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ABSTRACT

Universal service providers (USP) are increasingly active in business segments other than the segment consisting of their Universal Service Obligation (USO). Price regulation of USO services is usually cost-oriented and differentiated between USO- and non-USO-products. Hence, regulatory rules on cost allocation impact regulated prices and overall welfare. In this paper we analyze the effect of various cost allocation rules on the financing of USO, assuming a profit regulation in place. We use a stylized model with a set of products characterized by different price elasticities perceived by the USP. The model is calibrated for a scenario representing the postal market in industrialized countries.

As a benchmark, we derive a welfare optimal allocation of costs based on Ramsey prices such that the incumbent USP breaks even. We then compare this result to cost allocation rules applied in practice: Fully distributed cost based on activities (ABC), and cost allocated according to a net cost rebalancing (NCR) mechanism. Under NCR, a regulated USP is allowed to reallocate the net cost of the USO through internal transfer payment.

We find that cost allocation rules strongly affect prices and welfare under price control. NCR increases welfare clearly as compared to ABC.

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1. INTRODUCTION

Incumbent postal operators are increasingly active in business segments other than the core postal business of sending mail items, which is still part of the Universal Service Obligation (USO) in many countries. Often, price regulation is cost-oriented and differentiated between USO- and non-USO-products. Hence, regulatory rules on cost allocation impact regulated prices and overall welfare. In this paper we analyze the effect of various cost allocation rules on the financing of postal USO, assuming a profit regulation in place. We use a stylized model with a set of products characterized by different price elasticities perceived by the Universal Service Provider (USP). The model is calibrated for a scenario representing the postal market in industrialized countries.

As a benchmark, we derive a welfare optimal allocation of costs based on Ramsey prices such that the incumbent USP breaks even. We then compare this result to cost allocation rules applied in practice: Activity Based Costing (ABC) with fully distributed costs, and cost allocated according to a net cost rebalancing (NCR) mechanism.

ABC is the standard method and is most widely used in the postal sector (ERGP, 2011). Its key principle is the following: cost objects (products, customers, etc.) consume activities which in turn consume resources (ERGP 2012).

Under NCR, a regulated USP is allowed to reallocate the net cost of the USO through internal transfer payments. The reallocation may be limited to fixed or joint costs if cross-subsidization is an issue. In this way, the USP can charge the services for which it is able to generate a surplus on the market and relieve unprofitable (USO) services. The net cost balancing makes it possible for a USP to separate operational accounting from regulatory accounting: In a first step, cost can be allocated according to regular accounting principles (business accounting); in a second step, the net cost balancing is carried out (regulatory accounting). This interplay between the financing of the USO and price regulation makes it possible to provide universal services without external financing (with a USP inhibiting sufficient market power). Alternatively, if the USO is granted a legal monopoly over a subset of services to finance the USO, a net cost rebalancing mechanism will cap prices in the monopoly area such that the additional return will not exceed the net cost of the USO.[4]

The quantitative scenarios are considered under the restriction that there is no cross-subsidy in the sense of the Faulhaber (1975) rule. This rule specifies the *incremental cost test* as satisfied if the revenue from any quantity of service (or service bundle) of a multiproduct firm is greater than or equal to the change in total cost caused by not producing the service (or service bundle). The increment in cost is the difference in total cost with and without this quantity of service (or service bundle). This guarantees that the service does not receive a cross-subsidy. If the incremental cost test is not satisfied, cross-subsidization is present if the revenue of a product or product group exceeds its standalone cost. When satisfied, the service can be considered to not receive a cross-subsidy (see Parsons, 1998).

From our results we derive criteria for optimal cost allocation rules in a context with USO and different degrees of competition between product segments.

[4] A net cost rebalancing mechanism was implemented in the Swiss postal market, cf. Jaag and Maegli (2014).

The remainder of this paper is structured as follows: Section 2 presents a formal model comparing various cost allocation mechanisms. Section 3 applies the model and presents numerical results under a simple parameterization. Section 4 concludes.

2. QUANTITATIVE MODEL AND FORMAL RESULTS

We consider a postal operator that is active in a set of I markets. In each market $i \in I$ the postal operator can set its price p_i and faces a demand function $x(p_i)$. The supply of goods in market i causes variable cost denoted by $C_i(x_i(p_i))$, and fixed cost, denoted by F_i. Moreover, the USO is assumed to cause a fixed cost independent of serving a specific market, denoted by F_G. We interpret this fixed cost to be the net cost of the USO.

