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by

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04/2025

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SEEDS Working Paper 04/2025
June 2025
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Costly information and rational inattention by exporters

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Abstract:

In this paper, I present a structural gravity model within a framework that considers the cost of acquiring information. This yields a structural gravity equation that incorporates an additional factor related to export dispersion. Aggregated firm-level data from a large sample of countries provides empirical evidence that dispersion influences bilateral trade flows. Dispersion acts as both a source of information and a risk factor that demands risk premia.

Keywords:

Shannon's information theory, prior beliefs, extensive margin of trade

JEL classification:

D83, F10, F14

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1. Introduction

Exporting is widely recognized as a complex activity due to the inherent challenges and risks involved. Exporters face various trade barriers, including high setup costs for foreign distribution networks, costs arising from differences in languages, legal systems, institutional frameworks, and cultural norms, and difficulties traveling, communicating, and working with local partners. However, evidence indicates a distance elasticity puzzle. This refers to the fact that traditional models cannot account for the effect of distance on trade data using trade costs alone. Consequently, the literature has begun to consider whether distance could be a proxy for other barriers, such as information frictions.

The notion that trade elasticity increases with information costs is based on the observation that exporting involves risks arising from differences between the target and home countries, such as volatile exchange rates and unexpected foreign demand shocks. Exporters are also exposed to various external shocks, such as geopolitical tensions and trade conflicts. These information barriers are likely to affect the flow of goods between countries. While there is widespread agreement among economists that imperfect information can create significant barriers to trade, only a few studies have proposed a framework that formalizes the link between information and trade.

This paper aims to shed light on the source of differences in the extensive margin of trade by focusing on a model of rational inattention in which profit maximizing firms decide where to export their products. To achieve this, I take two steps. First, I construct a trade model of rationally inattentive firms, following the approach of Sims (2003, 2006). Secondly, I use aggregated customs data from the World Bank, covering a large sample of both developed and developing countries, to extend the traditional gravity model of international trade by studying the effect of information frictions within the rational inattention framework. In order to account for the importance of both traditional trade costs and costly information, I supplement the traditional gravity variables with a measure of exporters' priors based on the dispersion of foreign sales for each destination–sector pair. Empirical evidence confirms that dispersion influences bilateral trade flows, acting as both a source of information and a risk factor that demands risk premia.

These results are consistent with the contributions of Dasgupta and Mondria (2018) and Bertoli et al. (2020). Dasgupta and Mondria (2018) introduce the concept of rationally inattentive importers in a multi-country Ricardian trade model, where importers do not continuously monitor prices in all markets due to information processing costs. The model shows that changes in these information

costs can have non-monotonic and asymmetric effects on bilateral trade flows, which are different from traditional trade costs. Bertoli et al. (2020) assume that people are rationally inattentive when making migration decisions. The authors predict that migrants from countries with higher information costs or stronger prior knowledge will be less responsive to economic fluctuations. The attractiveness of alternative destinations is more important when migrants have a strong incentive to acquire information before moving. This incentive is the value of information, which is related to the variance of the prior distribution of destination-specific utility and the marginal cost of receiving signals about attractiveness. The distribution of past migration flows is used to infer the (unobserved) value of information.

Second, this paper is closely related to the trade literature concerned with imperfect information. These models include firm learning models (Albornoz et al., 2012; Allen 2014; Eaton et al., 2021), advertising models (Arkolakis, 2010), and network models (Rauch, 1999; Chaney, 2014). Exploring foreign markets can result in substantial sunk costs (Das et al., 2007). To avoid them, firms attempt to acquire as much information as possible from other firms before making risky decisions (Hausmann and Rodrik, 2003). This strategy is supported by the empirical research of Bertarelli (2025), Krautheim (2012), Koenig et al. (2010), and Greenaway and Kneller (2008), among others. This research is also motivated by an apparent contradiction between microeconomic data on trade and aggregate trade flows. At the micro level, export status changes frequently, whereas aggregate flows are highly persistent. I differently conjecture that the inertia in the aggregate data and the switching behavior observed at the firm level could be understood as the result of rational inattention. Fluctuations in internal firm factors affecting firms' shadow price of attention enable switching behavior to be rationalized even when fluctuations in external factors are insufficient to explain observed changes in export practices. An optimal information acquisition process is determined when rational behavior can be described as a problem of minimizing information costs. The approach to model rational inattention comes from the original ideas of Sims (2003, 2006), further developed by Matejka and McKay (2014), Caplin et al. (2019) and Pellegrino et al. (2024)². With limited attention, a firm may only consider a subset of the available alternatives, disregarding the rest. This subset is referred to as the 'consideration set' in existing literature. Assuming choices are random, the rational inattention approach evaluates the relationship between stochastic and attention-constrained choices. In this framework, the firm chooses information optimally, taking

² There are several applications of the rational inattention approach, for example in the marketing literature. For a general review, see Maćkowiak et al. (2023).

into account the costs of collecting information based on prior and posterior beliefs (Shannon model). According to Caplin et al. (2019), the Shannon model implies that, in discrete choice settings, many alternatives are generally never chosen. Indeed, the consideration set arises endogenously, based on prior beliefs and attention costs.

I proceed as follows. In section 2, I construct a trade model with rationally inattentive exporters. In section 3, I present the econometric strategy. Section 4 describes the data and estimates of the extensive margin of trade and discusses the results. Section 5 concludes.

2. The export model with rational inattention

With the aim of analyzing the choice of the destination country conditional upon exporting, I consider a firm in the origin country i that has to select its preferred destination from a set of options. More precisely, I consider a 3-stage model. In the first stage, the firm acquires information about the payoffs from exporting to different destinations. The range of possible destination markets is identified as a set of actions $A = \{a_1, a_2, \dots, a_M\}$. In the second stage, firms choose one destination in which they export to. In the third stage, the firm in origin country i exports and earns a payoff from the chosen destination.

The value of each alternative is ex ante uncertain, but this uncertainty can be reduced by allocating attention optimally taking into account the associated subjective costs. For simplicity, there are many states of the world W , where $w \in W$ denotes a generic state. The payoff of each action in each state is defined as $\pi: A \times W \rightarrow \mathbb{R}$.

Before making a decision, the firm can receive information about the state of the world in the form of an information structure consisting of a set of signals and a stochastic mapping between the true state of the world and these signals. More accurate signals lead to better choices, but they are more costly. In line with existing literature on rational inattention, I evaluate the cost of information using Shannon's mutual information theory, which establishes a relationship between signals and states (Shannon, 1948; Sims, 2003). The exporter is assumed to be a Bayesian decision-maker, endowed with prior beliefs over the states of the world. More specifically, a decision problem (ψ, A) involves a prior distribution $\psi \in \Psi(W)$ over the states of the world and a finite set of options A from which the firm must select. The cost of acquiring information is proportional to the mutual information between the signal ψ and the state w . The parameter $\lambda > 0$ converts the reduction in w 's entropy

induced by the chosen information acquisition strategy into metrics that are comparable with the payoffs.

The first step is to identify the set of chosen actions and the set of never-chosen actions. The firm must decide where to focus its attention, as some destinations may be disregarded entirely, and how much information to acquire before deciding where to export. This must be done while taking into account that signals conveying more information about the state of the world are more costly. The second step involves determining the optimal attention strategy, based on the consideration set obtained in the first step. The exporter obtain a noisy signal, which is (potentially) informative about the state vector. Then, after observing the signal, the exporter updates the prior into a posterior distribution and chooses a destination with the objective of maximizing the expected payoff.

