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The impact of energy efficiency policies on energy consumption in the EU Member States: a new approach based on Energy Policy indicators

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Abstract

The purpose of this project is to develop an econometric model aimed at estimating the impact of energy efficiency policies on energy consumption in the EU Member States in the period 1990-2013. The aim of the models is to answer three core research questions:

1. Are EU and national energy efficiency policies effective in reducing aggregate energy consumption? Can we derive a quantitative measure of the policy-induced energy saving in each year from 1990 to 2013, measured as a percentage of the energy consumption as it would have been in the absence of energy policies?
2. Are sector specific energy efficiency policies effective in reducing sector's energy consumption (sectors: household, services, industry, transport)? Can we measure effectiveness of energy policies in reducing consumption of energy in each sector?
3. Is the impact of sector specific energy efficiency policies different on different energy sources (sources: electricity, gas, oil, solid fuels)? Can we measure effectiveness of energy policies in reducing consumption of a given energy source in a given sector?

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1 Goals, methodology and summary of the main results

The purpose of this project is to develop an econometric model aimed at estimating the impact of energy efficiency policies on energy consumption in the EU Member States in the period 1990-2013. The aim of the models is to answer three core research questions:

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3. Is the impact of sector specific energy efficiency policies different on different energy sources (sources: electricity, gas, oil, solid fuels)? Can we measure effectiveness of energy policies in reducing consumption of a given energy source in a given sector?

A recent JRC Report (Bertoldi-Hirl, 2013) has addressed the same questions resorting to the counterfactual simulation approach proposed in Horowitz (2011), which is based on dividing the observed time span in a "pre-policy period", where policies are essentially absent, and a "policy period", characterized by the existence of relevant policies; an energy demand equation is then estimated in the pre-policy period, and the estimated model is used to forecast energy demand in the policy period, setting the non policy variables to their actual value; the difference between actual energy demand and the forecasted energy demand is regarded as the (estimated) saving induced by policy.

The approach in this study shares with Bertoldi-Hirl and Horowitz the idea of using a panel econometric model to evaluate policy effectiveness; however, instead of using counterfactual simulation, we try to introduce an explicit measure of energy policy as an explanatory variable in the econometric model; the model is then estimated using the entire period. To evaluate policy effectiveness, the estimated model is analyzed through simulation techniques to isolate the contribution of energy policy from the impact of other determinants (prices, level of activity, technology ...). The first simulation experiment is the simple and well-known step response analysis (en.wikipedia.org/wiki/Step_response): starting from an equilibrium initial state, the policy variable is given a unit step, and the dynamic response of energy consumption is measured and analyzed. In the present framework, it is also interesting to consider a variant of the step response: instead of a step function, starting from an equilibrium initial state, the entire historical path of the policy variable (24 years) is given as an input, and the response of energy consumption is measured and analyzed. The final step of the simulation is a measure of the energy saving induced by energy policies in the entire period.[1]

The results of this study are encouraging about the potentials of the new methodology, and provide some figures about policy induced energy savings in each country as well as EU29, i.e. EU28 plus Norway (see Table 16 on page 27) which, although puzzling in some respect, seem plausible in general. However it is important to remark that given the many methodological innovations contained in this study, the results have to be regarded as preliminary: in particular, the methodology proposed in this study to construct Energy Policy Indicators (EPI's) may be improved and fine-tuned as discussed below.

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[1] We may say that the counterfactual simulation approach estimates the model without the policy variable using the pre-policy period, and sets energy policy to zero in the simulated period, leaving the other variables at their historical level. Conversely, we estimate the model using the entire period (we do not need a "policy free" period for estimation), and then we simulate the entire period as if the other variables are fixed, allowing only the policy variable to change.

The structure of this report is the following:

Section 2 illustrates the methodology for constructing the Energy Policy Indicators. The methodology is based on MURE's database on policy measures (see www.measures-odyssee-mure.eu). The database classifies about 2000 energy policy measures adopted by EU29 countries since 1970, reporting the year of adoption and some stylized characteristics ("type" of measure, "expected impact" ...), along with a more detailed description of each measure. The basic version of our indicator is based on counting the number of measures adopted in each country in each year, and cumulating them over time. We also propose more advanced versions of the indicators where (i) the measures are not simply counted, but rather "weighted" before summing, according to their expected impact (in principle the "type" of measure or other characteristics could be used for weighting as an alternative) (ii) a "delay" parameter is introduced to take into account that some time is needed before a measure can reach its target level of energy saving. Out of the four alternative versions we propose,[2] our subsequent econometric analysis seems to support the most simple one, based on counting: however more alternatives should be explored (the "type" of measure is likely to be important). Another aspect that deserves more attentive investigation is the completeness and internal consistency of MURE database: the number of measures seems too low in some countries (e.g. Denmark) with respect to others (e.g. Spain): if this is due to incompleteness or over counting, the consequence is that policy induced saving will be underestimated in some countries and overestimated in some others. Double checking with the IEA "Policies and Measures Database" (www.iea.org/policiesandmeasures/energyefficiency/) might be a starting point to improve the quality of our indicators. Appendix 1 reports time series graphs of one version of our indicators (weighted and delayed according to impact) for each country.

Section 3 describes the database created for this study (main sources: Eurostat and Enerdata).

Section 4 describes the structure of the econometric models, the estimates, the simulation methodology used to isolate the effect of energy policy from the contribution of the other determinants of energy demand, and reports the results of the simulations, i.e. the percentage and absolute energy savings in each country and EU29. Summarizing, we propose three different dynamic panel models (estimated with Arellano-Bond estimator):

- Model 1, page 21: single equation for the whole economy - all sectors all fuels
- Model 2, page 25: 4 equations, one for each sector (Household, Services, Industry, Transport) - all fuels
- Model 3, page 28: 9 disaggregate equations, 3 sectors (excluding Transport) 3 fuels (Electricity, Gas, Oil).[3]

The results from Model 2 seem more reliable. As a matter of fact, Model 1 appears too aggregate, and seems to underestimate the effectiveness of policy, quite likely due to more relevant measurement errors in the EP indicator induced by composition effects. On the opposite side, the results from Model 3 appear too unstable (they are very sensitive to small changes in the dataset, like dropping some countries or shortening the time span): however we believe that there are margins for improving this model substantially, by spending some work on MURE database to disentangle in a reliable way the role of "fuel specific" measures, and by considering more carefully interfuel substitutability. The results on energy savings derived from Model 2 are reported in Table 16 on page 27; in short:

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[2] The four versions are given by all combinations of weighting (yes/no) and delaying (yes/no).

[3] In this report we have not considered a model disaggregated by fuel, but aggregated across sectors. Ideally, this would be possible, but we think less interesting, since policies are in general sector specific. Aggregating sectors, as we did in Model 1, is expected to reduce the estimated effects of energy policies, since in the aggregate model the measurement error is more severe.

- Energy policies seems to have an impact in reducing energy consumption. In the absence of energy policies consumption in EU29 countries would have been approximately 11% higher in 2013.
- Effectiveness of energy policies seems to be higher in Industry (20% saving in 2013 for EU29) intermediate for Household and Transport (10%), whereas for Services the magnitude and significance of the effect seems negligible.

The analysis of individual countries has to be regarded as very preliminary. As we said, although the quality and reliability of the MURE database seems in general good, some aspects deserve an accurate analysis, since they seem to contradict the common sense on the level of commitment of national governments with respect to energy policies. For example, according to the MURE database, the average country has adopted 66 energy policy measures between 1990 and 2013; Spain is reported to have taken 139 measures while Denmark only 27. Even worst if we focus on "high impact" measures: according to the MURE database, the average country has adopted 21 "high impact" energy policy measures between 1990 and 2013; Spain is reported to have taken 91 "high impact" measures while Denmark only 3.

Section 5 concludes, illustrating some directions for further research.