The profit function of the postal operator is given by

$$\pi = \sum_{i \in I} p_i x_i(p_i) - \sum_{i \in I} C_i\big(x_i(p_i)\big) - \sum_{i \in I} F_i - F_G$$

and welfare (measured by consumer surplus and assuming independent demands) is given by

$$W = \sum_{i \in I} \int_{p_i}^{\infty} x_i(\tilde{p}_i) d\tilde{p}_i.$$

We study three different regulatory frameworks: Ramsey Pricing (RP), Net Cost Rebalancing and (NCR), and Activity Based Cost allocation (ABC). In our set-up, they correspond to a zero profit condition to the following maximization problems:

$$(RP): \max_{p_i} W \;\; s.t. \pi = 0$$

$$(NCR): \max_{p_i} W \;\; s.t. p_i x_i(p_i) - C_i\big(x_i(p_i)\big) - F_i - \alpha_i F_g = 0 \; \forall i \in I, \sum_{i \in I} \alpha_i = 1,$$

$$0 \le \alpha_i \le 1 \; \forall i \in I$$

$$(ABC): \max_{p_i} W \;\; s.t. p_i x_i(p_i) - C_i\big(x_i(p_i)\big) - F_i - \frac{x_i(p_i)}{\sum_i x_i(p_i)} F_g = 0 \; \forall i \in I$$

With the zero profit condition the postal operator is indifferent between any cost allocation in the (NCR) and (ABC) regime. Hence, it is simply assumed that the postal operator acts as a welfare maximizer under the zero profit condition. Under this assumption it follows that

$$W_{AC} \le W_{NC} \le W_{RP}.$$

This inequality arises because the constraints in (RP) are less strict than (NCR) and the (NCR) constraints related to the distribution of F_g are less strict than in (ABC), where the weights are predefined. Mathematically speaking, if C_k denotes the admissible set for regime k, it holds that $C_{AC} \subset C_{NC} \subset C_{RP}$, and hence the above inequalities follow. Intuitively, the NCR regime allows more flexibility in allocating costs and hence in determining prices which results in higher welfare under the assumption that the postal operator's objective function is indeed welfare.

The above case with zero profit condition and the assumption that the postal operator maximizes welfare may not be realistic. In the following it is assumed that a rate-of-return-regulation is in place instead of a zero profit condition. Additionally, a Faulhaber rule is imposed as a constraint in the sense that the price of a product must at least cover its incremental costs.[5] The postal operator is allowed to make profits of at most β percent of total revenues ("profit regulation"). In this case, the postal operator is no longer indifferent between cost allocation mechanisms and will shift costs to maximize profits. Formally, the three regimes then correspond to the following maximization problems:

$$(RP): \max_{p_i} W \ s.t. \beta \sum_i p_i x_i(p_i) \leq \pi, p_i \geq c_i \ \forall i$$

$$(NCR): \max_{p_i} \pi \ s.t. (1-\beta) p_i x_i(p_i) \leq C_i\big(x_i(p_i)\big) + F_i + \alpha_i F_g \ \forall i \in I, \sum_{i \in I} \alpha_i = 1, 0 \leq \alpha_i \leq 1 \ \forall i \in I, p_i \geq c_i \ \forall i$$

$$(ABC): \max_{p_i} \pi \ s.t. (1-\beta) p_i x_i(p_i) \leq C_i\big(x_i(p_i)\big) + F_i + \frac{x_i(p_i)}{\sum_i x_i(p_i)} F_g \ \forall i \in I, p_i \geq c_i \ \forall i$$

From the first-order conditions to these maximization problems the following optimal prices can be derived:

$$p_i^{RP} = \left[\frac{1}{\varepsilon_{xi,p_i}} \frac{1+\lambda(1-\beta)}{\lambda} + (1-\beta)\right]^{-1} C_i'\big(x_i(p_i)\big)$$

$$p_i^{NC} = \left[\frac{1}{\varepsilon_{xi,p_i}} \frac{1+\lambda_i(1-\beta)}{1+\lambda_i} + \frac{1+\lambda_i(1-\beta)}{1+\lambda_i}\right]^{-1} C_i'\big(x_i(p_i)\big)$$

$$p_i^{AC} = \left[\frac{1}{\varepsilon_{xi,p_i}} \left(1+\lambda_i(1-\beta) + Q(p_k)\frac{F_G}{x_i(p_i)}\right) + \ 1+\lambda_i(1-\beta)\right]^{-1} C_i'\big(x_i(p_i)\big)$$

