Privatisations as price reforms: Evaluating consumers'welfare changes in the UK

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ABSTRACT. – This paper analyses the effects on consumers' welfare of the privatisation policy carried out in the UK since 1979. The approach we follow evaluates the privatisation of a State owned enterprise within the broader framework of the "policy reform" theory (DRÈZE and STERN [1990]). By adopting this perspective, the change in consumers' welfare "with" and "without" privatisations can be studied by appropriate welfare measures. We claim that an advantage of our approach is that of being able to provide the required welfare assessment in a simplified way by means of a limited set of information. In particular, we show that a series of welfare measures only based on aggregate information can be used where one accepts the use of first and second order approximations and a few "reasonable" assumptions on the shape of demand functions. These welfare measures are subsequently used for the evaluation of the welfare effects related to price variations in seven British privatised public utilities. We conclude that the contribution to consumers' welfare of the privatisation policy in the UK, when compared to the huge transfers involved in the process, has been rather modest.

Les privatisations et le système des prix : l'évaluation des changements de bien-être dus aux privatisations britanniques

RÉSUMÉ. – Ce papier analyse les effets sur le bien-être des consommateurs de la politique de privatisation menée au Royaume-Uni depuis 1979. L'approche que nous suivons évalue la privatisation d'une entreprise publique dans le cadre de la théorie de la réforme des politiques publiques (DRÈZE et STERN, [1990]). Dans cette perspective, le changement du bien-être des consommateurs avec ou sans privatisations peut être étudié par des mesures de bien-être convenablement définies. Nous avançons qu'un avantage de notre approche est de permettre de fournir une évaluation simple des variations de bien-être, en fonction d'un ensemble d'information limité. En particulier, nous montrons qu'une série de mesures de bien-être fondée uniquement sur des informations agrégées peut être utilisée quand on accepte des approximations du premier et du second ordre et quelques hypothèses raisonnables sur la forme des fonctions de demande. Ces mesures de bien-être sont ensuite utilisées dans l'évaluation des effets de bien-être engendrés par les variations de prix dans sept entreprises publiques privatisées. Nous concluons que les gains en bien-être des consommateurs au Royaume-Uni ont été assez faibles, comparés aux transferts importants impliqués dans le processus.

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1 Introduction

The privatisation policy carried out in the UK by Conservative governments during 18 years (since 1979 until 1997) has represented the largest and most famous episode of a new attitude towards the economic role of the state in the economy. Moreover, British privatisations have also anticipated by several years similar policies in other countries, so that they constitute a benchmark for other countries where the process still is in its infancy.

This justifies an analysis based on strictly economic grounds. Given the high number and the variety of the agents involved (consumers, shareholders, workers, taxpayers), the evaluation of the overall welfare impact of a large scale divestiture represents a very extensive task. This paper is part of a wider project (see FLORIO [2003]) aimed at attaining this goal. Our more limited objective here is that of assessing the welfare effects of British privatisations on consumers by means of a new simple and feasible approach.

For this purpose, the strategy we follow here is a one which sees the privatisation of a state-owned enterprise within the broader framework of the "policy reform" theory (DRÈZE and STERN [1990]; COADY and DRÈZE [2002]). Mainly known in its "tax reform" version, this approach allows for a normative analysis of policy regimes changes in a second best framework in the presence of small deviations from the *status quo* (DIXIT [1975]). Whether or not the cases under examination can be considered a "small reform" with reference to the *ex ante* and *ex post* market values can be assessed from the price and expenditure values reported on the top of table 1. One can observe that some privatised industries have experienced cumulative real price variations of more than 30%, namely in the telecommunication, gas and water sectors. However, the yearly change was small. In any case, DRÈZE and STERN's [1990] suggestion is of interest given that a policy reform approach maintains its validity also in the case of large reforms because it only entails the knowledge of the characteristics of the economic system in the neighbourhood of the starting point (*e.g.* STARRETT [1989]).

By adopting this viewpoint, the change in consumers' welfare "with" and "without" privatisations can be studied by means of the tools of applied welfare economics. The crucial variables are the prices, quantities and some characteristics of the demand functions (when opportune assumptions about them have been done).

Indeed, when looking through the seminal contributions by GUESNERIE [1977] and AHMAD and STERN [1984], the tax-policy reform theory turns out to be a "price reform" theory, that is an approach where the value judgement are contingent to the "direction" (and the "length" in the case of non marginal reforms) of the price vectors considered in the analysis. As a consequence, also the evaluation of privatisation effects on consumers welfare must be first of all based on the scrutiny of the market price changes.[1]

1. This view is also implicitly taken in some empirical analyses. See, for example, WADDAMS-PRICE and HANCOCK [1998], who make use of simple Marshallian surplus measures.

However, the identification of the price changes constitutes a necessary but not a sufficient condition for a reliable welfare analysis. First, industry market prices have to be compared with the consumer price index, in order to check for increases or decreases in "real terms". Second, prices variations have to be compared with productivity changes determined by technological shocks or changes in demand conditions (so that in these cases it would be wrong to attribute to privatisation effects what would have happened even in public firms). Third, when privatisation is accompanied by a change in market structure, for example from a statutory monopoly to a system of oligopolistic competition, changes in prices could be wholly or partially attributable to increased competitive pressure and not to the change in ownership; similar considerations can be made for the particular system of public control of prices or quantities supplied, which for example may change from being a quite lax or discretionary cost-plus regime to being a stricter one (*e.g.* a price cap "RPI-X" with a high "X" element). Fourth, by themselves, price and quantity variations do not capture welfare effects due to endogenous changes in the quality of the products (NEWBERY [2000], discusses several examples).

Having said this, all in all, the credibility of traditional welfare analyses is conditional on the close scrutiny of the determinants of price variations. However, once these problems are solved, we claim that the advantage of a price reform approach consists of being able to provide the required welfare assessment with a limited set of information on the characteristics of demand functions.

In fact, an unsatisfactory element regarding standard welfare analyses is that they often appear more as an academic exercise, carried out with complex econometric methods and heavy investments, rather than an effective tool in the hands of the regulators or governments for promptly assessing the effects of privatisation (or liberalisation, or new regulation) programs already carried out or simply designed. Indeed, this is in contrast with the "reform theory philosophy" and *de facto* limits the real relevance of applied welfare analysis. It is an aim of this paper to foster the feasibility of an empirical analysis of price reforms by showing that a series of "easy-to-implement" welfare measures are available under some reasonable assumptions. With the term "easy-to-implement" we mean a method which only requires the collection of information easily accessible from the most common statistical sources, or at worse limited processing of this information.

The structure of the paper is as follows. In the next section, we present some welfare change measures which allow for an evaluation of price reforms on the basis of aggregate price and demand information only. In section 3 we briefly present the policy reform under scrutiny, *i.e.* the privatisation of seven public utilities in the UK. In section 4 we illustrate the main results arising from the application of our approach. In section 5 we discuss a few caveats regarding our empirical analysis and make some suggestions for future research. Finally, section 6 concludes.

2 Welfare effects of price changes: some approximated indicators

Given the aim of this paper, we restrict the following analysis to the welfare effects related to the price changes which can be associated to the transfer of some industry from the public to the private sector. As a consequence, henceforth the term "price change" will be referred to a hypothetical "net privatisation effect", where the latter is the observed change with the reform, less the counterfactual change without the reform.

