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Pro-competitive regulation of local public services: theory and Italian legislation

Alessandro Petretto

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DISEI, Università degli Studi di Firenze
Via delle Pandette 9, 50127 Firenze (Italia) www.disei.unifi.it

Pro-competitive regulation of local public services: theory and Italian legislation

Alessandro Petretto[1]

SUMMARY: 1. Introduction, 2. Price-Cap and quality regulation of a natural monopoly: a basic model, 3. ARERA tariff structure for environmental services, Waste and Water, 4. The sale of a public firm: the Cost-benefit test, 5. Public-private partnership for building infrastructures, 6. Local public services as productive inputs, 7. Final remarks on Pro-competitive regulation in Italy

1. Introduction

Organizing and providing public services is one of the major purposes in industrialized economies where the role of the state is significant. The public services, the local ones in particular, display widespread externalities that require precise regulatory framework with an active presence of the public administration. And this is although the production, i.e. the organization of productive factors, may be delegated to private firms.

According to Italian legislation[2], a subsidiary of a public body is a corporation which provides instruments for public administration functions and public utility services. They are named *controlled* ones if the public body holds the majority of ownership shares. Among these there are also *in-house companies*, with an over-all public capital, in some way an administrative extension of public body itself. The firms providing *local public services*, by a network technology (LPS), this paper focus, represent only the 23% of the total number but more than 60% of the added value and are governed by a separate legislation[3]. The law entails that Independent National Authorities have to carry on a Pro-competitive regulation (PCR) of these firms, aiming to conciliate the benefits in terms of efficiency due to competition and rivalry with the public interests in terms of general welfare. So, PCR admits that the two economic contexts, competition and regulation, are not contradictory. Indeed, it foresees the cooperation between National Regulatory Authority and Antitrust National Authority, inside the same markets. PCR also considers that the supply chains of LPS are industries supplying public inputs to firms in a territory, influencing by this way the productivity of whole system.

Generally, natural monopoly is the prevailing industrial configuration in these markets; hence

[1] Professor emeritus at University of Florence. I would thank for suggestions and supports Andrea Boitani, my co-author in this topic since about thirty years ago, Carlo Cambini and Lorenzo Bardelli, once best students and now successful colleagues.

[2] T.U. Dlgs 175/2016.

[3] T.U. DLgs 201/2022, deriving from art. 8 of , "annual competition law" 11/2022, requested by EU law.

PCR establishes, according to EU law, the rules for the assignment of the right to provide. It can be committed to: (i) third parties, with a selective auction as competition *for* the market[4]; (ii) mixed companies, with chosen by auction private partners; (iii) in-house companies, with a detailed justification for a non-market solution. Given its peculiarity, there is a special regulation for in-house companies dealing with services of economic nature, imposed by EU law[5].

Italian version of PCR is a two-stage one, i.e. based on the link between the National authority (ARERA, Autorità regolazione reti energia e ambiente) and the so-called EGATO ("Enti di governo degli ambiti territoriali ottimali"). The latter ones are territorial (regional) authorities, direct expression of the public bodies ("Comuni") which bear the political responsibility of the LPS provision to the users/voters.

In this paper, we concentrate to the main instruments for developing the PCR. The first one refers to the classic tariff and quality regulation. The service is managed according to a Service contract (SC), between EGATO and the selected operator. Among other things, the SC recipes the tariff Price-CAP mechanism with quality constraints, specified by the National Authority (section 2). With imperfect information, the regulation, aiming at costs minimization and a minimum level of quality, allows a limited margin to the operator designing a set of incentives and penalties. In section 3 we will particularly treat the methodology developed in Italy by ARERA for Waste and Water services.

The second instrument we analyse is the sale of a public asset, i.e. the transfer of firm ownership or of a given set of shares, for instance from the in-house to a standard subsidiary company, even still under public control. T.U. 175/2016 requires the sale when the economic activities are not necessarily functional to the public body. Therefore, we formulate in Section 4, a Cost-Benefit rule to evaluate the change in the well-being of users and the social value of the monetary transfer from private to public. The CB rule should consider the externalities, the distributive effects and the impact on the *marginal cost of public funds* regarding the sale revenue. Symmetrically, the same rule can be applied for evaluating an in-house transformation.

