hSpeech Helsinki - 20 minutes

Beyond the icerberg hypothesis

**Slide 0**

The paper I will present to you is entitled “Beyond the iceberg hypothesis: opening the black box of transport costs”. It has been written with Guillaume Daudin, from University Paris Dauphine, and Jérôme Héricourt, from the University of Lille, in France. This is a work in progress, and this is actually the first time we present the paper. So I apologize in advance for not being clear enough, don’t hesitate to interrupt me in any case, and of course, any comment is more than welcome.

**Slide 1: Motivation**

Let’s start with the motivation of the paper. At the basis of our paper, is the question of trade costs. It is a surprise for no one here that trade costs have long been playing a central role in international economic analysis. They are thus considered as a major obstacle to international economic integration and international trade flows. Besides, even if trade costs have substantially decreased over the second half of the 20 th century, they remain substantial. Anderson and Van Wincoop in 2004 thus estimate that international trade costs represent a 74% markup over production costs.

Now, what is exactly behind the term “trade costs”? Trade costs are usually split into transaction costs[[1]](#footnote-1), trade-policy costs, time costs and transport costs per se. This last dimension is sizeable. According to Anderson and Van Wincoop, they represent 21% of international trade costs, or equivalently, a 15% markup.

This conveys the following picture: If many trade policy barriers have been removed over the last decades, the transport cost component of trade costs remains sizeable, and does not seem to be declining. They are accordingly the focus of the paper.

**Slide 2: Motivation (cont’)**

How to model trade costs now? The international trade literature has usually modeled trade costs as an ad-valorem equivalent, that is, as a constant percentage of the producer price per unit traded, what we commonly refer to as the “iceberg cost”. Yet, this is a debated question. Over the recent years in particular, the question arises of trade costs rather having an additive structure. And this question of the structure of transport costs (additive vs iceberg) is in fact, far from being anecdotal.

On the positive side, the presence of additive trade costs will affect the pattern of trade flows, as pointed out by Alchian & Allen in 1964) [[2]](#footnote-2). Additive costs also have strong normative implications, notably regarding the welfare gains of trade liberalization as underlined by Sorensen[[3]](#footnote-3). Empirically, a number of recent papers have provided evidence in support of the additive costs assumption.

All these elements suggest that trade costs are likely to display an additive component. However, not much is known on the quantitative side. Precisely, by how much? One objective of the paper is thus to provide an answer to this question.

**Slide 3: “Our paper in 3 questions (and 3 answers)”**

What do we do exactly in the paper? Our paper provides an empirical decomposition of the structure of transport costs over time, by explicitly distinguishing between ad-valorem and additive parts.

More precisely, our findings can be summarized in three answers, to three questions.

**First question**, what is the size of the iceberg and the additive transport costs? We provide a quantitative measure of both components, based on the US import flows over 1974-2013. We obtain that the mean value of the iceberg cost (the famous tau in the related literature) amounts to 2.5% of the export price in air transport, 3.2% in ocean shipping; the additive cost amounts to 1.8% and 2.9% of the export price.

**Second question**, what do we lose by skipping the additive part of transport costs? We provide various elements of answer to this question, that all point out to the same answer: We lose much. In particular, we obtain that, when additive costs are included, the estimate of the iceberg component is reduced by a factor of 2. As well, all measures of our goodness of fit show that the quality of fit is substantially better in presence of additive costs.

**Third question**, how have international transport costs evolved over time? We provide an answer to this question by exploiting the time dimension of our database. I would like to emphasize two main points on this aspect. First, we show the importance of disentangling the evolution of transport costs per se from the composition effects of trade patterns. When the composition effects are excluded, we find that the reduction of transport costs per se starts in 1985, and amounts to approximatively 40% between 1985 and 2013. Second, we find that the pattern of this decrease is not much different between ocean and air transport as long as the additive costs are included. This result stands in contrast with other related papers, such as Hummels (2007) and Behar and Venables (2011); again, it confirms the importance of the additive component in accounting for international transport costs.

**Slide 4: Plan of the talk**

Let me present the outline of the talk. First, I will briefly present the data sources. Then, I will explain our empirical methodology, before turning to the results. Last, I will conclude in a few words.

**Slide 5: Data Sources**

Our measure of transport costs at the basis of our estimation, is based on the difference between the export price (that is approximately, the fas price, for free alongside the shipment) and the import price (that corresponds to the cif price, for cost, insurance and freight).

