Indicatori di efficienza delle catene logistiche

- Urban supply chains and transportation policies -

Romeo Danielis*°, Elena Maggi**, Lucia Rotaris*, Eva Valeri*

*University of Trieste, Italy, **University of Molise, Italy, °corresponding author: danielis@units.it

1 Urban freight distribution as an urban supply chain issue

In order to analyse the impact of transport policies on urban freight distribution we propose in this paper to adopt a supply chain approach.

For a firm the *logistics* challenge consists in the integrated planning, control, realization and monitoring of all internal and network-wide material, part and product flows, including the necessary information flows, for the purpose of satisfying customer needs and realizing a profit. The main fields of the logistics activity can be broken down into; procurement logistics, production logistics, distribution logistics, after sales logistics and disposal logistics. The more complex the firm structure (in terms of number of manufacturing plants and warehouses), the greater the difficulty of efficiently managing its logistics, particularly when its components of the chain are operated by third-party firms.

For a system of firms, the term *supply chain* is used to identify a system of activities, people, technologies, information and resources targeted at transferring a product or a service along the entire chain: from the provider of raw materials to the end customer. *Supply chain management*[1] is the term used identify the set of issues and techniques involved in a supply chain.

As most end-consumers are located in urban areas, a supply chain does include a distribution system to deliver the goods in that complex environment that is a town or a city. In this paper, we use the term *urban supply chain* (hereafter, USC) to identify that part of a supply chain in charge of delivering the goods to an urban area.

Since supply chain decisions are typically taken in order to achieve commercial efficiency disregarding wider environmental objectives, city authorities try to reconcile the conflict between the private objectives and the social ones. The branch of science dealing with these issues has been called *city logistics*.

The efficient and effective performance of the USCs is crucial for the attractiveness and competitiveness of a city. However, because of its complex nature - consisting of intertwined actors (producers, wholesalers, transport operators, retailers, and consumers) with possibly conflicting objectives and multiple constraints – and because of the interaction with other urban function such as the residential, touristic, commercial, recreational, educational function - achieving a good performance is not an easy task[2].

The need for investigating urban freight distribution from a USC point of view is recognized by several authors.

Arunotayanun and Polak (2009, p. 2) write: “Existing approaches to the empirical analysis of freight demand have, almost without exception, ignored the influence of supply chain and logistics concepts and have instead relied to conceptual and methodological approaches developed in the passenger sector. Little attention has been paid either to characterising the actual behaviours of freight agents in this evolving

[1] Gibson et al. (2005, p.) state: "Supply Chain Management encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. importantly, it also includes coordination and collaboration with channel partners, 'which can be suppliers, intermediaries, third-party service providers, and customers. in essence, supply chain management integrates supply and demand management within and across companies. "

[2] Since in an urban setting the relevant infrastructures and agent behaviors interact in especially complex and important ways, Friesz et al. (2011) models such interaction as a dynamic noncooperative Nash game and highlights that the performance of any aspect of the urban supply chain depends on the performance of the rest of the supply chain.

structure of supply chains or to how to most effectively deploy modern demand modelling techniques to accommodate these complexities. Hence, little progress has currently been made in understanding and modelling freight agents' behaviours embraced with the supply chain concepts, leaving a large gap in this area of research." Such remarks, that Arunotayanun and Polak (2009) formulate having in mind intercity, business-to-business freight modelling, is also true, or we would dare to say, it is even truer for urban freight distribution because of the reasons that will be presented below. Aggregate models do have a value, but a deeper understanding of the supply chain dimension in which urban freight distribution takes place is essential to understand and forecast how a given set of policy or regulations affect goods distribution.
To similar conclusions arrive Browne and Gomez (2011) in a paper that investigate and quantify the impact of delivery restrictions on costs and environmental performance for a distribution operation. They state that their research "highlighted the importance of adopting a supply chain approach to the removal of restrictions and the need for public/private sector cooperation.".
This paper contributes to the existing literature by: a) characterizing the USCs; b) discussing how a USC can be modelled; c) showing how transport decisions are dealt within each USC; and analysing how USCs are affected by the many proposed freight transport policies.

2 Characterizing urban supply chains

An initial classification of the USCs can be based on the product type (called, hence, product USC). The most common product types distributed in an urban area are:

- fresh fruit and vegetables;
- milk and dairy products;
- meat and fish;
- bread and pastry;
- dry food: including long-life packaged products and beverages;
- frozen food: including ice-cream products;
- clothing and footwear: including clothing and accessories besides fur industry and leather;
- pharmaceutical products;
- flowers;
- newspapers;
- home furnishing and electronics;
- stationary and tobacco.

Important attributes of a USC relate to consignment frequency, consignment time, consignment size and the possibility of consolidation with other product supply chains. As illustrated in Table 1, compiled drawing from the literature and from the authors' own field research (Marcucci and Danielis, 2008; Danielis et al., 2010), such attributes are quite differentiated between product USC.

Table 1 - Product USC and their characteristics

	Consignment frequency	Consignment time	Consignment size	Possibility of consolidation with other product supply chains
Fresh fruit and vegetables	daily	fixed	large	no
Milk and dairy products	daily	fixed	small	no
Meat	weekly	flexible	large	no
Fish	daily	fixed	large	no
Bread and pastry	daily	fixed	small	no
Dry food and beverages	weekly	flexible	large	no
Frozen food	weekly	flexible	small	no
Clothing and footwear	seasonally	flexible	large	yes
Pharmaceutical products	More than once a day	fixed	small	no
Home furnishing and electronics	monthly	flexible	large	yes
Stationary and tobacco	weekly	flexible	small	yes
Newspapers	daily	fixed	small	no
Flower	daily	flexible	small	no

Starting with consignment frequency, Table 1 indicates that the USC requiring the higher frequency, often more than once a day, is that distributing pharmaceutical products. In Italy the 17,000 pharmacies existing in 2006 were supplied almost exclusively by 138 wholesalers via 150 distribution centres (Dallari, 2006). The pharmacies share an electronic database with real-time listings of the quantity of products required by each pharmacy, and the information is transmitted via electronic data interchange and Internet. The up to 4-times-a-day consignments are performed by third parties hired and paid directly by the wholesalers using refrigerated trucks and multi-drop routing.

Fresh fruit and vegetables, milk and dairy products, fish, bread and pastry, and newspapers are supplied on a daily basis. The common feature of these USCs is that they need to guarantee that their products are fresh and new every day: this implies highly effective procurement systems. In the case of fresh fruits and vegetable and fish, the products might have also very distant origins. They arrive at the local wholesaler markets and, at least in Italy, they are directly bought by the retailers and carried to their shops using their own vehicles. Milk and dairy products, bread and pastry, and newspapers, are distributed by specialized wholesalers or local producers.

Meat, dry food and beverages, frozen food, and stationary and tobacco do not require daily supply but tend to be supplied on a (bi-)weekly basis. These products are typically distributed by specialized wholesalers serving more than one city with their own vehicles.

Home furnishing and electronics, and clothing and footwear tend to be consigned once a month or even once a season. In case of special needs, the consignments are arranged via couriers.

