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INCOME EFFECTS AND CONSUMER DEMAND IN THE ERA OF PRIVATIZATION

Lorenzo Matteo Bianchi
Department of Economics and Management, Università degli Studi di Ferrara, Ferrara, Italy
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Abstract: The question raised in this paper is whether and how some core features of income distribution, e.g. the income levels or income inequality, should be relevant in the decision to privatize public firms. The paper provides a first answer in the framework of mixed oligopoly theory. In particular, we show that the scope for privatization is widened when the market is poorer, and when incomes become more concentrated. These unexpected results are accounted for in terms of the way distributional shocks alter the allocative inefficiency of imperfectly competitive markets.

Keywords Mixed oligopoly · Income distribution · Privatization

1 Introduction

The key question raised by this paper is whether and how the core features of income distribution and market demand should be relevant in the governments' decision to privatize public firms. In particular, this is the first attempt to address this issue in the perspective of the mixed oligopoly theory, which can be considered as the standard theoretical framework for the analysis of the strategic behaviour of the public sector in non-competitive markets. The relation between privatizations and the distribution of income and wealth has been a issue of great concern both in the political and in the scientific debate on the role of government in market economies. In particular, in the last decades there has been a widespread attention to the relationship between privatizations and income inequality: following the worldwide wave of privatizations started in the Eighties, a large body of empirical literature has investigated the impact of privatizations on inequality of income and wealth in the Western world, as well as in developing and transition economies (e.g. Birdsall and Nellis 2003; Kikeri and Nellis 2004; PenaMiguel and Cuadrado-Ballesteros 2021). While the findings of these papers differ as different countries or different economic sectors are investigated, all share a focus on the *ex-post* effect of privatizations on the inequality of incomes and/or wealth. This paper looks at the relation between privatization and income distribution from a different perspective: we do not concentrate on distributional features as a consequence of privatization, but rather as part of the key economic determinants of the decisions to privatize. In a sense, we see income distribution as one of the factors which determine the desirability of privatization, and we investigate this relation in a microeconomic perspective and in the partial equilibrium framework of mixed oligopoly. Framing our analysis in the mixed oligopoly setup is conceptually challenging, as in this context the demand side is typically tailored to assume away income effects. The main positive implication of this modelling strategy is that it allows a simple money-metric definition of the social welfare as the sum of the profits and the consumers' surplus – the latter being indeed an ideal measure of consumers' welfare if income effects are ruled out.

However, this analytical neatness comes at a cost: that of dismissing the possible role of the distribution of income in such key matters as the evaluation of the welfare gains obtained by the government through the public firm's activity, and the desirability of privatizations. Moreover, the markets in which public firms are typically active – health, education, transports, energy provision, just to quote some – can hardly be thought of as free from income effects. In order to allow for demand and income effects in the analysis of mixed markets, we revisit some early contributions in the theory of mixed oligopoly, by reformulating the demand side of the market as the outcome of the binary choice of a population of consumers, assumed to be heterogeneous with respect to income. The assumption of unit demand and binary choice, though admittedly applicable to a limited set of markets, has the advantage of establishing an immediate link between the shape of consumers' heterogeneity and that of market demand; at the same time, it preserves the possibility to quantify the consumers' welfare through the consumers' surplus. Given this general specification of the demand side, we then investigate the way in which changes in the distribution of the reservation prices – which we interpret as ultimately related to changes in the distribution of incomes – affect the range of situations in which privatization turns out to be desirable. In order to focus on the basic mechanisms of the mixed oligopoly models, we consider a simple Cournotian market with homogeneous product, where R&D, externalities, or international trade play no role. Our references are the seminal papers by De Fraja and Delbono (1989) and De Fraja (1991): in the former, firms produce under convex costs and the scope for privatization is defined in terms of the number of private firms active in the market – a fully private market being more efficient than a mixed market if the number of firms is sufficiently high; in the latter, the firms' technologies are assumed to be linear and the scope for privatization is defined in terms of the public firm's average cost, which is a priori assumed to be higher than that of the private competitors. We introduce in these models two distributional shocks, which can be thought of as very simple stylized examples of first and second order stochastic dominance, and we obtain the rather counter-intuitive result that the range of situations in which privatization is welfare enhancing widens both as the consumers become poorer, and as the consumers' incomes become more concentrated. We explain our results in terms of the size and elasticity effects of the changes in market demand, prompted by the associated changes in the distribution of income. In this way we try and extend to the mixed market case the idea that demand plays a relevant role in shaping competitiveness and market structure. The paper is organized as follows. The basic structure of the model is discussed in Section 2. The effects of the distributional shocks are analysed in Section 3, where we first concentrate on a generalized income increase, and then on a reduction of the variance of the incomes and reservation prices. We also provide some reflections on the role of the assumed objective function of the public firm. In Section 4 we gather some final remarks and conclusions.

