

Preliminary Draft

**Profitability of the Universal Postal Service Provider
in a Free Market with Economies of Scale in Collect and Delivery**

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Summary

What are the impacts of the full opening of the postal market,
and of a well-defined USO
on the customers and the operators
in the presence of economies of scale?

We developed a country model where:

Two operators play in a competitive market.

The Incumbent bears all the costs related to the USO.

The Entrant invests into an own distribution network.

There are economies of scale represented by a bottom up delivery model.

Each country is characterized by a given number of mail item per capita and
by a given urban/rural density.

The calibrated model allows to quantify impacts on
unit costs, tariffs, volumes, market shares and financial balances.

Structure of the model

- **Two customers** : a loyal **Retail** and a tariff sensitive **Business**.
- **Two operators**: the **Incumbent I** and the **Entrant E**.
- **Two delivery zones** : **Urban (dense)** and **Rural (non-dense)**.
- **An USO** imposed for the Incumbent.
- **A total market demand** equation and **market share** equations.
- Both operators use the same **postal technology**, included in an **activity based cost model**.
- **Five activities**: *collection, sorting, in-office delivery, transportation and street delivery*, grouped into **upstream (1)** and **downstream (2)**.
- **Market volume Q** is defined as the sum of all items delivered.
- **Delivery scale** of an operator is given by the **number of items she/he carries per person and per year**, given the size of the **total market Q** (Q^I/Q and Q^E/Q).

- The model solution starts with a the **Incumbent delivering 100%** of the volume.
- The Entrant decides to invest in his **own delivery network** (to bypass) the amount of mail he collects, as long as his unit cost is lower than the incumbent's tariff.

Customer behaviour (1/3)

1. Market model

$$\log \frac{Q_z^j}{\hat{Q}_z} = \varepsilon^j \log \frac{P_z^j}{\hat{P}_z}$$

Elasticity ε^j -0,3

$j = \{\text{Retail customer, Business customer}\}$

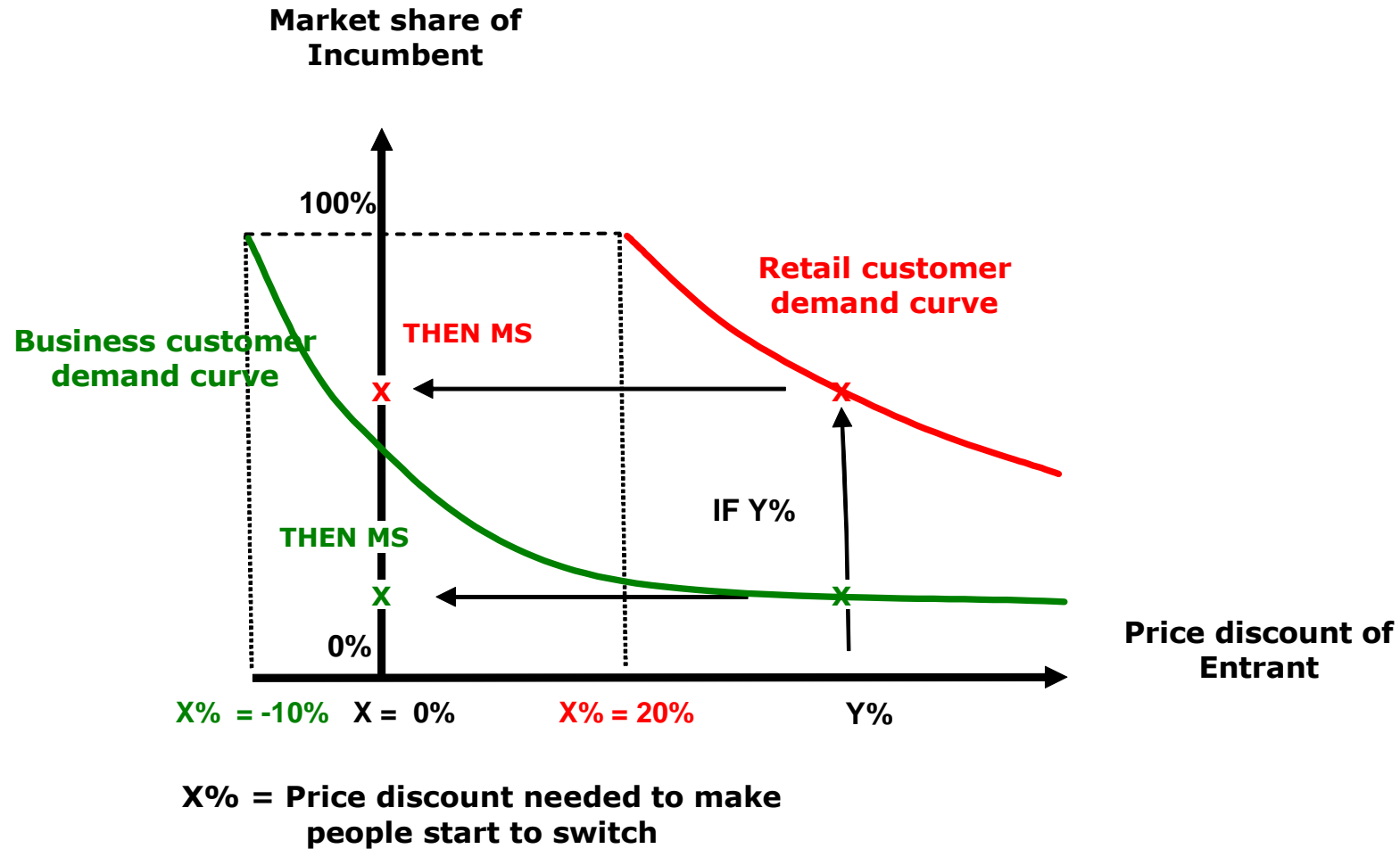
$z = \{\text{Urban delivery area, Rural delivery area}\}$

$P_z = \text{average market price}$

$\hat{}$ stands for the previous period

Customer behaviour (2/3)

2. Market share model : Switching Function



Customer behaviour (3/3)

2. Market share model

$$\frac{q_{E,z}^j}{Q_z} = \eta_z^j \left(\frac{p_{E,z}^j - p_{I,z}^j}{p_{I,z}^j} + X_z^j \right)$$

$j = \{\text{Retail customer, Business customer}\}$

$z = \{\text{Urban delivery area, Rural delivery area}\}$

$p_E = \text{Entrant tariff}$

$p_I = \text{Incumbent tariff}$

Customer loyalty X_z^j

	Dense	Non Dense
Retail	20%	20%
Business	-10%	-10%

Elasticity η_z^j

	Dense	Non dense
Retail	-0,75	-0,75
Business	-1.25	-1.25

Bottom up cost function with economies of scale (1/2)

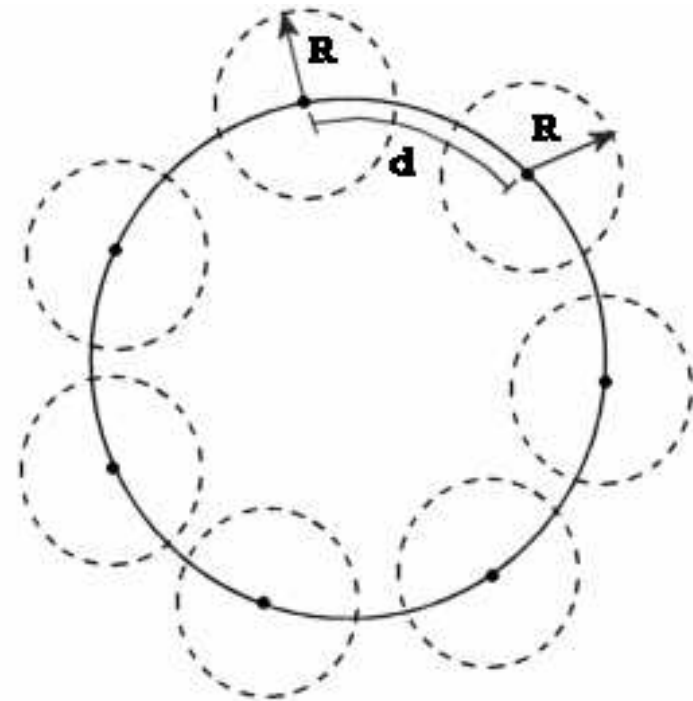
1. **Collection cost** : fixed – each collect mailbox has to be emptied whatever it contain.
2. **Sorting cost** : variable – sorting per delivery code.
3. **Transport cost** : variable – transport related to delivery rounds excluded.
4. **In-office delivery cost** : variable – mail sequencing per delivery round.
5. **Street delivery route travel costs** : fixed – depend of *delivery frequency, invested geographic coverage of delivery routes (gc) and grouping index or degree of density (g)*;
the 4 delivery modes are (% for USA): Foot (6%), Bicycle (0%), Park & loop (39%), Car (55%).
6. **Street delivery access time** : partly variable and partly fixed; depends on
1° *the percentage of possible stops that are accessed on an invested route, increasing with the volume and with the number of pieces per stop delivered in the zone*
2° *the grouping index or degree of density of the urban zone* which represents
the number of delivery points per stop, such as the average number of apartments in a building.
7. **Street delivery load time cost** : variable – time to deliver mail items in mailbox.
8. **Other costs** and overheads namely 24% of the previously described costs.