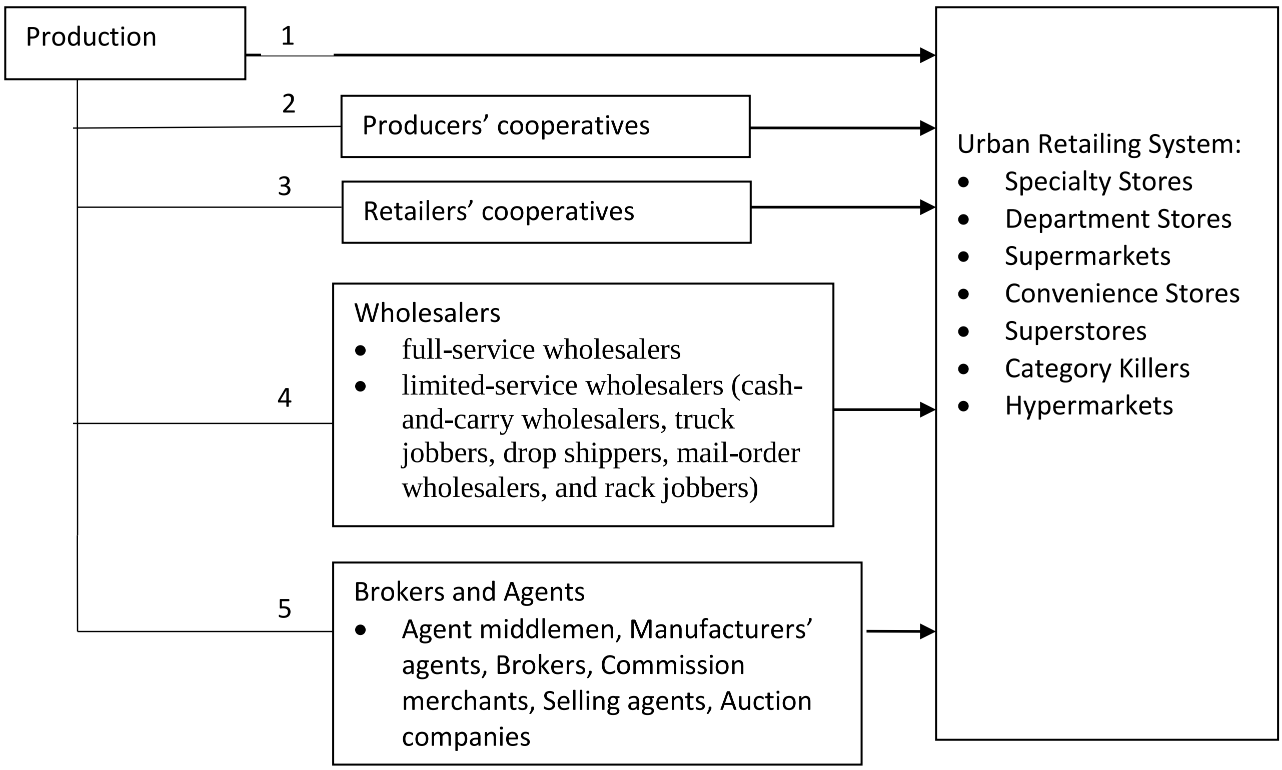
Consignment time varies also among USCs. The ones that require daily consignments are often characterized by fixed time requirements because the product has to be available on the shelf usually early in the morning. The remaining USCs are more flexible: they can be consigned during the day or even during off-shopping hours.

As to the consignment size, this usually depends on the product type. Fresh fruit and vegetables, meat, fish, clothing and footwear, dry food and beverages, and home furnishing and electronics usually have large consignment sizes, where the remaining USCs have typically small consignment sizes.

With regards with the possibility of consolidation between different product supply chains, this is limited, to some extent, to clothing and footwear, home furnishing and electronics, and stationary and tobacco. These products are usually packaged and transported by third-party transport operators.

A second classification of the USCs can be based on the structure and organization of USC. The most common types of USC are illustrated in Figure 1.

Figure 1 - Distribution channels of a generic supply chain. Source: authors' adaptation from Kotler and Armstrong (1999)



A USC can be short, or direct (n° 1 in Figure 1). Examples of direct USCS can be found in the delivery of fresh fruit and vegetable, bread and pastry, clothing and footwear, pharmaceuticals and flowers. In such cases the producers sell their goods directly to retailers. This type of organization avoids intermediary costs but requires an effort by the producer or by the retailer in order to organize, via own-account or third-party, the transportation of the goods. This form of USC is typically used either for perishable and/or locally produced goods or when the consumers are willing to pay a premium price for goods that come directly from a specific producer.

If the production of the good is fragmented among many small firms, the producers can enhance bargaining power and increase logistics efficiency by joining in associations (or cooperatives) aimed at collecting and selling the product to the retailers (n° 2 in Figure 1). Similarly, if the retail system is fragmented in many small firms, the retailers may join in associations or cooperatives (n° 3 in Figure 1).

The vast majority of the products, however, are intermediated by wholesalers, including general- (cash and carry), single-brand and specialty-line wholesalers (n° 4 in Figure 1). They are independent intermediaries that buy goods from manufacturers and sell to retailers. Since they take title to the goods, they assume certain risks and can suffer losses if products are damaged, become out-of-date or obsolete, are stolen, or are nod sold. At the same time, because they own the products, they are free to develop their own marketing strategies including setting prices. Merchant wholesalers include full-service wholesalers and limited-service merchant wholesalers. Limited-service wholesalers include cash-and-carry wholesalers, truck jobbers, drop shippers, mail-order wholesalers, and rack jobbers. Wholesalers play often a central role in organizing a USC and on the delivery of the goods to the retailers' stores.

Alternatively, the intermediary function of a USC might be performed by agents and brokers (n°4).

Indeed, the complexity of the channels increases as the number of actors interacting along the distribution chain raises, implying, if channel members adopt mark-up strategies, higher management costs for producers and higher prices for consumers. However, a large number of intermediaries allows the producers to reach many target markets and the consumers to choose among broader assortments of products.

Based on the literature and on the authors' field research, the five USCs types are associated with the product UCS as represented in Table 2.

Table 2 - Structure and organizational types of UCSs and product types

Type of USCs	Product type
1 Direct supply	fresh fruit and vegetables; bread and pastry; clothing and footwear; pharmaceutical products; flower
2 Wholesalers	fresh fruit and vegetables; meat; fish; dry food and beverages; frozen food; clothing and footwear; flower; newspapers
3 Producer cooperatives	fresh fruit and vegetable; milk and dairy products; fish
4 Brokers and agents	stationary; dairy products; dry food and beverages; frozen food
5 Retailer cooperatives	pharmaceutical products

It can be seen that some product types can be distributed via multiple structure and organizational types of USC. The most notable example is fresh fruit and vegetables.

A third classification of USCs focuses on the retail systems that supply the final consumer.

Two features differentiate the retail systems that distributed the goods in an urban area: dimension and property.

Originally, all goods where distributed via small, independent stores and few bigger regional stores. They were mostly family business with the owner working him\herself in the shop. In the last decades, such distribution systems has been complemented by stores organized and owned by retail groups (often, stock companies or cooperatives) offering one-stop–shopping for a wide variety of products in stores of different dimensions and complexity: convenience stores (less than 3,000 square feet); supermarkets (3,000 to 25,000 square feet); superstores (25,000 to 60,000 square feet); hypermarkets (above 60,000 square feet). The latter retail systems are characterized by large economies of scale, economies of scope and enhanced purchasing power which allows them to negotiate lower prices from their suppliers.

The size and the scope of the retail system has a strong influence on the procurement systems used. The small independent stores have small or no warehousing room. The goods are often delivered to them using small trucks. Usually they do not have a vehicle available and consignment take place during the shopping hours. On the contrary, a retail group has large warehousing space, vehicles and personal in charge of goods procurement (often procurement takes place at the group level not at the store level), and consignment size and time is chosen by the retailers on the basis of his\her own needs. Such features allow the retail groups to have higher consolidation levels, larger trucks, night time deliveries and, in general, a greater attention on the private efficiency of the procurement logistics.

Whereas family businesses specializes in specific products (all above product USC are possible), retail groups manage and offer many product USC at the same time.

To the above classification, two more retail systems should be added: a) the home retail system which delivers the goods bought on the internet directly to the consumer's house and b) the Ho.Re.Ca. (Hotel, Restaurant and Catering) system, where the end consumers directly consume a specific variety of goods, not a home, but in an hotel, restaurant, bar or cafe. Since the Ho.Re.Ca. system is often located in the historical centre of a city, the goods' procurement to this retail system has highly specific features.

3 Modelling the urban supply chain

Within a supply chain coordination is the key feature. Lack of coordination imply: inaccurate forecast, low capacity utilization, excessive inventory and inventory costs, inadequate customer service, multiple inventory turns, bad time to market, slow order fulfilment response, bad quality, insufficient customer focus and poor customer satisfaction.

Coordination may take three forms: a) vertical integration; b) long-term contracts aimed at increasing the total SC profit, reducing the overstock/understock costs and sharing the risks among the partners; c) short-term contracts.

