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"Carlo Bo"

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"The Demand Potential of an Urban Freight Consolidation Centre"

- Romeo Danielis (U. Trieste)
- Edoardo Marcucci (U. Urbino)

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The Demand Potential of an Urban Freight Consolidation Centre

Edoardo MARCUCCI[1*] and Romeo DANIELIS[§]

[*]Università degli Studi di Urbino, "Carlo Bo", Istituto di Scienze economiche, Via Saffi 42, 61029 URBINO (PU) - Italy.
[§]Università degli Studi di TRIESTE, Dipartimento di Scienze Economiche e Statistiche, Piazzale Europa, 1 - 31024 TRIESTE (TS) - Italy.

1. Introduction

A relevant share of urban traffic - estimated between 20% and 30% of total vehicle kilometres and responsible for between 16% and 50% of air pollution emissions (Dablanc, 2007; LET-Aria technologies, 2006) - is related to goods transport. Van and truck traffic increases congestion as well as noise and air pollution, especially in the narrow lanes of European city centres characterised by scarce curb side and off-road parking availability.

City administrators have designed and implemented a wide array of policies to tackle the urban goods transport issue. Some of the implemented policies are regulatory in nature and comprise dedicated parking stalls for loading/unloading trucks, access restrictions to some areas of the city centre, time restrictions, vehicle restrictions according to size, fuel typology, fuel efficiency, and minimum load factor. A second set of policies affects the costs of distributing goods within the city centre, i.e. by requiring the acquisition of time-based access permits or the use of vehicles with low environmental impact. A further, more ambitious, approach seeks to alter the logistics of the existing urban goods distribution via the creation of Urban Freight Consolidation Centres (UCC). This paper focuses on this last option.

There is little agreement in the literature about which characteristics would qualify a UCC or even about the name that should be used to represent it. The University of Westminster Report (2005, p. 3), cites 13 different definitions. Regan and Golob (2005) use the term "urban shared use freight terminals". For the purpose of our research, the term Urban Freight Consolidation Centre is appropriate as defined by Browne et al. (2005. p.3): "a logistics facility that is situated in relatively close proximity to the geographic area that it serves be that a city centre, an entire town or a specific site (e.g. shopping centre), from which consolidated deliveries are carried out within that area. A range of other value-added logistics and retail services can also be provided at the UCC. Logistics companies with deliveries scheduled for the urban area or site are able to transfer their loads at the UCC and thereby avoid entering the congested area. The UCC operator sorts and consolidates the loads from a number of logistics companies and delivers them, often on environmentally friendly vehicles, to an agreed delivery pattern."

UCCs have been discussed or implemented in various European cities including Amsterdam, Leiden, Utrecht, Berlin, Bremen, Köln, Freiburg, Kassel, Munich, La Rochelle, Basel, and Stockholm. In Italy, there are a few examples of UCCs located in Genoa, Padua, Ferrara, Venice, Ancona, Naples, and Milan.

Technically, the UCC implies adding a stage to an existing supply chain. From an economic point of view, the resulting transhipment to a store and to a new vehicle increases the total logistic cost by increasing the handling, administration, information and transaction costs[2] but it also

[1] Corresponding Author: marcucci@uniurb.it.
[2]Generally the company taking the goods to the UCC does not perform the final consignment. This implies the drafting, bargaining, and signing of yet another contract (with annexed responsibilities for delays, and improper or lost consignments), and additional information exchange between the two companies.

provides an opportunity to consolidate, regroup consignments, and re-direct and optimise consignment runs. The net result is unclear both from a private and social point of view.

A retailer will find the services of the UCC advantageous only if the cost of the delivery for the urban leg is greater than UCC service charges. . From a social point of view, the external costs generated when using the two different consignment schemes need to be considered. The UCC is justified when the cost of the urban leg using a private vehicle is larger than the sum of the additional costs imposed by the UCC (i.e. the cost of the delivery to the final user with the UCC vehicle and the difference between the external costs caused by UCC vehicle and the private vehicle).

The above costs and benefits depend on a large number of factors including the type of goods to be delivered, the organisational and business characteristics of the receiver (i.e., number of goods traded per day, store capacity, location, parking availability, etc.), the organisational and business characteristics of the transport operator (own account or third party, means of transportation available, number of drivers, number of consignments in the urban area, availability of private depots in the proximity of the urban area, etc.), the type of UCC (location, size, warehouse capacity, type of vehicles, type of ownership, etc.), and the characteristics of the urban area (size, traffic conditions and regulation, type of streets and lanes, degree of pedestrianisation etc.). The private and social viability of a UCC, consequently, needs to be evaluated case by case.