By defining these (consumption) price changes with the symbol dq, the welfare variation dW can be recovered starting from a generic Bergson-Samuelson Social Welfare Function, which arguments are the following individual (indirect) utility functions:

$$v^h \equiv v^h\Big(\mathbf{q}(\mathbf{p}), y^h, \mathbf{z}^h\Big), \qquad h = 1,\ldots,H, \tag{1}$$

where the vectors $\mathbf{q}$ and $\mathbf{p}$ respectively refer to consumption and producer prices, y^h is the exogenous or lump-sum personal income and $\mathbf{z}^h$ is a vector of social-demographic characteristics. For sake of simplicity, in the following we will consider producer and consumer price variations as equal, as it would normally be the case under constant returns to scale.

The literature (*e.g.* STARRETT [1989]), usually distinguishes between marginal and non-marginal price variation welfare effects. For the time being, we follow this distinction as well, by providing explicit references to existing literature when we make use of some consolidated results of price-tax reform theory.

2.1 Marginal price changes

A change of the consumption price of a generic good i implies a welfare function variation approximated at the first order equal to:

$$dW = \frac{\partial W}{\partial q_i} dq_i = \Bigg(\sum_h \sum_j \frac{\partial W}{\partial v^h} \frac{\partial v^h}{\partial q_j} \frac{dq_j}{dq_i}\Bigg) dq_i\,.$$

By using ROY's identity (*e.g.* STERN [1987]), the previous expression can be expressed as a function of individual market demands x_j^h, namely:

$$dW = -\Bigg(\sum_h \sum_j \frac{\partial W}{\partial v^h} \frac{\partial v^h}{\partial y^h} \frac{dq_j}{dq_i} x_j^h\Bigg) dq_i\,. \tag{2}$$

Next, by introducing the concept of marginal social value of income of household h, and defining it as $\beta^h \equiv \frac{\partial W}{\partial v^h}\frac{\partial v^h}{\partial y^h}$, equation (2) becomes:

$$dW = -\left(\sum_h \beta^h \sum_j x_j^h \frac{dq_j}{dq_i}\right) dq_i. \tag{3}$$

In the tax reform literature it is a routine simplification to consider irrelevant cross demand effects of the price of i on the prices of the j^{s} goods (*e.g.* CREEDY [2000]). In this case the welfare variation reduces to:

$$dW = \frac{\partial W}{\partial q_i} dq_i = -\sum_h \beta^h x_i^h dq_i. \tag{4}$$

Equation (4) represents a first useful formula for the case of privatisations with marginal effects on prices. From an empirical viewpoint, it is important to observe that, as long as marginal variations are considered, the assessment of the welfare effects of a price change does not need any behavioural parameter such as price or income elasticities. If identical unitary welfare weight are assigned ($\beta = 1$ for all h), equation (4) reduces to a LASPEYRES price index.[2]

The previous two equations also clarify that, by adopting a Bergson-Samuelson Social Welfare Function, the value of welfare changes reduces to a double weighting of the price variation, where the weights are observable market data (the individual demand) and a value judgement (the welfare weight β^h).

A different way of expressing formulae (3) and (4) which is not constrained to the use of household level data, namely those referring to the individual demand of goods, relates the welfare variation to the so-called distributional characteristic (see STERN [1987]). By defining the latter as

$$d_i \equiv \frac{1}{X_i} \sum_h \beta^h x_i^h, \tag{5}$$

and substituting it into (4) we get:

$$dW \equiv -d_i X_i dq_i. \tag{6}$$

In principle, the value of the previous expression can be immediately calculated with aggregate data only, provided that the information on the

2. In this case, instead of x_i^h, a value referred to an intermediate period lying between the pre- and post-policy changes can also be used. This leads to an approximation of the Marshallian consumer surplus (see WADDAMS PRICE and HANCOCK [1998]). In table 1, we also compute this welfare indicator as a benchmark for our measures.

distributional characteristic of good i is available. If this is not the case, a limited elaboration based on households expenditure surveys data is required.

Sometimes, a distributional characteristic normalised for $\overline{\beta}$ (*e.g.* NEWBERY [1995]) is used, that is:

$$\widetilde{d}_i \equiv \frac{1}{X_i} \sum_h \frac{\beta^h}{\overline{\beta}} x_i^h, \tag{5b}$$

where $\overline{\beta} = \sum_h \frac{\beta^h}{H}$ is the average of welfare weights over the households. Its value depends on the scale adopted for the β^hs. In this case the equivalent of expressions (6) is:

$$dW = -\overline{\beta}\widetilde{d}_i X_i dq_i. \tag{7}$$

When specific distributional characteristics are to be calculated, the specification of the social weights β^h is required. As it is well-known, the most used parameterisation is derived from the following additive social welfare function of iso-elastic utility functions, originally proposed by ATKINSON [1970]:

$$\begin{aligned} W &= \sum_{h=1}^{H} k \frac{\left(E^h\right)^{1-e}}{1-e}, \quad \text{for } e \neq 1 \\ &= \sum_{h=1}^{H} k \ln E^h, \qquad \text{for } e = 1 \end{aligned} \tag{8}$$

where E^h is the personal expenditure by individual or household h. The parameter k is usually chosen in order to take into account of the number of equivalent adults within each household, or in order to assign a weight equal to 1 to the individual with the lowest expenditure or the average expenditure (which yields respectively weights of the form $\beta^h = \left(E^h/E^1\right)^{-e}$ and $\beta^h = \left(E^h/\overline{E}\right)^{-e}$). The choice of a non-negative value (to ensure concavity) of e determines the degree of "inequality aversion".[3]

A reference value is often represented by $e = 1$, which involves the value judgment that a marginal transfer to someone at half the expenditure level of another has a social value of twice that of the reference person. Let us see now how the adoption of this value judgement may simplify welfare analysis.

3. Remark that ATKINSON's index resembles the constant (relative) risk aversion specification (CRRA) in uncertainty theory, with the coefficient e of inequality aversion equivalent to the coefficient of relative risk aversion. Hence, while with CRRA risk aversion is expressed in relative terms with respect to individual income or wealth, with this specification inequality aversion regards income differences in relative terms. It is customary to carry out some sensitivity analysis by considering values ranging from 0 (the Benthamian case) to 5 (very high inequality aversion).

In fact, by setting $k = 1/H$, with $e = 1$ we obtain $\beta^h = 1/E^h$ and $\overline{\beta} = 1/HM(E^h)$, where $HM(E^h)$ is the harmonic mean of individual consumption. Hence, the expression (7a) reduces to:

(9) $$dW = -X_i\left(\mathrm{HM}\left(E_i^h\right)\frac{\overline{w}_i}{\overline{E}_i}\right)dq_i,$$

where $\overline{w}_i$ is the average budget share on good i. By setting $\overline{\beta} = 1$, that is $\beta^h = HM(E^h)/E^h$, the previous equation can be additionally simplified to

(9b) $$dW = -X_i\left(\frac{\overline{w}_i}{\overline{E}_i}\right)dq_i.$$

The last expression allows for an assessment of distributional effects with aggregate data only even in the absence of information on distributional characteristics of the good.

