An Empirical Delineation of the European Market for Electric Power Generation

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Abstract. This paper analyses the possibilities of substitution between different kinds of equipment that can be used to produce electricity. We focus on the three main types of equipment namely hydraulic, thermal and nuclear. Our approach is a primal approach; we estimate CES and Generalized Leontief production functions on data from the European Communities Statistical Office (EUROSTAT) and the U.S. Department of Energy. Our main result is that nuclear and thermal units are shown as strong substitutes whatever the data or the functional forms we have used for econometric estimation. This result shows that the markets for nuclear and thermal equipments cannot be considered as separate markets. This conclusion is important with regard to the debate over the definition of markets within the energy sector. It is also important, with respect to the response the electric power generation sector can give, to any change in the relative prices of primary energies

Key words: productions function, elasticity of substitution, electric power generation

JEL Classification: C13, L11, L94.

I. Introduction

Electricity production may take various forms, among which the prime examples are hydraulic, traditional thermal and nuclear. The costs of producing electricity with these different kinds of technologies can follow very different paths. For example, an oil shock quickly results in an increase in fossil fuel prices, and thus, in a steep increase in the production costs of electrical plants that run on coal or natural gas. Similarly, in certain sectors of the electricity market, most notably nuclear, it is plausible that the future will see a progressive concentration of production into the hands of very few firms. One consequence of such a trend towards horizontal integration could be the growth of investment costs. Given these circumstances, a potential way to control the costs of electricity production lies in the ability to substitute back and forth among the set of available production techniques. Being able to estimate the extent to which this type of substitution is feasible is, therefore, of vital concern.

Two different approaches can be used to do this. The first is a primal approach and entails estimating a production function, while the second is a dual approach, which involves estimating a cost function[1]. The best choice between these two methods is, to a large degree, a function of the available data. For the purposes of this paper, the lack of data on prices, especially the prices of different kinds of equipment, leads us to favor the first approach. However, a brief analysis of our data will reveal further justification for this choice. One favorable feature of the data we use is the fact that they are published publicly on the internet, and thus easily accessible to all.

Our results show that there is strong potential for substitution among the different kinds of production technique. This finding indicates, as a consequence, that the electricity production market ought to be viewed holistically, and that it would be irrelevant to consider the markets of electric equipments as separated markets. One would be mistaken to think that each of these sectors can be considered independently of the others, as doing this would lead one to ignore the relative flexibility that is in fact at the disposal of producers. In view of this flexibility, it is all the more important to bear in mind the unlikelihood that production costs for traditional and nuclear plants vary in close conjunction with one another.

In addition, this article contributes to the active debate over the definition of markets within the energy sector, an issue whose relevance to current discussion is exemplified by the European Commission's report on the energy market[2].

II. The data

Our data comes from two sources: the European Communities Statistics Office (EUROSTAT)[3] and the U.S. Department of Energy (DOE).[4]

The EUROSTAT data reflects installed capacity of electricity and actual levels of electricity production in the EU 15, during the period from 1985 to 2003. On top of this, the DOE data allows us to expand our analysis to include Canada, Japan, and the individual U.S. states, although only for the period from 1990 to 2003.

An overview of the EUROSTAT data shows that, across all countries and methods of production, total net capacity rose steadily during the period in question, at an average rate of 1.64% per year. During the same timeframe, actual production rose significantly faster[5], as the gross and net levels of production grew by 2.36% and 2.45%, respectively.

However, as Figure 1 shows, different European countries employ the various available production techniques very differently. Clearly, a distinguishing feature of some countries is their "natural" capacity to produce hydraulic energy. Austria, for example, due to its particular geographic characteristics, relies heavily on hydraulic production. Another notable pattern is the variability across countries of nuclear production, which, for example, plays an important role in France but is not used at all in Denmark. The fact that investment in electricity production is so widely spread among the different techniques will serve as a boon to our econometric analysis offered in the rest of this paper.

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[1] Important research on the electricity sector has most frequently employed the dual approach. As P. Soderholm (1998) notes, in a survey of the literature, the cost function approach focuses most on the impact of price variations in combustibles on energy demand and on variable costs of production. As a result, this approach is best-suited to situations with the potential for short-term substitution.

[2] See http://ec.europa.eu/comm/competition/antitrust/others/sector_inquiries/energy/ .

[3] This data available at, http://europa.eu.int/comm/eurostat .

