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UTILITIES DEPRIVATION DYNAMICS AND ENERGY SECTOR REFORMS IN EUROPE

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"Utilities deprivation dynamics
and
energy sector reforms in Europe"

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Abstract:

In the late 1990s many European countries started comprehensive restructuring of their energy industries, the typical ingredients of the reforms are full or partial privatization, vertical disintegration, liberalization. In this paper we focus on the way in which energy sector reforms affect social affordability. The aim of this paper is to analyze the effects of energy reforms on the household probability of experiencing utilities deprivation (that is, to be unable to pay scheduled utility bills) in seven European Countries: Denmark, Belgium, France, Ireland, Italy, Netherlands and Spain. The period of analysis is 1994-2001. We also explore the dynamics of utilities deprivations focusing on the causes behind deprivation persistence. We differentiate between household heterogeneity and true state dependence. Then, controlling for observed and unobserved heterogeneity, we use the magnitude of average partial effects to investigate the relevance of any state dependence and the impact of energy sector reforms on the probability of experiencing utilities deprivations and on state dependence. We find evidence that vertical disintegration in the energy sector and privatization increase the household probability of experiencing utilities deprivation. Moreover, vertical disintegration also increases the household persistence in the status of deprivation.

Keywords: deprivation, utilities, privatization, liberalization, vertical disintegration, true state persistence

JEL Classification: L97, I31, C23, C25

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1. Introduction

In the late 1990s many European countries started comprehensive restructuring of their energy industries , the typical ingredients of the reforms are full or partial privatization, vertical disintegration, liberalization. These policies may have a direct impact on consumers' welfare through changes in the potential access to the services, changes in quality of the services and changes in the tariff structure. In this paper we focus on the way in which energy sector reforms affect social affordability. The utility bill is a non negligible component of consumers' expenditures and, as result of energy sector reforms and of tariff changes, the poor may face substantive losses in the consumer's surplus. For example, Ugaz and Price (2003) show that households in the bottom deciles of the income distribution suffer more intensively in absolute and relative (to their income) terms from tariffs rebalancing, particularly when under public ownership of the utilities there was cross-subsidies

The aim of this paper is to analyze the effects of energy reforms on the household probability of experiencing utilities deprivation (that is, to be unable to pay scheduled utility bills) in seven European Countries: Denmark, Belgium, France, Ireland, Italy, Netherlands and Spain. The period of analysis is 1994-2001. The data we use are from European Community Household Panel (ECHP), a survey that allows comparability of responses across the above mentioned countries . We also explore the dynamics of utilities deprivations focusing on the causes behind deprivation persistence. We differentiate between household heterogeneity (household could be heterogeneous with respect to characteristics that are relevant for the chance of experiencing deprivations) and true state dependence (experiencing utilities deprivations in a specific time period, in itself, increases the probability of undergoing deprivations in subsequent periods). Then, controlling for observed and unobserved heterogeneity, we use the magnitude of average partial effects to investigate the relevance of any state dependence and the impact of energy sector reforms on the probability of experiencing utilities deprivations and on state dependence.

This paper contributes to the literature in the following three ways. First, it analyzes if energy sector reforms are beneficial to household consumers through the magnitude of the impact of these factors on the probability of experiencing utilities deprivation and on the probability of persistence in the status of deprivation. Note that we offer fresh empirical evidence on utilities deprivation in a period characterized by relevant restructuring and privatization reforms of utility sector, even if in its earlier stages (ECHP data are unfortunately no more available beyond the years we consider): as far as we know, no previous studies focused on this issue. Second, we provide an analysis of the utilities deprivation dynamics identifying the causes of utilities deprivation: true state dependence, unobserved heterogeneity and/or observed heterogeneity. Third, to analyze the dynamics of utilities deprivation, we use an econometric technique, proposed by

Wooldridge 2005, able to estimate consistently a probit model with both lagged dependent and exogenous variables that have been never applied to this topic.

The paper is structured as follows. In section 2, we shortly review the trends in energy sector reforms in the EU. Section 3 gives information about the data we use. In Section 4, we present the econometric technique we use to study the effects of energy reforms on the probability of experiencing utilities deprivation and on the probability of persist in the status of deprivation. Section 5 presents our empirical findings. Some conclusions are made in Section 6.

2. Energy sector reforms and household welfare: research questions

While one of the main advantages of energy sector reforms should be the extra efficiency engendered by an increased competition, in the first half of the 1990s, there is very little evidence of competition associated with reforms of energy sector in Europe, except for power generation (Hall, 1997). In energy sector in EU, publicly owned companies continue to be important. In particular, in distribution, municipally-controlled companies are the norm (with the exception of the UK that is the only European country in having privatized entirely its electricity and gas industry, including the network infrastructures). Table 1 gives information on the ownership of electricity and gas industry in the countries that we analyze (Denmark, Belgium, France, Ireland, Italy, Netherlands and Spain): in 1997 only Belgium and Spain have a partially privatized energy sector. However, during the period 1994-2001, we observe many changes in the degree of vertical integration, entry regulation and public ownership in the country we analyze. In Figure 4, we report the evolution of an indicator of regulatory conditions (IRC) by country. This indicator takes a maximum value equal to six (maximum regulation) and a minimum value of zero (no regulation). It is computed averaging the OECD indicators of regulatory for the electricity and gas sectors. The latter indicators give information about state ownership, barriers to entry, involvement in business operations and market structure (Figure 1 and 2). Even if a high degree of discretion is involved in the computation of the OECD indicators, they have the merit of transparency: in facts, it is possible to trace each reported value to the underlying detailed information about policies and market conditions. We found that France exhibits the maximum level of regulation during the entire period of study (even if some energy reforms are implemented from 1998). Spain, instead, exhibits the lowest degree of regulation in 1994 and it implements further energy reforms during the period 1996-1999. The Netherlands starts with a degree of regulation about five in 1995 and implements a fast reform program decreasing its regulation index between 1998-2000 to a score of two.