As a general comment of this subsection, it must be pointed out that, however, these "socially weighted measures" do not account for one of the most elusive effects to capture in the transition from public to private firm, that is the change in the regime of price discrimination.[4]

2.2. Large price changes

For the case of large price variations, the use of second order approximations could be more appropriate. These include money metric measures (HARBERGER [1964]) and more general welfare measures allowing for distributional considerations (BANKS, BLUNDELL and LEWBEL [1996]).[5]

Unlike the case of the evaluation of small reforms, the assessment of large price changes usually requires information about individual demand elasticities. For example, the second order welfare approximation proposed by BANKS *et al.* [1996] takes the form (with a redundant notation of the elasticities required for its implementation):

(10) $$\frac{\Delta W}{\Delta q_i} \approx -\sum_h \beta^h x_i^h\left[1+\frac{1}{2}\frac{\Delta q_i}{q_i}\left(\frac{\partial x_i^h}{\partial q_i}\frac{q_i}{x_i^h}+\frac{\partial \beta^h}{\partial q_i}\frac{q_i}{\beta^h}\right)\right],$$

4. In the case of multi-product firms, sometimes both public and private firms are capable of charging different prices to different consumers for the same product. In turn, the different types of consumers could have different functions of demand, so that variation in welfare due to the change in regime would need to be ascertained for the different types of consumers. FLORIO [2004] discusses this point in detail for some British privatized industries.

5. The typical advantage of welfare approximate measures consists of their reduced informational requirements, as compared to the computation of "exact" measures based on the estimation of household expenditure functions. In Starrett words: " ...the method gives up on collecting hypothetical information concerning demand conditions in unobserved parts of the economic environment and instead extrapolates to those areas using curvatures at the *status quo*" (STARRETT [1989], p. 246).

that is:

$$\text{(10b)} \qquad \frac{\Delta W}{\Delta q_i} \approx -\left[\sum_h \beta^h x_i^h + \frac{\Delta q_i}{2}\sum_h\left(\beta^h \frac{\partial x_i^h}{\partial q_i} + x_i^h \frac{\partial \beta^h}{\partial q_i}\right)\right],$$

whilst the equivalent money metric approximation by HARBERGER [1964] is:

$$\text{(11)} \qquad \frac{\Delta X_i}{\Delta q_i} \approx -\sum_h x_i^{hc}\left[1 + \frac{1}{2}\frac{\Delta q_i}{q_i}\left(\frac{\partial x_i^{hc}}{\partial q_i}\frac{q_i}{x_i^{hc}}\right)\right],$$

where the "c" stands for "compensated".

Reliable estimation of individual elasticities requires the availability of microdata of adequate quality and the imposition of some identifying assumptions.[6] For the case in which these two conditions cannot be ensured by the analyst, a few additional restrictions or approximations are to be adopted in order to allow for an evaluation based on aggregated data (or, at least, elasticities) only.

The simplest solution for avoiding the use of household level information is to give up assigning different welfare weights in the equation (10) above (*e.g.* CREEDY [2000]). If we impose $\beta^h = 1$, for all h we get:

$$\frac{\Delta W}{\Delta q_i} \approx -\left[\sum_h x_i^h + \frac{\Delta q_i}{2}\sum_h \frac{\partial x_i^h}{\partial q_i}\right],$$

from which:

$$\text{(12)} \qquad \frac{\Delta W}{\Delta q_i} \approx -X_i\left[1 + \frac{\Delta q_i}{2q_i}\eta_{X_i,q_i}\right],$$

where η_{X_i,q_i} is the aggregate price elasticity.

Hence, a second order approximation which disregards distributional concerns only requires information about the aggregate demand and demand elasticity.

Let us now see if a welfare evaluation of price changes only based on aggregate level data is possible in the general case $\beta^h \neq 1$, for some h. In this case, to get a manageable expression, it is usually made the additional approximation of assuming the irrelevance of the price elasticity of welfare weights.[7]

6. With H individuals, the estimation of H parameters would of course be impossible. In order to overcome this problem, somewhat *ad hoc* (identifying) hypotheses must be done about the constancy, among the individuals, of some values. For example, in the familiar case of the AIDS model by DEATON and MUELLBAUER [1980b], the expenditure elasticities are recovered through the assumption that: $\frac{\partial w_i^h}{\partial \ln\left(x^h/P\right)} = \beta_i$, for $h = 1,...,H$.

7. The assumption of price invariance of welfare weights is recurrent in applied welfare analyses, but theoretically weak (*e.g.*, ROBERTS [1980]; BANKS *et al.* [1996]). For an empirical study in which welfare weights price elasticity is taken into account see RAY [1999].

Under this assumption, we now show that also second order welfare approximations can be expressed in terms of distributional characteristics. In this respect, let us first re-write equation (10b) as

$$\frac{\Delta W}{\Delta q_i} \approx -X_i \left[\sum_h \frac{\beta^h x_i^h}{X_i} + \frac{\Delta q_i}{2q_i} \frac{\overline{\partial x_i}}{\partial q_i} \frac{q_i}{\overline{x}_i H} \sum_h \left(\beta^h \frac{\partial x_i^h}{\partial q_i} / \frac{\overline{\partial x_i}}{\partial q_i} \right) \right],$$

that is

$$\frac{\Delta W}{\Delta q_i} \approx -X_i \left[\sum_h d_i + \frac{\Delta q_i}{2q_i} \eta_{X_i, q_i} \frac{1}{H} \sum_h \left(\beta^h \frac{\partial x_i^h}{\partial q_i} / \frac{\overline{\partial x_i}}{\partial q_i} \right) \right]. \tag{13}$$

By using the definition of distributional characteristic in (5) and exploiting the definition of covariance we have:

$$\frac{1}{H} \sum_h \left(\beta^h \frac{\partial x_i^h}{\partial q_i} / \frac{\overline{\partial x_i}}{\partial q_i} \right) = \overline{\beta} + b, \tag{14}$$

where

$$b = \operatorname{cov}\left(\left(\frac{\partial x_i^h}{\partial q_i} / \frac{\overline{\partial x_i}}{\partial q_i} \right), \beta^h \right).$$

Hence, by substituting (14) into (13) we finally get:

$$\frac{\Delta W}{\Delta q_i} = -X_i \left[d_i + (\overline{\beta} + b) \frac{\Delta q_i}{2q_i} \eta_{X_i, q_i} \right]. \tag{15}$$

In the case the use of $\widetilde{d_i}$ is preferred, it easy to verify that the equivalent to equation (15) is:

$$\frac{\Delta W}{\Delta q_i} = -X_i \overline{\beta} \left[\widetilde{d_i} + (1 + \widetilde{b}) \frac{\Delta q_i}{2q_i} \eta_{X_i, q_i} \right], \tag{15b}$$

where

$$\widetilde{b} = \operatorname{cov}\left(\left(\frac{\partial x_i^h}{\partial q_i} / \frac{\overline{\partial x_i}}{\partial q_i} \right), \frac{\beta^h}{\overline{\beta}} \right).$$ [8]

Thus, the estimation of a second order welfare approximation based on aggregated data, again, requires some information about the distributional characteristic associated to the good which provision is being privatised. In addition, an estimate of the aggregate demand elasticity to price is required.