In order to evaluate both the economic viability of a UCC scheme and its ability to improve goods distribution as well as alleviate local environmental and traffic problems within urban areas, it is important to have some knowledge of the cost and benefits associated with these various instances both from the private and the social point of view. The lack of knowledge on the cost structure and, hence, on the potential demand for the UCC services is one of the main causes of failure of many European UCC schemes that proved not economically viable once public funding became unavailable or insufficient[3].

Various scholarly contributions have recently been made in the attempt to clarify not only the economic, but also the strategic and political issues involved in the promotion of UCCs. Probably the most comprehensive and recent is the European project BESTUFS (www.bestuf.org). City Ports (Progetto City Ports, 2005), another European project, discussed the European and Italian experiences with the UCC strategy and provided a list of recommendations to local authorities or interested parties[4]. In an in-depth review of UCC experiences around the world commissioned by the UK Department of Transport, the University of Westminster Report (2005), calls for and proposes a comprehensive method for evaluating the effects of a UCC, including those on businesses and supply chains. The lack of evidence-based information on the costs and benefits of UCCs makes it difficult for potential operators or policy-makers to make decisions as to the viability of such initiatives.

One still unsettled question concerns the conditions under which the UCC is most likely to be privately and socially successful. The existing studies provide insufficient, uncertain, and qualitative information on this crucial aspect. On the basis of the available evidence, the University

[3] The University of Westminster Report (2005) states that "some UCC trials have been based on intuition rather than a quantified assessment and as a consequence are never likely to be viable".

[4] Specific recommendations are: (a) cooperation and collaboration promotion among local transport operators that can potentially become UCC users so as to overcome any pre-existing competition mechanisms; (b) promotion of integration agreements of urban transport demand (e.g. retailers belonging to the same or similar supply chain) so as to designate specific days or time windows within which to perform the final consignment - thus rationalising the productive process; (c) adoption of competitive regulation thus facilitating UCC operations; (d) agreeing and sharing with the interested agents those traffic regulatory policies considered most appropriate for sustaining a reorganisation of urban distribution; (e) infrastructural interventions aimed at a greater UCC accessibility both outbound (e.g. links with railway networks) and inbound (e.g. reserved or priority lanes, dedicated parking stalls); (f) warehousing facilities within the UCC that could produce a convenient service at a lower price than central facilities; (g) low environmental impact vehicles used for last mile consignment; (h) last mile freight consignment and scrap retrieval (green logistics) managed by a single and centralised third-party consortium; (g) use of telematic and localisation instruments to optimise fleet management.

of Westminster report (2005) concludes that UCCs are most likely to be successful in situations similar to those detailed below: specific and clearly defined geographical areas where there are delivery-related problems; town centres that are undergoing a «retailing renaissance»; historic town centres and districts that are suffering from delivery traffic congestion; new and large retail or commercial developments (both in and out of town); and major construction sites.

The Report also reaches the conclusion that the major potential beneficiaries from the establishment of UCCs would be: a) transport operators making small, multi-drop deliveries; b) shared-user distribution operations; c) businesses located in an environment where there are particular constraints on delivery operations (e.g. limited access conditions – physical or time related); and d) independent and smaller retail companies.

In Italy, research conducted within the City Ports project for the city of Bologna by analysing origin\destination flows and the logistic efficiency of the existing supply chains and their structural characteristics concludes that a UCC might attract traffic from the following supply chains: packages**,** dry products, home deliveries, and part of the hotel recreation and catering that does not include fresh products (Progetto City Ports, 2005b, p. 106).

This paper assume that, in the absence of sufficient empirical evidence, state preference (SP) data might be helpful for estimating potential demand for UCC services. SP analysis, using hypothetical scenarios and specific models to estimate choice probabilities, has been applied to a wide range of issues and could prove valuable for designing and implementing urban traffic policies. One of the most appealing characteristics of SP studies is the possibility of studying as yet non-existent transportation technologies, such as the UCC, in most urban areas. This paper pursues this line of research[5].

A crucial aspect determining the success or failure of a SP study is the formulation of realistic and informative alternative choice scenarios. In contrast to previous literature that studies the role of a UCC in isolation, in formulating our case-study scenarios we set our UCC evaluation within an explicit and specific urban traffic context. This decision stems from the observation that users decide whether or not they want to use the UCC or not depending not only on its specific characteristics but also on the characteristics of the alternative private transport.

