Feasible financing of the USO after Full Postal Market Opening: Empirical Analysis

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Introduction

FMO is now scheduled in the European Union for no later than January the 1st, 2011. FMO means that competitors can freely enter the postal market and offer the whole range of postal services including mail delivery. Competition is a potential threat on the financing of universal service obligations. These obligations usually include universal coverage, obligations in terms of service quality (frequency of delivery, reliability of the service, accessibility of contact points) and affordable and uniform tariff on a bundle of products.

Because new comers are not subject to such obligations, they can enter only the most profitable market segments leaving the less profitable ones to the universal service provider (USP). Profitable segments include industrial (or bulk) mail and mail delivery in the cheapest regions, where delivery stop points are most dense. This strategy is currently applied in Sweden by City Mail who proceeds mainly bulk mails and delivers them only in a limited portion of Sweden. It can cause the USP financial balances to become negative.

Different ways to finance this are described in the recently published Oxera study[1]. But is it possible to introduce objective criteria to choose between different ways to finance? Is it possible to decide whether it is possible to self-finance, to use a pay or play mechanism or do we have to ask the Government for a subsidy? We base our answer to this question on scale and postal density structures in a country and the fact that these factors influence the cost curve over the routes, the market penetration of the entrants in case of market opening and the financial results of both the USP and the entrants. Our theoretical answer is proposed in d'Alcantara G. and Gautier A. (2008). In this contribution we want to explore the sensitivity of our own model results with respect to assumptions about sensitivity of demand behaviour. Then we propose to apply the method for a number of countries using empirical data.

We first make a short summary of our results for two theoretical shapes of cost curves, the most-dense stop point route configuration and the most non-dense stop point route configuration. The main driver of delivery cost per-address is the density of delivery points is represented by the route's Grouping Index (see for example Boldron, Joram, Martin and Roy, 2007). Their values averaged over twenty equal semi-deciles of addresses as reported in vary

[1] http://www.oxera.com/cmsDocuments/Funding%20the%20USO%20in%20the%20postal%20sector.pdf

from 15 to 1. Route costs are an increasing function of postal non-density, highest non-density corresponding to one-family buildings. We use the Grouping Indices distributed in twenty equal semi-deciles of addresses in decreasing sequence over the Routes, starting from the densest and ending with the most non-dense which are the most expensive. In each case we apply the cost model using best practice technologies to obtain upstream and downstream unit costs as a function of scale and postal density information (the available Grouping Indices). On the basis of the cost curves (or fixed cost curves), we then apply the strategic national market opening model to the hypothetical country. For the two shape of the cost curve over the routes we then show the outcomes after FMO in terms of coverage percentages decided by the Entrants, uniform tariffs asked for by the national operators in charge of the Universal Postal Service, the financial balances of this USP and of the Entrants. This is done according to the four different regulatory set-ups ruling the price behavior of the USP.

We then analyse the sensitivity of these results of these two cases when we increase the price elasticities of demand and the displacement ratio.

Finally we consider the empirical implementation of our model using data for two countries. The empirical use of our FMO model for a country provides a prediction of what will be the result of the negotiations at the national level when the European FMO decision is applied. The results allow saying a) if the USO can be self-financed by USP tariff increases, b) how large the negative balance of the USP would be under well-defined conditions and whether this balance could be financed out of the Entrant's profits: if this is the case the pay-or-play mechanism could be used as the way to finance the Universal Postal Service, c) if a Government Subsidy is necessary because postal profits are not sufficient.

General discussion of the approach

Universal coverage at a uniform price by the USP implies that delivery in high cost region is priced below average cost while delivery in the low cost region is priced above average cost. Hence, USO implies cross-subsidies from the low-cost delivery zones to the high cost ones. Partial bypass by a new entrant put pressures on the universal service provider who then looses a fraction of its profit in the low cost regions. And since these profits (or part of them) are used to subsidy delivery in the high cost region, competition could threaten the USO financing. The extent of this problem will obviously depend on the scope of the USO and the importance of competition in the postal markets; but also, and this is the focus of our contribution, on the shape of the cost curve of the country related to objective factors such as population, geographical size and postal density (number of letter boxes per stop point in the delivery round). There may be situations where it results to be feasible to finance the USO using part of the profits generated by the postal competitors operating after the market opening. But there are also situations where it results that such profits are not sufficient so that an internal postal sector financing, such as pay or play for example, is not feasible. Then, another type of financial source is necessary such as a government subsidy. Cases where grave yard spirals occur are thus not the only possible reasons why USO could not be financed internally or would not provided welfare increasing impacts of the opening of the market. In practice one has to measure the existing situation in each country before one can say whether or not one or the other solution is feasible, given a precise definition of USO and safeguarding measures.

In competitive postal markets, the imposition of USO such as universal coverage and/or uniform pricing and the possibility to finance the USO have an influence on the level of competition on the market.[2] The latter in turn affects the USO financing and so both questions must be treated simultaneously. Moreover, financing the USO is not neutral with respect to welfare and efficiency (see and Choné, Flochel and Perrot, 2002).

Suppose that a competitor partially bypasses the USP and establishes its own delivery network in a part of the national territory. The entrant's coverage of the country will depend on the repartition of the delivery cost across the country. One could expect that the coverage by the entrant will depend on country specificities such as population density, grouping indices but also mail demand and prices. This is illustrated by the choice made by the new postal operators in The Netherlands and in Sweden: In The Netherlands, the new operators have now a nationwide network while in Sweden, it remains limited to the high density (mostly urban) areas.

In this paper, we consider the possibility to finance USO after FMO. For that, we construct two hypothetical countries that differ according to their distribution of the grouping index within the country. Grouping indices are a main driver of the delivery. The first configuration, named hereafter most-dense stop point route configuration, is such that a majority of the addresses (60%) are located in a high grouping index region (GI=15) resulting in a low delivery cost per address. The second configuration, the most non-dense stop point route configuration is such that 60% of the addresses are in a low grouping index region (GI=1) resulting in a high delivery cost per address.

