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WP-EMS
Working Papers Series in
Economics, Mathematics and Statistics

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The relevance of the concepts of specific and generic goods for the understanding of freight transport demand

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Abstract

In this paper, we investigate the theoretical and empirical relevance of the distinction between generic goods and specific goods for the understanding of freight transport demand. Specific goods are Taylor-made for a single customer while generic goods are produced irrespective of the final customer who will buy them. Theoretically, the distinction lays on a different relationship with time, based for specific goods on a trade-off between transport duration and cost, and for generic goods on optimal stock. The distinction affects shippers' valuation of freight transport attributes such as value of time, value of transport time reliability and value of the risk of loss and damages. The theoretical analysis has not so far been able to establish conclusively how shippers' valuation of freight transport attributes is affected by the type of good produced. Hence, some empirical evidence derived from stated preference data collected among Italian shippers is used to shed some light on the topic.

Keywords: generic good, specific good, freight transport, freight service evaluation, stated preferences.
JEL: L91, R49

1 Introduction

Let us define 'specific' a good which is Taylor-made for a single customer and 'generic' a good produced irrespective of the final customer who will buy them. As will be discussed in more detail in Section 2, theoretically, the distinction lays on a different relationship with time. When the good is generic, the producer has to trade off between the magnitude of the stock and the risk of stock-out; when the good is specific, the notion of stock from which a unit can be drawn is irrelevant and the producer trades off between the extra costs and the extra revenues related to the reduction of the lead time between order and delivery.

Consequently, it is to be expected that this distinction would affect shippers' valuation of freight transport attributes such as value of time, value of transport time reliability and value of the risk of loss and damages. Whether this in fact occurs or not and by how much has quite relevant policy implications considering the importance of, for instance, the value of transport-time savings in transport projects evaluation, and the strategic role of delivery time and reliability in the competition among firms.

As discussed in Section 3, unfortunately the theoretical analysis is to a large extent unable to establish conclusively how shippers' valuation of these freight transport attributes is affected by the type of good produced. Hence, there is a need for empirical work in order to shed some light on the topic. Section 4 presents some empirical evidence derived from stated preference data collected from Italian shippers. The data set is illustrated, the research questions are discussed and a Logit model including an interaction term for specificity is estimated in order to evaluate how the valuation of transport services by producers of the two types of goods. Section 5 draws some conclusions.

2 Definition, origin of the distinction and related literature

Let us start defining the two categories of goods: generic and specific. A generic good is produced regardless of who will be the consumer buying it. A specific good is made for a specific consumer based on specifications he agreed upon with the consumer. Examples of specific goods can be found in final consumption (automobile, glasses, some pieces of furniture) but also in intermediate consumptions. The latter situation takes place, for example, when the producer of a final consumption good needs to buy pieces having special characteristics. For instance, a car manufacturer may need to order from its subcontractors some specific inputs, based on the order made by the final customer. Specific goods can also be productive assets, for instance, a machinery that will be used in the production process. Therefore a specific good can be either an input or an output.

The relationship that firms have with time, that is the mechanisms that rules the trade-offs made by firms regarding the time dedicated to different operations, is different for generic goods and specific goods as illustrated in Table 1. Generic goods are produced for stock, while specific goods are produced for a given order. Generic goods' trade-off is between the extra cost of an increase of the stock and the extra benefits of reducing the probability of stock-out. Specific goods' trade-off originates in the existence of a willingness to pay of clients for fast delivery. When this willingness to pay is equal to zero, the producer would just choose the cost minimizing duration for production and transport. But when clients are willing to pay to reduce order-to-delivery duration (lead time), the producer faces a trade-off between a reduction in the duration of the production and transportation processes and an increase in costs (Chao and Graves, 1998).

Table 1 - Generic versus specific goods : a different decisional framework

Category	Definition	Inventory practice	Profit maximising strategy
Generic	Identical for different potential purchasers	Stock management	Optimal Stock
Specific	Different for each specific purchaser	Order to Delivery	Optimal order-to-delivery duration

The distinction between these two concepts is not completely novel in economics. However, its implications for the analysis of transport operations are still incipient. There are at least three lines of research that have developed distinctions similar to the one proposed in this paper.