It is often assumed that privatized companies, operating in a liberalized context, will necessarily be more efficient and cost-effective than public ones leading to better quality of the services and changes in the tariff structure that will benefit consumers through lower prices. The empirical evidence, however, is mixed. Moreover, according to some critical evaluations, household energy prices do not seem to benefit from competition and improved efficiency: only industrial consumes have had some benefits from more competition because, at least in the earlier stages of reform, they were the only ones that could shop around for cheaper rates (Hall, 1997). Household consumers may even suffer prices increase as a result of competition, as companies compete to win high-volume customers, while increasing prices for small consumers. Also, unbundling vertically integrated activities may increase the costs of providing power if economies of vertical integration exist. Figure 3 show, respectively, the evolution of real electricity and gas prices in Europe from 1994 to 2001. We have used Eurostat data about real household prices (tax included) in ppp at year 2000. During the entire period, Italy has the highest prices both in the electricity sector and in the gas sector. The Netherlands, one of the country that exhibits a fast deregulation, reports the strongest upward pressure on prices (especially, in the electricity sector). Note that electricity and gas prices result highly positively correlated (about 0.88). Instead, the correlation between the indicator of regulatory conditions (IRC) and the electricity and the gas prices results negative but low (respectively, -0.11 and -0.22): in first instance, deregulation seems to be associated with a slightly prices increase. Note that for the Netherlands the correlation between IRC and prices is above -0.8.

There are reasons to claim that the impact of energy utility reforms on the poor is either positive or negative. In facts, tracing such impact can be very complex. We may claim that energy sector reforms benefit the poor for the following reasons. First of all, reforms are supposed to contribute to growth (Cook and Uchida, 2001) and growth is required to reduce poverty and deprivation. Second, privatization is widely associated with development of the private sector (World Bank, 2001): privatization is supposed to increase the number of players who have a stake in making sure that the private sector operates efficiently (Kikeri et al. 1992). Thus, competition and efficiency would benefit consumer through lower prices (lower production costs for industrial consumers). Thirdly, privatization is expected to provide fiscal benefits raising revenue for the government and by removing the burden for government to finance investment (Campbell-White and Bhatia, 1998): this should allow the government to spend more on services for the poor (World Bank, 2000).

Energy sector reforms may also have a direct impact on consumers' welfare through changes in the potential access to the services and changes in quality of the services. Note that these changes might penalize the poor. In facts, private firms in order to maximize profits are selective about the type of investment that they undertake and about the customers that they serve with a preference for supply large consumers. Chiwaya (1999) reports that a "possible consequence of private power participation in a small economy is that independent power generation may remove high-load factor customers from the grid system. This is likely to result in increasing the cost of serving the remaining customers and thus in more defections, with higher costs and lower system reliability to be borne by the economy in general" (pp. 305). Moreover, private companies also demonstrate selectivity in their disconnections of non-payers after electricity privatization. We observe a fast expansion in the level of billing and installation of meters; but, increasing connections as well as investing in the network infrastructure are usually not high priorities.

Finally, energy sector reforms may also penalize the poor through reduction in employment after privatization, sometimes affecting up to 50% of the workforce. "Employment cuts appear to be more severe under certain forms of privatization, such as the contracting out of certain parts of the industry and total privatization or where there is a combination of privatization and restructuring. Moreover, employment increases after privatization are rare and usually follow periods of large-scale retrenchment" (ILO, 1998, pp.1). There seems also to be evidence that privatization rises the disparity between pay levels within enterprises (Bayliss, 2002). However, at the aggregate national level the impact on poverty is small because in the EU countries the employees in energy sector represent just over 1% of all employees.

Probably, however, the main direct impact on social welfare of energy utility reforms is through changes of tariffs, and particularly rebalancing when the companies shift way from cross-subsidies to the low users. This motivates our research: while a traditional approach to measuring welfare changes would consider statistical evidence on prices, consumption, and expenditures, in this paper we focus on non payment of utility bills, as reported by respondents to surveys in different countries and years. The advantage of this approach is that we can use micro-information on the characteristics of those households who declare to have experienced difficulties in paying their bills.

The importance of looking into micro information as a complement to more aggregate data has been recently stressed by research at the World Bank on poverty and energy reform in transition economies (Lampietti et al., 2007). The increase in tariffs for the poor can create an undesirable combination of high arrears in payment, reduction of consumption, shift to less priced but also less sustainable energy sources. These changes are not well captured by statistical aggregate data, and it is important to know them in order to achieve a better design of reforms (for example establishing forms of compensation to the poor or lifeline tariffs). While the countries we consider are far richer than those considered in the above mentioned research, and consequently social affordability problems of energy reforms are less widespread, we suggest that in some circumstances regulators and policy makers may have an interest to know more on these issues. This motivates our research.

3. The data

In order to analyze utilities deprivation in EU, we use micro-data from all eight waves (1994-2001) of the European Community Household Panel (ECHP). The ECHP is a multi-country comparative household panel survey conducted annually by following the same sample of households and persons in the Member States of the European Union. The main advantage of the ECHP is that it permits us to analyze economic and social household conditions from a dynamic point of view.

Our unit of analysis is the household. To define if a household suffers of utilities deprivations we use the information given by answers to the following question: "*Has the household been unable to pay scheduled utility bills, such as electricity, water, gas during the past 12 months?*".[1] Information about household attributes (i.e. no. of household working members, household size, household income) and social characteristics of the reference person (i.e. sex, age, education) are also available.