Thirdly, we are going to analyse the instrument of managing a public infrastructure. In section 5, we'll see the choice between two types of contracts: In the first one, a LPS operator chosen by one of the three modes according to the law, delegates to a private firm just the task of building an infrastructure, say a waste -or - energy plant, whose ownership remains to the delegating operator, in the second one there is a true partnership between the first firm and the second one. In this contract, the builder becomes also a service provider, an operator cooperating with the holder of the original

[4] Competition *in* the market takes place in sectors, such as electricity and gas distribution, where there are numerous retailers, competing in terms of price and quality.
[5] See art. 106 of the TFEU, Treaty on the Functioning of the European Union.

concession.

Finally, we argue that PCR is also an economic policy means: The provision of local public services not only affects the welfare of the inhabitants of a territory but also the production functions of firms in the territory as an added input. Consequently, in section 6, we guess that PCR improving LPS efficiency could favour the productivity of the system of firms on the territory.

2. Price-Cap and quality regulation of a natural monopoly: a basic model

When the efficient industrial configuration is only one operator, the regulation must, firstly, define the rules for a competitive auction to get the right to work as the sole operator. The competition *for* the market is obtained by a selective auction that tends to contain the initial tariff of the service. Secondly, once the management is in charge, the regulation requires to control the discretion of the operator in setting the dynamics of the tariff over time and the achievement of high level of quality.

Let define the firm profit as

$$\pi = tq - C(q, m, e) \qquad [1],$$

where tq is the revenue of tariffs, the cost function C(.) depends on the level of the service, q, the quality level, m, and a variable of effort, e, representing the incentive by the manager to improve the efficiency costs (effort). We may assume for the marginal costs the regular signs: $C_q > 0$, $C_m \geq 0$, $C_e \leq 0$. The variable quality is varying in an interval of indicators which we assume *observable* by the parties of the service contract and *verifiable* by the EGATO and the National Authority, $m_{min} \leq m \leq m_{max}$. Instead, the variable effort, lying in the interval $e_{min} \leq e \leq e_{max}$, is not observable by the two institutions but only by the manager of the firm.

The regulation works as imposing to firm profit maximization the following two constraints:

A. *Price-Cap* => $t(q) \leq t°$, (price limit)

B. Minimum quality: $m \geq m_{min}$

Therefore, the firm chooses q,m and e to

$Max\ \pi$ s.t. A and B constraints, or by maximizing the Lagrangean function:

$$\mathscr{L} = \pi - \lambda\,(t(q) - t°) + \sigma\,(m - m_{min});\ \lambda > 0 \text{ and } \sigma < 0 \qquad [2]$$

[6]

From the FOC of this maximization process we have, after some manipulation:

$$(i) \quad L = \frac{1}{\xi} + \frac{\lambda}{1-\lambda}\frac{C_q - t^{\circ}}{t^{\circ}} < \frac{1}{\xi}\ \text{, given } C_q < t° \qquad [3]$$

[6] The multipliers, in terms of duality, are $\lambda = \partial\mathscr{L}/\partial t° = \psi_t > 0$, $\sigma = \partial\mathscr{L}/\partial m_{min} = \psi_m < 0$, given the profit function $\psi(t,m,e)$.

where L is the Lerner index (mark-up), $L \equiv \frac{t(q) - C_q}{t(q)}$, and ξ the elasticity of demand $\xi \equiv \frac{q/t}{t'(q)}$.

Therefore, at the optimum it results $t(q^{\circ}) = t^{\circ} > t^{*}$, i.e. a second-best *allocative efficiency* as the mark-up is positive, then higher than that one in pure competition when L=0, with $t^* = C_q$ (the first best *allocative efficiency*), but lower than the pure monopolistic one when $L = 1/\xi$.

(ii) $C^{\circ}_m = \sigma \Rightarrow m = m_{min},$ [4]

implying a *regulated quality by standard.*[7].

(iii) $C^{\circ}_e = 0 \Rightarrow e = e_{max}$ [5]

implying *productive efficiency* as a dominant strategy of the operator.

This in theory, in practice the prevailing criterion of the price limit over time refers to the well-known formula:

$\Delta T \leq rpi - X$ [6]

where ΔT is the allowed increase of the tariff, *rpi* is the inflation rate by official Government documents and X is the share of the sector's productivity increase that benefits users by containing the tariff.

An extension of [6] is to imagine a multi-output service with two products provided by the firm. In this case, $\Delta T = \frac{t_1 q_1^0 + t_2 q_2^0}{t_1^0 q_1^0 + t_2^0 q_2^0}$ could be a Laspeyers index w.r.t. the base period 0. Therefore, the Price-cap formula appears as a constraint on revenues (*Revenue-Cap*) that the operator must comply with in choosing the corresponding tariffs for the current period, t_1 and t_2:

$R_1(t_1, t_2) \equiv t_1 q_1^0 + t_2 q_2^0 \leq \omega$ [7]

where the term $\omega \equiv (rpi - X)\,(t_1^0 q_1^0 + t_2^0 q_2^0)$ is given at time 1.