Bottom up Cost function with economies of scale (2/2)

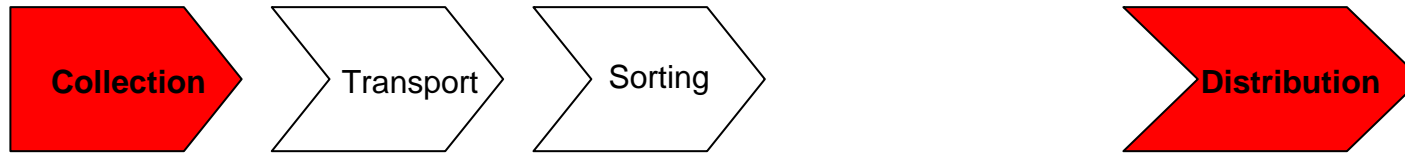
Street delivery route travel is modeled following Cohen & Chu (1997) as used in Roy (1999): **fixed cost** depends on **the loop to be covered to include the geographic coverage of the delivery network**. The route travel cost is modeled in 4 modes:

1. **Foot Delivery** depends of the number of hour worked
2. **Bicycle Delivery** depend of the hours worked and of bicycle maintenance
3. **Car Delivery** depend of the hours worked and of car maintenance

4. **Park & Loop Delivery** models the process of a fixed loop by car in which there are stops with small loops by foot: the street delivery access time is a function of ***the percentage of possible stops that are accessed on an invested route given by the Coverage function (COV), the number of items to deliver and the delivery density***. Costs depends of the hours worked and of car maintenance.

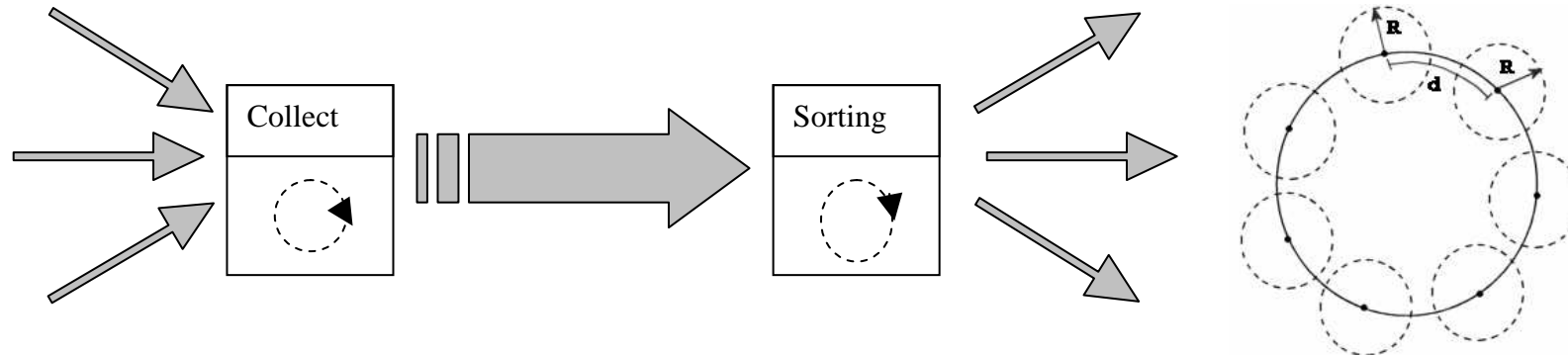


Activity chain: upstream and downstream



1. Upstream: Collection + Sorting + Transportation

2. Downstream: Distribution



Volume lost to the Entrant can be re-injected in the Incumbent's network, if her access tariff is set lower than the Entrant's unit cost

The Operator's break-even tariffs

The *Incumbent's tariff* is set equal in all zones z , because of the uniformity obligation, at **break-even level**, including the variable and fixed cost of the Universal Service Obligation divided over the total production sold by the Incumbent

$$p_I = \frac{\text{Total Network Cost}}{\text{Volume collected}}$$

The *Entrant's tariff*, is also a **break-even tariff**, without the uniformity constraint

$$p_{z,E} = \frac{\text{Total Network cost in zone } z + \text{rejection costs in zone } z}{\text{Volume collected addressed to zone } z}$$

Dynamic tariff model

The model behaves as follows:

1. the Entrant's invest in bypass delivery network (10% in Urban at starting point)
2. the Entrant's unit costs and tariffs change, necessary to be break-even
3. the market shares demands in the different customer and zonal market segments are given by customer behavior
4. the balance of receipts and costs of the Incumbent modifies her break-even tariff, with possible graveyard spiral
5. go to 1 if the variation of variables $>$ small criterium ε , up to convergence

Inputs of the model (1/2)

The inputs for the model are:

- **The market scale : number of items per person and per year and size of the population**
- **The cost parameters for each Activity Based Cost function : labor cost per hour in the Postal sector, rural/urban repartition**
- **Universal service obligation for the Incumbent:**
 - Daily distribution frequency (6 times)
 - Constant Quality ($J + 1$, $J + n$ arrival percentage), related to distribution frequency
 - Distribution in every areas (urban and rural zones): geographic coverage 100%
 - Cost based tariff uniformity for end-to-end and for network access
 - Affordable tariffs for the customers
 - Availability

Inputs of the model (2/2)

Service offered by the Entrant:

- Distribution 3 times per week (different in quality level than Incumbent)
- Uses self-employed at 50% of national hourly wage cost
- Different break-even tariffs for dense and non-dense zones
- A starting investment in a urban delivery network:
a share of 10% of total zonal volume
- Access to the Incumbent's delivery network for the residual volume,
namely the volume above his bypass potential
- Invest in additional own delivery network, the amount collected in excess
above his existing bypass capacity of the precedent period,
only if his tariff remains lower than the tariff of the Incumbent.

Values introduced for one run of the model

Country: the number of items delivered per person and per year and the population

Cost elements: Urban area = 80 %. Labour cost per hour = 20,32 €. Retail ratio = 0,5. Delivery frequency Incumbent = 6. Household size = 2,6.

Foot delivery = 6%. Bicycle delivery = 0%. Park & Loop delivery = 39%. Car delivery = 55%.

Exchange rate € per dollars (2003) = 0,88... CPI (2003) = 1,40...

Grouping index rural = 1. Grouping index urban = 2.

Retail and Business Customers: Market elasticity = -0,3. Retail loyalty = 20%

Business loyalty = -10%. Retail substitution = -0,75. Business substitution = -1,25.

Sigma = 1.