In these two countries, an incumbent USP must serve all addresses at a uniform price. After FMO, a competitor enters the market and decides on its address coverage and on its price. The entrant is not bounded to universal coverage and delivers mails only to the addresses for which it is profitable to do so. Entry obviously affects the USP's profit and its ability to finance the USO. In the paper, we are interested in the possibility of financing the USO after FMO. We restrict our attention to self-funded systems, where the costs of the USO are financed by the consumers and/or the firms without public subsidies paid by the regulator. We concentrate in particular on self-financed USO (the USP finances herself as it is currently the case in Sweden) and a pay-or-play mechanism where the entrant finances the USO unless it decides to have a nationwide coverage.

The pro and cons of each of the proposed safeguarding measures and their application in the postal sector, especially pay or play and increased commercial freedom, are various. First of all, when USO is defined by law, it is also essential to make sure there are financial resources to cover whatever losses caused by a non strictly market conform definition, such as tariff uniformity or the obligation to cover the whole territory every day for example. The second aspect is related to the question whether these financial resources should come from the global fiscal resources of the Government, following the principle of universality, or if the universal service has to be financed by the clients or by the competitors who do not have any USO. To balance pros and cons one should take into account that letter post is part of a much broader market of communication. Any Government Subsidy to the postal sector could be considered to cause a problem of unfair competition by competing communication services. A final aspect to be considered is related to the choice between self-financed and pay or play: in both cases the customer pays, but not in the same way, since in the case of the self-finance the USP has to increase its tariffs to break even – and this is a consequence of FMO which may

[2] Valletti, Hoernig and Barros (2002) show that the imposition of a uniform price constraint changes the market coverage by both the incumbent and the entrant.

be in contradiction with welfare maximization – while in pay-or-play only the prices of the competitors are increased to cover the cost of USO. Welfare analysis remains key for any political choice.

FMO Model

The FMO model used in this paper is similar to d'Alcantara G. and Gautier A. (2008). We consider a country composed of N addresses. Delivering a letter at address n involves a fixed cost $f_K(n)$ for firm K. We assume that addresses are ranked according to their fixed delivery cost: $\frac{\partial F(n)}{\partial n} \geq 0$. This ranking is based on objective factors such as the population density and the grouping index (see after). In addition to this fixed cost per address, proceeding one mail involves a constant unit cost c_K which is independent of the delivery location.

There are two firms competing for an average mail product. The incumbent serves all the addresses at a uniform price p_I. Universal coverage at uniform price are imposed by the regulator as part of the USO. The prospective entrant is not bounded to universal coverage and may choose to serve only a share n* of the total population.

We construct demand for mail delivered at address n. We make the assumption that demand depends only on prices and not on the receiver location. This implies that the entrant will serve first the cheapest addresses. In our calibration, we use a quadratic surplus function à la Singh and Vives (1984). From this function, we derive monopoly demand (when an address n is served only by the incumbent) and duopoly demands (when both firms deliver at n).

The firms offer differentiated products, for example the entrant could have a lower frequency of delivery (as it is the case in Sweden and The Netherlands where the newcomers only deliver mails twice or three times a week). Therefore, the consumers view the two products as imperfect substitutes.

Firms compete sequentially in prices. The incumbent sets its letter price first. Then, observing that choice, the entrant decides on its price and its coverage. In this model, a higher price charged by the incumbent implies that the entrant increases both its price and its coverage.

Cost functions

The cost functions are derived from the activity based cost model (d'Alcantara and Amerlynck, 2006). It uses the costs of the volumes of production factors and their unit costs multiplied by the amount of them needed for each activity. These are, for a given volume of product and over a given distance, collect from the senders, sort, transport and deliver to the receivers. The model is worked out for a number of types of products (p), zones of delivery (z) and delivery methods (m). In the version of the model used

- we have grouped all product types to obtain one single average postal product (single letter mail, bulk, parcels and newspapers)
- there are two zones defined: the Dense Stop Point zone, with a grouping index up to 15 and the Non Dense Stop Point zone with a grouping index of at least 1
- the Delivery methods (m) are respectively by Foot, by Motorcycle / Bicycle and by Car / Van / Truck.

The costs are computed as functions of specific technical coefficients. For example, the resulting sorting and/or sequencing cost of direct mail will be in general lower than letter mail because of a better address readability and format homogeneity because of corresponding technical coefficients.

In the model the proportion of two zones and their average grouping indices have to be given exogenously. To derive a cost curve for a theoretic country, we follow a procedure computing the costs corresponding to each Grouping Index located in the most Dense Stop Point zone successively. We first suppose that 5% of the population is located in a Dense Stop Point zone corresponding to a Grouping Index of 15. Simultaneously 95% of the populations is located in a Non Dense Stop Point zone with a Density Grouping Index equal to 1. This procedure is repeated respectively for the values 15 up to 1 of the Grouping Index in the Dense Stop Point zone.

In the first part of this contribution we consider two theoretical country configurations. These countries have an identical population of 5 million inhabitants and the average household size is 2.5, so that there are 2 million addresses in each country. The country surface area is 50.000 km². The scale per letter box is 500 (or the scale per person 200). The average hourly labour cost in the sector similar to postal is 25,00 €. Labour cost for freelance worker (fiscal, social security contributions…) is 80% of this cost.

The repartition of grouping index within the countries is summarized in Table 1. Grouping indices range from 15 to 1. In the most dense stop point route configuration, 60% of the addresses are located in zones with the highest grouping index of 15. The remaining 40% of the population are located in zones where the grouping index is monotonically decreasing from 15 to 1. In the most non-dense stop point route configuration, 60% of the addresses are located in zones with the lowest grouping index of 1. The remaining 40% of the population are located in zones where the grouping index is monotonically decreasing from 15 to 1.

Routes	Dense Stop Point Routes	Non dense Stop Point Routes
0	15,0	15
0,1	15,0	11,5
0,2	15,0	8,0
0,3	15,0	4,5
0,4	15,0	1,0
0,5	15,0	1,0
0,6	15,0	1,0
0,7	11,5	1,0
0,8	8,0	1,0
0,9	4,5	1,0
1	1,0	1,0

Table 1: Repartition of the grouping indices in country configurations with the most-dense stop point routes and the most non dense stop point routes.

It is interesting to show the Figure representing the GI curve of our hypothetical countries, as defined in Table 1.