In fact, local governments often set up transport policies that include both the UCC and complementary traffic regulations. One of the most successful cases in Italy so far is Padua. Along with the implementation of the UCC in 2004, an agreement was signed between the city administration and the UCC company that reserved specific areas for loading and downloading freight within the old city centre, permitted the use of reserved lanes, and allowed around-the-clock access to the Limited Traffic Zone. Only low impact (methane and electric) vehicles were allowed for urban consignment (Stefan, 2006). Genoa has adopted an even wider array of accompanying measures to the implementation of UCCs (Merella, 2006).

In this paper we explore the preference for using UCC services, as described by a set of attributes, instead of using private vehicles for transporting goods within the city centre. The conditions under which the private transport of goods takes place are determined both by the organizational efficiency of the transport operator and by the regulatory regime (access limitations, parking restrictions, access pricing, etc.). An SP experiment, mimicking the actual scenarios under which the transport choice takes place, is used to gather information on economic agents'

[5] On this line of research an Italian case-study on Milan, by Da Rios and Gattuso (2003), has attempted to evaluate the acceptability of UCCs by trying to understand the motivations behind the current scarce interest. They find that UCCs are: 1. thought to be inadequate for organised grand distribution since they would imply further distributive costs coupled with a highly fragmented distribution; 2. thought to be interesting by small retailers, especially those that do not buy their supplies directly, but at the same time, however, do not want to pay for warehouse management; 3. considered positively by operators that are or potentially are interested in electronic commerce. The parametric estimates made on the basis of the SP interviews performed show that there is an overall negative perception of the implementation of a UCC (-0,70) thus indicating a dis-utility associated with the presence of a UCC (Da Rios, Gattuso 2003, p. 206). This disutility is greater by 1% than the increment of the present transportation cost (-0,11) and smaller than the adoption of a consignment time window between 7 p.m. and 9 p.m. (-1,17).

preferences. Face-to-face interviews were carried out in the summer of 2006 in Fano, a city of about 58.000 inhabitants in the Marche region of Italy.

The formulation of a discrete choice model and the statistical estimation of its parameters based on the data collected provides quantitative answers two fundamental questions. What is the demand potential of a given UCC[6]? Which demand or supply segments of urban freight traffic might most likely be interested in using the UCC?

The paper is structured as follows. Section 2 illustrates the interview, the hypothetical choice exercises. Section 3 describes the model estimated and Section 4 describes the main characteristics of the sample. Section 5 presents the econometric results and some policy simulations. Section 6 discusses how the preference structure is affected by the type of good traded and by other business characteristics. Section 7 draws some conclusions and proposes future research objectives.

2. The interview and hypothetical choice exercises

Data collection consisted in administering a face-to-face interview to shopkeepers and small businesses located in the LTZ (Limited Traffic Zone, *Zona a Traffico Limitato*) of the city of Fano and transport operators serving the area.

As of February 2007, two areas of Fano are regulated: the area bordering the sea and the historical centre, which broadly corresponds to the LTZ. The regulation of the former is applied only in the summer months. The latter has been subject to yearlong regulation since 2001, and is concerned with vehicle weight and the time of access to the LTZ (it is limited to some vehicles between 4.30 and 7 p.m.). LTZ circulation permits are assigned upon request to single operators. There are two main categories of permits: permanent (city residents, garage owners or users, economic agents, doctors, newspaper distribution, etc.) and temporary (commercial goods delivery, personal goods delivery, etc.). Temporary permits are assigned when the agent requesting them holds all the prerequisites and after paying the amounts illustrated in table 1.

Table 1 – Costs of temporary permits in the city of Fano

Duration	Cost
Up to 2 hours	Euro 1,20
Between 2 and 4 hours	Euro 2,40
More than 24 and less than 4 days	Euro 3,60
From 5 days up to 10	Euro 6,00
More than 10 and up to 30 days	Euro 12,00

The interview aimed at gathering: a) general information on the business size and organisation and b) data on stated preferences between alternative choice scenarios.

The formulation of the scenarios needs to both be realistic and provide useful answers to relevant research questions. Two alternative scenarios were formulated: one based on the use of the UCC for delivery of goods to the final destination and one on the use of private vehicles (PV).

