Speech DEGIT - 25 minutes

Beyond the iceberg hypothesis

**Slide 0**

The paper I will present today is a joint work with Guillaume Daudin, from University Paris Dauphine, and Jérôme Héricourt, from the University of Lille, in France. This work is still in progress, 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, in particular as they are considered as a major obstacle international trade flows. If they have substantially decreased over the second half of the 20 th century, this does not mean that they have fully disappeared. Anderson and Van Wincoop in 2004 thus estimate that international trade costs represent a 74% markup over production costs. This remains substantial.

Now, what lies 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. According to Anderson and Van Wincoop, transport costs represent 30% of international trade costs, or equivalently, a 21% markup over the production cost.

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 deserves attention. International transport costs 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 tax equivalent, that is, as a constant percentage of the producer price per unit traded, what we commonly refer to as the “iceberg cost”, and as illustrated on this very standard equation (with p the import price, p tilde the export price, q the quantity exported and tau the ad-valorem cost).

Yet, this is a debated question. Over the recent years in particular, the following question has risen from the literature: Would not trade costs rather exhibit an additive structure? To start with an extreme –but hopefully clarifying- example, why would it be more costly to transport from Milan to Paris, a pair of Italian shoes at price 300 than a pair of Italian shoes at price 50 (which is typically implied by the iceberg assumption) ? More seriously, there is a bunch of anecdotal evidence that suggests that the pricing shipping structure often includes an additive component, as notably reported by Irrarazabal et al (2015) for the UPS fees.

In this case, the link between the import and the export values as it now exhibits an additive form, with t the additive cost.

**Slide 3**

Going deeper than anecdotal evidence, some empirical recent papers have provided empirical evidence in support of the additive costs assumption.

You may ask, what the deal? In fact, the literature points out that this question of the structure of transport costs (additive vs iceberg) is far from being anecdotal.

On the positive side, the literature has long emphasized its role in shaping the pattern of trade flows (see the seminal paper by Alchian & Allen in 1964). Additive costs also have strong normative implications, notably regarding the welfare gains of trade liberalization, as underlined by Sorensen (2014)[[2]](#footnote-2).

All these elements suggest that transport 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 4: “Our paper in 1 questions (and 3 answers)”**

More broadly, our ambition in the paper is to answer the following question: “Do additive transport costs matter?”

To address this question, we provide an empirical decomposition of the structure of transport costs over time (where we will explicitly distinguish between ad-valorem and additive parts), using the US imports database over the period 1974-2013, decomposed by transport mode (air or maritime transport).

What is our answer? Yes, additive costs matter.

More precisely, this answer can be decomposed in three parts.

**First, in terms of the size of additive transport costs.** Yes, the additive component is sizeable. As mean value over the period, we thus obtain that the additive cost amounts to 1.8% and 2.9% of the export price in air and ocean transport respectively. This is slightly lower than our estimates for the ad-valorem component. Put it differently, we obtain that additive costs represent approximately 50% of the overall transport costs. This is clearly sizeable.

**Second**, we show the importance of the additive cost component **in terms of the quality of fit.** What do we lose by skipping the additive part of transport costs? In fact, 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. And all measures of goodness of fit show that the quality of fit is substantially better in presence of additive costs.

**Slide 5**

**Third**, additive costs matter in accounting for the time trend of transport costs. We thus show that the modelling of the additive component is key. Why? Because it changes the decomposition of the trend patterns of transport costs, between what is attributable to trade composition effects (changes in the country partners, or in the type of products traded over time), and the changes in the transport costs per se. Precisely, we show that, when the additive component is appropriately modeled, the decrease in TC observed over the period is mostly attributable to a reduction of the `pure’’ transport costs, rather to trade composition effects, a result in strong contrast with Hummels (2007).

To summarize: All our results thus provide new quantitative evidence about the importance of the additive component in international transport costs.

**Slide 6: 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 7: Data Sources**

So, data sources.

Our measure of international transport costs is based on the difference between the export price and the import price of the US imports.

We indeed build this measure by exploiting information from the US Imports of Merchandise database. This database gives us the export price (that is the fas price, for free alongside the shipment) that is basically the price for one kg of merchandise at the origin country export point. It also gives us the import price, (or cif price, for cost, insurance and freight) which is the price of the same good, at the entry of the US this time.

This database makes theses series available on a yearly basis, over the period 1974-2013, at the 5-digit level, and distinguishes by transport mode of the product, air or vessel.

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 squares 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 8 : More on our database**

Before going further, let me say a word about our database. It is clear that this database is not immune of some limitations. By nature, it restricts our analysis to the study of international transport costs. It is thus silent about the other dimensions of international trade costs, unlike Irrarazabal et al. However, as pointed out in the Introduction, it is also clear that transport costs do represent a sizeable share of trade costs. Further, in terms of transport costs per se, our measure based on the cif-fas price gap captures the quantitative costs due to insurance, handling and freight, but not those “qualitative” costs related to the time value of goods lost in transit. [[3]](#footnote-3)In this respect, it is true that using this dataset embraces a partial view of international transport barriers.