2 A general Cournot model with consumers' binary choice

We consider a Cournotian market for a homogeneous product, where $n+1$ firms compete strategically. In this market two different ownership configurations are possible. The first is associated with a mixed oligopoly structure, in which one of the firms (indexed by 0) is publicly-owned and competes with n private firms. The latter are identical, their cost function being $C_0'(q_0) > C_0''(q_0) \geqslant C(q_i)$, with $C(q_i)>0$ and

$C(qi0)(\geqslant 0)0$ for $i = 1,\ldots,n$, while the public firm's technology implies the cost function $C\,q$, with $C(q)$ 0 and $C(q)$ 0. The second configuration is that of a fully pri(i) vate market, with n+1 identical private firms characterized by the $C\,q$ function,
$i = 0,\ldots,n$, described above.
On the demand side of this market each consumer is endowed with a utility function of the following type:
$U = y - p$ if she purchases a unit of the good
$U = 0$ if she does not purchase
Where p is the price of the good and y is the consumer's reservation price. Hence, the consumer enters the market and buys one unit of the good whenever her reservation price is higher than the market price. Consumers differ across their reservation prices – a heterogeneity which reflects the differences in their purchasing power, i.e. the personal distribution of incomes. We assume that y is defined over the interval $[0,y]$, and distributed according to a continuous differentiable density function $f(y)$, so that utility maximization generates the following market demand function:
$Q(p) = 1 - F(p)$
Where $F_{(p)} = \int_0^p f(y)dy$ and the population of consumers has been normalized to 1.
Under our binary choice hypothesis, the direct market demand $Q(p)$ exhibits a straightforward link with the distribution of the reservation prices and, ultimately, of incomes. In order to describe the Cournotian interaction between firms making use of a direct demand function, we follow the solution procedure suggested by Kreps (1990, ch. 10), i.e. we assume that firms compete indeed with respect to prices, but under the Cournot conjectures that the rivals will keep their sold quantity fixed. When setting its desired price, each firm does not evaluate the consequences of its decisions under the assumption that the rivals' price is kept constant - which would lead to a Bertrand type equilibrium. Rather, it assumes that the rivals' prices are changed in such a way as to keep their sold quantity constant – a conjecture which allows for price-setting being consistent with a Cournot type equilibrium. Given this very simple description of the demand and supply sides of the market, we proceed by sketching the Cournot-Nash equilibrium solutions both in the mixed oligopoly, and in the fully private case. *The mixed oligopoly*. If the market exhibits a mixed oligopoly structure, a welfare maximizing public firm interacts with n profit maximizing private firms. Given the market demand and costs functions described above, the social welfare (the sum of consumers' surplus and profits) can be written as

$$WM_{(p)} = \int_p^{\bar{y}} Q(z)dz + pQ(p) - C_0\left(Q(p) - \sum_{i=1}^{n} q_i\right) - \sum_{i=1}^{n} C(q_i) \qquad (1)$$

where the first term is the net consumers' surplus, the second gives aggregate revenues, and the other two terms are the total costs of the public and private firms, respectively. The objective function of the generic *i-th* private firm is the following profit function:
$\pi_i(p) = p(Q(p) - q0 - \sum j \neq i\ q_j) - c(Q(p) - q0 - \sum j \neq i\ q_j)$ (2)