2.1 Endogenous consideration set formation and optimal attention strategy

In the first step, the firm acts as a Bayesian expected profit maximiser, selecting the alternative with the highest expected payoff, given the posterior distribution of the action a , which has been induced by the signal ψ . The Shannon model can be solved by treating the decision problem as one of selecting the probability of each action $a \in A$ in each state w , which is denoted by $\rho(a|w)$. The value of $\rho(a|w)$ is equal to the expected value of the chosen actions minus the information costs, as determined by the Shannon mutual information between the states and actions:

[1]

$$\sum_{w \in W} \psi(w) \sum_{a \in A} \rho(a|w) \pi(a, w) - \lambda \left[\sum_{w \in W} \psi(w) \left(\sum_{a \in A} \rho(a|w) \ln \rho(a|w) \right) - \sum_{a \in A} \rho(a) \ln \rho(a) \right]$$

where $p(a) = \sum_{w \in W} \psi(w) p(a|w)$ is the unconditional probability of action a . Building on the work of Caplin et al. (2019), I take this analysis in two new directions. Firstly, it is common to observe many unchosen actions in a given decision problem. Secondly, the solution can be expressed in terms of unconditional probabilities $\rho(a) = \sum_{w \in W} \psi(w) \rho(a|w)$. More specifically, having determined the unconditional probabilities in the Shannon model, I define the set of actions chosen with positive probability as the consideration set $B(\rho) = \{a \in A | \rho(a) > 0\}$ with $B \subseteq A$.

Some assumptions are needed to describe the correlation structure between the valuations of the different alternatives. In this paper, I assume that each valuation is drawn from an independent (but not necessarily identical) distribution.

When alternative destinations are associated with independently distributed uncertain profits, the optimal attention strategy is a cut-off strategy expressed in terms of the expected payoff evaluated at prior beliefs (Caplin et al., 2019). In this case, it is important to evaluate the payoff in every state and the corresponding stochastic properties are relevant to the decision-making process.

The maximization problem [1] can be expressed in terms of unconditional probabilities (Matejka and McKay, 2015) as

$$[2] \quad \max_{p(a_1), \dots, p(a_M)} \sum_{w \in W} \lambda \sum_{a \in A} \rho(a_i) \exp(w_i/\lambda)$$

As Proposition 1 of Caplin et al. (2019) shows, the unconditional probability is optimal if and only if

$$[3] \quad \sum_{w \in W} \frac{\psi(w)z(a,w)}{\sum_{b \in A} \rho(b)z(b,w)} \leq 1$$

for all a , with equality if $a \in B(p)$. The corresponding state contingent choice probability is completely determined as follows

$$[4] \quad \rho(a|w) = \frac{\rho(a)z(a,w)}{\sum_{b \in B} \rho(b)z(b,w)}$$

where $z(a, w) = \exp(\pi(a, w)/\lambda)$ is a monotonic transformation of payoffs and λ is the marginal cost of information.

In this framework, the decision-maker ranks all possible alternatives using the expected (transformed) payoff $z(a, w)$. In this case, given two destinations in the consideration set, $l, k \in B(p)$, destination l is strictly preferred to k if the payoff for destination l is higher than that for destination k , that is $E[z(a_l, w)] > E[z(a_k, w)]$ or

$$[5] \quad \sum_{w_i \in W} \psi_l(w_i) \exp(\pi(a_l, w_i)/\lambda) > \sum_{w_i \in W} \psi_k(w_i) \exp(\pi(a_k, w_i)/\lambda).$$

More specifically, the payoff for destination k is first-order stochastically dominated by the distribution of the payoff for destination l , based on prior beliefs.

The optimal policy will be one that involves setting a cut-off point, c , such that

$$[6] \quad E[z(a_i, w)] = \sum_{w_i \in W} \psi(w_i) \exp(\pi(a_i, w)/\lambda) > c$$

If this condition is met, then the unconditional probability is strictly positive, $p(a_i) > 0$.

Moreover, the equilibrium posterior probability of exporting from country i to destination j is

$$[7] \quad \vartheta(a_i, w_j) = \frac{\rho(a_i|w_j)\psi(w_j)}{\rho(a_i)} = \frac{\psi(w_j)z(a_i, w_j)}{\sum_{b \in B} \rho(b)z(b, w_j)}$$

The last expression is obtained taking into account [4]. This posterior probability has a structure similar to a multinomial logit, except that it is adjusted by the prior probability $\psi(w_j)$, and is strongly influenced by the information cost, λ . Indeed, when λ is large, the posterior probability attaches a high weight to prior probability $\psi(w_j)$ as exporters process small amounts of information. In this case, if a country j is perceived as being highly profitable ex-ante, then it has a high probability of being chosen as a destination even if its actual profitability is low. When λ is low, the posterior choice probability attaches a high weight to the actual profit realizations as exporters process large amounts of information and receive signals about w that are much more precise. In addition, the nonlinear transformation of payoffs indicates that riskiness is a crucial factor of the information strategy. Indeed, if two destinations are associated with the same expected pay-off but one is riskier than the other, the risky destination is more valuable since the firm can tailor its information strategy to take advantage of this option when the valuation is high and avoid it when the valuation is low.

The analysis of Caplin et al. (2019) does not lead to an explicit solution for the unconditional probability in problem [1]. For doing so, we need an assumption about priors. In this paper, I assume that priors are asymmetric and influenced by exporters' bias, as in Pellegrino et al. (2024). The former characteristic states that prior distribution can be unequally dispersed across destinations. The latter one states that exporters can be systematically over-optimistic about specific destinations. More specifically, I assume Tweedie-family distributions with power index larger than two assume that all destinations $j \in A$, which are characterized by the same mean and heterogeneous dispersions as follows

$$[8] \quad z(a, w_j) \sim \text{Tw}_p \left(\mu, \frac{1}{I_j} \right)$$

where μ is the uniform mean, $\mu > 0$, and I_j is the destination-specific precision. Given these distributional assumptions, the optimal unconditional probability, $\rho(a) = \sum_{w \in W} \psi(w) \rho(a|w)$, is as follows

$$[9] \quad \rho(a) = \frac{I_j}{\sum_{b \in B} I_b}$$

The unconditional probability is positively affected by the prior precision. In other words, exporters display aversion to prior uncertainty. Exporters are more likely to select actions that they are better informed about ex-ante (they have a preference for familiarity). This result implies that the optimal strategy involves identifying the set of alternatives that have never been chosen. Let $K \leq M$ be defined as the number of target countries. This value is obtained in correspondence with the

unconditional probability for the K th country such that $\rho(a_K) > 0 \geq \rho(a_{K+1})$. The solution states that the firm ranks all alternatives and includes the best ones in the consideration set. The export model with costly information acquisition shows that the consideration set B includes K alternatives, with $B \subseteq A$, and that this set is determined by the payoff, $\pi(a, w)$, and prior precision. It is important to note that the solution implies that many alternatives are never chosen, particularly those with a low prior probability of high profit. Furthermore, no information about these alternatives is acquired.

Thus, the ranking depends on the expected payoff, $\bar{\pi}(a)$, and the information cost, λ . For a given value of the information cost, the number of destinations in the consideration set $B(p)$ is positively affected by ex-ante expected payoffs. However, the consideration set can change in non-monotonic ways with the information cost. When information costs are low, all destinations are above the cut-off point. When information costs are highest, only safe destinations are included in the consideration set. For intermediate information costs, the consideration set may change non-monotonically, as some options drop below the cut-off and others rise above it.

The corresponding conditional probability, given [4], is

$$[10] \quad \rho(a|w) = \frac{I_j^z(a,w)}{\sum_{b \in B} I_b^z(b,w)}$$

To summarize, for a given value of the information cost, the number of destinations in the consideration set $B(\rho)$ is positively affected by ex-ante expected payoffs. However, the consideration set can change in non-monotonic ways with the information cost. When information costs are low, all destinations are above the cut-off point. When information costs are highest, only safe destinations are included in the consideration set. For intermediate information costs, the consideration set may change non-monotonically, as some options drop below the cut-off and others rise above it.