The simplest USC is the direct producer-retailer supply chain. A successful producer-retailer relationship is crucial for the efficiency of an urban distribution system. It has been shown that the optimal results, both from private and system point of view, are obtained when the strategies of the two actors are coordinated (Goyal,1976). This requires that both the vendor (producer) and the buyer (retailer) make their data available to the other party to better plan the inventory management activities and that they agree on how to share the extra-profits gained via the inventory cost reduction. Full cooperation takes place in practice also when the vendor is authorized to manage the inventory levels of the buyer, taking decisions about the order quantity, the timing of the order, the reorder point and the replenishment of inventory. Such a case is termed the vendor-managed inventory system and allows the vendor to assume responsibility for maintaining inventory levels and determining order quantities for its customers. The vendor-managed inventory system has proven to be particularly beneficial for products having high demand variance and high outsourcing costs. In such a system, the operations of the vendor and buyer can be integrated through information sharing by using the information technologies such as electronic data interchange or internet-based protocols. The vendor can use this information to plan production, schedule deliveries, and manage inventory levels at the buyer. Formally the problem can be modelled as a joint economic lot size model so that system costs are reduced and capacity utilization is increased. These benefits of the vendor-managed inventory system have been widely recognized in different industries, especially in the retail industry (Wal-Mart, Kmart and JCPenny).
Modeling the optimal solution of this inventory control problem requires making some assumptions about:

- the demand: whether it is deterministic (external demand at each designated activity are known in advance with certainty) or stochastic (demand is assumed known up to a given probability distribution) and whether unsatisfied demand can be backlogged or not (unsatisfied demand is not retained);
- the supply chain: whether it is a single-product or a multi-product one;
- the time dependency of the problem: whether the parameters of the problem are stationary or not over time;
- the inventory position of each actor: whether it can be periodically reviewed or not.

Various types of coordination mechanisms have been used in supply chain coordination literature such as quantity discount, credit option, buy back/return policies, quantity flexibility, commitment of purchase quantity, etc..
Coordinating USC partners is not an easy task, since it requires: sharing strategic information, defining a common data collection methodology, and monitoring and measuring the management performance on the basis of the profits of the USC as a whole and not of the profits gained by each partner. A graphical illustration of difficulties is presented in Figure 2.

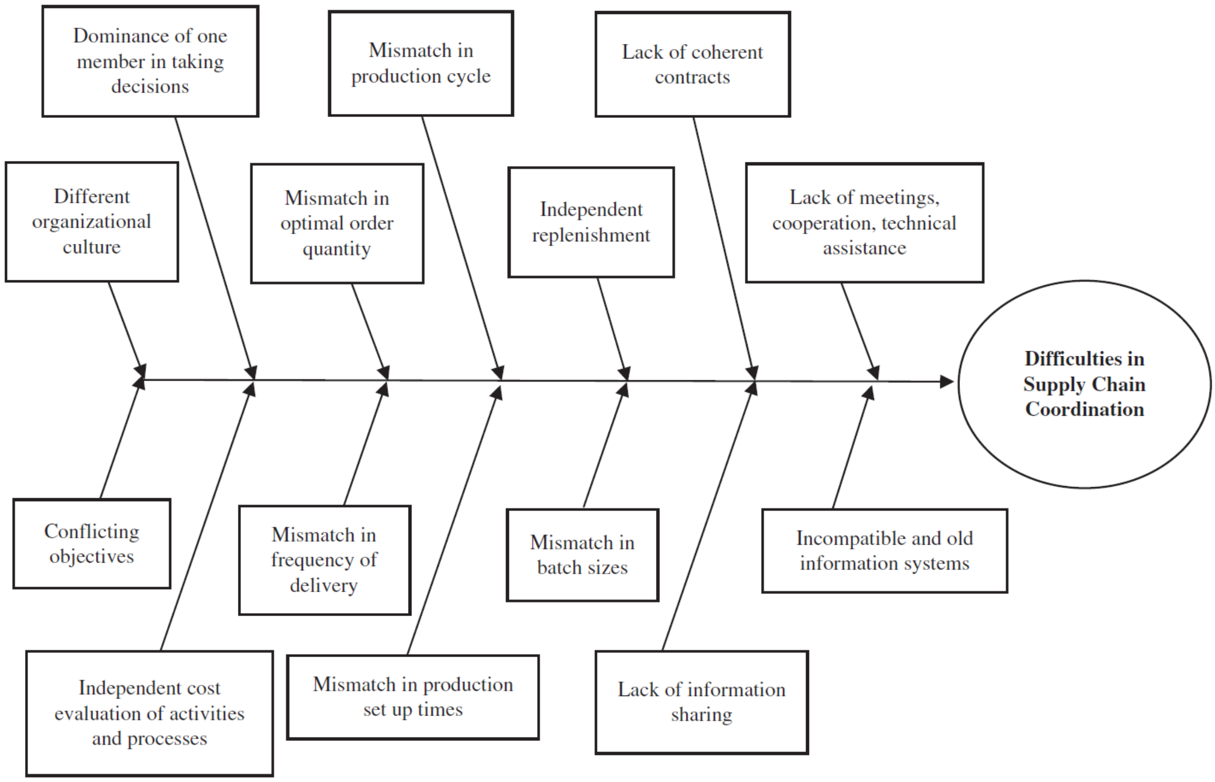


Fig. 2. Various difficulties in supply chain coordination.

Figure 2 – Coordination issues. Source: Arshinder et al. (2008 p. 329)

In the real world, unless both parties represent components of the same company, cooperation might not prevail since there is often a superior/subordinate relationship inherent in the situation where the dominant party prefers her/his priorities to lead the solution. As a result, decentralized modelling of the problem is necessary. Two models can be envisaged: a vendor-driven decentralized model and a buyer-driven decentralized model.

In a vendor-driven decentralized model, the vendor has the greater channel power and makes decisions (e.g. supply, replenishment, manufacturing etc.) independently to maximize its individual profit. Consequently, the buyer takes decisions subject to the vendor's optimal decisions. A vendor-driven decentralized model consists of two sub-problems: 1) the vendor maximizes its profits subject to his constraints, and 2) the buyer maximizes its profits subject both to his constraints and to the vendor's optimal decisions.

The opposite takes place in the buyer-driven decentralized model.

Without coordination between the vendor and buyer, a decentralized vendor-buyer system is profit inefficient because double marginalization takes place, since each party makes decisions considering only a portion of the total system profit. In fact, the decentralized model is used as a benchmark to evaluate the increase in efficiency deriving from the various coordination mechanisms.

In real markets, however, the issue is even more complicated because each buyer is typically supplied by many producers and each supplier generally serves many buyers. As a result, the joint economic lot size optimization problem requires to coordinate the deliveries carried out by the suppliers' network to the buyers' network and to take into account not only the inventory but also the transportation costs (Kim and Goya, 2009).

The supply chains comprising the producers' cooperatives or the retailers' cooperatives, depicted in Figure 1, represent a potential coordinating network to optimize inventory and transportation decisions.

The models discussed above mainly focus on the integration between two levels. But a supply chain can be made of more than two levels and its scope can be much larger. Technically, the models dealing with the optimization of the inventory and supply activity of more than two levels are called multi-echelon models. The most common notion of a multi-echelon inventory system is one involving a number of retail outlets (stores, facilities, installations, bases) to satisfy customer demands for goods and which, in turn, act as customers of higher-level wholesale activities (warehouses, depots, factories). The wholesale activities

themselves may be customers of still higher-level wholesale activities or production facilities. It is important to note that the system might pertain to a single product such as a particular kind and brand of food, but that for the same grocery store a different product may have a completely different structure (there may be a different factory, or no regional warehouses, or a different mix of retailers, etc.). A multi-echelon inventory system can be portrayed as a directed network wherein the nodes represent the various activities or facilities in the system and the linkages represent flows of goods and information. If the network has at most one incoming link for each node and flows are acyclic (that is there are no loops in the network), it is called "arborescence" or inverted tree structure (Figure 3). Although much more complex interconnected systems of facilities can exist (a retailer may obtain resupply from more than one wholesaler, or a wholesaler may procure from more than one factory, or a retailer may sometimes supply another retailer), most of the work in multi-echelon inventory theory has been confined to arborescence structures (Clark, 1972).

