

Privatization and Universal Service Obligations

by

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Telecommunications, airlines, and postal services have similar economic features. However, they have followed different privatization patterns. While privatization of the universal service provider (USP) is common in telecommunications and airlines, it is by far less frequent in the postal sector. This paper analyzes how the size of the universal service obligation (USO) and the mechanisms traditionally used to finance it have prevented privatization in the postal sector. By using a model of a mixed duopoly, we explain that privatization is inversely related to the cost of public funds for USO transfers and to the size of the USP's reserved area. (JEL: L 33, L 41, Q 28)

1 Introduction

Patterns of state control in telecommunications, airlines, and postal services in the former European Union (EU-15) countries were similar in the middle eighties, with full state ownership in all sectors and in almost all countries. Nonetheless, nowadays we find important differences: Full or partial privatization is commonplace in airlines and telecommunications. On the contrary, full or almost full state ownership remains as the regular pattern in the postal industry. Here private ownership has partially entered the capital of the incumbent operator in a few countries, but in most cases effective control remains in the hands of government. Beyond the EU, privatization only has happened in Argentina (where renationalization occurred in 2003) and Japan. The aim of this paper is to understand the absence of privatization in the postal sector. We argue that one of the factors that may explain this situation is the relevance of the universal service obligation (USO) in the postal sector.

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In order to understand the privatization pattern in the postal sector we use a model of a mixed duopoly, where one private firm (which can be more efficient than the universal service provider – USP) and one USP (which is in charge of the USO) compete for delivering the mail. In this context, we analyze under which circumstances the government will fully or partly privatize the USP. In the traditional analysis of mixed oligopolies it is considered that public firms exclusively maximize social welfare while private firms maximize profits. Instead of adopting this framework, we follow the models of MATSUMURA [1998] and CLAUDE AND HINDRIKS [2006], where the managers of a partly privatized USP consider a weighted sum of social welfare and the USP's profit.¹ In this context, they show that partial privatization is optimal if the private firm is more efficient. In spite of this, MATSUMURA AND KANDA [2005] explain that under free entry pure welfare-maximizing behaviour by the public firm is optimal. Our paper contributes to the literature on partial privatization by introducing the problem of financing the USO. In this extended model, we show that the government's privatization decision depends on the size of the USO and on the tools traditionally used to finance the USP.

As stated by PANZAR [2001, p. 103], “the cost of implementing any Universal Service Obligation depends upon both the cost of the resources used to provide the service, the prices at which the service is to be provided, *and* the subsidy mechanism through which universal service is to be obtained.” In the postal sector, one of the main drivers of USPs' cost is the obligation to deliver the mail a certain number of days during the week to a nation-wide network of mailboxes. The USP is financed through its commercial activity, but as this is usually not enough, the government uses other mechanisms to finance the USO, such as the price of postage, direct transfers (which entail a public cost), or reserving some regions or services to the USP. In Spain, interurban postal services are reserved to the USP. In the EU, letters below 50 grams, which may account for more than the 80% of the total traffic, are reserved to the USP until the full market opening (FMO), scheduled for January 1, 2011.²

Our model reflects this situation by assuming that the government can reserve a region of the country (or a group of services) for the USP. This measure determines a monopoly area for the USP and a duopoly area where the two firms compete à la Cournot.³ Taking this into account, we show that privatization is inversely related to the cost of the public funds and to the size of the USP's reserved area.

¹ Our work is related with the literature on incentive contracts that firm owners give their managers. Our objective function for the USP's manager relates to BARROS [1995], who considers that the owner of a firm may want his/her manager to pursue an objective different from that of profit maximization when there is interdependence between firms.

² WIK-CONSULT [2005] provides a complete analysis of postal regulatory agencies in the EU.

³ CREMER, DE RYCKE, AND GRIMAUD [1997] and CREW AND KLEINDORFER [2000], [2005] analyze the USO in the postal sector.

Privatization in Network Industries. Two decades ago, legal monopolies and reserved areas of business were frequent in western Europe. All EU countries had state-owned monopolies providing most of the services in the postal, telecom, and air travel industries. Public firms operated within a heavily monopolistic framework even if natural monopoly conditions were not present in these sectors or were less strong than in other sectors such as energy or water.

Public policies imposed costly service obligations, usually linked to distributive considerations or interterritorial cohesion. The provision of service obligations was frequently funded through cross-subsidies. In this way, (1) excess profits in urban mail distribution were used to finance deficits in rural areas, (2) excess profits in long-distance calls were used to finance deficits in local calls, and (3) excess profits in densely demanded domestic regular routes of air travel were used to finance deficits in domestic routes of low demand. In order to prevent potential competitors from contesting extraordinary profits in the most profitable segments of these industries, competition was restricted, and frequently one state-owned firm was given a legal monopoly to offer services in the so-called reserved areas. In this way, in the early eighties all dominant operators in EU-15 countries in postal, telecommunications, and air travel services were government-controlled firms, in most cases with 100% state ownership.⁴

The UK was the first European country to privatize, at the beginning of the eighties. As time went by, privatization was carried out over the whole EU, although its intensity has differed between countries. After twenty years of privatization, state ownership in the telecommunications, airline, and postal services has deeply changed. Part (1) in Table 1 displays the current situation of state ownership in dominant operators. Part (2) shows that privatization has been a truly active policy in many EU-15 countries since the middle eighties.

In telecommunications, six former public monopolies are nowadays totally private firms. In eight countries, the dominant operator is still government-controlled, although in all cases these firms have been partially privatized. Among airlines, three former public monopolies are nowadays fully private firms (Italy is on the way, and the Belgian operator disappeared in 2001 because of bankruptcy). The dominant airline is fully state-owned only in two countries. Several countries have privatized around half the main airline shares.