A first line of research has been developed in industrial economics. It is the distinction between *standardized* and *specific assets* (Williamson, 1998). It focuses on how the relationship between firms is affected by the specificity of the investment required. Although there are similarities between the Williamson's approach and the one proposed in this paper, the main difference is that the former relates to assets and not to outputs.

A second line of research relates to the *characterisation of production systems* - as illustrated by the writings of Woodward (1965), Tarondeau (1982), Delattre and Eymard-Duvernay (1983) (described in Burmeister, 2000), and Salais and Storper (1993). For instance, Salais and Storper distinguish the different productive systems based on the specificity of the inputs and the outputs. The combination of these dimensions results in the definition of four production environments: the industrial, the merchant, the interpersonal and the immaterial environment. Burmeister (2000) surveyed these categories and analysed the implications for logistics. In particular, she proposed criteria to define "logistic families" based on the productive configuration rather than *a priori* goods' classification. Burmeister's analysis is path-breaking in considering how productive configurations affect the logistic organisation of the firm. The most relevant difference between Burmeister's work and the present paper is that we place more emphasis on the implication of specificity on the valuation of transport attributes.

A third line of research belongs, not surprisingly, to logistics science and concentrates on the analysis of *how a production process converts generic inputs into specific outputs*. The analysis is exemplified by the concept of *differentiation point*, that is, the phase of the production process where the output is differentiated based on the specific requirements of a given customer. It analyses how a downstream shift of the differentiation point permits a reduction of order-to-delivery duration, often implying increased costs. This latest line of research is also a major source of inspiration to the present work. The most important difference being that we consider that inputs can be specific as well and that we concentrate on the implication of the distinction on the valuation of transport services.

Eventually, one should recall that the distinction discussed in this paper can be termed in other ways as well. For instance, the distinction between 'production-to-stock' and 'production-to-order', that is familiar in logistics science, covers a distinction similar to the one we investigate. One might also want to label the two categories 'differentiated' and 'not-differentiated' goods or 'completable' and 'not-completable' goods, as discussed in the next sections.

3 The relevance and implication of the distinction

In this section, we examine how the distinction is relevant for the understanding of the choices made by producers and of their valuation of transport attributes such as transport time, transport time reliability and the risk of loss and damages occurring during the shipment of their goods..

Value of transport time
The value of transport-time savings is determined by different mechanisms in the case of specific and in the case of generic goods. In the case of specific goods, a formal model developed by Massiani (2005) indicates that the benefits of transport time saving for a *specific good* are equal to the sum of two components. The first component includes the extra profit allowed by faster delivery, or the cost savings made by slowing the production process, or the cost savings made by choosing a slower,

transport mode, these three values being equal when the shipper maximises profit. The second component corresponds to lower inventory costs for the freight in transit. It is equal to the sum of the financial opportunity costs of having the good immobilized, the probability of damage insofar as it is proportional to the time spent in transportation and the costs of the change in the physical characteristics of the good during transport (e.g., for perishable goods).

The benefits for a *generic good* are substantially different. Based on the well-established models of optimal stock (e.g., Baumol and Vinod, 1970) the benefit of a transport-time reduction for each shipment will depend on the shipment's frequency, the carrying costs per unit of time, the quantity of good transported, the warehousing costs, and the accepted probability of stock-out.

The determinants of the value of time for the shipper for each shipment will be different for generic and specific goods. However, the analytical investigation of these determinants is not sufficient to derive further conclusions. For instance, no conclusion can be drawn on whether value of time of specific goods should be larger than the one of generic goods.

Value of transport time reliability

Theoretical elements about the shippers' evaluation of transport time reliability for generic and specific goods are scarce. Regarding *generic* goods, although the optimal stock model explicitly deals with uncertainty, it is the uncertainty regarding the level of demand and not the uncertainty regarding transport duration. As far as *specific* goods are concerned, an analytical framework is available to describe the trade-offs made by shippers (Massiani, 2005) and it is suitable for the introduction of transport-time variability. The formal derivation of the value of transport time reliability for the shippers exceeds the scope of the present article. However, in the absence of formal derivations, the analyst can elaborate some conjectures based on heuristics.