8. Equation (15) and (15b) become equal when scaling welfare weights so that $\overline{\beta} = 1$.

The importance of this behavioural parameter is enhanced or tempered by the presence of a second distributive parameter (b), which takes smaller values when the demand by the poorest is more rigid.[9]

2.3. Second order approximations in the case of some demand functional form assumptions

Unfortunately, differently from the other parameters, the covariances b and $\widetilde{b}$ can be computed only after having estimated the individual demand derivatives, which requires the use of microeconometric estimation techniques.

As an alternative, we suggest using functional form assumptions. For example, in the case of linear ENGEL curves, expression (15) clearly simplifies to

$$\frac{\Delta W}{\Delta q_i} = -X_i \left[d_i + \overline{\beta} \frac{\Delta q_i}{2q_i} \eta_{X_i, q_i} \right], \tag{16}$$

given that we have $b = 0$. The parameter b is also equal to 0 when the individual demand functions are linear, a hypothesis which can be seen as a good approximation of the real shape of the demand function in a neighbourhood of the starting point.[10]

Besides the last special case, it is of interest to infer at least what the sign of b could be under more general assumptions on the demand functions. For this purpose, we can base our subsequent analysis on a widely accepted (in empirical microeconomics) ENGEL curve structure such as the (linear-in-logs) Working-Leser one and its quadratic generalisations. The former is derived from the "PIGLOG" class of cost functions, which are the base of the well known DEATON and MUELLBAUER's [1980b] "AI" demand system and the "TRANSLOG" demand model by JORGENSON, LAU and STOKER [1982], whereas its quadratic generalisation lead to the "QUAIDS" demand model by BANKS, BLUNDELL and LEWBEL [1997].

In these models, the individual price derivatives are inferred from the estimation of the budget shares logprice derivatives, which we define as:

$$\frac{dw_i^h}{d \ln q_i} \equiv c_i^h.$$

As an example, let us consider the case of the AIDS model:

$$w_i = \alpha_i + \sum_j \gamma_{ij} \ln q_j + \delta_i \ln \left[\frac{E^h}{a(\mathbf{Q})} \right], \tag{17}$$

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9. With additive utility functions this is always the case for "necessities", due to the proportionality between price and expenditure elasticity implied by this functional assumption (*cf.* DEATON [1974]; DEATON and MUELLBAUER [1980a], ch. 5).

10. Hence, this hypothesis is typically reliable only in case of small price reforms.

where w_i is the individual budget share and $a(\mathbf{Q})$ is defined by the Translog price index formula:

$$\ln a(\mathbf{Q}) = \alpha_0 + \sum_i \alpha_i \ln q_i + \frac{1}{2} \sum_i \sum_j \gamma_{ij} \ln q_i \ln q_j .$$

In this case it is simple to show that:

$$c_i^h = \gamma_i - \delta_i \frac{d \ln a(\mathbf{Q})}{d \ln q_i} . \tag{18}$$

More in general, it can be easily shown (*e.g.*, BANKS *et al.* [1997]) that the uncompensated own-price elasticity in these models is equal to:

$$\eta_{x_i^h, q_i} = \frac{1}{w_i^h} c_i^h - 1 . \tag{19}$$

From the previous formula, if c_i^h is smaller (larger) than 0, the demand for good i will be "elastic" ("rigid").[11]

Actually, the elasticity' formula can tell us more. In particular, we can also recover the size of the individual demand derivatives. In fact, rearranging, we can write:

$$c_i^h = w_i^h \left(1 + \eta_{x_i^h, q_i} \right),$$

from which, after some algebra,

$$\frac{dx_i^h}{dq_i} = \left(c_i^h - w_i^h \right) \frac{E^h}{q_i^2},$$

that is:

$$\frac{dx_i^h}{dq_i} = c_i^h \frac{E^h}{q_i^2} - \frac{x_i^h}{q_i} .^{12} \tag{20}$$

11. However, it must be remarked that, being c_i^h variable across the individuals, some intervals of the estimated parameters in principle allow for the demand of a good to be elastic for some individuals and inelastic for others.

12. When $c_i^h < 0$, for all h, *i.e.* the demand is elastic for each individual, both terms on the right hand side of this equation are negative. This implies (provided that i is not an inferior good), that the individual demand responses become higher in absolute terms as the individual expenditure increases. As a consequence, the distribution of these price demand responses is negatively correlated to the distribution of the social weights (which are a negative function of E^h). Hence, for the linear – and quadratic – in-logs family of ENGEL curves, the term b in the equation (15) is negative (positive) if the demand for the good to which the price reform is referred is elastic (inelastic). Even without knowing the size of b, we can therefore conclude that equation (16) represents an upper (lower) bound of a second order welfare approximation if the individual demand of the good under scrutiny are elastic (inelastic).

By itself, the previous formula cannot help us so much given that an econometric estimation of c_i^h is required for its implementation. However, it is interesting to see which are its implications when setting the coefficient of inequality aversion e of the social welfare function equal to 1.

We leave to the appendix to show that in this case the covariance term $\widetilde{b}$ in equation (15b) simplifies to:

$$\widetilde{b} = \widetilde{d}_i - 1\,. \tag{21}$$

Consequently, it directly follows that equations (15b) reduces to:

$$\frac{\Delta W}{\Delta q_i} = -\widetilde{d}_i X_i \left[1 + \frac{\Delta q_i}{2q_i}\eta_{X_i,q_i}\right], \tag{22}$$

i.e., to an expression which is a function of the distributional characteristic and aggregate demand price elasticity.

Overall, general expressions such as (13) or more specific ones based on functional assumption such as (22) show us that the value of a second order approximation is always smaller than a first order one. In fact, second order approximations depict some efficiency effects by means of the aggregated elasticity parameter, which usually is negative. As it was remarked above, the proximity to the first order approximation is partially restored when the demand for the good is elastic (being the covariance b negative).

To summarise, in this section we have showed under which conditions the estimation of the effects on consumers' welfare of the price changes referable to the privatisation of some previously publicly provided goods can be based on aggregated data. In the next section, we briefly report on the British privatisation policies, which welfare effects we would like to estimate by means of our approach.

3 Price trends in the British privatised industries

The British privatised industries which we consider in this paper are the following ones: Telecommunications, Railways, Bus services, Electricity, Gas, Water and Coal. All of them were privatised by the British Conservative Governments in a period ranging from the early Eighties to mid Nineties (the reference years for each privatisation are reported on the top of table 1).

This large spread among the changes of ownership dates has of course entailed a certain degree of heterogeneity in the forms of public divestitures which were chosen and in the following regulatory initiatives adopted. However, on the whole the common feeling has been that of a unique policy ("privatisation") carried out in successive steps. We are also taking this perspective, but the limits of this assumption should be borne in mind.

This lack of synchrony affects the analysis of the price trends in the various industries after divesture. In fact, while for some sectors such as telecommunications and gas industry we dispose of about 15 yearly observations since their privatisation, for the rail and coal industries the "after privatisation" period reduces to 4 years only.[13] As a consequence, while for some cases a clear-cut judgement could be reliably expressed (*e.g.*, "telephony prices have decreased", or "water is more expensive than it was before privatisation"), for some other sectors a definite trend has not emerged yet.