The picture of the postal sector is extremely different. All countries in the EU-15 have preserved state control over dominant operators in that sector. State ownership is complete in most cases. Recently, some countries, including Belgium, Denmark, and Austria (this last one in 2006), have sold minority stakes. A majority of capital has been privatized only in the Netherlands and Germany. There, however, the state retains control through its regulatory institutions over the national postal operator in the provision of letter service (the USP).

⁴ The experience of the U.S. shows that in the early eighties competition in the reserved areas was already feasible. In 1978, entry barriers were suppressed for the main air routes, and the prices were deregulated. In 1984, AT&T was broken up and the regulation of long-distance calls was liberalized. See CARLTON AND PERLOFF [1990].

Table 1
State Ownership and Privatization in EU-15, December 2007

Country	(1) State ownership (%) in dominant operators (former public monopolies)		(2) Significant privatization activities, 1984–2007	
	Telephone	Airlines	Telephone	Airlines
Austria	30	40	1998, 2000, 2004	1988, 1999
Belgium	50	0 ^a	2004	1990, 1994, 1995
Denmark	0	50 ^b	1994, 1998	
Finland	51 ^c	58	1988, 1991, 2000, 2004	1995
France	27.5	19 ^d	1997, 1998, 2004, 2005, 2007	1999, 2004
Germany	33 ^e	0	1996, 1999, 2000, 2004, 2006	1989, 1994, 1997
Greece	28	100	1996, 1997, 1998, 1999, 2002, 2005, 2007	2000, 2003, 2004, 2005, 2006
Ireland	0	25	1996, 1999	2006
Italy	0	50	1997, 2002	1985, 1998, 2005
Luxembourg	–	–	–	–
Netherlands	0	0 ^d	1994, 1995, 2000, 2003, 2005, 2006	1994, 1996, 2001, 2004, 2005
Portugal	0	100	1995, 1996, 1997, 1999, 2000	
Spain	0	0	1987, 1995, 1997	1999, 2000, 2001
Sweden	51 ^e	50 ^b	2000, 2007	
United Kingdom	0	0	1984	1987

Notes: ^aThe former Belgium monopoly, Sabena, went bankrupt in 2001. At that moment, state ownership was 51%. A new and completely private airline was founded in 2002, SN Brussels Airlines. ^bScandinavian Airlines (SAS) has been and still is the main airline in most Scandinavian countries. State ownership is 50%, distributed between the Danish government (14.3%), the Swedish government (21.4%), and the Norwegian government (14.3%). ^cIn 2002 Swedish Telia and Finnish Sonera merged in TeliaSonera. By the end of 2007 the Swedish government held 37.3% of the capital and the Finnish government held 13.7%. ^dAir France and KLM (Netherlands) merged into Air France-KLM. The French government held 18.6% of the capital. ^eConcerning telecommunications, 15.4% was held by the Federal Republic of Germany, and 17.6% by KfW Bankengruppe. Concerning Deutsche Post, all shares publicly owned are held by KfW Bankengruppe. ^fIn Belgium, remaining state ownership is 50% plus one share. Sources: State ownership in telecommunications and airlines: Firms' web pages and 2005 financial reports. State ownership in postal sector: ECORYS [2005] and web pages of TNT-Post and Deutsche Post and WIK-CONSULT [2006]. Privatization operations: Privatization Barometer database for telecommunications, airlines, and postal sector (Fondazione Eni Enrico Mattei).

Why has the postal sector been so reluctant to privatize? Several reasons can explain this:

- (1) Opposition from powerful labor unions for fear of restructuring and job losses or losses in union power.
- (2) The perception and fear by large elements of the population that USO would suffer with privatization and that existing cross-subsidies would cease.
- (3) The preference among policymakers for transparency and legitimation, leading to encapsulating the payment of USOs within sector-specific USPs.
- (4) The much greater attractiveness for investors of telecoms than of postal operators. In telecoms, there has been significant growth in basic and enhanced services and therefore ready buyers for privatized firms. Airlines have attracted some investors along the way, with similar beliefs. In the postal sector, by contrast, operators have seen low or stagnant growth in their main lines of business. With large labor forces, there are no buyers that one would entrust with an important public mission.
- (5) In last place in importance in the public debate about privatization has been the question of the cost of public funds for financing USO transfers. This point has until now largely been confined to theoretical discussions in the postal economics literature (e.g., CREMER et al. [2008]). This is the focus of the present work.

Contribution to the Literature. The main contribution of this paper is to identify the strategic link between privatization and USOs. We show that the optimal privatization level is inversely related with the cost of public funds that are used to finance the USO. When the cost of public funds is important, the government prefers financing the USO through the price of postage rather than through a direct transfer. To implement this strategy, it maintains the state ownership of the USP, or just privatizes a part of it, because a public USP internalizes the deadweight loss of using transfers to subsidize the USO services. As a result, a partly privatized USP commercializes more letters than a private firm and obtains more profits. In spite of this, when the costs of using transfers to finance the USO are relatively small, the government might decide to partly or completely privatize the USP to take advantage of the higher efficiency of the private firm.

These results are new for the literature on mixed oligopolies. CREMER, MARCHAND, AND THISSE [1989], ESTRIN AND DE MEZA [1995], and MATSUMURA [1998] show that entry enhances welfare only when a public firm is less efficient than its private rivals.⁵ Our paper shows that the entry of inefficient firms is possible when USO transfers imply a cost. If the cost of public funds for financing the USO is positive, the USP increases its price, and this allows the entry of private firms that are equally or less efficient than the public firm.

⁵ DE FRAJA AND DELBONO [1990] review the first works in this direction. DE FRAJA AND DELBONO [1989], WHITE [1996], and KIND, NILSEN, AND SORGARD [2007] analyze the benefits of privatizing public firms under different economic situations.

