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DISTRIBUTIONAL EFFECTS OF PRICE REFORMS IN THE ITALIAN UTILITY MARKETS

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ABSTRACT

In this paper we analyse some distributional effects of the reforms of water and energy services in Italy. We first document the new regulation setting in these services, illustrating the dynamics of utility prices and of household expenditure in the period 1998-2005. We then propose a way to measure the affordability of public utilities, in order to investigate how many households would incur a potentially excessive burden, if they consumed a minimum quantity of utility services.
Finally, we calculate this index on data from the 'Survey on Family Budgets'. Our results show how the affordability of utility bills varies from region to region depending on climate, income, family endowment and size. The analysis – also based on a counterfactual exercise – finds that so far, utility reforms do not seem to have produced any negative effects on weaker households.

Keywords: Affordability, Public Utilities, Regulation, Gas, Electricity, Water
JEL: D12, L51, L97

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1 Introduction

In Italy, as in other European countries, regulatory reforms of public utilities have been implemented since the beginning of the Nineties. Progress in European integration, technological development and the deterioration of public finances have been the main driving forces of this process. Moreover, the importance of competition as a factor which fosters price decreases and promotes efficiency has been more widely recognised, while the natural monopoly and competitive elements are more clearly distinguished. Sometimes, there has also been a change in ownership from public to private hands.

Public utilities are often essential services and fairness considerations make it particularly desirable that prices are affordable. Indeed, as a household's expenditure in utility services increases with income, but less than proportionally - the elasticity of demand to income is positive, but typically very low – tariff changes produce relevant distributional effects. Therefore, reforms must strike a balance between the pursuit of efficiency and equity.

In this paper we firstly document the development of Italian liberalisation reforms in water and energy and we present the dynamics - in the period 1998-2005 - of prices and household expenditure for these utilities. We then propose a definition of "utility affordability", and we investigate whether there is an affordability problem for public utilities in Italy, how this problem varies in different areas and how it has developed after the introduction of the reforms.

Our results show that in this period water prices have increased substantially, while changes in energy prices remained below the dynamics of available cost indices. The number of households which have affordability problems seems to vary from year to year depending on price changes (in particular, the price of gas). This number in 2005 was lower than in 1998. We then carry out a "counterfactual" analysis, in an attempt to compare the actual result to what may have happened without the reforms. The result of this exercise is that utility reforms and the behaviour of the regulators seem to have been effective tools to defend consumers.

This analysis mainly contributes to two research areas. The first investigates the effects of regulatory utility reforms on households. The distributional impact of reforms in specific utility sectors was assessed by Wolak (1996) for US telecommunication, by Waddams Price and Hancock (1998) and Waddams Price (2005) for UK energy markets, by Gòmez-Lobo (1996) for the UK gas market.[1] McKenzie and Mookherjee (2003) analyse the effect of privatisation and

[1] Florio (2004) analyses more general welfare consequences of the whole UK privatisation programme.

restructuring of private utilities in four Latin American countries, showing how the effects on consumers were quite mixed, but usually favourable. This literature has not treated recent Italian regulatory reforms in the public utility sector and we aim to fill this gap, investigating the most interesting cases of basic utilities for households such as water, natural gas and electricity.[2] In these sectors, the public concern for the consumers is strong, but reforms have established the principle that prices should cover costs but additionally that firms should be given an incentive to be more efficient. This quite naturally raises a question of whether consumers suffer from the elimination (or reduction) of public subsidies, or rather benefit from greater efficiency, and of how these possible costs and benefits are spread across the population.

Our paper also contributes to the definition of an affordability measure for utility services consumption. Several papers and government reports highlight that it is very difficult to define suitable indicators to describe how many households are unable to afford a minimum quantity of these essential utilities. Basically, this is because such issues emerge from the interaction of many factors, such as low income, high prices, high fuel consumption (possibly due to poor thermal efficiency of housing[3]), or to climatic conditions, which affect both fuel and water consumption.

Operationally, the British Government[4] assumes that "a household is in fuel poverty if, in order to maintain a satisfactory heating regime, it would require to spend more than 10% of its income on all household fuel use" (DEFRA, 2001). Referring to water affordability, in 1999 the British Government firstly suggested "for illustrative purposes" to look at the number of households that spend more than 3% of their budget on water bills: this threshold is about the 1999/00 average ratio of the expenditure on water charges over income of the households in the three lowest-income decile groups. The US Environmental Protection Agency (1998) documents the use of different water affordability thresholds ranging from 1% to 2.5%. In both the UK and the US definitions, the thresholds do not refer to any minimum quantity of water considered necessary to avoid health risks and social exclusion.

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[2] Italian liberalization reforms also affected postal services, telecommunications, and transport that we have excluded here. Postal services are little used by families (and only slightly more by firms). Telecommunications are heavily liberalised, and competition – although limited by the presence of a dominant firm – operates quite widely, and consumers benefit from considerable service improvements as well as price decreases. This can now be considered a competitive sector (although with notable imperfections) where social concerns takes a secondary role. Public transport is however way behind, both locally and nationally. Restructuring of the train service has only just begun, with mainly cosmetic interventions on the dominant firm, absence of clear regulation (prices are still set by a Governmental body with very obscure criteria), and only an embryo of competition for the market; public subsidies in this sector are still widespread, and market orientation is a principle present only on paper.

[3] See Healy (2001) for a cross country comparison of the relative importance of these factors.

[4] See Sefton (2002) for a detailed discussion of the cost-effectiveness of the British Home Energy Efficient Scheme.

To the best of our knowledge, there is no official definition of water affordability and fuel poverty in Italy. To fill this gap, we have started our analysis by estimating the average family expenditure for water, gas and electricity on the data of the official Survey on Family Budgets: such figure amounts to 5-6% of family's total expenditure and varies both with income and with climatic conditions. Moreover, while electricity prices for small consumers are nationally uniform, the variability of water and gas prices across Italian regions is very substantial.

Given this heterogeneity, we have proposed a definition of an affordability index, which we differentiate by family size and climatic area. More precisely, we identify regional specific reference expenditures which refer to the standard consumption of poor households in different climatic areas. We show that about 15% of Italian families face an affordability problem for at least one of the services considered. Given the minimum consumption level defined by the affordability line at the beginning of the period considered, we then investigate how the phenomenon of utility poverty evolves over time due to price and income variability. This indicates that over the period 1998-2005 the restructuring of Italian utilities has not damaged consumers, especially in the energy sectors. We document that this finding is robust to the strategy adopted to measure the welfare changes of the consumers

We finally run a counterfactual analysis, trying to predict how prices would have changed, had they followed the same price rules in place without the reforms, which were a mixture of cost-plus and of simple indexing to inflation. Although based on several assumptions, this simulation allows us to build counterfactual affordability indices on the basis of counterfactual prices. This shows that the number of families with affordability problems would have been higher, had the reforms not been implemented.

Our results also contribute to the widespread debate on the effectiveness of utility reforms in Europe and elsewhere[5]. In the first place, we document the difficult combination of European Directives and national implementation plans, where local constraints play a major role. The presence of a national regulator for energy stands in sharp contrast with the highly decentralised price setting regime for water services – and our results confirm that the former structure is considerably more effective. Moreover, we show how regional differences should be used to make affordability analyses more accurate. Finally, the Italian case has the advantage of starting from a heavily controlled system, such that prices without reforms could be highly predictable,

[5] See Domah and Pollitt (2001) and Joskow (2006) as examples of the numerous contributions on the theme.

and the counterfactual analysis proves free from several shortcomings which affect other attempts.

The paper is organised as follows. Section 2 briefly describes the development of the liberalisation reforms in Italy and the new regulation for the water and energy sectors. Section 3 illustrates the Italian data and the first descriptive analysis of utility prices and household expenditure in the period 1998-2005. Section 4 describes the methodology of our analysis and introduces the affordability index we use. Section 5 shows the main results on the distributional effects of utilities reforms, while Section 6 contains the counterfactual exercise. Section 7 presents some policy implications and concludes the paper.

2 Utility reforms in Italy

The privatisation and liberalisation of utility sectors started in Italy with a degree of caution, given that this country has been traditionally attached to public ownership of utilities and direct control of services. Let us first briefly discuss the fundamental features of the reforms of the Italian water, electricity and gas sectors, focussing mainly on how these reforms have affected price changes and showing trends in utility prices.

2.1 Water

The water service in Italy has always been considered a local public service, and only since 1990 – with Law 142/90 - could the service be provided by limited companies. The sector is extremely fragmented, and data have always been little more than approximations, but it is reckoned that in 1996 about 8,100 independent subjects were managing at least one part of the water service in Italy (from abduction to purification and disposal).[6] Since 1945, water prices have been determined locally and approved at a national level; traditionally, they have been extremely low and were adjusted to a very limited extent until 1974-75, when high inflation led to a cost-plus regulatory system. Since the second half of the 80s, water tariffs increased in waves: between 1984 and 1987 they were determined according to planned inflation, while between 1987 and 1994 - given the large deficits of local managing bodies – they were allowed to grow at a greater rate to recover the cost of service.

In 1994, the Italian water and wastewater services system was thoroughly reformed by Law 36/94 (the so called “Galli Law”) to give water companies better incentives for efficient

[6] Bardelli and Muraro (2003).

production and pricing. The key elements of this reforming law were a) the *functional integration* of all the activities of the water cycle into an "integrated water service"; b) *territorial integration*, through the definition of Optimal Territorial Basins (ATO) of relevant size, aimed at exploiting economies of scale and scope where a single operator should manage the whole integrated service under the supervision of a regulatory local Authority; c) the distinction between planning and control on one hand, and management on the other one, in order to promote the entry of private operators (competition *for* the market)[7]. As for prices, each ATO could choose between a new tariff system and the old one set by the Government in 1995.[8] The implementation of the reforming law started slowly, but then significantly accelerated after 2001 due to correlated legislative action and judicial decisions.[9] By June 2005, 87 out of 91 ATO, corresponding to 97% of the Italian population, had an operative local authority. Moreover, half of them implemented the new tariff system, while the remaining still adopted the Government's (CIPE) tariff system.

According to the reforming law, the new tariff was adjusted with a price-cap mechanism that limited annual increases of the ATO average tariff and allowed the concession to cover the cost of capital and have a return on investment. In particular, the tariff scheme incorporated operating costs (net of a 0.5-2% annual efficiency gain), including depreciation of assets and a 7% return on investment. Thus, the new tariff applied the "full cost recovery principle", which - along with the high level of investment planned for the whole integrated water service[10] - caused substantial increases in tariffs.

2.2 Energy

2.2.1 Natural gas

The main feature of the Italian market for natural gas is the presence of a strong dominant firm (Eni). The Italian liberalisation plan (Law 164/00) was approved in August 2000. Although the decree contains several relevant elements, those likely to have a direct impact on prices are the following:

In order to restrain the market power of the dominant firm, only a legal separation of the different activities within the Eni group was decided, which however left the dominance of Eni

[7] For a detailed description of the Italian water reform see Muraro (2001)
[8] Details about the latter system can be found in Section 6.
[9] For a discussion see OECD (2004), p.119-121; Muraro and Valbonesi (2003).

unchallenged. Third parties could have access to infrastructure on the basis of tariffs defined by the regulator according to a non-discriminatory and cost reflective standard. Mild antitrust ceilings were introduced in the interim period of liberalisation (no operator can inject more than 75% of total gas consumption into the national transport network – a threshold to be gradually reduced to 61% in 2010 – or sell more than 50% of total gas consumption to final customers). Since January 2003, all customers are eligible and the market is completely open.

The transition towards a genuinely competitive environment is extremely slow. This is due to the existence of long term contracts which still allows the incumbent to control the market. The partial unbundling of the Eni group that operates in all industrial segments, maintaining an extremely high market share in each, is the most pervasive problem in the liberalisation process. Moreover, given the almost total dependence of Italy on imports, the link between energy and foreign policy remains strong. In distribution, concentration has increased through mergers and the gradual disappearance of direct service provided by local authorities. Out of the 732 distributors active in 1997, in 2006 little more than 300 survive.

Although the timetable of demand opening has been quick, only in late 2004 has some competition for small customers been effectively started in certain areas. Therefore, the authority still maintains price control for small customers (lower offers are allowed). Since 2001, final prices are regulated with a price cap (*RPI-x*) revised every four years. The price formula is aimed at covering all costs from wholesale to local distribution, and it contains uplift elements, which aim at compensating firms for “unpredictable” events and at rewarding them for their activities of demand control and for quality improvements.

2.2.2 Electricity

Until 1999 the Italian electricity market was characterised by a vertically integrated dominant firm, Enel, with a dominant position in all market segments. In the downstream segment some small, local public utilities were present, especially in large cities in the centre – north of the country. All customers before 1999 were forced to buy electricity from their local distributor at a uniform national tariff.

The implementation of the EC Directive on electricity was given by Law 79 in February 1999. Access to the transmission network is now open to third parties on the basis of conditions

[10] A recent investment forecast by the *Comitato di Vigilanza sull’Uso delle Risorse Idriche* (the National Authority) for the integrated system for water service is about 51 billion euro, where about 28 billion euro are in the sewage and treatment segments (Co.Vi.Ri, 2004, p.2)

set by the regulatory Authority.[11] Since 2004 the wholesale market has been organised as a competitive pool market, along the initial British example. In order to reduce Enel's market power upstream, no firm is allowed to own more than 50% of total installed power or to sell more than 50% of total energy, including imports. Therefore, Enel formed three companies which have been sold in public auctions.