The way in which the welfare and profit function (1) and (2) have been written highlights the key implications of the Cournot conjectures in a price-setting framework: through its objective function maximization, each firm determines its desired market price, by assuming that the quantity produced by its rivals is kept constant, i.e. by assuming that price changes affect only its own quantity, and therefore that the changes in the latter coincide with the changes in aggregate demand.

The public firm maximizes the welfare function (1) with respect to p, assuming that all q_i , $i = 1,\ldots,n$, are kept constant; this yields

$p=C_0^{\bullet}(q_0)$, (3)

the standard interpretation of which is that for given quantities of the private firms, the public firm produces that quantity q_0 such that the market price equates its marginal cost, $j \neq C_0(q_0)$. Consider now the generic *i-th* private firm. For given q_0 and given q , $j\ i$, profit maximization with respect to p yields

$$\left(Q(p)-q_0-\sum_{j\neq i}q_j\right)+p\frac{dQ}{dp}-C'\left(Q(p)-q_0-\sum_{j\neq i}q_j\right)dQ$$

$= 0\ dp$ Recalling that $dQ/dp = -f(p)$, the above can be written as

$$\overline{q_i}-(p-C'(q_i))f(p)=0$$

$q = q$

Since all private firms are identical, $_i$ for all i and this boils down to

$$q\ (\quad)=p-C^{\bullet}(q)\,f(p) \qquad (4)$$

$(\bullet)$

Once the shape of the density f and the properties of the cost functions are specified, eqs. (3) and (4) along with $Q(p) = q_0 + nq$ explicitly determine the equilibrium values of q_0 , q and p.

The fully private market. If all the $n+1$ firms are private – a situation which we interpret as the outcome of a policy of privatization of the public firm – the welfare function is

$y \qquad n$

$=0 \qquad\qquad j\neq i$

$$W^P(p)=\int_p Q(z)dz+pQ(p)-\sum C(Q(p)-q_0-\sum q_j) \quad (1')i$$

The first order condition for profit maximization evaluated under symmetry ($q_i = q = Q_n + (p1)$ for $i = 0,\ldots,n$) implies

$$\overline{Q(p)} = \left(p-C'\left(\frac{Q(p)}{n+1}\right)\right)$$

$n+1 f(p) \qquad (5)$

Once the shape of the density $f(\cdot)$ and the properties of the cost function are specified, eq. (5) along with $q = Q(p)/(n+1)$ explicitly determine the equilibrium values of q and p.

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3 The scope for privatization and the distribution of income

As highlighted in the early literature on mixed oligopoly and privatization, in the above basic setup the only rationale for a welfare enhancing privatization is the existence of a cost inefficiency on the public firm side. This can be traced back either to differences in technology, as in De Fraja (1991), henceforth DF, or to the firms' different strategic behaviour, as in De Fraja and Delbono (1989) , henceforth DFD. In particular, for the purposes of our analysis we can rule out the existence of fixed costs, and synthesize the DF assumptions in the following cost functions for the public and private firms, respectively:

$C_0(q_0)=c_0q_0$ (6 a)

$C(q_i)=cq_i$ (6 b)

with $c_0 > c$. An implication of this exogenous cost differential is that there exists a threshold value of the relative inefficiency of the public firm ($c_0 - c$), such that privatization turns out to be welfare enhancing beyond that value.

Alternatively, DFD assume a common convex (quadratic) cost function for both types of firms:

$C(q_i)= 2\,k\,q^2_i\; i = 0,\ldots,n + 1\; k > 0$ (6 c)

In this case, it is the higher production level implied by welfare maximization that generates higher marginal and average costs for the public firm. The higher overall production observed in a mixed market is therefore associated to an inefficiently unequal distribution of costs among firms. Privatization of the public firm turns out to be beneficial, if this inefficiency outweighs the beneficial effects of expanding output – which actually occurs when the number of the rival private firms n is sufficiently high.