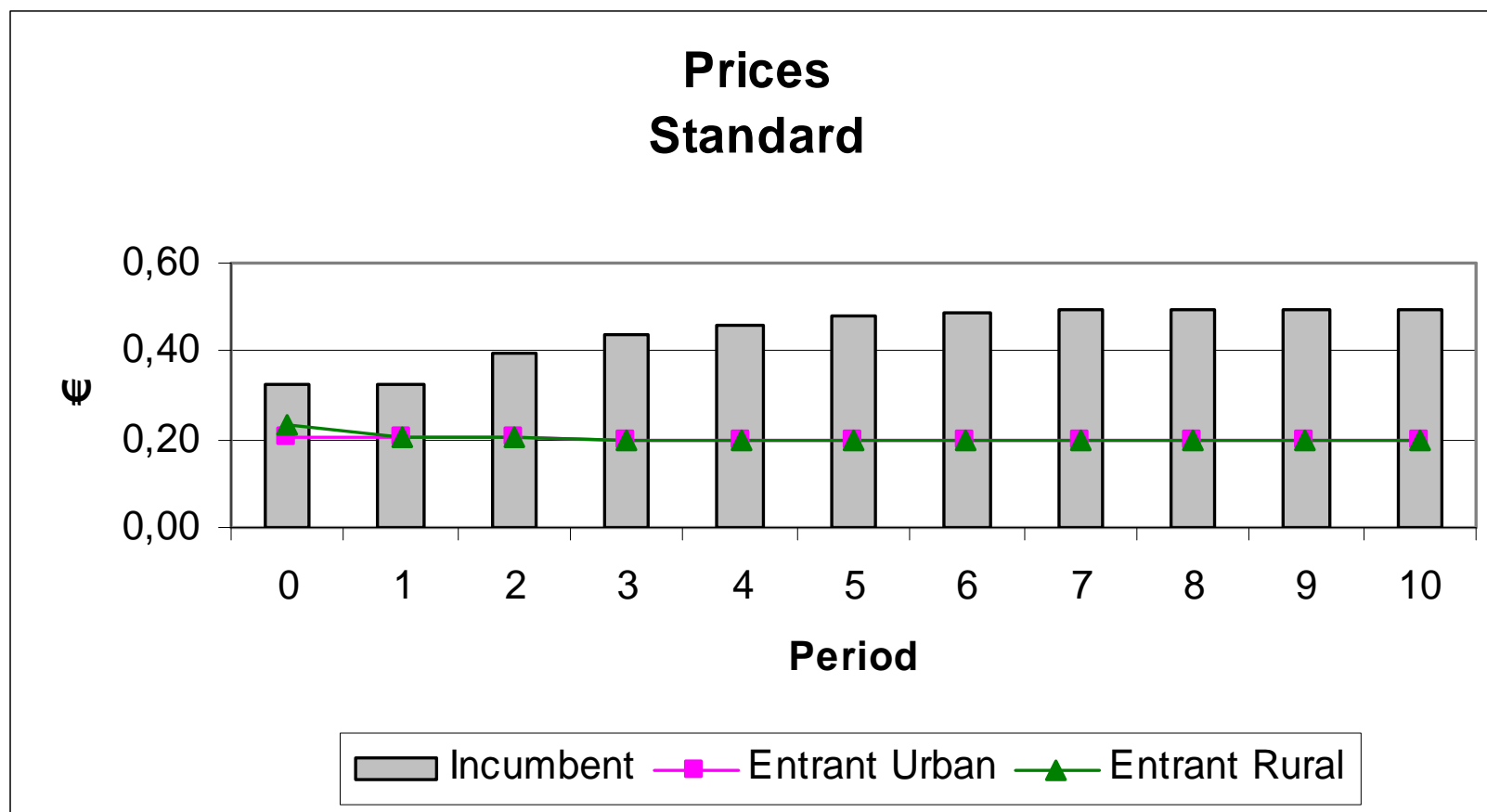
Competitor: Freelance cost ratio= 0,5. Delivery frequency Entrant = 3.

E starting coverage urban = 10% E starting coverage rural= 0%.

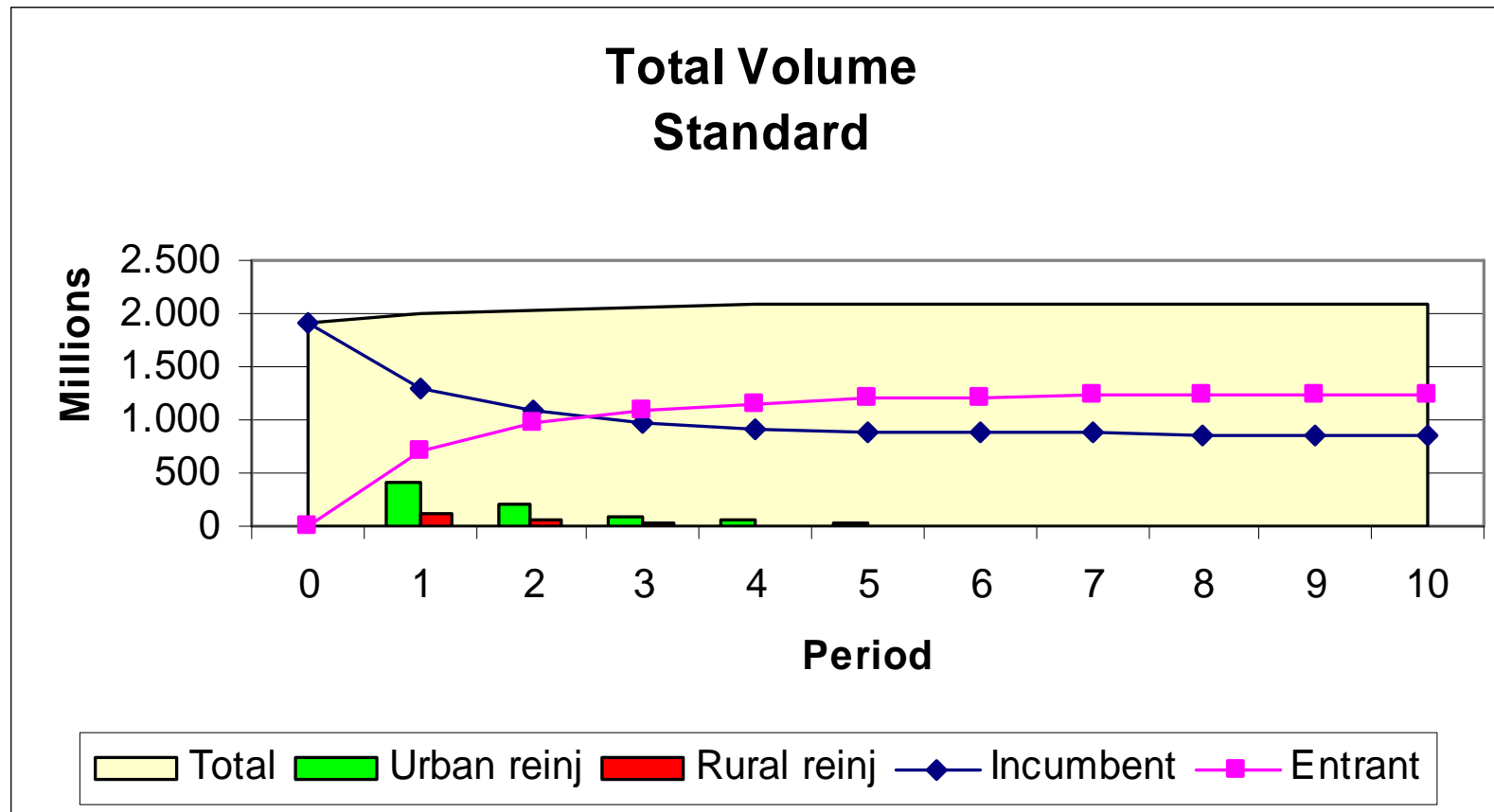
Price regulation: Access pricing = accessed cost. Including overhead costs = Yes.