We build this measure by exploiting information of the US Imports of Merchandise database. This database gives us the export price (or fas price), or basically the price for one kg of merchandise at the origin country export point. This is denoted ptilde in the following slides. We will also make use of the import price (ie, the cif price), which is the price of the same good, but at the entry of the US this time. This price is denoted p. This database makes theses series available on a yearly basis, over the period 1974-2013, at the very disaggregated HS 10 level, and distinguishes by transport mode of the product, air or vessel. Notice that this dataset has also been used by Hummels (in 2007), but we cover a longer period (Hummels stops in 2004).

Our measure of international transport costs is thus based on the ratio p over ptilde. We use sectorial data at the 3-digit classification level, even if the data is available at a more disaggregated level. This is for computational reasons. As I will detail later, we use a non-linear least quares estimator, that makes the computation of the estimates extremely burdensome, especially given the long period of time we want to cover. Confronted to this arbitrage, we have retained the 3-digit level as our benchmark classification. However, we ensure of the robustness of our results by running estimations at the 4-digit level on some selected years.

Depending on the year considered, this leaves us with around 200 products (at the 3-digit level), from approximatively 200 countries of origin.

**Slide 6: Empirical specification**

I start this section about the empirical specification, by explaining the equation we will estimate.

We start from the very standard equation that expresses the import price p as a function of the export price ptilde, given both per-kg, or additive transport cost, denoted t, and the ad-valorem, or iceberg cost, denoted tau, as written here

P = tau ptilde + p

With tau higher or equal to 1, and t being positive.

Denoting I the origin country dimension and k the product dimension, we rewrite it to get the following equation, that is at the root of our estimation, that will be made for eack year over 1974-2013.

Note that this equation is in fact also time-specific (in annual frequency) and mode-specific (air or vessel), even if we do not identify these two dimensions to not complicate the notations.

**Slide 7: Empirical specification: The estimation strategy**

I will now briefly describe our estimation strategy, without coming into many details (they are explained in the paper). Starting from the above equation, we make some assumptions on the specification of transport costs and the error term. Then, taking the log, we get the following equation (1)

Where ti, tk, taui, tauk are the parameters to be estimated, that is, fixed effects specific to each country of origin and each sector k (by year, by transport mode, app. 800 fixed effects);

As you see, this equation is non-linear (due to the additive costs). Accordingly, we use the non-linear least squares estimation method.

A key question we ask in the paper, is how to characterize the importance of additive, relative to ad-valorem costs? A natural way to answer this question is to perform the estimation constraining t to be 0, and compare the estimated results and the fitting properties of both models.

Accordingly, for each year and transport mode, we estimate two equations, when additive costs are included, as specified in Equation (1), and when they are excluded, based on Equation (2).

After running the estimations, we re-build the weighted average over the product-country dimension, to finally get 3 measures of transport costs, by year and by transport mode

* Tau hat adv (the iceberg component) and t hat add (the additive component), when both costs are included (ie, estimating Equation 1)
* Tau hat ice, when the ad-valorem component is estimated alone.

**Slide 8: Result 1**

I will now present our results.

As I said in the Introduction, our first contribution to the literature is to provide estimates for the size of both the iceberg and the additive components of transport costs, as reported in this Table. This table reports the average values over the period 1974-2013, of the weighted mean and median of both types of transport costs, by transport mode, expressed in percentage of the export price. Precisely, we report two types of estimates, at the upper level of the table, when only ad-valorem costs are modeled, and I the lower part, when the additive component is included.

Two main comments can be made. First, transport costs are sizeable: They represent approximately a 5% margin over the export price[[4]](#footnote-4). Second, we are able to quantify the values of these costs. Opening the black box of transport costs, we thus get that the iceberg component amounts to 2.5% and 3.2% of the export price in air and vessel respectively. As well, we estimate the values of the additive cost to be around 1.8% and 2.9% of the export price in air and vessel respectively. Up to our knowledge, we are the first ones to provide such a quantitative evaluation of transport costs, which provide valuable insights to the literature that needs to calibrate these tau and t values.

**Slide 9: Result 2**

The second main result of the paper is to demonstrate the importance of taking into account the additive component of international transport costs. In fact, we have several results that underlie this conclusion.