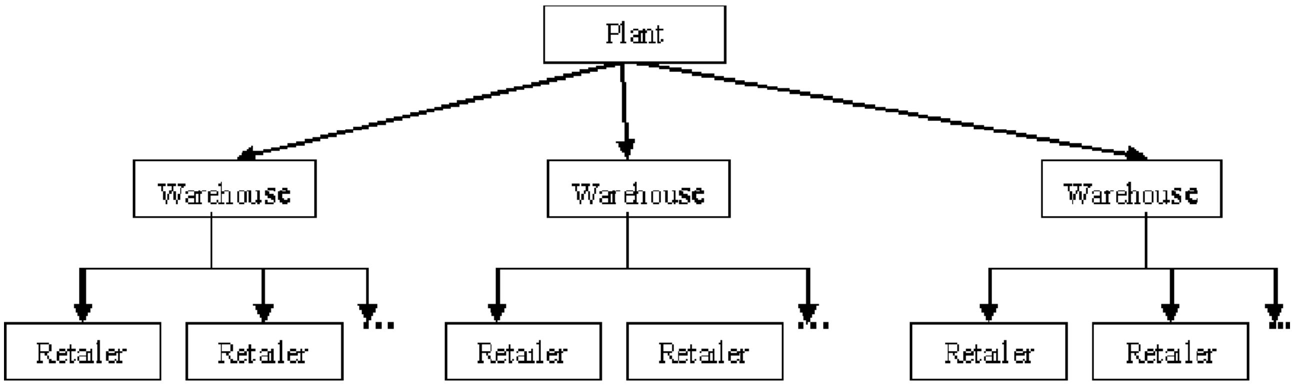


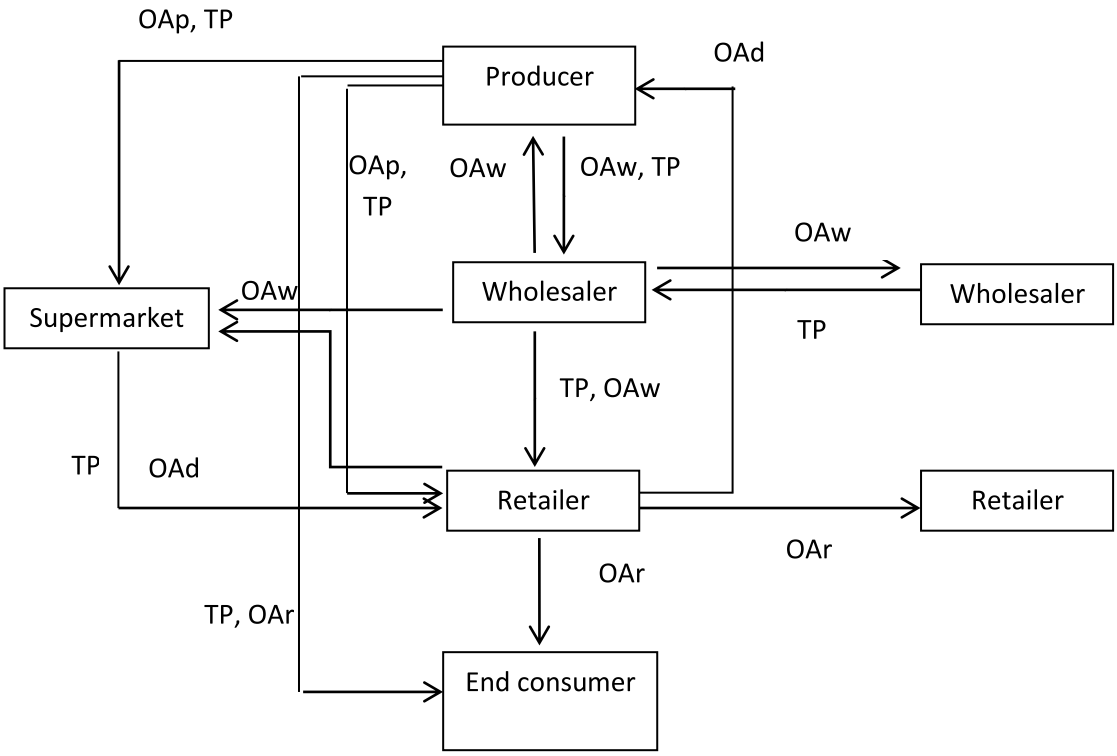
Figure 3 – Graphical representation of an "arborescence" or inverted tree structure.

As in the vendor-managed inventory system, the problem consists in managing the inventories throughout the entire supply chain so that for any echelon the stocking level should be planned taking into account not only its own inventory position but also the inventory of all the downstream echelons. The optimal planning of the inventory level for each echelon should not be determined on the basis of the demand information derived from the next downstream echelon, but on the demand from the end consumers, reducing the demand variability and, consequently, the inventory costs. Yang and Wee (2001), for instance, show that the integrated approach results in a significant cost reduction compared to that of independent decision making by each individual entity of the supply chain. Their model however, does not explain how the increase in cost at retailer level is to be compensated due to implementation of the integrated policy.
Having identified from a theoretical point of view how a USC can be modelled, we turn in the next section to the description of some real world example, concentrating mainly on the transportation features.

4 Urban supply chains and the organization and performance of the transportation activities

The structure of the USC influences the transport organization. In the following subsection it will be described which transport decisions are taken by which actor of the supply chain with regards to whether to be involved in the delivery\procurement of goods or to leave it to other actors of the supply chain or to specialized third-party transport operators. When an actor decides to be part of goods delivery\procurement, s\he needs to buy a vehicle or use her\his own car. The question is then which vehicle(s) will be bought in terms of size and type of engine (diesel, electric, alternative fuels). Next, it is interesting to know how efficiently the vehicle is used in terms of load factor.
In a research project carried out at the University of Trieste, various product supply chains have been studied and a field survey has been made, mostly in Rome and in Trieste, to answer these research questions.

Generally, three actors of the supply chain were interviewed: the producer, the wholesaler and the retailer. For the details about each chain refer to Danielis (2013). As an example, we report in Figure 3 the structure of the food supply chain.



Legenda: OA = own account; TP = third-party transport; OAp, OAw, OAr = producer's own account, wholesaler's own account and retailer's own account

Figure 4 – Actors and transport relationships in the food supply chain

The food supply chain is one of the more complicated. The producers buy inputs from other suppliers or wholesales. The delivery is performed by transport operators or own-account by the wholesaler. Producers deliver their goods with own vehicles or using third-party transport operators to the wholesaler, to the retailers and to end consumers. Some producers deliver also to supermarkets, usually with own vehicles.
The wholesalers buy the goods from the producers. The procurement is performed with own vehicles, by third party transport operators and with the producers' vehicles. The wholesalers deliver the goods to the retailers, to supermarkets and to other wholesalers. The wholesalers normally make use of their own vehicles, only sometime the make use of third-party transport operators.
The food retailers buy directly from the producers, transporting the goods with their own vehicles or with the producers' vehicles. Alternatively, they buy from the wholesaler with deliveries made by the wholesalers' vehicles or by third-party transport operators. Furthermore, they buy from the supermarkets or other retailers, with own vehicles or third-party transport operators' vehicles.
In our sample, two out of ten retailers consign using own vehicles their products also to the end consumer. When a third-party transport operator is hired, the sender is in charge of organizing the delivery. Note that own-account transport relative to third-party transport tend to prevail in the food USC.

The degree of transport outsourcing.

The survey allowed us to estimate the degree of transport outsourcing across urban product supply chains, using as an indicator the number of weekly deliveries made via own-account or third-party. As reported in table 3, the results are quite differentiated among USCs.