Tariff uniformity on access = Yes

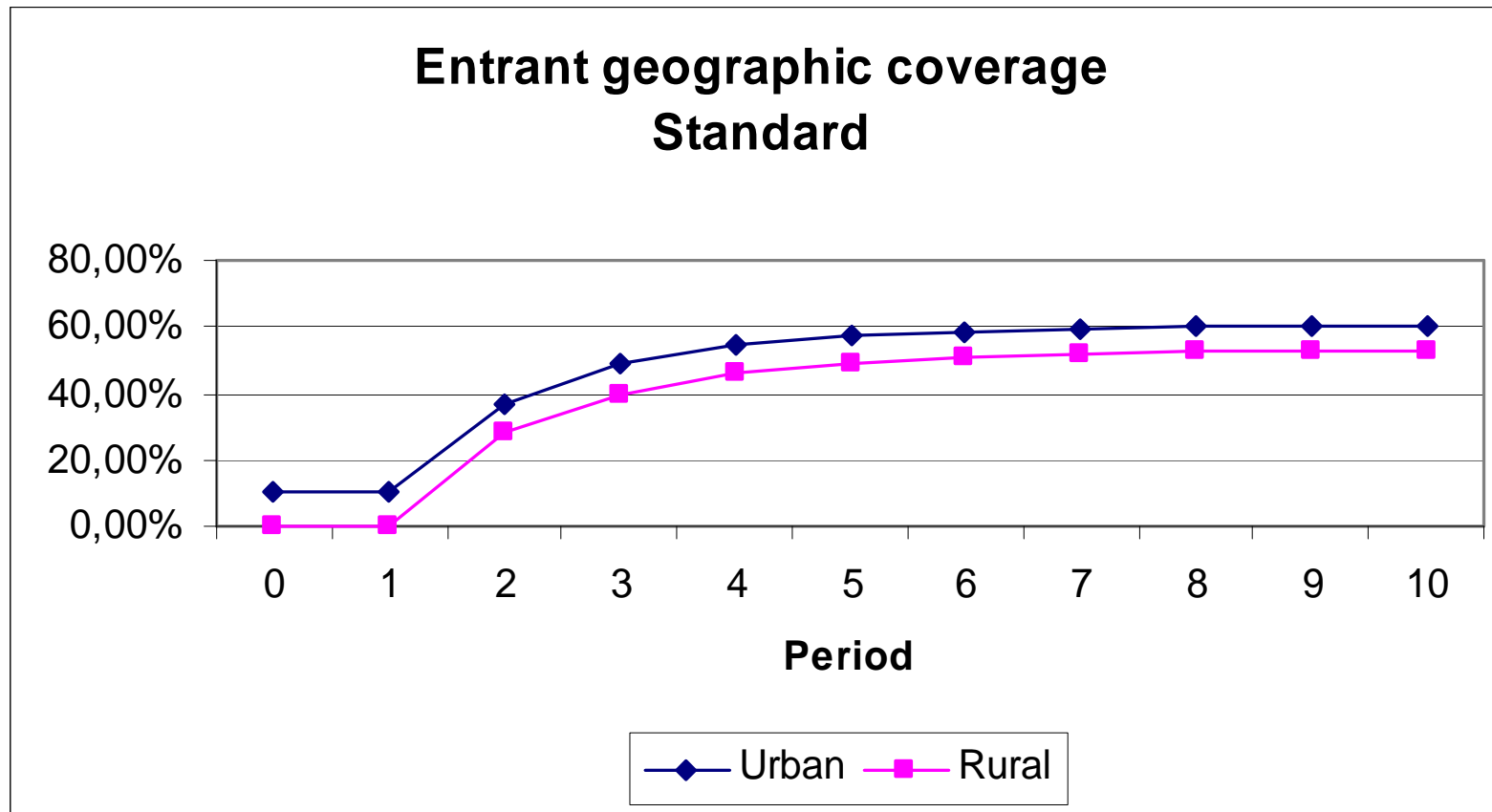
Model solution standard country



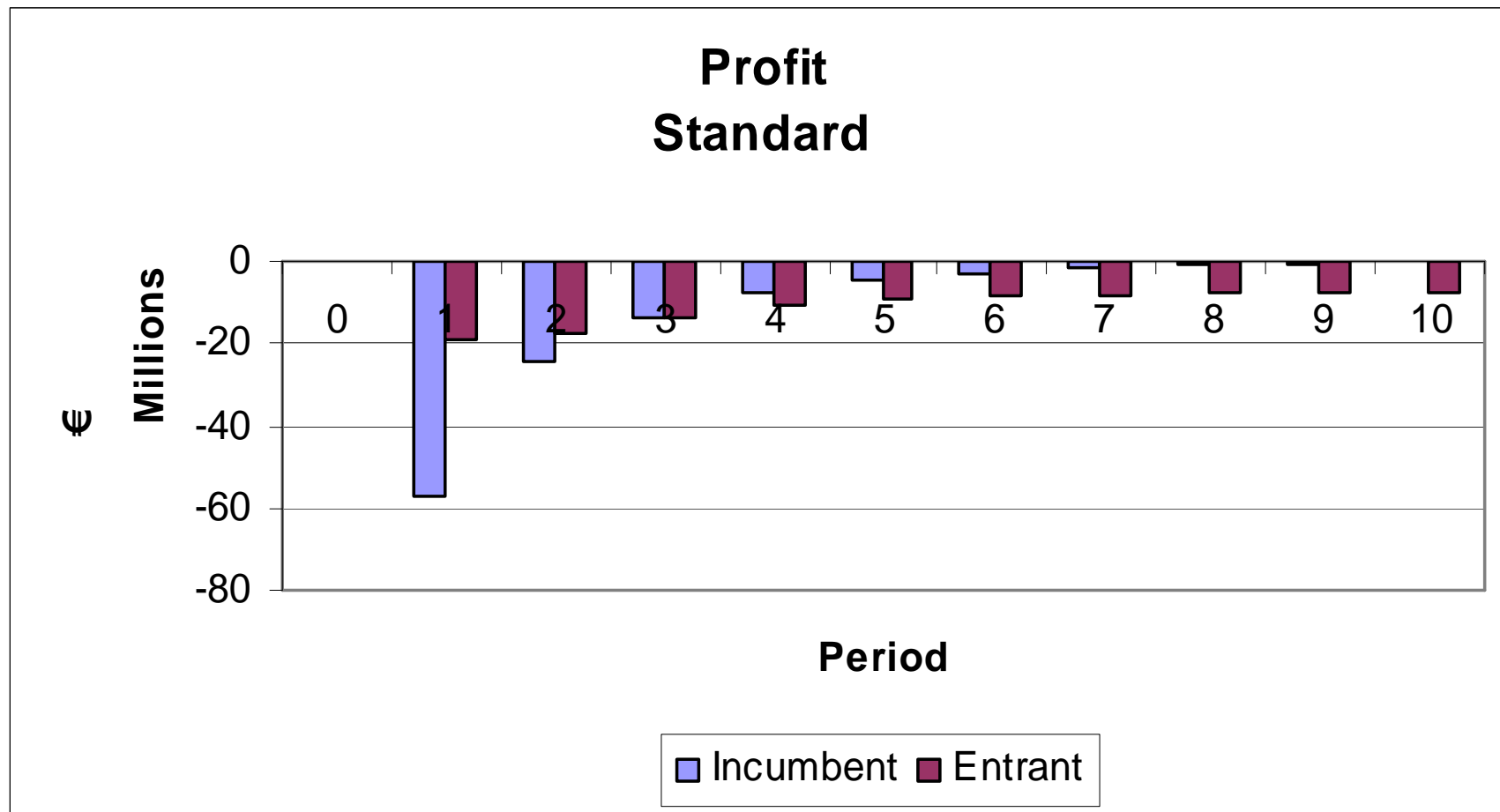
Model solution standard country



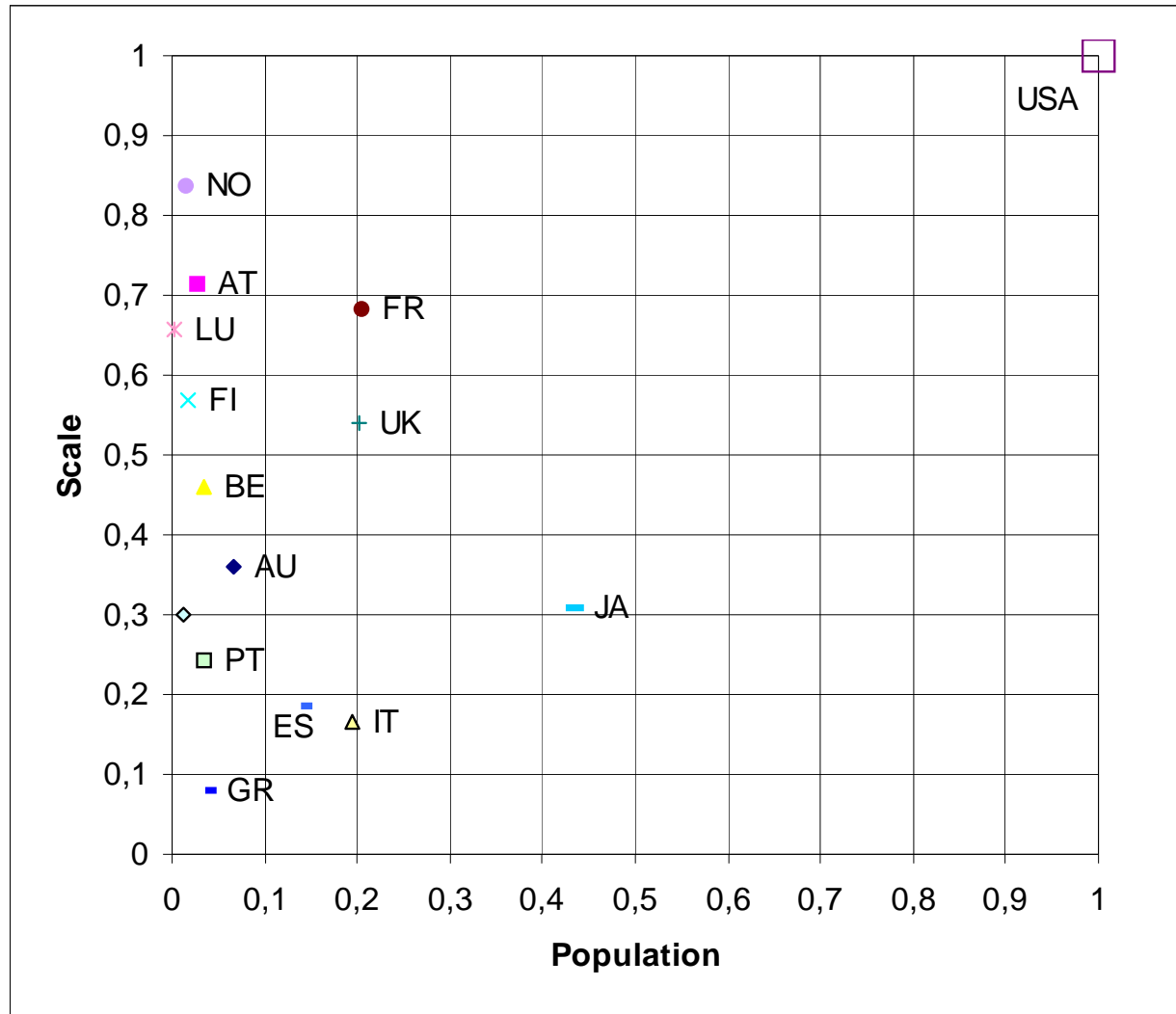
Model solution standard country