[4] This data available at, http://www.eia.doe.gov/emeu/iea/elec.html .

[5] During this period, gross production rose from 3.78 to 4.43 GWh per MW of net capacity, and for net production, the values are from 3.58 to 4.23 GWh/MW. In both cases, the ratio of production to capacity rose, on average, by 0.9% per annum.

Relative proportion of technologies in European electricity production

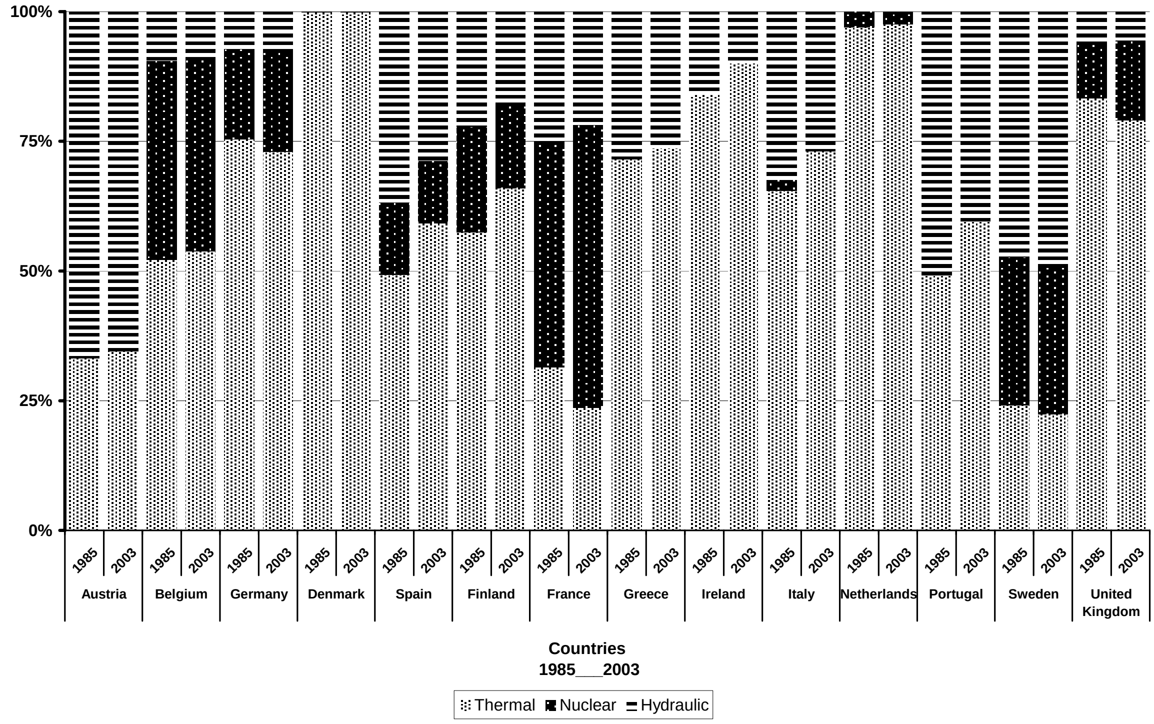

Figure 1

Figure 1 also gives the change in total capacity of production plants over the course of the observed period. A more detailed analysis of the figures on the time period 1985 - 2003 reveals a slow but steady evolution in the importance of different production techniques in different countries. This pattern suggests that the composition of production techniques is not especially sensitive to structural changes in the economic environment. As a result of this, the primal approach would tend to be preferable.

III. Model and estimation from European data

We assume that the production technology can be represented by a weakly separable *production function*, such that the production level Y is given by the relation,

$$Y = ag\left(K_T, K_H, K_N\right)$$

where a is a constant reflecting the employment of other factors of production, K_T, K_H, and K_N designate the three categories of capital corresponding to the thermal, hydraulic, and nuclear production methods, respectively.

We propose to estimate parametrically the function $y = g\left(K_T, K_H, K_N\right)$, where y can be considered to vary proportionally with *Y*, since *a* is a constant.

1. THE CES PRODUCTION FUNCTION

There exist various possible specifications of the function *g*, among which is the CES form[6], defined in the following way,

$$y = A\left[\alpha_T K_T^{-\rho} + \alpha_H K_H^{-\rho} + \left(1-\alpha_T-\alpha_H\right)K_N^{-\rho}\right]^{-1/\rho}. \qquad (1)$$

The major disadvantage of this specification is that it imposes, *a priori*, the same elasticity of substitution, σ_{ij}, – in the sense of Allen (AES) – between any given inputs *i* and *j*, no matter what they are. We have thus,

$$\sigma_{ij} = \frac{1}{1+\rho} \quad \forall i,j \quad i,j = T,H,N \ .$$

The results of the estimation, using the form given by (1) and employing the maximum likelihood technique, are given in Table I.