2.2 Equilibrium export decisions and gravity

To obtain the equilibrium extensive margin of trade, I solve the model backwards by starting from stage 3 where I determine the expected profit of the firm in origin i deciding how much to export to destination j . Then, I go back to stage 2, where the firm chooses one destination in which to export to. Finally, I consider the first stage, where the firm decides the optimal information acquisition strategy to know the payoffs associated to all possible destinations.

In the third stage, given destination j (selected in stage 2), the exporter calculate the expected pay-off. The demand function from destination j is stochastic, with constant elasticity of substitution ε , with $\varepsilon > 1$, as follows

$$[11] \quad x_j = Y_j \left(\frac{p_j}{P_j} \right)^{-\varepsilon} \exp(\sigma_j \varepsilon_j) \quad \text{with } \varepsilon_j \sim N(0,1)$$

where Y_j denotes aggregate expenditure and P_j denotes the aggregate price index in country j , which are exogenous at country i level, and p_j is the price of the exported good. Foreign demand is subject to a lognormally-distributed shock ε_j with zero mean.

Each firm f in country i produces its output at a cost c_{if} , where c_{if} measures the amount of input required to produce a unit of output. I assume that the unit cost of inputs is 1 for simplicity³. The cost parameter c_{if} varies across firms, thereby reflecting differences in productivity levels between firms within the same country. Since firms face isoelastic demand functions they set prices as a constant mark-up over marginal costs. I denote q by the inverse of the mark-up. I model variable trade costs as iceberg costs. Firms produce a quantity $\tau > 1$ to sell one unit to a foreign customer. Finally, the firm can export to country j if it has paid the sunk cost f_{ij} . To simplify notation, from now on I drop the f subscript.

Since the foreign demand [11] is stochastic, also the variable profit is subject to a lognormally-distributed shock ε_{ij} with zero mean. More precisely, I can write the variable profit as

$$[12] \quad \pi_{ij}^v = \bar{\pi}_{ij}^v \exp(\sigma_j \varepsilon_j)$$

Given the demand function [11] and assuming that the exporter cannot acquire information over the shock ε_{ij} , then the firm considers the foreign consumers' demand as $\mu_j \equiv Y_j \left(\frac{p_j}{P_j} \right)^{-\varepsilon}$ in the profit maximizing problem. The corresponding variable profit function is therefore

$$[13] \quad \pi_{ij}^v = (1 - q) \left(\frac{\tau_{ij} c_i}{q P_j} \right)^{1-\varepsilon} Y_j \exp(\sigma_j \varepsilon_j)$$

and the net profit function is $\pi_{ij} = \pi_{ij}^v - f_{ij}$.

The solution to the export problem is characterized by a unique threshold value c_{ij}^* such that the firm exports to destination j if $c_i \in [0, c_{ij}^*)$ and stays outside this market if $c_i \in [c_{ij}^*, \infty)$.

In the information acquisition process, the firm formulates a prior on the expected pay-off. I express it as the combination of two components that determine the conditional export probability [10].

³ In general, the input cost varies across countries, reflecting international differences in production costs, and this will be taken into account in the empirical analysis.

The first one is the average per exporter profit $\bar{\pi}_{ij}^g$ which is observed in the economy. It is impossible to acquire any information about the shock ϵ_j . The second one regards the exporter's prior information set, as described in the previous section. In particular I consider an additional term to account for the exporter's degree of optimism, $\exp(-\alpha\sigma_{ij}^2/2)$. This shock is due to distortions, which are assumed to be influenced by the dispersion of priors. If $\sigma_{ij}^2 = 0$, the exporters mimic (in expectation) the world's export shares. Otherwise, there will be an export differential. If $\sigma_{ij}^2 < \sigma_{ik}^2$, country i 's exporters have ex-ante more precise information about destination j 's demand than about country k . Finally, I consider that the pay-off is affected by the foreign demand shock ϵ_{ij} , which is unlearnable by the exporter, as stated in equation [12]. Thus, I express the variable profit as

$$[14] \quad \pi_{ij}^v = \bar{\pi}_{ij}^v \exp(-\alpha\sigma_{ij}^2/2 + \sigma_j\epsilon_{ij}) = \exp(\tilde{\pi}_{ij} + \sigma_j\epsilon_{ij})$$

where $\tilde{\pi}_{ij} \equiv \ln \bar{\pi}_{ij}^g - \alpha\sigma_{ij}^2/2$ is the prior-adjusted payoff of exporting from country i to country j .

In the second stage, given that the variable profit is [14], the exporter chooses a destination j where to export, by solving the following maximization problem

$$[15] \quad \max_j E^\vartheta \{ \exp[E(\pi_{ij}^g | \mu_j, \sigma_j^2)] \} = \max_j E^\vartheta [\exp(\tilde{\pi}_{ij})]$$

where the expectation E^ϑ refers to the posterior probability [7].

Finally, I move back to the first stage. In this stage, the exporter solves the unrestricted information acquisition problem (1). I assume that the agents' prior belief $\Psi(W)$ follows a Tempered Stable distribution, with mean $\mu > 0$ and precision equal to $I_j = \exp(-\alpha\sigma_{ij}^2/2)$, the corresponding unconditional probability [9] is

$$[16] \quad \rho_{ij}^\circ = \frac{\exp(-\alpha\sigma_{ij}^2/2)}{\sum_{b \in B} \exp(-\alpha\sigma_{ib}^2/2)}.$$

Therefore, the probability is logit in the dispersion of priors.

The corresponding conditional probability, given [10], [14], and [16] is

$$[17] \quad \rho_{ij} = \frac{\exp[\ln \bar{\pi}_{ij}^g - \alpha\sigma_{ij}^2/2 + \sigma_j\epsilon_{ij}]}{\sum_{b \in B} \exp[\ln \bar{\pi}_{ib}^g - \alpha\sigma_{ib}^2/2 + \sigma_b\epsilon_{ib}]}$$

To evaluate the effect of priors on the unconditional probability, I calculate the derivative of (the log of) the unconditional probability [16] with respect to the dispersion of priors σ_{ij}^2

$$[18] \quad \frac{\partial \ln \rho_{ij}^\circ}{\partial (\sigma_{ij}^2)} = -\frac{\alpha}{2} [1 - \rho_{ij}]$$

It is easy to observe that the sign of this derivative is affected by the sign of the parameter α .

To conclude it is important to remember that there are two sources of uncertainty. A stochastic shock ϵ_{ij} , on which firms cannot acquire information, and an uncertain payoff on which it is possible to acquire (costly) information to reduce uncertainty. An important observation is that some degree of knowledge about prior precisions is needed to infer an ordering of payoffs from choice probabilities. In settings where information is costly, the fact that some choice j is observed in the data with high frequency does not necessarily imply that decision makers rank it highly: it may equally reflect that the decision makers exogenously possess better information about that choice, or that their beliefs are biased. Thus, this is the key motivation for incorporating heterogeneity in the dispersion of prior information in addition to the traditional gravity determinants of expected profits. These effects will be tested with data.

The next section describes the econometric strategy, which aims to analyze firms' behavior in line with the standard gravity approach by taking into account the optimal attention process.