2 The "Energy Policy Indicator" (EPI)

The most challenging part of this study is to construct annual time series measuring the intensity of the energy policies for each country, from 1975 to 2013.[4]

The idea of introducing this type of variable in the econometric analysis of effectiveness of policies is not new, see Filippini et al. (2014), Bigano et al. (2011), Saussay et al. (2012), but we propose a new methodology to construct the indicator, where the relevance and the year of introduction of the policy measures is taken into account.

As in Filippini et al (2014), the natural starting point is the MURE Database. The MURE database (www.measures-odyssee-mure.eu) provides an overview of the most important energy efficiency policy measures in the EU Member States (and Norway), plus the EU measures. The database is structured by final energy consumption sectors (household, tertiary, industry, transport) and also includes a general cross-cutting section. The focus is on single policy measures in order to allow a specific analysis of each measure. More general programs comprising several measures are mainly described in the cross-cutting section of MURE. The homogeneity of the measure descriptions over sectors and countries is ensured by detailed guidelines (Schlomann & Eichhammer 2011). All measures are classified according to specific keywords, thus allowing queries based on criteria as e.g.

- their status (completed, on-going or planned);
- their year of introduction and completion;
- their type: legislative/normative (e.g. standards for new dwellings), legislative/informative (e.g. obligatory labels for appliances), financial (e.g. subsidies), fiscal (e.g. tax deductions), information/education, cooperative (e.g. voluntary agreements) and taxes (on energy or CO-emissions);
- the targeted end-uses and the main actors involved by the policy measures;
- their semi-quantitative impact based on experts judgement: low, medium or high impact (see below);

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[4] The analysis of the policy measures in the MURE's database shows that some countries have introduced relevant measures before 1990. However, 95% of all measures adopted in Europe before 2014 have been adopted after 1990. Therefore, although the indicators are constructed starting in 1975, they are used in the subsequent econometric analysis from 1990.

- the end-uses involved and the quantitative impact of the policy measure related to a specific end-use (if this information is available);
- whether the measure is related to EU directives

The purpose of the proposed methodology is to create, for each country (i) in each year (t), several "Energy Policy Indicators" (EPI's) obtained as a weighted sum of the policy measures adopted in country i in year t, cumulated over time. Each EPI is based on a given type of measure (e.g. fiscal measures in the industry sector). The general idea of the methodology is the following: assume that country i has adopted K_i relevant measures (i.e. measures of the type of interest) over the period $t = 1, \ldots, T$; define

$t_{k,i}$: year of adoption of the k-th relevant measure in country i

$w_{k,i}$: weight of the k-th relevant measure in country i

$\delta_{k,i}$: "delay" of the k-th relevant measure in country i

$d_t^{k,i}$: dummy indicating if the k-th measure in country i has been adopted in year t (i.e. $t_{k,i} = t$)

by "delay" of a measure we mean the number of years needed for the measure to achieve the regime level of reduction of energy consumption. The EP indicator is then given by

$$EPI_{i,t} = \sum_{j=1}^{t} \left(\sum_{k=1}^{K_i} \sum_{h=0}^{\delta_{k,i}-1} \frac{w_{k,i}}{\delta_{k,i}} d_{j-h}^{k,i} \right)$$

Notice that the first difference

$$\Delta EPI_{i,t} = \sum_{k=1}^{K_i} \sum_{h=0}^{\delta_{k,i}-1} \frac{w_{k,i}}{\delta_{k,i}} d_{j-h}^{k,i}$$

is a measure of the energy policy effort in year t, which is cumulated to obtain $EPI_{i,t}$. It is important to remark that due to this cumulation, in the EPI indicator all energy policy measures are assumed to have a permanent effect, since they are counted in every year since MURE's "Starting date", even after the "Ending date" (when it is reported): we assume in fact for simplicity that the measure is discontinued when it has achieved the target, permanently reducing the energy need. Ideally, one might easily modify the indicators by introducing another parameter, say "degree of persistence", to be associated to each measure: the most recent version of MURE database has some evaluation of this aspect, although not for all measures.

The methodology, based on the MURE database, has been implemented here for all 29 countries, and from 1975 (t=1) to 2013 (t=39). This allows creating 30 energy policy indicators:

1. 25 disaggregate energy policy indicators for each country, labelled EPI_sitj in the dataset, where s stands for "sector" (i:1,...,5) and t stands for "type" (j:1,...,5).[5] The sector codes are given in Table 1, while the types are summarized in Table 2. Notice that the "macro types" illustrated in Table 2 correspond to more specific types, which depend on the sector. We refer to the MURE database for a more detailed illustration; as an example, Table 3 illustrates the 38 types corresponding the macro-types of Table 2 for the household sector.
2. sectoral indicators, labelled EPI_si, aggregating all measures in each sector

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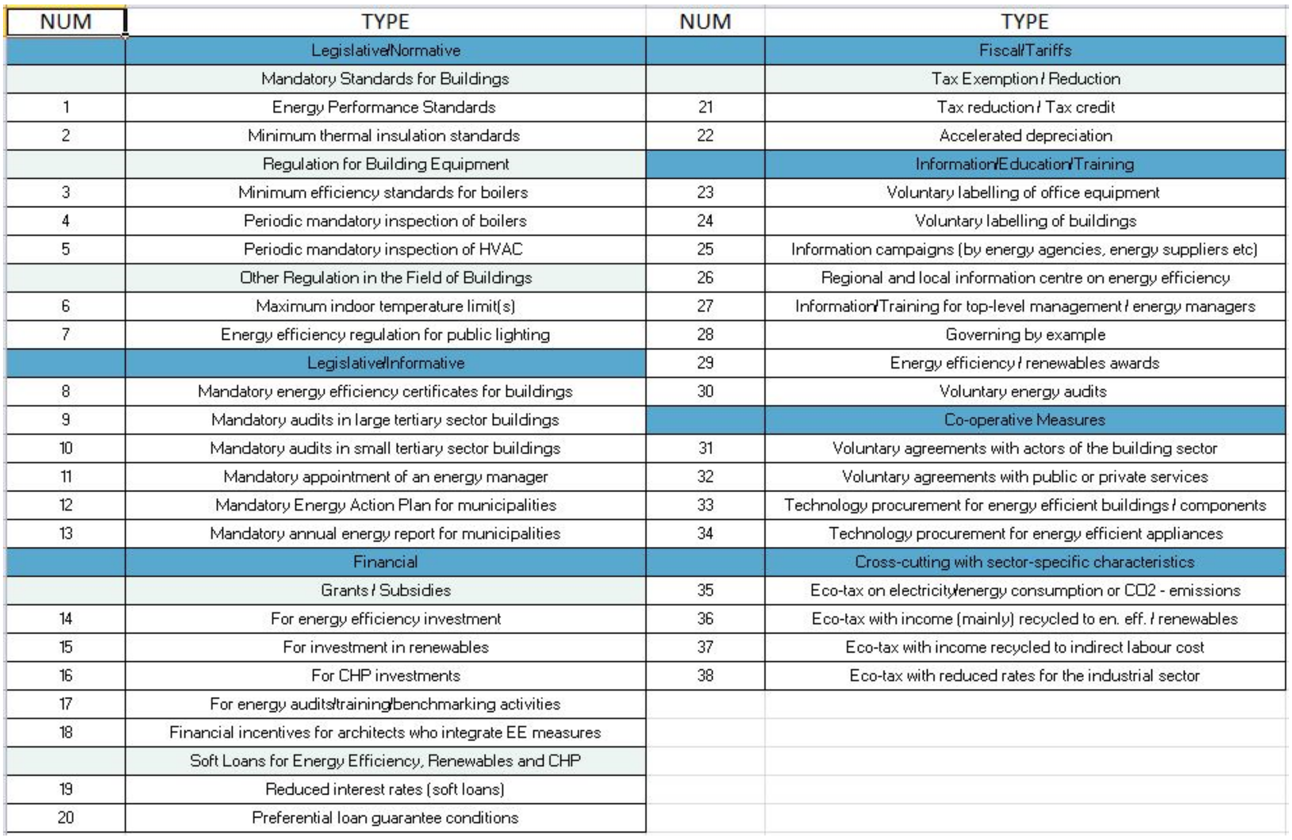
[5] When a measure belongs to different types, its contribution is evenly divided across types.