Table I. Estimation of the CES production function

Parameters	Estimated Values	Standard Errors	Student Statistics
A	12.1700	0.1285	94.739
α_T	0.4010	0.0065	62.174
α_H	0.1848	0.0095	19.403
ρ	-0.8055	0.0340	-23.707

Of note is the fact that all of the parameters are significant and that the values for elasticity of substitution are,

$$\sigma_{TH} = \sigma_{TN} = \sigma_{HN} = \frac{1}{1+\rho} = \frac{1}{1-0.8055} = 5.14 \ .$$

2. THE NESTED CES PRODUCTION FUNCTION

As we have seen, the standard CES form constrains the elasticity between any pair of inputs to be the same. It is possible that imposing, *a priori*, this constraint on the elasticities prevents us from estimating parameter values that are unbiased. Furthermore, for other reasons, this constraint can be regarded as problematic: nuclear and thermal production does not, in fact, compete head-on with hydraulic production. As is frequently pointed out, hydraulic production capacity is exploited up until the point where it ceases to justify itself, either because the remaining potential production sites offer returns that are too low, or because the cost to the environment is too great. This implies that the substitutability between thermal and nuclear production depends not at all on the hydraulic production capacity. This characteristic translates formally to a parametric function that is weakly separable. Conserving the CES form, the function to estimate can thus be written,

[6] The CES (Constant Elasticity of Substitution) form is due to K. Arrow, H. Chenery, B. Minhas et R. Solow (1961).

$$y = A\left\{\beta K_H^{-\mu} + (1-\beta)\left[\alpha K_T^{-\rho} + (1-\alpha) K_N^{-\rho}\right]^{\mu/\rho}\right\}^{-1/\mu}. \quad (2)$$

The maximum likelihood estimation of parameters in function (2) using the EUROSTAT data are given in Table II.

Table II. Estimation of the nested CES production function

Parameters	Estimated Values	Standard Errors	Student Statistics
A	11.9948	0.1415	84.776
β	0.2221	0.0120	18.535
α	0.4735	0.0089	53.160
ρ	-0.8332	0.0362	-22.989
μ	-1.4990	0.1668	-8.988

One can show that the AES between thermal and hydraulic, on the one hand (σ_{TH}), and between nuclear and hydraulic, on the other (σ_{NH}), are equal to one another at $1/(1+\mu)$. In contrast, the AES between nuclear and thermal is, in this case, no longer constant and therefore demands a more complex set of calculations. Noting the production function, *f*, and its first and second derivatives, f_i and f_{ij}, McFadden (1978) shows that σ_{NT} can be calculated using the following formula,

$$\sigma_{NT} = \frac{K_N f_N + K_H f_H + K_T f_T}{K_N K_T} \frac{|F_{NT}|}{|F|}, \quad (3)$$

where $|F|$ denotes the determinant of the Hessian associated with the production function, namely,

$$|F| = \begin{vmatrix} 0 & f_N & f_H & f_T \\ f_N & f_{NN} & f_{NH} & f_{NT} \\ f_H & f_{HN} & f_{HH} & f_{HT} \\ f_T & f_{TN} & f_{TH} & f_{TT} \end{vmatrix},$$

and $|F_{ij}|$ the cofactor associated with the element f_{ij} in the Hessian.

The values for σ_{TH} and σ_{NH} are the following:

$$\sigma_{NH} = \sigma_{TH} = \frac{1}{1+\mu} = \frac{1}{1-1.4990} = -2.00\,.$$

As such, both nuclear and thermal production are seen to be complements to hydraulic production.

Table III shows the sample mean of the elasticity of substitution between nuclear and thermal production, by country, as well as the corresponding empirical standard error. This allows us to observe that, within individual countries, this elasticity is essentially invariant across time. From one country to another, on the other hand, it can vary quite significantly. This result is not really surprising if we report our attention to figure 1 where it is shown that the different countries considered have chosen to use the different technologies in many different ways. Clearly, from our data it was not likely to exhibit constant elasticities of substitution. This motivates us for estimating a more flexible function form. Nevertheless, at that point of our work, nuclear production and thermal production are revealed to be unwaveringly substitutes.