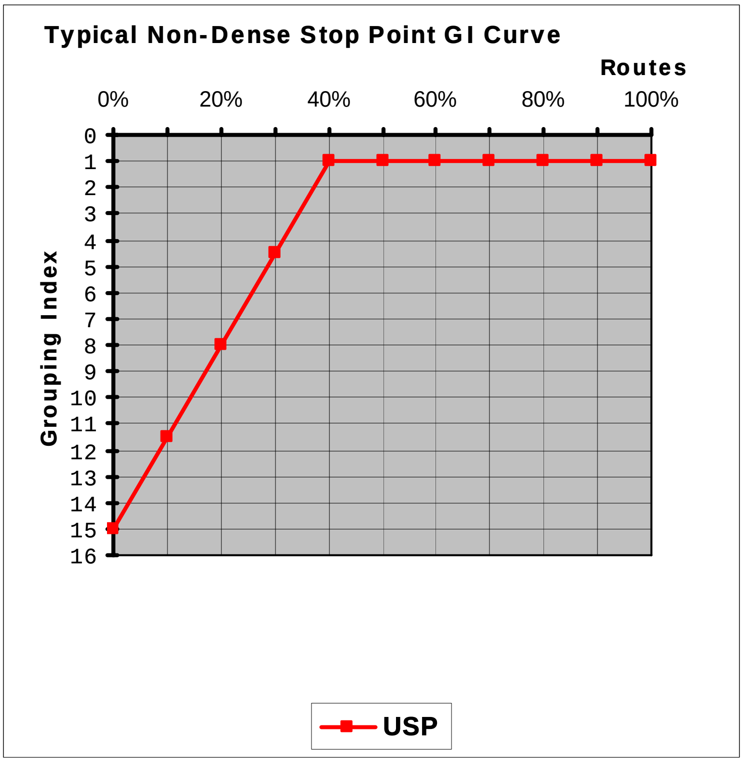

Figure 1 Grouping Index Curve for a typical Non-Dense Stop Point Country

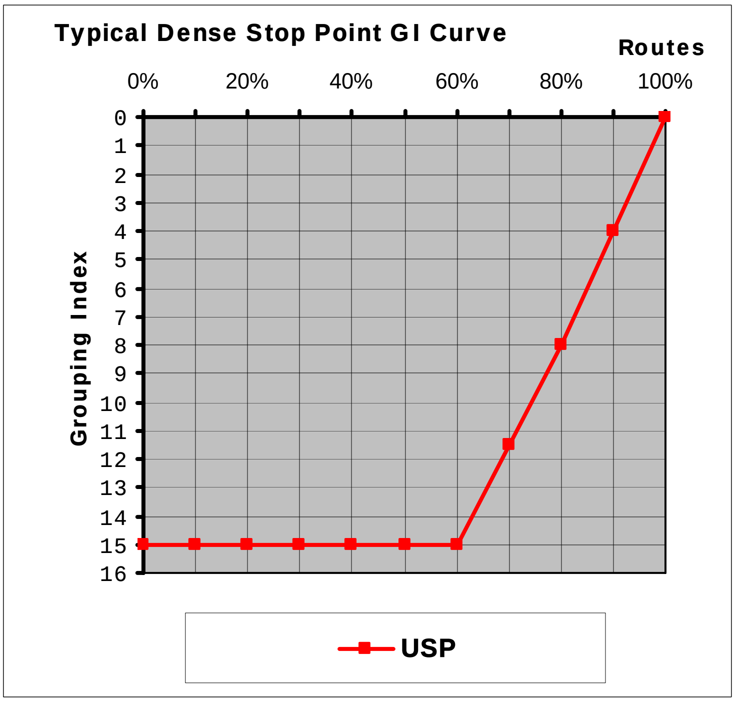

Figure 2 Grouping Index Curve for a typical Dense Stop Point Country

After having determined the Grouping Indices for all the routes of a country, the second step is to derive the cost corresponding to each GI. For each theoretical country, we estimate a delivery cost per-address and a unit cost per mail item. Results are given in Table 2. One important step in the computation is the determination of the total average share of fixed costs in total costs of the operator. This share is computed using the cost model under assumptions of decreasing volume resulting from the market share of the Incumbent. This value is crucially important.

Routes	Dense Stop Point Routes	Non dense Stop Point Routes
0	59.5€	59.5€
0,1	59.5€	96.5€
0,2	59.5€	137,0€
0,3	59.5€	176.5€
0,4	59.5€	214.5€
0,5	59.5€	214.5€
0,6	59.5€	214.5€
0,7	96.5€	214.5€
0,8	137,0€	214.5€
0,9	176.5€	214.5€
1	214.5€	214.5€

Table 2: Fixed cost per-address for the GI curves in euros.

It is interesting to notice that the main drivers of these fixed costs are not the number of items per person but rather the number of inhabitants (population) and the country surface area. These are given for each country and were defined above. Modifying the size of population modifies the number of letter boxes, the distances between these and therefore the time needed to deliver. Modifying the size of the country also modifies the distances of the delivery rounds. Modifying the number of letters per person does not modify the fixed cost to be financed, but only the variable and the average costs.

Results for the low sensitivity demand specification

We run two set of simulations based on two demand specifications. The main differences are the price sensitivity of the demand functions. The first scenario (favorable to the incumbent) takes demand functions that have limited price sensitivity. We increase the sensitivity of demand functions in the second scenario, which makes it more favorable to the entrant.

We use the following elements to calibrate the demand functions: (1) we consider that a monopoly USP faces a demand of 500 postal items per household if it charges a price of 0.35€/0.45€ in respectively the dense stop point case and the non dense stop point case, (2) at this price/mailing volume, the elasticity of the monopoly demand is –0.1. When the two firms compete, we assume that (3) the displacement ratio is equal to 0.75 meaning that 75% of the mails proceeded by the entrant were previously carried by the USP, (4) at identical prices, the mail volume per address carried by the entrant is equal to 30% of the Incumbent's volume and (5) with a 20% price discount, the entrant has a mailing volume per address equal to 70% of the mailing volume of the entrant. This implies a shifting elasticity of -0.90. The parameters used to calibrate this model are similar to the ones used by De Donder, Cremer, Dudley and Rodriguez (2006) and d'Alcantara G. and Gautier A. (2008).