Table 3 - C\proprio o c\terzi: percentuale di spedizioni settimanali

Urban supply chains	**% own account**	**% third party**
Clothing and shoes	12,5	87,5
Food: sweets and diet food	71,4	28,6
Fresh food	46,2	53,8
Ice cream	0,7	99,3
Frozen food	78,4	21,6
Dry food	79,6	20,4
Fresh fish	71,4	28,6
Drink and beverages	47,9	52,1
Alchoolic bevarages	87,9	12,1
Stationary	99,3	0,7
Flowers and plants	76,3	23,7
Construction material	6,6	93,4
Furniture	50,0	50,0
Printing material	0,0	100,0
Drugs and beaty products	81,1	18,9
Electric and computer products	49,7	50,3
Newspapers and tobacco	100,0	0,0

In the interviewed sample, USCs in which the use of third-party transport operators by and large prevails are: clothing and footwear, frozen food, building material and publishing. The USCs in which own account prevails are: bread and sweets, frozen foods, dry foods, wines and liquors, stationery, flowers and plants, drugs, tobacco and newspapers, and the fish cool. The delivers are made in similar percentages by own account or third-party transport operators in these USCs: fresh food, soft drinks and minerals, furniture, and electrical and computer science.

A specific section of the survey asked for reasons why own-account or third party transport are chosen or not chosen. The results are reported in Tables 4 and 5.

Table 4 – Advantages of performing own-account transport (54 interviews)

Motivation	Food	Furni-ture	Beve-rages	Statio-nary	Pharma-ceuticals	Flow-ers	Constr. material	Elect.& Comput.	Ave-rage
Control over service quality	21	27	27	44	17	22	22	8	22
Direct relationship with customers	29	22	32	22	17	31	17	11	25
Joint services	6	17	9	11	11	9	17	33	13
Advertisement	7	8	1	0	0	2	0	3	4
Cheaper than T-PTO	12	8	6	6	0	18	28	15	11
Previous investments	5	2	12	0	50	0	11	6	7
Joint inventory and transport management	15	8	6	0	0	16	6	11	11
Fiscal advantages	3	5	1	11	0	2	0	9	3
Checks on quality and prices	3	3	6	6	6	0	0	3	4
Column total	100	100	100	100	100	100	100	100	100

Table 4 shows that on average maintaining a direct relationship with the customer and controlling over the service quality are the most important factors in the decision to perform own account transport instead of using third party transport operators. Performing joint services, managing joint the warehouse and transport and purely economic reasons are of secondary importance. Even less relevant are the possibility of carrying

advertisements in the vehicles, fiscal advantages, the locked-in situation of having already made the investments and the possibility of performing checks on quality and prices at the customer store. The answers, however, vary among supply chains. The pharmaceutical wholesalers deem as an important motivation the fact that previous investments have already been made. In the electronics and computers supply chain the possibility of performing joint services when delivering the goods is seen as relevant. For the construction materials supply chain the economic advantages are very large. In the flower and in the beverages supply chain the direct relationship with the customers is considered extremely important.

Table 5 – Disadvantages of performing own-account transport (58 interviews)

Motivation	Cloth& shoe	Food	Furni-ture	Beve-rages	Statio-nary	Print-ing	Pharma-ceuticals	Folw-ers	Constr. material	Elect.& Comput.	Ave.
Need to have a person in charge	0	7	6	8	0	14	10	16	14	31	11
Need for drivers	29	20	15	25	0	0	36	29	25	5	20
More expensive than T-PTO	29	8	10	21	0	43	12	0	13	3	11
Buy a vehicle	43	40	56	26	57	0	33	50	34	39	38
Lower service quality	0	2	1	0	0	0	0	0	7	0	1
Unsuitable for long distances	0	21	11	18	0	43	7	6	7	12	15
Inventory management not feasible	0	2	1	2	43	0	2	0	0	10	3
Column total	100	100	100	100	100	100	100	100	100	100	100

Turning to the disadvantages of performing own-account transport, buying and maintain a vehicle and the need for a driver are considered the most relevant. Also a disadvantage is its unsuitability for long distances and the need to have a person in charge of organizing deliveries. It may also turn out disadvantageous from an economic point of view. The effect on service quality and the increased difficulty of running a warehouse are not seen as a disadvantage. Also for the disadvantages, there is large variation among product supply chains. The need of having a person in charge of managing the deliveries is seen as a disadvantage especially in the electronic and computer supply chain. The need of hiring drivers is felt as a problem primarily in the pharmaceutical supply chain. The printing material supply chain deems that the own-account is more expensive and unsuitable for long distances, while the negative effect on inventory management is felt in the stationary supply chain.

The degree of efficiency in the use of the own- account vehicles

The general question of measuring the private and social efficiency of a USC will be deal with in the last section. At this point we focus specifically on some aspects of efficiency in the use of vehicles. In the sample the average number of vehicles is equal to two for manufacturers, four for the wholesalers and one for retailers. The producers have vehicles registered on average in 2004 (7 years old, since the survey took place in 2010), the wholesalers in 2005 and the retailers in 2003. Regarding the fuel type, diesel vehicles are mostly used by all stakeholders. The loading rate has been estimated both for procurement and delivery (Table 6 and 7).

Table 6 – Loading rate for own-account vehicles in procurement

Urban supply chains	Producer	Wholesaler	Retailer
Clothing and shoes			50%
Food: sweets and diet food	15%		
Fresh food		23%	62%
Frozen food	50%	50%	
Dry food	90%		33%
Dry food			65%
Drink and beverages		50%	75%
Flowers and plants	50%		80%
Furniture	72%		
Drugs and beauty products		60%	
Electric and computer products		17%	
Average value	55%	40%	61%

Table7 – Loading rate for own-account vehicles in distribution

Urban supply chains	Producer	Wholesaler	Retailer
Food: sweets and diet food	70%		
Fresh food		80%	
Frozen food	50%	80%	
Ice cream	75%		
Dry food		40%	100%
Drink and beverages	100%	78%	
Alcoholic beverages		78%	43%
Flowers and plants	50%	100%	10%
Construction material		100%	
Furniture	85%	100%	
Drugs and beauty products		50%	
Electric and computer products		60%	
Average value	72%	77%	51%

It results that in procurement the average loading rate for own account is equal to 61% for retailers, 55% for producers and 40% for wholesalers. In particular, the retail chains of flowers and plants and wines and liquors have a higher rate of supply, whereas it is significantly lower than the dry food. The producers have high loading rates in the procurement of dry food and furniture. The wholesalers, instead, have a rate high enough only in the case of pharmaceuticals, equal to 60%, while in other chains the value is lower.
Given that the use of their own account with respect to the third party responds to a variety of needs - such as the characteristics of the product and the requirements of speed, the length of the paths, etc.., - retailers and manufacturers are in procurement more efficient from the standpoint of the loading rate than wholesalers.
In distribution, the picture is rather different. First of all, note that the wholesale use own account much more often than producers and retailers. It is therefore very interesting and meaningful that the loading rate of own account vehicles is the highest for wholesalers, compared to producers and retailers, which is 77%. Namely, the phase of the distribution is handled by the wholesaler also with attention to the efficiency in achieving a high degree of filling of vehicles on their own account. This is especially true in some sectors, such as furniture, building material and the flowers and plants, where the loading rate is 100%.

5 Urban freight transport policies and urban supply chains

In the following paragraphs five specific, frequently implemented, urban freight transport policies will be examined: goods vehicle time-access regulation, vehicle type restrictions, loading\unloading (L\U) policies, fiscal policies and the promotion urban transhipment and consolidation centres (UTCC). Other relevant policies such as public-private partnerships, information and communication technology, intelligent transportation systems and land use planning will not be discussed in this paper not because they are not relevant but in order to limit the scope of the paper.

The research question on how do these policies affect the different USCs will be discussed from a conceptual point of view and drawing from the so far limited existing literature[3].

Access times restrictions, very frequently used in practice, aim at limiting the use of road space to trucks in favour of passenger traffic and the liveability of the city. Since this policy implies a reduction of the time available for delivery, it imposes an additional constraint in the search of a solution to the carriers' routing optimization problem.