While referring the reader to FLORIO ([2004], ch. 7) for a more detailed description of the evolution of the real prices and of the institutional aspects, such as the price cap systems adopted by the sectors' regulators, here we briefly focus on a point particularly important when analysing privatisation policies as "price reforms", *i.e.* the fact that trends in prices "before" and "after" privatisation in the UK does not show a clear structural break, at least until the end of the "Conservative era".

More in detail, in the case of electricity – which privatisation started in 1990,[14] – real prices had been falling for over a decade under public ownership and they increased in preparation for privatisation and in the years that followed, especially prices for the residential users. Subsequently they started falling again in a way not too different from the long term trend up to 1995, date which seems to mark the starting point of a more clear decreasing trend (of course still in its infancy).

In the case of gas there was a net drop in real prices after privatisation in 1986, but prices had been falling with respect to the Retail Price Index also in the Seventies when British Gas was a nationalized industry. Conversely, a relative increase was again registered by considering the 5 years preceding the privatisation of British Gas. Like in the case of electricity, an apparent stronger decreasing trend has started since the mid Nineties.

The privatisation of British Telecom dates back to 1984. Although the construction of a price index for this industry represents a very difficult task (due to the variety of contracts, the changes in the pricing methods and the difficulty in obtaining disaggregated data for each category of user), the existing aggregate estimates suggest that after privatisation there has been a reduction in the unit cost for business users and, for a number of years, an increase in the unit cost for domestic and public phone users. More recently (and a couple of years before the aforementioned cases), a generalised reduction in tariffs has been taking place, following a change in the regulatory constraint and increased competition.[15]

No clear trend emerges also for those services which have registered relative price increases since privatisation. In the case of water, the tariffs rose considerably after privatisation, but a counterfactual scenario under continued public ownership may suggest that at least a part of the price increase was linked to new costly environmental standards. In addition, the lack of adequate previous information precludes us to control for the behaviour of the

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13. Being 1999 the last year that we have considered.
14. In that year the twelve Regional Electricity Companies in England and Wales were privatised, followed by the two Scottish companies in 1991.
15. For more details see FLORIO [2004].

prices under the public ownership. Also in the case of buses and rail the price of the service increased after privatisation, but the same had happened before.

4 Empirical analysis

In this section we apply the set of welfare measures presented above and we offer a preliminary evaluation of the (gross) social impact of the British privatisations in seven industries. We consider both first and second order approximations. The former are useful as benchmarks, while the latter are probably more appropriate for larger reforms.

The first data from which to start is the direction of the market price changes. The time series by ONS (various editions) display a dichotomous behaviour of real price, with a relative reduction for telephony, electricity and gas and an increase for water and transport. The size of these variations and the overall families' expenditure in the related sectors is, however, not homogenous. Our broad calculations suggest a decrease of 16% of the consumer prices of the privatised industries as compared to the path of the Retail Price Index (RPI) since 1987 to 1999.[16] To set 1987 as the starting year for evaluating the price effects of the British privatisation policy as a whole is, of course, an *ad hoc* hypothesis.

The same applies for those assumptions which define the share of the price variation actually attributable to the change of ownership. The determination of this percentage always is a difficult task (which should be handled by drawing a counterfactual scenario) and becomes particularly critical when looking to privatisation as a price reform. As a starting point, one could argue that a benchmark hypothesis about privatisation effects on price changes lies between either assuming that privatisations were responsible for all price changes or that continuation of public ownership would have generated exactly the same price changes as those observed.

In the estimates we are presenting below, we substantially avoid dealing with this problem by considering the most favourable scenario about privatisation effects, that is by attributing to the change of ownership regime the whole deviation of the prices of the privatised industries with respect to the RPI. In this sense, the following results constitute an upper bound to any positive or negative welfare effects.[17]

The results of the analysis carried out at the individual industry level are presented in tables 1 and 2. The first part of these tables contains the information used for the implementation of the various measures reported therein. In particular, the privatisation year[18] has been used for determining the "price

16. We obtained this value by building an aggregate LASPEYRES index of the privatised industries centred on 1987 by using the industry-level ONS time series.
17. Of course, this is true since, on the whole, we are evaluating a price decrease.
18. For those cases in which the privatisation has been carried out in subsequent steps, a median year has been considered.

reform" interval. Having taken into consideration 1999 as the final year of our analysis, for each commodity the welfare variations have been calculated in one case (table 1) as the effects of a unique price reform which size is given by the difference between the percentage variation of the related prices index and the overall RPI in the interval "privatisation year-1999", and as the sum of yearly price reforms in the other case (table 2). The second order measures need to compute the aggregate demand price elasticities. For the aims of this paper, we have used the values reported in FLORIO (2004).[19]

As for the distributional characteristics (reported on the top of table 1) which were used in the implementation of the various formulae, we calculated them by using the 1994 edition of the Family Expenditure Survey.[20] Following the most standard approach, the social weights have been derived by using an Atkinson's Social Welfare Function like that in (8) and scaled so that to set their mean $\overline{\beta}$ equal to 1, which makes the implementation of formulae (15) easier. The total household expenditure data which is needed for the computation of the distributional characteristic has been expressed in terms of equivalent adult. The OECD equivalence scales were used for this purpose.[21] The distributional characteristics used in the tables are only those corresponding to a "coefficient of inequality aversion" equal to one.

As said when we derived equation (15-15b), the only actual micro level data which we would need when implementing a second order welfare approximation are the covariance "b" and "$\widetilde{b}$". In order to overcome this problem, a Working-Leser (or its quadratic extension) functional form assumption has been done with respect to the ENGEL curves of the observed demands so that, having set to 1 the coefficient of inequality aversion, equation (22) could be used when computing the second order welfare approximation.

As for the sector expenditures, we have used "median year expenditures" (between privatisation and 1999) for the calculations reported in table 1, when we considered price variations as a "one shot" change; and annual expenditures when computing the welfare effects as a sum of yearly changes. To keep a direct "monetary" interpretation of the welfare measures, we have scaled price indexes in order to set the price of the reference year equal to 1. This allows us to consider the recorded expenditures as if they were "quantities" and directly apply the approximated measures (which are usually based on quantity indexes). All the welfare changes are expressed at 1994 prices.[22] The

19. In general, the specialised economic literature offers several studies on aggregate demand to which the analyst can refer without undertaking new specific estimations. A new estimation of price elasticities is left for future research.

20. As we said in the Introduction, this paper aims to promote the adoption of "easier" approaches in applied welfare analyses in which, in principle, only the use of aggregated data should be required. Under this perspective, commonly used distributional value judgements (such as distributional characteristics) on the consumption of single commodities could be considered as an aggregate information. By making direct use of a micro-level dataset we are someway weakening the consistency of our approach, but the supply of tabulated distributional characteristics (which would not constitute a difficult task!) is not at present foreseen in the national household expenditures reports.

21. According to these scales, the first adult counts as 1, additional adults as 0.7 and children as 0.5.

22. Similarly to the computation of distributional characteristic, we chose 1994 as a reference year given that, between the various industries, it represents the "median of the median years between the privatisation year and 1999".

values reported permit an immediate cost-benefit analysis of the other net gains or losses by other agents involved in British privatisations.