Between 1997 and 1999 all prices were still set administratively, but in this period the previous price system was "cleaned up", eliminating certain subsidies and clarifying the complex structure of charges and surcharges. Since 2000, large customers (defined as "eligible") face free final prices, while prices to small customers are subject to a price cap set by the national Authority (*RPI-x*) with uniform national prices. The thresholds for eligibility were established to accelerate the process of market opening relative to the dates set in the Directive. Since July 2007, all customers will be eligible, although domestic ones are "protected" by a regulated price cap.

Since 2004, prices in the wholesale segment are free. Since January 2000, prices of distribution and transmission are regulated according to a *RPI-x* system with an automatic pass-through of wholesale price increases to final prices to non-eligible customers. Distributors selling energy to non-eligible customers must buy the energy for these customers through a Single Buyer, a State controlled body.

2.3 Utility prices

While in electricity small customers still face the same price nationally, there are some relevant regional differences for other utilities. For instance, in water services the annual expenditure in Milan for 200 m^3/year in 2004, was less than half in Bari and Florence. Similar gaps occur in marginal prices. Moreover, as the tariffs specified for the future must cover investment costs including a return on capital, whenever large investments are planned, large increases in water tariffs are included. For instance, between 2004 and 2019 water tariffs will increase by 65% in Milan, 33% in Florence, 32% in Turin and 21% in Rome. A similar heterogeneity characterizes natural gas: considering a standard consumption of 1400m^3, the expenditure for natural gas in Palermo is about 33% larger than in Florence.

[11] According to the 1999 law, 'the management and full control of the transmission network' had to be in the hands of an independent system operator (the *Gestore della rete di trasmissione nazionale*, Grtn) which remained State owned, while the *ownership* of the network initially remained with Terna (a company of the Enel group). The unification of the

How has this system performed over time? While the new system determines tariffs which must cover large investments, in the energy sector prices should fall due to greater efficiency, but are also affected by international fuel prices and by competition limitations in the national upstream segments. The final outcome on the relevant monthly price indices from January 1998 to September 2006 is shown in Figure 1.

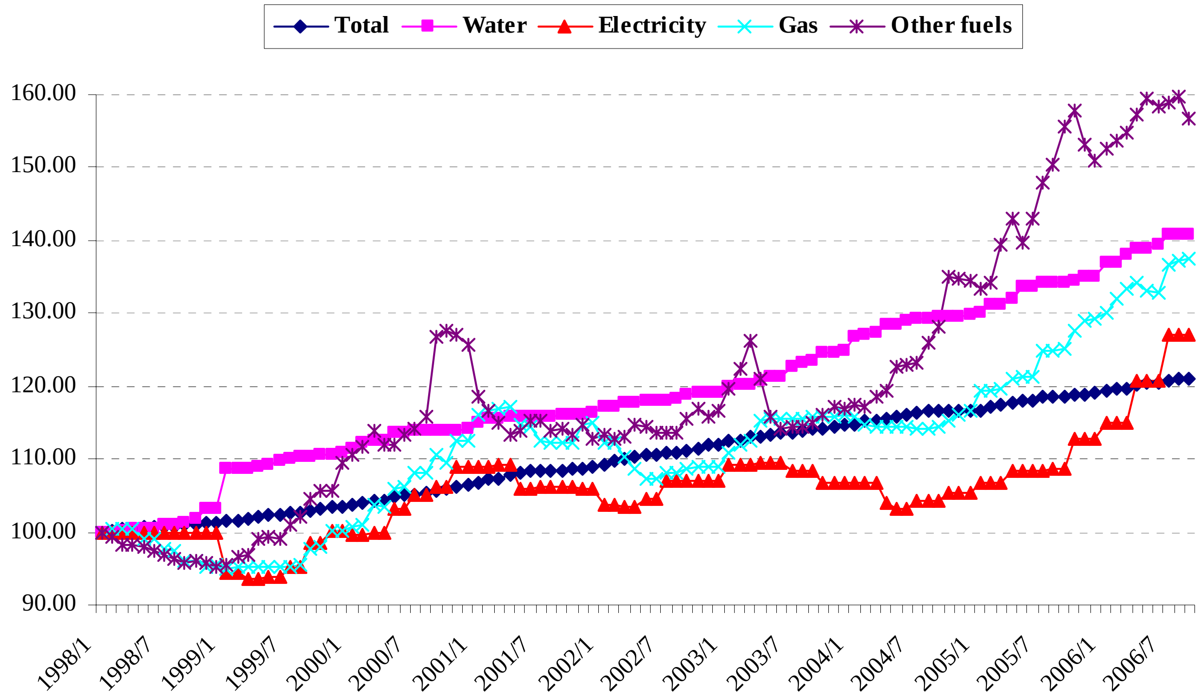

Figure 1: Price dynamics for basic utilities and for total household consumption. Source: Istat

Water charges increased by more than 35% during the period 1998-2005, while the average increase in the consumers price index was only 19%. The difference is to a large extent due to one episode in January 1999, with a sudden monthly increase of 5.3%.[12] After that episode, changes in water prices were almost in line with inflation until 2003. Since 2003, the growth rate of water tariffs has been significantly higher, basically due to the implementation of the reforming law and – specifically – of the adoption of the new tariff system in most of the country.

Since 1999, electricity prices follow an RPI-x scheme set by the energy authority but are revised upwards as fuel costs increase; they are revised bimonthly and sometimes have no

network owner and the system operator was completed in 2005; now no electricity firm owns more than 5% of shares of the system operator.

[12] This was due to the addition of VAT to the part of water price which covered sewage costs.

changes at all.[13] Gas prices must respect a similar constraint, although they are more closely related to international prices. While real electricity prices decreased over this period, gas prices have moved on average in line with inflation until 2004.

Prima facie, it would seem that the new regulation of the electricity sector has produced reasonable results for final consumers, while the new regime for water prices – a normalisation in the tax regime, a reduction in subsidies and the need to strengthen investments – required a clear price increase

3 The data

Our main data sources are the ISTAT Surveys on Family Budgets (SFB) from 1998 to 2005. These surveys (which correspond to the British FES and the CEX in the US, with independent samples of about 20,000 households per year, representative of the Italian population) provide detailed information on expenditure and demographics, some information on stock of durables and housing conditions, but no information on income. The data are collected by a face-to-face interview (plus a weekly diary) during which the households are asked whether the house they live in has potable water, electricity and heating (if yes, the technology adopted and fuel used). Households have to provide information about the amount of the latest bill for electricity and natural gas, and on the expenditure during the three months before the interview for water, other fuels (LPG, kerosene, diesel oil, coal and wood) and centralized heating. Data on ordinary and extraordinary maintenance works are collected for the three months before the interview. Information on main and secondary residences are clearly separable.

The ISTAT data allow us to assign (almost) every household to its region of residence, but not its city. Therefore, we only use variables defined at a regional level to describe climate conditions and infrastructural endowments. This is a limitation for our data, because more detailed information on the place of residence would allow us to understand the climate the household has to cope with and the infrastructure endowment it could exploit.[14] Since 1998, ISTAT provides local price indices for total expenditure for all the capitals of the administrative regions, and water, heating gas and diesel indices for 14 out of 20. We consider these indices as

[13] The index is characterised by a sudden drop of 5.7% in January 1999 due to the Authority's decision 161/98 which has reformed electricity prices, eliminating an extra fuel charge (the so-called component A1 of the final price).

[14] Within the same region, municipalities along the coast have a different climate than municipalities in mountain areas (e.g., Calabria or Basilicata), and the natural gas network is much less widespread in mountain areas.

representative of price dynamics for the whole region. We therefore use local price indices where available, and refer to the national price indices when the local information is missing.

3.1 *Utility expenditure across Italy*

Given that fuel and water consumption strongly correlate with climate conditions, much of the statistics we present are conditional on climatic regions. We operate on the basis of the official *Degrees-days* index,[15] and we group the 20 administrative regions into four classes:

1. **warm regions**, with average degrees-days index not greater than 1300 (Campania, Sicily and Sardinia, 19.2% of Italian households)
2. **tepid regions**, with average degrees-days index between 1300 and 1800 (Liguria, Lazio, Puglia, Calabria, 21.6% of Italian households)
3. **cool regions**, with average degrees-days index between 1800 and 2300 (Tuscany, Umbria, Marche, Abruzzi, Molise and Basilicata, 12.9% of Italian households)
4. **cold regions**, with average degrees-days index above 2300 (Piedmont, Valle d'Aosta, Lombardy, Trentino Alto Adige, Veneto, Friuli Venezia Giulia and Emilia Romagna, 46.4% of Italian households)

Consumption levels are strictly related to the heating technology and to the networks the households can rely on; our descriptive data analysis in a related paper[16] show large heterogeneity in these areas. In particular, in the cold, northern regions households have better natural gas, electricity and water networks; home ownership is more frequent, which might cause more extraordinary maintenance work and have better walls, floors and frames. In warmer regions, single family houses are more common, overcrowding[17] is more likely, 2% of dwellings do not have potable water and in 2005 18.4% do not have any heating system. The housing stocks of warmer and tepid regions are poorer (and, probably, less efficient) than those of the cool and cold regions, and differences in climate explain only part of this heterogeneity.

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[15] This index is defined by the Italian law as the sum, over the conventional period the heating is on, of the positive differences between 20 C^{o} and the external temperature, that is $\sum_t (20 - T_t) \times 1(20 > T_t)$, where T_t is the average external temperature for day *t*. The index is produced by ENEA (National Body for Energy and Environment) at municipal level and it is the official index the authorities look at to define the periods when households are allowed to use their heating systems. We calculate a regional index as the weighted average of municipal indices, with weights given by municipal population.

[16] Miniaci, Scarpa e Valbonesi (2005), p.22, tab. 5.1.

[17] Eurostat defines a household to live in a overcrowded accommodation if the ratio between number of cohabitating persons and number of available rooms is greater than one.

Moreover, concerning household technological endowment, the Survey on Family Budgets shows that almost all households have a fridge and a washing machine, while other appliances are not so common, which might cause heterogeneity in energy consumption. In 2005, only 1.6% of the families in the cold area use room-specific appliances to heat their houses, while this fraction amounts to 32% in the warm area; about 80% of the heating systems in the cold area use natural gas, and more than one half of the households rely on joint production of heating and hot water, in the warmer regions, the use of LPG, coal, wood and electricity for heating is widespread, and the electric boiler is used by more than 50% of the households to heat the water. The percentage of households with a dishwasher is 42% in the cold area and only 19% in the warm; finally, about ¼ of households own an air conditioning system in the warm and in the cold area, versus a 13% in the cool area.

Table 1 provides a picture of total household expenditure based on our calculations, like other tables unless otherwise specified,[18] and specific expenditure for water, electricity, natural gas and other fuels (LPG, heating gasoil, coal and wood), in 2005. We always calculate the statistics on utility expenditure considering only those households that reported some expenditure at the interview.[19] While water and electricity are used by almost 100% of the population we divide the users for gas and fuels between those for which natural gas is the main source of heating and the others (which may however use gas for cooking and/or as secondary heating sources).

The living standards of the areas result are differentiated greatly: in 2005, the average expenditure per capita in the northern cold regions is 72% higher than in the (southern) warm part of Italy. These differences are not necessarily reflected in utility expenditure: in 2005, individuals in warm regions spent about 17% less for water than individuals in the cold area, but about 10% more in electricity. When we consider heating fuels expenditure, the average per capita expenditure for heating in the cold area was 2.3 to 3.5 times the one in the warm area, depending on fuel type.

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[18] We follow the official definition of economic consumption, and therefore we refer to total expenditure, net of any mortgage refunds, life insurance and private pension premium, and expenditure for extraordinary maintenance works.

[19] For natural gas and electricity the amount of the last bill is asked (whenever it was paid), but for water and other fuels the households are asked to report the amount spent during the last 3 months. As the billing frequency is not controlled by the consumers, we can consider the statistics computed for the sub-sample of respondent with positive expenditure to be consistent estimates for the whole sample of users.

Table 1: Monthly per capita expenditure of Italian households, 2005 averages.

			Natural gas		Other fuels		
	Water	**Electricity**	Households using natural gas as main heating fuel	Other households	Households using other fuels as main heating fuels	Other households	**Total expenditure**
Warm	6.79	16.53	16.92	10.41	16.13	8.00	652.46
Tepid	7.44	15.24	23.92	17.13	28.76	16.71	853.77
Cool	8.93	14.84	34.84	21.98	49.80	29.55	939.18
Cold	8.15	14.98	38.10	17.53	56.27	33.63	1,122.03
Italy	7.86	15.35	32.11	15.62	32.92	18.72	936.70

Family size is crucial to understand to what extent households can exploit “economies of scale”. This is particularly true in our case as utilities are mainly devoted to the production of (intra-household) public goods, such as lighting and heating. Considering Italy as a whole, the 2005 per capita expenditure for water in a 4 member family was only 65% of the per capita expenditure of a couple. The same ratio was 72% for electricity, 55% for natural gas and other fuels (see Miniaci *et al.* (2005) for further details). But the total expenditure of larger households is higher, and all utilities have increasing block tariffs, so that larger households may face higher marginal prices.[20]

3.2 The period 1998-2005

Over the period covered by our analysis, the Italian economy experienced years of income growth as well as a period of recession (the first two quarters of 2003). The survey data document an increase in total family expenditure between 1998 and 2000, a decrease in 2001 and 2002, especially for warm and cold regions, and an increase again in 2003 and 2004.