In the next section, we shall see as this Price-cap model has, in some way, inspired the tariff mechanism chosen by ARERA for the Italian environmental services.

3. ARERA tariff structure for environmental services, Waste and Water

ARERA has developed in the last years a sophisticated structure of tariff regulation, firstly for Water and then for Waste services. Both models have been changing periodically by considering more and more elements for pursuing efficiency as well as environmental and social aims[8]. Although different the two systems have common features and follow some main general principles, which are:

- *Revenue-cap*: a cap applied to revenues which are equal to computed *standardised costs,*

[7] In this case, a *Negligence Rule* of responsibility is working, i.e the firm is not sanctioned if $m > m_{min}$, if instead $m < m_{min}$ it must pay a fine. See Kaplow and Shavell (2002), Shavell (2005) for the various notions of responsibility and the application to economic analysis.

[8] Now we have, respectively, the scheme MTI-4 2024-2029 for Water service and the scheme MTR-2 2022-2025 (MTR-3 is in preparation), for Waste service [ARERA, 2022, 2024].

recognised and verified by the Authority.

- *Full cost recovery*: the revenues from tariffs cover all the cost configurations, so excluding other means for financing firm activity.
- *Asymmetric regulation*: variables tariff schemes are designed according to the specific characteristics of the firms (4 classes for Waste and 6 for Water).
- *EGATO role*: It is the holder of the service contract in each territory, so it must check the quality of the service and the volume of the realized investment. EGATO also indicates the group and therefore the regulatory scheme in which to place the operator of its territory.

Now we are going to expose some hints of the two schemes.

3.1 Waste Service

In the Waste, the total annual revenue T_a is given by the sum of the eligible costs respectively referred to variable costs, TV_a and fixed costs, TF_a, for a regulation interval of n years: $T_a = TV_a + TF_a,\ a = 1,...n.$ Variable costs (materials and personnel) are net of the proceeds from the sale of material and energy deriving from waste; a parameter defines the *sharing* of these revenues between operator and users. Fixed costs include common costs and capital use costs.

The *Revenue-Cap* places a limit on the dynamics of revenues, for asymmetrical regulation schemes, i.e. one for each type j of operator, j=1,…4, according to the different territorial and institutional contexts:

$$\frac{T_a}{T_{a-1}} \leq (1+\rho_a^j) \qquad [8]$$

$$\rho_a^j = rpi_a - X_a^j + QL_a^j + PG_a^j \qquad [9]$$

where rpi is the official inflation rate, X is the firm/user sharing factor by productivity gains, QL is the factor referring to quality improvements, PG to organizational and management perimeter changes (aggregations). X leads to a reduction in the tariff as a distribution of the efficiency gains to the user. Both QL and PG lead instead to an increase in the tariff because they cover specific costs that improve the service to users benefit (*paying tariff*). The PG and QL values define, through two intervals each, 4 tariff regulation schemes: QL = {0; ≤2%}; PG = {0; ≤3%}, depending on whether:

- there has been (or not) a qualitative improvement and
- there has been (or not) an institutional and dimensional change.

The sharing factor of the productivity increase is X= (0,1%; 0.5%).

Variable costs TV_a are the costs for uncategorised waste collection and transport plus treatment and disposal, $(CRT_a + CTS_a)$, the costs for waste sorting transport plus energy treatment and recovery, $(CRD_a + CTR_a)$, the expected costs for quality improvement and changes in the setting and scale $(CQ_{TV_a}^{\exp} + COI_{TV_a}^{\exp})$. This amount is net of the sharing of revenues from energy sales recognised by the EPR ("Extended Producer Responsibility") systems", $-b(AR_a + AR_{SC_a})$, where b is the revenue sharing coefficient. Finally, we must insert an adjustment component $RCTot_{TV_a}$ balancing the difference between the costs estimated by ARERA and the actual ones, inserted in the final financial sheet at consumptive. Hence

$$\begin{aligned} TV_a &= (CRT_a + CTS_a) + (CRD_a + CTR_a) + (CQ_{TV_a}^{\exp} + COI_{TV_a}^{\exp}) - \\ &- b(AR_a + AR_{SC_a}) + RCTot_{TV_a} \end{aligned} \qquad [10]$$