As reported in the left columns of the tables, we have computed both first and second order welfare change approximations, whether without or with distributive corrections. The "socially unweighted" first order measure is a LASPEYRES Index in case of table 2 (welfare changes as cumulated yearly changes). In case of table 1 (price variations considered as a one shot change) we have used a modified version of the Marshallian surplus approximation by WADDAMS PRICE and HANCOCK ([1998], appendix B), where expenditures and prices are those of the median year between privatisation and 1999. The second order measures correspond to formulae (16) and (22).

Let us finally turn to the results.[23] Due to the dissimilarity in the direction of the price changes, consumers had both losses and gains. In both tables, the larger gain is clearly referable to telephony, surely determined by the relative importance of this service within the privatised basket, the length of the "post reform" period (privatisation of BT occurred in 1984), but also by the substantial price decrease recorded since its privatisation. The second privatised industry which has substantially contributed to the increase of consumers' welfare has been the gas one (which privatisation dates 1986). By looking to the yearly welfare changes (not reported in this paper) one would observe that the importance of the benefits deriving from this sector has been decreasing in the recent years, as a result of its reduced weight in consumers' expenditures. This is the opposite of what has happened with respect to the water sector, which presently represents the larger source of losses for British consumers among the privatised utilities.

Besides being an important part of the consumers' privatised good basket, this sector exhibit price variations of more than 30% in absolute terms. In these cases it becomes particularly important to focus on second order measures, given the high monetary values which can be involved, and check for the different implications of the procedures which respectively lead to table 1 and table 2 results. In table 1, the difference between first and second order approximations can reach values close to 15% (*e.g.*, see the row reporting the "first order error" between the first and second order "socially weighted" measures, which indicate underestimates of the welfare gains of about 11% for the telephone industry and an overestimate of about 14% for the water sector).[24] Conversely, in table 2 the first order error is usually less than 3%. If no reliable aggregate demand elasticities are available, this clearly advocates for a computation of the welfare effects on a yearly price variation base, which reduces the overall result to a sum of "small price reforms".

23. A reader can notice that our welfare change estimates do not have standard errors, a limitation shared by comparable studies (WADDAMS PRICE and HANCKOCK [1998]; NEWBERY [1995]; BANKS *et al.* [1996]). In fact, a more detailed study would be needed, by deriving and applying an analytical formula for the estimation of standard errors, based on the "Delta Method" (*e.g.* GREENE [2000]), which should take into account of the variance of distributional characteristics and demands estimates, together with the variance-covariance of price elasticities estimates.

24. It can be easily seen that this percentage value is nearly independent of the size of the price variation.

The use of the simpler procedure adopted in the case of table 1 also has some consequences in the determination of the size of the welfare change. When considering a privatised industry which has shown most of its price change (and consequently of the quantity change, with a roughly constant demand elasticity) in the last years, the use of the median year as unique base for the computation leads to strong underestimates of the welfare effect since price changes are being multiplied for a relatively smaller demand level (nearest to the pre-privatisation level than to the end of the period under scrutiny in absolute terms). This is the case of telephony. On the contrary (as in the water case) we incur in a likely overestimate when a large price variation mostly occurs in the first years after privatisation. By computing the price reform effect as cumulated yearly changes, this problem disappears since reference demands for the welfare evaluation are modified on a yearly base.

As for the distributional corrections,[25] in general their size is substantially determined by the value of the distributional characteristic also in the case of the second order approximation.[26] Moreover, in the exercise reported in these tables, even the slight differences existing in the general case disappear due to effects of the functional form hypothesis (linear or quadratic-in logs "latent" ENGEL curves of the goods under examination) which was used in order to obtain the simplified formula (22).

The last column of the tables provides an indicator of the aggregate effects on consumer welfare. As for the differences between first and second order measures, the aggregation seems to exacerbate the first order error in both cases, but the effects are particularly severe in the first case (28.7%). When summing over yearly variation, the difference is limited to 3.4%. Let us finally note that the procedure adopted in table 2 leads to a definitely more positive evaluation about the overall gross impact of the privatisation policy.

25. These corrections do not include the impact of rebalancing of tariffs within each industry and by different types of consumers. This impact could be substantial for some classes of users, namely low users who usually are those in the bottom income brackets (see WADDAMS PRICE [2003])

26. This is immediate when looking how the distributional characteristic enters equation (15). For first order approximation this relationship is trivial.

TABLE 1

Welfare changes by privatised industry. Millions 1994 constant pounds. 1984-1999. At median years expenditure

	Privatised utilities							
	Phone	*Rail*	*Bus*	*Electricity*	*Gas*	*Water*	*Coal*	*TOTAL*
Privatisation year	1984	1995	1989	1990	1986	1990	1995	
Median year	1991	1997	1994	1994	1992	1994	1997	
E^*	6842	3144	2808	8082	5684	4014	499	
P^*	0.88	1.19	1.14	1.01	0.85	1.52	0.82	
P^1	0.98	1.18	1.04	0.97	1.02	1.14	0.85	
P^2	0.6	1.22	1.19	0.8	0.71	1.7	0.8	
η_{X_i,q_i}	0.6	0.8	0.9	0.5	0.7	0.5	0.2	
$\ddot{d}_i$	0.875	0.573	0.756	0.893	0.9	0.938	0.992	
Welfare measures								
First order approximations								
Marshallian Surplus : $M = E^* \ (p^1 - p^2)/p^*$	2779.243	-113.960	-417.030	1360.337	1815.768	-2225.584	22.609	3221.382
"Socially weighted": $dW \equiv -d_i X_i dq_i$	2431.837	-65.299	-315.274	1214.781	1634.191	-2087.598	22.428	2835.065
Distributive correction	*-12.50%*	*-42.70%*	*-24.40%*	*-10.70%*	*-10.00%*	*-6.20%*	*-0.80%*	*-11.99%*
Second order approximations								
"Unweighted" : $\Delta W \approx -X_i \left[1 + \frac{\Delta q_i}{2q_i}\eta_{X_i,q_i}\right]\Delta q_i$	3092.939	-112.155	-389.159	1417.579	2010.828	-1917.087	22.721	4125.666
"Socially weighted" (Linear or quadratic-in-logs Engel curves)								
$\Delta W = -\tilde{d}_i X_i \left[1 + \frac{\Delta q_i}{2q_i}\eta_{X_i,q_i}\right]\Delta q_i$	2706.322	-64.265	-294.204	1265.898	1809.745	-1798.228	22.539	3647.807
First order "error"	*11.29%*	*-1.58%*	*-6.68%*	*4.21%*	*10.74%*	*-13.86%*	*0.50%*	*28.67%*

Note: The symbol * refers to median year values.

TABLE 2

Welfare changes by privatised industry. Millions 1994 constant pounds. 1984-1999. Cumulated yearly changes.