When we consider the dynamics of utility expenditure between 1998 – 2005, we also have to take into account three relevant changes during this period. First of all, a greater diffusion of

[20] This raises a fairness and an efficiency issue for the block tariffs which do not take into account family size.

natural gas: currently, more than 92% of the Italian population is reached by the gas network.[21] Second, among those served by natural gas, various households changed their heating systems from other fuels to natural gas: overall, the percentage of households using heating diesel to heat their homes more than halved between 1998 and 2005, while the fraction of households using natural gas for heating increased from 63.5% to 72.8% during the same period. Third, the composition and size of the stock of electric appliances owned by households changed over time: the fraction of families using air conditioning increased from 7% to 23%, while the percentage with an electric boiler changed from 30.1% to 21.9%.

In Table A1 in the Appendix we analyse households' expenditure both in current and in constant 1998 prices. We deflate the expenditure in each utility with the commodity specific price index[22]. We use local consumer price indices for total expenditure, and, where available, for water, gas and diesel. We use the national consumer price index for electricity (as we have a single national price) and for those regions for which local information are not available.[23]

The figures at 1998 prices show that in 2005, total per capita expenditure in utilities is 4% higher than the 1998 expenditure. Electricity is both the only utility whose expenditure almost regularly increased since 1998, and whose weight on the family budget increased most in real terms (from 1.4 in 1998 to 2.0 in 2005, see Table A2)

4 Methodology

The analysis in Section 3.1 clearly indicates that an approach to the affordability problem based on a unified national criterion for all regions runs the risk of introducing large biases. Here, we suggest a way to incorporate regional differences into the analysis, and to define a plausible minimum threshold. Therefore, we first need to define the minimum "reference" expenditures. We have two possibilities:

a) to adopt the absolute poverty framework and refer to medical and/or physical parameters to define the minimum quantity of service;

b) to work in a relative poverty framework, and thus define the minimum quantity as that considered acceptable not to be "socially excluded".

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[21] Between 1997 and 2002, the number of households served by natural gas networks increased by 33% in Calabria, 21% in Molise and Sicily, 18% in Puglia, 16% in Basilicata, and 12% in Trentino Alto Adige. Data from Ref (2004).

[22] For "other fuels" we calculate the expenditure at 1995 prices using the "other liquid fuels" CPI if diesel oil or LPG, and the total expenditure CPI for coal and wood.

The first option, adopted in Britain for the definition of fuel poverty[24], is difficult to apply to Italy as there are no households surveys useful to estimate a reference basket in physical terms. We therefore follow the second approach. In order to build an index to measure affordability for public utility services, we then proceed in three steps.

1. **The reference basket for utility services.** For each utility *i*, area *A* and family size *n*, we take as a standard the median expenditure (at 1998 price) of those households falling below the (national) relative poverty line during the period 1998-2005 as a standard. By doing so, we focus on the households which are most vulnerable because of their income levels, but we consider that their needs are heterogeneous, due to their different regions of residence. This defines our reference point $\overline{q}_{i,98}^{nA}$ (and implicitly it determines a "*reference basket*" for utility services). These quantities are defined once and for all. We then use the reference basket to define the potential utility bill.
2. **The potential utility bill.** For each year we update the cost of the reference basket in order to determine how much each family (given its size and the area of residence) *would spend* to acquire the reference basket. This defines the "*potential bill*" in utilities for each year. For each household, we calculate the ratio between this potential bill and the actual total expenditure, and we label those households with values for a ratio above a certain threshold (see below) as "households with affordability problems". Formally, if E_{jt}^{nA} denotes total expenditure at time $t = 98, \ldots, 05$ of family j whose size is n and which lives in area A, the family faces an affordability problem at time t for service i if

$$\frac{p_{i,t}\overline{q}_{i,98}^{nA}}{E_{jt}^{nA}} > r_i$$

   where $p_{i,t}$ is the current price of service i and r_i is the critical threshold for utility i.

3. **The affordability threshold.** Finally, we use the reference basket in order to define the threshold r_i. We define this value as the median *potential bill to total expenditure ratio* ($p_{i,t}\overline{q}_{i,98}^{nA} / E_{jt}^{nA}$) of those households falling below the national relative poverty line in 1998-2005.

[23] Local price indices for utilities are not available for Trentino Alto Adige (4% of the population of the cold area), Calabria (15% of the population of the tepid area) and Abruzzo, Molise and Basilicata (27% of the cool area).

[24]This is what the British government does by estimating the cost *"to maintain a satisfactory heating regime"*, which in turn is set by the World Health Organization, and by using it in its definition of fuel poverty. The Italian Poverty Commission (Istat, 2004) uses a similar approach for food.

We then define the affordability index as the fraction of households living in the area *A*, whose ratio $p_{i,t}\overline{q}_{i,98}^{nA} / E_{jt}^{nA}$ falls above the threshold r_i

$$AP_t^A \equiv \frac{1}{n_A}\sum_{j=1}^{n_A} 1\left(\frac{p_{i,t}\overline{q}_{i,98}^{nA}}{E_{jt}^{nA}} > r_i\right),$$

where n_A is the total number of households living in the area. Thus, AP_t^A is a headcount index in which the value of the potential bill is area specific, while the threshold is nationally defined. It takes into account the fact that climatic conditions, technological endowments and household production economies of scale may vary across different areas, but at the same time is not affected by the differences in income across areas.

Notice that we do not consider whether the *actual* consumption of a household is affordable or not, but whether the standard quantity $\overline{q}_{i,98}^{nA}$ – which could be larger or smaller that the quantity actually consumed by the household *i* of size *n* – could be purchased without budget problems. In doing so, we avoid including those households which spent a lot due to “above standards” (given their size) consumption levels among the “households with affordability problems”. In the same way, we instead include households with “under-consumption”, a phenomenon which may characterize poor households who spend little because of tight budget constraints.

The index AP_t^A is useful for the specific policy measures of each utility service. It highlights when, where and to what extent households face an affordability problem for a specific utility. In this way, it would allow policy makers to target local assistance programmes or tariff reshapes better. However, note that the index AP_t^A, like all headcount indices, does not provide any information either on the intensity of the affordability problem, or on the distribution of losses or gains over the whole population. In order to provide a complete picture of the evolution of the affordability issue we also analyse the full distribution of the *potential bill to total expenditure ratio* and compare it across time and areas.

5 The affordability problem in Italy

5.1 Defining the thresholds

Our reference basket is defined as the median expenditure for the utilities, conditional on family size and area of residence, of those households falling below the (national) relative poverty line. The cost of that basket is then updated each year using current prices. Table 4 below reports the values of the reference baskets in 1998.

Table 4: The cost of standard consumption levels of water, electricity, gas and other fuels, by family size and area, 1998 prices, Euro.

		Warm	
# family members	Water	Electricity	Heating
1	6.79	16.09	8.49
2	10.02	22.77	14.00
3	11.81	29.70	15.96
4	13.53	36.46	20.36
		Tepid	
# family members	Water	Electricity	Heating
1	7.70	14.02	12.75
2	10.36	18.70	19.69
3	11.76	24.31	24.17
4	14.24	31.02	27.97
		Cool	
# family members	Water	Electricity	Heating
1	6.94	12.91	22.08
2	9.69	17.75	26.90
3	11.17	22.23	30.16
4	13.26	28.08	39.42
		Cold	
# family members	Water	Electricity	Heating
1	5.16	10.76	22.77
2	7.57	17.02	33.17
3	10.62	20.93	37.21
4	12.05	25.71	45.50

It is worth stressing that these are the median monthly expenditure of relatively poor households, and that more than 80% of these households have pre-school children and/or a pensioner and/or a housewife. That is, we can consider these as representative expenditure of a low income household with intensive home use. With this definition, the amount considered socially acceptable for heating in the cold area is more than the double of the corresponding amount for the warm area, the standard electricity consumption is the highest in the warm area and the water reference expenditure is almost constant across all areas.

To obtain the threshold shares, to which we defined the affordability headcount index, we calculate the ratio between the amounts in Table 4 and total family expenditures and take its median value for those households falling below the national relative poverty line. Table 5 shows these estimates, which can be read as follows: a family is in fuel poverty if the ratio between its reference expenditure for heating - see Table 4 - and its total expenditure is above 3.15%.

Table 5: Threshold budget shares for water, fuel and electricity poverty

	Water	Electricity	Heating	Total utilities
Threshold potential budget shares (%)	1.44	3.09	3.15	7.86

Compared to other thresholds (see Frankhauser and Tepic, 2006) the figures in Table 5 are remarkably lower. Standard benchmarks are 10% for electricity, in the 2.5-5% interval for water and they range from 6% to 20% for heating. These differences can be due to the fact that most of these thresholds refer to developing or transition (low-income) countries and they are not caused by the choice to use a reference expenditure. In fact the corresponding median budget shares for actual utility bills are very close to those in Table 5: 1.4% for water, 3.1% for electricity, 3.4% for gas and 7% for total utility bill. As any threshold choice is debatable, we provide evidence that none of our main results depends upon this threshold.

5.2 The measurement of the affordability problem

Having defined the reference expenditure in utility services and the appropriate affordability thresholds, we can now see how the problem evolved. According to our definition, in 1998 about 6.4%, 7.2% and 10.2% of Italian households were in water, electricity or fuel poverty respectively (see Table 6), the overall potential utility bill was unaffordable for 6.3% of the households. Overall, about 3.1 million households (14.8% of the households; 7.1 million individuals, 13.1% of the population) had an affordability problem with at least one of the utility considered, 915,000 living in the warm regions, 1,314,000 in the cold ones (see Table A6 in Appendix)[25].

[25] In the UK there were 5.5 million households in fuel poverty in 2001, DEFRA (2001).

Table 6: Percentage of households with affordability problems by utility and year

Year	Water	Electricity	Heating	Total utilities expenditure	At least one
1998	6.43	7.20	10.20	6.35	14.82
1999	7.65	6.21	10.64	6.48	15.03
2000	6.68	6.89	13.60	7.32	17.26
2001	6.67	7.23	14.26	7.45	18.65
2002	6.19	6.06	11.41	6.21	15.27
2003	5.43	5.46	11.03	5.69	14.52
2004	5.70	4.67	9.90	5.12	13.07
2005	5.24	4.73	11.88	5.59	14.71

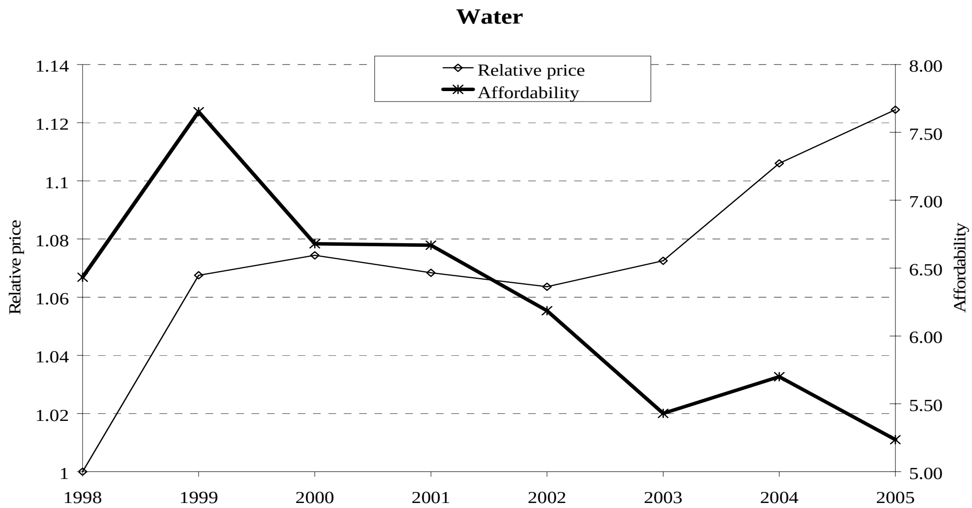
Seven years later, in 2005, only 5.2% and 4.7% of the households were in water and electricity poverty respectively, while 11.9% had affordability problems with heating. Overall about 3.4 million households (14.7% of the households; 7.6 million individuals, 13.2% of the population) were facing an affordability problem with at least one of the utilities, 789,000 living in the warm regions, 1,658,000 in the cold ones.