The impact of access time restrictions on own account carriers is likely to be marginal since they perform a single origin-destination trip (e.g., from the general fruit and vegetables market to their shop) often outside the restricted time windows. On the contrary, third party carriers have to solve a more difficult routing optimization problem, often with multiple origin-destination points, spread all along the working time and on geographically distant shops. Hence, an additional constraint is likely to impose large adjustment costs, generate suboptimal routing, decrease load factors and require larger fleets and a larger number of lorry drivers. Large retail organisation are an intermediate case between own-account and third-party operators. Such speculation is confirmed by Quak and de Koster (2009) who study the impact of governmental time windows, vehicle restrictions, and different retailers' logistical concepts on the financial and environmental performance of retailers. They use a case study with two cases that differ in their drop sizes as input for an experiment. They show that the cost impact of time windows is the largest for retailers who combine many deliveries in one vehicle round-trip. The cost increase due to vehicle restrictions is the largest for retailers whose round-trip lengths are restricted by vehicle capacity. Vehicle restrictions and time windows together do not increase a retailer's cost more than individually. They also find that variations in delivery volume and store dispersion hardly influence the impact of urban policy and the retailer's logistical concept decisions.

Quak and de Koster (2007) discuss which dimensions related to a retailer's network structure and logistical planning will determine its sensitivity to time-windows. They focus on various retailer characteristics (product characteristics, network structure, logistical planning) and distribution performance (operational, financial, environmental). Since they use fourteen cases, although the sample is too small to consider any statistical analysis. They conclude that the impact of increasing time-window pressure varies among different retailers. The retailers that supply more stores during the time-window hours - thanks to the short distance, short unloading time, and larger drop size – are affected the least. On the contrary, the retailers which use their vehicles most during a 24-h period in the current situation are affected the most by time-windows.

Turning to the impacts on the product USCs, one observes that pharmaceutical products although distributed by third-party carriers using multi-drop routing are, in practice, exempted from this restriction, hence, they suffer no impact. With regard to fresh food, some products (especially meat and milk) are distributed by third-party carriers using multi-drop routing practices, whereas others (such as non-industrial fish, fruit&vegetables) are procured via own-account transport. If the former can not adjust to the time window regulation by developing an early schedule in non-restricted times because of self-implied time-window constraints, the impact is likely to be relevant. Some segments of Ho.Re.Ca. are impacted when supplied by third-party carriers or wholesalers. Lastly, clothing&footwear will bear only marginal effects since deliveries are less frequent and mostly single-drop. Both Ho.Re.Ca. and clothing&footwear might have self-implied time windows because of staff constraints.

Vehicle restrictions, either by weight, engine type or load factor, aim at containing the environmental and congestion externalities. They cause an increase in fleet size, and an accelerated fleet renewal rate. Larger companies are likely to be able to cope with this policy better than small firms or own-account carriers. The most affected distribution channels are those which require large quantities and frequent deliveries. Pharmaceutical products are delivered frequently but by small vehicles since the size of the parcels is generally small. Moreover, they are typically exempted from this regulation, hence they are not affected. On the contrary, fresh food, being characterized both by large quantities and frequent deliveries are highly affected, especially when distributed via large retail organization, because of the weight restrictions, and via

[3] Danielis et al. (2010) have previously discussed this aspect at some length.

own account, because of the engine type restrictions. Ho.Re.Ca. requires less frequent deliveries and small to medium quantities. Hence, it should suffer relatively less the impact of this policy, although procurement takes often place by own-account transport. Clothing&footwear involves infrequent deliveries, seasonal large quantities and small replenishment deliveries. Hence, it is only marginally impacted. A potential side effect is on the size of the consignments, probably reduced in order to be transported with smaller vehicles.

Urban goods distribution needs proper spaces for L\U activities. Unless a shop has its own private, internal L\U bay, it relies on off-street or on- street parking spaces. This generates a conflict with the parking needs for passenger cars, highly requested in central areas. The aim of *L\U policies* is, hence, both to regulate the loading bay use among truck users and to prevent private cars to use the L\U bays. L\u policies affect substantially consignment costs and times. The actual practice of irregular on-street parking contains the carrier costs and times but generates high congestion costs. The provision of a larger number of L\U bays and their effective enforcement would probably leave unchanged or slightly increase the private costs and times, but certainly reduce social costs. Pharmaceutical products are frequently delivered but require short L\U times since the parcels are typically small, hence, the impact of a L\U regulation is likely to be modest. On the contrary, fresh food is highly impacted since it is frequently delivered, and requires medium\large L\U times. Most shops located in city centres do not have internal bays for L\U activities, with the exception of large retail organizations who generally have personnel dedicated to stock management activities. Ho.Re.Ca. products are less frequently supplied with medium L\U times, hence, the impact of a L\U regulation is likely to be small. Clothing&footwear stores are occasionally supplied in large quantities for seasonal orders and require large L\U times. More frequently, though, they are supplied in small quantities with short L\U times.

Fiscal policies, either in the form of congestion toll or, more frequently, area licensing fees, are used in some cities to regulate access to central areas. They aim to internalize congestion costs and to achieve an optimal congestion level. The reduction of travel time and the increase of punctuality in the deliveries improve the efficiency of freight urban transport. A study of 2001 in Stockholm has estimated that "the total gain in travel matched about 2-3% of the total time production, and was valued to about € 50 million per year" (Eliasson and Lundberg, 2002). It is possible to suppose that in certain USCs, where the time is a key competitiveness factor, the value of the reduced travel time is higher than the charge to pay. Also the study of Greater London Authority (2006) confirms that the London congestion charging helps to free road space and improve journey times for service and delivery vehicles.

Fiscal policies should also induce an increase in load factors and multi-drop deliveries. As a result social efficiency of the overall transport system should be achieved.

Congestion tolls affect negatively consignment costs, unless the value of the time saved is higher than the fare. But this happens only when the value the goods transported is high. A survey of Transport for London (2006) on the retail, hotels & restaurants, wholesale, manufacturing, education and construction, highlights that just under half of businesses in the charging zone and over half of businesses in the boundary zone consider transport costs to be negligible. Of those businesses in the charging zone, 13% of businesses suggest that transport costs account for over 10% of total business costs. Thus, for the majority of sectors, there are no patterns that indicate a possible congestion charging effect on the business performance. The City of Stockholm (2006) founds that, in most cases, the road pricing had a marginal impact on the companies' overall transport costs, but generally transport costs account for a very small proportion of the final price of goods and services. In particular, the cost to companies of congestion taxes over a 12-month period equated to less than 0.5% of the value of total production of goods and services in the area.

As area licensing fees are not proportional to the number of daily access entries, the higher is the daily consignment frequency the lower will be the per-trip cost. As a consequence, the delivery costs of own-account carries are more impacted by fees than those of third-party carries since their load factors are lower. Finally, according to the literature (McKinnon, 2006), the cost of the fiscal policy can be more easily shifted from carriers to retailers when consignments are less-than-truck load.

Danielis et al. (2010) speculate that the impact of fiscal policies might differ among distribution channels. It is observed that pharmaceutical products are generally exempted. With reference to fresh food, when an area licensing fee is applied, the impact on fresh food delivery costs is likely to be small since they are characterized by frequent deliveries of large quantities. On the contrary, the impact on the Ho.Re.Ca. and clothing&footwear delivery costs are likely to be relatively higher, since they have less frequent consignments made mostly via own-account. However, the final effect on goods prices paid by final consumers is uncertain, as well as the effect on land rents since they depend on the characteristics of the