Our modeling the demand side of the market as strictly connected to the distribution of income, allows us to establish a link between the properties of the latter and the range of situations in which privatization is desirable. In particular, in what follows we study the way in which changes in the income distribution affect the threshold value of the cost inefficiency ($c_0 - c$) in the DF model, and the threshold value of n in the DFD model. In order to keep tractability, we proceed with simple examples, by comparing the solutions of both models for different basic distributions of the reservation prices, which can be ranked according to a first or second order stochastic dominance criterion. To start with, in subsection 3.1 we examine the effects of a generalized income increase, formalized in terms of an increase of the upper bound y of the support of a uniform distribution. In subsection 3.2 we study the effects of income concentration, through the comparison of the solutions under a uniform and a quadratic Beta distribution. Through these analyses we try to offer a first insight on the general issue of the role and desirability of public ownership under different distributional patterns.

3.1 The case of a generalized income increase

We start by assuming that the distribution $f(y)$ of the reservation prices is uniform over the support $[0,y]$. Therefore, we have

$$(p) = \frac{1}{\bar{y}},\ F(p) = \int_0^p \frac{1}{\bar{y}}\ p\,fdx = \frac{}{\bar{y}},$$

such that y is a parameter of first order stochastic dominance. The resulting market demand function is

$$Q(p) = 1 - \frac{p}{y} \quad (7)$$

The DF model. Normalizing $c=0$ in (6b), the inefficiency of the public firm is fully captured by c_0 . In the mixed market, the reaction functions (3) and (4) become

$$p^{MDF} = \frac{c_0}{2} \quad ((3a) \text{ and } (4a))$$

$$q^{MDF} = \frac{1}{2} - \frac{c_0}{2y}$$

where the the superscript M denotes the mixed market. Using the assumptions (6a), (6b) and (7) in (1), and substituting (3a) and (4a), we obtain the equilibrium value of welfare in the mixed market:

$$W^{DFM} = y - \frac{c_0}{2} + \frac{2c_0^2}{n} \quad (8)$$

Footnote 7 (Continued) evant market configurations.

If the market is fully private, denoted with the superscript P, the first order condition (5) implies

$$p^{PDF} = \frac{y}{n+2} \quad ((5a))$$

Under (6a), (6b) and (7), substituting (5a) into (1') yields the equilibrium value of welfare in the fully privatized case:

$$W^{DF} = \frac{y}{2} \frac{(n+4)}{(n+2)^2} \quad (9)$$

Our threshold value of c_0 can of course be recovered by equating (8) and (9):

$$c_0^* = \frac{y}{2n+1}\left[(n+2)^2 - \sqrt{n^4 + 8n^3 + 24n^2 + 30n + 15}\right] \quad (10)$$

Equation (10) shows that c_0^* is decreasing in n and linearly increasing in y . Though analytically trivial, this result conveys a noteworthy message: the richer the market, the wider the scope for public ownership and the narrower that for privatization. As consumers become richer, market demand increases for all prices and the market welfare potential enlarges. In a mixed market the price remains unchanged; by contrast, in a fully privatized market the price increases whenever (as in this example) higher demand is associated with a lower demand elasticity. Hence, our first order stochastic dominance shock on incomes magnifies the regulatory impact of the public firm, with the related increase of the threshold value of c_0.