Table III. Allen Elasticity of Substitution between nuclear and thermal (nested CES) (*)

Belgium	6.22 *(0.01)*
Germany	6.16 *(0.02)*
Spain	8.87 *(0.37)*
Finland	6.85 *(0.12)*
France	7.07 *(0.11)*
Italy	8.76 *(0.11)*
Netherlands	6.00 *(0.00)*
Sweden	11.78 *(0.31)*
UK	6.11 *(0.01)*

(*) Standard errors in parenthesis

3. THE GENERALIZED LEONTIEF PRODUCTION FUNCTION

The functional forms that we have used up to now all suffer from the disadvantage that they impose certain *a priori* restrictions on the elasticities of substitution. The CES form is, in effect, not a flexible functional form. This being the case, we believe it is useful to supplement the preceding results by providing an estimation in the Generalized Leontief (GL) functional form, which is defined by the relation, [7]

$$Y = \alpha_N K_N + \alpha_T K_T + \alpha_H K_H + 2\alpha_{NT}\sqrt{K_N K_T} + 2\alpha_{NH}\sqrt{K_N K_H} + 2\alpha_{TH}\sqrt{K_T K_H}\ . \qquad (4)$$

Table IV gives the results of this estimation, using the Ordinary Least Squares method. Note that the majority of the parameters are significant.

Table IV. Estimation of the Generalized Leontief production function

Parameters	Estimated Values	Standard Errors	Student Statistics
α_N	4.6106	0.3313	13.92
α_T	4.0875	0.1854	22.05
α_H	4.0189	0.5562	7.23
α_{NT}	0.9911	0.1922	5.16
α_{NH}	-0.6768	0.3837	-1.76
α_{TH}	-0.6579	0.2620	-2.51

Table V gives the average values and elasticities for selected countries, with the empirical standard error in italics. These results confirm both the substitutability between nuclear and thermal production, on the one hand, and the complementarity between nuclear and hydraulic

[7] The GL, introduced by Diewert (1971) is, along with the Translog (TL) form, due to Christensen, Jorgenson and Lau (1973), among the flexible functional form, the most commonly used in the literature. Our choice of the GL over the TL is forced by the fact that various countries have zero capacities for certain technologies, particularly nuclear.

production, on the other. The results also indicate that the precise degree of substitutability between thermal and hydraulic production varies across countries.

Table V. Allen Elasticity of Substitution (Generalized Leontief) (*)

	Nuclear-Thermal	Nuclear-Hydraulic	Thermal-Hydraulic
Belgium	6.138 *(0.038)*	-0.854 *(0.030)*	-0.661 *(0.092)*
Germany	5.561 *(0.065)*	-2.004 *(0.179)*	0.001 *(0.077)*
Spain	10.719 *(0.710)*	-5.127 *(0.218)*	-2.637 *(0.121)*
Finland	6.972 *(0.323)*	-3.817 *(0.124)*	-1.513 *(0.155)*
France	7.587 *(0.252)*	-1.666 *(0.131)*	-4.046 *(0.248)*
Italy	9.423 *(0.105)*	-11.563 *(1.625)*	-3.453 *(0.352)*
Netherlands	3.286 *(0.075)*	-2.852 *(0.119)*	1.827 *(0.017)*
Sweden	15.961 *(0.532)*	-3.158 *(0.057)*	-4.661 *(0.172)*
UK	5.143 *(0.177)*	-2.319 *(0.448)*	0.277 *(0.088)*

(*) Standard errors in parenthesis

IV. Extension to include U.S., Japan and Canada data

1. THE NESTED CES PRODUCTION FUNCTION

Here we repeat the previous forms of estimation using the DOE data. Table VI gives the results, from this data set, of the nested CES form, given in equation (2). The values of elasticity between nuclear and thermal production derived from this estimation are provided in the appendix, in Table VII.