The fixed costs recognised in the tariff, TF_a, refer to sweeping and washing streets costs CSL_a, common costs, CC_a, capital costs, CK_a, and as before quality improvement components $CQ_{TF_a}^{\exp} + COI_{TF_a}^{exp}$, and an adjustment components $RCTot_{TF_a}$. Therefore

$$TF_a = CSL_a + CC_a + CK_a + CQ_{TF_a}^{\exp} + COI_{TF_a}^{exp} + RCTot_{TF_a} \qquad [11]$$

3.2 Water Service

Also, the Water tariff structure guarantees full coverage of investment and operating costs. Some components of the tariff must also cover the environmental burden in accordance with the 'Polluter pays' principle. As Waste, the Water tariff follows the dynamic *Revenue-CAP* rule, applied to revenues equal to recognised by the regulator costs.

The allowed tariff dynamics is regulated through the setting of a "price limit" that differentiates operators into 6 groups, based on three criteria:

- they are more or less lacking in terms of water infrastructure (they have a ratio between investments planned in the next 4 years and the value of assets managed that is higher (not) than a parameter Ψ) and that therefore require (or not) a greater effort to adjust the stock;
- whether or not they are undergoing industrial reorganisation (e.g. aggregations or changes in objectives or activities) which involves specific costs in the transition phases, the logic of asymmetrical incentive regulation is to allow operators in transitional framework a less rigid and binding price limit (an incentive to aggregations too);

- they achieve total costs (VRG) per capita above or below the average benchmark (obtained by the method of estimating the stochastic production frontier), and, therefore, they must (or not) make them more efficient by enlarging (or reducing) the allowed mark-up for the more efficient unity.

The EGATO will indicate the group and therefore the regulatory scheme in which to place its operator, together with parameters within the allowed intervals.

The tariff *multiplier* defined by [12] provides the allowed tariff dynamics. It is the ratio between eligible revenues per year *a,* VRG^a , and estimated total tariff revenues for the operator[9] , $tarif^{a-1}mq^{a-2}$ plus revenues from other water activities per year *a*-2, R_b^{a-2} .

$$\vartheta^a = \frac{VRG^a}{T^{a-2}} \qquad T^{a-2} \equiv tarif^{a-1}mq^{a-2} + R_b^{a-2} \qquad [12]$$

VRG^a corresponding to the sum of the recognized and admitted costs, in other words the capital costs, $Capex^a$, which includes fiscal and financial costs, the increase in new investments, $FoNI^a$, operating costs, $Opex^a$, environmental costs, ERC^a , and balanced adjustments relating to the operator's revenues, Rc^a_{Tot} [10]. Therefore,

$$VRG^a = Capex^a + FoNI^a + Opex^a + ERC^a + Rc^a_{Tot} \qquad [13]$$

The differentiated price limit per operator in each regulatory scheme, *j*=1..6, works as follows

$$\frac{\vartheta^a}{\vartheta^{a-1}} \le \Gamma^j \equiv \left[1 + rpi + (1+\gamma_{Kj})K - (1+\gamma_{Xj})X\right]; \quad j = 1,2...6 \qquad [14].$$

The parameter Γ^j establishes the growth rate of the multiplier and implicitly the *Revenue-cap*, given [12][11]. It is differentiated among operators according to the parameters associated with components *K* (planned investments compared to actual investments) and *X* (production efficiency).

For example, at scheme IV, it is

$$\Gamma^{IV} = (1+rpi) + 1.5K - X \qquad [15].$$

[9] It is obtained by multiplying the average tariff (tariff component) in *a*-1 by the quantitative component in year *a*-2, expressed in square metres produced and distributed. This is a simplification of the original MTI formula, which provides for the scalar product of the vector of the tariff components and the transposed vector of the quantitative elements of all types of users.

[10] For simplicity's sake, we have omitted the ΔCuit component relating to external investments.

[11] Precisely it is $\frac{VRG^a}{VRG^{a-1}} \le \Gamma^j \frac{T^{j,a-2}}{T^{j,a-3}}$. So, the cap on *VRG* depends also on the dynamics of past revenues. If these are increasing Γ^j is also the cap to revenues.

For the common values of the *rpi*, *K* and *X*, the need for (planned) investments, due to the infrastructural deficiency ($\gamma_K = 0.5$) lightens the constraint of the "price limit", while the mean value of the cost efficiency ($\gamma_X = 1$) maintains the "bite" of the planned sharing mechanism unchanged.