As first argument, when decomposing transport costs, we find that the additive dimension is quantitatively sizeable. As shown in Table 1, omitting the additive term substantially biases the iceberg component upwards. We thus find that the ad-valorem cost is roughly reduced by a factor of 2 when additive costs are modeled in the estimation. To make this with numbers, it is reduced from 5.8% to 3.2% for ocean shipping (as mean value over the period); similarly, it switches from 5.1% to 2.5% in air transport.

Put it differently, we find that additive component represents a sizeable share of the overall transport costs: 48.2% in average over the period for ocean shipping, 42.3% for air transport. Notice that these results, that I present as average values over the whole period, also hold on a yearly basis throughout the period (as I will show you later in Figure).

Second argument, in terms of goodness of fit. In order to deliver a more systematic diagnosis about the importance of the additive component, we explore the performances of both models (with and without the additive component) in fitting the observed cif/fas price gap. To do so, we rely on 4 measures of goodness of fit, and all deliver the same message: We get a systematically better goodness of fit when including the additive component, even when taking into account the additional degrees of freedom.

**Slide 10: Result 3: Characterizing time trends**

Our third contribution is to provide an empirical characterization of the trends of transport costs since 1974, using the time dimension of our database.

This figure somehow constitutes our starting point on this dimension. It represents the overall transport costs, in % of the export price, as the sum of the iceberg cost (the grey area) and the additive component (the black area), year by year, and by transport mode, over the 1974-2013 period. Two main comments can be made at this point. First, the magnitude of transport costs is lower in air transport than in Vessel, for all years considered (as well as on average, see Table 1). Second, transport costs have been falling since 1974, for both transport modes. We thus obtain a 50% decrease in air transport, and a slightly larger decrease in Vessel, with a 60% reduction between 1974 and 2013.

**Slide 11 : Time trends and the composition effects**

Does this result mean a decrease of transport cost per se? Not necessarily. In fact, the evolution of overall transport costs over time depend on both the changes in the pure transport costs, ie the costs per product and/or per country of origin, as well as the changes in the composition of trade flows: Total transport costs may have decreased over time because the US import more goods that are cheaper to transport, and/ or from countries with which it is cheaper to trade.

It is then necessary to eliminate the composition effects of trade flows, to isolate the evolution of transport costs per se

This is what we do, in accordance with Hummels (2007). I skip here the details of the method, to directly go to what we obtain.

**Slide 12**

The results are reported in this figure: Panel a presents the evolution of transport costs for air (dotted line) and vessel (plain line), when only an ad-valorem specification is modelled; panel (b), same thing but when both iceberg and additive costs are modeled.

**Slide 12-13 Three main findings**

Two main findings emerge.

First, the importance of excluding the composition effects: In both panels, we see that the reduction in transport costs starts in 1985, not in 1974 as the previous figure suggested

* This means that the initial reduction of overall trade costs over 1974-1984 is in fact attributable to change in the composition of trade patterns. This is also a result obtaine dby Hummels (2007).
* When the composition effects are excluded, we estimate that overall pure transport costs have declined by approximatively 40% since 1985.

Second result, the importance of the additive component of transport costs. What argument do I have on this point here? Consider the sub-period 1985-2005. When only iceberg costs are modeled, Panel a reveals a stronger decrease in Air transport, than in Ocean. This result stands in accordance with the findings of Hummels (2007) and Behar & Venables (2001).

But, and in contrast to these papers, we find no substantial difference between both transport modes when the additive component is included in the specification, as reported in Panel (b).

**Revoir les explications qu’ils donnent + les enjeux**

In accordance with the rest of the paper, these results therefore emphasize the importance of taking into account the additive component of transport costs, this time accounting for the time trends of transport costs.

**Slide 14 – Decomposing pure TC over time**

In this last slide, I want to go deeper with you in the understanding of this last result. This figure reports the time trends of transport costs, once the composition effects have been excluded, by transport mode: In panel (a) for Air, in panel (b) for Vessel. On each panel, we report the evolution of the additive cost (plain line) and the ad-valorem cost (dotted line).

Let me start with Vessel: In accordance with the above figure, we find that both components exhibit a similar downward trend.

For Air transport, we obtain much more contrasted trends. On the period 1985-2005, we estimate a substantial decrease in the ad-valorem costs, but roughly constant additive costs: This provides an explanation to the difference of results between Panels a and b above. When the additive component is omitted, the reduction of the iceberg component leads to over-estimate the decrease in total transport costs on this period.