Model solution standard country

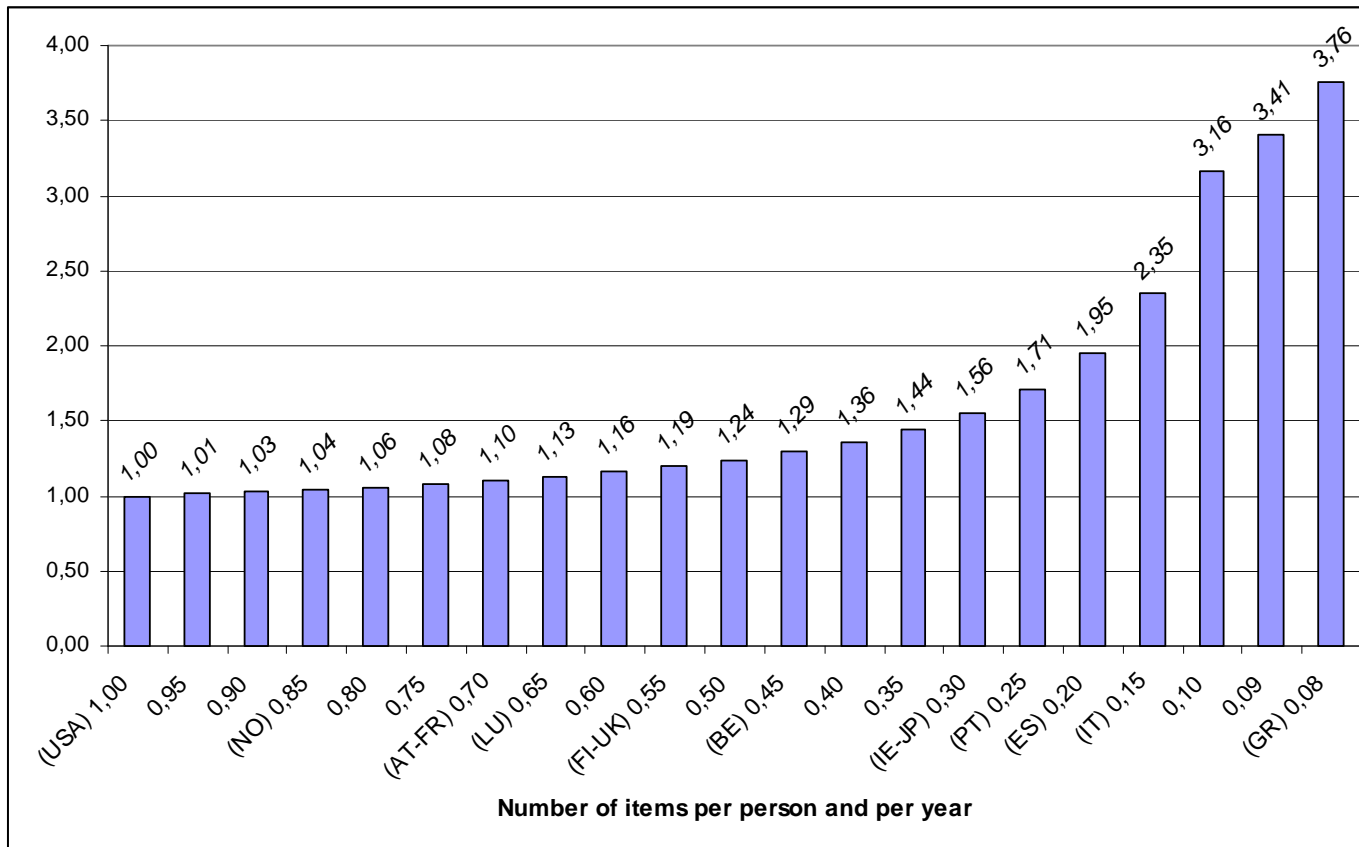


Countries

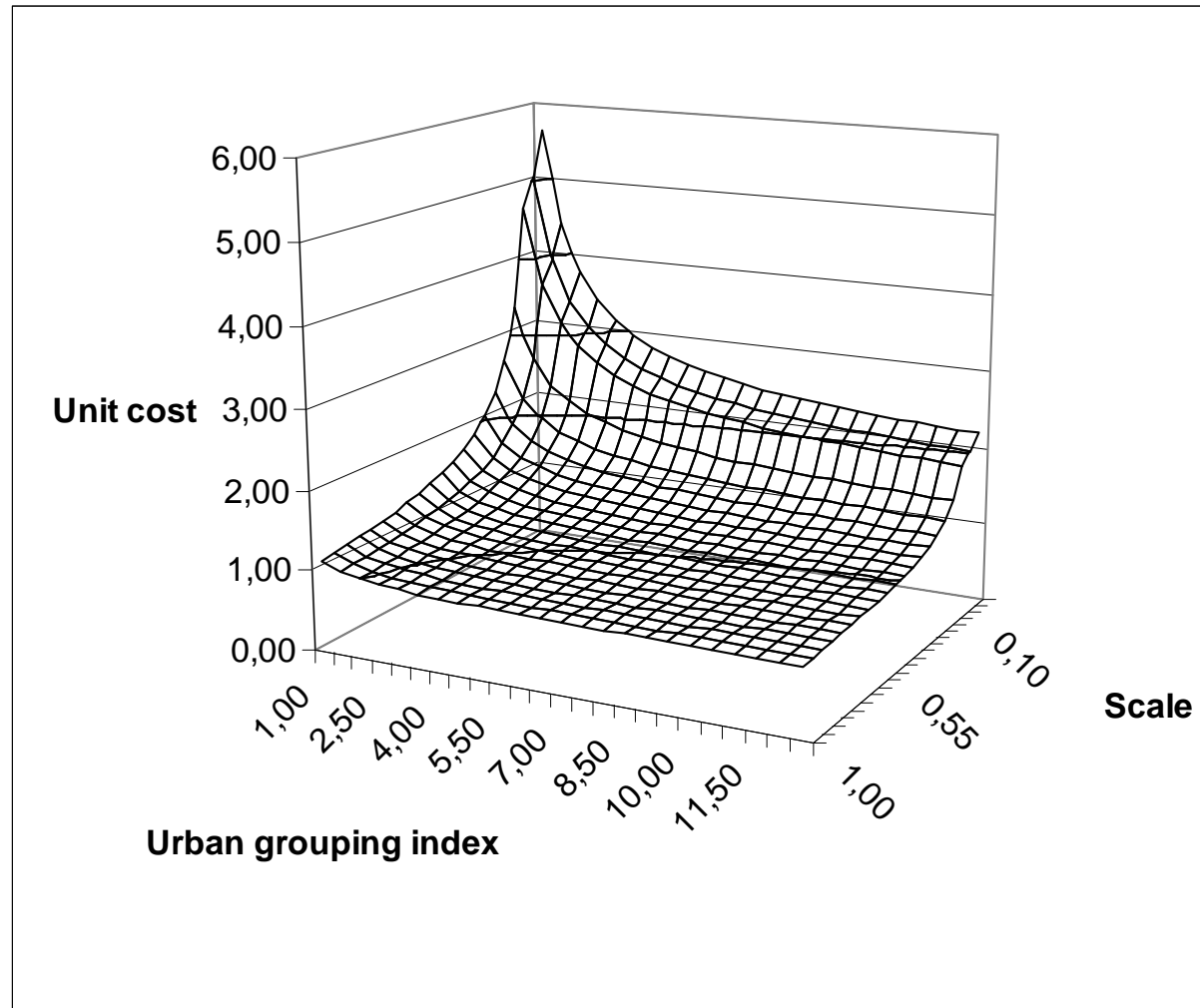


Standardized Unit Cost in function of Scale

$g_U = 2$	USA	Norway	Austria-France	Finland-UK	Belgium	Ireland - Japan	Portugal	Spain	Italy	Greece