We focus on seven European countries (we had to exclude other countries because of data availability problems): Denmark, Belgium, France, Ireland, Italy, Netherlands and Spain.[2] Descriptive statistics about the sample composition by country are reported in Table 4. In Table 5, we reports utilities deprivation rates for each country from 1994 to 2001. We observe that Ireland and France are the countries with the highest utilities deprivation rates in 1994 (about 9%). The Netherlands has, instead, the lowest proportion of population deprived in utilities: about 2%. In 2001, the percentage of people suffering utilities deprivations results lower in all countries. Note that the country that experienced the wider decrease in deprivation is Ireland. Table 6 gives some more information about who the household deprived in utilities are. About 44% of the deprived household is also poor,[3] while only the 16% of the not deprived household is poor. As expected, deprived households have the highest percentages of female and low educated reference persons. The mean household size and the mean number of household worker members are, respectively, higher and lower for deprived households than the ones registered for no deprived households.

Finally, to describe the national reform patterns on vertical integration, entry regulation and public ownership by sector we use REGREF, a database developed by the OECD. See Figure 1 and 2 for details about the indicators construction, and Table 2 and 3 for descriptive statistics.

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[1] Note that, for Italy and The Netherlands, this question has been asked only if the household have declared some degree of difficulty in make ends meet. Therefore, our utilities deprivation indicator assumes value equal to one if both the household has been unable to pay bills and the household has experienced difficulty in making ends meet.

[2] Note that information on energy domestic prices and utilities deprivation over the entire period 1994-2001 is available only for these six countries included in the ECHP.

[3] Percentage computed using as poverty line the 60% of the median equivalent household income.

4. The Model

Static analysis

We construct an individual indicator of utilities deprivations that is equal to one if deprivation occurs and zero if it does not. This is a binary outcome variable, therefore we initially estimate the effects of energy regulation changes on the probability of being deprived using a standard probit model on repeated cross-section data with correction for clustering of errors at the household level of deprivation. The explanatory variables also includes household size, number of household working members, household equivalent income (in ppp), controls for sex, age and education level of the household reference person, year dummies and country dummies.

The results of the standard analysis might be not correct if there are households' unobserved characteristics that persist over time. Including unobserved heterogeneity, the model can be formally written as

$$P(y_{it} = 1 \mid \mathbf{x}_{it}) = \phi(\mathbf{x}_{it}\beta + c_i) \tag{1}$$

where ϕ is the cumulative distribution function of the standard normal distribution, the dependent variable y_{it} is the utilities deprivation state of household i at time t, c_i is the household specific effect, $\mathbf{x}_{it}$ is a vector of regressors (including energy regulation indicators), and the parameters β are the parameters that have to be estimated by maximum likelihood.

Dynamic analysis

To analyze how utilities deprivation evolves over time, we use a dynamic panel data probit model proposed by Wooldridge, 2005 (see also Poggi, 2007, for an application). In simple words, we analyze the impact of past deprivation on actual deprivation controlling for observed and unobserved heterogeneity. Note that this method requires a balanced panel. For household i observed from time t=1 to t=7,[4] the conditional probability that deprivation occurs is

$$P(y_{it} = 1 \mid y_{it-1}, \ldots, y_{io}, c_i) = \phi(\mathbf{z}_{it}\gamma + \rho y_{it-1} + c_i). \tag{2}$$

[4] Note that t=0 refers the first available wave (that is 1994), while the period of study is 1995-2001

where $\mathbf{z}_i$ and $\mathbf{z}_{it}$ are respectively vectors of time-constant and time-varying explanatory variables. Note that we are assuming the followings: first, the dynamics are first order, once c_i is conditioned on; second, the unobserved effect is additive inside the distribution function, ϕ. As suggested by Wooldridge (2005), the parameters in (2) can be consistently estimated by specifying a density for the household specific effect given the deprivation initial condition, y_{i0}, and the time-constant explanatory variables, $\mathbf{z}_i$.[5] Therefore, we assume that

$$c_i \mid y_{i0} \sim \text{Normal}\,(a_0 + a_1\, y_{i0} + \mathbf{z}_i\, \mathbf{a}_2\,,\, \sigma^2_a) \qquad (3)$$

where a_0, a_1 and $\mathbf{a}_2$ are parameters to be estimated and σ^2_a is the conditional standard deviation of the household specific effect, c_i. Note that the vector $\mathbf{z}_i$ appears in (3), and not on the right hand side of equation (2), because otherwise we could not identify the coefficients for the time constant covariates.

Given (2) and (3), we can write the conditional density for the conditional distribution as

$$f(y_{it}\,, \ldots, y_{iT} \mid y_{io}\,, c_i\,;\rho) = \Pi_t\ \{\phi\,(\rho y_{it-1} + c_i\,)^{yt}\ .\ [1\text{-}\phi\,(\rho y_{it-1} + c_i\,)]^{1\text{-}yt}\}$$

Then, we maximize the density obtained integrating the above equation respect to the normal distribution in (3) in order to estimate the parameters ρ, a_0, a_1, $\mathbf{a}_2$, σ^2_a. The estimation is consistent only under the hypothesis that the model is correctly specified. Note that in the model, the value of ρ determines if the deprivation sequence $\{y_{it}\}$ features true state dependence while the estimate of σ^2_a indicates the size of the dispersion accounted by unobserved heterogeneity. Finally, we estimate the impact of variations in energy regulation on the probability of experiencing utility deprivation (averaged over the distribution of the other attributes in the population) using the following consistent estimator of the average partial effects:

$$N^{-1}\sum_{i=1}^{N}\phi\left(z_t\,\hat{\gamma}_a + \hat{\rho}_a\, y_{t-1} + \hat{a}_{0a} + \hat{a}_{1a}\, y_{i0} + z_i\,\hat{a}_{2a}\right)$$

[5] This represents a simple solution to the initial condition problems in dynamic non-linear panel data models with unobserved heterogeneity. In this way, it is possible to account for correlation between the households specific effects and levels of deprivation experienced by the households in the initial period and for correlation between unobserved and observed households characteristics.

where the parameters are estimated using the conditional MLEs and the a subscript denotes multiplication by

$$\left(1+\hat{\sigma}_a^2\right)^{-1/2}$$

Finally, note the Wooldridge's method for estimating a dynamic probit model has some advantages in facing selection and attrition problems. In particular, it allows selection and attrition to depend on the initial conditions and, therefore, it allows attrition to differ across initial levels of deprivation. In particular, individuals with different initial statuses are allowed to have different missing data probabilities. Thus, it is possible to consider selection and attrition without explicitly modelling them as a function of the initial conditions (Wooldridge, 2005).