Table VI. Estimation of nested CES using DOE data

Parameters	Estimated Values	Standard Errors	Student Statistics
A	13.7482	0.0835	164.624
β	0.3406	0.0040	84.886
α	0.4944	0.0065	75.704
ρ	-0.8361	0.0212	-39.423
μ	-1.2447	0.0413	-30.118

The results do not suggest any significant modifications to our above conclusions. In particular, the sign of the elasticities confirms the substitutability between nuclear and thermal production in all countries included in our sample. The variability across countries is more significant when non-European countries are taken into account. Two U.S. states, Oregon and Washington State have an especially lofty level of elasticity. They stand out compared to other elements in the sample because of their large proportion of hydraulic compared to total production capacity. The results in Table VI are not significantly affected by these states' inclusion in or exclusion from the U.S. sample. Let us note that nuclear and thermal production both emerge as complements to hydraulic production, each with equal elasticities given by,

$$\sigma_{NH} = \sigma_{TH} = \frac{1}{1+\mu} = \frac{1}{1-1.4990} = -4{,}09\,.$$

2. THE GENERALIZED LEONTIEF PRODUCTION FUNCTION

As in the previous section, we use the DOE data to estimate the Generalized Leontief production function (4). The results are given in Table VIII.

Table VIII. Estimation of Generalized Leontief Function Using DOE Data

Parameters	Estimated Values	Standard Errors	Student Statistics
α_N	3.4800	0.2156	16.1386
α_T	4.3692	0.0766	57.0090
α_H	5.2617	0.1668	31.5537
α_{NT}	0.6442	0.0944	6.8261
α_{NH}	0.5592	0.2179	2.5661
α_{TH}	-0.6826	0.1034	-6.5996

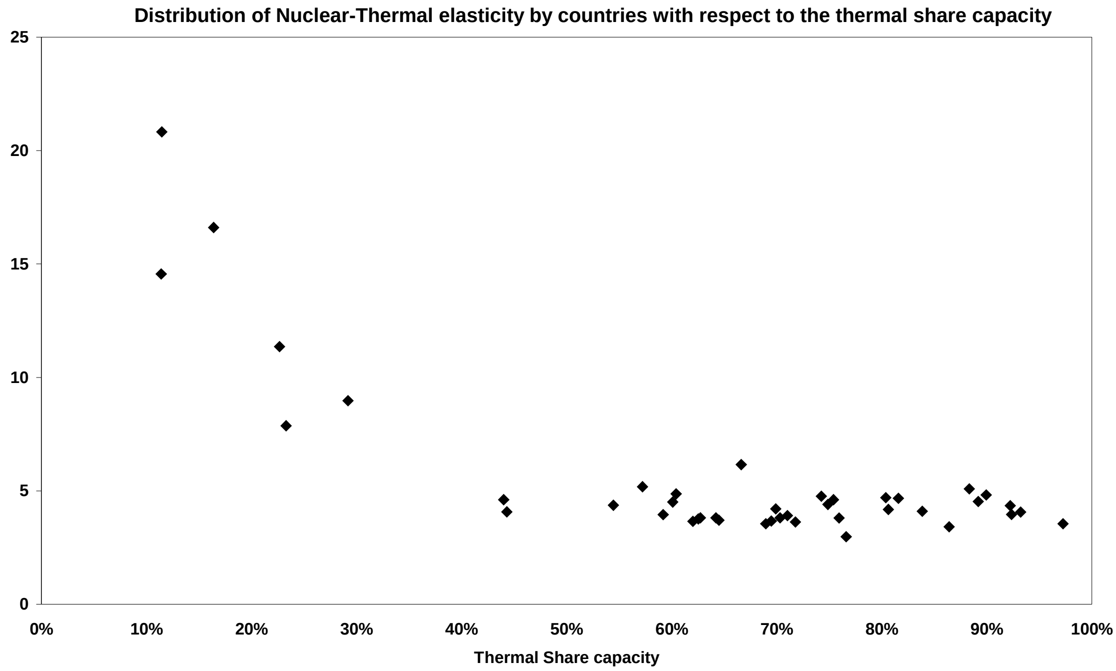

Figure 2

The elasticities of substitution derived from this estimation are offered in Table VII, in the appendix. About the issue of nuclear-thermal substitutability, this estimation confirms the previous result. It is also worth noting that for any country (or U.S. state) the empirical standard error, and then the confidence interval, for this elasticity are very small. The same conclusion does not apply if we compare the different countries. Nevertheless, the distribution of the nuclear-thermal elasticity plotted on figure 2 shows that there are only 6 countries for which this elasticity is very large.[8] These countries are also those which have the smaller relative share of thermal capacity and consequently those for which substituting thermal to nuclear is relatively easier.

[8] Let us note that nuclear-thermal elasticities are also very large for those 6 countries when the nested CES is used instead of the Generalized Leontief (see table VII in the appendix).