For *generic* goods, the conjecture is that transport time unreliability increases the risks of stock out and thus the need for a safety stock. Unreliability adds a second reason to the existence of a safety stock beyond the changes in demand per time unit. The cost of unreliability (and thus the benefits of an increased reliability) consists in the costs of safety stocks held to reduce the probability of stock-out.

For *specific* goods, the cost of unreliability consists mainly in the penalty that the producer will suffer if it delivers the good with a delay, and the cost of the slack time that he will have to make allowance for in order to reduce the probability of delay. Profit maximising will make the producer choose a slack-time such that marginal cost of increasing the slack time will equate the marginal benefit of reducing the possible delay. When the variability of transport time is reduced, the benefits for the producer of a specific good will consist of the reduction in the slack time and the reduction in the costs associated with the optimal probability of delay.

The conclusion regarding the value of transport time reliability is relatively similar to the one made previously about value of time. The mechanisms determining the value of reliability are different for specific and generic goods, but there is no indication on which of the two types of goods has the highest value of transport time reliability.

Value of the risk of loss and damages

The value of the loss and damages which might occur during a shipment for both types of goods needs to be assessed based on conjecture, considering that, here again, a formal analysis has not been developed yet. The conjecture, however, is that the consequences of losses or damages may be less serious for generic goods than for specific goods because the safety stock that is made to accommodate changes in the demanded quantity can also be used to replace outputs that are lost or damaged during transport. This is not the case for specific goods where lost or damaged goods need to be produced again or repaired. The conclusion in terms of value of risk of loss and damages per shipment may, however, not be straightforward since one also has to take into account the unit value of the output and the number of output units per shipment.

To conclude this section, it appears that a formal analysis of the valuation of transport attributes for *generic* and *specific* goods is still a path of investigation for economists. Additionally, even when theoretical results are available, as is the case for value of time, they are inconclusive on the ranking of transport attributes valuations between the different categories of good. For this reason, the use of field

data is necessary to shed further light on the differences of transport attribute valuations by the different firm categories.

4 Empirical results

In this section we present the data collected, the model estimated and the quantitative results obtained.

4.1 Data

A field data collection has taken place in Italy between January and June 2005 via face-to-face interviews with the aim of estimating shippers' valuation of freight transport services based on stated preferences data. A detailed illustration of the interview and some results concerning attribute cut-offs are reported in Danielis and Marcucci (2007). A sample of 99 firms was interviewed located in Friuli Venezia Giulia, a region in the north-east of Italy, in Marche and in Lazio - both regions located in central Italy. 30 of the firms produce mechanical equipment, 24 metal products, 30 furniture, 9 chemical products, and 6 electronics. All firms buy transport services.

The face-to-face interview was made up of 4 parts: 1) the definition of the typical and of the alternative shipment; 2) the specification of cut-offs; 3) the SP choice experiment; 4) a detailed interview concerning the firm's production and logistical organisation. The face-to-face interview lasted about an hour. Parts 1) and 2) are not relevant for this paper and are discussed at length in Danielis and Marcucci (2007). In part 3) respondents were asked to choose among three alternatives, two randomly generated by the software in order to assure design orthogonality and a third one consisting of the typical shipment of the firm. As regards to part 4), since the questions asked on the logistics organisation of the firms did not allow to univocally determine whether the firms produced a generic or specific good, it was decided to re-contact the firms by telephone and ask them specific question about the nature of the good produced. Telephone calls took place during the second semester of the year 2006. We were able to trace down and have replies from 66 firms.

The objective of the latter investigation was to shed light on three sets of research questions we considered of relevance. A first set of questions deals with how the distinction between the two types of goods is perceived by firm managers.