5. Empirical results

In order to understand the impacts of energy sector reform on utilities deprivation and on its dynamics, we estimate the models presented in the previous section. We discuss the results in two stages. First, we present the estimate of the static analysis. Second, we show the results of the dynamic analysis emphasizing the importance of the dynamics in the model and the impact on the dynamics of energy reforms.

Statics analysis

In the first instance, we estimate on pooled data correcting the standard errors for correlation at the household level. The estimates and the robust standard errors are presented in the first two columns of Table 7.[6] The results are typical of those found in the literature of poverty and deprivation. The household probabilities of experiencing utilities deprivation is higher if the reference person is medium and low educated, and it is lower if the reference person is male; moreover, the probability of being deprived decreases when age rises, and when the number of household working members increases. As expected, only huge variations in income reduce the probabilities of experiencing utilities deprivation. Note that the probability of being deprived rises when the number of household member increases: if we consider the latter as a proxy of household energy consumption, we find that the probability of being deprived increases when consumption (and, therefore, the amount to pay) rises. Of most interest in this regression are the estimated coefficients on energy regulation indicators. A

[6] The reference group is composed of Danish households with as reference person a high educated female; the omitted year dummy refers to 1994.

decrease in the degree of electricity or gas public ownership (i.e. privatization) rises the probability of experiencing utilities deprivation. Also, a reduction in the degree of electricity vertical integration increases the probability of being deprived. Decreases in the entry regulation (i.e. liberalization) seem to not have statistically significant effects on utilities deprivation during the period of study. Finally, the probability of experiencing deprivation decreases over time and it varies across Countries.

The previous conclusions may well be incorrect if there are unobserved characteristics which differ systematically between households. Thus, we move to panel analysis. Column 3 and 4 of Table 7 report coefficients and standard deviations using the random effects estimator and unbalanced panel (Column 5 and 6 report coefficients and standard errors using the random effects estimator and balanced panel). Much unobserved heterogeneity is found, but the results are similar at the ones of the standard probit model. Of most interest, only the estimated coefficient of the electricity vertical integration and the gas public ownership are clearly statistically significant.[7] Note that we also re-estimated the model correcting for correlation at the country level: the coefficients associated to electricity vertical integration and gas public ownership are still statistically significant, respectively, at 10% level and at 1% level.[8] Therefore, we can conclude that decreasing vertical integration in electricity sector and reducing public ownership in gas sector lead to higher probabilities of experiencing utilities deprivation in the period of study.[9] Instead, electricity public ownership and gas entry regulation are slightly statistically significant (at 10% level) only if the unbalanced panel is used (and if we do not correct for correlation at country level), thus no conclusions may be draw.

Dynamic analysis

The static analysis, that we made, indicates that reforms in the degree of vertical integration in the electricity sector and changes in the level of public ownership in the gas sector clearly affect the probability of experiencing utilities deprivation during 1994-2001. Thus, we ideally wish to understand the impact of these factors on the dynamics of utilities deprivation. But, in order to estimate the latter, we need to focus on the period 1995-2001 (using the information about the household levels of deprivation at 1994 as initial condition) and, during this period, we do not observe any reforms in the

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[7] These variables result statistically significant at 1% level if the unbalanced panel is used; while, they result statistically significant at 10% level if the balanced panel is used. The decrease in the degree of significance of these variables may be due to small variations in the sample composition when we move from the unbalanced to the balance panel.
[8] The estimates are available up to requirement.
[9] Note that we tested alternative specifications of the model. In particular, we tested the following specifications: first, a specification with area dummies at level NUTs 2; second, a specification including macro-economic variables; third, a specification including an index of the real household price for electricity and gas. All these specifications lead to the same

level of public ownership. In particular, we observed that the level of public ownership changes only in Belgium and Italy from a degree of public ownership equal to five in 1994 to levels of public ownership, respectively, equal to one and three in 1995. No other variations are registered during the period of study. Therefore, our attention needs to be restricted to the impact of reforms in electricity vertical integration on the dynamics of deprivation from 1995 to 2001.

We estimate the dynamic probit model presented in Section 4 and we present in Table 8 the conditional maximum likelihood estimates and the asymptotic standard errors. In our specification of the model, we include a variable that captures the degree of vertical integration in the electricity sector in country j at time t: this is our variable of interest. As before, the explanatory variables also include sex, age and education dummies for the household reference person, household size, the number of household working members, the equivalent income, year dummies and country dummies. [10] We also include for the time-varying indicator of vertical integration, the corresponding time-invariant dummies (vert_96,…, vert_01) in order to allow for a correlation between the household specific effects and the indicator of vertical integration. Following the same motivation, we also include as covariate the mean over time of the remaining time-varying variables. Note that our model permits us to correct for eventual selection and attrition problems and to solve the initial condition problem that arises since the start of the observation period does not coincide with the start of the stochastic process generating household deprivation experiences (see Section 4).