The DFD model. If all firms, private and public, share the same cost function (6c), then the reaction functions (3) and (4) become

$$p^{y} = k\left(1 - \frac{q}{y} - nq\right)$$

$$q = \frac{1}{2}(p - kq) \quad ((3b) \text{ and } (4b))$$

which yield

$pMDFD = \left(\frac{y+k}{2}\right)^2 - ky + kny$ (11)

$qMDFD = (y+k) + kny$ (12)

Using (6c) and (7) into (1), and substituting (11) and (12) we get the equilibrium value of welfare in the mixed market

$$W = DFDM = y^2(1+n)k^3 + (3(+(4n+n)2^2)yk^2 +) (2\,3+2n)y^2k + y^3 \quad (13)$$

$$2\,y+k + kny$$

If the market is fully private, equation (5) becomes

$$n+11(1-py)=(p-k(n+11(1-py)))1y \quad (14)$$

solving which gives

$$pPDFD = \left(\frac{y+k}{y(2+n)+k}\right)\,y \quad (15)$$

Substituting (14) into (1') under assumptions (6c) and (7) gives the value of welfare in the fully private market

$$WDFD = 2\,(n+1)(y(2+n)+k)-2 \quad (16)$$

The threshold value of n above which privatization is welfare enhancing is obtained by equating (13) and (15) , and is given by

$$n^* = \frac{\sqrt{4y^3k + 13y^2k^2 + 12yk^3 + 4k^4 - ky}}{2ky}$$

Which is actually increasing in y , so long as $k<y/2$.

The intuition for this result is again based on the interplay between the demand and cost factors underlying the privatization decisions. Indeed, in this model a generalized increase in income has a twofold effect on the desirability of privatization. On the one hand, similarly to the DF case, with higher demand and lower demand elasticity the positive impact of the public firm, in terms of exploiting the higher welfare potential and lowering the market price, is magnified. On the other hand, the shape of the cost function is such that the increase in y brings about an increase in the imbalance in the distribution of costs, which in principle strengthens the case for a fully private market. For low values of k (flat cost curves), the first effect prevails and the threshold value of n increases: the positive demand shock enlarges the range of cases in which the fully private configuration is dominated by the mixed one. As k increases, the first effect weakens, due to the equilibrium prices (11) and (14) getting closer, while the second effect is reinforced, as the cost differential increases – yielding in the end a reversal of the overall effect of y on n^* , for $k>y/2$.

To sum up, both models show that it is more likely for a market to benefit from the privatization of a public firm, if the market itself is 'poor'. Indeed, if the socalled Robinson effect is at work, i.e. if demand and demand elasticity are negatively related, the lower is the consumers' willingness to pay, the closer is the fully private solution to allocative efficiency – which makes more desirable to do away with the cost inefficiency directly or indirectly associated to public ownership. We now turn our attention to a different distributive shock, namely an increase in income concentration.

3.2 The case of income concentration

In order to study the effect of changes in the concentration of income across consumers, we analyse the way in which the relevant threshold values of the two models are altered by a shift from a uniform distribution to a symmetric quadratic Beta density function. The relation between these two distributions is of second order stochastic dominance, the uniform distribution being a mean preserving spread of the symmetric Beta. Both distributions are defined over the support [0,1].

Given the symmetric quadratic Beta distribution

$$f(p) = 6p(1-p),\ F(p) = \int_0^p 6x(1-x)dx = 3p^2 - 2p^3 \qquad (17)$$

the market demand is

$$Q(p) = 1+2p^3-3p^2 \qquad (18)$$

The DF model. Under the same assumptions on (6a) and (6b) of subsection 3.1, if the market demand is given by (7b), then the equations (3a) and (4a) of the mixed market case become

$$pMDF = c_0 \quad \square qMDF = 6c_20(1-c_0) \qquad (19)$$

where (3c) coincides with (3a) and is repeated here for convenience, and the ~ denotes the value of the relevant variables under the Beta distribution. Therefore, the corresponding equilibrium value of welfare in the mixed market is

$$W^{\square}{}_{DF}{}^{M} = \frac{1}{2} - c_0 + (1+6n)c^3{}_0 - (\frac{1}{2} + 6n)c^4{}_0 \qquad (20)$$