- Does the distinction between generic and specific goods correspond to something that they understand?
- How clear-cut is the difference between generic and specific goods? Are there some goods that are partly specific and partly generic?
- Does a single firm produce simultaneously the two types of good?

A second set of questions deals with the descriptive characteristics of the two categories.

- Are there some features that make generic goods different from specific goods firms? For instance are generic goods cheaper, are they transported on shorter distances, etc.
- Are there some proxies for specificity/genericity that can be used to identify whether a certain firm produces a generic/specific good in the absence of *ad hoc* information?
- Are generic/specific goods produced in different sectors?

A third set of questions concerns the difference in the valuation of transport services for the two different categories.

- How do generic/specific good producers value differently transport services?

In the questionnaire, the questions actually asked to firms were phrased in three different ways:

(1) differentiation: "*Are your products differentiated for each single customer or are they produced indistinctively for many customers?*" or "*are they differentiated for certain products, but not for others?*"

(2) If firms chose the last answer, they were asked a further question regarding "*the percentage of differentiated products*".

(3) Eventually, another question was explicitly asked concerning whether they could *complete* production in advance. This question is another way of asking firms whether they can have a stock of completed outputs in which they can pick a unit when an order is passed by a client. We will refer to this concept as "*completability/not completability*". This actual phrasing was: "*can you complete the production of your product without agreeing on some feature with the customer?*"

A priori, a high degree of correspondence is to be expected between these different phrasings. However the survey provided a different picture as will be illustrated below. To avoid confusion in the subsequent part of this paper, we will distinctively use three categorizations: generic vs. specific (defined a priori), differentiated vs. undifferentiated (answer to questions (1) and (2) above), completable vs. not-completable (answer to question (3) above).

4.2 Understanding of the distinction by the firms

Survey responses to question (1) indicate that the distinction between generic and specific goods is well understood by firms. Results also indicate that the distinction is clear-cut: 84% of the firms state that their products are either completely differentiated or undifferentiated, while 16% of the firms state that their products are partly differentiated and partly undifferentiated.

A second result is that with some surprise the a-priori expectation that undifferentiation (*produced indistinctively for different consumers*) would be highly correlated with completability (referred to the question: *the production can be completed without agreeing with the customer on the features of the product)* is not confirmed by the data. As Table 2 illustrates, the correlation is not as high as expected. As expected, none of the shipments that are differentiated are said to be completable. However, against expectations, 58% of the shipments that are said undifferentiated are said to be non-completable. Similarly, 45% of the goods that are said to be not-completable are said to be undifferentiated. Feedback from field data interviewers indicates that this situation is typical of companies that only needed to make minor customizations to the goods for a certain client. Although such situations should be considered as specific, according to our definitions, it appears that it was classified as undifferentiated by the interviewee.

Table 2 - Differentiation and completability

Percentage in each colon				Percentage in each line			
	Undiff.	Diff.			Undiff.	Diff.	Total
Completable	42%	0%		Completable	100%	0%	100 %
Non completable	58%	100%		Non completable	45%	55%	100 %
Total :	100 %	100 %					

These results suggested us that when considering the relationship of production with time, it is more convenient to use questions phrased in terms of "completability" rather than in terms of "differentiation".

4.3 Characteristics of the firms

What is the relationship between the type of good produced and the characteristics of the firm?

Comparing firms by sector (Table 3), it appears that the largest share of not-completable goods is in steel industry (88% are not-completable), whereas it appears that in this sector 52% of the shipments are completely differentiated. In mechanics and furniture the percentage of not-completable

products is still quite high, but a lower percentage (29% and 25%) are termed as differentiated. This result may indicate that an important category of specific goods are input of the production process (intermediate goods).

Table 3 - Completability and sectors

	Mechanics		Metal products		Furniture		Total
Completable	5	(21%)	2	(13%)	6	(23%)	13
Not-completable	19	(79%)	14	(88%)	20	(77%)	53
Total	24	(100%)	16	(100%)	26	(100%)	66

Analysing the relationship with firm size, no strong evidence was found of a link between dimension and completability of the shipment, although firm larger than 50 employees appear to produce a high percentage of specific goods.