In this model, prices and the entrant's coverage are strategic substitutes. This means that any increase in the incumbent's letter price increases both the price of the entrant and its coverage of the territory.

a) Dense Stop Point route configuration

In each demand context, the Regulator - or the incumbent - has multiple options. The Regulator decides first what the regulatory set-up is and the incumbent plays according to the rules given. We consider five different price scenarios for the incumbent, defined by the Regulator. In the first, the incumbent continues to charge the monopoly break-even price. In the second, the price is set at a lower level to exclude the competitor from the market. In the third scenario, we search the lowest possible price compatible with a positive profit for the incumbent. In the fourth, we leave complete commercial freedom to the incumbent. In the last, we search for the lowest possible price compatible with a pay-or-play mechanism. To be viable such mechanism must be such that the losses of the incumbent could be perfectly compensated by the profits of the entrant.

In the Dense Stop Point route configuration, key elements for this calibration exercise are given in Table 3. Without the threat of entry by the competitor, the break-even price for the incumbent is equal to 0.22€, with a mail volume per-address of 518 items. Notice that, if the incumbent would have been free to pick a profit-maximizing price, the price increase would have been considerable since the elasticity of demand is low.

After FMO, if the incumbent continues to charge the pre-FMO price of 0.22€, the competitor enters the market. At that price, the competitor enters the market and reaches the break-even point. Its product is sold at 0.18€ and it covers only the most dense zone (60%) of addresses. The entrant captures 25% of the total mail volume and 39% of the mail volume for the covered addresses. Entry with constant pre-FMO prices implies that the incumbent is no longer at the break-even point. Specifically, entry results in a loss of 35 million euros for the incumbent.

	Pre-FMO price	No entry	Break-even price	Pay or Play	Profit max
p^I	0.22€	0.21€	0.28€	0.26€	0.42€
p^E	0.18€	/	0.20	0.20€	0.26€
X^I (%)	75%	100%	69%	71%	51%
X^E (%)	25%	0%	31%	29%	49%
n (%)	61%	0%	63%	63%	77%
$\prod^I$ Mio €	-35	-27	0	-7.5	37.7
$\prod^E$ Mio €	0	0	11	7.5	57.1

Table 3: Main results for the Dense Stop Point route configuration
X^I and X^E are mail volumes of Incumbent and Entrant as a % of total mail.

At pre-FMO prices, the USP is no longer able to serve all addresses at a uniform price. If it modifies its price, it must take into account that a higher (resp. lower) price will make entry even more (resp. less) profitable resulting in a higher (resp. lower) price and higher (resp. lower) coverage by the entrant.

To illustrate the "No entry" option, consider a 0.01€ price decrease. At a price of 0.21€, the entrant is no longer able to achieve the break-even point, even in the case where it serves only the low cost addresses. But still, excluding the entrant, if it reduces the losses to 27 millions €, the result remains incompatible with USO financing.

Another option, called "Break-even", is to raise the price up to 0.28€. At that price, the entrant covers 63% of the territory and captures 31% of the total mail volume. A price of 0.28€ is the lowest possible price compatible with FMO and a non-negative profit constraint for the incumbent. Notice that in this case, the incumbent price increases compared to the pre-FMO price of 0.22€ while the entrant offers only a 10% discount on the incumbent's pre-FMO price.

Alternatively, in the "Profit Maximizing" option, it is possible to have both firms realizing a positive profit, for a price p_I above 0.28€, with a USP profit maximizing price of 0.42€.

Finally, the Regulator can impose "Pay or Play". The entrant participating in a pay or play mechanism has the choice between fulfilling the same USO obligations than the incumbent, that is universal coverage at uniform price or to compensate the incumbent for its universal service obligations. Such mechanism is feasible with an incumbent price of at least 0.26€. At that price, the incumbent is still making losses but these losses can be perfectly compensated by a fixed payment by the entrant.

The above scenario appears to be constructed under favourable hypothesis for the incumbent and for USO financing: a limited price elasticity of -0.1 which allow a USP price increase with small reductions in the mail volume and the entrant capturing only a limited volume of the mails with a price discount.

b) Non-Dense Stop Point route configuration

In the Non-Dense Stop Point route configuration, as summarized in Table 4, the break-even price for a monopoly incumbent is 0.37€. At that price, entry is profitable and the entrant delivers to 18% of the total addresses resulting in a total loss of 24 Mio € for the incumbent. With limited demand elasticity, it is possible for the market to self-finance the USO by increasing the pre-FMO price. Applying a pay-or-play mechanism requires only a 0.03€ increase to the pre-FMO price.

If the incumbent price must increase compared to the pre-FMO situation (with the assumption that without competitive threat by the entrant the price is set at the break-even level), the consumers that send letters to the population located in the most dense locations can use the entrant's mailing service at a considerably lower price.

	Pre-FMO price	No entry	Break-even price	Pay or Play	Profit max
p^I	0.37€	0.22€	0.41€	0.40€	0.55€
p^E	0.26€	/	0.28	0.27€	0.33€
X^I (%)	90%	100%	87%	88%	70%
X^E (%)	10%	0%	13%	12%	30%
n (%)	18%	0%	23%	21%	45%
$\prod^I$ Mio €	-24	-149	0	-7.1	40
$\prod^E$ Mio €	4.8	0	8.4	7.1	31

Table 4: Main results Non-Dense Stop Point route configuration
X^I and X^E are mail volumes of Incumbent and Entrant as a % of total mail.

Results for the high demand sensitivity specification

In the second demand specification, we take a more elastic demand (the elasticity of the monopoly demand is -0.4), a higher displacement ration (0.90), and a duopoly demand more sensitive to the entrant's price. Specifically, we assume that for an equal price, the entrant has a volume per address equals to 20% of the incumbent's volume and with a 20% price discount, both firms have an equal mailing volume per address. This implies a shifting elasticity of -1.66. In the second demand specification, the incumbent faces a demand which is more sensitive to its own price and to the price of the competitor. Moreover, the business stealing effect of the entrant (captured by the value of the displacement ratio) is higher.