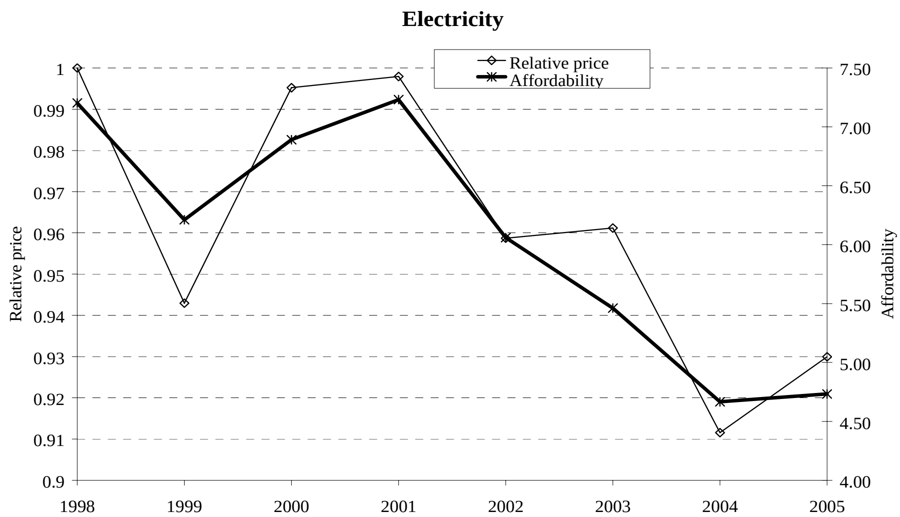
The fraction of households facing a potential affordability problem varies with family size and area: in 2005 about 9% of the households in the warm regions were "utility" poor, while this fraction was less than 4% in the cold area; heating was a problem for about 16% of the households of the cool and cold areas, but for less than 7% of the family in the rest of the country. The potential electricity bill was unaffordable for more than 17% of households in the warm area while it was almost always affordable for those living in the cold regions; water bills were a problem mainly in the warm and tepid area (see table A5 for further details).

The affordability of the total reference utility bill improved over time: it was hardly affordable for 6.35% of households in 1998 and for 5.6% in 2005. This improvement came after a dip between 1998 and 2001, mainly due to the increase of the index for the heating services.

Figure 4 shows the relationship between the affordability problem index calculated for each utility and its national relative price (relative to CPI). The affordability indices of electricity and heating are positively and strongly correlated with the relevant utility's relative price, while this is reversed for water.

Comparing the affordability levels in heating, water and electricity for the different Italian regions (aggregated as cold, cool, tepid and warm areas) in 2005 with those recorded in 1998 (see Table A4 and Table A5 in Appendix), we find that the largest relative increase was for heating in the warm area (the percentage of households with affordability problems almost doubled); while the largest improvement was electricity in the cold regions (from 1.4% to 0.4%). Looking at the total utilities bill, all areas have fewer households with affordability problems: the affordability headcount indexes reduced 5% in the warm and cold areas and more than 20% in other regions.





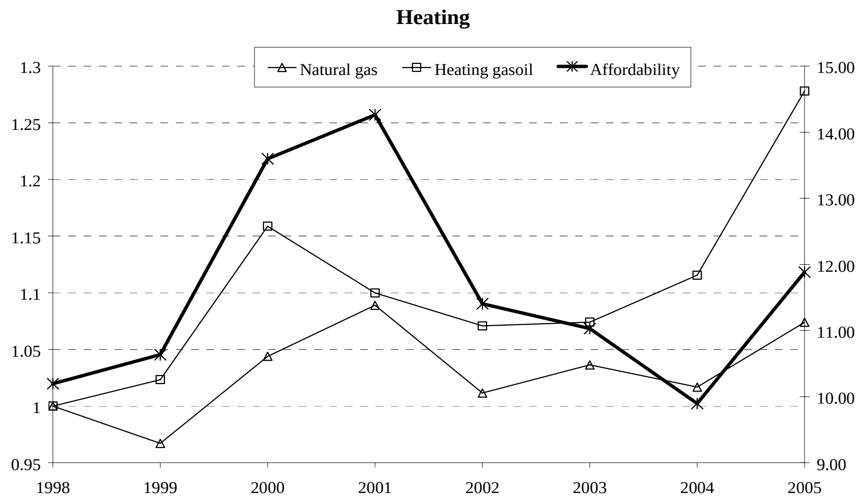


Figure 4: Affordability indices for water, heating and electricity and utility relative prices over time.

The analysis so far started from a given threshold, defined on the basis of the median consumption of poor households. In order to show that these conclusions are qualitatively robust to different specifications of the thresholds, we now show the distributions of potential and actual expenditures in different utilities and areas. Figure 5 allows us to analyse the total utility bill, while the situation for each utility is considered in the Appendix.

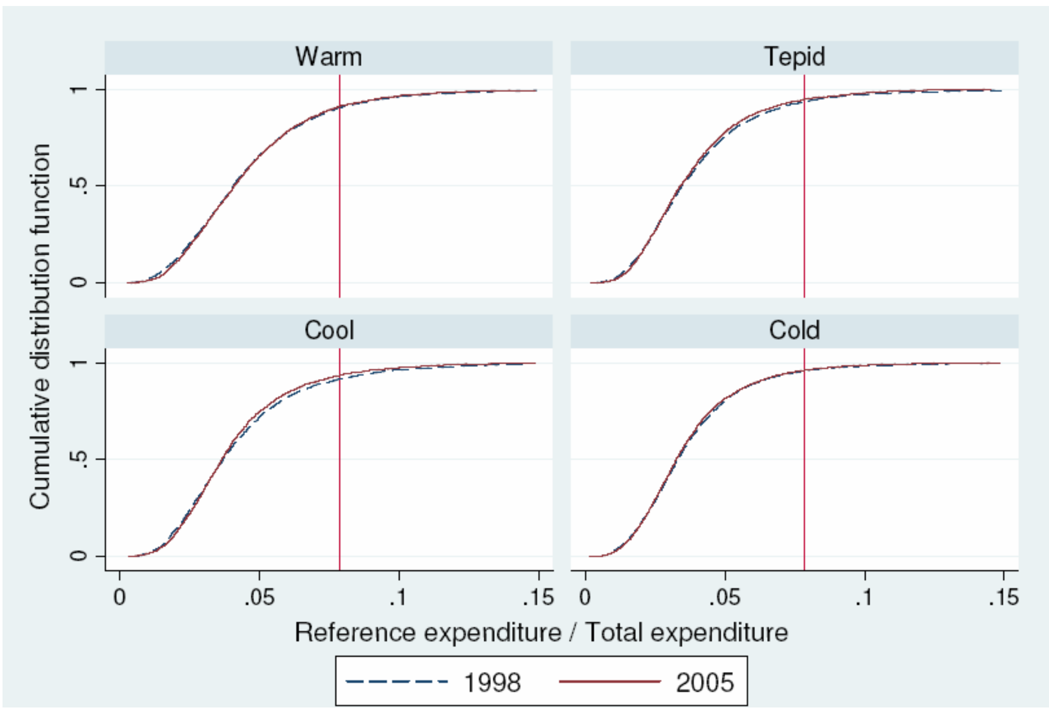


Figure 5: Cumulative distribution functions of the ratios $p_{i,t}\bar{q}_{i,98}^{nA} / E_{jt}^{nA}$ **for <u>the total utility bill</u>, 1998 vs 2005**

Comparing the whole distributions of the *potential bill* to total expenditure ratios, we can appreciate losses and gains during the period, and to see whether these changes affected the whole population or only part of it. In Figure 5 we compare the 1998 and the 2005 estimated cumulative distribution functions of the $p_{i,t}\bar{q}_{i,98}^{nA} / E_{jt}^{nA}$ ratios, the vertical lines correspond to the utility specific thresholds r_i. The headcount index we have used so far corresponds to the difference (vertical distance) between 1 and the value of the cumulative distribution function at r_i. Thus, Figure 5 can be read as follows: for each value of the "*potential bill* to total expenditure" ratio $p_{i,t}\bar{q}_{i,98}^{nA} / E_{jt}^{nA}$, at which the 1998 curve is above the 2005 curve, the fraction of households with an affordability problem increased, that is the utility affordability worsened. The estimated 1998 and 2005 curves are such that either the two almost overlap (Figure 5), or they do not cross each other (as in the case for electricity, Figure A2, and water and heating in the warm area, Figure A1 and A3). In the first case, we can say that the households welfare did not change during the period for that utility and that area. In the second case, one distribution dominates the other. The potential electricity bill has become more affordable for all households, for households living in the warm area water has become more affordable but less so for heating. Considering total utility expenditure, in Figure 5, as the curves overlap we can conclude that there were no significant changes in affordability between 1998 and 2005. Similar figures conditional on family size and area are shown in appendix (Figures A4-A7).

Notice that the situations in which affordability changes are not negligible are those in which the dynamics of that utility price significantly differ from the overall consumer price index. This is the case for electricity (see Figure 1), but also – especially in the warm area – for water (water tariffs were almost constant in all southern and island regions in 1998-2005) and heating (the price of heating gas increased more than 50% in Palermo).

So far we have documented what happened to Italian utility prices in the period 1998-2005, but we have not really made an evaluation of whether these changes in utility prices can be attributed to reforms. In order to tackle this issue, we need to study what *could have happened* without these reforms. This is the goal of the next section.

6 An attempt to design a "counterfactual scenario"

In order to bridge the gap between a description of "utility poverty" trends and an evaluation of policy reforms, we need to ask whether these reforms actually made a difference. However, the answer depends on "what could have happened", had the reforms not been put in place. This requires building a counterfactual scenario, where we conjecture price dynamics for utilities without any reforms. We are aware that any hypothesis in this direction is "speculative", but – given this – we consider the exercise anyway worthwhile.

To the best of our knowledge, this exercise has not been tried with Italian data. Similar attempts in this direction have been carried out on the US[26], where the reforms intervened in relatively open markets, and where a counterfactual exercise is thus particularly hard. Relative to the US, the Italian case has an important advantage. Before the reforms, all final prices were formed on the basis of fairly established rules. The main cost component for electricity (wholesale prices) was translated into final prices according to an index, which has been calculated even after the reform. Although the levels of imported gas prices are hard to know, the dynamics of international gas prices are fairly well known.

Therefore, in order to predict what prices could have been without the reform, the most plausible hypotheses on the dynamics of natural gas, water and electricity prices are simply the elements of a "business as usual" scenario, where prices are formed according to the rules which were in place before the Nineties' reforms. More precisely, specifically referring to each utility, we consider the following scenario:

1. <u>Electricity.</u> According to the regulator (see Aeeg, 2006), 2/3 of the total price of electricity for small customers depend on the wholesale price, while the remaining third covers other costs (transmission, distribution, taxes). Before the reform, the wholesale price was indexed to a parameter calculated by the Authority, the so called *CT* (cost of electricity production using fossil fuels). Other costs were typically covered ex-post, and we may assume that they could vary in line with inflation. Our counterfactual price thus changes according to a weighted average of the CT and of actual inflation, where the weights are those suggested by the regulator. In Figure 6, the Italian consumer price index for electricity is drawn along with the production cost index (*CT*) and our counterfactual price series. The consumer price did not absorb the changes in wholesale prices, and consumers were protected both from cost variability and probably from a high average wholesale price.

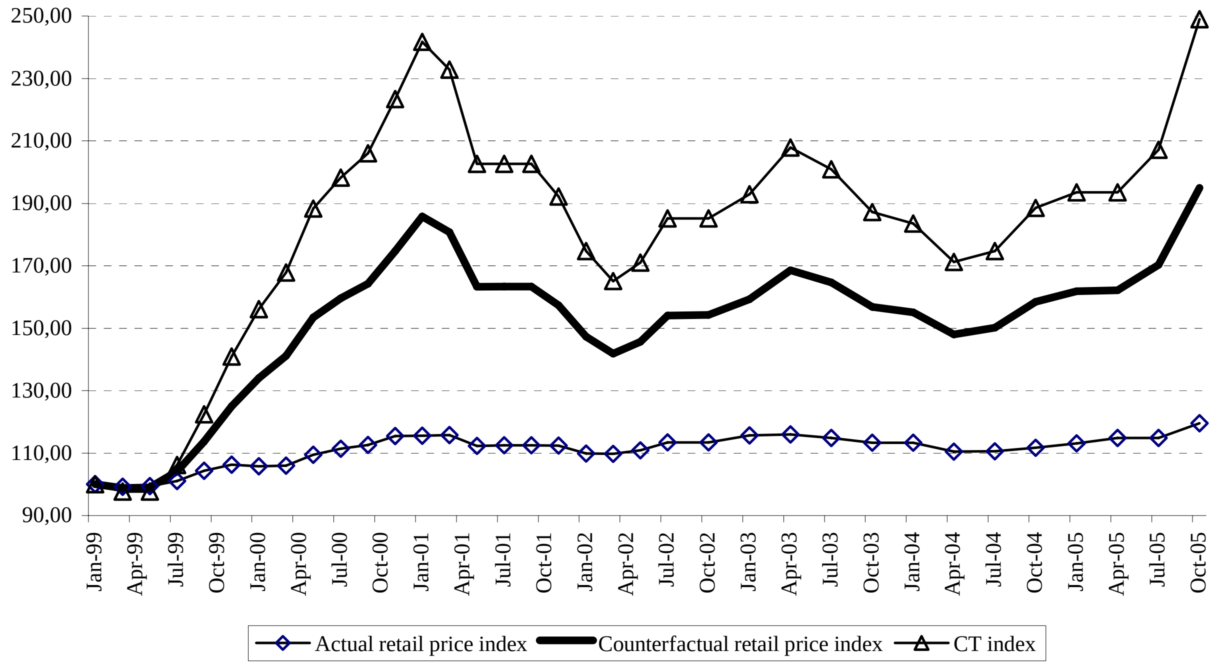


Figure 6: Actual and counterfactual national retail price index for electricity. Sources: ISTAT, AEEG and our computation

The resulting counterfactual time series of the electricity tariff is dramatically different from the actual one, both for steeper growth and higher variability.