specific markets. As McKinnon stated (2006), fiscal policies produce most likely small effects, at least in the short run, on strategical and commercial decisions, while they might have some effect on the tactical and operational ones.
The empirical evidence on the impact of the pricing policies on the USCs is still scant[4].
Some evidence relates to the impact of the congestion charging on the overall economy and in some cases on retail. Despite the difficulty of discerning the impact on business performance from the range of factors impacting the economy (Transport for London, 2006), congestion charging seems to have a neutral o very modest impact on the economy, depending on charge level (Whitehead, 2005; for London see Ernest & Young, 2006; Transport for London, 2006; 2008; for Stockholm case see City of Stockholm, 2006; Matsson, 2003; Eliasson *et al.*, 2009 and Eliasson, 2008; for Trondheim case see Tretvik, 2003).
Winsor-Cundell (2003), however, illustrating the results of a London Chamber of Commerce and Industry investigation on the impact of London congestion charging based on a direct survey on 1,430 retailers states that 76% of the respondents report reduced revenues and a fall of productivity, 33% consider relocation and 28% consider closing their business due to the charge. Food shops appear to be more impacted than luxury goods. Moreover, "even though just-in-time delivery is common in many sectors, the short shelf-life of food products means that food distribution has particularly limited flexibility in responding to new charging regimes" (Steedman, 2006). Very frequently, in the food supply chain any additional costs are passed down the chain to the last ring.
Similar conclusions are reported in London First (2006). The retail and leisure sectors, small businesses and those close to the boundary of the zone are considered to have been most adversely affected. As concerns the size of firms, a survey on retailers within the London charging zone in 2003 developed by the Commission for Integrated Transport (2003) founds that small retailers of convenience and food products, with respect to the large ones, appear to be less able to take advantage of the reduced congestion, more concerned with the costs of the scheme than with the benefits. This is exacerbated by the widespread practice of couriers, express delivery, and other transport organizations imposing surcharges for deliveries in the charging area or reducing service levels (for example three deliveries a week in place of daily deliveries). The suppliers increase the price of their services in order to make a quick profit, generally taking no account of increased efficiency as a result of reduced delivery time or increased reliability. Instead, the chains of convenience stores have the power to exert pressure on suppliers, avoiding the surcharges.
However, May *et al.*, (2010) claim that the impact of congestion pricing on the economy has been much smaller than that predicted by the business community.
In a counterfactual study, Quddus *et al.* (2007) focuses on the John Lewis Oxford Street (JLOS) store, one of the biggest retail stores located within the charged zone. He also finds a drop in sales attributable to congestion charging of 5.5% by the time-series model and of 8.2% by the panel model over a period of about eleven months following the introduction of the charge, compared to the other five stores outside the area.
To opposite conclusions comes the study performed by Daunfeldt *et al.* (2009) using revenue data from 14 shopping malls, 9 within the charged area of Stockholm and 5 outside the charged area. The data also include revenue data from a sample of retail stores located along the main shopping streets in Stockholm. The results show that the Stockholm road pricing trial did not negatively affect retail revenue, neither in shopping malls nor in the sample of retail stores. As possible explanations for this result the authors argue that: a) probably that most stores and shopping malls are open in evenings and on weekends in Sweden, making it easy to avoid the congestion fee by changing the time when the shopping is being done, b) people to a larger extent uses public transport for shopping trips, c) as parking fees are quite expensive in the Stockholm city, it is also likely that car-borne shoppers are high-income earners that are less sensitive to changing their shopping behaviour when congestion charges are introduced, and d) as habits that change slowly, it is possible that the retail businesses might be affected negatively by the introduction of congestion charges even though the results do not support so far this view.
A further interesting issue is the spatial impact of a charging scheme. Löchl (2006) performs a theoretical analysis and reviews the existing evidence. The case of Trondheim has been particularly researched after the introduction of road pricing in 1991. Avant Management A/S (1992) found that 10% of the customers had changed their shopping behaviour by moving their shopping to other destinations or times after the introduction of the cordon pricing. Moreover, while business people located in the city centre had predicted major negative swings in trade prior to the cordon pricing, the Chamber of Commerce of Trondheim

[4] As Beria and Boggio (2012) state, the literature on acceptability (both ex-ante and ex-post) is much more detailed than the literature on the actual effects of the implemented measures.

concluded from an own ex post survey that there was hardly any effect on trade at all. Anyway, there was a long lasting general trend of growth in areas outside and decline in areas of the cordon. Tretvik (1999) even concludes a general trend line of modest but steady growth in retail sales in real terms inside the cordon since the introduction as he later reports (Tretvik, 2003, 89).
Finally, one other possible impact of road pricing is also the increase of home deliveries from shops to final consumer (Steedman, 2006). According to Winsor-Cundell (2003), since the introduction of the congestion charge in London there was an 11.8 per cent increase in telephone orders. The small size of these deliveries and the widespread location of the consumers can cause problems of vehicle load factor maximization, negatively influencing the congestion.
The *development of a UTCC* aims at optimizing the consolidation and routing patterns of the existing distribution channels and at using less polluting vehicles. Since it introduces an extra node in the distribution channel which imposes extra logistics costs, own account or third-party operators or the logistics coordinator of the distribution channel might not be willing to use it. The actual urban goods distribution regulation may obviously influence the decision favouring the use of UTCC vehicles against all other non- UTCC vehicles (see the case of Vicenza). Given the previous discussion we believe that pharmaceutical products and fresh food will not make use of a UTCC, since the specific characteristics of the goods distributed require dedicated and integrated channels and infrastructures, strong logistics coordination, and fast and frequent deliveries. On the contrary, clothing&footwear and Ho.Re.Ca, especially when supplied via own-account, clothing&footwear for occasional replenishment orders and Ho.Re.Ca for goods other-than-fresh food might accept to use a UTCC. Gonzalez-Feliu and Morana (2010), analysing the case of Cityporto, the UTCC for the city of Padua (Italy), in operation since 2004, report that the main customers are third-party transport operators, which buy the last mile service from Cityporto, who is also granted the privilege of accessing the limited traffic zone of Padua, hence avoid the inconvenience of entering the city centre. More recently, also a soft drinks distribution company has signed a partnership with Cityporto for restaurant and bar deliveries.

6 Conclusions and further research needs

This paper moves from the belief that adopting a supply chain approach is crucial to understand how urban freight distribution works and what will be the impact of the various potential urban transport policies. The paper has tried to contribute to the existing literature by: a) characterizing the USCs; b) discussing how a USC can be modelled, which role do actors play and how the coordination issue can be handled; c) showing how transport decisions, in particular whether to use own-account or third-party transport operators, are dealt within each USC and by each actor; and analysing how USCs are affected by the many proposed freight transport policies.
Although much progress has been made in the field, both with regards to modelling and empirical analysis, we think that important progress needs to be made with regards to both the *ex-ante* and the *ex-post* evaluation of the private and social efficiency of the different UCSs and on how they are impacted by transport policies.
Adopting the methodologies proposed for the supply chain evaluation can be a way forward and should be tested. As reviewing the various supply chain evaluation methodologies, and the corresponding literature, is outside the scope of this paper, we just mention the two most important ones. One is the Supply-Chain Council's Supply-Chain Operations Reference (SCOR) model that decomposes the processes within a supply chain and incorporates multiple performance indicators into one measurement system. It deals with: 1) reliability measures (e.g., fill rate, perfect order fulfilment); 2) cost measures (e.g., cost of goods sold); 3) responsiveness measures (e.g., order fulfilment lead-time); and 4) asset measures (e.g., inventories). The second one is called Balanced Scorecard model and employs performance metrics from financial (e.g., cost of manufacturing and cost of warehousing), to customer (e.g., on-time delivery and order fill rate), business process (e.g., manufacturing adherence-to-plan), innovation and technology perspective (e.g. new-product development cycle time). Although it is aimed at measuring the producer-customer relationship, that is two subsequent agents within the same supply chain, it can easily be adapted to track the supply chain as a whole. Adapting and applying these methodology to the different USCs, we believe, would greatly enhance our understanding on how to improve freight distribution in an urban area.

7 References

Arshinder, A. K., Deshmukh, S.G. (2008) "Supply chain coordination: Perspectives, empirical studies and research directions", International Journal of Production Economics 115: 316-335.

Arunotayanun, K. Polak, J. (2009) "Accounting for Supply Chain Structures in Modelling Freight Mode Choice Behaviour", paper presente at the European Transport Conference 2009.

Avant Management A/S (1992) *Handelsundersøkelsen 1992, Trondheim med omkringliggende kommuner*. [The trade inquiry of 1992, Trondheim with surrounding municipalities.]

Beria P., Boggio M. (2012), *The role of transport supply in the acceptability of pollution charging extension. The case of Milan*. XIV Conference of the Italian Association of Transport Economics, Bari - Italy June 28th - 30th, 2012 .