After controlling for the unobserved effects and observed heterogeneity, the coefficient on the lagged utilities deprivation is highly statistically significant . The initial value of utilities deprivation is also very important, and it implies that there is substantial correlation between the initial condition and the unobserved heterogeneity. In fact, the coefficient on initial deprivation (1.04) is larger than the coefficient on the lag (0.71). Moreover, the estimate of the conditional standard error of c_i (σ_a) is equal to 0.65 and it is statistically different from zero: this means that there is a lot of unobserved heterogeneity. Among the explanatory variables included, if the reference person is male, the household has a lower probability of experiencing utilities deprivation. Instead, if the reference person is low educated, the household has a higher probability of experiencing deprivation. The probability of experiencing utilities deprivation decreases when the number of household working members rises and when the reference person becomes older. The coefficient of household size is positive and statistically different from zero. Of most interest, the estimate coefficient of the indicator of electricity vertical integration is negative and statistically significant: unbundling vertical integrated activities is associated with a higher

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results about the signs of the coefficients associated with vertical integration and public ownership (and their statistically significance).

[10] The reference group is composed of Danish households with as reference person a high educated female; the omitted year dummy refers to 1996.

probability of utilities deprivation. A possible explanation may be found in the presence of economies of vertical integration: in facts, unbundling vertical integrated activities in presence of economies of vertical integration increases the costs of providing power having, in last instance, upward pressures on prices (that are presumable positive correlated with utilities deprivation).[11]

Using the consistent estimator of the average partial effect illustrated in Section 4, we estimate the size of the dynamics. Thus, we estimate the probability of being deprived given that the household is or is not deprived in the former year. The difference is an estimate of the state dependence of being deprived in utilities. The probability to experience utilities deprivation given that the household is deprived in the former year is about 3.54%, while it decreases to 0.81% if the household is not deprived the year before. Thus, the estimation of the state dependence of utilities deprivation is about 0.0273: this means that households experiencing deprivations in the former period have 2.73% higher probability of being deprived than those not deprived the year before (Table 9).

We also estimate the impact of variations in electricity vertical integration on the conditional probability of experiencing utilities deprivation (Table 9). If we suppose that the vertical integration is maximum (that is, the indicator is equal to six), the probability of experiencing utilities deprivation is about 1.14%, but it increases to 2.87% if the household is deprived in the former year. If we suppose that the electricity vertical integration is minimum (that is, the indicator is equal to zero), the probability of experiencing utilities deprivation is 2.81% and it increases to 7.65% if the household is deprived in the former year. Therefore, the probability of experiencing utilities deprivation increases when vertical integration decreases (either if the household is or not is deprived in the former year). Of most interest, the estimated state dependence increases when electricity vertical integration decreases: if vertical integration is maximum, households experiencing deprivations in the former year have 2.22% higher probability of being deprived than those not deprived the year before, this probability increases to 5.57% if the indicator of vertical integration is equal to zero. Therefore, unbundling vertical integrated activities does not only increase the probability of experiencing utilities deprivation but it also increases the probability of persistence in the status of deprived.

[11] For example, see Beccio and Piacenza (2004) for evidence of economies of vertical integration in the Italian electricity sector.

Conclusions

This study provide an analysis of the effects of energy reforms on the household probability of experiencing utilities deprivation in seven European Countries (Denmark, Belgium, France, Ireland, Italy, Netherlands and Spain) during the period 1994-2001. The dynamics of utilities deprivations and the impact of energy reforms on the household persistence in the status of deprivation are also studied. Note that, using descriptive statistics, we show that in average only about 5.98% of the households in the sample experiences utilities deprivation in 1994. At the end of the period of study, the percentage of people suffering utilities deprivations results lower in all countries.

Our main findings are the following ones. First, we do find evidence that unbundling vertical integrated activities in energy sector and reducing public ownership in gas sector lead to higher probability of experiencing utilities deprivation in the period of study. Second, looking at the persistence of utilities deprivation over time, we do find evidence of household heterogeneity and true state dependence, even after controlling for observed household differences. Observed household characteristics, and household initial conditions, also appear strictly related to the probability of experiencing utilities deprivation. Third, not only the probability of experiencing utilities deprivation increases when electricity vertical integration decreases, but the estimated true state dependence increases when vertical integration decreases.

While the effects we have been able to detect are small, and the overall utility deprivation issue is limited and decreasing in the countries we have considered, our findings suggest three questions for future research. First, the existence of true state dependence implies that regulators or policy-makers should focus on specific consumers, where the simple fact of having been unable to pay a bill is an important predictor of future behavior. Thus, matching survey data with information available to the suppliers would offer a more complete picture of the problem and would help to identify possible remedial actions.

Secondly, there is some (limited) evidence that decreasing public ownership increases utility deprivation. While this finding may seem to go against the efficiency rationale of privatization, and the implication of lower costs (and prices, under competition) it is, however, consistent with the traditional objectives of state- or municipally owned companies and their pricing policies.

Third, and perhaps more controversial, we have found robust evidence that unbundling increases the probability of deprivation. This is what one would expect if there are economies from vertical integration that are going to be lost after restructuring. In fact, full liberalization was not operative in the years we consider, and one may think that those costs are necessary to achieve future benefits of competition on subsequent years. This is, however, an issue that has to be left to future research, that can be particularly needed for the new Member States of the EU, where poverty is more widespread, regulation weaker, and where the tariff changes following the reform of energy utilities are substantial.