4. The sale of a public firm: the Cost-benefit test

According to the T.U. 175/2016 when a public firm is not pursuing the public interest better than a private firm could do, the public body owner should dismiss the asset. In other words, the sale on the market of the shares of a public enterprise should occur if and only if a social welfare gain is expected from the change of ownership [Boitani and Petretto (1999), Petretto (2017)]. A proxy of the gain, in the state *v*, facing a given institutional context and a given level of user's demand, can be represented as follows:

$$\Delta W(\nu) = \Delta\Phi(\nu) + \Delta\Psi(\nu) \qquad [16]$$

where $\Delta\Phi(\nu)$ represents the firm's social value change from public to private ownership and $\Delta\Psi(\nu)$ represents the social value of the revenue from sale. The former is given by the expression

$$\Delta\Phi(\nu) \equiv VS_p(\nu) - VS_g(\nu), \qquad [17]$$

Where $VSp(\nu)$ is the value for the collectivity at time t_0, of the firm, if under the control of private shareholders and $VSg(\nu)$ is the corresponding value of the firm, if remaining public. Both notions of value come from discounting the flow of expected future social direct and indirect benefits and costs computed at the shadow prices as in a standard CB procedure [Hindriks and Myles, 2013, ch. IX]. Both are given by the weighted sum of consumer and producer surpluses in the two cases. Thus, it would be as follows.

$$VS_i(\nu) \equiv S_i(\nu) + \varepsilon\,\Pi_i(\nu);\; i = p, g. \qquad [18]$$

with the distributive term $\varepsilon, 0 \leq \varepsilon \leq 1$, assigning to the public income a higher social value than to a private one.

$\Delta\Phi(\nu)$ can be positive or negative. If the ownership change is simply a shift from a public welfare maximizing monopoly to an unregulated private one, it would imply $\Delta\Phi(\nu) < 0$. If, instead, the sale is preceded by competition promotion through an independent regulation mechanism, i.e. a PCR, the gap between the two values may be reduced, even up to the change of sign.

The social value of revenue from the sale is given by

$$\Delta\Psi(\nu) \equiv -\varepsilon\Delta\Pi(\nu) + (1+\lambda)\Delta R(\nu), \qquad [19]$$

The first term of the R.H.S. is the reduction of the producer surplus bore by the private owners and is given by *P,* the sale price, going from the private to the public coffer, $-\Delta\Pi(\nu) = P,$ weighted with the distributive term $\varepsilon, 0 \leq \varepsilon \leq 1$. The second term is the increase of public surplus by the sale, $\Delta R(\nu) = P,$ evaluated at the shadow price given by the *marginal cost of public funds* (1+λ) [Dahlby 2008]. According to this, the value of one more euro is higher than one because the lump sum revenue from the sale could reduce the distortion coming from other sources to get money, like taxation. Consequently $\Delta\Psi(\nu) = (1+\lambda-\varepsilon)P$ and the social welfare change of the privatization is as follows

$$\Delta W(\nu) = (VS_p(\nu) - VS_g(\nu)) + (1+\lambda-\varepsilon)P. \quad [20]$$

Therefore, we may summarize the rule of social desirability: The sale of a public asset is convenient if the effective price $P>0$ (a negative price is not allowed) is greater than P_g, the minimum price acceptable by the state, i.e. the price at which the society is indifferent to the transaction:

$$\Delta W(\nu) > 0 \text{ if } P > \frac{VS_g(\nu) - VS_p(\nu)}{(1+\lambda-\varepsilon)} \equiv Pg. \quad [21]$$

Note that, from the previous rule, social welfare always increases, ceteris paribus, with the sale price if one more € from privatization has a value equal to the amount by which the marginal cost of public funds is higher than distributive term: $\frac{\partial \Delta W(\nu)}{\partial P} = (1+\lambda) - \varepsilon > 0$.

The seller will try to extract from the potential buyer a quite high sale price, possibly until the maximum amount she is willing to pay, P^*. This is given by the amount at which the private buyer evaluates this firm, $VP(\nu)$, the discounted value of the cash-flow net of the reward to the manager. This value, obtained by a purely private calculus, differs from both the firm's values $VS_p(\nu)$ and $VS_g(\nu)$, which, as seen, consider also a social evaluation.