The attributes and levels employed for describing the two alternatives are reported in Tables 2 and 3. An example of the resulting choice task is illustrated in Table 4. 16 choice tasks were administered to each respondent.

[6] It is important to recall under this respect that direct forecasting or calculation of elasticities on the basis of a model estimated on SP data alone might prove ambiguous since the scale of the SP coefficients might differ from RP. SP are more appropriate for calculating ratios of coefficients such as the value of time. Reliable forecasting would need RP even if, in this case, we are not in a position to do so since there is no UCC in Fano. For this aspect refer to Bradley and Daly 1992.

Table 2 – Attributes and levels used to characterise UCC services

Attributes	*Levels*
Delivery cost per parcel	0,5 Euro, 1 Euro, 2 Euro, 3 Euro
Delivery time	Within day of arrival, next day, after two days
Tracking and tracing	Yes, No
Warehouse availability	Yes, No

Table 3 – Attributes and levels used to characterise the use of PV (private vehicles)

Attributes	*Levels*
Average urban travel speed	5 km/h; 10 km/h; 20 km/h
Hourly width of the delivery time windows	24h; 8h; 6h; 4h
Distance of the available parking stall from the location of delivery	0 m; 20 m; 100 m
Annual access permit cost per vehicle	0 Euro; 50 Euro; 100 Euro; 150 Euro
Down-town vehicle restriction constraints	Access allowed: only to vehicles below 3.5 ton; only to Euro2 engine vehicles or above; to all vehicle

Table 4 – Example of choice task

Given the following conditions, would you prefer to use a private vehicle for your (own account or third party) transport of goods within the LTZ of FANO or would you rather use a UCC, if available, to which you could remit freight consignments?	
Option A – PV (private vehicles)	Option B – UCC
Annual access permit cost: 100 Euro Average urban traffic speed: 20 km/h Time window width: 8 hours Average distance of parking stalls from destination: 100 m Access available only to vehicles of less than 3.5 tons	UCC service cost: 0.5 Euro per parcel Delivery time: within arrival day Without tracking-and-tracing service With warehousing services

In order to limit task complexity the number of attributes has been limited to 4 and 5 to characterise, respectively, the UCC and PV. The UCC attributes concern costs, delivery time, and additional provided services such as tracking-and-tracing and warehousing in order to characterise the amount of financial and technological resources used to attract potential users to the UCC. The alternative option of employing a PV for the urban leg is characterised by the prevailing traffic congestion in the urban area (in terms of average traffic speed) and by a series of rules and regulations set by the city administration regarding the cost and time of access to the restricted zones of the urban area, parking, and the type of vehicles allowed. Four of the five attributes, hence, are policy instruments available to local authorities to regulate traffic within the urban area.

Attribute levels need to be drawn from real life situations and allow sufficient variability to guarantee the statistical robustness of the model. Since only a few UCCs are in operation in Italy, very little information exists on costs, delivery time, and additional services (the most comprehensive source of information is Progetto City Ports, 2005). Therefore, the values adopted for specifying the ranges of UCC attributes reflect assumptions more than actual data. In contrast, information is available and abundant on the varied traffic regulations enforced in the Italian cities (Progetto City Ports, 2005) so that PV attribute levels are both realistic and differentiated.

3. The model

The choice between the UCC and the PV is modelled based on the assumption that agents want to maximise their utility function. The utility derived from the use of a UCC is represented by the following equation:

$$U_{UCC} = \beta_{\text{costant}}\text{costant}+\beta_{\text{cost}}\text{cost}+\beta_{\text{d\_time}}\text{time}+\beta_{\text{track\&trace}}\text{track\&trace}+\beta_{\text{store}}\text{store}+\varepsilon \quad (1)$$

and the one derived from the use of the PV mode is

$$U_{PV} = \beta_{\text{permit}}\text{permit}+\beta_{\text{speed}}\text{speed}+\beta_{\text{a\_hours}}\text{a\_hours}+\beta_{\text{distance}}\text{distance}+\beta_{\text{r-35ton}}\text{r35ton}+\beta_{\text{r-euro2}}\text{r-euro2}+\varepsilon \quad (2)$$

The theoretical foundation used to describe this choice context is based on the microeconomic choice theory that states (3) where an agent has a preference relation over any two choice options and chooses between them so to maximise his personal utility.

$$i \succsim j \Leftrightarrow U_i \geq U_j \quad (3)$$

The approach followed in this work aims at measuring the agents' willingness to pay for UCC services as it depends on both the characteristics of the UCC service and from the traffic policies locally implemented.