"sector" code	Sector
1	Household
2	Services
3	Industry
4	Transport
5	Cross-cutting measures

Table 1: Sectors (MURE).

"type" code	Type of policy measure
1	Financial, fiscal/tarifs
2	Legislative/normative (standard)
3	Legislative/informative (labels)
4	Information/education/training
5	Other

Table 2: Policy Measures.



NUM	TYPE	NUM	TYPE
	Legislative/Normative		Fiscal/Tariffs
	Mandatory Standards for Buildings		Tax Exemption / Reduction
1	Energy Performance Standards	21	Tax reduction / Tax credit
2	Minimum thermal insulation standards	22	Accelerated depreciation
	Regulation for Building Equipment		Information/Education/Training
3	Minimum efficiency standards for boilers	23	Voluntary labelling of office equipment
4	Periodic mandatory inspection of boilers	24	Voluntary labelling of buildings
5	Periodic mandatory inspection of HVAC	25	Information campaigns (by energy agencies, energy suppliers etc)
	Other Regulation in the Field of Buildings	26	Regional and local information centre on energy efficiency
6	Maximum indoor temperature limit(s)	27	Information/Training for top-level management / energy managers
7	Energy efficiency regulation for public lighting	28	Governing by example
	Legislative/Informative	29	Energy efficiency / renewables awards
8	Mandatory energy efficiency certificates for buildings	30	Voluntary energy audits
9	Mandatory audits in large tertiary sector buildings		Co-operative Measures
10	Mandatory audits in small tertiary sector buildings	31	Voluntary agreements with actors of the building sector
11	Mandatory appointment of an energy manager	32	Voluntary agreements with public or private services
12	Mandatory Energy Action Plan for municipalities	33	Technology procurement for energy efficient buildings / components
13	Mandatory annual energy report for municipalities	34	Technology procurement for energy efficient appliances
	Financial		Cross-cutting with sector-specific characteristics
	Grants / Subsidies	35	Eco-tax on electricity/energy consumption or CO2 - emissions
14	For energy efficiency investment	36	Eco-tax with income (mainly) recycled to en. eff. / renewables
15	For investment in renewables	37	Eco-tax with income recycled to indirect labour cost
16	For CHP investments	38	Eco-tax with reduced rates for the industrial sector
17	For energy audits/training/benchmarking activities		
18	Financial incentives for architects who integrate EE measures		
	Soft Loans for Energy Efficiency, Renewables and CHP		
19	Reduced interest rates (soft loans)		
20	Preferential loan guarantee conditions		

Table 3: MURE's mesure types, household sector.

Different versions of the 30 indicators may been obtained, by changing the weighting and "dalay" schemes. As an illustration, in this study we consider four alternative weighting schemes and two alternative "delay" schemes:

- Weighting scheme 1 (Equal weighting): $w_{k,i} = 1$ for all k and i
- Weighting scheme 2 (MURE weighting): as mentioned above, MURE provides a semi-quantitative evaluation of the impact of each measure, based on quantitative evaluations or expert estimates;

the following limits (in each case in % of the overall final energy or electricity consumption of a sector) are defined for the three impact levels: low = less than 0.1%, medium = 0.1 - 0.5% and high= greater than 0.5% savings. Notice that MURE clarifies that the semi-quantitative assessment is made by the participating institution in each country, and therefore it may not be completely consistent among countries. However we have tried to develop a weighting scheme based on this information, which is easily accessible in the MURE database. We have therefore considered $w_{k,i} = 0.05$ for all measures whose semi-quantitative impact is LOW (the same weight is given also to the measures whose semi-quantitative impact is unknown), $w_{k,i} = 0.3$ for all measures whose semi-quantitative impact is MEDIUM, $w_{k,i} = 0.7$ for all measures whose semi-quantitative impact is HIGH. In practice, using this weighting scheme, the weighted indicator may be interpreter as the percentage decrease in energy consumption expected to be achieved by the policy measures (according to the MURE's impact evaluation) as compared to the energy intensity the sector would have experienced in the absence of policies.

- Weighting scheme 3 (Exclude low/unknown impact): $w_{k,i} = 0$ for all measures whose semi-quantitative impact is LOW (or unknown), $w_{k,i} = 1$ for all measures whose semi-quantitative impact is MEDIUM or HIGH
- Weighting scheme 4 (High impact only): $w_{k,i} = 0$ for all measures whose semi-quantitative impact is LOW or MEDIUM (or unknown), $w_{k,i} = 1$ for all measures whose semi-quantitative impact is HIGH
- "delay" scheme 1 (no delay): all measures are assumed to be fully effective in the year they are adopted: $\delta_{k,i} = 0$ for all k and i
- "delay" scheme 2 (delay related to impact): the number of years needed before a measure is fully effective depends on its impact: $\delta_{k,i} = 5$ for all measures whose semi-quantitative impact is LOW (or unknown), $\delta_{k,i} = 6$ for all measures whose semi-quantitative impact is MEDIUM, $\delta_{k,i} = 7$ for all measures whose semi-quantitative impact is HIGH. The delay has the effect of smoothing the resulting EP indicator.

Notice that the weighting scheme may alter the "within" and "between" variability of the EP indicators substantially. As an example, Figure 1 compares EPI's for Germany (first row) and Italy (second row) for the household sector based on the weighting scheme 1 (Equal weighting, first column) and on the weighting scheme 2 (MURE weighting, second column).[6]

Neglecting the MURE semi-quantitative impact indicator the number of measures in 2013 in the two countries is not so different (30 in Germany, 24 in Italy); conversely, the weighted indicator is approximately 1/3 in Italy in 2013 with respect to Germany. Notice also that, according to the weighted indicator Italy has not introduced relevant policies before 2005, whereas the equally weighted index seems to suggest that relevant policies started already in the mid-nineties.

In the empirical analysis, we will check which scheme offers the most coherent results. However, it is important to remark that this is a preliminary study, and that alternative schemes, based on a deeper understanding of the MURE database (and possibly on a detailed analysis of each measure) could be considered, hopefully improving the reliability of the EP indices and the empirical results.

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[6] The "delay" scheme 2 is adopted here. In the plots FCOUNT=EPI_s1t1, SCOUNT=EPI_s1t2, LCOUNT=EPI_s1t3, ICOUNT=EPI_s1t4, OCOUNT=EPI_s1t5 and TCOUNT=EPI_s1 based on the weighting scheme 1 (Equal weights), while FWEIGHT, SWEIGHT, LWEIGHT, IWEIGHT, OWEIGHT and TWEIGHT are the corresponding indicators based on the weighting scheme 2 (MURE weights).