Our model also analyzes the relationship between privatization and the size of the USP's reserved area. The relevance of the size of the reserved area for privatization has not been analyzed before in the recent literature on partial privatization. We explain that when prices are not regulated and the USP exploits in exclusivity a large region of the country (or an important range of the services), the government's optimal policy is to maintain the state ownership of the USP. Indeed, when the reserved area is large, privatization would increase prices and reduce social welfare. By contrast, when the reserved area is small and the private firm is more efficient than the USP, partial or complete privatization is welfare-enhancing. In this case, as privatization reduces the USP's production and profits, it requires more transfers to finance the USO. However, overall welfare increases due to the higher efficiency of the private firm. An interesting corollary of this analysis is that when the government is able to modify the size of the reserved area, it gives a larger exclusivity area to the USP the higher the cost of public funds is. As before, the intuition is that the USP's profits reduce the costly transfers.

The rest of the paper continues as follows. Next we present the main features of the theoretical model. Then we develop a model that analyzes the relationship between privatization and the design of the USO. Thereafter, we note that our theoretical findings are consistent on several levels with the slow rate of privatization in the postal sector relative to that of telecoms and airlines. Finally, we summarize our conclusions.

2 A Simple Privatization Model under Entry

This section presents a model of a mixed duopoly to analyze the privatization of USPs in the postal sector. Imagine one USP ($i = 0$) and one private operator ($i = 1$) that compete à la Cournot.

Consumers send letters in a continuum $[0, 1]$ of different locations of a country. The USP operates in the whole country. However, it has a reserve area in the region $[0, \mu]$, where $0 \leq \mu \leq 1$, and it is a duopolist in the region $[\mu, 1]$.⁶ Denote by x_0 and x_1 the quantities supplied in the duopoly region by the USP and the entrant, respectively. In addition, let $X = x_0 + x_1$.

Demand in the reserved and duopoly regions is $X(p) = 1 - p$, where p is the market price. The price in the duopoly region is then determined as $p^D = 1 - x_0 - x_1$. The USP chooses a price in the reserved region that cannot exceed the price in the duopoly region, that is, $p^R \leq p^D$.⁷ As we will see below, this constraint is binding in equilibrium. That is, the monopoly price in the reserved region is higher than the

⁶ This situation reflects markets like the Spanish one, where the USP has a reserved area in interurban services and is a duopolist in the urban areas. Alternatively, we could assume the USP has a reserve for some services and the rest of the market is liberalized.

⁷ A uniform price is usual in industries where the USP has a reserve over a geographical region. As it will become evident later, this policy creates a strategic link between the monopoly and the duopoly region, and affects the optimal size of the reserve

equilibrium price in the duopoly region when one firm operates in both markets. Therefore, $p = p^R = p^D = 1 - x_0 - x_1$.

The private firm can be equally or more efficient than the USP. We denote by c the constant marginal cost of the private firm, and by $c(1 + \alpha)$ the constant marginal cost of the USP. Therefore, $\alpha \geq 0$ reflects the relative inefficiency of the USP. Notice that when the demand function is $X(p) = 1 - p$, $\alpha < (1 - c)/c$ is the maximum value of α that allows a positive production for the USP.⁸

The government and the firms play a game in two stages. In the first stage, the government chooses the USP's privatization level. In the second stage, the duopolists determine their productions, competing à la Cournot.

The profit of the USP is the sum of the profits obtained in the reserved and duopoly areas, less the USO costs F , plus a transfer from the government, T :

$$(1) \quad \pi_0 = \pi + T = (1 - \mu)[p - c(1 + \alpha)]x_0 + \mu[p - c(1 + \alpha)]X - F + T.$$

The effective cost of sustaining the USO is determined exogenously, and neither the USP nor the government can modify it. For simplicity, we consider that USO costs are so important that the USP always incurs a deficit.

The private firm only operates in the duopoly area and obtains the following profit:

$$(2) \quad \pi_1 = (1 - \mu)[p - c]x_1.$$

The government considers a welfare function that reflects the unweighted sum of the consumer's surplus and the profits of the duopolists. Moreover, the government takes into account the cost of public funds to finance the USP, which is denoted as λ .⁹ The welfare function is thus

$$(3) \quad \hat{W} = (1 - \mu) \left[\int_0^{x_0+x_1} (1 - y)dy - p(x_0 + x_1) \right] + \mu \left[\int_0^X (1 - y)dy - p(X) \right] - (1 + \lambda)T + \pi_0 + \pi_1.$$

Following CLAUDE AND HINDRIKS [2006], we consider that the objective function of the USP's managers is a convex combination of welfare and profits, where the weights reflect the degree of privatization. We denote as $0 \leq \theta \leq 1$ the proportion of the USP shares controlled by the government. When $\theta = 1$ the USP is completely state-owned, and when $\theta = 0$ it is fully private. Therefore, in the second stage of the

area. See also ANTON, VAN DER WEIDE, AND VETTAS [2002], VALLETTI, BARROS, AND HOERNIG [2002], and CALZADA [2009].

⁸ DE FRAJA [1993] and WILLNER [1999] explain that public firms pay higher wages. BÖS AND PETERS [1995] explain that public firms have less information on the true costs of the firm. Furthermore, political theory can explain some regulations: HART, SHLEIFER, AND VISHNY [1997] predict that public ownership relates to higher employment, providing political rents to politicians. Alternatively, politicians seeking rents may choose privatizing the service, which makes it easier to receive political funding and material rents.

⁹ BROWNING [1987] shows that in developed countries λ varies between 0.2 and 0.3.

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game the USP's managers decide the production of the firm, taking into account the following expression:

$$(4) \quad V = \theta W + (1 - \theta)\pi_0.$$

When the USP is completely state-owned, the problem of the USP's managers is to set the quantity x_0 that maximizes the welfare function in (3), subject to the USP's breakeven constraint. That is, they consider that $T = -\pi$, where $\pi = \pi_0 - T$ is defined in (1). Having this in mind, we can rewrite the welfare function considered by the managers as follows:

$$(5) \quad W = (1 - \mu) \left[\int_0^{x_0+x_1} (1-y)dy - p(x_0+x_1) \right] \\ + \mu \left[\int_0^X (1-y)dy - p(X) \right] + (1 + \lambda)\pi + \pi_1.$$

By contrast, when the USP is fully private, the USP's managers maximize the profit function in (1). Afterwards, the USP receives a transfer to guarantee its budget balance.