4. The sample

The 86 businesses interviewed are located in the city centre of the urban area. They can be grouped into 5 categories, as reported in Table 5, taking into account both the product types traded and the store area.

Table 5 – Type of businesses in the sample

Category	N°	%
Fresh and non-fresh grocery, mainly in small shops	15	17%
Bars, restaurants and pizzerias	9	10%
Garments, mainly in small shops	18	21%
Everything but garments, mainly in small shops	40	47%
Specialized goods, mainly in medium shops	4	5%
Total	86	100%

Almost half of the businesses in the sample are non-garment small shops (bookshops, opticians, flower shops, shoes shops, etc.). 21% of the shops are garment small shops. Fresh and non-fresh grocery make up 17% of the sample followed by a smaller, but still consistent, 10% of bars, restaurants and pizzerias. The medium size, specialised shops are about 5%. 6 transport companies offering transport services for the urban area were also interviewed.

The average size of these businesses is small, in terms of numbers of employees. 58 businesses have less than 4 employees. Only 5 businesses have more than 10 employees. The average size is also small in terms of square metres. 59 businesses have less than 100 square metres of retail floor space. 5 businesses have more than 500 square metres. The picture is similar in terms of turnover.

67 businesses out of 86 have their own, although small, warehousing facilities on the premises of the shop.

5. Results and policy analysis

Table 6 – Multinomial Logit estimated over the entire data set excluding transport operators

Variables	*Coeff.*	*t-ratio*
Alternative specific constant for UCC	-0.71172	-2.81
Cost (UCC service cost for single parcel delivery)	-0.3209	-4.88
Time (delivery time measured from UCC consignment to delivery to final destination)	-0.53388	-6.87
Tracking-and-tracing service	-0.04976	-0.40
Warehouse availability	-0.02204	-0.18
Annual cost of the access pass to the LTZ	-0.00865	-7.63
Average speed of the urban traffic	-0.00226	-0.23
Time windows width (in hours)	0.008801	1.29
Distance of available parking space from delivery location	-0.00783	-5.47
Access restriction to vehicles weighting more than 3,5 tons	0.035665	0.24
Access restriction to vehicles with a below Euro2 engine	-0.1134	-0.75

Nobs =1376;
Log likelihood function = -780,0469,
No coefficients - adjusted rho square = -0,17555;
Constants only - adjusted rho square = -0,08159.

The SP interviews provided us with 1376 observations concerning hypothetical choices made by the agents thus permitting the estimation of a Multinomial Logit Model (MNL). The results are illustrated in Table 6. The explanatory power of the model is not high, although it can be considered acceptable.

The UCC constant is statistically significant with a negative sign, implying a negative consideration of the UCC for reasons other than those specified in the model.

Four of the variables specified in the model are statistically significant at a 5% level. These are: UCC service cost, delivery time, annual cost of the access permits to the LTZ, and parking distance from the shop. They are to be considered as having a major role in explaining the choice between UCC and private transport. The remaining variables play a much smaller or no role. Notice that two of them are related to the UCC (service cost and delivery time) and two are related to PV regulation (access cost and distance of parking stalls from delivery location). Overall, two of the variables are related to financial aspects and two to the time efficiency of operations.

Tracking-and-tracing service and warehousing do not have a relevant influence on choice. This does not imply that these services are not considered important or appreciated. It simply means that on a relative importance scale, and in this specific choice context, they play an irrelevant role in comparison to the previously mentioned variables. A possible explanation is that, as appeared in a recent survey by D'Elia et al. (2004, p.92-93)[7], in most cases in Italy information technologies have been used very little thus far, so that awareness of the possibilities offered by tracking-and-tracing services is limited. As to the warehousing services, they are probably of little interest to these businesses since most of them have their own facilities.

Similarly, with reference to private transport, the constraints on the type of vehicles and the average speed within the city centre had no role in explaining choice. Investment considerations regarding new vehicles and the benefits deriving from lower congestion levels were of relatively little relevance in explaining the choices made by the people in our sample. Even if not statistically significant (at a 5% level), the time windows attribute demonstrated a certain explanatory power compared to the previous two variables. These findings are of interest for the regulatory vs. pricing debate in urban transport since they imply that some aspects of the utility function have relatively

[7] "Around 50% of the interviewed declared not to use any sort of IT instrument. Those that use a computer utilise it to write lettersand/or invoices, or manage warehouse stocks. Very few use the internet to send e-mails."

more weight than others in explaining transport choices. In our case study, varying the traffic speed appears to be less decisive than varying the distance to available parking space.