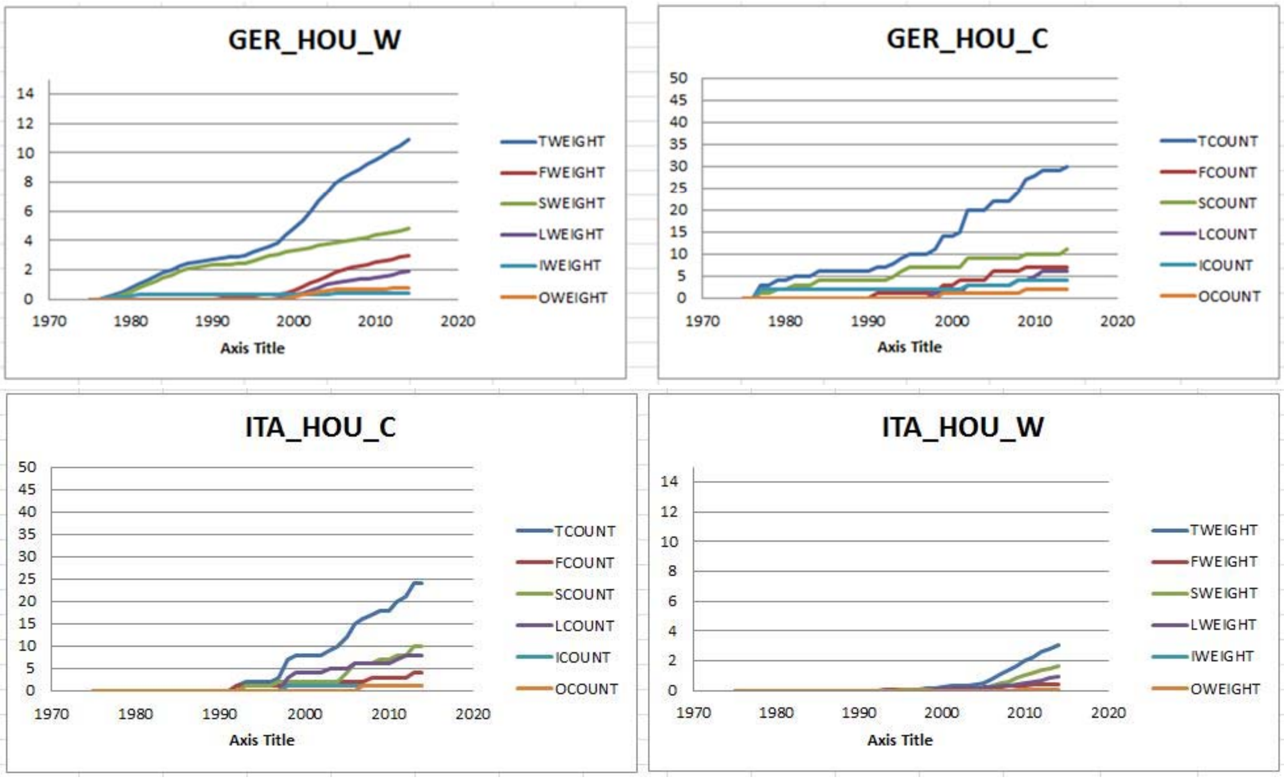


Figure 1: Policy intensity in Germany and Italy, Household sector.

We illustrate here some descriptive statistics for the Energy Policy indicators based on weighting scheme 2 and delaying scheme 2, to provide some evidence about general tendencies in EU, based on averages taken on the 29 countries. A more detailed analysis of each country is in Appendix 1.

Figure 2 illustrates the average across countries of the 5 sectoral policy intensity indicators.

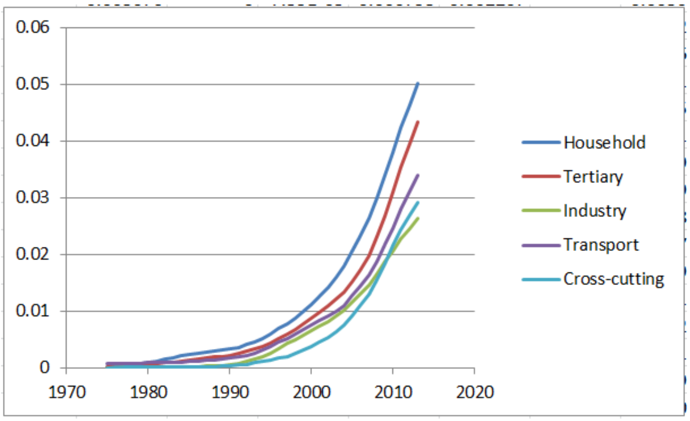


Figure 2: Policy intensity indicators (1990-2013), average of EU-29 countries.

Household seems to have the highest expected level of policy induced energy saving, amounting at approximately 5% in 2013. Literally taken this means that, according to our interpretation of MURE's estimates, household's energy consumption would have been 5% higher in the absence of policies in the average country everything else being unchanged. This interpretation is probably overrating the precision of the indicator, which is admittedly based on semi-quantitative measures. The impact of energy policies on the industrial sector seems roughly half with respect to household.

Taking the first difference of the Policy intensity indicators, see Figure 3, we observe that energy policy intensity started in the eighties, and has been steadily increasing reaching a peak around 2008-2010, experiencing its first decline in the last three years (although it should be double checked to which extent this is due to sluggish updates of the MURE database). According to these measure, energy policies account for savings in the order of 0.4% per year at the end of the sample for Household and Tertiary sector, around 0.3% for Transport, and around 0.2% for industry.

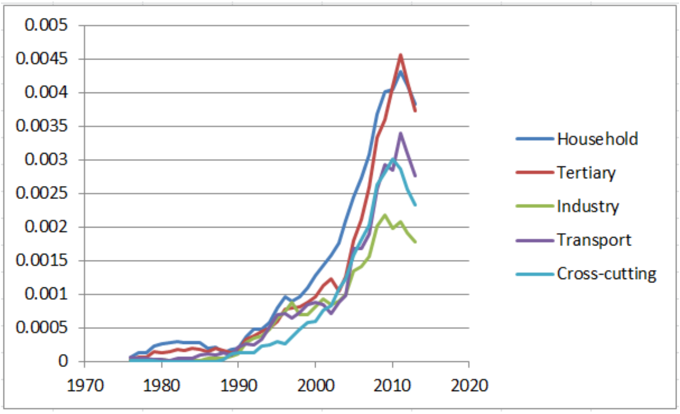


Figure 3: First differences of the policy intensity indicators (1991-2013), average of EU-29 countries.