Furthermore, the nuclear-hydraulic substitution is still positive (except for Utah, where it is not significantly different from 0). Note also that when European countries are excluded from the estimation, nuclear and hydraulic production emerge squarely as complements. As we have advocated above, the particular status of hydraulic production, among the overall set of production techniques, suggests it ought to be treated separately. We believe, also, that it would be useful to perform the above estimations again in such a way so as to explicitly consider nuclear, coal, and “other thermal” (natural gas); however, obtaining such data is made difficult by the existence of production equipment that can run on both natural gas and coal.

V. Conclusion

The results presented in this paper could be improved upon, in particular, as we have suggested, by distinguishing specifically between two types of thermal production: coal and natural gas.
Another potential improvement would be to consider only off-peak production, but this is made impossible by the lack of sufficiently detailed data. One can nonetheless bear in mind that, since some peak-time capacity does not compete with nuclear capacity, the elasticities obtained here are likely weaker than those one would get by considering only off-peak capacity.
We can thus conclude that the possibilities for substitution between nuclear and thermal production are real and substantial. This result carries a great deal of importance when considering the energy sector’s future course – a course that will undoubtedly exhibit profound shifts[9] over the coming years.
We have in mind not only issues such as the evolution in the price of fossil fuels and the greenhouse effect, but also changes in the markets for production equipment such as the market for nuclear plants. Our results allow such changes to be foreseen with a certain degree of optimism.

References

K. Arrow, H. Chenery, B. Minhas and R. Solow (1961), “Capital-Labor Substitution and Economic Efficiency”, *Review of Economics and Statistics*, **43**:5, August.

L. R. Christensen, D. W. Jorgenson and L. J. Lau (1973), “Transcendental Logarithmic Production frontiers”, *Review of Economics and Statistics*, **55**:1, February, 28-45.

W. E. Diewert (1971), “An Application of the Shephard Duality Theorem: A Generalized Production Function”, *Journal of Political Economy*, **79**:3, May June, 482-507.

D. McFadden (1978) “Estimation Techniques for the Elasticity of Substitution and other Production Parameters”, in Fuss, McFadden (Eds.), “Production economics: a Dual Approach to Theory and Applications”, Vol 2, Amsterdam North Holland, **73**-123.

[9] For example, with respect to the electricity sector in the EU 15, the IEA estimates (in World Energy Outlook 2020 Global Electricity Investment Challenge) that, during the 30 years to come, investment in capacity could represent 618 GW, in other words, more than the capacity in 2000 of 584 GW. Nearly half of this investment will be geared towards replacement of current equipments.

P. Soderholm (1998) “The Modeling of Fuel Use in the Power Sector: A Survey of Econometric Analysis”, *The Journal of Energy Literature*, **4**:2, 3-27.

Appendix

Table VII. Allen Elasticities between nuclear and thermal (DOE data, nested CES and Generalized Leontief) (*)