Scale	1,00	0,85	0,70	0,55	0,45	0,30	0,25	0,20	0,15	0,08
Unit costs	1,00	1,04	1,10	1,19	1,29	1,56	1,71	1,95	2,35	3,76

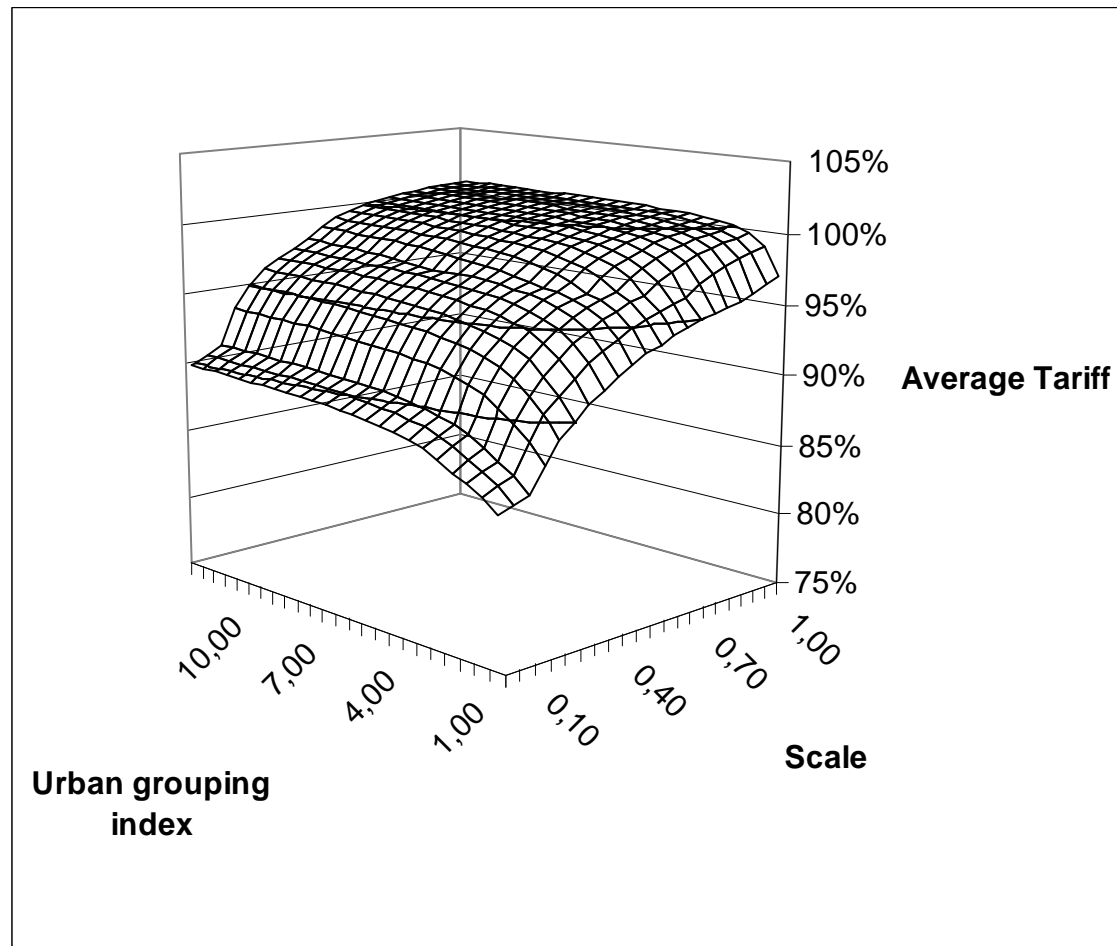


Unit costs as a function of scale and density (urban grouping index)