In the fully private case, demand being given by (7b) implies the first order condition

$$\frac{n}{n+1}\left(1+2p^3-3p^2\right) = 6p^2(1-p)$$

and the equilibrium price

$$PDF = \frac{1+\sqrt{33+24n}}{2(8+6n)}$$

The equilibrium value of welfare is therefore $\square_{DF}{}^{P}$

$$W = \frac{4}{1+\sqrt{33+24n}} + \frac{3}{-2}\left(\frac{1+\sqrt{33+24n}}{2(8+6n)}\right)^2 - \frac{1}{2}\left(\frac{1+\sqrt{33+24n}}{2(8+6n)}\right)^3$$

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The value of $\tilde{c}_0^*$ beyond which privatization is desirable under the Beta distribution is given by equating (16) and (18). The solution for different values of n is obtained numerically. In Table 1 we compare these values of $\tilde{c}_0^*$ with those given by eq. (10), i.e. c^*_0 under the uniform distribution with y=1.

The Table shows that for $n<7$ the higher income concentration associated with the Beta distribution implies a reduction in the threshold value of c_0 : income concentration widens the range of situations in which privatization is welfare enhancing. For $n\geq 7$, the opposite occurs. This pattern can be explained with reference to the effects of the distributive shock on the demand side of the market, shown in Fig. 1. As we move from the uniform to the Beta distribution, we observe the demand effect, according to which the demand constraint perceived by the firms is relaxed (tightened) for $p<(>)1/2$; the size effect, according to which for any positive price under the Beta distribution the maximum possible welfare is lower; and the elasticity effect, with market demand elasticity increasing (decreasing) for $p>(<)1/4$.

The size effect unambiguously reduces the relative advantage in terms of welfare of the presence of a public firm. As far as the demand and demand elasticity effects are concerned, it can be checked that for $n\leq 2$, as incomes become more concentrated, firms perceive an increase in demand coupled with an increase in demand elasticity; the fully private market outcome is closer to allocative efficiency, and this reinforces the size effect in reducing the scope for public ownership. As n increases, the elasticity effect is reversed, and the increase in demand is accompanied by a reduction in elasticity. This partially counterbalances the size effect up to n=7 , dominating it for $n>7$.

The DFD model. If demand is given by (7b) and the supply side of the market is described by (6c) for all firms, then the reaction functions of the public and private firms are respectively

$p=k(1+2p^3-3p^2-nq)$ (3 d) $q=(p-kq)6p(1-p)$ (4 d)

The system (3d)-(4d) can be solved only by giving specific numeric values to k and n, delivering the equilibrium values $\tilde{p}^M_{DFD}(k,n)$ and $\tilde{q}^M_{DFD}(k,n)$. For those k and n, the corresponding equilibrium value of welfare can then be calculated as

$W\square DFDM$ = 1 + 3($\square pDFDM$)4 −2($\square pMDFD$) 3
−k(1+2($\square pMDFD$)3−3($\square p2MDFD$)2−n($\square qDFDM$))2 −$nk$$(\tilde{q}^M_{DFD})$2
2

– –

2 2(21) If the market is fully private, the first order condition (5) becomes

1 1
(1+2p3 −3p2) = (p−k((1+2p3 −3p2)P)) 6p(1−p) (5 d)

n+1 n+1

Also in this case the solution for the equilibrium price, $\tilde{p}_{DFD}(k,n)$, is obtained only for specific numeric values of k and n. Given the latter, the welfare in the fully private case is then given by

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$$W^{\square}_{DFDP} = \frac{1}{2} + \frac{3}{2}\left(\tilde{p}^{P}_{DFD}\right)^{4} - 2\left(\tilde{p}^{P}_{DFD}\right)^{3} - k\frac{\left(1 + 2\left(\tilde{p}^{P}_{DFD}\right)^{3} - 3\left(\tilde{p}^{P}_{DFD}\right)^{2}\right)^{2}}{2(n+1)} \quad (22)$$

For given k, the comparison of the values of $W^{\square}_{DFD}{}^{M}$ and $W^{\square}_{DFD}{}^{P}$ obtained for different numeric values of n allows to identify by approximation the threshold value $^{\square}n^{*}$ beyond which $W^{\blacklozenge}_{DFD}{}^{P} > W^{\blacklozenge}_{DFD}{}^{M}$, i.e. privatization becomes welfare enhancing. The first column of Table 2 lists these thresholds for different values of $k_{<}1$. They can easily be compared with those calculated for the uniform distribution, listed in the second column.

