-D classification

While the Argentine customs nomenclature disaggregates products up to the 12-digit level the international Harmonized System (HS) only reaches the 6-digit level of

disaggregation. Since the Micro-D classification uses the maximum level of disaggregation in the Argentine nomenclature, it is not easily replicable in other countries. In order to facilitate the use of the Micro-D classification by researchers in other countries, we build a coarser version of the Micro-D at the 6-digit HS level. We denote the resulting classification the "6-digit Micro-D".

For every 6-digit code, we compute the share of differentiated exports during the period 2007-2011 and classify the code as D if this share is higher than 50%. In order to classify 6-digit codes in which Argentina does not display any export, we proceed as follows. When all items within a 6-digit code are classified as D or U under the Micro-D, the code inherits this classification. When the 6-digit code includes both U and D items, we classify it as U to be conservative.[23]

The resulting classification is very similar to the Micro-D. The correlation between both classifications at the 12-digit level is 0.93. Food and beverage products, where package size plays an important role, explain most of the differences, since this characteristic is mostly available at the 12-digit level. The correlation between both classifications for these products is 0.45 while for other products it is 0.97.

As we showed in section 4, the Micro-D classification can identify differentiated products more accurately than the Rauch classification. Nevertheless, the application

[23] We provide a Stata file at authors' and journal's websites with the full 6-digit Micro-D classification and the shares for every code (with missing values in products not exported by Argentina).

of the 6-digit Micro-D will necessarily lose precision when applied to exports of other Latin American countries, especially when the food and beverage export composition is different from the Argentine composition. We check whether the 6-digit Micro-D also works better than Rauch by replicating the analysis performed in section 4 of the paper. First, we compare price levels by regressing the (log) unit value of each product (6-digit HS) on a set of dummies for each differentiation condition, controlling for fixed effects at the 2-digit level (column 1) and at the 4-digit level (column 2), both interacted with year and unit of measurement. Results are shown in table C.1.

Table C.1: Price level estimations.

	Price (ln)	Price (ln)
Both	1.0929***	0.5575***
	(0.1899)	(0.1286)
Only 6-dig. Micro-D	0.5446***	0.3427***
	(0.1849)	(0.0903)
Only Rauch	0.3126***	0.2603***
	(0.0997)	(0.0878)
2 digit HS-Unit-Year FE	Y	N
4 digit HS-Unit-Year FE	N	Y
Observations	20,063	20,063
R^2	0.6331	0.8392

Clustered standard errors by 2-digit HS-year in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Results are similar to those reported in Table 3. Products classified as D by at least one classification display higher prices than U (benchmark) products. Products classified as D by both classifications have the highest prices and products classified as D only

by the 6-digit Micro-D display higher prices than products classified as D only by Rauch.

Then, we replicate the analysis made in Table 4 by regressing products' (log) price on the destination country per-capita income and on the interaction of this variable with differentiation-condition dummies, controlling for year-unit of measurement-product (6-digit HS) fixed effects.

Table C.2: Price elasticity and destination country income

	Price (ln)
GDP pc (ln)	0.0353***
	(0.0055)
Rauch*GDP pc (ln)	0.0138
	(0.0106)
6-dig. Micro-D*GDP pc (ln)	0.0490***
	(0.0104)
Both*GDP pc (ln)	0.0218***
	(0.0069)
6-digit HS-Unit-Year FE	Y
Observations	228,608
R^2	0.8025

Source: Authors' estimations based on INDEC and World Bank.
Clustered standard errors by 6-digit HS-year in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

The results are also analogous to those in Table 4, obtained by using the Micro-D. Not only export prices are on average higher for products exported to higher-income countries under any differentiation condition, but also the 6-digit Micro-D displays the strongest relationship with income even compared to D products under both

classifications. An interesting difference that arises in this case is that products classified as D only by Rauch do not display a significantly stronger relationship with destination income than products classified as U by both classifications.

Finally, we analyze export price volatility of products according to differentiation condition. We compute the coefficient of variation of the export price at the product-destination level over the period 2002-2011, and regress it on the set of dummies for each condition, controlling for fixed effects at the 2-digit level and at the 4-digit level, both interacted with destination and unit of measurement. As in Table 5, we perform a regression for all products and for those that were exported in all years (continuous). Results are shown in table C.3.

Table C.3: Price volatility

	(1) All products	(2) Continuous products	(3) All products	(4) Continuous products
Only Rauch	0.0575***	0.0570***	0.0000	0.1117
	(0.0094)	(0.0206)	(0.0253)	(0.0828)
Only 6-dig. Micro-D	0.0726***	0.0484**	-0.0508**	-0.0860
	(0.0112)	(0.0231)	(0.0208)	(0.0736)
Both	0.1106***	0.0482***	-0.0137	-0.1004
	(0.0094)	(0.0178)	(0.0288)	(0.0930)
2-digit HS-Unit-Dest. FE	Y	Y	N	N
4-digit HS-Unit-Dest FE	N	N	Y	Y
Observations	75,359	14,482	75,359	14,482
R^2	0.2501	0.3532	0.5875	0.7023

Clustered standard errors by 2-digit HS-destination in parentheses. Dependent variable: Price variation coefficient.

*** p<0.01, ** p<0.05, * p<0.1

The regression results are quite similar to those reported in Table 5. Controlling for 2-digit HS fixed effects, D products (either under Rauch, Micro-D or Both) have a greater volatility than U products. When we control for 4-digit fixed effects we find no (statistically significant) differences between U products and products classified as D by Rauch and by both classifications. Products classified as D only by the 6-digit Micro-D show less volatility than the benchmark when we analyze all products, but the statistical significance of this difference disappears when we look at continuous products.

In sum, despite the loss of precision due to aggregation, the 6-digit Micro-D appears to be a better alternative than the Rauch classification for capturing differentiation at an internationally harmonized level of disaggregation.