It can be, hence, concluded that firms can only be weakly characterised according to product completability. In the next section, we will check whether there is a relationship between completability and shippers' transport attributes valuation.

4.4 The valuation of transport attributes

In these paragraphs, we present the results of an econometric analysis based on a random utility logit model. Two models are estimated: a base-case model including all relevant attributes and a model including an interaction term between attributes and completability. Model 1 is based on the following utility function

$$U = asc\_sq + \sum_i b_i x_i + \varepsilon_i \tag{1}$$

asc_sq is the alternative specific constant for the currently chosen alternative. It measures the resilience to the status quo.

x_i includes the following attributes characterising transport service:

- transport time: the door-to-door transport time for the shipment in days,
- freight cost: measured as % change compared with current cost,
- punctuality: measured as % of shipments that reach destination on time (defined with less than half a day delay)
- intermodality: a categorical variable assuming value 0 when the shipment is made entirely by truck and 1 when both road and rail are used,
- risk of loss and damages: is expressed as % of shipments that are either damaged or lost,
- frequency: a categorical variable assuming value 1 when the shipment frequency is low and 0 when the shipment frequency is high,
- rigidity: a categorical variable assuming value 0 when it is easy to change shipment organization and 1 when it is relatively difficult.

Model 2 adds an interaction term to Model 1:

$$U = asc\_sq + \sum_i b_i x_i + not.compl \cdot \sum_i \tilde{b}_i x_i + \varepsilon_i \tag{2}$$

where the variable *not-compl* assumes value 1 when the good cannot be completed without information provided by the customer and 0 when it can be completed. Model 1 serves as a benchmark to Model 2 and allows us to test the hypothesis concerning the relevance of the completable\not-completable distinction to the evaluation of service attributes. The econometric estimates of the two models are reported in Table 4.

Table 4 - Discrete choice models' estimates

	Model 1		Model 2	
	Coeff.	t-ratio	Coeff.	t-ratio
ASC_SQ	0.706	5.55	0.726	5.66
Intermodality	0.763	3.95	0.013	0.03
Freight cost	-10.910	-12.88	-13.566	-6.93
Transport time	-0.445	-5.05	-0.332	-1.82
Punctuality	0.375	1.97	0.843	2.11
Loss and damage	-23.235	-14.69	-22.059	-6.86
Frequency	-0.213	-1.02	0.252	0.51
Rigidity	-0.566	-2.71	0.186	0.37
Not-compl.* Intermodality			0.920	1.83
Not-compl.* Freight cost			3.152	1.47
Not-compl.* Transport time			-0.136	-0.68
Not-compl.* Punctuality			-0.602	-1.33
Not-compl.* Loss&damage			-1.243	-0.34
Not-compl.* Frequency			-0.594	-1.10
Not-compl.* Rigidity			-0.894	-1.63
Adjusted rho-squared	0.47303		0.47565	

N° of observations 975 deriving from 65 interviews

Regarding Model 1, it can be observed that the explanatory power of the model is quite high (the adjusted rho-squared is equal to 0,473), all coefficients are significant but the one for frequency. The most significant variables are freight costs and the risk of loss and damage, followed by transport time and intermodality. Since no distinction was made between goods, the coefficients of Model 1 refer to all goods, hence, to what we might call an 'aggregate' or 'average' good.

Model 2 presents two groups of coefficients. The first set of coefficients corresponds to the completable goods (when the categorical variable *not-compl* is equal to 0). They can be compared with the ones of model one, and indicate how the valuation of each attribute for a completable good compares with the one for an 'average' good.

Notice that the introduction of the interaction term for non-completability in model 2, compared with model 1, improves, but only slightly, the adjusted rho-squared (from 0,473 to 0,475). In fact, the null hypothesis that the interaction terms have all coefficients equal to zero cannot be rejected with 5 % confidence by the log likelihood ratio test. The interpretation is that the data collected during our survey does not support the thesis that the two types of goods entail an overall different valuation of transport service attributes. However, the comparison between each single coefficient of the two models provides interesting information.