More generally, when $0 < \theta < 1$, the managers of the partly privatized USP maximize their objective function in (4), where W is the welfare function in (5) and π_0 is the profit function in (1), taking into account that T is the minimum required subsidy to achieve breakeven operations.

In the first stage of the game, the government determines the USP's privatization level through its shareholding. It chooses the value of θ that maximizes the welfare function in (5). That is, it establishes the privatization level that maximizes welfare, taking into account that for any value of θ the USP participation constraint is satisfied.

3 The Government's Interest in Privatization

This section analyzes the relationship between the government's optimal privatization policy and the cost of the USOs. First, we consider the case where the USP and the private firm cover the same part of the country. Afterwards, in section 4, we analyze how the reserve of a region of the country (or some services) to the USP modifies the government's privatization decision.

Consider that the duopolists cover the same region, that is, $\mu = 0$. The following lemma shows the productions of firms in the second stage of the game. These productions depend on the USP's privatization level.

LEMMA 1 *When $\mu = 0$, an increase in the privatization of the USP reduces its production and increases the production of the private firm. The effect of privatization on total production depends on both the relative efficiency of firms and the USP's privatization level.*

PROOF Differentiating the USP's managers' and the private firm's objective functions in (2) and (4), and rearranging, we obtain the following Nash equilibrium

production levels:

$$(6) \quad x_0 = 1 - c - \frac{2(1 - (1 - \lambda)\theta) - c[1 - \alpha - \theta(1 - \lambda(1 - \alpha))]}{3 + (3\lambda - 2)\theta},$$

$$(7) \quad x_1 = \frac{1 - (1 - \lambda)\theta - c[1 - \alpha - \theta(1 - \lambda(1 - \alpha))]}{3 + (3\lambda - 2)\theta}.$$

Examination of these production levels yields the results of the lemma. *Q.E.D.*

When the USP is completely public, it is more aggressive in the production market than the private firm is. In this situation, if λ (the cost of public funds for USO transfers) is zero, the private firm only produces if it is more efficient than the USP. Indeed, when $\theta = 1$ and $\lambda = 0$, the firms produce $x_0 = 1 - c(1 + 2\alpha)$ and $x_1 = c\alpha$. Clearly, the private firm only produces if $\alpha > 0$.

However, when $\lambda > 0$ the private firm produces a positive quantity, even if it is equally or less efficient than the USP. For example, when $\theta = 1$ and $\alpha = 0$ the productions are

$$(8) \quad x_0 = 1 - c - \frac{2(1 - c)\lambda}{1 + 3\lambda}, \quad x_1 = \frac{(1 - c)\lambda}{1 + 3\lambda}.$$

A positive λ increases the government's costs of financing the USO through a transfer, and consequently the USP's managers partly finance the USO by increasing the price of postage. This strategy may allow the entry of an inefficient private firm. We summarize this result in the next corollary.

COROLLARY 1 *When $\mu = 0$ and the cost of public funds for USO transfers is positive, a private firm can enter the market even if it is less efficient than the USP.*

The production levels in (6) and (7) also show that the distortions created by λ are reduced with privatization. When the privatization level increases, the USP's managers are less concerned about the cost of public funds for USO transfers and this moderates the pressure for increasing the prices and reducing the production level. However, privatization weakens market competition, and firms reduce their productions.

Once we know the equilibrium production levels, we can determine the transfer that allows the USP to break even. The following lemma gives the relationship between the equilibrium transfer and the cost of public funds.

LEMMA 2 *Assuming that $\mu = 0$, a positive cost of public funds reduces the USP's transfer as long as $\lambda < \hat{\lambda} = (2\theta - 1)/\theta$.*

PROOF Substituting the production levels in (6) and (7) in the USP's profit function in (1) and considering that $T = -\pi$ yields

$$(9) \quad T = F - \frac{(c(1 + 2\alpha) - 1)^2(1 - (1 - \lambda)\theta)(1 + \lambda\theta)}{(3 + (3\lambda - 2)\theta)^2}.$$

Observe that for $\theta \leq 1$ one has $T \leq F$. Moreover, for $\lambda < \hat{\lambda}$ it can be verified that $\partial T/\partial \lambda < 0$ and $\partial T/\partial \theta > 0$. *Q.E.D.*

The intuition behind this result is that for $\lambda < \hat{\lambda}$ an increase of the cost of public funds induces the USP's manager to increase the retail price and to ask for a transfer lower than F . However, if the cost of public funds is larger than $\hat{\lambda}$, the USP's managers prefer a larger transfer, because an additional increase of prices would reduce welfare more than an increase of the direct transfer given to the USP. Having this in mind, the minimum transfer is reached for $\hat{\lambda} = (2\theta - 1)/\theta$, and the maximum for $\lambda = (\theta - 1)/\theta$. Thus, for example, when $\theta = 1$, the transfer is $T = F - (c(1 + 2\alpha) - 1)^2/8$ for $\lambda = 1$, and $T = F$ for $\lambda = 0$. Finally, note that for $\lambda < \hat{\lambda}$ one has $\partial T/\partial \theta > 0$. This result reflects that for a given level of λ an increase of the level of state ownership of the USO reduces the prices, and the government must give a larger transfer to the USP to finance its USO costs.

The previous results have shown that the production of firms depends on the government's privatization strategy in the first stage of the game. The next proposition shows how this privatization decision depends on mechanisms used to finance the USO.