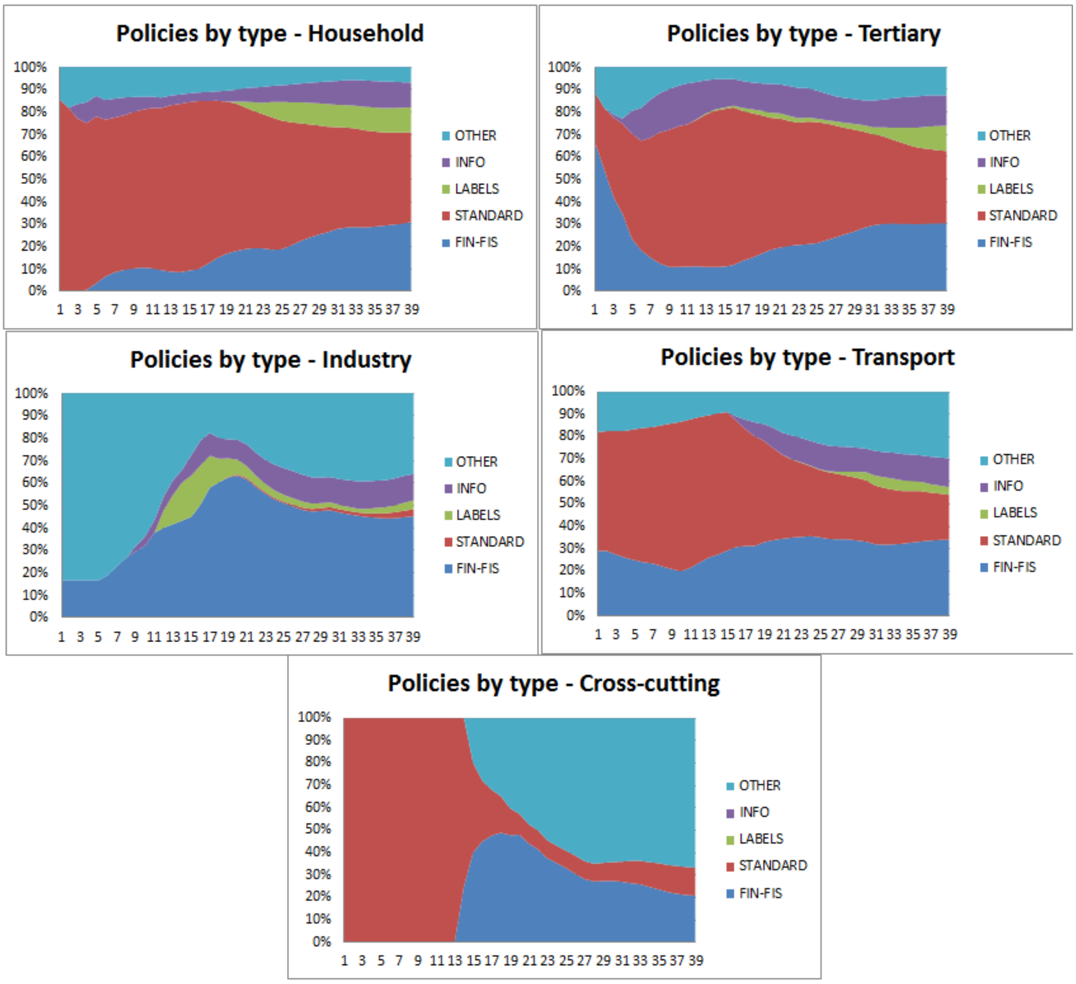
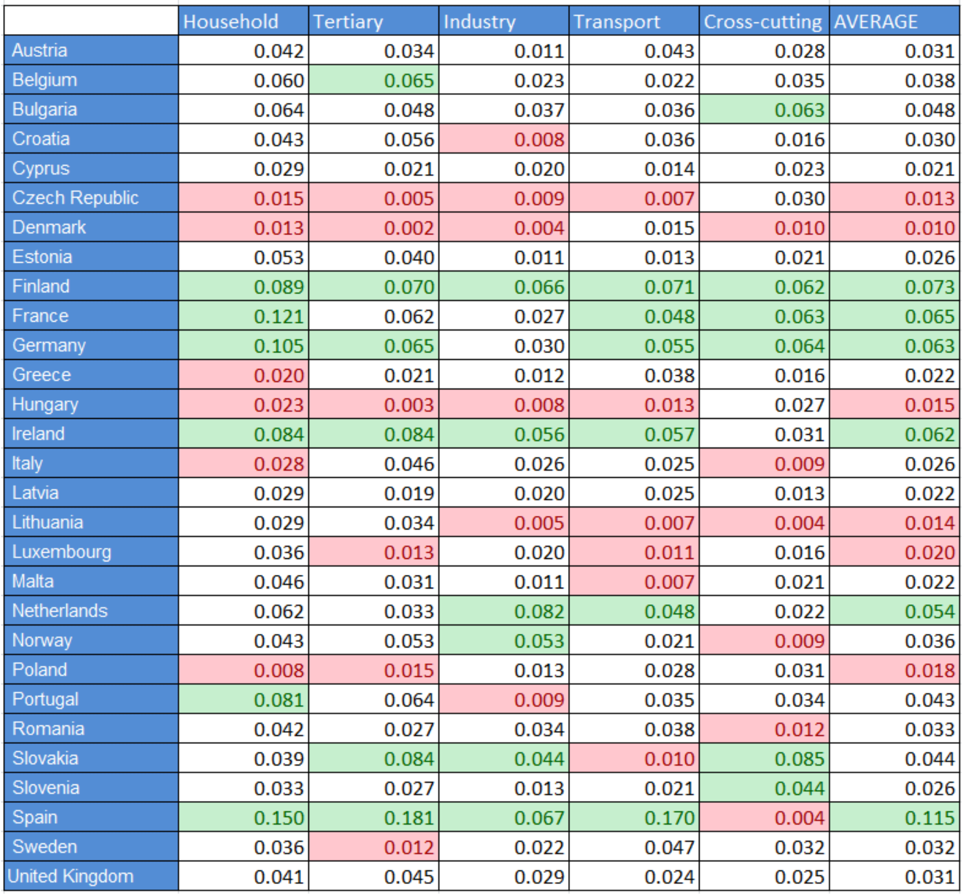


Figure 4: Policy mix changes per sector in the period (1975-2013), average of EU-29 countries.

Figure 4 shows how the policy mix has changed over the last 4 decades in the "average European country". The importance of Financial/Fiscal measures has grown, while Legislative/normative measures (standard) seem to be less central (they seem to be absent for industry). Legislative/informative (labels) and Information/training seem to have a minor but increasing role.

Finally, we provide a summary about policy intensity in each country (more details on each country are given in Appendix 1). Table 4 shows the differences in policy intensity across countries considering the entire period 1975-2013, considering each sector and a weighted average of sectors (heuristic weights are 25% for household, 10% for tertiary, 25% for industry, 25% for transport, 15% for cross-cutting).

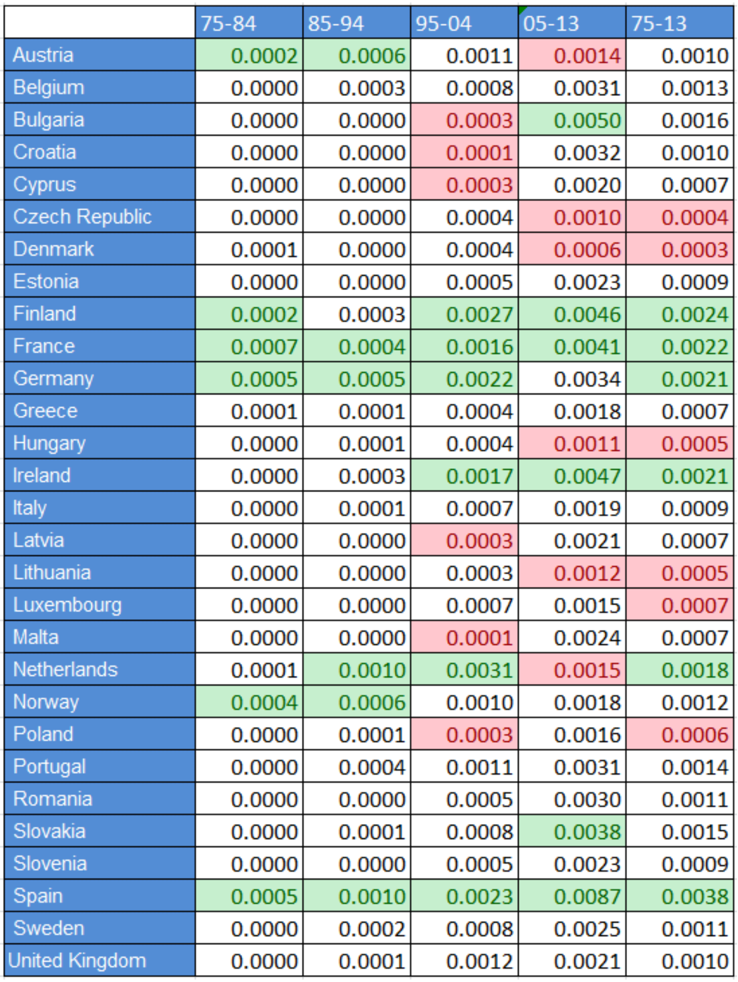


	Household	Tertiary	Industry	Transport	Cross-cutting	AVERAGE
Austria	0.042	0.034	0.011	0.043	0.028	0.031
Belgium	0.060	0.065	0.023	0.022	0.035	0.038
Bulgaria	0.064	0.048	0.037	0.036	0.063	0.048
Croatia	0.043	0.056	0.008	0.036	0.016	0.030
Cyprus	0.029	0.021	0.020	0.014	0.023	0.021
Czech Republic	0.015	0.005	0.009	0.007	0.030	0.013
Denmark	0.013	0.002	0.004	0.015	0.010	0.010
Estonia	0.053	0.040	0.011	0.013	0.021	0.026
Finland	0.089	0.070	0.066	0.071	0.062	0.073
France	0.121	0.062	0.027	0.048	0.063	0.065
Germany	0.105	0.065	0.030	0.055	0.064	0.063
Greece	0.020	0.021	0.012	0.038	0.016	0.022
Hungary	0.023	0.003	0.008	0.013	0.027	0.015
Ireland	0.084	0.084	0.056	0.057	0.031	0.062
Italy	0.028	0.046	0.026	0.025	0.009	0.026
Latvia	0.029	0.019	0.020	0.025	0.013	0.022
Lithuania	0.029	0.034	0.005	0.007	0.004	0.014
Luxembourg	0.036	0.013	0.020	0.011	0.016	0.020
Malta	0.046	0.031	0.011	0.007	0.021	0.022
Netherlands	0.062	0.033	0.082	0.048	0.022	0.054
Norway	0.043	0.053	0.053	0.021	0.009	0.036
Poland	0.008	0.015	0.013	0.028	0.031	0.018
Portugal	0.081	0.064	0.009	0.035	0.034	0.043
Romania	0.042	0.027	0.034	0.038	0.012	0.033
Slovakia	0.039	0.084	0.044	0.010	0.085	0.044
Slovenia	0.033	0.027	0.013	0.021	0.044	0.026
Spain	0.150	0.181	0.067	0.170	0.004	0.115
Sweden	0.036	0.012	0.022	0.047	0.032	0.032
United Kingdom	0.041	0.045	0.029	0.024	0.025	0.031

Table 4: Policy intensity in each sector and each country (entire period 1975-2013). Green = high intensity, Red = low intensity.