3. Econometric strategy

The objective is to test the empirical relevance of information frictions and rational inattention in shaping export decisions. To this end, I apply a theory-based approach to the data, considering the optimal attention strategy expressed with the (conditional) probability of exporting to a specific target country [17]. A gravity-type equation based on the extensive margin of trade is used by taking into account the probability of exporting to a specific target country. The extensive margin of trade for country i and sector s with destination j follows the traditional literature based on Melitz (2003) and, therefore, can be expressed as

$$[19] \quad N_{ijst} = \rho_{ijst} \times N_{ist} \times \varsigma_{ijst}$$

where $N_{ist} = \sum_j N_{ijst}$ is the total number of exporters in sector s , country i and year t to all destinations; ς_{ijst} is an error term and ρ_{ijst} is the probability that the destination j is the profit-maximizing destination for a firm from country i – sector s – year t . Replacing the probability ρ_{ijst} given by [17] in [19], I obtain

$$[20] \quad N_{ijst} = N_{ist} \exp[\ln \bar{\pi}_{ijst}^v - \alpha \sigma_{ijst-}^2 + \sigma_{jst} \epsilon_{jst} + \theta_{ist}]$$

where $\theta_{ist} = -\ln[\sum_{b \in B} \exp(\ln \bar{\pi}_{ibst}^v - \alpha \sigma_{ibst-}^2 + \sigma_{bst} \epsilon_{ibst})]$. Given that the variable profit [13] can be reformulated in logs as

$$\ln \bar{\pi}_{ijst}^g = d_{ist} + d_{jt} - (\varepsilon - 1) \ln \tau_{ij}$$

with $d_{ist} = (1 - q) \left(\frac{c_{ist}}{q} \right)^{1-\varepsilon}$ and $d_{jt} = Y_{jt} (P_{jt})^{\varepsilon-1}$, I can re-write [20] as follows:

$$[21] \quad N_{ijst} = N_{ist} \exp[d_{ist} + d_{jt} - (\varepsilon - 1) \ln \tau_{ij} - \alpha \sigma_{ijst-1}^2 + \sigma_{jst} \epsilon_{ijst} + \theta_{ist}]$$

As highlighted by Caplin et al (2019), the riskiness of export destinations may either increase or decrease the export probability, depending upon its role in the export decision, either as a source of information or as a negative characteristics due to uncertainty. In fact, the prior dispersion is influenced by the information cost and the actual information collected, as stated in section 2.1. If a destination j is perceived as being highly profitable ex-ante, then it has a high probability of being chosen even if its actual profitability is low. In other words, when the information cost is high, the posterior probability attaches a high weight to the prior. Conversely, when the information cost is low, the posterior choice probability attaches a high weight to the actual profit realizations as exporters process large amounts of information and receive signals that are much more precise. If two destinations are associated with the same pay-off but one is riskier than the other, the risky destination is less valuable. In addition, riskiness also affects priors. Given the nonlinear transformation of payoffs, if two destinations are associated with the same expected pay-off but one is riskier than the other, the risky destination is more valuable since the firm can tailor its information strategy to take advantage of this option when the valuation is high and avoid it when the valuation is low.

To evaluate the impact of dispersion on the extensive margin of trade, I build a prior dispersion variable that varies across sectors and export destinations. More specifically, I assume that the stochastic characteristics of exports that affect priors are described through a simple factor structure with a sector-specific component ξ_s and two (time-varying) origin and destination country components, χ_{it} and χ_{jt} , given by

$$[22] \quad \epsilon_{ijst} = \xi_s \chi_{it} \chi_{jt}$$

where χ_{it} and χ_{jt} are random variables, and the scalars ξ_s are sector specific factor loadings to identify macroeconomic and sector-specific shocks, in line with Juvenal and Monteiro (2024). The estimates of ϵ_{ijst} , χ_{it} , and χ_{jt} , denoted $\hat{\epsilon}_{ijst}$, $\hat{\chi}_{it}$ and $\hat{\chi}_{jt}$, are obtained using (the log of) total exports by sector from country i to destination j , $X_{ijst} = x_{ijst} \times N_{ijst}$, total exports from country i to all destinations for all sectors, $X_{it} = \sum_j \sum_s X_{ijst}$, and total exports to country j from all origins and all sectors, $X_{jt} = \sum_i \sum_s X_{ijst}$. In particular,

$$[23] \quad \hat{\epsilon}_{ijst} = \ln(X_{ijst}) \quad \hat{\chi}_{it} = \ln(X_{it}) \quad \hat{\chi}_{jt} = \ln(X_{jt})$$

The prior dispersion σ_{ijst-1}^2 for sector s and destination j is estimated as

$$[24] \quad \hat{\sigma}_{ijst}^2 = \frac{std(\hat{\epsilon}_{ij})}{mean(\hat{\epsilon}_{ijst})} corr(\hat{\chi}_{it}, \hat{\chi}_{jt})$$

where $std(\hat{\epsilon}_{ij})$ is given by the standard deviation of country i total export sales by sector to destination j , $mean(\hat{\epsilon}_{ijst})$ is given by the corresponding mean and the ratio of the two is the coefficient of variation; $corr(\hat{\chi}_{it}, \hat{\chi}_{jt})$ is the correlation between $\hat{\chi}_{it}$ and $\hat{\chi}_{jt}$.

In summary, the gravity equation is estimated in multiplicative form (Model 1) as follows:

$$[21] \quad E(N_{ijst}) = N_{ist} \exp(z_{ijst}\beta) \\ = N_{ist} \exp(\alpha_1 dist_{ij} + \alpha_3 \sigma_{ijst-1}^2 + z_{ij}\beta + \theta_{ist} + \theta_{jst})$$

where σ_{ijst-1}^2 is a (1-year lagged) prior dispersion, $dist_{ij}$ is the (log of) distance between country i and country j , $\ln N_{jst-1}$ is the (time-varying) destination-specific spillover, z_{ij} is a set of (time-invariant) traditional gravity variables. The interpretation of gravity variables is of giving proxies of trade costs⁴. θ_{ist} are origin-sector-year fixed effects, θ_{jst} are destination-sector-year fixed effects. The set of time-varying exporter (importer) dummies that control for outward (inward) multilateral resistances. The rich structure of fixed effects allows controlling for origin-sector specificities such as productivity shocks, and destination-sector specific factors, such as policy-induced barriers to exports. The purpose and main advantage of specification (21) is that it will deliver benchmark estimates of the effects of the standard gravity covariates (e.g. distance, contiguity, etc.) for the extensive margin of trade. The total number of exporters at the origin country-sector level (N_{ist}) is included among the regressors with a coefficient which is constrained to 1.

Besides traditional geographical, cultural and linguistic variables, I consider information spillovers from all exporters to the same destination, defined as destination-specific spillovers. This is empirically justified by previous evidence, such as Bertarelli (2025), Choquette and Meinen (2015), Cassey and Schmeiser (2013), Krautheim (2012), and Koenig (2009). Second, given that information requirements for export activities in geographically more distant markets are likely to be higher, I introduce two interaction terms of the distance variable and the prior dispersion with the spillover variable. More specifically, the prior dispersion and the distance variable are interacted with the number of exporters from all countries to the same destination-sector in year $t-1$. Thus, in Model 2 specification, I enrich the set of explanatory variables by adding a spillover variable and two interactions as follows:

⁴ These variables are traditionally justified in a framework where exporters are subject to heterogeneous trade costs, with the noise following an extreme value distribution. See, for example, Santos Silva et al. (2014).

$$[22] \quad E(N_{ijst}) = N_{ist} \exp(\alpha_1 dist_{ij} + \alpha_2 dist_{ij} * \ln N_{jst-1} + \alpha_3 \sigma_{ijs}^2 + \alpha_4 \sigma_{ijst}^2 * \ln N_{jst-1} + z_{ij}\beta + \theta_{ist} + \theta_{jst})$$

In Model 3 specification, I differently consider an interaction variable between distance and prior dispersion (without the spillover variable) as follows:

$$[23] \quad E(N_{ijst}) = N_{ist} \exp(\alpha_1 dist_{ij} + \alpha_3 \sigma_{ijst-}^2 + \alpha_5 \sigma_{ijst-1}^2 * dist_{ij} + z_{ij}\beta + \theta_{ist} + \theta_{jst})$$

Adding these interaction variables into the econometric model implies that exporters can observe the determinants of the accessibility of destination j, but they can observe more precise local economic conditions at a cost.