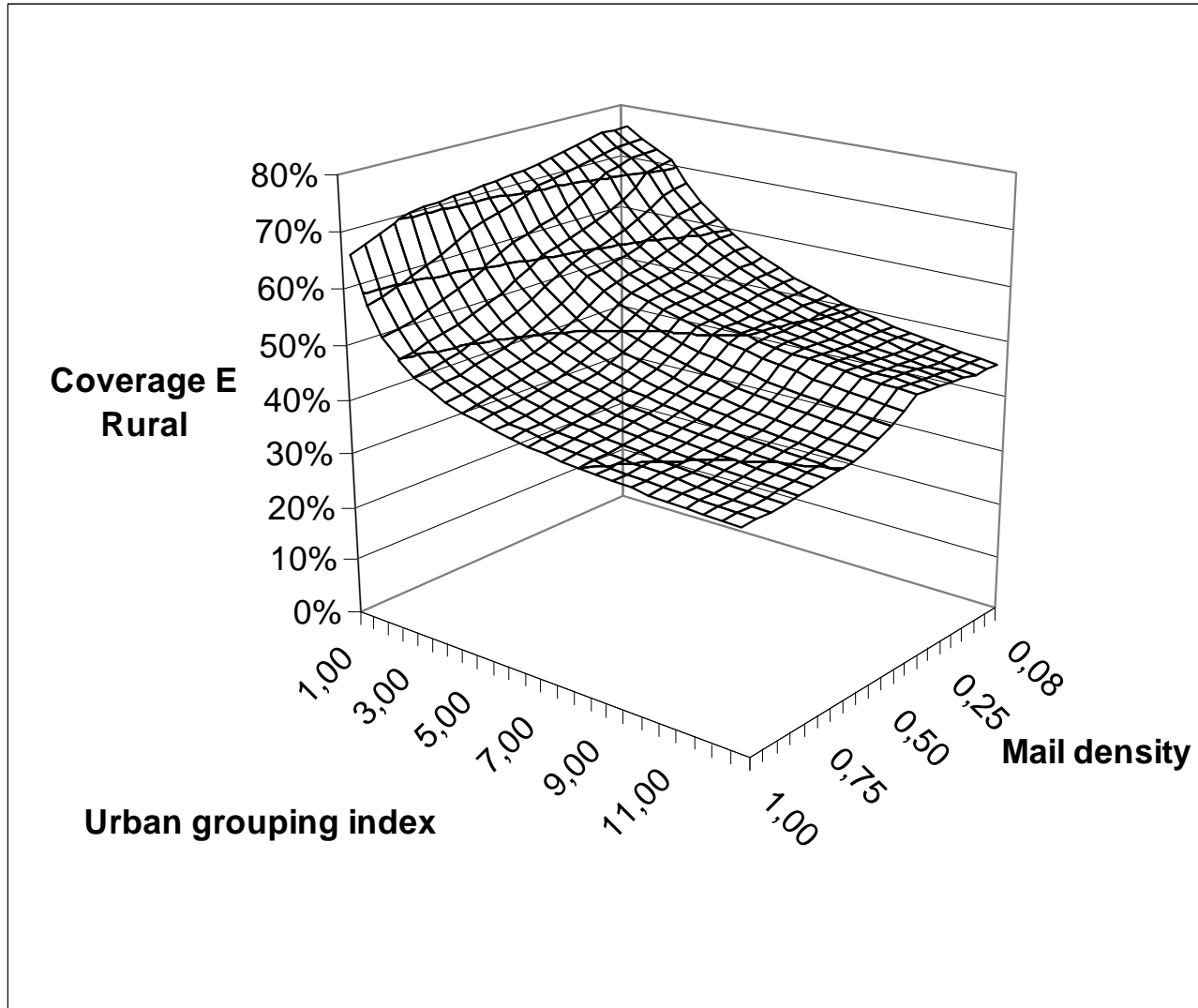


Average tariff as a function of scale and density (urban grouping index)

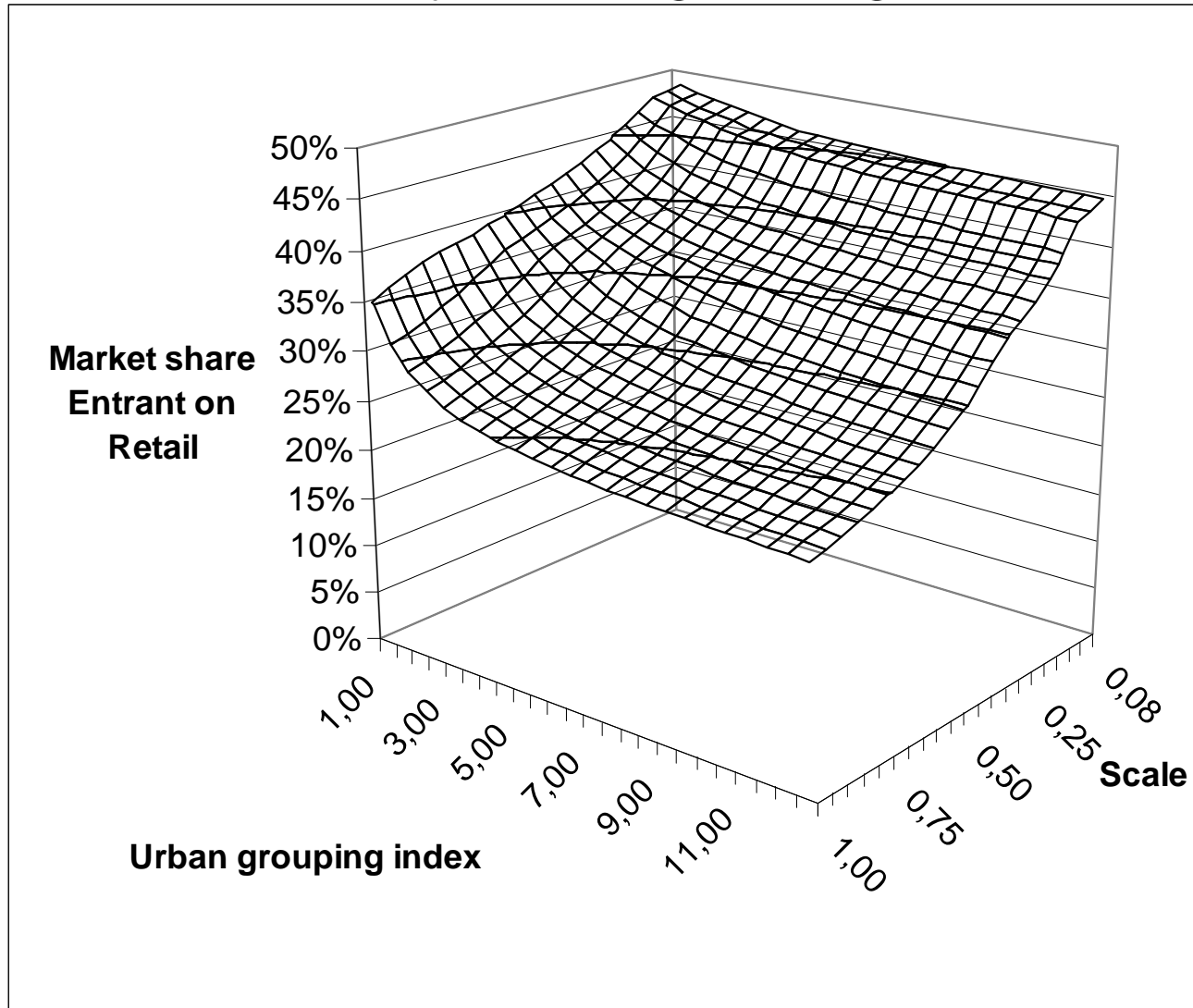
Care: density and scale are upside down on their axis



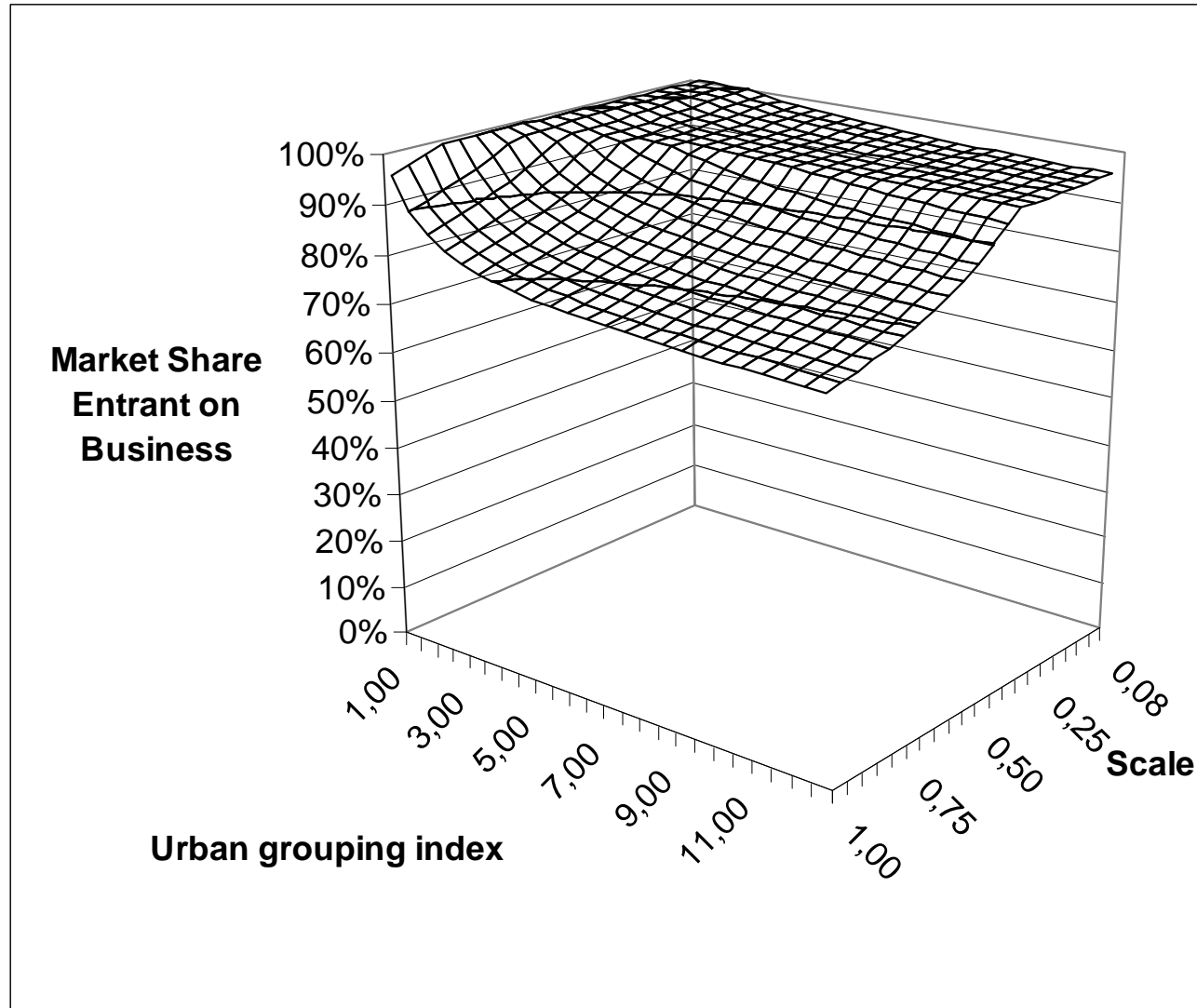
Coverage of the Rural zone by the Entrant as a function of scale and density (grouping index)