The last column of the table suggests that Finland, France, Germany, Ireland, Netherlands and Spain have been the most active countries in their energy saving policies (the policy induced savings in these countries seems to be around 6%, reaching 11% for Spain). On the other end, Czech Republic, Denmark, Hungary, Lithuania, Luxembourg and Poland have policy induced energy savings below 2%.

Table 5 gives an overview on the changes of energy policy intensity over time. In practice before 1995 energy policies was at an embryonic stage, and just in a few countries (Austria, France, Germany, Netherlands, Norway and Spain), while the others essentially did not implement relevant policies in the first two decades. Some of the "pioneer" countries (France, Germany and Spain) continued to lead in the next two decades, while others (Austria, Netherlands and Norway) slowed down. Ireland, and more recently Bulgaria and Slovakia joined the leading group.



	75-84	85-94	95-04	05-13	75-13
Austria	0.0002	0.0006	0.0011	0.0014	0.0010
Belgium	0.0000	0.0003	0.0008	0.0031	0.0013
Bulgaria	0.0000	0.0000	0.0003	0.0050	0.0016
Croatia	0.0000	0.0000	0.0001	0.0032	0.0010
Cyprus	0.0000	0.0000	0.0003	0.0020	0.0007
Czech Republic	0.0000	0.0000	0.0004	0.0010	0.0004
Denmark	0.0001	0.0000	0.0004	0.0006	0.0003
Estonia	0.0000	0.0000	0.0005	0.0023	0.0009
Finland	0.0002	0.0003	0.0027	0.0046	0.0024
France	0.0007	0.0004	0.0016	0.0041	0.0022
Germany	0.0005	0.0005	0.0022	0.0034	0.0021
Greece	0.0001	0.0001	0.0004	0.0018	0.0007
Hungary	0.0000	0.0001	0.0004	0.0011	0.0005
Ireland	0.0000	0.0003	0.0017	0.0047	0.0021
Italy	0.0000	0.0001	0.0007	0.0019	0.0009
Latvia	0.0000	0.0000	0.0003	0.0021	0.0007
Lithuania	0.0000	0.0000	0.0003	0.0012	0.0005
Luxembourg	0.0000	0.0000	0.0007	0.0015	0.0007
Malta	0.0000	0.0000	0.0001	0.0024	0.0007
Netherlands	0.0001	0.0010	0.0031	0.0015	0.0018
Norway	0.0004	0.0006	0.0010	0.0018	0.0012
Poland	0.0000	0.0001	0.0003	0.0016	0.0006
Portugal	0.0000	0.0004	0.0011	0.0031	0.0014
Romania	0.0000	0.0000	0.0005	0.0030	0.0011
Slovakia	0.0000	0.0001	0.0008	0.0038	0.0015
Slovenia	0.0000	0.0000	0.0005	0.0023	0.0009
Spain	0.0005	0.0010	0.0023	0.0087	0.0038
Sweden	0.0000	0.0002	0.0008	0.0025	0.0011
United Kingdom	0.0000	0.0001	0.0012	0.0021	0.0010

Table 5: Policy intensity per year in different subperiods and in the whole period (weighted average across sectors, green = high intensity, red = low intensity).

3 The dataset

In this project we have created a dataset covering 29 european countries (EU28 + Norway) listed in Table Table 6 (the country code i=1,...,29 is based on the alphabetical order).

The data are annual, from 1990 to 2013 (t=1,...,24), with some missings depending on the country and the variable. The main sources are Eurostat (ec.europa.eu/eurostat/data/database), Enerdata (Global Energy and CO2 data, services.enerdata.net) and the MURE database for energy policy measures (www.measures-odyssee-mure.eu, see the previous Section).

Whenever possible, the data are disaggregated by sector (4 sectors: Household, Tertiary, Industry and transport, see Table 7 for sector codes h=0,...,4) and by energy source (4 energy sources: Electricity, Gas, Oil and Solid fuels, see Table 8 for energy source codes k=0,...,4). We excluded all other sectors (agriculture) and all other sources (biomass, heat, solar, uranium, renewable, waste, ...). As we will show below, the weight of the excluded sectors and sources in terms of energy consumption varies across countries, ranging from about 5% to about 40%.

Country_code	Country	Country_code	Country
1	Austria	16	Latvia
2	Belgium	17	Lithuania
3	Bulgaria	18	Luxembourg
4	Croatia	19	Malta
5	Cyprus	20	Netherlands
6	Czech Republic	21	Norway
7	Denmark	22	Poland
8	Estonia	23	Portugal
9	Finland	24	Romania
10	France	25	Slovakia
11	Germany	26	Slovenia
12	Greece	27	Spain
13	Hungary	28	Sweden
14	Ireland	29	United Kingdom
15	Italy		

Table 6: Countries.

Sector code (h)	Sector
0	All sectors
1	Household
2	Tertiary
3	Industry
4	Transport

Table 7: Sectors.

Energy source code (k)	Energy source
0	All energy sources
1	Electricity
2	Gas
3	Total petroleum fuels
4	Solid fuels

Table 8: Energy Sources.

We can group the variables in the dataset in five groups, introduced in the following Subsections; a short description of each variable in the dataset, illustrating the number of missing values and the within and between variability is provided in Appendix 2.

3.1 Quantity variables

The souce is Eurostat, and all quantities are in TJ; no missing values:[7]

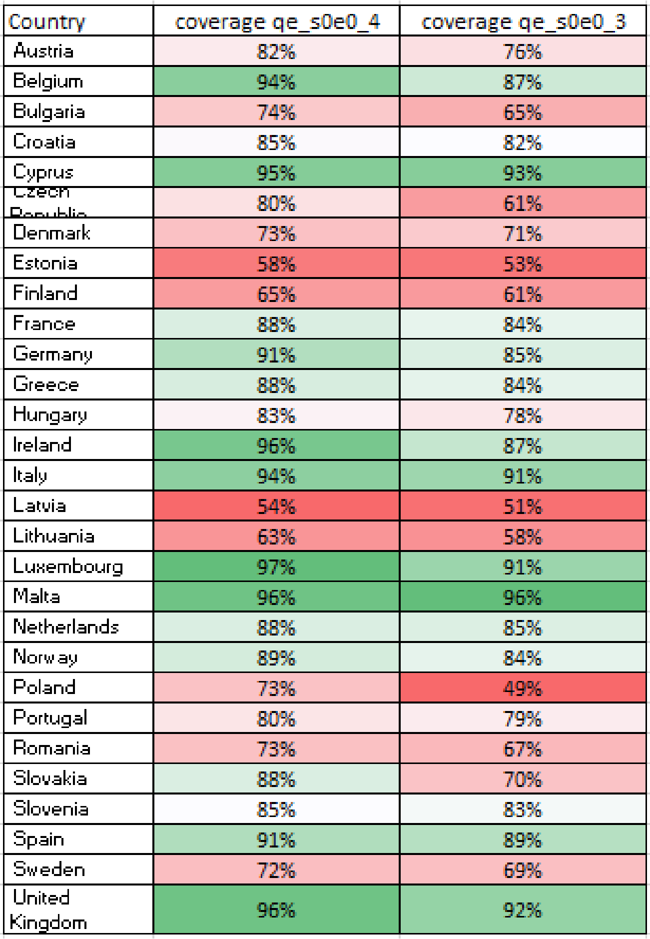
- $q_{hk,it}$: energy demand, sector h (1=household, 2=services, 3=industry, 4=transport) source k (1=electricity, 2=gas, 3=oil, 4=solid fuel), country i year t.