Finally, in Model 4 I consider all interaction variables, used in Model 2 and Model3, as follows

$$[24] \quad E(N_{ijst}) = N_{ist} \exp(\alpha_1 dist_{ij} + \alpha_2 dist_{ij} * \ln N_{jst-1} + \alpha_3 \sigma_{ijst-1}^2 + \alpha_4 \sigma_{ijst-}^2 * \ln N_{jst-1} + \alpha_5 \sigma_{ijst-}^2 * dist_{ij} + z_{ij}\beta + \theta_{ist} + \theta_{jst})$$

I estimate equations from [21] to [24] using a Poisson pseudo-maximum-likelihood estimator with clustered standard errors at origin-destination pair level, in line with Santos Silva and Tenreyro (2006). More precisely, I use the Stata command `ppmlhdfc`, developed by Correia et al. (2019, 2020) to handle the large number of fixed effects efficiently.

4. Empirical evidence based on the rational inattention hypothesis

The empirical analysis uses the World Bank Exporter Dynamics Database (WB-EDD), which includes data on firms in 56 developing countries and seven high-income countries, aggregated at the two-digit Harmonized Commodity Description and Coding System (HS) industry level. The database contains detailed exporter characteristics and extensive and intensive margin measures, based on firm-level customs information, for the period between 1997 and 2014. There are 196 partner economies (see Tables A1 and A2 in the Appendix for a list of countries and sectors, respectively). Given the nature of the research question, I will use country-sector-destination observations.

4.1 Description of variables

The rational inattention approach has highlighted that firms' decision to export can be described with a two-step process. The first step for firms is to establish the optimal consideration set to minimize the cost of collecting information. They then decide on the specific destinations to export to as the optimal attention strategy. This process requires all possible destinations to be ranked. If I observe an export flow to some destinations, then it is plausible to assume that those destinations

are included in the consideration set. I denote with K_{ist} the number of destinations where firms in country i - sector s - year t actually export to. It is also true that other destinations could be part of the same set. However, no data are available for them. The second step is to compute the probability to export to each destination.

Table 1: Top-20 main destinations for each origin country-sector-year triplet

| Order | Destination name | Region | Freq. | Percent |
|-------|----------------------|----------------------------|-------|---------|
| 1 | United States | North America | 8210 | 14.69 |
| 2 | France | Europe & Central Asia | 2966 | 5.31 |
| 3 | South Africa | Sub-Saharan Africa | 2481 | 4.44 |
| 4 | Sweden | Europe & Central Asia | 1656 | 2.96 |
| 5 | Italy | Europe & Central Asia | 1486 | 2.66 |
| 6 | Germany | Europe & Central Asia | 1163 | 2.08 |
| 7 | Angola | Sub-Saharan Africa | 1145 | 2.05 |
| 8 | Saudi Arabia | Middle East & North Africa | 1095 | 1.96 |
| 9 | United Arab Emirates | Middle East & North Africa | 1079 | 1.93 |
| 10 | China | East Asia & Pacific | 955 | 1.71 |
| 11 | Spain | Europe & Central Asia | 936 | 1.68 |
| 12 | Norway | Europe & Central Asia | 919 | 1.64 |
| 13 | India | South Asia | 880 | 1.57 |
| 14 | Zimbabwe | Sub-Saharan Africa | 878 | 1.57 |
| 15 | Peru | Latin America & Caribbean | 839 | 1.50 |
| 16 | El Salvador | Latin America & Caribbean | 829 | 1.48 |
| 17 | United Kingdom | Europe & Central Asia | 797 | 1.43 |
| 18 | Argentina | Latin America & Caribbean | 784 | 1.40 |
| 19 | Nicaragua | Latin America & Caribbean | 730 | 1.31 |
| 20 | Kenya | Sub-Saharan Africa | 688 | 1.23 |
| 20 | Sudan | Sub-Saharan Africa | 688 | 1.23 |

Source: author's elaboration on WB-EDD database.

As a preliminary check, given the central role of rankings for acquiring information on possible destinations, I identify the main export destination of each origin-sector-year triplet to evaluate the representitiveness of the sample. Interestingly, 196 countries represent the main destination for at least one of the 55875 origin-sector-year triplets in the estimation sample. The 20 best destinations are geographically distributed all over the world (see Table 1). As expected, the United States is the most important main destination, accumulating the largest proportion of flows from a given origin. However, this occurs in only 14.7% of cases. The second most common main destination is France, accounting for 5.3% of all origin-sector-year triplets. China is in 10th position, while India is in 13th. Seven African countries and four Latin American countries appear among the 20 countries that most frequently play the role of main destination.

Taking into account the rational inattention framework, I estimate a structural gravity for sectoral trade along the extensive margin, controlling for multilateral resistances and employing the PPML estimator to analyze the impact of the determinants of the optimal consideration set and the probability of entering a specific destination market described in sections 2 and 3. The rational inattention approach highlights the crucial role of the expected payoffs and the perceived dispersion of payoffs. Regarding prior dispersion, I consider the prior dispersion for sector s and destination j as given by [25]. Data on total exports are retrieved from the WB database. For what concerns expected payoffs, I consider traditional gravity-type determinants. Traditional gravity-type variables come from the CEPII database: Contiguity is a dummy variable that equals 1 if the two countries share a land border; distance is defined as the natural logarithm of the distance between capitals (in kilometers); a common language is indicated by a dummy variable that equals 1 if the two countries share an official language; and colonial ties are indicated by a dummy variable that equals 1 if the importer has ever colonized or been colonized by the exporter, or if the two countries were once part of the same country. RTA is a dummy variable that equals 1 if the two countries belong to the same regional trade agreement and 0 otherwise. It measures the degree of trade creation effects of the regional trade agreement between members. Both WTO is a dummy variable that equals 1 if the two countries are members of the WTO.

Origin-sector-year and destination-sector-year fixed effects account for multilateral resistance terms (Anderson and van Wincoop, 2003). Outward and inward multilateral resistances are interpreted as sellers' and buyers' incidence of all trade costs (Anderson and Yotov, 2010)⁵. This set of regressors is used for estimating Model 1.

The summary statistics for all WB-EDD variables are reported in Table 2.

In Model 1, I consider the log of distance between capital cities and the prior dispersion index among regressors.

Table 2: Summary statistics for the WB-EDD variables (origin-sector-year triplets)

| Variable | Description | Obs | Mean | Std. dev. | Min | Max |
|------------|--|---------|---------|-----------|-----|-------|
| K_{ist} | N. destination markets | 1504079 | 81.15 | 48.51 | 1 | 206 |
| N_{ijst} | N. exporters to destination j | 1752689 | 14.04 | 71.16 | 0 | 7624 |
| N_{ist} | N. exporters to all K_{ist} destinations | 1752689 | 1810.31 | 4470.41 | 0 | 92215 |
| N_{jst} | N. exporters from all origins to destination j | 1752689 | 247.91 | 606.41 | 0 | 18423 |

⁵ The outward multilateral resistance consistently aggregates the incidence of trade costs on the producers of sector s in origin i as if they exported to a unified world market. The inward multilateral resistance consistently aggregates the incidence of trade costs on the consumers of sector s in destination j as if they consumed from a unified world market.

| | | | | | | |
|---------------------|------------------|--------|-------|-------|--------|-------|
| σ_{ijst-1}^2 | Prior dispersion | 621064 | 0.006 | 0.119 | -10.97 | 25.87 |
|---------------------|------------------|--------|-------|-------|--------|-------|

Source: author's elaboration on WB-EDD database for sector-level data according to the HS-2 digit classification.