In this more sensitive demand scenario and in the case of a Dense Stop Point route country configuration, Table 5 shows that the pre-FMO price is set at a comparable level of 0.22€ and, at that price, the entrant covers 61% of the country. But, it manages to capture a larger fraction of the mail stream (41% of the total volume). Consequently, losses for the incumbent increase dramatically (to -70 Mio €) while the entrant's profit increases slightly (3.4 Mio €).

In this demand specification, there does not exist a price compatible with a zero (or non-negative) profit for the incumbent. This means that it is impossible for the incumbent to self-finance its USO. Moreover, there does not exist neither a price where the incumbent's losses could be compensated by the entrant's profit. In other words, it is not possible to have a Pay-or-Play mechanism.

In Table 5 and 6 we show what happens if the Regulator allows the USP price to be increased, step by step in each column. The result is that the market size won by the competitor increases in the most profitable zones, so that the USP financial balance worsens. This implies a further increase in USP price towards break-even and a graveyard spiral.

	No entry price	Pre-FMO price	Price + 0.3€	Price + 0.8€…
p^I	0.20€	0.22€	0.25€	0.30€
p^E	/	0.14€	0.15€	0.17€
X^I (%)	100%	58%	47%	23%
X^E (%)	0%	41%	53%	77%
n (%)	0%	61%	66%	75%
$\prod^I$ Mio €	-70	-70	-79	-120
$\prod^E$ Mio €	/	3.4	18	48

Table 5: Main results Non-Dense Stop Point route configuration

	Price – 0.5€	Pre-FMO price	Price + 0.3€	Price + 0.8€…
p^I	0.30€	0.35€	0.40€	0.45€
p^E	0.19€	0.22€	0.24€	0.26€
X^I (%)	94%	85%	76%	61%
X^E (%)	6%	15%	24%	39%
n (%)	10%	21%	31%	43%
$\prod^I$ Mio €	-61	-43	-46	-75
$\prod^E$ Mio €	1.5	6.8	15	29

Table 6: Main results Non-Dense Stop Point route configuration
X^I and X^E are mail volumes of Incumbent and Entrant as a % of total mail.

With a more price sensitive demand, any increase in the incumbent's price increases the mail volume of the entrant and therefore its profit per-address. This in turn, increases the entrant's coverage of the territory causing further losses for the incumbent's. This mechanism is commonly known as the graveyard spiral (see d'Alcantara G. and B. Amerlynck, 2004 and Crew, M. and Kleindorfer P., 2005). This is a significant conclusion: the shape of the cost curve is important but sensitivity of demand may cause the competitive market to generate diverging prices and be therefore more sensitive to a non market conform USO definition.

Examples of empirical analysis for Spain and France

It is interesting to see the shape of the grouping index curves of countries following the numbers published in Boldron F., Joram D., Martin L. and Roy B., (2007). Figure 3 shows the GI curves – GI's in the sequence of decreasing GI's or going from the dense stop point zones to the non-dense stop point zones – in Spain and France. This Figure can be compared to the ones for our hypothetical countries, as defined in Figure 1 and 2.

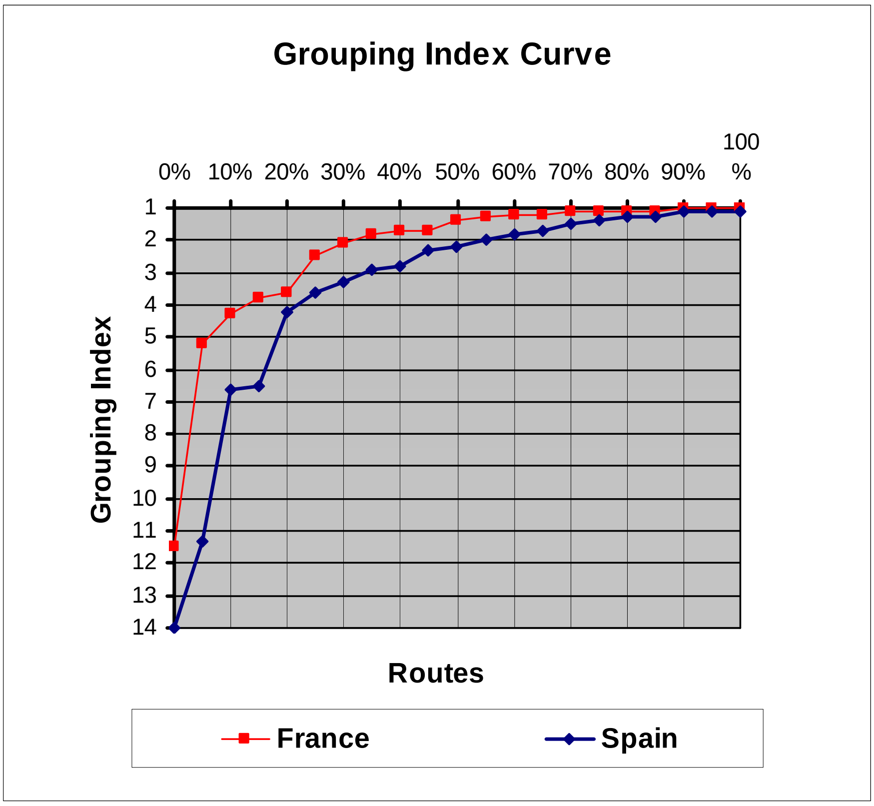

Figure 3 Grouping Index Curve for Spain and France

For both countries the costs per unit are derived from the above defined activity based cost model and from the following publicly available country data.

	France	Spain
Total population [inhabitant]	60.320.000	44.108.530
Country surface area [km²]	544.435	504.782
Population density	111	87
National currency [NC]	€	€
Percentage of population in Urban area [%]	76%	76%
Average household size [inhabitant/household]	2,5	2,9
Average hourly labour cost NACE I [NC/hour]	30,00 €	30,00 €
Labour cost for freelance worker [%]	73%	77%
Scale per Person	341	91
Scale per address	854	263

The computed unit cost curves for the two countries are shown in Figure 4. They reveal very different shapes: the unit costs in Spain follow a linearly increasing shape up to 45% of the routes, a constant level from 45% up to 70% of the routes and an increasing shape again from 70% up to 100%. On the other hand France reveals one single linearly increasing shape for the whole territory.