2. Natural gas. Despite the reforms started in the second part of the Nineties, only from 2001 have we some effect of the reforms on final prices, as until then the final gas price was formed according to the old rules. In the old regime, the final price was made of three parts: fixed transport costs, distribution costs and wholesale price. The first component was indexed to inflation, the second one varied according to local investment decisions (in 1997 there were about 700 distributors) but in practice followed inflation quite closely, and the wholesale price was indexed to wholesale national diesel prices.[27] This established a close correlation between national diesel and gas prices, which we estimate, and we assume would have continued, had the reform not been introduced. The decision 237/00 by the energy authority has changed things quite drastically, stating that since 2002 the pass through of wholesale prices to consumers should be indexed to a mix of international fuel prices, while regulated components followed a *RPI-x* rule. The result is shown in Figure 7.

[26] See Apt (2005), Joskow (2006) among others.
[27] Notice that actual wholesale gas prices were considered "sensitive" information and were not known even to public authorities.

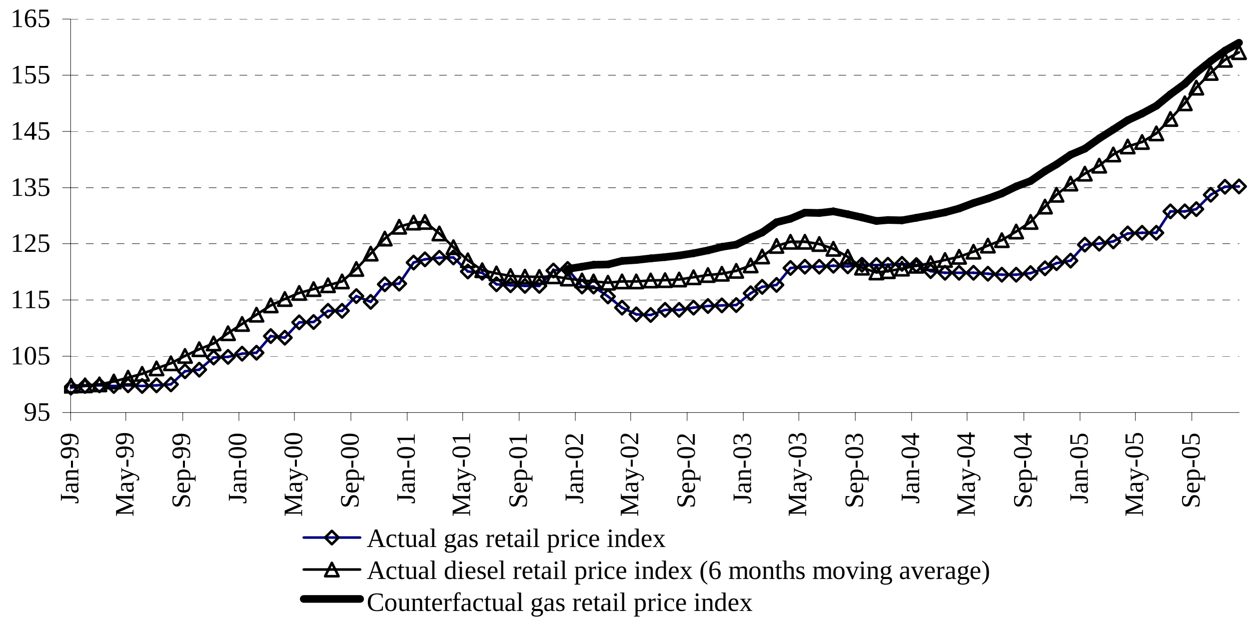


Figure 7: Actual and counterfactual national retail price index for natural gas and heating diesel. Sources: ISTAT, and our calculation

In order to preserve the observed heterogeneity in local gas prices, we use this national counterfactual index to construct local (counterfactual) price indices. So, for each region we first regress the local (actual) gas price growth onto the national gas price growth using simple linear regressions, and then use these coefficients to estimate regional (counterfactual) price indices on the basis of the national counterfactual scenario.

Finally, notice that the gas price is only one of the prices, relevant to heating affordability. The fraction of houses heated with natural gas varies between 25% (in warm areas) to 82% in the (high consumption) cold regions; almost all other houses either have no heating, or use diesel. The price of diesel is not directly affected by the reform and therefore its counterfactual price is assumed to coincide with its actual price. The price index used to analyse how affordability would have changed without the reform keeps into account this proportion.

3. Water. A governmental body (CIPE), still sets rules for the changes in water prices for all operators who have not yet implemented the new tariff system. From 1996 to 2002 this body allowed water tariffs to increase according to a price cap mechanism which determined price increases in the range 0-1.4%. Further increases were allowed to refund investment

costs and to account for variation in operative costs. Since 2002, these government water tariffs have not been updated. The kink in 2003 that can be seen in the water price index in Figure 1 was caused mainly by the actual implementation of the reform. Therefore, we can say that in absence of reform the water price dynamics would not have changed in 2003. As already discussed in Section 2.3 before 2003, changes in water prices were almost in line with inflation (see Figure 1), we therefore consider the following as a natural counterfactual scenario: the time series of overall CPI shifted upward by a monthly increase of 5.3% registered in January 1999 due to fiscal innovations. Actual and counterfactual water price dynamics are compared in Figure 8.

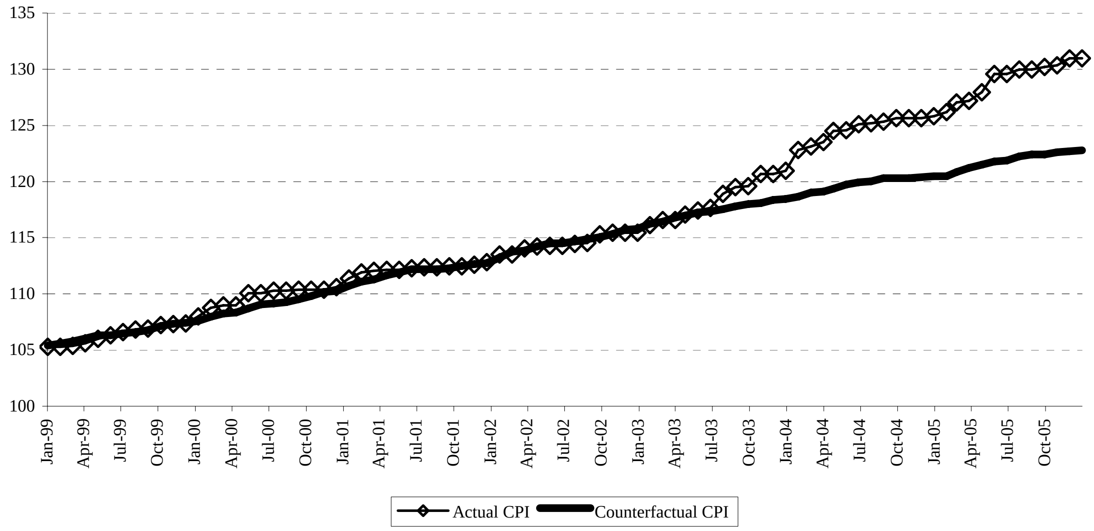


Figure 8: Actual and counterfactual national retail price index for water. Source: ISTAT and our calculation

Having made precise how utility prices are determined in our counterfactual scenario, we can now start the affordability analysis, where general inflation and income dynamics are taken as given. The affordability analysis under this scenario is summarized in Figure 9 below (utility specific graphs are in the Appendix). In this graph we compare the actual 2005 distribution of the “potential bill to actual total expenditure” ratios with the alternative scenario.

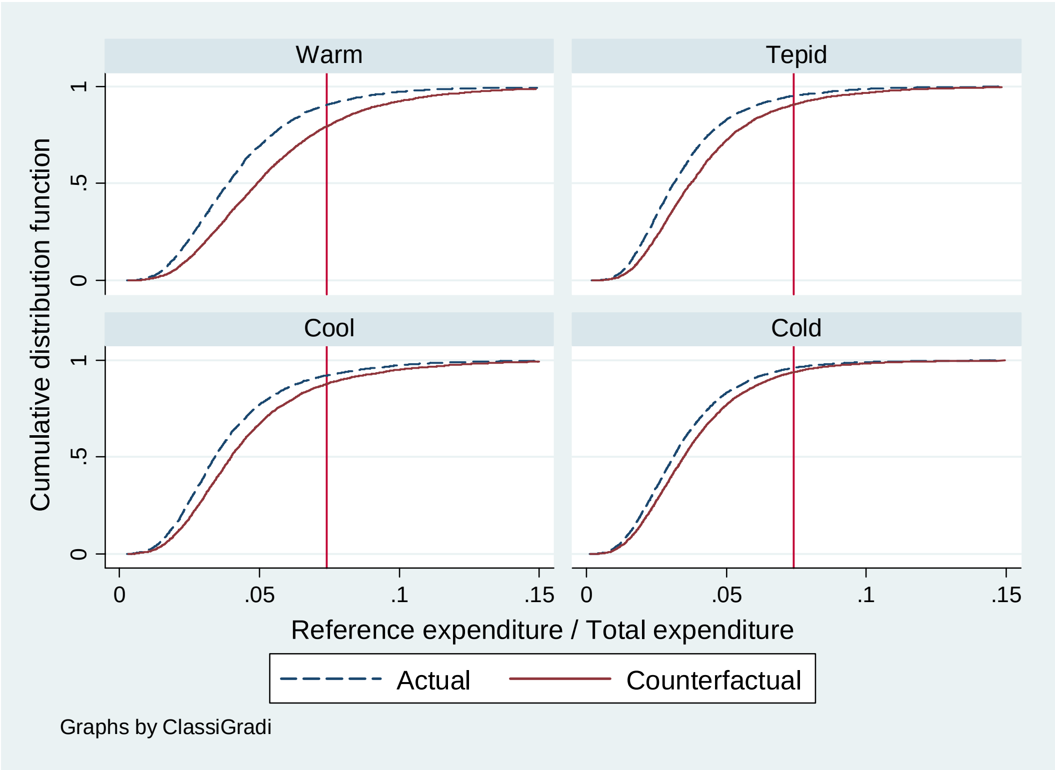


Figure 9: Cumulative distribution functions of the ratios $p_{i,t}\bar{q}_{i,98}^{nA} / E_{jt}^{nA}$ **for the total utility bill, actual vs counterfactual 2005.**

In almost all cases, either the two estimated cumulative distribution functions overlap, or the counterfactual distribution is to the right of the real one.[28] This certainly holds for the total utility bill, and suggests that in 2005 all households would prefer the actual situation to the one which would have emerged without the reform process. That is, on average the control over tariff dynamics protected the consumer.

As we have seen, the sector where the difference between the actual situation and the counterfactual scenario is largest is electricity. To this end, a significant role has been played by the fairly high value of the *x* factor, set by Aeeg on the electricity infrastructures, whose price has been decreased by more than 20% over the period. As for generation, the CT was probably a fairly generous way of remunerating generators, and the change in the fuel usage of the generating plants (some have been converted from fuel oil to gas) might probably explain part of the good result obtained. Although this can only partially be due to the reforms, notice that these cost decreases would not have been passed on to the consumers under the previous regime, where the (rarely updated) cost index CT has been for long time the sole reference point.

In natural gas, the counterfactual price is only slightly higher than the actual price. The difference is partly due to the separation of gas prices from national diesel prices, and partly it is due to the RPI-x system for infrastructure, which has decreased the regulated components of the final price. This effect is less pronounced than in electricity, as in gas the new regime was applied later and in a less "aggressive" way.

As for water services, actual end-of-period prices are higher than they would otherwise have been. The gap opened up since 2003, namely when the new price regime has really been implemented, and this is at least partly due to the need to increase prices to cover planned investments. However, notice that this sector also lacks a national regulatory authority and a price system, really able to prompt efficiency. To what extent the current price level may also be due to poor regulation, is still an open issue.

7 Conclusions and policy implications

We have investigated how the implementation of Italian public utility reforms had an impact on the affordability of water, electricity and heating for households. So we have briefly documented the Italian public utility reforms in water, electricity and gas sectors with specific emphasis on price dynamics in the period 1998-2005. We then have looked at expenditure for these utilities on family budgets over the same period. Then, we have proposed an affordability index for public utility consumption conditional on demographic, climatic and family indicators, providing estimates. In particular, our affordability index was built on a "reference basket" for the consumption of utility services. In doing so we must explicitly identify the quantity of services the policy makers should refer to when evaluating the consumer welfare effects of a reform. We have identified the reference basket considering the consumption of the poorest part of the population, but in principle the definition of the *potential bill* can be the outcome of a bargaining process between consumers, service providers and market regulators. The standard approach discusses affordability with respect to actual consumption. Therefore, unlike our approach, it implicitly assumes that current consumption levels and distribution are socially desirable, neglects the case of under and over-consumption, and requires an estimate of a utility demand system in order to predict the effects of any tariff reform.

[28] The only exceptions refer to water expenditure in cool and cold areas. The differences are extremely small and refer to the utility with the lowest share in total expenditure.

Our results show that taking into account territorial heterogeneity is crucial for a meaningful measure of affordability, and therefore to improve targeting policies aimed at alleviating the problem. Our main finding indicates that, in the period considered, reforms in water, natural gas and electricity markets were not accompanied by exacerbated affordability issues in Italy. Moreover, the counterfactual exercise confirms the positive effects of those reforms on households welfare.

Possible extensions could include an analysis of the effects of future price reforms on households' welfare. The issue of the sustainability of utility prices especially for poor households may be linked to the regulators' choices, in that utility prices also have a distributional effect. If we could forecast that certain utility prices must increase, how to design tariffs in order e.g., to minimise the negative consequences on poorer households becomes particularly relevant. Our analysis could also provide guidance on how tariffs could be adjusted to meet concerns about welfare distribution among different income groups.