Table 3: Extensive margin of trade and optimal attention strategy

| | <i>Model 1</i> | | <i>Model 2</i> | | <i>Model 3</i> | | <i>Model 4</i> | |
|---|----------------|-----------|----------------|-----------|----------------|-----------|----------------|-----------|
| | Coefficient | std. err. | Coefficient | std. err. | Coefficient | std. err. | Coefficient | std. err. |
| Distance (log) | 0.038 | 0.026 | 0.042 | 0.026 | 0.049* | 0.026 | -0.127 | 0.112 |
| Distance (log) \times $\ln N_{jst-1}$ | | | | | | | 0.030 | 0.023 |
| σ_{ijst-1}^2 | -3.008*** | 0.241 | 1.559*** | 0.464 | 0.025 | 1.772 | 3.571** | 1.678 |
| $\sigma_{ijst-1}^2 \times \ln N_{jst-1}$ | | | -0.834*** | 0.108 | | | -0.815*** | 0.109 |
| $\sigma_{ijst-1}^2 \times$ Distance (log) | | | | | -0.342* | 0.194 | -0.232 | 0.189 |
| Contiguity | -0.216 | 0.150 | -0.203 | 0.108 | -0.213 | 0.150 | -0.179 | 0.146 |
| Common language | -0.028 | 0.050 | -0.027 | 0.049 | -0.027 | 0.050 | -0.029 | 0.049 |
| Colony | -0.155 | 0.103 | -0.153 | 0.104 | -0.156 | 0.103 | -0.165 | 0.103 |
| Both WTO | 1.458*** | 0.375 | 1.478*** | 0.381 | 1.442*** | 0.368 | 1.467*** | 0.375 |
| Same RTA | 0.777*** | 0.146 | 0.771*** | 0.145 | 0.776*** | 0.146 | 0.771*** | 0.145 |
| Constant | -5.805*** | 0.401 | -5.846*** | 0.403 | -5.884*** | 0.408 | -5.976*** | 0.437 |
| N. obs | 928189 | | 928189 | | 928239 | | 928189 | |
| Pseudo R2 | 0.6896 | | 0.6907 | | 0.6897 | | 0.6907 | |
| AIC | 2.18E+07 | | 2.17E+07 | | 2.18E+07 | | 2.17E+07 | |
| BIC | 2.18E+07 | | 2.17E+07 | | 2.18E+07 | | 2.17E+07 | |

Notes: *** p < 0.01, ** p < 0.05, * p < 0.10; PPML-HDFE estimates of equation [21], [22], [23], and [24] with origin-product-year, destination-product-year fixed effects; standard errors are clustered at origin-destination pair level.

In Model 2, I include the number of firms from any countries exporting to the same destination-sector group among regressors to account for destination-specific spillovers. To make up for the potential circularity and simultaneity problems, following Bernard and Jensen (2004) and Koenig et al. (2010), I lag the spillover variable one year. If firm i 's export behavior depends on the surrounding firms' behavior, the latter is itself impacted by firm i 's export performance, which induces a reverse causality problem. Further, simultaneity may be an issue since unobserved demand-side shocks could affect both the export performance of firm i and the performance of its neighbors. This variable is also interacted with the prior dispersion and the distance variables.

In Model 3, I differently evaluate if distance affects the information acquisition strategy by considering an interaction term between distance and the prior dispersion. In Model 4, I integrate all interaction variables.

4.2 Results

This section describes the results related to the extensive margin of trade, as indicated by the coefficients of the Model 1–Model 4 specifications shown in Table 2.

Taking stock of the theoretical analysis developed in section 3, a greater dispersion of priors may either increase or decrease the export propensity. In the former case, dispersion is informative and is not interpreted as a risk factor. In the latter case, the negative effect relates to the potential loss in the destination market and signals that the dispersion is to be interpreted as a risk factor.

In Model 1, the negative coefficient of the dispersion variable seems to indicate that dispersion is perceived as a measure of riskiness. This result aligns with the evidence found by Juvenal and Monteiro (2024)⁶, whereby uncertainty calls for a risk premium to encourage firms to export to uncertain destinations.

However, this result appears to mask two distinct forces at play. Taking the size of destination markets into account reveals quite different results. In fact, the Model 2 specification, which includes the number of exporters from all origins to the same destination sector interacting with the dispersion variable, tells a different story. The coefficients of Model 2 highlight the dual role of the prior dispersion variable. Dispersion is informative and has a positive influence on export propensity. However, this positive effect is offset by a negative effect related to risk. The latter effect is stronger the larger the potential loss in the destination market, which is proportional to the size of that market. The results for Models 3 and 4 reveal that distance plays a less significant role in influencing the dispersion of information. AIC and BIC suggest that Models 2 and 4 are the preferred specifications.

If both the reporter and their partner are members of the WTO and of the same RTA, this encourages export propensity. The role of contiguity, common language and colonial ties in promoting cross-border trade does not appear to be statistically significant.

5. Concluding remarks

In this paper, I propose an extension to the traditional structural gravity model that includes the concept of rational inattention by exporters. I then empirically study how prior dispersion affects exporter behavior using aggregated firm-level panel data from a large sample of developed and

⁶They estimate a structural gravity equation that includes an additional factor related to risk premia. By including risk in otherwise perfect foresight models, they can identify an important source of business cycle fluctuations especially during large economic downturns.

developing countries. The rational inattention approach describes the information acquisition process as a problem of minimizing information costs. The firm must decide where to focus its attention, as some destinations may be disregarded entirely, and how much information to acquire before deciding where to export. In the optimal attention strategy, exporters obtain a noisy signal that is potentially informative about the state of the world. Then, the exporter chooses a destination with the objective of maximizing the expected payoff. Using the empirical dispersion of aggregate export flows makes it possible to identify the two channels through which dispersion affects firms' behavior: dispersion can be either informative or signal uncertain economic conditions. Indeed, the extensive margin of trade is positively affected by the dispersion measure. However, this positive effect is offset by the risk premium required for destinations where there is potential for large losses.

One promising avenue for future research would be to use this framework to identify how information costly acquisition shapes the composition of products exported in addition to the export destinations.

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Appendix A: Other assumptions on the prior distribution

The analysis of Caplin et al. (2019) does not lead to an explicit solution for the unconditional probability in problem [1]. For doing so, we need an assumption about priors. In this paper, I assume that priors follow Tempered Stable distributions. In the literature, other assumptions provide a closed-form solution. Matejka and McKay (2014) show that if prior beliefs are exchangeable in j , that is destinations are ex-ante identical, then the unconditional probability is described by the classical multinomial logit model. This model is obtained from an information theory and not from an extreme value distribution assumption, typically used for modelling trade costs.

Differently, the approach of Dasgupta and Mondria (2018) provides a closed-form solution for a case where the priors follow a one-parameter Cardell C-distribution. The parameter of this distribution coincides with the information cost parameter (λ)⁷. In the same vein, an explicit solution for the unconditional probability has been obtained in Bertoli et al. (2020) by assuming that the distribution of payoffs for destination j is $\pi_j = \bar{\pi}(a_j) + \varepsilon_j$, where ε_j is identically and independently drawn according to a Cardell distribution $C(\lambda)$, with $\lambda \in (0, 1)$. Given these distributional assumptions, the optimal unconditional probability⁸, $\rho(a) = \sum_{w \in W} \psi(w) \rho(a|w)$, is as follows

$$[A.1] \quad \rho(a) = \frac{\exp[\bar{\pi}(a)/(1-\lambda)]}{\sum_{b \in B} \exp[\bar{\pi}(b)/(1-\lambda)]}$$

This result implies that the optimal strategy involves identifying the set of alternatives that have never been chosen. Let $K \leq M$ be defined as the number of target countries. This value is obtained in correspondence with the unconditional probability for the K th country such that $\rho(a_K) > 0 \geq \rho(a_{K+1})$. The solution states that the firm ranks all alternatives and includes the best ones in the consideration set. The export model with costly information acquisition shows that the consideration set B includes K alternatives, with $B \subseteq A$, and that this set is determined by the payoff, $\pi(a, w)$, and the information cost, λ . It is important to note that the solution implies that

⁷ Other assumptions have been considered in the literature, as briefly reviewed in Appendix A.