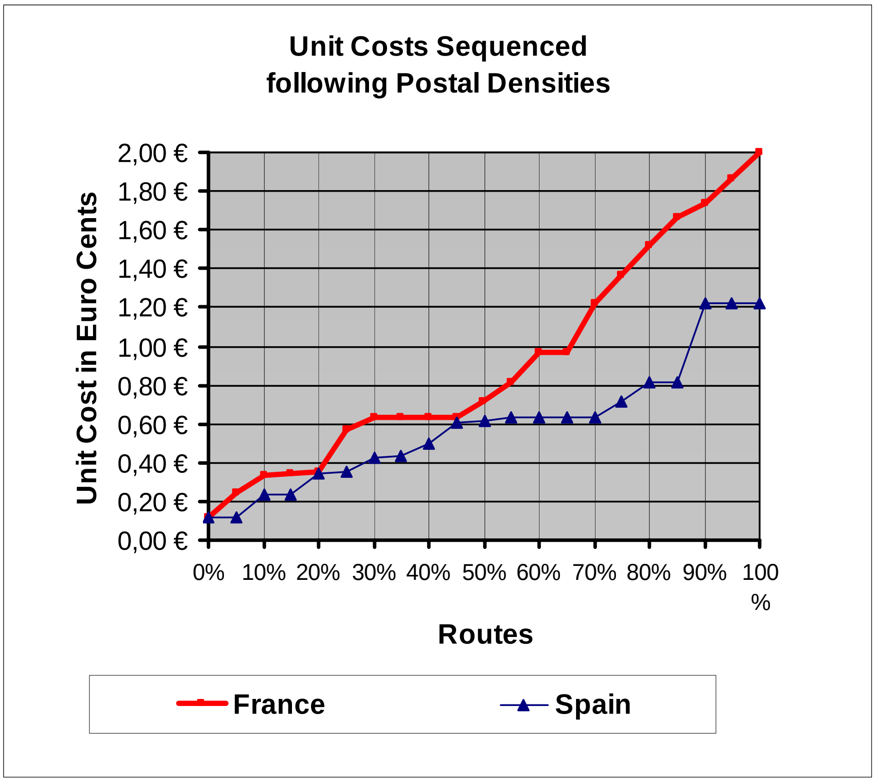

Figure 4 Unit Cost curves for Spain and France

a) Low demand sensitivity scenario

What are the results of our FMO model in the case of low demand sensitivity?
Table 7 and 8 show the results for Spain and for France. In both countries the USP keeps a large part of the market (at least 86 and 89%). In both countries Pay-or-Play mechanisms of financing the US is feasible. But in case the Regulator chooses the Profit Maximizing set-up, the French USP obtains a profitable balance of 959 Million € while the Spanish one of 263 Million €. No Government Subsidy is necessary.

	Pre-FMO prices	Break-even price	Pay-or-Play	Max Profit
p_I	0.40€	0.43€	0.42€	0.51€
p_E	0.26€	0.27€	0.27€	0.30€
n (%)	10.58%	11.52%	11.19%	15%
X_I (%)	93.5%	92.6%	92.9%	89%
X_E(%)	6.5%	7.4%	7.1%	11%
$\prod^I$ Mio €	-86	0	-29.3	263
$\prod^E$ Mio €	25	32	29.3	58

Table 7: Main results for Spain
Total fixed cost: 1.74 10^9 € Break even price: 0.40€

	Pre-FMO prices	Break-even price	Pay-or-Play	Max Profit
p_I	0.27€	0.28€	0.28€	0.36€
p_E	0.19€	0.19€	0.19€	0.22€
n (%)	5.4%	6.5%	6.5%	20%
X_I (%)	97%	96%	96%	86%
X_E(%)	3%	4%	4%	14%
$\prod^I$ Mio €	-109	0	-5.2	959
$\prod^E$ Mio €	1.5	5.4	5.2	177

Table 8: Main results for France
Total fixed cost: 4,63 10^9 € Break even price: 0.27€
X^I and X^E are mail volumes of Incumbent and Entrant as a % of total mail.

b) High demand sensitivity scenario

What are the results of our FMO model in the case of high demand sensitivity? Table 9 and 10 show the results for Spain and for France. Both for Spain and for France we see that there is no Break-even or Pay-or-Play solution to the model. In other words the graveyard mechanism is operational. In the case of a regulatory set-up where the USP is allowed to maximize its profits the result shows that the USP keeps a significant part of the market (85-87%), but large Government Subsidies are required to finance the US: 443 Million € in France compared with 195 Million € in Spain; eventually, after deduction of the profits of the Entrants, 382 Million € in France compared to 136 Million € in Spain.

The conclusion is that both factors determining the way the USO has to be financed seem to be important: the shape of the cost curve and the sensitivity of demand.

	Pre-FMO prices	Break-even price	Pay-or-Play	Max Profit
p_I	0.40€	/	/	0.42€
p_E	0.23€	/	/	0.24€
n (%)	14.1%	/	/	15%
X_I (%)	87.1%	/	/	85.8%
X_E(%)	12.9%	/	/	14.2%
$\prod^I$ Mio €	-205.2	/	/	-195
$\prod^E$ Mio €	51.4	/	/	58

Table 9: Main results for Spain
Total fixed cost: 1.74 10^9 € Break even price: 0.40€

	Pre-FMO prices	Break-even price	Pay-or-Play	Max Profit
p_I	0.27€	/	/	0.28€
p_E	0.17€	/	/	0.17€
n (%)	13%	/	/	15%
X_I (%)	89%	/	/	87%
X_E(%)	11%	/	/	13%
$\prod^I$ Mio €	-450	/	/	-443
$\prod^E$ Mio €	44	/	/	61

Table 10: Main results for France
Total fixed cost: 4,63 10^9 € Break even price: 0.27€
X^I and X^E are mail volumes of Incumbent and Entrant as a % of total mail.

Conclusion

The main conclusion of this contribution is that we have shown two factors to be taken into account to anticipate the way the Universal Service can be financed: the shape of the cost curve and the sensitivity of demand. Sensitivity of demand combined with the non market conform USO definition may in certain cases also cause the prices to diverge.