8 Appendix

Table A1: Average per capita monthly expenditure, by year

	Total expenditure	Water	Electricity	Gas	Other fuels
	Current prices				
1998	774.54	5.84	12.01	23.80	24.08
1999	782.85	6.50	12.14	24.56	24.31
2000	823.09	6.47	12.13	25.26	24.56
2001	822.58	6.76	12.95	24.54	25.89
2002	823.58	6.76	13.31	26.15	24.17
2003	869.62	7.38	14.25	27.09	25.20
2004	920.12	7.80	14.61	29.05	26.96
2005	936.70	7.86	15.35	30.80	28.83
	Constant prices (1998=100)				
	Total expenditure	**Water**	**Electricity**	**Gas**	**Other fuels**
1998	774.54	5.84	12.01	23.80	24.08
1999	773.99	6.24	11.64	24.45	23.17
2000	793.84	6.13	12.59	22.97	20.59
2001	771.69	6.25	13.87	20.68	21.94
2002	753.72	6.19	14.03	23.75	20.38
2003	776.85	6.56	15.45	23.40	20.61
2004	806.31	6.67	15.34	25.19	21.27
2005	807.09	6.53	16.74	24.62	20.43

Table A2: Median households' utility budget shares, by year (%)

	Current Prices					Constant Prices (1998=100)				
	Water									
	Warm	Tepid	Cool	Cold	Italy	Warm	Tepid	Cool	Cold	Italy
1998	0.87	0.64	0.72	0.54	0.64	0.87	0.64	0.72	0.54	0.64
1999	0.91	0.78	0.68	0.59	0.69	0.89	0.76	0.66	0.57	0.67
2000	0.89	0.80	0.75	0.57	0.69	0.89	0.78	0.74	0.55	0.68
2001	0.99	0.90	0.76	0.54	0.71	0.99	0.90	0.71	0.53	0.70
2002	0.95	0.78	0.72	0.61	0.72	0.98	0.80	0.72	0.60	0.72
2003	1.00	0.80	0.76	0.62	0.73	1.07	0.82	0.74	0.60	0.73
2004	0.98	0.91	0.76	0.62	0.75	1.07	0.90	0.71	0.58	0.74
2005	0.96	0.84	0.83	0.63	0.77	1.06	0.82	0.75	0.59	0.74
	Electricity									
	Current Prices					Constant Prices (1998=100)				
	Warm	Tepid	Cool	Cold	Italy	Warm	Tepid	Cool	Cold	Italy
1998	2.19	1.56	1.38	1.14	1.42	2.19	1.56	1.38	1.14	1.42
1999	2.43	1.69	1.37	1.12	1.44	2.35	1.64	1.32	1.09	1.40
2000	2.20	1.69	1.34	1.14	1.43	2.35	1.82	1.43	1.23	1.54
2001	2.28	1.73	1.45	1.25	1.53	2.58	1.98	1.64	1.43	1.75
2002	2.31	1.74	1.51	1.34	1.59	2.65	2.01	1.73	1.55	1.83
2003	2.21	1.71	1.55	1.32	1.59	2.68	2.08	1.87	1.61	1.93

2004	2.32	1.80	1.54	1.25	1.56	2.79	2.16	1.83	1.50	1.87
2005	2.59	1.77	1.59	1.29	1.61	3.27	2.26	2.00	1.64	2.04

Gas

	Current Prices					Constant Prices (1998=100)				
	Warm	Tepid	Cool	Cold	Italy	Warm	Tepid	Cool	Cold	Italy
1998	1.68	1.94	2.68	2.73	2.36	1.68	1.94	2.68	2.73	2.36
1999	1.64	2.01	2.97	2.65	2.42	1.65	2.01	2.97	2.67	2.43
2000	1.72	1.87	2.81	2.64	2.33	1.65	1.75	2.55	2.46	2.18
2001	1.81	1.93	2.60	2.68	2.34	1.66	1.76	2.32	2.42	2.12
2002	1.80	1.89	2.72	2.82	2.40	1.74	1.91	2.62	2.84	2.39
2003	1.85	2.22	2.89	2.72	2.48	1.78	2.15	2.69	2.65	2.38
2004	1.96	2.24	2.97	2.73	2.49	1.93	2.22	2.87	2.72	2.47
2005	2.02	2.36	3.22	2.92	2.70	1.84	2.21	2.94	2.70	2.50

Other Fuels

	Current Prices					Constant Prices (1998=100)				
	Warm	Tepid	Cool	Cold	Italy	Warm	Tepid	Cool	Cold	Italy
1998	0.99	1.68	3.20	3.86	1.77	0.99	1.68	3.20	3.86	1.77
1999	0.98	1.78	2.80	3.77	1.67	0.92	1.72	2.72	3.56	1.59
2000	1.06	1.76	2.95	3.58	1.80	0.88	1.51	2.60	3.03	1.54
2001	1.04	1.88	3.54	3.58	1.87	0.90	1.68	3.27	3.16	1.66
2002	1.03	1.96	2.84	3.73	1.81	0.95	1.78	2.62	3.38	1.66
2003	1.02	1.80	3.13	2.96	1.65	0.96	1.63	2.90	2.64	1.55
2004	1.02	1.98	3.71	3.20	1.70	0.94	1.73	3.42	2.87	1.52
2005	1.20	2.09	4.01	3.46	1.84	0.96	1.65	3.38	2.71	1.48

Table A4: Percentage of households with affordability problems by utility, area and family size, 1998

# family members	Water	Electricity	Heating	Total utility expenditure
Warm				
1	20.83	26.76	3.96	12.92
2	17.42	21.41	4.30	11.41
3	11.65	18.06	1.79	7.01
4 or more	10.20	22.07	1.73	8.30
Total	14.11	21.95	2.72	9.57
Tepid				
# family members	Water	Electricity	Heating	Total utility expenditure
1	14.11	10.20	6.77	8.79
2	10.79	6.58	7.52	7.25
3	6.20	5.76	5.30	5.30
4 or more	6.72	7.26	4.03	5.14
Total	9.28	7.32	5.89	6.53
Cool				
# family members	Water	Electricity	Heating	Total utility expenditure
1	15.40	9.45	34.42	19.51
2	7.22	3.98	14.49	7.87
3	2.52	1.60	5.46	2.66
4 or more	2.70	2.70	9.87	4.30
Total	6.91	4.37	15.84	8.46
Cold				
# family members	Water	Electricity	Heating	Total utility expenditure
1	2.84	2.49	20.51	7.09
2	1.46	1.80	17.70	5.49
3	0.74	0.45	7.90	1.67
4 or more	0.60	0.60	8.32	1.87
Total	1.44	1.39	14.06	4.20

Table A5: Percentage of households with affordability problems by utility, area and family size, 2005

# family members	Water	Electricity	Heating	Total utility expenditure
			Warm	
# family members	Water	Electricity	Heating	Total utility expenditure
1	11.03	19.07	3.79	9.81
2	13.82	19.06	8.02	11.82
3	6.79	14.38	3.96	7.10
4	6.56	17.32	5.23	7.73
Total	9.31	17.54	5.26	9.02
			Tepid	
# family members	Water	Electricity	Heating	Total utility expenditure
1	12.76	5.98	7.78	7.12
2	9.60	4.11	8.45	6.11
3	4.11	2.26	5.16	3.26
4	4.66	3.10	4.70	3.56
Total	8.09	4.02	6.59	5.15
			Cool	
# family members	Water	Electricity	Heating	Total utility expenditure
1	10.64	3.50	30.74	13.83
2	5.91	1.93	15.30	5.47
3	2.32	0.65	7.18	2.41
4	2.86	1.49	11.05	4.26
Total	5.62	1.95	16.47	6.65
			Cold	
# family members	Water	Electricity	Heating	Total utility expenditure
1	2.56	0.56	19.51	5.88
2	1.76	0.55	18.25	4.04
3	1.90	0.24	10.80	2.50
4	1.58	0.29	12.12	2.73
Total	1.98	0.44	15.86	3.99

Table A6: Percentage of households with affordability problems by utility, area and year

	Water	Electricity	Heating	Total utility expenditure	At least one utility
Warm					
1998	14.11	21.95	2.72	9.57	21.95
1999	15.79	19.06	3.19	10.15	19.16
2000	12.40	19.40	3.59	9.57	19.40
2001	12.63	22.61	3.22	10.19	22.61
2002	11.49	18.52	2.47	8.37	18.52
2003	9.41	17.11	2.48	7.29	17.11
2004	9.83	15.68	3.37	7.62	15.68
2005	9.31	17.54	5.26	9.02	17.54
Tepid					
	Water	Electricity	Heating	Total utility expenditure	At least one utility
1998	9.28	7.32	5.89	6.53	9.42
1999	13.72	7.48	8.14	8.30	13.72
2000	12.55	8.92	10.75	9.33	13.22
2001	11.94	8.42	9.91	8.92	12.58
2002	10.13	6.64	6.94	6.85	10.31
2003	9.26	6.00	6.58	6.22	9.50
2004	9.86	5.11	6.56	5.88	10.22
2005	8.09	4.02	6.59	5.15	8.70
Cool					
	Water	Electricity	Heating	Total utility expenditure	At least one utility
1998	6.91	4.37	15.84	8.46	15.84
1999	6.54	3.00	14.59	7.11	14.59
2000	5.87	4.06	18.15	8.54	18.15
2001	7.36	4.01	20.38	9.25	20.38
2002	6.33	3.55	16.91	8.13	16.91
2003	5.28	2.64	16.12	6.83	16.12
2004	6.60	2.28	15.66	7.00	15.66
2005	5.62	1.95	16.47	6.65	16.47
Cold					
	Water	Electricity	Heating	Total utility expenditure	At least one utility
1998	1.44	1.39	14.06	4.20	14.06
1999	1.38	0.87	14.00	3.79	14.00
2000	1.53	1.25	18.04	4.99	18.04
2001	1.31	0.93	19.39	5.01	19.39
2002	1.89	1.12	15.79	4.35	15.79
2003	1.85	1.00	15.36	4.36	15.36
2004	1.62	0.45	12.53	3.09	12.53
2005	1.98	0.44	15.86	3.99	15.86

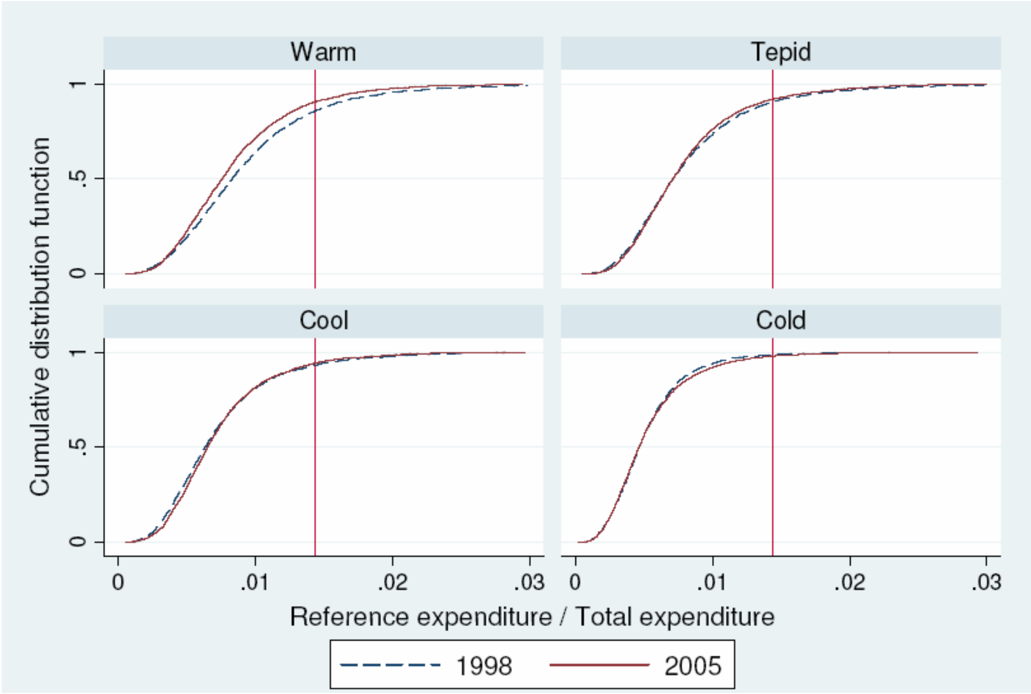


Figure A1: Cumulative distribution functions of the ratios $p_{i,t}\bar{q}_{i,98}^{nA} / E_{jt}^{nA}$ for <u>water</u>, 1998 vs 2005