Thus, the maximum welfare increase from the sale to a potential buyer is:

$$\Delta W^*(\nu) = VS_p(\nu) - VS_g(\nu) + (1+\lambda-\varepsilon)VP(\nu) \quad [22]$$

Then, the maximum welfare increase, measured in terms of fiscal revenue increase, is given by the relative difference between the maximum and the minimum price:

$$\frac{\Delta W^*(\nu)}{\Delta\Psi(\nu)} = \frac{P^* - Pg}{P}. \quad [23]$$

The dimension of the *beneficial sale price interval*: $Pg \leq P \leq P^*$, is indeterminate as it depends on the context of the regulation. A PCR should assure a buyer giving an ex-post higher social value, $VS_p(\nu)$, and thus a lower P_g with a reduction of the lower limit of the beneficial sale price interval. However, also P* will be lower with the dissipation of all expected extra profits and then the upper limit of the interval.

5. **Public-private partnership for building infrastructures**

Let a public multi-utility firm decide to build an infrastructure, like a tramway network, a regional gas transportation network, an incinerator plant or a wastewater drainage plant. How to build it? By a separate contract by which the multi-utility delegates to a private firm just the task of building the infrastructure or by a contract specifying a true partnership between it and the builder, so by a Private-public partnership (P-P-P)? In the latter contract, often named as *Project financing,* the builder is also the service provider, a specialized operator, while in the former it is only a building constructor, and the multi-utility provides the service by itself.

The choice of the best mode is meaningful only if we face incomplete contracts, otherwise, with complete contracts, the two alternatives would be indifferent[12]. The incompleteness here derives from the limited observability and verifiability of some innovations that can be carried out after signing the contract.

Hart (2003) models this situation by a sequential game, where, in the first stage, there is the building of the infrastructure and, in the second stage, the service is operating (e.g. the typical phases of waste disposal). After the contract, it is possible to do two types of innovations, or investments. The first one, *i*, is defined as *productive investment* because it increases the quality while containing the operating costs of producing the service. The second innovation, *e*, is named as *unproductive investment* because it reduces the operating costs but also damages the quality of the service.

Let the benefit function from the facility be given as follows:

$$B = B_0 + \beta(i) - b(e); \; \beta'(i) > 0, b'(e) > 0 \qquad [24]$$

And the function of the operating cost of the service:

$$C = C_0 - \gamma(i) - c(e); \quad \gamma'(i) > 0, c'(e) > 0 \qquad [25].$$

The First best, complete contract, situation is designed on picking up $i \geq 0, e \geq 0$ to max

$$\begin{aligned} &B - C - i - e = \\ &= B_0 + \beta(i) - b(e) - C_0 + \gamma(i) + c(e) - i - e. \end{aligned} \qquad [26]$$

The F.O.C.s are:

$$\begin{aligned} &\beta'(i^*) + \gamma'(i^*) = 1, \\ &c'(e^*) - b'(e^*) \leq 1 \end{aligned} \qquad [27]$$

The first condition of [27] implies that at the optimum $i^*>0$, i.e. the social productive investment is positive, while the second one implies a corner solution, $e^*=0$[13]. At the First best, all we

[12] There is a long literature on the link between contract theory and regulation theory. See e.g. Laffont and Tirole (1993), Aghion and Holden (2011), Bolton and Dewatripont (2005).

[13] The unproductive investment is zero at the optimum as we suppose that the condition is satisfied at the origin, $c'(0) - b'(0) \leq 1,$ so there is no need to increase *e* over 0.

need is only a productive investment, being able to both increase quality and reduce costs. i^* will be written in the contract.

Now let us consider the case of a separate incomplete contract just to build, or "unbundling", at a fixed remuneration P_0. The builder builds the infrastructure at the cheapest cost, while staying within the terms of the contract; innovations, if any, would be made after the contract. However, the builder would choose i and e to maximize (P_0–i-e), so $\hat{i} = \hat{e} = 0$, i.e. no innovations are developed even after the contract, as the builder cannot appropriate in some way the benefits of them. Thus, the best the entrusting body can do is to write a good contract with many specifications about the *plant quality*.

Let us now consider the P-P-P, "bundling", case. Now the builder, being a provider too, chooses i and e to max:

$$\left[P_0 - C_0 + \gamma(i) + c(e) - i - e\right] \qquad [28]$$

Notice as the benefit function [24] does not enter the builder-operator payoff [28].

The F.O.C s are

$$\gamma'(\bar{i}) = 1, \quad c'(\bar{e}) = 1. \qquad [29]$$

They imply $\bar{i} > 0, \bar{e} > 0$. Therefore, by comparing the two cases we have $\bar{i} > \hat{i} = 0$; $\bar{i} < i^*$ and $\bar{e} > e^* = \hat{e} = 0$, so both innovations are higher in the bundling case than in the unbundling one, but the productive investment is lower than in FB case and the unproductive higher.