⁸ See section 2.1.2 in Bertoli et al. (2020).

many alternatives are never chosen, particularly those with a low prior probability of high profit. Furthermore, no information about these alternatives is acquired.

Thus, the ranking depends on the expectation of the transformed profit, $\exp[\bar{\pi}(a)/(1-\lambda)]$, which in turn depends on the expected payoff, $\bar{\pi}(a)$, and the information cost, λ .

The corresponding conditional probability, given [A.1], is

$$[A.2] \quad \rho(a|w) = \frac{\exp\left[\frac{\bar{\pi}(a)}{\lambda(1-\lambda)}\right]}{\sum_{b \in B} \exp\left[\frac{\bar{\pi}(b)}{\lambda(1-\lambda)}\right]}$$

To evaluate the effect of the information cost on the unconditional probability, I calculate the derivative of (the log of) the unconditional probability [A.1] with respect to the information cost

$$[A.3] \quad \frac{\partial \ln \rho_{ij}^{\circ}}{\partial \lambda} = \frac{1}{(1-\lambda)^2} [\tilde{\pi}_{ij} - \sum_{b \in B} \rho_{ib}^{\circ} \tilde{\pi}_{ij}]$$

It is easy to observe that the sign of this derivative is affected by the expression in the squared brackets. The sign is certainly positive for the most attractive destinations and negative for the least attractive ones. Therefore, the unconditional probability is a non-monotonic function of λ .

Second, the rational inattention approach highlights the importance of interaction effects between the characteristics of the payoffs and the information cost. Indeed, the impact of payoffs characteristics on the conditional probability is affected by the information cost. This can be observed from the derivative of (the log of) the unconditional probability [A.1] with respect to the gross profit and the prior dispersion

$$[A.4] \quad \frac{\partial \ln \rho_{ij}^{\circ}}{\partial \ln \pi_{ij}^g} = \frac{1}{1-\lambda} [1 - \rho_{ij}^{\circ}]$$

$$[A.5] \quad \frac{\partial \ln \rho_{ij}^{\circ}}{\partial \sigma_{ij}^2} = -\frac{1}{(1-\lambda)\sigma_{ij}^2} [1 - \rho_{ij}^{\circ}]$$

The derivatives are positive and negative, respectively, and are affected by λ . The information cost has a direct impact on their values. In fact, the larger the information cost, the larger the positive effect of the expected pay-off on the exporter probability to j and the larger is (in absolute terms) the effect on dispersion. There is also an indirect impact of λ through the effect on the unconditional probability. This effect can be either positive and negative, depending on the rank position of destination j . In best destinations, a higher information cost leads to increasing the probability so the size of the derivative (in absolute terms) is lower. Differently, in least destinations an increase of information cost will magnify the effect of payoff expected value and its uncertainty.

Appendix B: Description of countries and sectors, WB-ED database

Table B1: Description of origin countries, classified by income classes (World Bank)

| |
|---|
| <ul style="list-style-type: none"> • <i>High-income countries</i> (including upper-middle-income countries): |
| Albania, Botswana, Bulgaria, Chile, Colombia, Costa Rica, Croatia, Denmark, Dominican Republic, Ecuador, Gabon, Iran, Jordan, Kuwait, Lebanon, Macedonia, Mauritius, Mexico, Norway, Peru, Portugal, South Africa, Spain, Thailand, Uruguay |
| <ul style="list-style-type: none"> • <i>Low-income countries</i> (including lower-middle-income countries): |
| Bangladesh, Bolivia, Burkina Faso, Cambodia, Cameroon, Cote d'Ivoire, Egypt, El Salvador, Ethiopia, Georgia, Guatemala, Guinea, Kenya, Kyrgyzstan, Laos, Madagascar, Malawi, Mali, Morocco, Myanmar, Nepal, Nicaragua, Niger, Pakistan, Paraguay, Rwanda, Sao Tome and Principe, Senegal, Sri Lanka, Swaziland, Tanzania, Uganda, Yemen, Zambia |

Table B2: Description of HS-2 digit sectors

| |
|--|
| 1-LIVE ANIMALS |
| 2-MEAT AND EDIBLE MEAT OFFAL |
| 3-FISH AND CRUSTACEANS, MOLLUSCS AND OTHER AQUATIC INVERTEBRATES |
| 4-DAIRY PRODUCE, BIRDS' EGGS, NATURAL HONEY. EDIBLE PRODUCTS OF ANIMAL ORIGIN, NESOI |
| 5-PRODUCTS OF ANIMAL ORIGIN, NESOI |
| 6-LIVE TREES AND OTHER PLANTS |
| 7-EDIBLE VEGETABLES AND CERTAIN ROOTS AND TUBERS |
| 8-EDIBLE FRUITS AND NUTS, PEEL OF CITRUS FRUIT OR MELONS |
| 9-COFFEE, TEA, MATE AND SPICES |
| 10-CEREALS |
| 11-MILLING INDUSTRY PRODUCTS; MALT; STARCHES; INULIN; WHEAT GLUTEN |
| 12-OIL SEEDS AND OLEAGINOUS FRUITS; MISCELLANEOUS GRAINS, SEEDS AND FRUITS; INDUSTRIAL OR MEDICINAL PLANTS; STRAW AND FODDER |
| 13-LAC; GUMS; RESINS AND OTHER VEGETABLE SAPS AND EXTRACTS |
| 14-VEGETABLE PLAITING MATERIALS AND VEGETABLE PRODUCTS, NESOI |
| 15-ANIMAL OR VEGETABLE FATS AND OILS AND THEIR CLEAVAGE PRODUCTS; PREPARED EDIBLE FATS; ANIMAL OR VEGETABLE WAXES |
| 16-EDIBLE PREPARATIONS OF MEAT, FISH, CRUSTACEANS, MOLLUSCS OR OTHER AQUATIC INVERTEBRATES |
| 17-SUGARS AND SUGAR CONFECTIONERY |
| 18-COCOA AND COCOA PREPARATIONS |
| 19-PREPARATIONS OF CEREALS, FLOUR, STARCH OR MILK; BAKERS' WARES |
| 20-PREPARATIONS OF VEGETABLES, FRUIT, NUTS, OR OTHER PARTS OF PLANTS |
| 21-MISCELLANEOUS EDIBLE PREPARATIONS |
| 22-BEVERAGES, SPIRITS AND VINEGAR |
| 23-RESIDUES AND WASTE FROM THE FOOD INDUSTRIES; PREPARED ANIMAL FEED |
| 24-TOBACCO AND MANUFACTURED TOBACCO SUBSTITUTES |
| 25-SALT; SULFUR; EARTHS AND STONE; PLASTERING MATERIALS, LIME AND CEMENT |
| 26-ORES, SLAG AND ASH |