PROPOSITION 1 *When $\mu = 0$, the government's interest in privatizing the USP decreases as the cost of public funds to finance the USO transfers increases.*

PROOF Substituting the production levels in (6) and (7) in the government's social welfare function in (5) and calculating the welfare-maximizing privatization level yields

$$(10) \quad \hat{\theta} = \frac{1 + \lambda - c[1 + \lambda + 5\alpha + 2\lambda\alpha]}{1 + \lambda - \lambda^2 - c[1 + \lambda(1 - \alpha) + 4\alpha - \lambda^2(1 + 2\alpha)]}.$$

Differentiating equation (10) with respect to λ and evaluating the result at $\alpha = (1 - c)/c$ (i.e., the maximum value of α that allows a positive production for the USP), we obtain

$$(11) \quad \left. \frac{\partial \hat{\theta}}{\partial \lambda} \right|_{\alpha = \frac{1-c}{c}} = \frac{11 + \lambda(8 + \lambda)}{(\lambda - 1)^2(3 + \lambda)^2} > 0.$$

More generally, for $\alpha \in [0, (1 - c)/c]$ one has $\partial \hat{\theta}/\partial \lambda > 0$. Therefore, the truncation of $\hat{\theta}$ in (10) to the unit interval is the solution to the optimal-privatization problem. That is, the optimal privatization is given by $\theta^* = \min[\max(\hat{\theta}, 0), 1]$. *Q.E.D.*

The intuition of the proposition is that when $\lambda > 0$ the government prefers to finance a part of the USO costs through the price of postage rather than through a transfer to the USP. The objective of reducing the costly USO transfers is better accomplished by increasing the level of state ownership of the USP, because only a public or a partly privatized USP internalizes the deadweight loss of transfers. By contrast, the production and the transfer that a completely private USP obtains do not depend on the cost of public funds for financing the transfers.

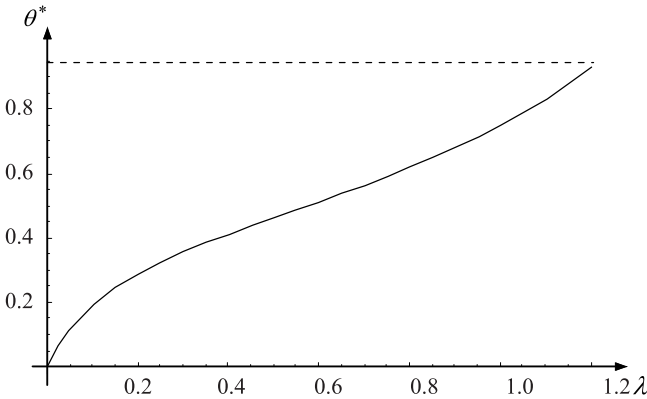
Finally, note that when $\lambda = 0$ and $\mu = 0$ we obtain $\theta^* = (1 - c - 5c\alpha)/(1 - c - 4c\alpha)$. This is the optimal privatization level found by CLAUDE and HINDRIKS [2006] in a model where the cost of public funds is zero and the USP does not have

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a reserved area. In this framework, the only reason to partly privatize the USP is that it is less efficient than the entrant. Therefore, in the particular case where $\alpha = 0$ the government would prefer a completely state-owned USP.

Figure 1 provides a numerical simulation to illustrate how the optimal level of public ownership increases with the cost of public funds for transfers. In our example, when the USP's marginal cost is 20% higher than those of the private firm and the cost of public funds is zero, the government decides to completely privatize the USP. However, if the cost of USO transfers is positive, the government should partly, or even completely, nationalize the USP.

Figure 1
Relationship between the Optimal Privatization Level and the Political Cost of Transfers
($c = 0.5, \alpha = 0.2, \text{ and } \mu = 0$)



4 Privatization and the Size of the Reserved Area

The previous analysis has assumed that the duopolists compete in the whole country. Next, we contemplate the possibility that the government can reserve a region to the USP before firms determine their productions, $\mu > 0$. In particular, we analyze how the size of the USP's reserved area influences the optimal privatization policy. This analysis is especially relevant for the postal sector, since establishing a reserved area has been the traditional way of financing the USO.

PROPOSITION 2 *Assume that $\mu \geq 0$. When the cost of public funds is sufficiently low, the government may decide to partly privatize the USP, but this incentive is smaller when the USP's reserved area is large. When the cost of public funds is sufficiently high, the government always prefers a completely public USP.*

PROOF Consider that $\mu \geq 0$. Solving the problem of the USP and the private firm defined in section 3, we obtain the following equilibrium production levels:

$$(12) \quad x_0 = 1 - c - \frac{2[1 - (1 - \lambda)\theta - c[1 - \alpha - \theta(1 - \lambda(1 - \alpha))]]}{3 + (3\lambda - 2)\theta - \mu(1 - (1 - \lambda)\theta)},$$

$$(13) \quad x_1 = \frac{1 - (1 - \lambda)\theta - c[1 - \alpha - \theta(1 - \lambda(1 - \alpha))]}{3 + (3\lambda - 2)\theta - \mu(1 - (1 - \lambda)\theta)}.$$

Taking these quantities into account, we can show that $p = 1 - x_0 - x_1$ is not higher than the monopoly price in the reserved region. Therefore, from now on we can consider that the price in the monopoly region is the same as in the duopoly region: $p = p^R = p^D$. In order to prove this, define the product of a monopoly as

$$(14) \quad X^m = \frac{(1 - c(1 + m))(1 + \lambda\theta)}{2 - (1 - 2\lambda)\theta}.$$

Observe that for $\mu = 1$ we have $X^m = X = x_0 + x_1$, because in this case the USP is a monopoly in the whole country. Besides, it can be verified that for $0 \leq \mu < 1$ and $\theta \in (0, 1)$ we always have $X^m < X$. To sum up, we can conclude that the monopoly price is at least as high as the price in the duopoly region.