The conclusion is that in the unbundling case, the builder is not boosted to invest in either investment. She under-invests w.r.t. the benchmark because she cannot internalize quality improvements and operating cost reductions. Therefore, the unbundling contract is carried out only if the *quality of the building* can be well specified and ex-post checked and verified by the entrusting administration at low costs. In this case, the innovations are in some sense almost superfluous. In P-P-P bundling case, the builder-operator can internalize the costs reduction by both investments, and does not internalize either quality improvement or quality reduction, so, w.r.t. the benchmark, she over-invests in e and under-invests in i. This contract is carried out only if the *quality of the service* can be well specified in the initial statement, so there are good performance measures which can be used to reward or penalize the service provider. Instead, it is the building quality to be not well specified.

In case of the infrastructures in environmental LPS (specifically Water) the P-P-P could be the preferred contract of the two. Private shareholders could bring greater operational efficiency thanks to the experience gained in the field in other contexts, greater availability of capital, thanks to the contribution of financial resources that are difficult to find independently by the operator, particularly when the debt lever has been exhausted and a greater drive for innovation through the introduction of new techniques that can improve the quality of the service. Finally, the risk motive, as with P-P-P, the public operator passes on most of the risk of the investment returns to the private proposer [Ref 2025].

6. Local public services as productive inputs

LPS are instruments for increasing the productivity of private factors, labour and capital, both directly, when they are rival and excludable (*private goods*), in which case the costs are represented by tariffs, and indirectly through non-excludable services although rival ones (*common goods*). Sometimes, the services related to these activities in the area are non-rival and non-excludable (*pure public goods*), such as the environmental implications of interventions for the protection of natural resources and as an application of the circular economy for waste, purification and sewerage.

A simple analytical model helps to understand how the causal relationship LPS-firm productivity is realized. We elaborate on the one proposed by Giordano et *al.* (2020) which, in turn, simplifies those by Barro (1990) and others [Irmen and Kuehnel (2009)].

$$y_{ij} = A_{ij} l_{ij}^{1-\alpha} k_{ij}^{\alpha} (\frac{\xi_j G}{n})^{\alpha} \qquad [30]$$

[30] is a Cobb-Douglas production function of the representative firm i in territory j (metropolitan area or province), whose production depends on exogenous technical progress, A_{ij}, private capital, k_{ij} and labour, l_{ij}. G is the input represented by the access at a public asset, an infrastructure managed by a public (or private regulated) enterprise in j, allowed to n firms operating in a larger regional area[14]. It can be, say, an aqueduct, a disposal plant, a tramway, but also social goods, like education. The parameter $\xi j \leq 1$ indicates the efficiency of the public service input in the territory, an exogenous variable of economic policy. The efficiency of these activities can be ascertained by controlling the quantity levels of supply, the production costs, the economies of scale and/or scope, and the provision quality.[15]

The production function [30] can be simplified, without loss of generality by considering capital input as fixed, i.e. $k_{ij} = 1$. This makes it possible to identify with $\alpha<1$ the weight in terms of elasticity of public input compared to private input, an indicator of relative importance of the role of the public sector.

[14] Notice that if the number of users is higher than that on the metropolitan area j, e.g. a region, it means that the service is not a *club good*, but somewhat a public one.
[15] The stochastic frontiers and DEA methods are widely applied in the literature to make international comparisons of public sector efficiency. See e.g. Afonso et *al*. (2005) and European Commission (2008).

$$y_{ij} = A_{ij} l_{ij}^{1-\alpha} (\xi_j G / n)^{\alpha} \quad [31]$$

From this we may derive the functions of *average* and *marginal productivity* of the private input l_{ij}

$$APL_{ij} = A_{ij} l_{ij}^{-\alpha} (\xi_j G / n)^{\alpha} = A_{ij} (\frac{\xi_j G}{nl_{ij}})^{\alpha} \quad [32]$$

$$MPL_{ij} = A_{ij}(1-\alpha) l_{ij}^{-\frac{\alpha}{1-\alpha}} (\xi_j G / n)^{\alpha} = A_{ij}(1-\alpha)\left(\frac{\xi_j G}{nl_{ij}^{\frac{1}{1-\alpha}}}\right)^{\alpha} \quad [33]$$

Now, both APL and MPL, for a given level of public service, are increasing in ξ_j, i.e. the efficiency of the public service provided in area j: $\frac{\partial APL_{ij}}{\partial \xi_j} > 0, \frac{\partial MPL_{ij}}{\partial \xi_j} > 0$.