Entrant's Retail Market Share as a function of scale and density (urban grouping index)



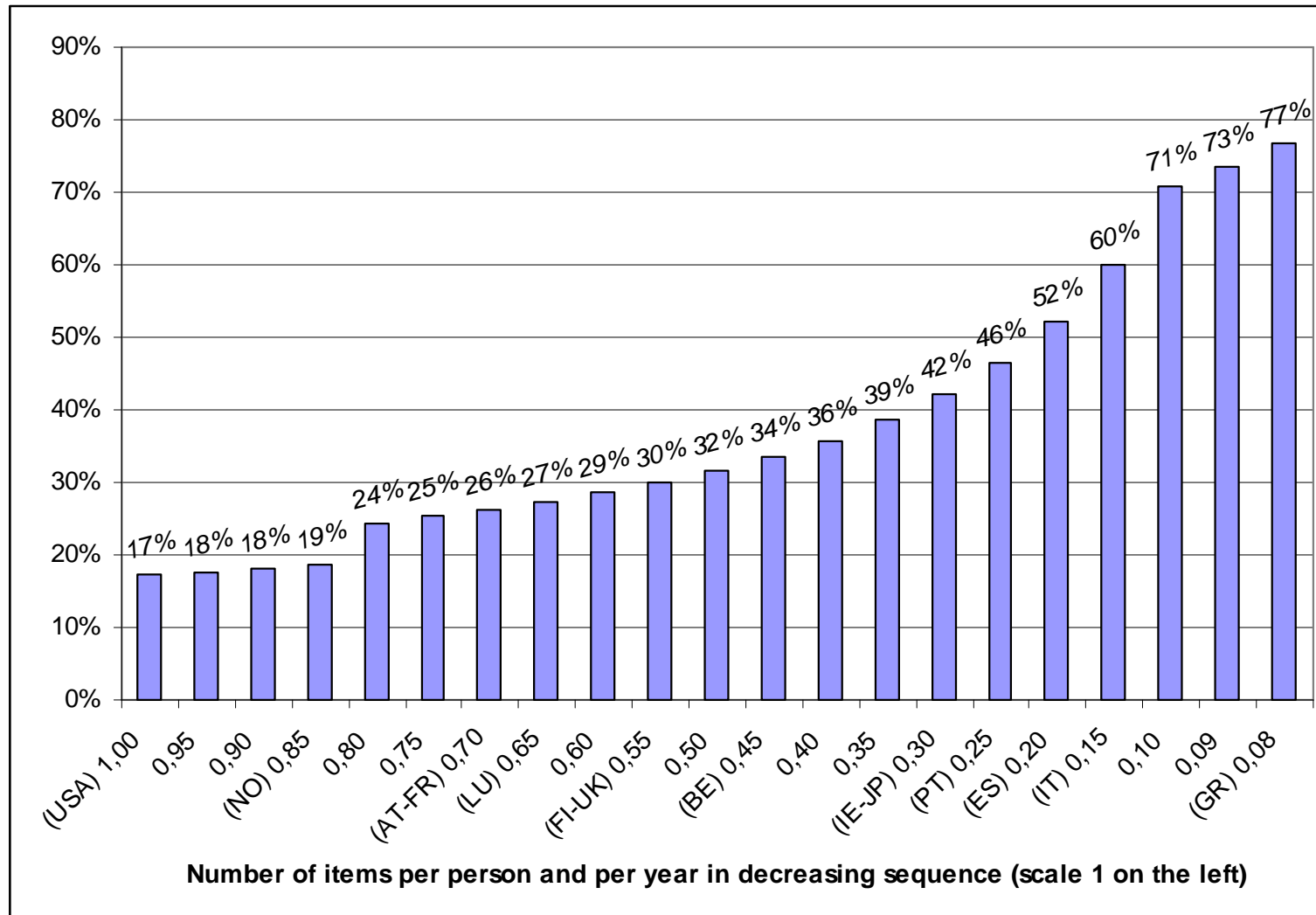
Entrant's Business Market Share as a function of scale and urban grouping index



Model Results per Country Scale

	USA	Norway	Austria France	Luxembourg	Finland-UK	Belgium	Ireland -Japan	Portugal	Spain	Italy	Greece
	1,00	0,85	0,70	0,65	0,55	0,45	0,30	0,25	0,20	0,15	0,08
Unit cost	1,00	1,04	1,10	1,13	1,19	1,29	1,56	1,71	1,95	2,35	3,76
Volume	110%	111%	113%	114%	116%	117%	119%	120%	121%	122%	125%
Tariff Incumbent	153%	160%	172%	177%	188%	193%	206%	212%	219%	226%	240%
Entrant Urban Tariff	61%	59%	57%	57%	55%	52%	48%	46%	43%	40%	34%
Entrant Rural Tariff	71%	71%	70%	70%	70%	69%	68%	67%	66%	65%	64%
Entrant Share Retail Collect	29%	31%	34%	35%	37%	38%	41%	42%	44%	45%	48%
Entrant Share Business Collect	86%	89%	94%	96%	98%	99%	99%	100%	100%	100%	100%
Financial Needs Entrant	18%	23%	30%	33%	40%	49%	68%	78%	90%	108%	146%

Financial need of Incumbent at constant tariffs in % of own sales



Summary of market opening with economies of scale 1/2

Per country, we measure the impact of opening the postal market, given an exogenously defined USO for the Incumbent, on **unit costs, tariffs, volumes, market shares and financial balances** using a detailed scale and density related bottom up cost model.

1° **In the break-even solution**, the model result in an average tariff which become lower and in market shares of the Entrant which become higher in small scale and/or rural (less dense) countries. In this case **Incumbent's increases in tariff necessary for break-even are higher**: this will provide more opportunity for the Entrant to benefit from a tariff discount.

2° **In the solution where the Incumbent is not allowed to increase her tariff**, her financial loss as a the Provider of the Universal Postal Service Obligation is higher in small scale and/or rural (less dense) countries than in large scale ones.

Summary of market opening with economies of scale 2/2

One cannot generalize conclusions about market opening in the large scale country, such as the USA, to small scale countries, such as European countries:

- If a break-even Tariff increase of 53% in the USA (Cohen 2004 mentioned up to 78%), one finds increases of more than 100% in European countries
- Alternatively, to *finance the loss of the USO provider* for an amount of 17% of sales in the USA is not comparable to orders of magnitude of 40% up to 80% calculated for European countries.

In countries with a higher mail delivery density it is more difficult to compete for the Entrant. The reason for this paradox is because there is *uniform tariff constraint on the Incumbent*, which implies a relatively lower uniform tariff because delivery costs in the urban zones are lower. This is why the Entrant abandons his rural network almost everywhere, when the grouping index is high (relatively low delivery costs).

The Entrant will need more financial capital to finance the development of his delivery network, in order to bypass the Incumbent's network **in small scale and/or rural (less dense) countries.**

Sensitivity analysis and improvements

The sensitivity of the numerical results obtained to various factors such as:

Demand coefficients: sigma , epsilon, Retail customer's ratio,
matrix of loyalty parameters X and elasticities

USO definition: uniform tariffs for retail and/or business, delivery frequency,
access tariff rule: avoided cost / accessed cost, Crew-Kleindorfer DAP rule,
with / without overhead cost margin Laffont-Tirole price cap

Entrant: Labor factor cost discount of the Entrant, distribution frequency of Entrant.

Further improvement of the model: introduction of a game theoretic approach in
the tariff decision rules of both operators (duopoly).

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