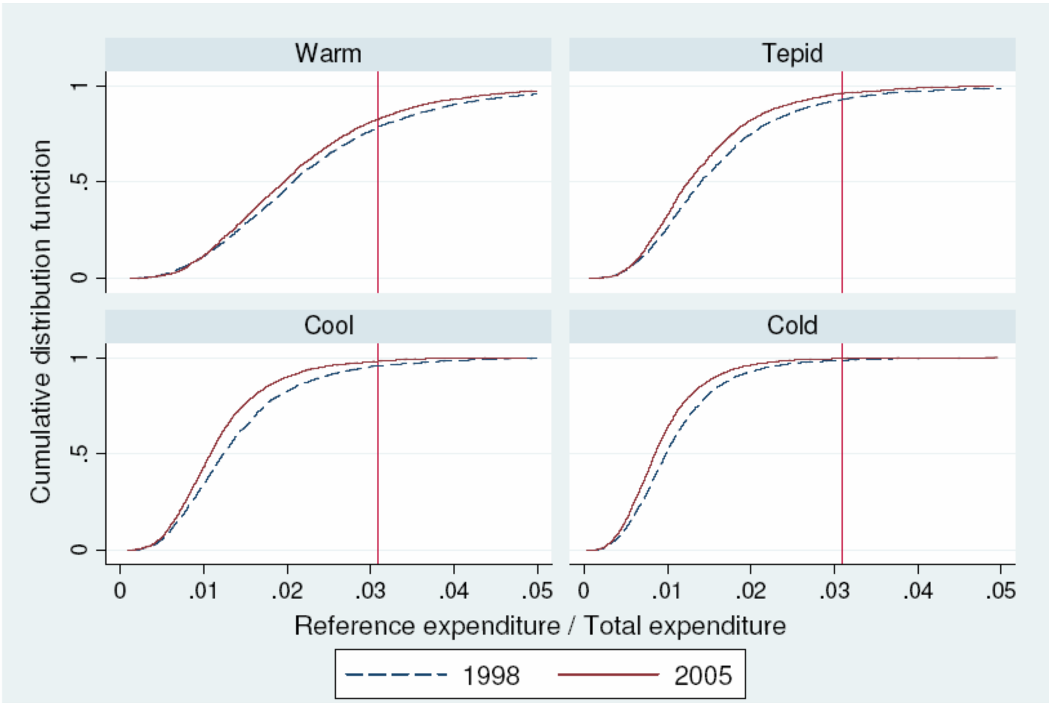


Figure A2: Cumulative distribution functions of the ratios $p_{i,t}\bar{q}_{i,98}^{nA} / E_{jt}^{nA}$ for <u>electricity</u>, 1998 vs 2005

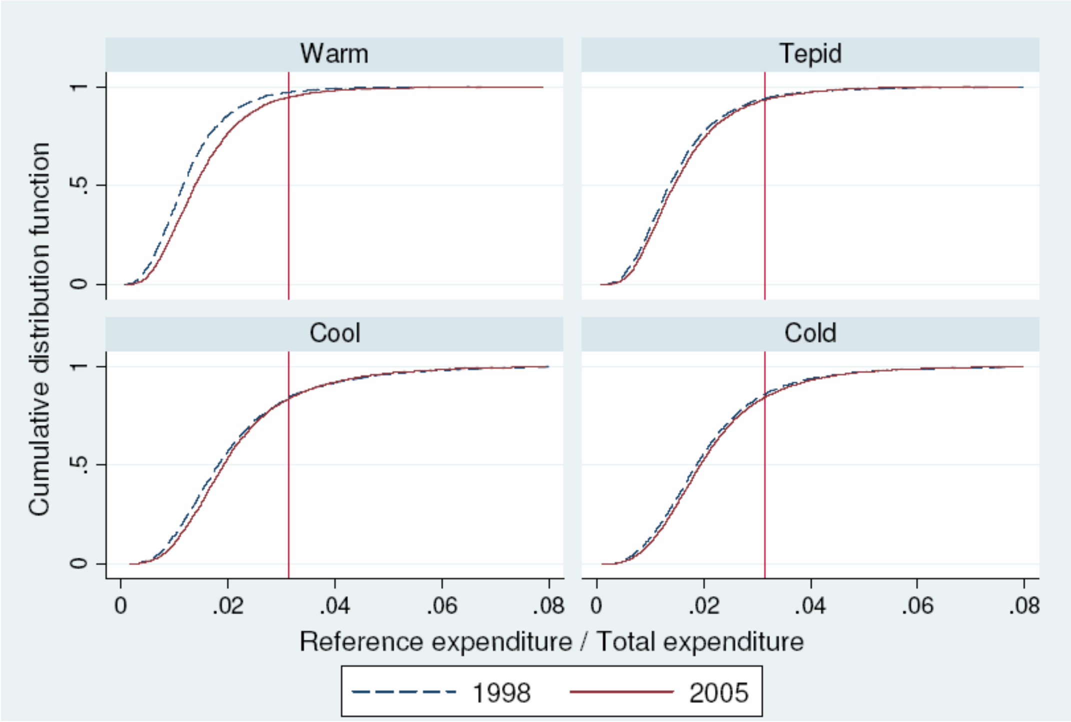


Figure A3: Cumulative distribution functions of the ratios $p_{i,t}\overline{q}_{i,98}^{nA} / E_{jt}^{nA}$ for heating, 1998 vs 2005

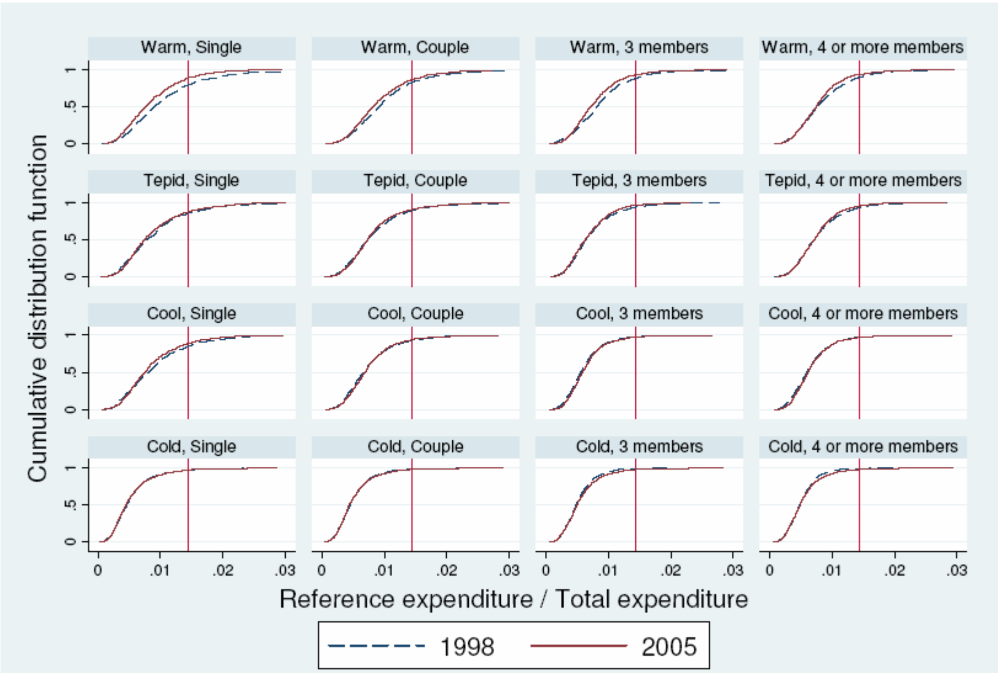


Figure A4: Cumulative distribution functions of the ratios $p_{i,t}\overline{q}_{i,98}^{nA} / E_{jt}^{nA}$ for <u>water</u> by area and family size, 1998 vs 2005

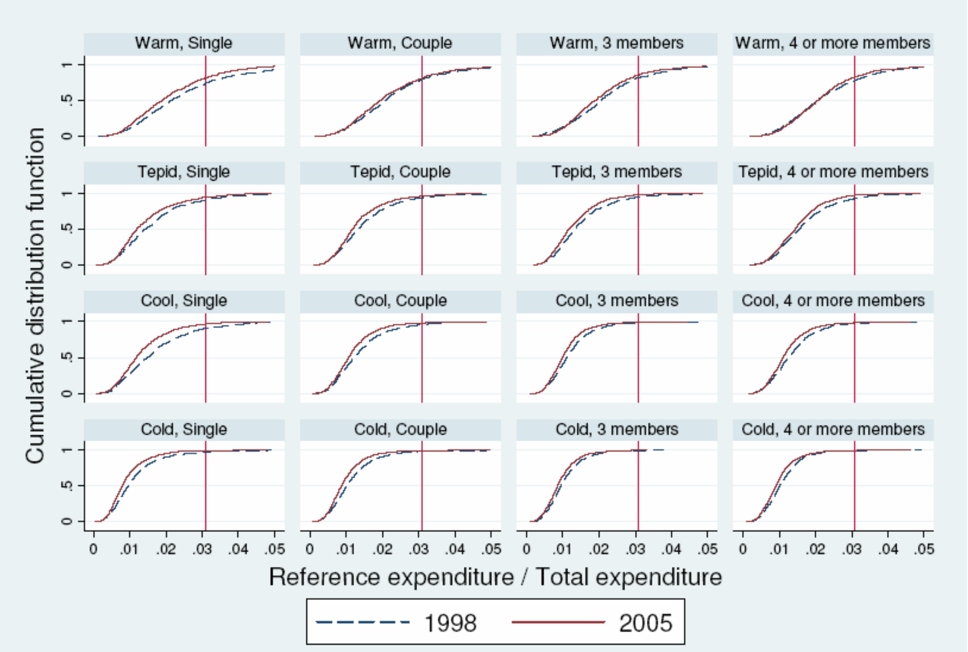


Figure A5: Cumulative distribution functions of the ratios $p_{i,t}\overline{q}_{i,98}^{nA} / E_{jt}^{nA}$ for <u>electricity</u> by area and family size, 1998 vs 2005

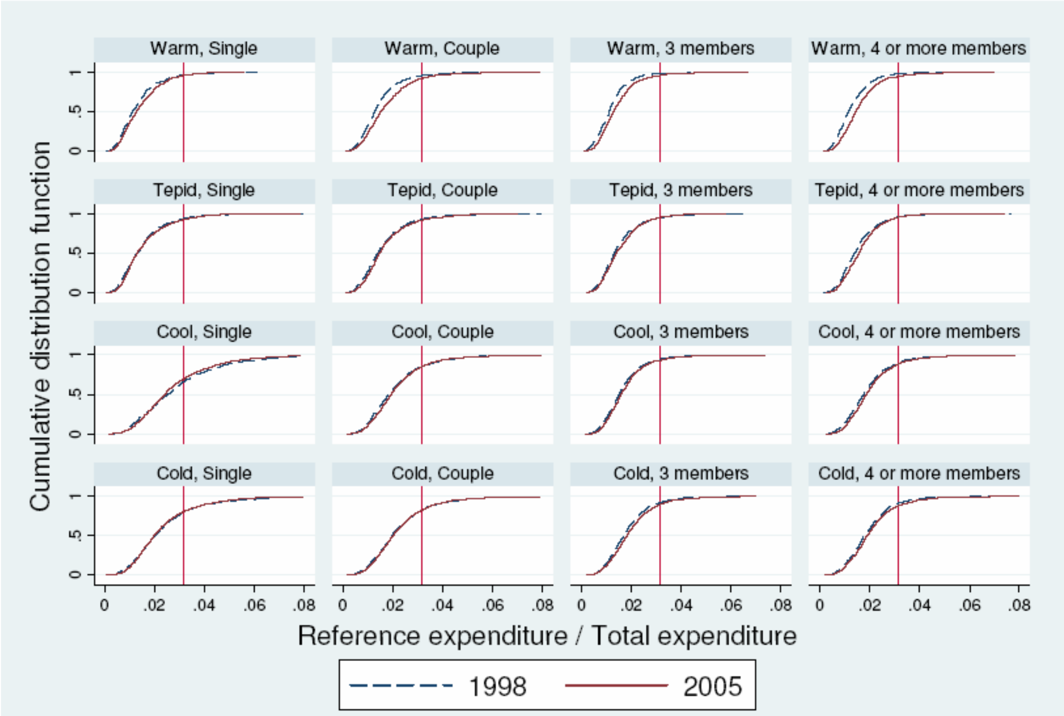


Figure A6: Cumulative distribution functions of the ratios $p_{i,t}\overline{q}_{i,98}^{nA} / E_{jt}^{nA}$ for <u>heating</u> by area and family size, 1998 vs 2005