Country	Nested CES	Generalized Leontief		
	Nuclear – Thermal	Nuclear - Thermal	Hydraulic- Thermal	Nuclear - Hydraulic
Belgium	6.13 *(0.00)*	5.18 *(0.07)*	-26.82 *(2.07)*	33.46 *(1.07)*
Germany	6.37 *(0.10)*	4.40 *(0.17)*	-9.36 *(0.45)*	16.23 *(1.30)*
Spain	10.22 *(0.31)*	4.37 *(0.19)*	-12.28 *(0.52)*	4.95 *(0.26)*
Finland	8.24 *(0.16)*	3.71 *(0.07)*	-11.16 *(0.46)*	7.33 *(0.30)*
France	8.31 *(0.14)*	7.87 *(0.41)*	-60.23 *(2.48)*	2.67 *(0.34)*
Netherlands	6.11 *(0.00)*	3.55 *(0.08)*	0.48 *(0.10)*	17.18 *(0.18)*
Sweden	17.36 *(0.71)*	11.36 *(0.59)*	-18.11 *(0.46)*	2.44 *(0.03)*
UK	6.21 *(0.01)*	4.70 *(0.03)*	-6.64 *(0.51)*	18.37 *(0.18)*
Canada	26.13 *(2.23)*	8.98 *(0.19)*	-9.98 *(0.79)*	2.40 *(0.08)*
Japan	6.99 *(0.12)*	3.81 *(0.06)*	-10.72 *(0.36)*	11.07 *(0.61)*
Alabama	7.41 *(0.15)*	3.81 *(0.04)*	-12.96 *(1.29)*	9.44 *(0.51)*
Arkansas	7.41 *(0.14)*	3.67 *(0.02)*	-10.45 *(0.65)*	9.34 *(0.42)*
Arizona	8.02 *(0.27)*	3.95 *(0.12)*	-14.19 *(1.56)*	7.73 *(0.70)*
California	10.50 *(0.31)*	3.65 *(0.11)*	-9.25 *(0.24)*	4.75 *(0.21)*
Connecticut	6.21 *(0.01)*	4.51 *(0.30)*	-22.12 *(7.58)*	24.00 *(2.57)*
Florida	6.10 *(0.00)*	4.82 *(0.11)*	-1.50 *(0.35)*	21.28 *(0.35)*
Georgia	7.31 *(0.17)*	3.63 *(0.06)*	-9.77 *(1.01)*	9.59 *(0.52)*
Iowa	6.18 *(0.00)*	3.96 *(0.02)*	-2.05 *(0.09)*	16.03 *(0.10)*
Illinois	6.10 *(0.00)*	6.16 *(0.10)*	-15.91 *(4.96)*	34.75 *(3.80)*
Kansas	6.10 *(0.00)*	5.09 *(0.04)*	-1.60 *(0.11)*	23.03 *(0.21)*
Louisiana	6.14 *(0.00)*	4.53 *(0.07)*	-2.73 *(0.36)*	18.51 *(0.13)*
Massachusetts	8.08 *(0.26)*	2.98 *(0.07)*	-6.95 *(0.50)*	7.19 *(0.41)*
Maryland	6.40 *(0.03)*	4.18 *(0.06)*	-6.85 *(0.35)*	14.82 *(0.38)*
Maine	9.35 *(0.08)*	4.87 *(0.09)*	-17.59 *(0.25)*	5.33 *(0.12)*
Michigan	6.80 *(0.07)*	3.80 *(0.01)*	-8.60 *(0.61)*	11.78 *(0.31)*
Minnesota	6.21 *(0.02)*	4.67 *(0.04)*	-6.12 *(0.42)*	18.16 *(0.28)*
Missouri	6.64 *(0.04)*	3.42 *(0.03)*	-4.79 *(0.32)*	11.57 *(0.15)*
North Carolina	6.79 *(0.07)*	3.91 *(0.02)*	-10.82 *(0.95)*	12.19 *(0.34)*
Nebraska	6.27 *(0.03)*	4.61 *(0.07)*	-9.16 *(0.64)*	17.83 *(0.56)*
New Hampshire	7.51 *(0.16)*	4.08 *(0.15)*	-27.75 *(4.13)*	8.47 *(0.72)*
New Jersey	6.23 *(0.01)*	4.76 *(0.03)*	-9.76 *(0.94)*	19.15 *(0.45)*
New York	7.94 *(0.38)*	3.55 *(0.03)*	-9.79 *(0.27)*	7.94 *(0.71)*
Ohio	6.12 *(0.00)*	4.35 *(0.06)*	-1.35 *(0.12)*	18.60 *(0.24)*
Oregon	77.11 *(0.86)*	16.61 *(0.10)*	-6.32 *(0.04)*	3.27 *(0.02)*
Pennsylvania	6.48 *(0.01)*	4.21 *(0.01)*	-11.89 *(0.51)*	15.07 *(0.09)*
South Carolina	8.24 *(0.30)*	4.61 *(0.36)*	-23.30 *(2.84)*	6.60 *(0.84)*
Tennessee	8.75 *(0.23)*	3.76 *(0.12)*	-11.14 *(0.90)*	6.51 *(0.33)*
Texas	6.14 *(0.00)*	4.07 *(0.09)*	-1.42 *(0.27)*	17.10 *(0.22)*
Virginia	8.09 *(0.26)*	3.81 *(0.14)*	-12.23 *(1.04)*	7.64 *(0.54)*
Utah	13.56 *(2.13)*	20.83 *(0.62)*	-46.67 *(13.29)*	-0.05 *(1.26)*
Washington	111.19 *(13.92)*	14.56 *(0.88)*	-4.53 *(0.31)*	2.76 *(0.15)*
Wisconsin	6.37 *(0.03)*	4.10 *(0.03)*	-5.61 *(0.59)*	14.70 *(0.23)*

(*) Standard errors in parenthesis