[5] Formally, Faulhaber's incremental cost test is to be applied to individual services and to all possible groups of services. In a two-product company with break-even constraint this translates to the restriction that $p_i x_i \geq c_i x_i + F_i$. If there are no product specific fixed costs ($F_i = 0$), the restriction simplifies to $p_i \geq c_i$, i.e. prices must exceed variable cost. For analytical convenience, the latter is assumed in the formal part of the analysis (Section 2). The results are nevertheless in line with the numerical findings in Section 3 (which assume $F_i > 0$).

where $Q(p_k) = \frac{\sum_{k\neq i}(\lambda_k-1)x_k(p_k)}{(\sum_j x_j(p_j))^2}$ while λ and λ_i denote the Lagrange multipliers in the corresponding constraints, respectively.

While p_i^{RP} is the optimal price from the viewpoint of consumers in the given set-up, the prices p_i^{NC} and p_i^{AC} are the prices the postal operator chooses in the respective regime.

From these prices we can see that in all cases the optimal price depends negatively on the price elasticity of demand, ε_{x_i,p_i}, as in the standard Ramsey Pricing case. However, in this general specification, it is not possible to make a statement about whether the NCR or ABC regime is superior in terms of welfare and how large the differences are.

3. NUMERICAL RESULTS AND DISCUSSION

To get a better understanding of the two regimes, we present numerical simulations for a stylized model. It is assumed that the postal operator is active in two markets. One market has a higher price elasticity of demand whereas the other market has a lower price elasticity of demand for a given price and quantity. The demand function for the two markets is assumed to be of the form

$$x_i(p_i) = A_i - \varepsilon_i * p_i \; where \; i \in \{h, l\}.$$

For the numerical simulations we set the following parameters $\beta = 0.05, c = 0.5$. Demand parameters A_i, ε_i are then calibrated to satisfy the following equalities for a price set to unity, i.e. $p_l = p_h = 1$,

$$x_h = x_l = 1'000'000'000$$

$$\epsilon_l = -0.5 = \frac{\partial x_l}{\partial p_l}\frac{p_l}{x_l}$$

$$\epsilon_h = \frac{\partial x_h}{\partial p_h}\frac{p_h}{x_h}$$

where the elasticity of demand ϵ_h is varied from –0.75 to -3. In our base case we set $\epsilon_h = -1.5$. This value corresponds to empirical estimates of postal price elasticities (see e.g. Nikali, 2011). Moreover, we set $\mathrm{F_h} = F_l = (1'000'000'000 - \mathrm{F}_g)/2$ and let F_g vary from 10 million up to 500 million. In the base case we set $\mathrm{F}_g = 200$ million. This calibration set-up mirrors the cost and demand structure in the Swiss postal market.

In the above described base case, the optimal prices as shown in Table 1 emerge in the different regimes. The regime "Monopolist" is the case with an unconstrained monopolist charging the monopoly price in both market segments. In this setup the prices in NCR are closer to the welfare optimal prices in RP than the prices under ABC. This also reflects in higher welfare in NCR compared to ABC as shown in the last row of the table.

Table 1: Simulation results base case calibration

	RP	Monopolist	NCR	ABC	Elasticity at RP prices
Price h	0.87	1.08	0.89	1.11	-1.09
Price l	1.27	1.75	1.25	1.08	-0.73
Welfare	1226.62	645.833	1225.76	1148.22	

To check the robustness of this result in our base calibration, we let ϵ_h vary from -0.75 to -3 in incremental steps of 0.25 and let F_g vary from 10 million up to 500 million in incremental steps of 10 million. For all parameter constellations the optimal prices and the welfare outcomes are calculated for all regimes. Table 2 und 3 summarize the results of this computation. Table 2 reports the welfare difference between NCR and ABC for different parameter constellations. Table 3 contains the descriptive statistics of the sensitivity analysis. In all parameter constellations, NCR is always better than ABC in terms of welfare. On average NCR offers a welfare surplus of 4.29% compared to ABC which corresponds to an absolute difference of 61.75 million.