Thanks to the econometric model estimate, one can forecast the choice probability of alternative scenarios and simulate the likely effects of different freight traffic management policies.

Let us set the reference scenario as made up of the following "realistic" characteristics. For UCC: a 3 Euro cost per consigned parcel, 2 days delivery time, and for PV a 100 Euro annual cost of access permit to the LTZ and a 0 metre distance for parking[8]. Note that all the other variables, with the exception of the constant, are assumed to have a value of zero so that they do not play any role in determining the choice. The application of the reference "realistic" scenario results in an average 13% chance that goods transported within the city of Fano will go through the UCC while 87% will use PVs.

It is not easy to compare this estimate with the UCC schemes in operation since, as Browne et al. (2005) argue, the measured outcomes are often insufficient and not easily comparable. Furthermore, the results of the UCC schemes are often estimated simply in absolute terms (number of parcels handled or trips made) or in percentages but with reference only to the type of goods handled by the UCC and not all the goods entering the urban area. Nonetheless, from the scarce available information reported by the University of Westminster Report (2005)[9], one gets the feeling that 13% of total deliveries would be quite a successful result.

Let us now consider the following management measures: *measure 1*: UCC service cost equal to zero. The public authority totally subsidises the UCC service such that is offered for free thus employing a simple and extreme financial intervention on the supply side; *measure 2*: Delivery time is reduced from 2 to 1 day thus introducing a substantial improvement in the time efficiency of the UCC; *measure 3*: The downtown access permit is increased from 100 Euro to 200 Euro. The public authority uses a fiscal instrument on the demand side (one could alternatively imagine the introduction of road pricing or congestion charge mechanisms in the city centre); *measure 4*: The average distance from the dedicated parking stalls to the shop is increased from 0 metres to, on average, 100 metres. The local public authority invests in dedicated parking stalls and strictly enforces the parking restrictions. Alternatively, one could imagine the introduction of selective access restrictions within the restricted traffic zones.

The effects of the implementation of the above-mentioned measures, singularly or jointly, is reported in table 7.

[8] Zero metres distance is unrealistic for legal parking but quite realistic in the case of illegal, second row parking, not uncommon in Italian cities. It has been estimated that, for instance, in Cosenza, there is about 62% of irregular parking when considering freight distribution trips (D'Elia et al. 2004, p.94).

[9] The University of Westminster Report (2005) quotes: an estimated 28% decrease in the total distance travelled (compared with not using a UCC) in Tenjin, the central business district in Fukoaka, Japan, and one of the most successful UCC schemes so far; only marginal reduction in total traffic mileage in the central business district of Kassel, Germany; a 12.7% reduction in vehicle journeys into the city centre of Bremen, Germany, one of the first schemes in operation; a 50 % reduction in number of vehicles travelling into the city centre / day of Freiburg, Germany; a 37% reduction in the freight vehicles travelling in the historic centre of Siena, Italy.

Table 7 – Effect of single and joint management measures

Measures	Scenario	UCC	PV
Base	Base: cost UCC=3 Euro, Delivery time=2days, Access permit cost=100 Euro, Parking stall distance=0m	13%	87%
Base, and P1	S1: cost UCC=0 Euro, Delivery time=2days, Access permit cost=100 Euro, Parking stall distance =0m	29%	71%
Base, and P2	S2: cost UCC=3 Euro, Delivery time=1day, Access permit cost =100 Euro, Parking stall distance =0m	21%	79%
Base, and P3	S3: cost UCC=3 Euro, Delivery time=2days, Access permit cost=200 Euro, Parking stall distance=0m	27%	73%
Base, and P4	S4: cost UCC=3 Euro, Delivery time=2days, Access permit cost=100 Euro, Parking stall distance=100m	25%	75%
Base, and P1+P2	S5: cost UCC=0 Euro, Delivery time=1day, Access permit cost=100 Euro, Parking stall distance=0m	41%	59%
Base, and P3+P4	S6: cost UCC=3 Euro, Delivery time=2days, Access permit cost=200 Euro, Parking stall distance=100m	44%	56%
Base, and P1+P2+P3+P4	S7: cost UCC=0 Euro, Delivery time=1day, Access permit cost=200 Euro, Parking stall distance=100m	78%	22%

The effect of the adoption of P1, zero delivery cost, increases the probability of choosing UCC from 13% to 29%. Evidently, in this case the financial burden falls totally on the public authority. The reduction of delivery time by half (P2) increases the UCC choice probability to 21% with a result not substantially different from the previous measure. To decide between these two measures one would have to compare the relative cost-efficiency of both intervention policies. It could well be that P2 requiring more personnel and more vehicles might be more cost-efficient than P1.