Welfare measures	Privatised utilities: *Phone*	*Rail*	*Bus*	*Electricity*	*Gas*	*Water*	*Coal*	*TOTAL*
First order approximations								
"Laspeyres index": $M = X1\ (p^t - p^{t+1})$	4211.055	-132.640	-411.214	1438.416	2072.856	-1701.746	33.601	5510.329
"Socially weighted": $dW \equiv -d_i X_i dq_i$	3684.673	-76.003	-310.878	1284.506	1865.570	-1596.238	33.332	4884.963
Distributive correction	*-12.50%*	*-42.70%*	*-24.40%*	*-10.70%*	*-10.00%*	*-6.20%*	*-0.80%*	*-11.35%*
Second order approximations								
"Unweighted"								
$\Delta W \approx -X_i \left[1 + \frac{\Delta q_i}{2q_i}\eta_{X_i,q_i}\right]\Delta q_i$	4290.320	-133.820	-397.713	1469.587	2111.365	-1675.905	33.674	5697.508
"Socially weighted" (Linear or quadratic-in-logs Engel curves)								
$\Delta W = -\tilde{d}_i X_i \left[1 + \frac{\Delta q_i}{2q_i}\eta_{X_i,q_i}\right]\Delta q_i$	3754.030	-76.679	-300.671	1312.341	1900.229	-1571.999	33.405	5050.655
First order "error"	*1.88%*	*0.89%*	*-3.28%*	*2.17%*	*1.86%*	*-1.52%*	*0.22%*	*3.39%*

5 Some cautionary remarks

In this paper we use actual observed prices deflated by the RPI index, *i.e.* the same deflator that the British regulators use in order to determine the price cap, with different formulas of the RPI-X type. We think this procedure is simple and appropriate to our case study, but there are alternatives we may have considered. In fact, what we observe are nominal prices, or indexes based on nominal prices (and some quantity weights) and it is well known that official price indexes in some cases suffer of a series of aggregation problems.

The main problem for the industries we consider is that official price indexes provided by the British Office of National Statistics (like by most other official sources) are not quality-adjusted. For example, it is recognized that water quality improved after privatisation, while transport service quality probably decreased. Likewise, the telecommunication industry experienced a major change with the advent of digital switching and mobile phones. This is a first source of possible bias in any empirical analysis that uses official price indexes.

A second problem regards the use of the RPI deflator: while this deflator is more or less appropriate for a median consumer, it may be quite biased for consumers in some income brackets. If we had to consider micro-data with different welfare weights without parallel price information, this would be a major issue which could undermine the usefulness of disaggregated analyses.[27] Under our approach, this is in fact a minor concern, but we still must remember that any welfare analysis that uses an aggregate deflator may disregard the specific inflation changes (and related welfare effects) for some classes of consumers. In particular, given the negative effects on poorest household arising from nonlinear pricing policies often adopted after privatisation, we may conjecture that an aggregate level analysis is likely to underestimate the negative distributional welfare effects of privatisation.

Besides these aggregation problems, one could be interested to look at a broader set of relative prices, *i.e.* price indexes determined on the basis of some *ad hoc* time series or cross country analyses. This is an important point which we feel that it deserves some elucidation, although it goes far beyond the scope of this paper. Observed prices trends for any industry are the result of common and idiosyncratic or specific shocks. For example, when we look at electricity prices in several European countries, a number of factors may play a role as possible determinants (see NEWBERY [2000]). There are common shocks through macroeconomic unbalances, but they affect national industries in a dissimilar way. Different countries use different technological mix, *e.g.* hydro, nuclear, oil, or coal power generation. In turn, regulatory

27. However, micro-level estimates could be advocated in order to check for the "approximation performance" of the welfare measures that we have proposed and used in this paper. A similar exercise, which is beyond the scope of this work, has been carried out by BANKS *et al.* [1996], in order to test working of the welfare approximations they proposed. In their exercise, the difference between second order approximations and exact measures (in the form of a Quadratic Almost Ideal Demand System expenditure function), amounted only to 0.3%.

mechanisms and industrial policy vary over time and across countries, *e.g.* from vertical integration and public monopoly to privatization and full liberalization.

Thus, one may think that one interesting welfare analysis would be to compare actual prices with virtual prices, those prices that a British consumer of electricity would have experienced if he or she could enjoy an alternative scenario (*e.g.* the average electricity prices in a sample of other countries). In principle, the comparison of actual prices with a set of alternative prices would be consistent with the opportunity cost approach to welfare analysis, i.e. with social cost-benefit analysis.[28] In practice, what we observe is the price index as it emerges from a complex process, and in order to disentangle the policy reform impact we would need to control for other variables and possibly propose counterfactuals based on other policy settings, drawing from past and international experience. This is a daunting task that we do not attempt here.

As a final point, it is still true that any welfare analysis that uses shadow prices or opportunity cost indexes, must start from actual observed prices as the benchmark. After all, consumers pay actual pounds for the public services they use, and it is interesting to compute whether for a given country and period of time their welfare increased or worsened. Privatisation in the UK was a major policy shock that affected the industries we consider, and our approach offers a preliminary test of what happened to consumers' welfare in constant pounds "after" privatization, not necessarily "because" of privatization; and we said before that we believe that our procedure offers an upper bound to any possible estimate based on counterfactuals and or shadow prices (the primal and dual approach in the DRÈZE and STERN [1990] setting.

6 Conclusions

This paper has investigated the possibilities of applying a (price) reform approach to the analysis of the effects of the British privatisation policy on consumers' welfare. To this aim, a series of first order and second order approximated measures has been discussed and introduced, fostering the use of distributional characteristics as an aggregate indicator of some distributional implications of policy reforms.

The implementation of the proposed measures has revealed the presence of relevant effects at the single industry level, although with a heterogeneous behaviour. At an aggregate level the effects partially compensate each other. Considering that we have attributed to privatisations the whole price change, and that a much less favourable scenario about privatisation effects on prices could have been adopted, particularly under a counterfactual of continued nationalised industry, we conclude that the overall contribution to British

28. FLORIO [2004] uses this approach for the overall evaluation of British privatization; see also GALAL *et al.* [1994] for several case studies).

consumers' welfare of the privatisation policy has been rather modest, if compared to the huge monetary values involved in the process of asset transfer from the public sector to private shareholders. The range of gross welfare impacts we find is between £ 2.8 billions with socially weighted first order approximation for a "median year" change, and £ 5.7 billions for unweighted second order approximation as cumulated yearly changes. This is equivalent to a welfare increase per capita in constant 1994 pounds in a range between £ 48 (for the first-order socially weighted median year calculation) and £ 97 (for the second order unweighted yearly change calculation). However, the net impact, we may conjecture, was even less than this range of already modest estimates, for two reasons. First, because it is unlikely that the nationalised industry were totally unable to pass to consumers exogenous savings in costs (*e.g.*, decreasing cost in telecommunications and in fuel prices). Second, because of the additional negative welfare impact of tariff rebalancing and regressive price discrimination. When we consider the latter two points, one may infer that for some egalitarian welfare function the net social welfare impact on consumers of the British privatisation is negligible.

Of course, what is lacking at this stage of our investigation is just the construction of a plausible counterfactual scenarios regarding price performance under continued public ownership. If these scenarios are somewhat determined (for example looking at cost trends and their determinants), the researcher (or the regulator) can easily go through welfare computations. For this purpose, a series of "ready-to-implement" formulae are available also for large "price reforms", and they do not need the estimation of a micro-level demand system, if one is ready to give up determining an "exact measure" of the welfare change. Besides, at an aggregate level, even a first order approximation (which does not take into account the curvatures of aggregate demands) seems to provide a quite accurate indication of the overall welfare effects, if one considers the whole "reform" as a sum of small yearly changes. ▼

• References

AHMAD E., STERN N. (1984). – « The Theory of Reform and Indian Indirect Taxes », *Journal of Public Economics*, 25, p. 259-298.