Table 3 shows that the welfare difference between NCR and ABC increases with a larger difference between the two elasticities and a higher level of fixed cost F_g. This makes intuitive sense: NCR allows for pricing closer to the Ramsey solution. This is the more important the higher the difference between the two elasticities is and the broader the scope for NCR (since the net cost is equal to fixed cost F_g in our example).

Table 2: Sensitivity analysis welfare difference

Elasticity *F_g(Mio.)*	-0.75	-1.00	-1.25	-1.50	-2.00
100	7.34	11.01	13.21	14.68	16.51
300	36.68	55.03	66.03	73.37	82.54
500	71.19	106.92	128.14	142.38	160.18

Table 3: Summary statistics sensitivity analysis

	Mean	*Median*	Min	Max
Welfare Differential NCR-ABC (%)	*4.29%*	*3.41%*	*0.07%*	*12.46%*
Welfare Differential NCR-ABC (million.)	*61.75*	*48.86*	*1.14*	*174.87*

4. CONCLUSIONS

Incumbent operators providing universal services are increasingly active in competitive markets. Prices of USO-products are often regulated. The traditional solution to regulate the USO-products is separating accounts between USO- and non-USO products and imposing a product-specific rate-of-return regulation on US products with fully allocated cost as a point of reference.

This paper analyzes the effect of different cross-subsidy-free cost allocation rules for the universal service provider on prices and welfare (consumer surplus). As an economic benchmark, a welfare maximizing regulation regime is derived resulting in Ramsey prices. The benchmark is compared to two alternatives: ABC costing with fully distributed costs based on activities, and NCR, where a regulated USP is allowed to reallocate the net cost of the USO through internal transfer payments. All three scenarios are held cross-subsidy free in the sense of Faulhaber (1975).

We find that cost allocation rules strongly affect prices and welfare under price control. The formal analysis reveals that with all mechanisms, optimal prices depend (negatively) on demand elasticity. Intuitively, under profit regulation, an increase in revenue increases absolute profits. The results reveal that the Ramsey-based regime is superior in terms of welfare, however it is not possible to rank ABC and NCR in relative terms. The numerical analysis based on a stylized calibrated model reflecting an industrialized postal market confirms that Ramsey prices result in the highest welfare. An unconstrained monopolist results in a clear welfare loss as compared to all three regulated regimes. The NCR regime leads to results that almost duplicate the Ramsey optimum. As a consequence, and as expected, the NCR regime is generally superior to ABC costing and almost achieves the Ramsey second best (because in comparison it is less restricted by the amount of the net cost which is allowed to be reallocated). With the chosen calibration, on average, NCR increases welfare by 4% compared to ABC costing. The welfare difference between NCR and ABC is large if the difference in elasticities of products are high and/or net costs are high.

In summary, a net cost rebalancing mechanism increases welfare as compared to ABC costing clearly. In relative terms, ABC costing decreases overall welfare consistently. The welfare increases are induced by a more market oriented, but cross-subsidy free pricing by the USP. A net cost rebalancing mechanism may hence reduce external compensation for the USO.[6]

The results indicate that a net cost rebalancing mechanism can be applied to effectively and optimally constrain a universal service provider with a legal monopoly that is active in other markets as well. In analogy, an NCR regime can be imposed on a USP with significant market power (SMP) that is active in other markets as well. More generally, a NCR-kind approach may be an alternative to regulate SMP.

[6] Price regulation can represent a means for (partial) financing of the USO, see Jaag (2013).

References

ERGP (2011). Draft ERGP Report on common cost allocation.

ERGP (2012). Draft ERGP common position on cost allocation rules.

Faulhaber, G. (1975). Cross-subsidization: pricing in Public Enterprises, American Economics Review 65(5), 966–977.

Jaag, C. (2013). Price Regulation and the Financing of Universal Services in Network Industries, Review of Law and Economics 9(1), 125–150.

Jaag C., and Maegli, M. (2014). Market Regulations and USO in the Revised Swiss Postal Act: Provisions and Authorities, Swiss Economics Working Paper.

Nikali, H. (2011). Does the level of price elasticity change with the progression of substitution? In M. Crew and P. Kleindorfer (eds.) Reinventing the Postal Sector in an Electronic Ag, Cheltenham. Edward Elgar, 36–46.

Parsons, S. (1998). Cross-Subsidization in Telecommunications. Journal of Regulatory Economics 13, 157–182.