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Figure 1. Sectoral Indicator of regulatory reform: Electricity

Electricity								
	Weights by theme (b_j)	**Question weights (c_k)**	Coding of data					
Entry regulation:	1/3							
How are the terms and conditions of third party access (TPA) to the electricity transmission grid determined?		1/3	Regulated TPA 0		Negotiated TPA 3		No TPA 6	
Is there a liberalised wholesale market for electricity (a wholesale pool)?		1/3	yes 0			no 6		
What is the minimum consumption threshold that consumers must exceed in order to be able to choose their electricity supplier ?		1/3	No threshold 0	<250 gigawatts 1	Between 250 and 500 gigawatts 2	Between 500 and 1000 gigawatts 3	More than 1000 gigawatts 4	No consumer choice 6
Public ownership:	1/3							
What is the ownership structure of the largest companies in the generation, transmission, distribution, and supply segments of the electricity industry?		1	Private 0	Mostly Private 1.5	Mixed 3	Mostly Public 4.5	Public 6	
Vertical Integration:	1/3							
What is the degree of vertical separation between the transmission and generation segments of the electricity industry?		1/2	Separate Companies 0		Accounting separation 3		Integrated 6	
What is the overall degree of vertical integration in the electricity industry?		1/2	Unbundled 0		Mixed 3		Integrated 6	
Country scores (0-6)			$S_j b_j \, S_k c_k$ answer$_{jk}$					

Source: OECD

Figure 2. Sectoral Indicator of regulatory reform: Gas

Gas					
	Weights by theme (b_j)	**Question weights (c_k)**	Coding of data		
Entry regulation:	1/4				
			Regulated TPA	Negotiated TPA	No TPA
How are the terms and conditions of third party access (TPA) to the gas transmission grid determined?		1/3	0	3	6
What percentage of the retail market is open to consumer choice?		1/3	(1-% of market open to choice/100)*6		
			No, free entry in all markets	Yes, in some markets	Yes, in all markets
Do national, state or provincial laws or other regulations restrict the number of competitors allowed to operate a business in at least some markets in the sector: gas production/import		1/3	0	3	6
Public ownership:	1/4				
			None	Between 0 and 100 %	100%
What percentage of shares in the largest firm in the gas production/import sector are owned by government?		1/3	0	3	6
What percentage of shares in the largest firm in the gas transmission sector are owned by government?		1/3	0	3	6
What percentage of shares in the largest firm in the gas distribution sector are owned by government?		1/3	0	3	6
Vertical Integration:	1/4				
			Ownership separation	Legal/Accounting separation	Integrated
What is the degree of vertical separation between gas production/import and the other segments of the industry?		1/2	0	3	6
What is the degree of vertical separation between gas supply and the other segments of the industry?		3/10	0	3	6
Is gas distribution vertically separate from gas supply?		1/5	0	3	6
Country scores (0-6)			$S_j b_j S_k c_k$ answer$_{jk}$		

Source: OECD

Figure 3. Real household electricity and gas prices in ppp by country (taxes included)

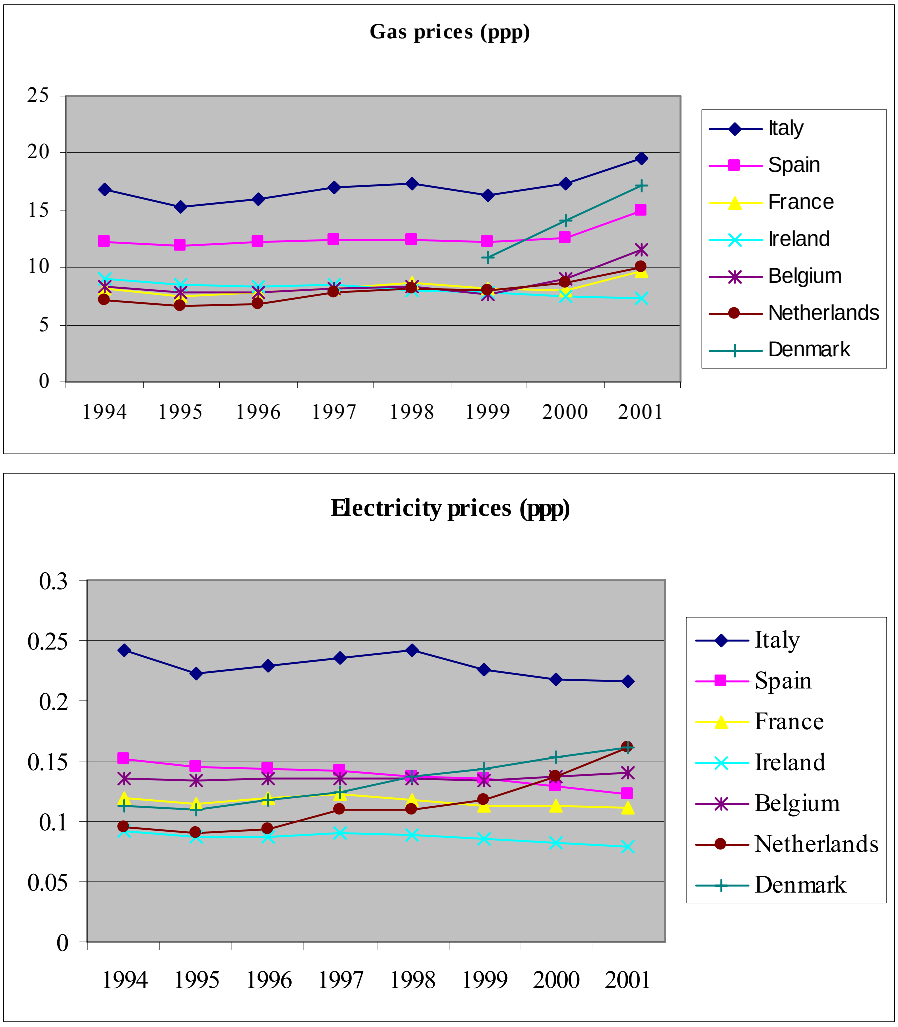

Figure 4. Index of electricity and gas regulatory conditions (ICR)