This conclusion therefore requires:

(1) additional efforts to collect precise cost data per zone and obtain the resulting cost curve in function of stop point density; the exact cost of delivery (fixed and unit cost) in the most non-dense zones of each country is the result of a complex process: daily deliveries may have to be made in mountain regions, in very sparsely populated regions, in regions with very bad roads… Since these costs are related to the quality and the length of a road, a track or a path in the final mile, there may be different ways to modify the amount of time needed by the postman to reach a letterbox at the end of this road. It is important that the policy makers realise that this cost information needs to be available in a very precise way before any realistic conclusions could be reached.

(2) eventually a more appropriate definition of USO should be chosen, excluding of a number of postal product from the uniformity constraint; in some countries there may be an important part of mail such as bulk mail for which uniform tariffs will be no longer true. It is not clear at this point of time what will become the choice; the national regulator could revise the USO such as to diminish the delivery costs in the most extreme non-dense stop point routes zones. This is modifying the content of USO.

(3) additional research to decrease uncertainty about the size of the parameters characterizing demand behaviour; this can be done by focussing on specific groups of clients and products; in may require heavy data collection such as in the case of conjoint analysis.

On the other hand one should be very careful in using any of the results from our empirical analysis for Spain and France. These countries were taken as examples and as illustration. Data and assumptions used are not appropriate for the policy makers to take any conclusion about how to finance the USP seriously. The only point is that they show it is possible to apply a method and a model, which could be refined; that the cost curve should be observed and modified in view of representing best practice technologies (and not calculated following a model); and that the parameters describing the sensitivity of demand have to be measured properly for existing client groups and products.

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APPENDIX The Cost Model

1. *Collect*

1.1 Collect rounds

The collect rounds cost divides into the collect vehicle cost and the collect agent cost.

$$collect\_vehicle\_cost = collect\_days \times collect\_daily\_distance \\ \times collect\_vehicle\_cost\_per\_km$$

$$collect\_agent\_cost = collect\_days \times collect\_daily\_distance \times \frac{labor\_cost}{collect\_vehicle\_speed} \\ \times \left[collect\_freelance \times freelance\_ratio + \left(1 - collect\_freelance\right)\right]$$

Where,

- *collect_days* = the number of collection days in a year.
- *collect_daily_distance* = the number of kilometers needed to daily collect the mail in the postal boxes.
- *collect_vehicle_cost_per_km* = the cost per kilometer of the collect vehicles (including fuel, maintenance, depreciation…).
- *labor_cost* = the hourly cost of labor.
- *collect_vehicle_speed* = the average speed of collect vehicles.
- *collect_freelance* = the percentage of freelance workforce in collect.
- *freelance_ratio* = the ratio between the cost of a freelance worker and the cost of non freelance worker.

Because of the business model of New Entrants, its daily collect distance is proportional to its mail volume collected.

1.2 Postal counters

The postal counter cost divides into the building cost and the counter agent cost.

$$counter\_building\_cost = counters \times counter\_surface \times counter\_building\_cost\_per\_m^2 \\ \times \begin{bmatrix} franchised\_counters \times franchised\_cost \\ + \left(1 - franchised\_counters\right) \end{bmatrix} \\ \times counter\_allocation\_to\_postal$$

$$counter\_agent\_cost = counters \times \left(1 - franchised\_counters\right) \\ \times counter\_agents \times collect\_days \\ \times counter\_opening\_time\_window \times labor \\ \times \left[counter\_freelance \times freelance\_ratio + (1 - counter\_freelance)\right] \\ \times counter\_allocation\_to\_postal$$

Where,

- *counters* = the number of postal counters of the USP. This number can be modified by regulation during FMO.
- *franchised_counters* = the percentage of total counters that are franchised. This percentage can be modified by regulation during FMO, it is then the maximum between the counters already franchised and the counters authorized to be franchised that is taken.
- *franchised_cost* = the ratio between the cost of a franchised counter and the cost of a non franchised counter.
- *counter_surface* = the average surface of a postal counter.
- *counter_building_cost_per_m²* = the average cost of building per m² (including taxes, insurances, energy, maintenance…).
- *counter_allocation_to_postal* = percentage of postal counter allocated to postal USO activity.
- *counter_agents* = the average number of postal agent operating a postal counter.
- *counter_opening_time_window* = the open time window of a postal counter per day.
- *counter_freelance* = the percentage of freelance workforce in postal counters.

Because of its business model there are no postal counter costs for New Entrants.

1. Sorting

The sorting activity includes the cost of the sorting centers, the cost of the sorting machine and the cost of the sorting agents.

$$sorting\_centers\_building\_cost = sorting\_centers \times sorting\_center\_surface \times sorting\_building\_cost\_per\_m^2$$

$$sorting\_machine\_cost = \left[\frac{\displaystyle\sum_{p \in product} \frac{volume_p \times automated\_sorting\_percentage_p}{automated\_sorting\_capacity_p}}{collect\_days \times 24} \right] \times sorting\_machine\_unit\_cost$$

$$sorting\_agent\_cost = sorting\_hours \times labor \times \left[sorting\_freelance \times freelance\_ratio + (1 - sorting\_freelance) \right]$$

$$sorting\_hours = \left(\sum_{p \in product} \frac{volume_p \times automated\_sorting\_percentage_p}{automated\_sorting\_capacity_p} \right) \times sorting\_agent\_per\_machine + \sum_{p \in product} \frac{volume_p \times manual\_sorting\_percentage_p}{manual\_sorting\_capacity_p}$$

Where,

- *sorting_centers* = the number of sorting centers.
- *sorting_center_surface* = the average surface of a sorting center.

- *sorting_building_cost_per_m²* = the average cost of building per m² (including taxes, insurances, energy, maintenance…).
- *product* = the set of all products.
- $volume_p$ = the collected mail volume of product *p*.
- $automated\_sorting\_percentage_p$ = the percentage of product *p* that is mechanically sorted.
- $automated\_sorting\_capacity_p$ = the average number of mail item of product *p* that can be sorted by a sorting machine per hour.
- *sorting_machine_unit_cost* = the average cost of a single sorting machine (including maintenance, depreciation…).
- *sorting_agent_per_machine* = the average number of agent operating a sorting machine (including video coders).
- $manual\_sorting\_percentage_p$ = the percentage of product *p* that is manually sorted.
- $manual\_sorting\_capacity_p$ = the average number of mail item of product *p* that can be manually sorted by a sorting agent per hour.
- *sorting_freelance* = the percentage of freelance workforce in sorting activity.