Yet, this dataset also has (at least) 3 advantages. First, it covers all imports to the US, over a long period of time, allowing to get a broad view of international transport. Second, this is a reliable dataset, coming from a single, homogenous and trustworthy customs origin, and which has already been used by Hummels (2007) but on a shorter period of time (Hummels stops in 2004). Third, and very importantly, this database provides us with both the import and the export prices; this is crucial, as it allows us to estimate the *levels* of both the ad-valorem and the additive transport costs, which is not the case of Irrarazabal et al (2015).

**Slide 9: Empirical specification (1)**

I start this section about the empirical specification, by explaining the equation at the root of our estimation

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

p = tau ptilde + t

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

We rewrite this equation to make explicitly appear the origin country dimension (i) and k the product dimension, at the k= 5 digit level, as written in Equation (1). This equation is at the root of our estimation, and it will be estimated for each year over 1974-2013. Note that this equation is also mode-specific (air or vessel), even if we do not identify these two dimensions to not complicate the notations.

**Slide 10: Empirical specification (2)**

How do we get from Equation (1) to the estimated equation? I won’t detail this point here, but let me just mention the three main simplifying assumptions. Two are related to the specification of both additive and multiplicative costs: Following Irarrazabal et al., we assume that they are separable between the country and the production dimensions; further, as mentioned in the Introduction, we adopt the 3-digit classification level as benchmark: That is, we assume that all products k within the same 3-digit sector s share the same structure of costs. The third assumption relates to the specification of the error term, given the constraint that the import/export price gap is always greater than 1 by construction.

As a result, taking logs, we finally estimate the following equation […)

With epsilon ik following a normal law centered on 0 and where ti, ts, taui, taus are the parameters to be estimated, ie fixed effects specific to each country of origin and each sector s.

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

**Slide 11 Empirical specification (3)**

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 models, when additive costs are excluded, based on Equation (2), and when they are included, as specified in Equation (3). In this case, this leaves us with approximatively 800 fixed effects to estimate (by year and transport mode, at the 3-digit level).

**Slide 12**

Last point on the methodology: 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 ice, when the ad-valorem component is estimated alone, based on Equation 2 – Model (A).
* Tau hat adv (the iceberg component) and t hat (the additive component), when both costs are included, ie, estimating Equation 3 – Model (B).

**15 minutes remaining**

**Slide 13: Question and our answers**

We can now come to the question at the heart of the paper: Do additive costs matter? Let me present how we answer (yes) to this question.

**Slide 14 – Size of the additive transport costs**

Coming to the first result, in terms of size, we can find some elements of answer in this Table. It 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 the results of estimating the two models: At the upper level of the table, when only ad-valorem costs are modeled (Model A), and in the lower part, when the additive component is included (Model B).

**Slide 15**

So, are additive costs quantitatively important? The figures reported in the above Table drive us to make a positive answer: International transport costs do exhibit a sizeable additive component.

Additive costs indeed represent roughly half of total transport costs, 48.2% for vessel, and 42.3% for air in average over the period; further, we can show that this result not only holds on average, but also throughout the period. Last, 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.

One contribution of our paper is thus to go deeper in the structure of international transport costs, thereby opening the black box of transport costs: We thus find that the iceberg component amounts to 2.5% and 3.2% of the export price in air and vessel respectively, as mean values over the period. As well, the mean values of the additive cost is around 1.8% and 2.9% of the export price in air and vessel respectively. This quantitative assessment can be very useful for the related more theoretical papers, which need to calibrate their models.

**Slide 15: Result 2: Quality of fit**

Second element that help us formulate a positive answer about the importance of the additive component, if we now look in terms of quality 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 import/export price gap. To do so, we rely on 4 measures of goodness of fit (described in the slides and in more details in the paper), 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 16: Result 3: Characterizing time trends**

Our third element of answer relies on the empirical characterization of the trends of transport costs since 1974, using the time dimension of our database.

This figure constitutes our starting point of our analysis 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. More precisely, Air transport costs have decreased by 50%. We obtain a slightly larger decrease in Vessel, with a 60% reduction between 1974 and 2013.

**Slide 17 : 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 1°) the changes in the *pure* transport costs, ie the costs per product and/or per country of origin, and 2°) 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).

In my talk, I just want to give you a sketch of our strategy to identify the composition effects. We start with our estimates of the additive and the multiplicative TC components we have just obtained. From these values, we extract the “pure" TC component by the mean of a time fixed-effect.

We this obtain a fitted and an unfitted measure for both the additive and the ad-valorem component, that we rewrite as indices, with the reference value of 100 in 1974.

Further, we build a unified measure of “total” transport costs, by agglomerating the two components, again from which we extract a fitted measure.

Hence, the comparison between the unfitted TC measure, and the fitted measure (composition effects excluded) will inform us about the underlying sources of the trend patterns of transport costs.