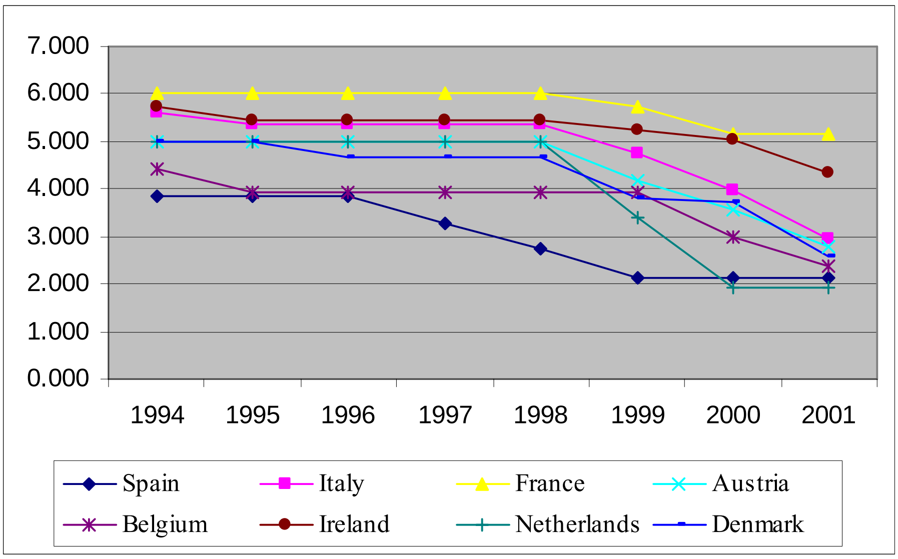

Table 1. Dominant ownership of electricity and gas industry in EU, 1997

(M=municipal; P=private; S=state)

Country	Electricity Generation	Electricity Transmission	Electricity Distribution	Gas Transmission	Gas Distribution
Denmark	M	S/M	M/P	S	S
Belgium	P	P	P/M	S/P	P/M
France	S	S	S	S	S
Ireland	S	S	S	S	S
Italy	S	S	S	S	M
Netherlands	S	S	M	S/P	M
Spain	S/P	S	S/P	S/P	S/P

Source: Hall, 1997

Table 2. OECD indicators of regulatory conditions: electricity

Electricity	Entry regulation		Public ownership		Vertical integration	
	1994	2001	1994	2001	1994	2001
Denmark	6	0.3	4.5	3	6	1.5
Netherlands	6	0.3	6	0	4.5	1.5
Belgium	5	2.3	1.5	1.5	6	1.5
France	6	2.3	6	6	6	4.5
Ireland	6	2.3	6	6	4.5	1.5
Italy	6	2.3	6	3	6	1.5
Spain	5	0.3	3	1.5	3	1.5

Table 3. OECD indicators of regulatory conditions: gas

Electricity	Entry regulation		Public ownership		Vertical integration	
	1994	2001	1994	2001	1994	2001
Denmark	4	2.4	6	6	3	0.9
Netherlands	6	2.1	6	2	4.8	3.9
Belgium	4	2.1	4	1	4.8	3.9
France	6	6	6	6	6	6
Ireland	6	3.5	6	6	6	6
Italy	6	3.1	6	3	4.8	3.3
Spain	6	4.6	6	0	6	3.9

Table 4. Descriptive statistics

Year is 1994	Netherl.	Belgium	France	Ireland	Italy	Spain	Denmark
Proportion of household							
reference person: male	84.31	80.34	84.00	84.13	90.12	89.72	60.92
reference person: low education	13.08	26.32	30.81	54.08	57.02	67.45	25.38
Mean no. of household working members	1.27	1.33	1.18	1.49	1.38	1.26	1.33
Mean no. of household members	2.73	2.89	2.84	3.99	3.36	3.57	2.44
Mean age	41.4	40.3	40.6	43.0	43.8	44.4	41.6
Total net equivalent household income	10995	12908	11449	9075	8582	7584	11671
Proportion of poor household	13.68	16.83	18.14	21.86	21.49	21.25	8.86
No. observation (unbalanced)	4151	2602	5671	3024	5406	5285	2664
No. observation (balanced)	1574	992	2425	888	2029	2064	1084

Table 5. Proportion of household deprived in utilities

Country	1994	1995	1996	1997	1998	1999	2000	2001
Denmark	3.30%	2.45%	2.47%	2.40%	1.93%	1.70%	1.58%	1.56%
The Netherlands	1.73%	1.36%	1.35%	1.57%	1.09%	1.06%	1.10%	1.16%
Belgium	6.65%	5.74%	6.04%	7.08%	6.07%	4.73%	4.91%	5.82%
France	9.42%	8.21%	8.01%	7.29%	7.05%	6.05%	6.19%	5.72%
Ireland	9.46%	7.00%	7.10%	5.65%	4.10%	3.73%	2.41%	2.94%
Italy	4.44%	4.02%	4.30%	4.14%	3.52%	3.63%	3.36%	3.42%
Spain	6.23%	4.69%	4.00%	4.20%	3.12%	2.30%	2.34%	2.42%
All	5.98%	4.91%	4.83%	4.61%	3.88%	3.36%	3.23%	3.27%

Table 6: who are the households deprived in utilities?

% household (1995-2001)	If deprived	If not deprived
Poor	43.69	15.83
reference person: male	67.47	76.04
reference person: low education	58.22	43.54
Mean household size	3.36	2.99
Mean num of household working members	0.99	1.38
Mean total net equivalent household income	7220	11798

Table 7. Estimation results (Model A)