Browne, M., Gomez, M. (2011) "The impact on urban distribution operations of upstream supply chain constraints", International Journal of Physical Distribution & Logistics Management, Vol. 41 Iss: 9, pp.896 – 912

City of Stockholm (2006), *Stockholmsforsoket: Facts and results from the Stockholm trials*, first version. Congestion Charge Secretariat, Stockholm.

Clark, A. (1972) "An informal survey of multi-echelon inventory theory", W.P. Serial T-259 The George Washington University School of Engineering and Applied Science Institute for Management Science and Engineering.

Commission for Integrated Transport, November (2003), *The impact of congestion charging on specified economic sectors and workers.*

Dallari, F. (2006) "La filiera farmaceutica. Quali criticità e quali prospettive per la logistica dei farmaci in Italia? Centro di Ricerca sulla Logistica, Verona, 25 October 2006 (powerpoint presentation).

Danielis (2013) La distribuzione urbana delle merci. Analisi e politiche, EUT. (fortcoming)

Danielis, R., Rotaris, L., Marcucci, E. (2010), "Urban freight policies and distribution channels: a discussion based on evidence from Italian cities", *European Transport/Trasporti Europei* **46**: 114 - 146.

Daunfeldt, S.-O., Rudholm, N., Ramme, U. (2009), Congestion charges and retail revenues: results from the Stockhom road pricing trial. *Transportation Research Part A* **43**: 306–309.

DfT (2005), *Transport and Land Use Interaction in the Context of Road Pricing*. Discussion paper. Department for Transport (UK).

Eliasson J. (2008), Lessons from the Stockholm congestion charging trial, *Transport Policy* **15**: 395–404

Eliasson J., Lundberg M. (2002), *Road pricing in urban areas*, Vägverket, Publication 136E Swedish National Road Administration and T&E, available at: http://www.transport-pricing.net/download/swedishreport.pdf

Eliasson, J., Hultkrantz, L., Rosqvist, L. (2009), Stockholm congestion charging trial. *Transportation Research Part A* **43**: 237–310.

Ernest & Young (2006), *Review of transport for London's assessment of business and economic impacts of the congestion charge*, third annual report 2005, available at: http://www.london.gov.uk/mayor/economic_unit/docs/impacts-of-cc.pdf

Forkert, S., Eichhorn, C. (2008) *Innovative Approaches in City Logistics: Inner-City Night Delivery*. Niches, available at: http://www.niches-transport.org/>

Friesz, Terry L. & Lee, Ilsoo & Lin, Cheng-Chang, 2011. "Competition and disruption in a dynamic urban supply chain," Transportation Research Part B: Methodological, Elsevier, vol. 45(8), pages 1212-1231, September.

Geroliminis, N., Daganzo, C. (2005), *A Review of Green Logistics Schemes Used in Cities around the World*. UC Berkeley Center for Future Urban Transport, A Volvo Center of Excellence.

Gibson, B.J., Mentzer, J.T., Cook, R.L. (2005), "Supply Chain Management: The Pursuit of a Consensus Definition", *Journal of Business Logistics*, Vol. 26, No. 2, pp. 17-25.

Gonzalez-Feliu, J., Morana, J. (2010) Are City Logistics Solutions Sustainable? The Cityporto case, TeMa, 3 (2), pp.55-64.

Greater London Authority (2006), *Retail in London*, Working Paper I, Service and delivery issues, June 2006.
Hensher, D.A. and Puckett, S.M. (2005), Refocusing the modelling of freight distribution: Development of an economic-based framework to evaluate supply chain behaviour in response to congestion charging, *Transportation*, **32**: 573–602.
Holguín-Veras, J., (2006), *The truth, the myths, and the possible in freight road pricing in congested urban areas*, Association for European Transport and contributors.
Holguín-Veras, J., Silas, M., Polimeni, J., Cruz, B. (2007), An Investigation on the Effectiveness of Joint Receiver–Carrier Policies to Increase Truck Traffic in the Off-peak Hours. Part I: The Behavior of Receivers, *Network Spatial Economics* **7(3)**: 277–295.
Holguín-Veras, J., Silas, M., Polimeni, J., Cruz, B. (2008), An Investigation on the Effectiveness of Joint Receiver–Carrier Policies to Increase Truck Traffic in the Off-peak Hours, Part II: The Behavior of Receivers, *Network Spatial Economics* **8 (4)**: 327–354.
Kim T, Goyal SK (2009). A Consolidated Delivery Policy of Multiple Suppliers for a Single Buyer. Int. J. Procure. Manage., 2(3): 267-287.
Kotler, P., Armstrong, G. (1999) Principles of marketing, – 8th ed – Prentice Hall, New Jersey.
Löchl, M. (2006), *Land use effects of road pricing – a literature review*. 6th Swiss Transport Research Conference paper, Monte Verità / Ascona (CH).
London First (2006), *Getting London to work, London*, available at http://www.london-first.co.uk/documents/042_Getting_London_to_Work_-_full_report.pdf
Maggi E. (2004), "Il governo dei flussi logistici per uno sviluppo urbano sostenibile", in Boscacci F., Maggi E. (eds), *La logistica urbana. Gli elementi conoscitivi per una governance del processo*, Polipress, Milan, 117-145.
Maggi E. (2007), *La logistica urbana delle merci. Aspetti economici e normativi*, Polipress, Milano.
Maggi E. (2007), *La logistica urbana delle merci. Aspetti economici e normativi* (Freight Urban Logistics. Economics and Normative Issues), Polipress, Milan.
Marcucci, E., Danielis, R. (2008), The potential demand for a urban freight consolidation centre, *Transportation* **35**: 269-284.
Mattsson, L.G. (2003), *Modelling Road Pricing Reform in Stockholm*. IMPRINT-EUROPE seminar: Implementing Pricing Policies in Transport: Phasin, Leuven, Belgium.
May A.D., Koh A., Blackledge D., Fioretto M. (2010), Overcoming the barriers to implementing urban road user charging schemes'. *European Transport Research Review* **2(1)**: pp.53-68.
Mckinnon, A.C. (2006) "A review of European truck tolling schemes and assessment of their possible impact on logistics systems", International Journal of Logistics: Research and Applications, 9(3): 191–205.
Quak, H.J., de Koster, M.B.M. (2007), "Exploring retailers' sensitivity to local sustainability policies", *Journal of Operations Management* **25**: 1103-1122.
Quak, H.J., de Koster, R. (2009), Delivering goods in urban areas: how to deal with urban policy restrictions and the environment. *Transportation Science* **43**: 211-227.
Quddus M.A., Carmel A., Bell M.G.H. (2007), The impact of the congestion charge on retail: the London experience. *Transport Policy* **14**: 433-444.
Steedman P. (2006), *Road Pricing. Could it promote sustainable food systems?* Report of an expert workshop held in association with the RSA, Food Ethics Council, December 2006.
Transport for London - TfL (2006), *Central London Congestion Charging. Impacts monitoring*. Fourth Annual Report, June 2006, available at http://www.tfl.gov.uk/microsites/freight/publications.aspx
Transport for London - TfL (2008), *Central London congestion charging. Impacts monitoring.* Sixth annual report, available at http://www.tfl.gov.uk/microsites/freight/publications.aspx
Tretvik, T. (1999) The EUROPRICE project: the Trondheim toll ring and the effects on retailing, *SINTEF Memo N-12/99*, SINTEF, Trondheim.
Tretvik, T. (2003) Urban road pricing in Norway: public acceptability and travel behaviour, in J. Schade and B. Schlag (eds.) *Acceptability of transport pricing strategies*, 77-92, Elsevier, Oxford.
Whitehead T. (2005), Road user charging and business performance: identifying the processes of economic change, *Transport Policy* **9**: 221–240.
Winsor-Cundell E. (2003), *The retail survey. The Impact of the Congestion Charge on the Retail Sector*, The London Chamber of Commerce and Industry Campaigns Team, May 2003.

Yang, P. C., and Wee, H. M., (2001) “A quick response production strategy to market demand,” Production Planning & Control, 12(4), 326-334.