Regarding equations (12) and (13), note that for $\lambda > (\theta - 1)/\theta$, which is guaranteed for $0 \leq \theta \leq 1$, one has $\mu(1 - (1 - \lambda)\theta) > 0$. Having this in mind, $\mu > 0$ implies a smaller production of the USP and a larger production of the private firm than when $\mu = 0$.

The intuition for this result is the following: When $\mu > 0$, the USP has a monopoly for a group of consumers. In this context, the USP's managers are interested in fixing the unique price of all postage closer to the monopoly price that they would fix if $\mu = 1$. Their incentive for raising the price increases with the size of the reserved area. On the other hand, the consequence of an increase in the price is a reduction of the USP's production and an increase of the private firm's production in the duopoly area.¹⁰

Substituting the quantities in (12) and (13) into the government's welfare function and differentiating, we obtain the optimal privatization level:

$$(15) \quad \hat{\theta} = \frac{1 + (1 - \mu)\lambda - c[1 - \lambda(1 + \alpha(2 - \mu))(1 - \mu) + \alpha(5 - (5 - \mu)\mu)]}{(1 + \lambda(1 - \lambda(1 - \mu))) - c[1 + \alpha(\mu - 2)^2 - \lambda^2(1 - \alpha(\mu - 1)(\mu - 2)) + \lambda(1 - \alpha - \mu(1 - \alpha))]}.$$

It can be verified that $\hat{\theta}(\mu) = 1$ both for $\mu^*(\lambda) = 2 + 1/\lambda - ((1 - c)\lambda)/(c(1 + \lambda)\alpha)$ and for $\mu = 1$. Observe also that $\hat{\theta}(\mu) \geq 1$ for $\mu^*(\lambda) \leq \mu \leq 1$ and $\hat{\theta}(\mu) \leq 1$ for $0 \leq \mu \leq \mu^*(\lambda)$. Moreover, one has $\partial\hat{\theta}/\partial\mu|_{\mu^*} > 0$ for $0 < \lambda < \lambda^*$, where $\lambda^* = (cm + \sqrt{mc(1 - c)})/(1 - c(1 + m))$. Moreover, $\mu^*(\lambda^*) = 1$. Therefore, we can con-

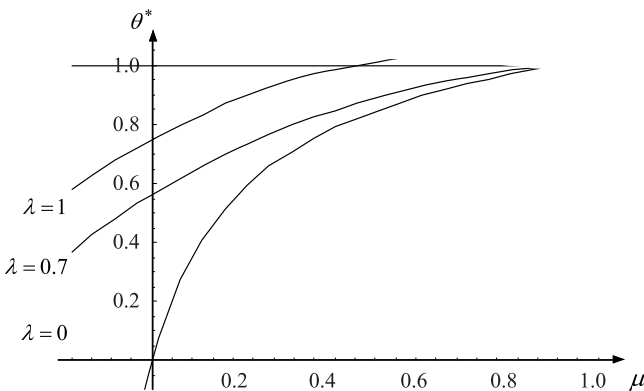
¹⁰ If the USP sets different prices in the reserved and the duopoly area, an increase of the reserved area only reduces the USP's production in this region.

clude that for $\mu \in [0, \mu^*]$ we have $\partial \hat{\theta} / \partial \mu > 0$, and for $\mu \in [\mu^*, 1]$ we are in a corner solution where $\hat{\theta} = 1$. This allows us to consider that the truncation of $\hat{\theta}$ to the unit interval gives the solution to the government's optimization problem. Formally, the optimal privatization level is $\theta^* = \min[\max(\hat{\theta}, 0), 1]$. *Q.E.D.*

The proposition shows that privatization becomes less desirable as the size of the reserved area increases. Intuitively, when a group of services are reserved to the USP, the government is less interested in privatizing, because a public monopoly guarantees greater social welfare than a private one. By contrast, when the USP's reserved area is small, privatization is more attractive, because of the assumed higher efficiency of the private firm. If the relative efficiency of the private firm is sufficiently high, the government can even decide to totally privatize the USP.

Figure 2 illustrates the government's privatization decision when the USP's marginal cost is 20% higher than those of the private firm. Observe that in this example, when $\lambda = 0$ and $\mu = 0$, the government decides to completely privatize the USP, and therefore $\theta^* = 0$. That is, the higher efficiency of the entrant is a good incentive for privatization. However, if the size of the reserved area is larger, the government prefers a smaller level of privatization. The negative relationship between privatization and the size of the reserved area appears for all values of $\lambda \geq 0$. However, in the figure it is seen that for $\lambda > 0$ the government establishes complete state ownership of the USP when $\mu < 1$. This result could be seen as an alternative illustration of Proposition 1, as it indicates that the USP's state ownership is positively related with the cost of public funds for transfers. Finally, observe that for $\mu = 1$ the government prefers a completely state-owned USP, regardless of the value of λ . Indeed, a public monopoly is always preferred to a private one.

Figure 2
Relationship between the Optimal Privatization Level and Size of the Reserved Area
($c = 0.5$ and $\alpha = 0.2$)



5 Establishment of the USP's Reserved Area

An essential aspect of the regulation of an industry is determining the scope of the USP's reserved area. In the postal sector, for example, it is believed that the authorities determine the size of the reserved area in order to guarantee the viability of the USP. However, the size of the reserved area depends on the other instruments used by the government to finance the USO (i.e., prices and transfers). In this section, we analyze the relationship between the size of the reserved area and the cost of public funds for financing USO transfers.

Imagine for simplicity that the USP has a fixed privatization level and that it is as efficient as the private operator. Next, we slightly modify our model to consider a game in two stages: firstly the government determines the size of the reserved area, and secondly the duopolists choose their production.