Increasing the cost of the access permit (P3) would raise the UCC choice probability to 27% representing the second best result of the three measures examined so far. The financial burden, in this case, would be on the transportation companies and final customers, with a likely loss of competitiveness of the shops located in the city centre and with a negative response by all the categories influenced by it.

P4 influences required times and relative ease of unloading. Eliminating parking opportunities (frequently illegal) close to final destinations and increasing average parking distance to 100 m raises UCC choice probability to 25% and, in this case, there is no direct financial burden imposed but the policy produces a reduction of the number of deliveries per day with a related increase of delivery costs that, at least initially, will bear on transport operators. Politically, P3 is the most easily accepted policy, in the authors' opinion.

Scenario 5 assumes the simultaneous implementation of both the specific measures on the UCC, total subsidisation of the UCC service and a 50% increase of UCC time efficiency with respect to the base case. In this case, the UCC choice probability would rise up to 41%.

Scenario 6, on the contrary, foresees the joint implementation of both the policies aimed at the PV, that is, the increase in the cost of city-centre access permit along with the introduction of severe parking restrictions. The UCC choice probability would increase to 44%.

Scenario 7 implies the joint adoption of all four policies resulting in a UCC choice probability of 78%.

To summarise, given the preference structure of our sample, using a choice model based on the four main relevant variables, under the present costs and traffic regulation, we found that a UCC would be able to attract 13% of the consignments made to the businesses located in the city centre. The share is not dramatic but it can help improve the urban quality and traffic in the city centre. This share can be increased by introducing appropriate policies aimed at altering the UCC or PV costs and efficiency. Depending on the policy or mix of policies adopted, the UCC share can be increased to about half the consignments in the city centre with a maximum of 78% when all policies are implemented.

6. Business and type-of-good determinants of choice probabilities

The second question raised in the introduction regards which segments of urban freight traffic would probably be more interested in taking advantage of UCC services. A number of estimates and simulations were carried out by segmenting the sample or by introducing covariates in the model. Since the results are preliminary and based on a limited sample size, we will not report the detailed results here. Interested readers can request information directly from the authors or read the working paper Danielis and Marcucci (2006). The following, however, is a brief summary and a discussion.

It is quite likely that the preference structure varies depending on the type of businesses involved. A mixed logit model allowing random coefficients confirmed this hypothesis. However, it is not a simple task to prove which are the main determinants of the utility functions. The type of business comes to mind first. The type and number of businesses is virtually very high, however, and the categories are uncertain. One can start with a number of hypothetical business categories and test their relevance in explaining the preference heterogeneity or let the data decide how to group business using a latent class model. We have tentatively followed the first method and subdivided businesses into the 5 categories listed in Table 4: 1) fresh and non-fresh grocery, mainly in small shops; 2) bars, restaurants and pizzerias; 3) garments, mainly in small shops; 4) non-garments, mainly in small shops; 5) specialised goods, mainly in medium shops. Organising our discussion by attribute first, we find the following. *Parking stalls distance*: specialised goods, mainly in medium shops, bars, and restaurants seemed the most sensitive to the distance of the dedicated parking stalls due probably to high freight volumes dispatched and the delivery frequency. *UCC service cost*: Grocery, garment, and non-garment businesses show, on average, a lower aversion to UCC service cost compared to medium surface and bars & restaurants. Volume and frequency might be, as before, the determinants of this result. *Access permit cost*: for this attribute, quite reasonably, there is no statistically significant difference among type of businesses. The aversion to a money payment is equally shared among businesses. *Width of the delivery time window*: bar and restaurants appear more sensitive with respect to the medium sized-shops, while groceries are less sensitive (in our sample there are mainly groceries specialising in dry food). The garment businesses have the lowest sensitivity to width of delivery time window, understandingly being characterised by a low number of deliveries.

To summarise, businesses with frequent, differentiated, and high volume deliveries appear less prone to use the UCC services. This is quite unfortunate from a social perspective because they are the one most likely to produce a large volume of urban traffic.