ATKINSON A. B. (1970). – « On Measurement of Inequality », *Journal of Economic Theory*, 2, p. 244-263.

BANKS J., BLUNDELL R., LEWBEL A. (1996). – « Tax Reform and Welfare Measurement: Do We Need Demand System Estimation? », *Economic Journal,* 106, p. 1227-1241.

BANKS J., BLUNDELL R., LEWBEL A.(1997). – « Quadratic Engel curves, indirect tax reform and welfare measurement' », *Review of Economics and Statistics*, 79, p. 527-539.

COADY D., DRÈZE J. (2002). – « Commodity Taxation and Social Welfare: The Generalized Ramsey Rule », *International Tax and Public Finance*, 9, p. 95-316

CREEDY J. (2000). – « Measuring welfare changes and the excess burden of taxation », *Bulletin of Economic Research*, 52, p. 1-45.

DEATON A. (1974). – "A reconsideration of the empirical implications of additive preferences", *Economic Journal*, 84, p. 338-345.

DEATON A., MUELLBAUER J. (1980a). – *Economics and Consumer Behaviour*, Cambridge University Press, Cambridge.

DEATON A., MUELLBAUER J. (1980b). – « An almost ideal demand system », *American Economic Review*, 70, p. 312-326.

DIXIT A. (1975). – « Welfare effects of tax and price changes », *Journal of Public Economics*, 4, p. 103-123.

DRÈZE J.P., STERN N. (1990). – « Policy reform, shadow prices, and market prices », *Journal of Public Economics*, 42, p. 1-45.

FLORIO M. (2003). – « Does Privatisation matter? The performance of British Telecom over forty years 1960-2000 », *Fiscal Studies*, 24, p. 197-234.

FLORIO M. (2004). – *The Great Divestiture. Evaluating the Welfare Impact of the British Privatizations 1979-1997*, The MIT Press, Cambridge (Mass), forthcoming.

GALAL A., JONES L., TANDON P., VOGELSANG I. (1994). – *Welfare Consequences of Selling Public Enterprises: An Empirical Analysis*, Oxford University Press for the World Bank, Oxford.

GREENE W. (2000). – *Econometric Analysis*, Prentice Hall, Upper Saddle River, NJ.

GUESNERIE R. (1977). – « On the Direction of Tax Reform », *Journal of Public Economics*, 7, p. 179-202.

HARBERGER A. (1964). – « Taxation, resource allocation and welfare », in *The role of direct and in direct taxes in the Federal Riserve System*, Princeton University Press, Princeton.

JORGENSON D.W., LAU L.J., STOKER T.M. (1982). – « The Trascendental Logarithmic Model of Aggregate Consumer Behavior », *in* R. Basmann and G. Rhodes (eds.), *Advances in Econometrics*, JAI Press, Greenwich, Ct.

NEWBERY D.M.G. (1995). – « The distributional impact of price changes in Hungary and in the United Kingdom », *Economic Journal*, 105, p. 847-863.

NEWBERY D.M.G. (2000). – *Privatisations, restructuring and regulation of network utilities*, The Walras-Pareto Lectures, The MIT Press, Cambridge (Mass.)

RAY R. (1999). – « Marginal and non-marginal commodity tax reforms with rank two and rank three demographic demand systems », *Oxford Economic Papers*, 51, p. 689-712.

ROBERTS K. (1980). – « Price-independent welfare prescriptions », *Journal of Public Economics*, 13, p. 277-298.

STARRETT D.A. (1989). – *Foundations of public economics*, Cambridge University Press, Cambridge.

STERN N.H. (1987). – « Aspects of the General Theory of Tax Reform », *in* Newbery, D.M.G. e N.H. Stern (eds.), *The Theory of Taxation for Developing Countries*, Oxford University Press, Oxford, UK.

WADDAMS PRICE C. (2003). – « L'impatto delle privatizzazioni sui consumatori britannici », *Economia Pubblica*, 33, p. 77-93.

WADDAMS PRICE C., HANCOCK R. (1998). – « Distributional Effects of Liberalising UK Residential Utility Markets », *Fiscal Studies*, 18, p. 295-319.

APPENDIX

In this appendix we must show that

$$\widetilde{b} = \widetilde{d}_i - 1 \tag{A.1}$$

As it was seen in the previous section, with a coefficient of inequality aversion equal to 1 the social weights can be set equal to $\beta^h = 1/E^h$. Then, let us note that the covariance term $\widetilde{b}$ in equation (15b) can be rewritten as:

$$\widetilde{b} = \frac{1}{H}\left(\overline{\frac{\partial x_i^h}{\partial q_i}}\right)^{-1} \sum_{h=1}^{H} \frac{\partial x_i^h}{\partial q_i} \frac{\beta^h}{\overline{\beta}} - 1\,. \tag{A.2}$$

The application of the relationships between the parameters defined by equation (20) yields:

$$\widetilde{b} = \frac{1}{H}\left(\overline{\frac{\partial x_i^h}{\partial q_i}}\right)^{-1} \sum_{h=1}^{H} \frac{1}{q_i^2}\left(c_i^h - w_i^h\right) E^h \frac{\beta^h}{\overline{\beta}} - 1\,. \tag{A.3}$$

Without loss of generality we can set $\overline{\beta} = 1$.[29] By substituting the $\beta^h = 1/E^h$ into the previous equation we therefore get,

$$\widetilde{b} = \frac{1}{q_i^2}\left(\overline{\frac{\partial x_i^h}{\partial q_i}}\right)^{-1} (\overline{c}_i - \overline{w}_i) - 1\,. \tag{A.4}$$

From equation (19), remember that the following relationship holds:

$$\overline{\eta}_{x_i^h, q_i} = \overline{\frac{\partial x_i^h}{\partial q_i}} \frac{q_i}{\overline{x}_i} = \frac{1}{\overline{w}_i}\overline{c}_i - 1\,,$$

from which:

$$\overline{\frac{\partial x_i^h}{\partial q_i}} \frac{q_i}{\overline{x}_i} = \frac{(\overline{c}_i - \overline{w}_i)}{\overline{w}_i} \tag{A.5}$$

Solving by $(\overline{c}_i - \overline{w}_i)$ and substituting into the covariance expression we therefore get:

29. In this case we also have $d_i = \widetilde{d}_i$.

$$\widetilde{b} = \frac{1}{q_i^2}\left(\overline{\frac{\partial x_i^h}{\partial q_i}}\right)^{-1}\overline{\frac{\partial x_i^h}{\partial q_i}}\,\frac{q_i}{\overline{x}_i}\overline{w}_i - 1\,,$$

from which

$$\widetilde{b} = \frac{1}{\overline{x}_i H}\sum_h \frac{x_i^h}{E^h} - 1\,.$$

By using the value $\beta^h = 1/E^h$ arising from the hypothesis $e = 1$ we have:

(A.6) $$\widetilde{b} = \frac{1}{X_i}\sum_h x_i^h \beta^h - 1\,,$$

that is, remembering the definition of distributive characteristic,

(A.7) $$\widetilde{b} = d_i - 1.$$

Q.E.D.