Second, these trends are reversed around 2005, with the iceberg component exhibiting a kind of inverted U-shape, altogether with a strong decline in the additive parts. This is a result we find intriguing… If you have any suggestion to account for this, it is welcome !

**Compléments**

**Sur les termes iceberg vs ad-valorem**

L’idée de iceberg, le bien “fond” quand on le déplace, c’est donc une partie du bien transporté qui se déplace. Donc, le coût iceberg est un coût ad-valorem, mais l’inverse n’est pas vrai; le terme ad-valorem est plus “general”; hypothèse spécifique au terme iceberg, il n’y a pas de bien spécifique “transport”. Quand on transporte des voitures, une partie des voitures va à l’eau. Distinction qui est en dehors de notre focus, on assimile les deux.

**On the literature review.**

The Alchian and Allen conjecture (Alchian and Allen, 1964), that points out that the relative price of two varieties of some good will depend on the level of trade costs, does rely on the existence of additive costs: The relative demand for more expensive/higher quality product goods should increase with trade cost (“shipping the good apples out").

Lashkaripour (2016) challenges this view. He finds supporting evidence for the ad-valorem assumption by taking into account the fact that more expensive goods are systematically heavier and hence more costly to transport. One can yet be concerned by the generality of this result. By nature, his study is restricted to goods that are enumerated by items in the statistics (they represent 60% of US imports). Furthermore, while the positive correlation between weight and price seems reasonable for goods from the second industrial revolution like cars, it is dubious in the case of ITC goods which importance has been rising since 1994 (the end point of Lashkaripour's study).

Besides, a number of empirical papers provide a strong empirical support to the role of additive costs in international costs. Based on a firm-product-level database of French exporters, Martin (2012) finds that firms charge higher fas unit values on exports to more remote countries, in contradiction with the ad-valorem hypothesis. Hummels and Skiba’s (2004) estimates imply that doubling freight costs increases average fas export prices by 80-141 percent, consistent with high quality goods being sold in markets with high freight costs. These findings deliver strong empirical support in favor of the Alchian-Allen conjecture.

Calibrating on Norwegian firm-level data for 2004, Irarrazabal et al. (2015) find that an additive import tariff reduces welfare and trade by more than an identically-sized ad-valorem tariff. While these results suggest that important welfare gains can be achieved by reducing additive trade costs, not much progress has been done in quantifying such gains.

Contribution à la littérature

De manière générale

- Confirm the literature about the importance of the additive component of trade costs (Martin, 2012, Hummels & Skiba, 2004)

- But, we quantify it

- Over a large spectrum of time (1974 to 2013) and distinguishing between air and sea transport

=> A broad view of the magnitude of additive costs in international trade over time

**Par rapport au papier de Irrarazabal et al**: Closely related to our paper is the work by Irarrazabal et al. (2015), which develops a structural framework for inferring additive trade costs from firm-level trade data. Based on Norwegian exports in 2004, they find that additive costs are about 14% of the median consumer price. Our paper complements their findings in many respects. While they study trade costs in general, our database implies that we focus on international transport costs. Similarly to them, our various results emphasize the important role of the additive component of international transport costs. Further, our empirical analysis allows us to provide a quantitative measure of the levels of both the iceberg and the additive trade costs. Last, we exploit exhaustive information about the imports flows of the US, over a large time span from 1974 to 2013. In this respect, our results deliver a broader view of the magnitude of additive costs in international trade over time.

**Par rapport à la littérature sur les time trends of transport costs** : By exploiting the time coverage of our database, our paper is also related to the international trade literature that studies the patterns of trade costs over time, such as Hummels (2007) and Behar and Venables (2011).

We notably share in common with these papers to investigate the time trends of transport costs by transport mode (i.e., air or sea). Many argue that transport costs have substantially decreased with technological advance in transportation, infrastructure development and new communication technologies (seeLafourcade and Thisse, 2011). Glaeser and Kohlhase (2004) find that, over the twentieth century, the cost of moving goods have declined by over 90% in real terms. However, Hummels (2007) shows that the bulk of price declines in transportation comes from air transport, where average cost per ton-kilometer shipped dropped by 92% between 1955 and 2004. Concerning ocean shipping, which represents the major part of world trade, decline in trade prices are much less obvious, a conclusion in accordance with the studies reviewed by Behar and Venables (2011). Our paper contributes to this debate. In particular, we show the importance of taking into account the additive component in characterizing the time trends of international transport costs.