Table 1 Threshold values of the

	$^{\square}n^{*}$	n^{*}
k=0.01	9.0	9.7
k=0.025	4.8	6.1
k=0.05	3.0	4.3
k=0.075	2.4	3.6
k=0.10	2.0	3.2
k=0.25	1.5	2.3
k=0.50	1.6	2.1
k=0.75	1.9	2.2
k=1.00	2.2	2.4

$\tilde{c}_0^*$ $^*_0$ ^{c} n n n n n n n n n

public firm inefficiency

$^{=}1$	0.044492	0.056080
$^{=}2$	0.025603	0.031404
$^{=}3$	0.017046	0.020056
$^{=}4$	0.012360	0.013913
$^{=}5$	0.0094770	0.010216
$^{=}6$	0.0075582	0.0078187
$^{=}7$	0.0062067	0.0061764
$^{=}8$	0.0052131	0.0050021
$^{=}9$	0.0044578	0.0041336
$^{=}10$	0.0038679	0.0034731

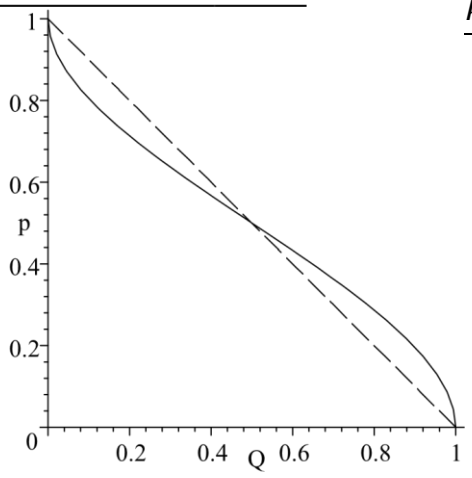

Fig. 1 Demand under Uniform (dash) and Beta (solid) distributions

It turns out that for all values of k the critical value of n with the Beta distribution is lower, thus signaling that the concentration of incomes widens the range of situations in which privatization is desirable. The intuition behind this result relies again on the size effect and the elasticity effect of the distributional shock. The key role is played here by the size effect, i.e. the reduction in potential welfare given by the shift from the uniform to the Beta distribution. The elasticity effect may either reinforce the size effect – when the price is high enough to ensure that demand elasticity increases – or partially counterbalance it. The decrease in the maximum achievable consumers' surplus makes public ownership less attractive,

and this notwithstanding a possible increase of the price over cost margin in the alternative fully private configuration.

3.3 Alternative objective functions of the public firm

In the previous sections we have compared the impact of distributive shocks on a fully private oligopoly and on an alternative mixed market, under the assumption that the public firm active in the latter maximizes the social welfare. An interesting question is how our conclusions would be affected by alternative assumptions on the public firm's behaviour.