The number of sorting centers for New Entrant is proportional to its mail volume collected.

2. Transport

The transport cost is divided in the transport vehicle cost and the transport agent cost.

$$\begin{aligned} transport\_vehicle\_cost = {} & transport\_distance \\ & \times transport\_vehicle\_cost\_per\_km \\ & \times collect\_days \end{aligned}$$

$$\begin{aligned} transport\_agent\_cost = {} & \frac{transport\_distance}{transport\_vehicle\_speed} \times collect\_days \\ & \times \left[transport\_freelance \times freelence\_ratio + (1 - transport\_freelance)\right] \\ & \times labor \end{aligned}$$

Where,

- *transport_distance* = the daily distance of transport in kilometer.
- *transport_vehicle_cost_per_km* = the cost per kilometer of the transport vehicles (including fuel, maintenance, depreciation…).
- *transport_vehicle_speed* = the average speed of transport vehicles.
- *transport_freelance* = the percentage of freelance workforce in transport activity.

3. Delivery

4.1 Sequencing

The automated sequencing is included into the sorting activity. The sequencing cost is related to manual sequencing. The cost of this activity is divided into building cost (the delivery offices) and sequencing agent cost.

$$sequencing\_building\_cost = delivery\_offices \times delivery\_office\_surface \times delivery\_office\_building\_cost\_per\_m^2$$

$$sequencing\_agent\_cost = \sum_{p \in product} \frac{volume_p \times manual\_sequencing\_percentage_p}{manual\_sequencing\_capacity_p} \times \left[freelance\_delivery \times freelance\_ratio + (1 - freelance\_delivery) \right] \times labor$$

Where,

- *delivery_offices* = the number of delivery offices.
- *delivery_office_surface* = the average surface of a delivery office.
- *delivery_office_building_cost_per_m²* = the average cost of building per m² (including taxes, insurances, energy, maintenance…).
- $manual\_sequencing\_percentage_p$ = the percentage of product *p* that is manually sequenced.
- $manual\_sequencing\_capacity_p$ = the average number of mail item of product *p* that can be manually sequenced by a sorting agent per hour.
- *freelance_delivery* = percentage of freelance workforce in delivery activity.

4.2 Route travel (RT)

The route travel activity is divided into delivery vehicle cost and delivery agent cost.

$$route\_distance_{m,z} = \frac{delivery\_points_{m,z} \times distance\_between\_stop_{m,z}}{1000 \times grouping\_index_z} \times routes_{m,z}$$

$$RT\_vehicle\_cost = \sum_{\substack{z \in delivery\_zones \\ m \in delivery\_methods}} \begin{pmatrix} route\_distance_{m,z} \times delivery\_vehicle\_cost\_per\_km_m \\ \times delivery\_frequency_z \times 52 \end{pmatrix}$$

$$RT\_agent\_cost = \sum_{\substack{z \in delivery\_zones \\ m \in delivery\_methods}} \left(\frac{route\_distance_{m,z}}{delivery\_vehicle\_speed_m} \times 52 \times delivery\_frequency_z \right) \times \left[delivery\_freelance \times freelance\_ratio + (1 - delivery\_freelance) \right] \times labor$$

Where,

- $delivery\_points_{m,z}$ = the average number of delivery points per delivery route served by delivery method *m* in delivery zone *z*.
- $distance\_between\_stop_{m,z}$ = the average distance in meter between stops on a delivery route served by delivery method *m* in delivery zone *z*.
- $\boldsymbol{grouping\_index_z}$ = the average number of delivery points per stops on a delivery route in delivery zone *z*.
- $routes_{m,z}$ = the number of delivery routes served by delivery method *m* in delivery zone *z*.
- *delivery_zones* = the set of all delivery zones.
- *delivery_methods* = the set of all delivery methods.

- *delivery_vehicle_cost_per_km*$_m$ = the cost per kilometer of the delivery vehicles involved in delivery method *m* (including fuel, maintenance, depreciation…).
- *delivery_frequency*$_z$ = the weekly delivery frequency in delivery zone *z*
- *delivery_vehicle_speed*$_m$ = the average delivery speed of vehicle involved in delivery method *m*.

4.3 Delivery access time (DAT)

$$stops_{m,z} = \frac{delivery\_points_{m,z}}{grouping\_index_z} \times routes_{m,z} \times coverage\_function_z$$

$$DAT\_cost = \sum_{\substack{z \in delivery\_zones \\ m \in delivery\_methods}} \left(\frac{stops_{m,z} \times 2 \times deviation\_distance_{m,z}}{1000 \times delivery\_vehicle\_speed_m} \times 52 \times delivery\_frequency_z \right)$$
$$\times \left[delivery\_freelance \times freelance\_ratio + (1 - delivery\_freelance) \right]$$
$$\times\ labor$$

Where,
coverage_function$_z$ = the percentage of potential stops where the delivery agent actually stops in delivery zone *z*. For more details about this function see d'Alcantara and Amerlynck (2006).
deviation_distance$_{m,z}$ = the average deviation distance to access the delivery points at a stop from a delivery route served by delivery method *m* in delivery zone *z*, in meter.

4.4 Load time (LT)

$$LT\_cost = \sum_{\substack{p \in products \\ z \in delivery\_zones}} \frac{volume\_delivered_{p,z} \times load\_time_p}{3600}$$
$$\times \left[delivery\_freelance \times freelance\_ratio + (1 - delivery\_freelance) \right]$$
$$\times\ labor$$

Where,

- *volume_delivered*$_{p,z}$ = the mail volume of product *p* delivered in zone *z*. For USP, this volume includes the volume collected and the volume re-injected by NE.
- *load_time*$_p$ = the average time in second for delivering a single piece of product *p* into the delivery receptacle.