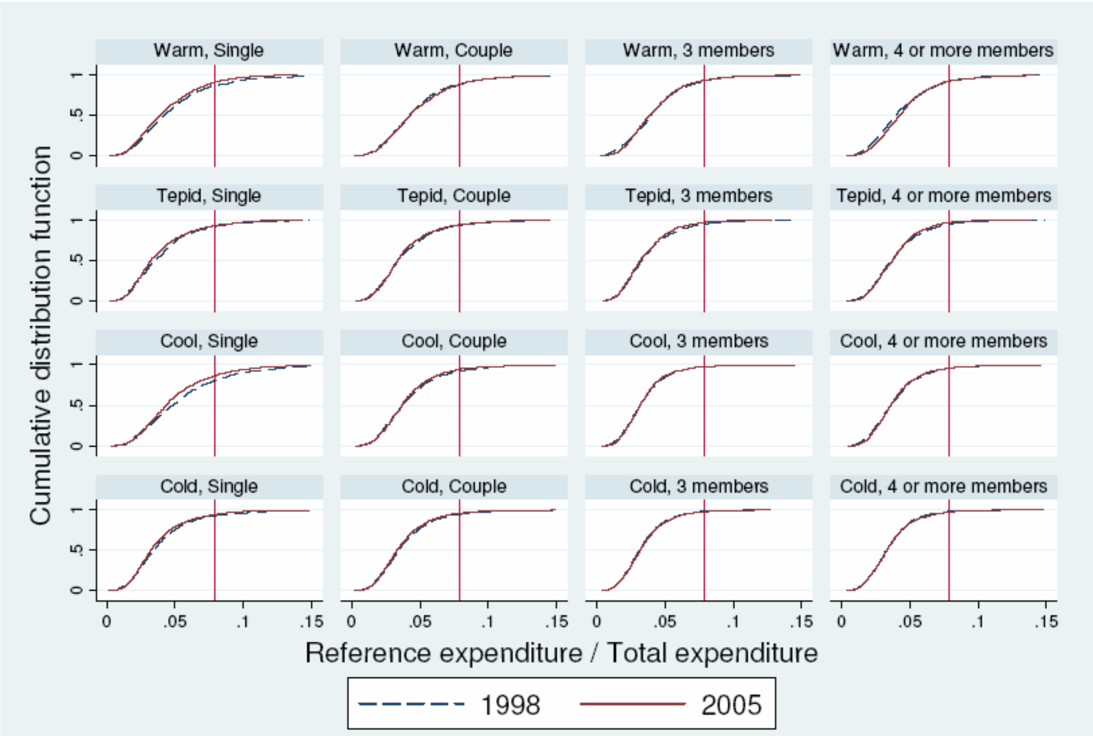


Figure A7: Cumulative distribution functions of the ratios $p_{i,t}\overline{q}_{i,98}^{nA} / E_{jt}^{nA}$ for <u>the whole of the utility bills</u> by area and family size 1998 vs 2005

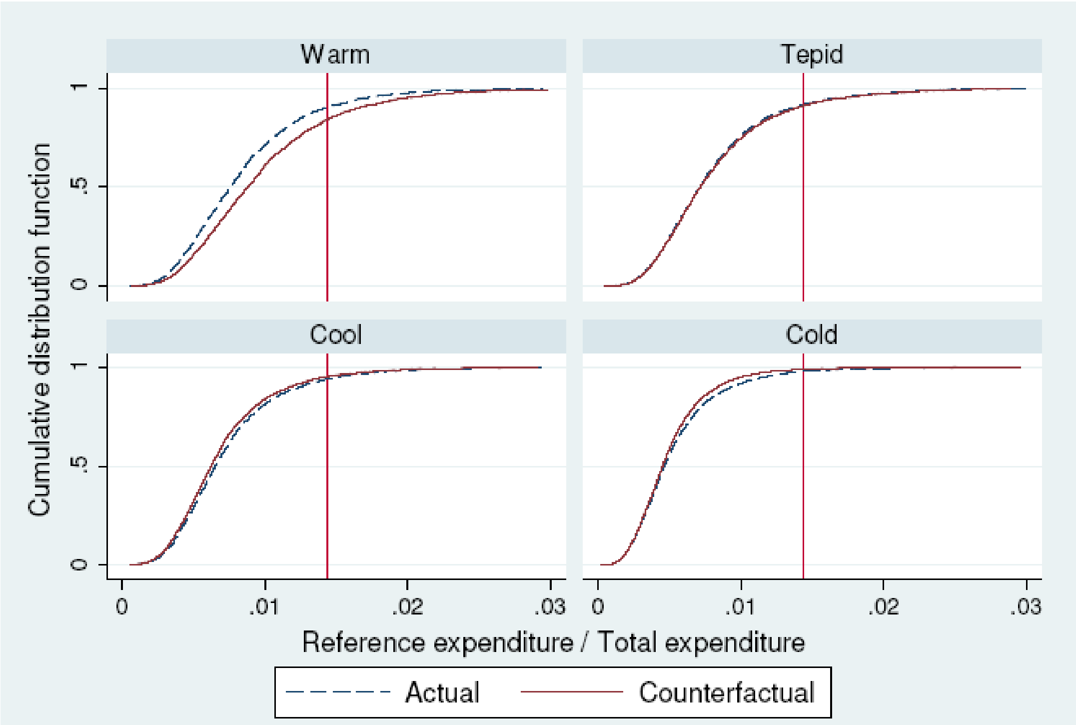


Figure A8: Cumulative distribution functions of the ratios $p_{i,t}\bar{q}^{nA}_{i,98} / E^{nA}_{jt}$ for <u>water</u>, actual vs counterfactual 2005.

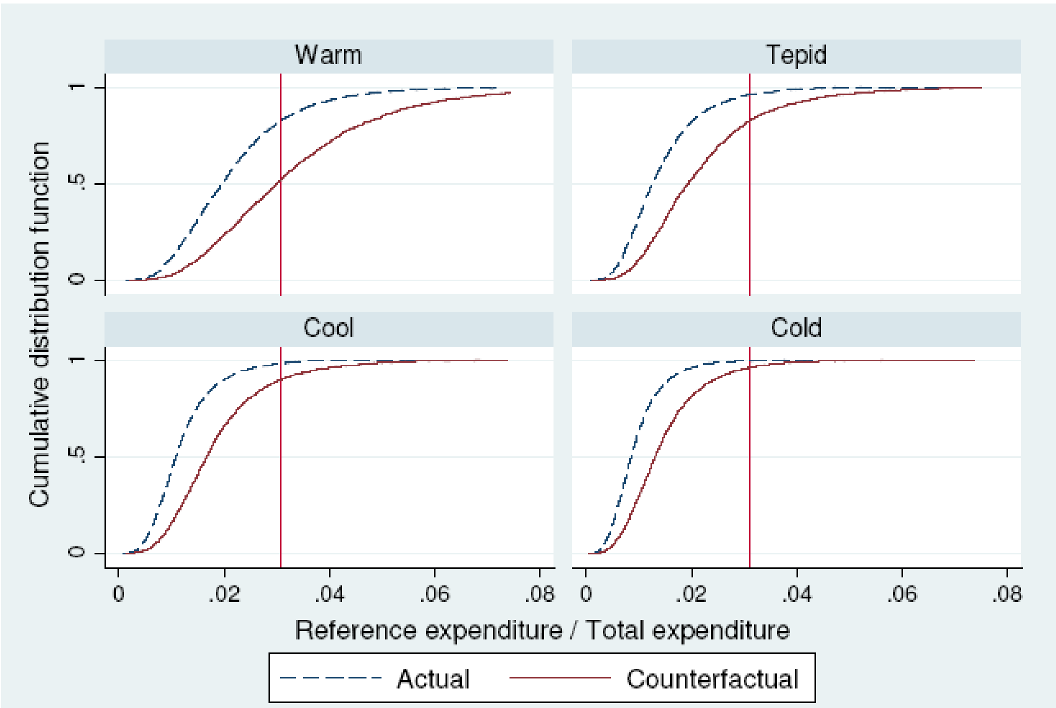


Figure A9: Cumulative distribution functions of the ratios $p_{i,t}\bar{q}^{nA}_{i,98} / E^{nA}_{jt}$ for <u>electricity</u>, actual vs counterfactual 2005.

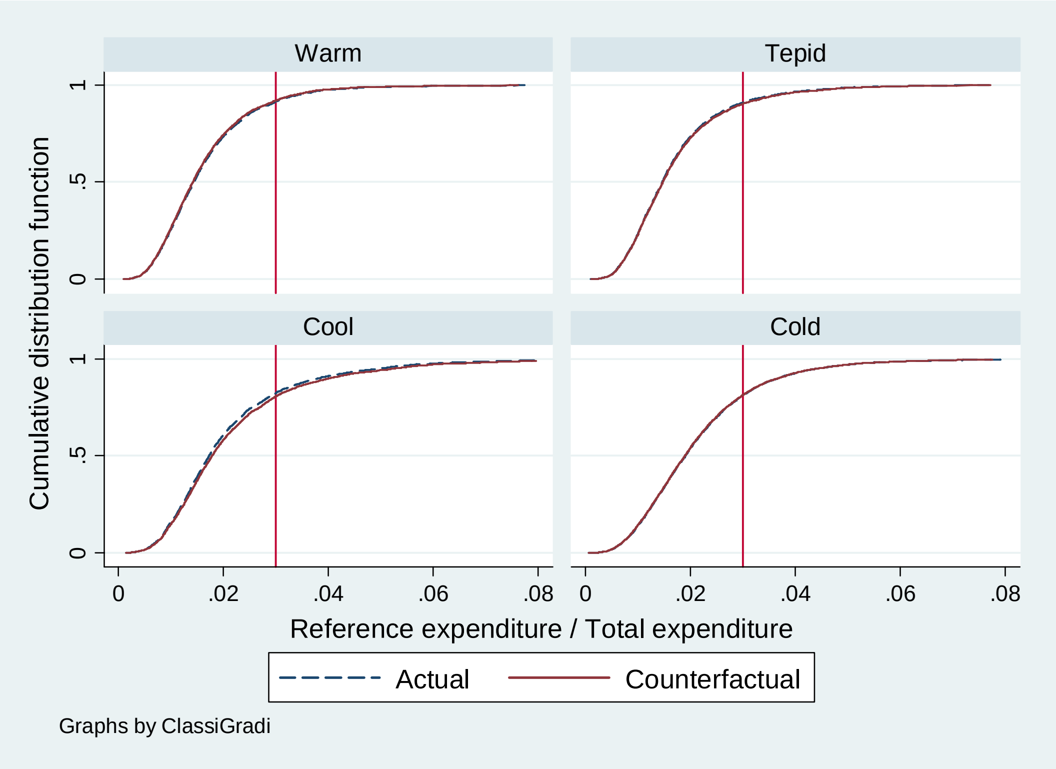


Figure A10: Cumulative distribution functions of the ratios $p_{i,t}\overline{q}_{i,98}^{nA} / E_{jt}^{nA}$ for heating, actual vs counterfactual 2005.

References.

AEEG (2006), *Relazione Annuale sullo Stato dei Servizi e sull'Attività Svolta*, Roma: Presidenza del Consiglio dei Ministri, Dipartimento per l'informazione e l'editoria, http://www.autorita.energia.it/relaz_ann/06/rel_ann_06.pdf

Apt, J. (2005), Competition has not lowered US Industrial Electricity Prices, *Electricity Journal*, vol.18, pp.52-61.

Bardelli, L. and G. Muraro (2003), L'offerta e la regolamentazione dei servizi idrici: l'esperienza italiana, in Muraro G. and P. Valbonesi (eds): I servizi idrici tra mercato e regole, Roma: Carocci.

Co.Vi.Ri (2004), *Secondo Rapporto Annuale sui Piani d'Ambito*, Roma: Ministero dell'Ambiente, http://www2.minambiente.it/sito/cvri/docs/IIrapporto_piani_ambito_marzo 2004.pdf

Domah, P. and Pollitt, M.G. (2001) Restructuring and privatisation of electricity distribution and supply businesses in England and Wales: a social cost-benefit analysis, *Fiscal Studies*, 22(1): 107-146

Fankhauser, S. and S. Tepic (2006), Can poor consumers pay for energy and water? An affordability analysis for transition countries, *Energy Policy*, forthcoming.

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

Gomez-Lobo, A. (1996), The Welfare Consequences of Tariff Rebalancing in the Domestic Gas Market, *Fiscal Studies*, 17(4): 49-65.

Hancock R. and C. Waddams Price (1998), Distributional effects of liberalizing UK residential utility markets, *Fiscal Studies*, 19/3: 295-319.

Healy, J. (2001), Home Sweet Home? Assessing Housing Conditions and Fuel Poverty in Europe, ERSR W.P. 01/13, University College Dublin

DEFRA (2001). The UK Fuel Poverty Strategy - 1st Annual Progress Report 2003, http://www.dti.gov.uk/energy/consumers/fuel_poverty/index.shtml

ISTAT (2004), La povertà assoluta: informazioni sulla metodologia di stima, Approfondimenti – Famiglia e società, Roma: ISTAT

Joskow, P. (2006), Markets for Power in the United States: An Interim Assessment, *Energy Journal*, vol. 27, pp.1-36.

Miniaci, R. Scarpa, C. and P. Valbonesi (2005), Restructuring Italian utility markets: household distributional effect, FEEM Working Paper No. 134.05.

McKenzie, D. and D. Mookherjee (2003), The Distributive Impact of Privatization in Latin America: Evidence from Four Countries, *Economia, The Journal of the Latin American and Caribbean Economic Association*, vol.3, n.2, p.161-233.

Muraro (2001), The State and the reform of water services, Memorandum for OECD EPR mission; http://www2.minambiente.it/sito/cvri/docs/finale_state_of_water_services.pdf

Muraro G. and P. Valbonesi (2003): *I servizi idrici tra mercato e regole*, Roma: Carocci.

OECD (2003), Social issues in the provision and pricing of water services, OECD, Paris.

OECD (2004), Competition and regulation of the water sector, OECD, Paris, http://www.oecd.org/dataoecd/44/1/33691325.pdf

Sefton, T. (2002), Targeting Fuel Poverty in England: is the government getting warm?, *Fiscal Studies*, 23/3: 369-399.

US Environmental Protection Agency (1998) Information for States on Developing Affordability Criteria for Drinking Water, EPA 816-R-98-002

Waddams Price, C. (2005), Effect of Liberalising UK Retail Energy Markets on Consumers, forthcoming, *Oxford Review of Economic Policy*.

Wolak, F. (1996), The welfare impacts of competitive telecommunication supply: a household level analysis, *Brookings Papers on Economic Activity: Microeconomics*, 269-350.