Idée : trouver des chiffres sur la période récente. Que dit Hummels (2007)? Est-ce qu’il trouve 40%?

**Sur la database**

Attention, dans les US imports flows, ce qu’on appellee export price est le “dutiable value” = la valur en douane (sur laquelle les droits de douane à l’importation vont être calculés par l’administration US)

*Confirmer avec Guillaume*

**Sur la stratégie d’estimation**

First thing to say, we follow Irrarazabal et al by making two assumptions on the specification of transport costs. First, we assume that both types of costs are separable between the origin country I and the product k dimensions. Second, we model this separability in a multiplicative manner for the iceberg cost, and an additive manner for the per-kg cost, as specified here.

We also have to take into account the fact that the observed cif-fas price ratio is higher than 1 (by construction, the cif price cannot be lower than the fas price). Taking into this constraint implies that the error term is always positive, which we ensure by specifying the estimated equation as follows,

With epsilon ik following a normal law centered on 0.

After conducting these estimations, we rebuilt a measure of each component that is country and product specific (always by year and by transport mode) (tau hat ik, t hat ik). Last step, we take the average over the product and country dimension, using the value of each trade flow (ik specific) over total trade flows as a weighting scheme.

We thus obtain a synthetic indicator of each type of transport cost, tau add, tau ice and t, by year and transport mode.

**Pourquoi privilégier, dans la presentation des résultats, la moyenne par rapport à la médiane? P**our Air, les coûts additifs sont bien plus bas pour la médiane que pour la moyenne.

Pourquoi la moyenne est plus élevée que la médiane : raison économétrique. Par essence, le terme estimé est borne à 0, et pour avoir des erreurs centrées sur 0 on les suppose de forme multiplicative, et on estime en log. En log, la distribution des erreurs est centrée réduite. Mais quand ensuite, on reconstruit en prenant l’exponentielle, forcément la distribution des termes positifs (à droite) est non bornée, à la difference des termes à gauche, bornée à 0, ce qui donne alors une médiane plus forte que la moyenne.

On voit bien l’explication sur air dans le tableau de back up, qui montre le min et le max, sur le terme additive, il y a des points vraiment très élevés.

Mais donc, si on poursuit l’argument, on peut se dire que si on exclut les outliers observés de manière plus restrictive (en passant le seuil de 5 percentiles à 10 percentiles), alors on va plus changer la moyenne (à la baisse), que la médiane? Quelle est la robustesse de nos résultats à cela?

*A discuter avec Guillaume*

**Slide 10, figure 1: les coûts de transport sont plus faibles dansl’aérien que dans le vessel**

Mais on ne peut pas comparer comme ça, il faut éliminer les effets de composition. Argument de Hummels, on a évolué pour faire transporter des biens plus coûteux à transporter en air, avant en bateau, donc sans tenir compte des effets de composition on trouve le même ordre de grandeur de baisse (nous aussi), mais quand on les élimine on trouve que la baisse des TC “purs” est plus marquée en air qu’en aérien

Nous aussi

Ce qu’on montre à ce stade, c’est que ce n’est plus vrai quand on tient compte des additifs

* On a un message sur l’évolution des TC “purs” within a given mode (ils ont baissé de la même ampleur);
* Mais on ne peut rien dire sur la difference de niveau
* On peut dire sur la différence de niveau des coûts de transport totaux (sans éliminer les effets de composition, figure 1, on sait qu’ils sont plus élevés dans le vessel), mais on ne peut pas faire la même analyse sur les “purs” TC (on part de 100 en air comme en vessel en 1974).
* A faire? Piste de recherché, comparer ce que ça coûte de transporter le même bien du même pays, par rapport à vessel, au cours du temps.

1. Information costs, contract enforcement costs, costs associated to the use of different currencies, … [↑](#footnote-ref-1)
2. Avoir en tête la référence « shipping the goods apples out. Revoir les arguments sur le papier de Lashkaripour et la réponse qu’on peut faire. points out that additive costs implies that the relative price of two varieties of different qualities will depend on the level of trade costs as long as they are additive [↑](#footnote-ref-2)
3. . In particular, Sorensen analytically shows that the welfare gains from reducing trade barriers are much larger when it occurs through a reduction of the additive costs than for the iceberg cost. Voir compléments en fin de speech [↑](#footnote-ref-3)
4. This is lower than the 15% markup mentioned in Introduction. Explanation, only « quantitative » transport costs ? [↑](#footnote-ref-4)