**Slide 18: Time trends in transport costs: Results**

The results are reported in this figure: In each panel, it reports the evolution of transport costs over the period for both the unfitted (plain blue line) and the fitted (dotted red line) measures, for the ad-valorem component (upper panel), for the additive component (middle) and for the total cost measure (bottom), for Air (LHS) and for Ocean shipping (RHS).

**Slide 19 : Time trends in transport costs: Comments**

Two main comments can be made. First, international transport costs have substantially decreased over the period (1974-2013); this is in line with the literature, see Lafourcade & Thisse (2011), and completely consistent with the first Figure I showed. More interestingly, the decrease (50% for Air, 60% for Vessel) is roughly of the same order of magnitude for both the ad-valorem and the additive components.

Second, and most importantly in our view, we find that composition effects do not play a major role in accounting for the time trend of overall transport costs. Looking at the various panels, there is indeed not much difference in the time trend between the “raw” (or unfitted) TC measure and the fitted measure (composition effects excluded). For Air, the 50% decrease in transport costs over time can thus be almost entirely be attributed to the reduction of transport costs per se, for both additive and multiplicative components. Composition effects are slightly more pronounced in maritime transport, where the 60% decrease can be roughly decomposed in a 50% decrease of pure TC, the remaining 10% coming from trade composition effects; but this is mainly the case for the multiplicative component.

**Slide 20: Time trends in transport costs: The role of additive costs**

This result stands in sharp contrast with Hummels (2007), according to whom pure transport costs have decreased much more than the unfitted ones (over 1974-2004). That is, this suggests an important role to trade composition effects

This is not what we obtain here (whereas we use the same database, until 2004). So, where does the difference of result come from?

In fact, we can show that it comes from the treatment of the additive component of transport costs. Assuming, as we do, and not Hummels, that the additive costs vary over the triple dimension time/product/country partner indeed proves to be key in the decomposition of the time trend of transport costs, between what is attributable to trade composition effects and the time change of the “pure” TC. To prove this point more clearer, we make the counterfactual experiment: What if we relax this assumption?

**Slide 21**

As we detail in the paper, if we apply Hummel’s methodology by rather assuming a constant share of additive costs over time, country, product, we get the following picture:

As you can see, the unfitted TC measure decreases by more than the fitted measure, for both Air and Vessel. This suggests a much more important role to trade composition effects than they actually do.

This constitutes our third element of answer: Additive costs do indeed matter, as the way they are modelled turns out to be key in the understanding of the underlying sources of the trend patterns of international transport costs.

**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 “général”; 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). Alchian and Allen point 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. This truly relies 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.

**Sur la database**

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

*Confirmer avec Guillaume*

**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 différence 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*

**Sur la stratégie d’estimation empirique**

*Concerning the specification of the transport costs*

First, starting from the above equation, we follow Irrarazabal et al (2015) by making two assumptions on the specification of transport costs. First, both iceberg and additive costs are separable between the origin country i and the product k dimensions; second, we will assume separability in a multiplicative manner for ad-valorem costs and additive manner for per-kg costs

Second, as I explained before, we adopt the 3-digit classification level for our benchmark estimation, even though data is available at a more disaggregated level. Put it differently, this amounts making the additional assumption that all products k (5 digit) within the same 3-digit sector s share the same structure of costs, as written here in equation.

*Concerning the specification of the error term*

Third, the estimated equation should also take into account the constraint that, by construction, the import/export price gap cannot be lower than 1. Ie, this implies that the error term should always be positive and multiplicative, as written in this equation.

**Slide Figure 1: les coûts de transport sont plus faibles dans l’aérien que dans le vessel**

Oui c’est une information, mais cela nous montre les “overall trade costs”. Mais pour pouvoir vraiment comparer les deux, 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 du fait que les couts additifs varient dans le temps/par pays/ par produit.

**Sur les chiffres par comparaison avec Anderson et Van Wincoop**

Nous: transport costs amount to approximativaley 6% of the export cost (vessel), 5% for air. Anderson et Van Wincoop (JEL, 2004), citent un mark-up de 21%, qu’ils décomposent en 9% de time cost, et un “pure transport costs” markup de 12%; à partir d’un papier de Hummels de 2001, qui utilise des données de 1994 (sur les US).

Question, pourquoi est-ce que vous avez des TC aussi bas?

Réponse : Il faut comparer aux transports costs “quantitatifs” soit 10% chez AVW, vs 5-6 % chez nous.

Pourquoi c’est plus bas? Raison majeure, c’est que les données sur lesquelles AVW fixent leurs chiffres datent déjà de deux décennies, or comme on le montre dans le papier, la baisse des coûts de transport est sur toute la période, et notamment marquée à partir de 2005.

En fait la réponse ne marche pas car en 1994-95 on est en fait sur la valeur moyenne sur la période; la raison est ailleurs. **A creuser**.

1. Information costs, contract enforcement costs, costs associated to the use of different currencies, … [↑](#footnote-ref-1)
2. . 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-2)
3. AVW: the 21% markup over production costs decomposes into 12% made of freight costs and a 9% tax equivalent of the time value of goods in transit. [↑](#footnote-ref-3)