Giordano et *al*. (2020) measured the impact of the efficiency of public services on the productivity of firms in a provincial area, by estimating with a panel model a function that has as a dependent variable the productivity of firm *i*, in sector *s* and in province *p*, $Y_{ips.}$ The crucial hypothesis to be tested is that the productivity of firms in the sectors that are most dependent on the inputs provided by public services are those that "gain" ("lose") the most from the efficiency (inefficiency) of the latter; i.e., formally, the increase in labour productivity as the parameter ξ_j increases with the elasticity of the public input α, so $\frac{\partial^2 ATL_{ij}}{\partial \xi_j \partial \alpha} > 0.$ As examples of sectors particularly influenced by public service inputs (α high) we can mention the waste service w.r.t. fashion sectors, such as leather goods and footwear. An area in which the removal system is not efficient, in which there is no recycling market that allows a significant amount of waste to be recovered and transformed, limiting the amount to be sent for disposal, and finally the absence of high-tech plants that avoid resorting to landfilling, does not support the needed recovery of the sector.

In Giordano et *al.* (2020) the productivity depends on some control variables too, in the form of dimensional indicators (larger firms are usually more productive), $X_{isp},$ as well as on the set of fixed factors of sector α_s and province α_p, as well as on the term error, ε_{isp}.

$$Y_{isp} = \beta\, Z_{isp} + \gamma X_{isp} + \alpha_p + \alpha_s + \varepsilon_{isp} \quad [34]$$

where $Z_{isp} \equiv GovDep_{is} * GovEff_{ip}$ is a composite index as $GovDep_{is}$ and $GovEff_{ip}$ are calculated indicators of respectively dependency and efficiency [see e.g. Giordano and Tomassino (2013)]. Thus, β captures the effect of LPS efficiency on firm's productivity. Estimates show on average a higher effect in the sectors most "dependent" on the public and, in general, in the provinces and districts with the highest efficiency level of the public sector. Indeed, Z_{isp} is significant at 1% for the indicators *output/labour costs*, *output/worker*, *GVA/worker,* at a relevant mean value of β, with peaks in some sectors and provinces.

7. Final remarks on Pro-competitive regulation in Italy

Local Public Services have a relevant impact on the welfare of users and of all the inhabitants of a territory. The production of these services affects also the system of firms, especially medium and small manufacturing, as productive inputs. It is not far-fetched to say that the average inefficiency of these activities has been one of the reasons for the low productivity dynamics in Italy. Throughout the decades at the turn of the century, public service enterprises have been characterized by a noticeable fragmentation, a governance not consistent with the entrepreneurship required by the pressure of technological innovation, a lack of awareness of the industrial nature of these activities and a consequent lack of investment volumes, noticeably in waste and water services.

In this paper we argue that a Pro-competitive regulation of local public services can provide an institutional framework for achieving not only the standard objectives of cost efficiency and high quality but also the social and environmental ones. A legislative scheme consistent with this PCR policy is designed in LD 201/2022, a law in application of the 2022 Annual Law on Competition and the European legislation. We mean that the principles there defined, if applied throughout the national territory, would raise the levels of efficiency and sustainability of the system of LPS firms. In particular, the incentive mechanism for environmental services, designed and implemented in the last years by the independent national Authority, ARERA, could produce widespread positive effects.

In this regard, ARERA has built an econometric model measuring the relative distance of the various water service operators from the standard cost frontier (average or minimum) using the criterion of stochastic cost frontiers. The results highlight a significant loss of aggregate efficiency but with much territorial variability, due to the high deformity of institutional structures and sizes [Ref Research Laboratory (2023, 2025)]. However, the struggle to the reform process is strong and widespread. The slow application of the new regulation model is going to divide the country between a Centre-North projected, with some major players, towards European levels of performance and a South still restrained in outdated governance schemes.

These considerations can outline some useful economic policies: first, by defending and by strengthening the independence and powers of the national regulatory authority, with the tariff schemes developed over the years; second, by consolidating the role of the EGATOs, as a link between ARERA and the local public bodies, by providing them with adequate resources (with the substitutive powers of the Region for defaulter local public bodies); third, by favouring public-private partnerships for acquiring resources to investments in plants and networks and for developing essential parallel markets (e.g. the recycling one); finally, by removing the ideological barriers to some corporate forms of the operators (e.g. the quoted companies with possibly a share of stocks in private hands).

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