We have also tested the importance of business characteristics such as warehouse availability, truck ownership, and total turnover. This latter variable appears to be the only one that has an influence on the preference structure. It appears to have a decreasing disutility in relation to the increase of waiting time for the consignments, to the cost of access permit as the total turnover increases, to UCC service cost and to parking stalls distance. Hence, the bigger the company, the more flexible and better suited it is to cope with the costs and regulation of urban goods transport and with the potential limitations of the use of a UCC.

Again, this is not good news from a social point of view because the city centre is mainly characterized by a large number of small shops, whereas large businesses tend to locate in the outskirts of a city where land rent values are lower.

The picture so far described is based only on the preferences of the receivers. Another major actor in the urban transport business is the transport operator that actually carries out the task and directly faces the traffic issues in urban areas. In Fano, it was possible to interview only 6 transport operators, but the preliminary results z. Transport operators are more interested in transport efficiency while the monetary cost is, up to a certain point, transferred to retailers. The preliminary results concerning the choice probabilities between UCC and PV for the transport operators show that they are much more likely to use the UCC than receivers in a *status quo*

scenario. All the policies discussed induce substantial shifts in choice probability and, in particular, changing the average parking distance produces the greatest effect. The combination of all four policies would induce even bigger shifts in choice probabilities.

7. Conclusions and future research objectives

Most cities need to deal with the large number of trucks and lorries delivering goods in the urban area while preserving the economic sustainability of the businesses located in their territories and, at the same time, preserving accessibility and environmental quality. UCC schemes represent an ambitious attempt to improve urban goods distribution by introducing a physical infrastructure dedicated to the consolidation and rationalisation of good transport flows. The historical evidence presents some success stories but also many failures with loss of (often public) resources. Therefore, it is important to study the conditions under which the UCC scheme works and produces positive (private and social) effects for the local community.

In general terms, it is politically unfeasible to impose the delivery of goods via the UCC, though there are some examples of such an authoritarian approach. On the contrary, the feasibility of a UCC, in terms of acceptability among the relevant decision-makers, should be tested first. Moreover, one should test even the appropriateness of regulatory policies providing negative incentives to private vehicles' freight consignments to the city centre or positive incentives to the use of the UCC. These policies might not carry any theoretical justification when the social costs of using the UCC are larger than social benefits. This latter case could, for example, prove true when the main distributor or producer has already optimised the logistic flows. In most real world instances, operators choose whether to use the UCC services or to keep on transporting goods by private or third-account means.

In this paper, we report the results of an SP study aimed at investigating how transport decisions are made by receivers or by transport operators and the prediction of the share of consignments that would be delivered via a UCC in the city of Fano.

Some interesting results have emerged. Given the prevailing traffic conditions and the present regulatory regime, the implementation of a hypothetical UCC would attract a share of around 13% of goods delivered to the city centre. This share, compared with the results obtained by the UCC schemes currently in operation, could be considered satisfactory both for the purpose of reducing the negative impacts associated with truck and lorry traffic and, most likely, for the purpose of making the UCC economically viable.

Given the preference structure of the sampled businesses, it is estimated that the introduction of more stringent traffic regulations could increase such share to 25-27%, whereas improving the time efficiency of the UCC relative to the current "realistic" level, could raise the share to 21%. Providing the UCC service at zero cost via a public subsidy would raise the share to 29%. A joint implementation of various policies might further increase that share up to 50%.

Preliminary investigations on the type-of-good and business determinants of the stated preferences lead us to believe that some businesses, notably garment and non-garment related businesses, show a good propensity to use the UCC since they do not require specific and sophisticated logistic performances and services. Food and grocery businesses appear moderately interested in UCC, while bars, restaurants and hotels along with medium-sized specialised stores show greater resistances probably due to a need of high frequency and punctuality and to a need for higher logistics quality.

High overall turnover, usually associated with greater company size, seems to be associated with a greater ease in accepting the implementation of UCC projects. Less certain is the effect of warehouse availability, whereas the presence of private vehicles seems not to play an important role.

More research is certainly needed both to increase the number of observations within the city of Fano and to compare these findings across cities of similar or different size. This would help

in testing the robustness of the results obtained and to verify whether other geographical or cultural factors should be taken into account.

A further issue that deserves attention, in our opinion, is whether transport operators' preferences differ from those of the receivers. Our preliminary results suggest that this might prove true. If that is, in fact, the case, it might be fruitful to study how collective supply chain decisions are made in urban freight transportation along the lines suggested by Hensher et al. (2004).

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