| |
|--|
| 28-INORGANIC CHEMICALS; ORGANIC OR INORGANIC COMPOUNDS OF PRECIOUS METALS, OF RARE-EARTH METALS, OF RADIOACTIVE ELEMENTS OR OF ISOTOPES |
| 29-ORGANIC CHEMICALS |
| 30-PHARMACEUTICAL PRODUCTS |
| 31-FERTILIZERS |
| 32-TANNING OR DYEING EXTRACTS; TANNINS AND DERIVATIVES; DYES, PIGMENTS AND OTHER COLORING MATTER; PAINTS AND VARNISHES; PUTTY AND OTHER MASTICS; INKS |
| 33-ESSENTIAL OILS AND RESINOIDS; PERFUMERY, COSMETIC OR TOILET PREPARATIONS |
| 34-SOAP ETC.; LUBRICATING PRODUCTS; WAXES, POLISHING OR SCOURING PRODUCTS; CANDLES ETC., MODELING PASTES; DENTAL WAXES AND DENTAL PLASTER PREPARATIONS |
| 35-ALBUMINOIDAL SUBSTANCES; MODIFIED STARCHES; GLUES; ENZYMES |
| 36-EXPLOSIVES; PYROTECHNIC PRODUCTS; MATCHES; PYROPHORIC ALLOYS; CERTAIN COMBUSTIBLE PREPARATIONS |
| 37-PHOTOGRAPHIC OR CINEMATOGRAPHIC GOODS |
| 38-MISCELLANEOUS CHEMICAL PRODUCTS |
| 39-PLASTICS AND ARTICLES THEREOF |
| 40-RUBBER AND ARTICLES THEREOF |
| 41-RAW HIDES AND SKINS (OTHER THAN FURSKINS) AND LEATHER |
| 42-ARTICLES OF LEATHER; SADDLERY AND HARNESS; TRAVEL GOODS, HANDBAGS AND SIMILAR CONTAINERS; ARTICLES OF GUT (OTHER THAN SILKWORM GUT) |
| 43-FURSKINS AND ARTIFICIAL FUR; MANUFACTURES THEREOF |
| 44-WOOD AND ARTICLES OF WOOD; WOOD CHARCOAL |
| 45-CORK AND ARTICLES OF CORK |
| 46-MANUFACTURES OF STRAW, ESPARTO OR OTHER PLAITING MATERIALS; BASKETWARE AND WICKERWORK |
| 47-PULP OF WOOD OR OTHER FIBROUS CELLULOSIC MATERIAL; RECOVERED (WASTE AND SCRAP) PAPER AND PAPERBOARD |
| 48-PAPER AND PAPERBOARD; ARTICLES OF PAPER PULP, PAPER OR PAPERBOARD |
| 49-PRINTED BOOKS, NEWSPAPERS, PICTURES AND OTHER PRINTED PRODUCTS; MANUSCRIPTS, TYPESCRIPTS AND PLANS |
| 50-SILK, INCLUDING YARNS AND WOVEN FABRICS THEREOF |
| 51-WOOL AND FINE OR COARSE ANIMAL HAIR, INCLUDING YARNS AND WOVEN FABRICS THEREOF; HORSEHAIR YARN AND WOVEN FABRIC |
| 52-COTTON, INCLUDING YARNS AND WOVEN FABRICS THEREOF |
| 53-VEGETABLE TEXTILE FIBERS NESOI; YARNS AND WOVEN FABRICS OF VEGETABLE TEXTILE FIBERS NESOI AND PAPER |
| 54-MANMADE FILAMENTS, INCLUDING YARNS AND WOVEN FABRICS THEREOF |
| 55-MANMADE STAPLE FIBERS, INCLUDING YARNS AND WOVEN FABRICS THEREOF |
| 56-WADDING, FELT AND NONWOVENS; SPECIAL YARNS; TWINE, CORDAGE, ROPES AND CABLES AND ARTICLES THEREOF |
| 57-CARPETS AND OTHER TEXTILE FLOOR COVERINGS |
| 58-SPECIAL WOVEN FABRICS; TUFTED TEXTILE FABRICS; LACE; TAPESTRIES; TRIMMINGS; EMBROIDERY |
| 59-IMPREGNATED, COATED, COVERED OR LAMINATED TEXTILE FABRICS; TEXTILE ARTICLES SUITABLE FOR INDUSTRIAL USE |
| 60-KNITTED OR CROCHETED FABRICS |
| 61-ARTICLES OF APPAREL AND CLOTHING ACCESSORIES, KNITTED OR CROCHETED |
| 62-ARTICLES OF APPAREL AND CLOTHING ACCESSORIES, NOT KNITTED OR CROCHETED |
| 63-MADE-UP TEXTILE ARTICLES NESOI; NEEDLECRAFT SETS; WORN CLOTHING AND WORN TEXTILE ARTICLES; RAGS |
| 64-FOOTWEAR, GAITERS AND THE LIKE; PARTS OF SUCH ARTICLES |
| 65-HEADGEAR AND PARTS THEREOF |
| 66-UMBRELLAS, SUN UMBRELLAS, WALKING-STICKS, SEAT-STICKS, WHIPS, RIDING-CROPS AND PARTS THEREOF |
| 67-PREPARED FEATHERS AND DOWN AND ARTICLES THEREOF; ARTIFICIAL FLOWERS; ARTICLES OF HUMAN HAIR |
| 68-ARTICLES OF STONE, PLASTER, CEMENT, ASBESTOS, MICA OR SIMILAR MATERIALS |

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| 69-CERAMIC PRODUCTS |
| 70-GLASS AND GLASSWARE |
| 71-NATURAL OR CULTURED PEARLS, PRECIOUS OR SEMIPRECIOUS STONES, PRECIOUS METALS; PRECIOUS METAL CLAD METALS, ARTICLES THEREOF; IMITATION JEWELRY; COIN |
| 72-IRON AND STEEL |
| 73-ARTICLES OF IRON OR STEEL |
| 74-COPPER AND ARTICLES THEREOF |
| 75-NICKEL AND ARTICLES THEREOF |
| 76-ALUMINUM AND ARTICLES THEREOF |
| 78-LEAD AND ARTICLES THEREOF |
| 79-ZINC AND ARTICLES THEREOF |
| 80-TIN AND ARTICLES THEREOF |
| 81-BASE METALS NESOI; CERMETS; ARTICLES THEREOF |
| 82-TOOLS, IMPLEMENTS, CUTLERY, SPOONS AND FORKS, OF BASE METAL; PARTS THEREOF OF BASE METAL |
| 83-MISCELLANEOUS ARTICLES OF BASE METAL |
| 84-NUCLEAR REACTORS, BOILERS, MACHINERY AND MECHANICAL APPLIANCES; PARTS THEREOF |
| 85-ELECTRICAL MACHINERY AND EQUIPMENT AND PARTS THEREOF; SOUND RECORDERS AND REPRODUCERS, TELEVISION RECORDERS AND REPRODUCERS, PARTS AND ACCESSORIES |
| 86-RAILWAY OR TRAMWAY LOCOMOTIVES, ROLLING STOCK, TRACK FIXTURES AND FITTINGS, AND PARTS THEREOF; MECHANICAL ETC. TRAFFIC SIGNAL EQUIPMENT OF ALL KINDS |
| 87-VEHICLES, OTHER THAN RAILWAY OR TRAMWAY ROLLING STOCK, AND PARTS AND ACCESSORIES THEREOF |
| 88-AIRCRAFT, SPACECRAFT, AND PARTS THEREOF |
| 89-SHIPS, BOATS AND FLOATING STRUCTURES |
| 90-OPTICAL, PHOTOGRAPHIC, CINEMATOGRAPHIC, MEASURING, CHECKING, PRECISION, MEDICAL OR SURGICAL INSTRUMENTS AND APPARATUS; PARTS AND ACCESSORIES THEREOF |
| 91-CLOCKS AND WATCHES AND PARTS THEREOF |
| 92-MUSICAL INSTRUMENTS; PARTS AND ACCESSORIES THEREOF |
| 93-ARMS AND AMMUNITION; PARTS AND ACCESSORIES THEREOF |
| 94-FURNITURE; BEDDING, CUSHIONS ETC.; LAMPS AND LIGHTING FITTINGS NESOI; ILLUMINATED SIGNS, NAMEPLATES AND THE LIKE; PREFABRICATED BUILDINGS |
| 95-TOYS, GAMES AND SPORTS EQUIPMENT; PARTS AND ACCESSORIES THEREOF |
| 96-MISCELLANEOUS MANUFACTURED ARTICLES |
| 97-SPECIAL PRODUCTS |