Dependent variable is Utilities deprivation	Unbalanced panel Coef.		Robust S.E.	Unbalanced panel Coef.		S.E.	Balanced panel Coef.		S.E.
Reference person: male	-0.2330	***	0.0255	-0.3105	***	0.0244	-0.2827	***	0.0425
Reference person: age	-0.0106	***	0.0012	-0.0168	***	0.0010	-0.0115	***	0.0020
Ref. person: medium education	0.1451	***	0.0470	0.2825	***	0.0332	0.1571	***	0.0533
Ref. person: low education	0.3252	***	0.0660	0.5249	***	0.0324	0.3818	***	0.0532
No. of household members	0.0846	***	0.0198	0.1296	***	0.0075	0.0711	***	0.0129
No. of household working members	-0.2038	***	0.0367	-0.2741	***	0.0120	-0.1985	***	0.0189
Household equivalent income	-0.00005	**	0.0000	-0.00003	***	0.0000	-0.0001	***	0.0000
Electricity: entry regulation	0.0033		0.0114	0.0038		0.0150	0.0320		0.0240
Electricity: public ownership	-0.0167	*	0.0093	-0.0218	*	0.0127	-0.0023		0.0213
Electricity: vertical integration	-0.0355	***	0.0109	-0.0507	***	0.0150	-0.0432	*	0.0224
Gas: entry regulation	0.0160		0.0133	0.0294	*	0.0164	0.0109		0.0270
Gas: public owenership	-0.0387	***	0.0103	-0.0537	***	0.0149	-0.0439	*	0.0245
Gas: vertical integration	0.0297		0.0191	0.0181		0.0224	-0.0257		0.0340
Year is 1995	-0.1267	***	0.0205	-0.2018	***	0.0283	-0.1688	***	0.0447
Year is 1996	-0.1287	***	0.0230	-0.2170	***	0.0291	-0.1429	***	0.0451
Year is 1997	-0.1473	***	0.0263	-0.2602	***	0.0297	-0.2063	***	0.0459
Year is 1998	-0.2015	***	0.0351	-0.3613	***	0.0319	-0.3306	***	0.0489
Year is 1999	-0.2835	***	0.0431	-0.4844	***	0.0492	-0.3797	***	0.0754
Year is 2000	-0.3026	***	0.0535	-0.5164	***	0.0655	-0.4308	***	0.1023
Year is 2001	-0.2883	***	0.0618	-0.5164	***	0.0699	-0.3806	***	0.1088
Country is The Netherlands	-0.6366	***	0.0802	-0.8209	***	0.0955	-0.8205	***	0.1583
Country is Belgium	0.1893	**	0.0758	0.3138	***	0.0986	0.3790	**	0.1641
Country is France	0.3828	***	0.0729	0.6291	***	0.0797	0.7000	***	0.1226
Country is Ireland	0.0837		0.0941	0.3028	***	0.0899	0.4015	***	0.1427
Country is Italy	-0.1792	**	0.0831	-0.0991		0.0735	-0.0791		0.1208
Country is Spain	-0.5526	***	0.1242	-0.5279	***	0.1313	-0.2991		0.2102
Constant	-0.5406	**	0.2339	-1.2257	***	0.1563	-1.1911	***	0.2560
sigma_a				1.0682	***	0.0119	1.0801	***	0.0195
Rho				0.5330	***	0.0056	0.5385	***	0.0090
Pseudo-R2	0.1303			0.1162			0.0750		
Log-Likelihood	-28456			-24983			-10047		

Note: (***) means statistically significant at 1%, (**) means statistically significant at 5%, and (*) means statistically significant at 10%

Table 8. Estimation results (Model B)

Dependent variable is Utilities deprivation	Balanced panel Coef.		S.E.
Lag utilities deprivation	0.7108	***	0.0353
utilities deprivation at 1994	1.0388	***	0.0458
Reference person is male	-0.1638	***	0.0367
Reference person: age	-0.0085	***	0.0017
Reference person: education is medium	0.0273		0.0483
Reference person: education is low	0.1393	***	0.0475
No. of household members (at 1994)	0.0483	***	0.0123
No. of household working members (hwork)	-0.0861	***	0.0235
Household equivalent income (income)	-0.00002	***	0.0000
Electricity: vertical integration (vert)	-0.0911	**	0.0358
Year is 1995	-0.0816		0.1704
Year is 1997	-0.3231	**	0.1548
Year is 1998	-0.4568	***	0.1599
Year is 1999	-0.6579	***	0.1663
Year is 2000	-0.5888	***	0.1706
Year is 2001	-0.6685	***	0.1831
Country is The Netherlands	-0.4945	***	0.0976
Country is Belgium	0.3824	***	0.0768
Country is France	0.3970	***	0.0685
Country is Ireland	0.0235		0.0858
Country is Italy	-0.0045		0.0738
Country is Spain	-0.3388	***	0.1086
vert_96	-0.0084		0.0324
vert_97	0.0381		0.0297
vert_98	0.0386		0.0306
vert_99	0.0610	*	0.0320
vert_00	0.0211		0.0353
vert_01	0.0499		0.0384
m_hwork	-0.0987	***	0.0354
m_income	-0.0001	***	0.0000
Constant	-0.6496	***	0.2350
sigma_u	0.6457	***	0.0133
Rho	0.2942	***	0.0085
Pseudo-R2	0.2743		
Log-Likelihood	7882.88		

Note: (***) means statistically significant at 1%, (**) means statistically significant at 5%, and (*) means statistically significant at 10%.

The variable m_x is the mean over time of the variable x.

Table 9. Estimated partial effects and state dependence (Model B)

	All sample	Deprived at t-1	Not deprived at t-1	Estimate state dependence
Prob of being deprived at t	1.35%	3.54%	0.81%	2.73%
Prob of being deprived at t				
if vertical integration is 0	2.81%	7.65%	2.08%	5.57%
if vertical integration is 1	2.43%	6.56%	1.73%	4.83%
if vertical integration is 2	2.09%	5.61%	1.43%	4.18%
if vertical integration is 3	1.80%	4.77%	1.18%	3.59%
if vertical integration is 4	1.55%	4.05%	0.97%	3.08%
if vertical integration is 5	1.33%	3.42%	0.80%	2.62%
if vertical integration is 6	1.14%	2.87%	0.65%	2.22%

Note: vertical integration refers to the electricity sector and it is an indicator assuming value between zero (minimal vertical integration) and six (maximum vertical integration); deprivation is utilities deprivation.