The coefficient for the freight cost attribute is higher for completable goods than the coefficient for the 'average' good as found in model 1 (-13.56 relative to -10.91). This can be a signal that completable goods competition is more cost oriented relative to not-completable goods.

Transport time coefficient is lower for completable goods than for the 'average' good. The ratio between the time and cost coefficients, an indicator of the value of time, is equal to 0.024 (expressed as a % change in cost for one day time saving) for completable goods and to 0.041 for 'average' good, implying that transportation time for completable goods is less important than for non-completable goods.

On the contrary, the punctuality coefficient is much higher for completable goods (0.843) than for the 'average' good (0.375). The value of punctuality is twice as much for completable goods relative to the 'average' good (0.062 to 0.034 expressed as a % change in cost for a reduction of one percent probability of delay). It indicates that punctuality is more important for completable goods than for the not-completable goods. One possible explanation for such an observation is that the not-completable (specific) good producer has more market power than the completable (generic) good producer. Once an order is passed, the customer is tied to the producer, who hence can take advantage of some degrees of freedom with respect to contract agreements.

The loss and damage coefficient is similar equivalent, though slightly lower for completable goods than for the 'average' good. The value of the risk of loss and damage is equal to 1.62 ((value of a percent change in risk of loss and damage expressed as a percent change in cost) for completable goods and to 2.12 for the 'average' good.

To conclude, the comparison between the 'average' model (Model 1) and the model allowing for different sensitivity as regards to completable and not-completable goods (Model 2) allows us to derive two conclusions:

- our sample of firms does not exhibit an overall difference in freight transport attribute evaluation;
- there is, however, at a single coefficient level some (weak) statistical evidence which might lead to think that completable good (generic) producers tend to be more cost sensitive, to have a lower value of time, and a higher value of punctuality.

5 Discussion and conclusions

In this article, we have investigated the thesis that firms have a different relationship with time based on whether they can produce their output units in advance or they need to agree some features with a customer before completing the production. In the former case the good could be termed generic (or undifferentiated or completable) and in the latter specific (or differentiated or not-completable).

From a theoretical point of view, the analysis suggests marked differences in the productive framework corresponding to each category. It also suggests that the valuation of transport's service attributes belong to two very different decision processes. However, theoretical speculation alone is not sufficient to indicate whether the various service attributes are valued higher for generic or for specific goods.

In order to test and complement the theoretical analysis, we have used survey data collected among Italian shippers. The empirical evidence leads to the following conclusions. It appears that the distinction, for instance when phrased in terms of "differentiation" of the production, is meaningful for interviewed companies. Goods differentiation is clear-cut and a large majority of firms define that their outputs are 100 % differentiated or 100 % undifferentiated, intermediate cases are rare.

However, the concept of *differentiation* did not prove entirely univocal to describe the temporal trade-offs made by firms. Indeed, some companies state that their outputs are *differentiated* but still cannot be completed until all features of a given order are agreed upon with the customer. This shifts the interest of the analysis to the question phrased in terms of "*completability*" rather than in terms of "*differentiation*". Hence, the rest of the paper has been based on the distinction between completable and not-completable goods.

The econometric analysis of the stated preference data on the choice among freight transport services in the case of Italian shippers in three specific industrial sectors (mechanics, metal products, furniture) allowed us to test the relevance of the distinction between completable goods and the 'average' goods. The distinction moderately improves the significance of the model but the hypothesis that there is an overall difference in freight transport attribute evaluation between the producers of the two types of goods is not rejected. At individual coefficient level, some of them appear to be different between completable\not-completable goods. Completable (generic) goods seem more sensitive to freight cost savings and punctuality; they have a lower value of time and a higher value of reliability. It remains an open research question whether these results are specific to the industrial sectors investigated.

To conclude, this paper introduced an important distinction between two types of goods that bear a different relationship with time and should entail a different evaluation of freight service attribute by shippers. The case study is a first attempt to investigate empirically such assumption. More theoretical and empirical research on the issue is certainly needed.

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