PROPOSITION 3 Assume that θ is fixed and $\alpha = 0$. If $\theta = 1$, the government establishes $\mu = 1$ for any value of λ . If $0 < \theta < 1$, the government establishes $\mu = 1$ if $\lambda^* > (-2 + \theta + \sqrt{4 + 4\theta - 7\theta^2})/4\theta$, and $\mu < 1$ otherwise. If $\theta = 0$, the government establishes $\mu = 1$ if $\lambda > 1/2$, and $\mu < 1$ otherwise.

PROOF From the firms' objective functions, we obtain that when $\alpha = 0$ the equilibrium productions provided by the USP and the private firm are

(16)
$$x_0 = \frac{(1 - c)[1 - \mu + \lambda\theta + (1 - \lambda)\mu\theta]}{3 - \mu - (2 - \lambda(3 - \mu) - \mu)\theta}, \quad x_1 = \frac{(1 - c)(1 - (1 - \lambda)\theta)}{3 - \mu - (2 - \lambda(3 - \mu) - \mu)\theta}.$$

Substituting these production levels into the government's welfare function and differentiating with respect to μ yields

(17)
$$\frac{\partial W}{\partial \mu} = \frac{(c - 1)^2(1 - (1 - \lambda)\theta)^2[1 + \lambda(\theta - 2) - \theta - 2\lambda^2\theta]}{(-3 + (2 - 3\lambda)\theta + \mu(1 - (1 - \lambda)\theta))^3}.$$

Observe that this derivative has a minimum for $\lambda^* = (-2 + \theta + \sqrt{4 + 4\theta - 7\theta^2})/4\theta$, where

(18)
$$\lambda^* = \begin{cases} 1/2 & \text{for } \theta = 0, \\ (0, 1/2) & \text{for } 0 < \theta < 1, \\ 0 & \text{for } \theta = 1. \end{cases}$$

Therefore, the derivative is negative for $\lambda < \lambda^*$ and positive for $\lambda > \lambda^*$. Taking this into account, we can conclude that for $\theta = 0$, we have $\partial W/\partial \mu > 0$ for $\lambda > 1/2$. For $\theta \in (0, 1)$, we have $\partial W/\partial \mu > 0$ for a value of λ^* in the range $(0, 1/2)$. Finally, for $\theta = 1$, we have $\partial W/\partial \mu > 0$ for any value $\lambda > 0$, and therefore $\mu = 1$. Q.E.D.

From Proposition 3 we conclude that when the two firms are equally efficient, the government reserves all services to the USP if it is completely state-owned. If the USP is partly or fully privatized, the government still reserves all services to the USP if the costs of USO transfers are larger than λ^* . Otherwise, it allows entry into the market.

The intuition of this result is similar to that of Proposition 1. If the costs of public funds for transfers are important, the government prefers to increase the production of the USP in order to increase its revenues and reduce the volume of transfers. One mechanism to attain this objective is the enlargement of the USP's reserved area.

The level of the costs of public funds that leads the government to create a reserve area is smaller when the USP is partly privatized than when it is completely private. The larger the level of privatization is, the larger the cost of public funds has to be to justify the reserving of all services to the USP. However, in the welfare-optimal solution, even a fully privatized USP would be granted a monopoly over all services if the costs of public funds to finance the USO were high enough.

6 *The Absence of Privatization in the Postal Sector*

The objective of this section is to discuss if the predictions of our model are adequate to explain the different privatization patterns that have been adopted by the EU since the eighties in the telecommunications, the airline, and the postal sector.

The theoretical literature on privatization shows that the differences in efficiency between public and private firms justify partial privatization. Differences in efficiency might explain privatization in the airline and the telecommunications industries in the EU, where technological changes have been important in the last decades. In addition, in these two sectors the regulation of access to essential facilities has facilitated the development of competition. For airlines, there is a complete separation between the firms that operate the airports and the airline companies. In telecommunications, the unbundling of the local loop and other access policies allow entrants to compete on the same level playing field as the incumbent's network.

In the postal sector, by contrast, the impact of technological change has been very limited. Although entrants are able to use more efficient technologies than that of the USP in some parts of the production process (sorting and transport), they still have to rely on the USP's network to deliver their letters. Moreover, the regulations of access and worksharing discounts has only been undertaken in a few countries, and only affect a small number of access services (Table 2). This situation may explain the small extent of privatization in the postal sector.¹¹

In addition to these insights, our theoretical model of the previous sections suggests a complementary way to understand the low frequency of privatization of postal firms in the EU. We have shown that when the costs of USOs are high, governments will be less prone to privatization, and this is what occurs in the postal sector. Since the beginning of the eighties, the size of the universal service in the telecommunications, airline, and postal sectors has evolved in different ways.

In the airline and the telecommunications industries, the growth of the traffic and the decrease of costs have reduced considerably the burden of universal service.

¹¹ On access regulation in the telecommunications and postal industries see LAFFONT AND TIROLE [1996], SHERMAN [2001], and BILLETTE DE VILLEMEUR et al. [2003].

Table 2
Market Share of the Incumbent Operator and Regulation of Access (2004)

	Delivery of addressed mail (%)	Delivery of unaddressed mail (%)	Regulated downstream access	Regulated upstream access
Austria	99.8	80	no	no
Belgium ^b	>98	19	no	no
Denmark	95–97	50–60	no	no
Finland	99–99.5 ^a	43.4	negotiated access to delivery points	no
France	>98 ^a	53	negotiated access to sorting centers	no
Germany ^b	94	96	access to PO boxes and sorting centers	yes
Greece	100	100	no	no
Ireland	100	50	no	no
Italy ^c	98–99	–	no	no
Luxembourg	98–99	80	no	no
Netherlands	95.8	–	acc. PO boxes, negot. access sort. centers	no
Portugal ^d	99.4	45	no	no
Spain	89.4	–	no	no
Sweden	92.9	64	acc. PO boxes, negot. access sort. centers	no
UK	99.5	–	negot. access sort. cent. and deliv. points	no

Notes: ^a Excluding newspapers. ^b The information for Belgium and Germany is for 2003. ^c Figures on Italy should be treated with caution, because very little is known about the Italian market. ^d The data about unaddressed advertising mail in Portugal have been estimated by CTT-Correios.