---

[7] We have also collected quantities from Enerdata and checked the coherence with Eurostat. Enerdata provides data for a longer time period, but the data on oil products and solid sources are disaggregate and the components are measured in different units: the attempt to convert and aggregate them provides time series which do not match Eurostat very much, so we decided to use Eurostat for quantities and Enerdata for prices.

- $q^4_{h0,it} = \sum_{k=1}^{4} q_{hk,it}$: it is not total demand of sector h, since it excludes other sources
- $q^3_{h0,it} = \sum_{k=1}^{3} q_{hk,it}$: (excludes solid fuels also)
- $q^4_{00,it} = \sum_{h=1}^{4} q^4_{h0,it}$: it is not total demand in the country, since it excludes other sources and other sectors
- $q^3_{00,it} = \sum_{h=1}^{4} q^3_{h0,it}$: (excludes solid fuels also)
- $q_{h0,it}$: total energy demand (all sources) for sector h, provided by Eurostat
- $q_{00,it}$: total energy demand (all sources, all sectors), provided by Eurostat

The average coverage of $q^4_{00,it}$ and $q^3_{00,it}$ on total (including all sectors and all sources) energy consumption $q_{00,it}$ in each country is given in Table 9.



Country	coverage qe_s0e0_4	coverage qe_s0e0_3
Austria	82%	76%
Belgium	94%	87%
Bulgaria	74%	65%
Croatia	85%	82%
Cyprus	95%	93%
Czech Republic	80%	61%
Denmark	73%	71%
Estonia	58%	53%
Finland	65%	61%
France	88%	84%
Germany	91%	85%
Greece	88%	84%
Hungary	83%	78%
Ireland	96%	87%
Italy	94%	91%
Latvia	54%	51%
Lithuania	63%	58%
Luxembourg	97%	91%
Malta	96%	96%
Netherlands	88%	85%
Norway	89%	84%
Poland	73%	49%
Portugal	80%	79%
Romania	73%	67%
Slovakia	88%	70%
Slovenia	85%	83%
Spain	91%	89%
Sweden	72%	69%
United Kingdom	96%	92%

Table 9: Average coverage (1990-2013) of $q^4_{h0,it}$ and $q^3_{h0,it}$ on total energy consumption $q_{00,it}$

3.2 Price variables

The souce is Enerdata, and all prices have been converted in KEuro/TJ from the original unit. Despite the effort in reconstructing many points based on reasonable assumptions,[8] many missing values remain.

- $p_{hk,it}$: price of energy, sector h (1=household, 2=services, 3=industry, 4=transport) source k (1=electricity, 2=gas, 3=oil, 4=solid fuel). More specifically, we have chosen the following series from the Enerdata database:
    - $p_{11,it}$: "Price per toe in € of electricity for households (taxes incl.)", divided by 0.01163 to convert in KEuro/TJ. This series from Enerdata is very similar to the Eurostat series for

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[8] Eurostat also provides prices, but only for Electricity (e=1) and Gas (e=2) and for Household (s=1) and Industry (s=3). For these sources and sectors Eurostat prices and Enerdata prices are very similar (see below).

household consumer band DC, which is the median band with the highest number of electricity and gas consumers in the majority of Member States.[9] We have opted for the Enerdata series since it has fewer missing values.

- $p_{12,it}$: "Price per toe in € of natural gas for households (taxes incl.) NCV", divided by 0.01163 to convert in KEuro/TJ. This series from Enerdata is very similar to the Eurostat series for household consumer band D2, which is the median bands with the highest number of gas consumers in the majority of Member States.[10] We have opted for the Enerdata series since it has fewer missing values.
- $p_{13,it}$: "Price per toe in € of light fuel oil for households (taxes incl.)", divided by 0.9×0.01163 to convert in KEuro/TJ.
- $p_{14,it}$: "Price per toe in € of bituminous coal for households (taxes incl.)", divided by 0.01163 to convert in KEuro/TJ. We have not considered the price of other solid fuels since the series are too incomplete. The coverage of bituminous coal on solid fuels seems high. The series has many missing values, especially in those countries where the weight of solid fuels for household is low.
- $p_{21,it}$: There is no official time series for the price of electricity for services. Therefore, we use the average (equally weighted) of the prices for household ($p_{11,it}$) and the prices for industry ($p_{31,it}$).
- $p_{22,it}$: There is no official time series for the price of gas for services. Therefore, we use the average (equally weighted) of the prices for household ($p_{12,it}$) and the prices for industry ($p_{32,it}$).
- $p_{23,it}$: There is no official time series for the price of oil products for services. Therefore, we use the average (equally weighted) of the prices for household ($p_{13,it}$) and the prices for industry ($p_{33,it}$).
- $p_{24,it}$: There is no official time series for the price of solid fuels for services. Therefore, we use the average (equally weighted) of the prices for household ($p_{14,it}$) and the prices for industry ($p_{34,it}$).
- $p_{31,it}$: "Price per toe in € of electricity in industry (taxes incl.)", divided by 0.01163 to convert in KEuro/TJ. This series from Enerdata is very similar to the Eurostat series for industrial sector band IC, which typically represent medium size enterprises.[11] We have opted for the Enerdata series since it has fewer missing values.
- $p_{32,it}$: "Price per toe in € of natural gas in industry (taxes incl.) NCV", divided by 0.01163 to convert in KEuro/TJ. This series from Enerdata is very similar to the Eurostat series for industrial sector band I3, which typically represent medium size enterprises.[12] We have opted for the Enerdata series since it has fewer missing values.
- $p_{33,it}$: We use the average (equally weighted) of "Price per toe in € of heavy fuel oil in industry (taxes incl.)" and "Price per toe in € of light fuel oil in industry (taxes incl.)". We have not considered the price of other oil products since the series are too incomplete. The coverage of these two products seems high, and the weight, although varying across countries and years, is similar. In most countries, the price of light fuel is approximately twice the price of heavy fuel. We have then divided by 0.01163 to convert in KEuro/TJ.

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[9] The limiting values for the consumer band DC is: 2,500kWh < Consumption < 5,000kWh.

[10] The limiting values for the consumer band D2 are: 20 GJ < Consumption < 200 GJ equivalent to 5,560 kWh < Consumption < 55,560 kWh.

[11] The limiting values for the consumer band IC are 500 MWh < Consumption < 2,000 MWh.

[12] The limiting values for the consumer band I3 are: 10 000 GJ < Consumption < 100 000 GJ equivalent to 2,780 MWh < Consumption < 27,780 MWh.