Indeed, when investigating this issue two routes can be followed. On the one hand, the way in which it deviates from welfare maximization can be set exogenously: relying upon White (2002), we might assume that the public firm maximizes a generalized welfare function, i.e. a weighted sum of the consumers' surplus, the private profits and the public profits, allowing for a 'political' degree of freedom in the determination of the relative size of the above weights. On the other hand, the direction and the extent of the deviation can be determined endogenously, through a strategic manipulation: the weights of the generalized welfare function which inspires the public firm's behaviour are not exogenously given, but rather optimally (strategically) determined by the government according to a welfare maximizing criterion. This is indeed the approach followed by the literature on partial privatization, public strategic delegation, or consumer-oriented behaviour of the public firm. If the exogenous objective function approach is followed, then the desirability of a mixed *vs* private market structure overlooks efficiency considerations, and directly derives from the postulated system of weights. More interesting is asking how distributive shocks affect the desirability of privatization when the public firm's decisions are driven by an optimal objective function, determined by a welfare maximizing government in a preliminary stage. To this purpose, we recall that in this latter framework any type of optimal unilateral manipulation generates the same outcome as the commitment of the leader in a Stackelberg game (Basu 1995; Benassi et al. 2014). An optimal partial privatization where the objective function of the public firm is a weighted average of welfare and its own profits; an optimal strategic delegation, where the objective function combines welfare and own revenues; a consumer-oriented behaviour, where the objective function is a weighted average of welfare and consumers' surplus – all these alternative hypotheses boil down to assuming that the public firm is a market leader. The way in which they alter the effects of a first order stochastic dominance shock is therefore quite straightforward: the existence of a commitment of the public firm increases the equilibrium welfare, and therefore shrinks in both models the scope for privatization. In particular, it can be shown that the threshold value in the DF model increases for all values of the relevant distributive parameter and becomes more (positively) reactive to an increase in income. In the DFD model we recover

Table 2 Threshold values for the number of firms

The original result of dominance of the Stackelberg equilibrium: if the public firm is a leader (which can be interpreted as optimally manipulated) there is no scope for privatization (no finite threshold value of n), independently of the distribution of income.

4 Conclusions

In this paper we have reconsidered the canonical models of mixed oligopoly by De Fraja (1991), and De Fraja and Delbono (1989), modelling the market demand as the outcome of the binary individual choice of a population of consumers, heterogeneous with respect to income. Within this setup we have studied how stylized changes in the distribution of the consumers' willingness to pay – which we interpret as ultimately related to changes in the distribution of income – modify the range of situations in which the privatization of the publicly owned firm is welfare enhancing. We have focused on two types of 'distributional' changes: a generalized increase in incomes that generates the stretching of a uniform distribution of the reservation prices – an example of first order stochastic dominance; and a concentration of incomes around the mean, which implies a shift from a uniform to a quadratic Beta distribution of the reservation prices – an example of mean preserving, second order stochastic dominance. In these examples, the scope for privatization turns out to be wider, the 'poorer' is the market and the higher is income concentration. The presence of a public firm is more beneficial the richer are the consumers and the more dispersed are incomes. These results can be traced back to the way in which the distributional shocks affect the market demand and, through the latter, the size of the allocative inefficiency under imperfect competition. Our generalized increase in incomes increases the potential welfare achievable in the market, and is accompanied by a reduction in demand elasticity, both effects widening the scope for the regulatory intervention of the public firm. On the contrary, our example of income concentration implies a reduction of the potential welfare, the effects of which on the desirability of privatization are amplified (or only partially counterbalanced) by the effects on demand elasticity.

The above relationship between income, demand and desirability of privatization can be seen as the direct consequence, in a mixed oligopoly framework, of the way in which the demand side factors typically affect market competitiveness. If the focus of the public intervention in the market is its regulatory role, then demand should matter in any policy maker's assessment of the desirability a mixed market structure, and the factors driving the demand size and elasticity in different sectors or economies should explicitly be taken into account. Within this setup, the scope for a public firm is wider in a richer market, because the deadweight loss is higher in that market. However, one might argue that this seems at odds with a popular view, which invokes the direct intervention of public firms in some key markets in order to protect the weakest and poorest segments of the population. But this discrepancy is not surprising when we recall that the mixed oligopoly approach is strictly of the partial equilibrium type, and that it assigns to the public firm exclusively an allocative efficiency objective. While pursuing the latter has an impact on the functional distribution of income, it disregards the personal distribution – one unit of additional income having the same weight independently of its accruing to a rich or a poor consumer. In our opinion this suggests to extend the theoretical analysis of the relation between income distribution and the perceived advantages of privatizations to a general equilibrium framework, where the public firms can be assigned more comprehensive objective functions.

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