Source: ECORYS [2005].

Nowadays there are very few USOs in the airline industry, and they are often associated with the isolation or the insularity of some regions. Within the EU, USOs in air traffic exist in many countries, and either regional or national governments administer and subsidize USOs. In France, Germany, Italy, Spain, and Scotland regional authorities manage USOs. In Ireland, Portugal, and Sweden national authorities manage USOs (WILLIAMS AND PAGLIARI [2004]). In many cases, governments finance these obligations through budget subsidies to the airlines. In telecommunications, incumbent operators face USOs that benefit specific social groups and rural regions. In spite of this, the cost of the USO is small, and in the EU countries it has not justified any compensation to the USPs.¹²

By contrast, in the postal sector the cost of the USO is still very important. Regulations about coverage and frequency of delivery are very costly. Moreover, the present evolution of the sector does not alleviate this situation: the volume of letters delivered is decreasing, and technological progress only has a moderate impact on costs.

¹² Many developing countries in Latin America, Asia, and Africa have totally privatized the telecommunication and electricity industries, even if the costs of USO are important. However, in these countries privatization has been used to attract foreign investors, because the expansion of the service cannot be financed internally.

Finally, an important difference of the postal sector with respect to the telecommunications and airline sectors is the use of reserve services to sustain the USO. In the EU, during the nineties several telecommunications services such as basic telephony were kept temporarily under the control of the USPs in order to increase their profitability. In January of 1998, however, the European telecommunications market was completely liberalized.¹³

Concerning air travel, in the late eighties and early nineties the European Commission passed several legislative packages (1987, 1990, and 1992) intended to completely liberalize the sector. A core feature in these packages was the total suppression of legal monopolistic conditions in domestic regular flights, until then prevalent in most EU countries. All EU air companies now enjoy the same rights in any EU country. Implementation of liberalization was completed throughout the nineties, and reserved areas have disappeared.

In the postal sector, the EU current policies foresee the complete elimination of reserved areas in 2011, but at present they are the essential mechanism to finance the USP. On January of 2006, the reserved area was reduced from letters of at most 100 grams, or 3 times the public tariff for an item in the lowest weight class of the fastest category of the service, to letters of at most 50 grams, or 2.5 times the basic first-class tariff (Article 7(1) of Postal Directive 2002/39/EC). It remains to decide how the USP will be financed in the future and if this will change the state ownership of USPs. Our theoretical model shows that a big reserved area makes privatization of the USP less preferable. First of all, it would be controversial to allow a private operator to exploit a reserved area. And secondly, with a big reserved area, privatization brings about little efficiency gain.

7 Conclusions

In this paper we have analyzed the interactions between state ownership and USOs in network industries. We have explained that when the costs of using transfers to finance the USO are high, governments prefer to increase the USP's reserved area and to use the price of the service to finance the USO. In our model development, we have shown that these mechanisms provide incentives for state ownership of USPs. Moreover, we have seen that a possible problem of this policy is that it increases the profitability of some routes or services and as a result might promote the entry of inefficient firms. This, in turn, makes necessary additional increases of prices, which once again facilitate entry into the newly profitable routes.¹⁴ This phenomenon has been named by CREW AND KLEINDORDER [2000] the *graveyard spiral* and is one of the main distortions that can originate from an inadequate USO policy.

¹³ In the early nineties Ireland, Spain, Portugal, and Greece obtained a moratorium to liberalize the market five years later. The stated objective was to guarantee the expansion of the service before liberalization.

¹⁴ This problem is illustrated, for example, in COHEN et al. [2004] and CREW AND KLEINDORFER [2005].

Perhaps there are sound reasons to maintain universal service in industries like the postal service. In addition, governments have many incentives to keep the dominant operators under state control. However, this should not be an obstacle to having USOs financed in the most efficient form. Using explicit transfers from the budget can be a more efficient way to finance the USPs than distortionary instruments such as increasing the prices and creating big reserved areas. Indeed, budget subsidies are used in several EU countries in air transportation, as explained before. Certainly, however, public transfer may increase the lobbying activity of firms. It would be question of study to determine if these costs are higher than the distortions generated by the maintenance of public USPs.

Another important consequence of the USO is its influence on the decision to privatize the USP. In our view, the government's concern about the costs of public funds is one of the factors that explain the absence of privatization in the postal sector. In contrast to the case of the telecommunications and the airline industries, in the postal sector USO costs are important, and government might find it less costly to finance them through a public firm. We consider that this situation can be exacerbated when the government perceives that the society is reluctant to give transfers to the USP. This *political cost* of USO transfers, which we conjecture can be higher than the economic cost of public funds, might reflect, for example, voters' disaffection against the government, which can arise from the increase of taxes that is needed to finance the transfers. Generally, budget subsidies are much more visible and accountable than cross-subsidies through prices, so social and political control of budget subsidies can be greater. Hence, taxation can be politically more costly than cross-subsidization.

In this context, the government's reluctance to privatize, which can be due to the political cost of USO transfers, could be reduced by the creation of an independent regulatory agency in charge of monitoring the industry. An independent regulator is less concerned about the political costs of using taxes to finance transfers. Therefore, its choices will likely be closer to the optimal size of USO transfers and the optimal dimension for the reserved area. Regulators, in addition, can be less reluctant to use other mechanisms to finance the USO, such as a universal service fund or a reverse auction.

Our analysis provides useful and intuitive explanations for the slow privatization process in the postal sector. Indeed, other factors can additionally contribute to explain slow postal privatization. Nevertheless, our analysis offers a new approach to understand the interaction of privatization and universal service in network industries.

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