  - $p_{34,it}$: "Price per toe in € of bituminous coal in industry (taxes incl.)", divided by 0.01163 to convert in KEuro/TJ. We have not considered the price of other solid fuels since the series are too incomplete. The coverage of bituminous coal on solid fuels in industry seems high. The series has many missing values, expecially in those countries where the weight of solid fuels for industry is low.
  - $p_{41,it}$: We have not collected any price, since the weight of electricity for transport is extremely low.
  - $p_{42,it}$: We have not collected any price, since the weight of gas for transport is extremely low.
  - $p_{43,it}$: "Price per toe in € of premium gasoline (taxes incl.)", divided by 0.01163 to convert in KEuro/TJ. We have not considered the price of other fuels since the series are too incomplete. The coverage of premium gasoline on oil products for transport is high, and the price of other fuels, when available, is highly correlated.
  - $p_{44,it}$: We have not collected any price, since the weight of solid fuel for transport is extremely low.
- $p_{h0,it}^4 = \sum_{k=1}^4 \alpha_{hk,it}^4 \, p_{hk,it}$: reference price for $q_{h0,it}^4$, obtained as a (time varying weighted) average of energy prices for sector h. The weights represent the relevance of source k in sector h (4 sources, excluding the others), and are therefore given by $\alpha_{hk,it}^4 = \frac{q_{hk,it}}{\sum_{s=1}^4 q_{hs,it}}$; If the weight $\alpha_{hk,it}^4 < 0.1$ then source k is excluded for that year and that country, and $p_{ho,it}^4$ is computed as a weighted average of just the other prices (the small weight is set to zero and the others are readjusted to sum up to one).[13] If the prices of sources whose weight is larger than 0.1 is missing, $p_{h0,it}^4$ is also considered as missing.
- $p_{h0,it}^3 = \sum_{k=1}^3 \alpha_{hk,it}^3 \, p_{hk,it}$: reference price for $q_{h0,it}^4$, where solid fuels are also excluded. The weights represent the relevance of source k in sector h (3 sources, excluding the others), and are therefore given by $\alpha_{hk,it}^3 = \frac{q_{hk,it}}{\sum_{s=1}^3 q_{hs,it}}$, used as illustrated above.
- $p_{00,it}^4 = \sum_{h=1}^4 \omega_{h,it}^4 \, p_{h0,it}^4$: reference price for $q_{00,it}^4$, obtained as a (time varying weighted) average of sectoral energy prices. The weights represent the relevance of sector h in "the whole economy" (meant as 4 sectors, 4 sources), and are therefore given by $\omega_{h,it}^4 = \frac{q_{h0,it}^4}{\sum_{s=1}^4 q_{s0,it}^4}$.
- $p_{00,it}^3 = \sum_{h=1}^4 \omega_{h,it}^3 \, p_{h0,it}^3$: reference price for $q_{00,it}^3$, obtained as a (time varying weighted) average of sectoral energy prices. The weights represent the relevance of sector h in "the whole economy" (meant as 4 sectors, 3 sources), and are therefore given by $\omega_{h,it}^3 = \frac{q_{h0,it}^3}{\sum_{s=1}^4 q_{s0,it}^3}$.

3.3 Policy variables

The source is the MURE database, and the methodology is illustrated in the previous Section. Different versions of the EP indicators are computed, by changing the weighting and "delay" scheme. In the econometric models discussed in the following we have tried all of them: the better results are found using the weighting scheme 1 (equal weight, i.e. just count the policy measures) and delay scheme 1 (no delay).

- $pol_{h0,it}$: energy policy indicator, sector h (corresponding to EPI_si in the previous Section).
- $pol_{00,it} = \sum_{h=1}^4 \delta_{h,it} \, pol_{h0,it}$: energy policy indicator, whole country's economy, obtained as a (time varying weighted) average of sectoral energy policy indicators. The weights represent the relevance of sector h in "the whole economy" (meant as 4 sectors, all sources), and are therefore given by $\delta_{h,it} = \frac{q_{h0,it}}{\sum_{s=1}^4 q_{s0,it}}$ (the cross cutting measures are not accounted for at the moment).

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[13] The reason for excluding sources with small weight is that, in many countries, the price of sources whose weight is small are missing (or unreliable).

3.4 Other control variables

We divide the other control variables in 4 groups.

1. Other control variables (all models)

- pop_{it}: population, source Eurostat, no missing values. For France, we have considered metropolitan France only (i.e. excluding overseas territories).
- $rgdp_{it}$, $ngdp_{it}$, def_{it}: real GDP, nominal GDP, GDP deflator, source Eurostat, available for all 29 countries from 1995 with few missings, available for a subset of countries before 1995. For some countries (Bulgaria, Hungary, Latvia, Lithuania, Luxembourg, Malta, Romania, Slovenia) the initial part of the time series is available for either RGDP or NGDP, but not both. For these countries, we have backcasted DEF by applying the average inflation in Europe, and then we have used DEF and the available time series to work out the other. Finally, RGDP and NGDP are unavailable for Greece in 2013, and have been reconstructed by applying the average growth rate for Greek RGDP and NGDP in the period 2006-2012 to the 2012 value.
- hdd_{it}: source Eurostat, availability 1980-2009. Heating degree day (HDD) is a measurement designed to reflect the demand for energy needed to heat buildings. Eurostat calculates heating degree days as (18°C - T_{mean}) if T_{mean} is lower than 15 °C (heating threshold) and zero if T_{mean} is greater than or equal 15 °C; T_{mean} is the mean daily outdoor temperature, calculated as $T_{mean} = \frac{T_{min}+T_{max}}{2}$. Unfortunately, Eurostat does not provide cooling degree days which would be useful for the regression analysis for countries in Southern Europe. According to the European Environment Agency (www.eea.europa.eu/data-and-maps/indicators/heating-degree-days-1/assessment), "the number of heating degree days has decreased by 13% over the last 3 decades, yet with substantial interannual variation. The decrease in HDD has not been homogeneous across Europe: the absolute decrease has been largest in the cool regions in northern Europe where heating demand is highest. Temperatures in Europe are projected to continue to increase. Hence, the trend of decreasing numbers of HDD is very likely to continue, and most likely to accelerate. For example, the heat demand for space heating in 2050 was projected to decrease by 25 % in the UK, and by 9 % in the EU". Therefore, since HDD available at Eurostat for the period 1980 until 2009, HDD have been extrapolated up to 2013 using an ARMA(1,1) model with constant and trend estimated for each country
- $other^4_{h0,it} = \frac{q_{h0,it}-q^4_{h0,it}}{q_{h0,it}}$: share of sources different from (1=electricity, 2=gas, 3=oil, 4=solid fuel) for sector h, based on Eurostat quantities
- $other^4_{00,it} = \frac{q_{00,it}-q^4_{00,it}}{q_{00,it}}$: share of sources different from (1=electricity, 2=gas, 3=oil, 4=solid fuel) for the whole economy, based on Eurostat quantities
- $other^3_{h0,it} = \frac{q_{h0,it}-q^3_{h0,it}}{q_{h0,it}}$: share of sources different from (1=electricity, 2=gas, 3=oil) for sector h, based on Eurostat quantities
- $other^3_{00,it} = \frac{q_{00,it}-q^3_{00,it}}{q_{00,it}}$: share of sources different from (1=electricity, 2=gas, 3=oil) for the whole economy, based on Eurostat quantities

2. Other control variables (household):

- $dwell_{it}$: stock of dwellings (thousand), source enerdata
- $floor_{it}$: average floor area of dwellings (m²), source enerdata
- $area\_s1_{it} = \frac{dwell_{it} \times floor_{it}}{1000}$: total floor area of dwellings (km²)
- $percfreez_{it}$: Rate of equipment ownership for freezers (%), source enerdata (interpolated)
- $percwash_{it}$: Rate of equipment ownership for washing machine (%), source enerdata (interpolated)
- $percdish_{it}$: Rate of equipment ownership for dishwasher (%), source enerdata (interpolated)

- $percequip\_s1_{it} = \frac{percfreez_{it}+percwash_{it}+percdish_{it}}{3}$: Rate of equipment ownership (%)
- $rcons\_s1_{it}$: Real private consumption (M€2005), source enerdata

3. Other control variables (services):

- rva_s2_{it}: Real value added of tertiary sector (M€2005), source enerdata
- $empl\_s2_{it}$: Employment of tertiary sector (thousand), source enerdata

4. 4.Other control variables (industry):

- rva_s3_{it}: Real value added of industry (M€2005), source enerdata
- $rginv\_s3_{it}$: Real gross investment of industry (M€2005), source enerdata

5. Other control variables (transport):

- $cars\_s4_{it}$: stock of cars (milions), source enerdata
- $goods\_s4_{it}$: trafic of goods (tkm), source enerdata

3.5 Other variables related to energy policy

We have included in our database also other variables which are related to energy policy. It is clear from the literature analysis that energy policies have multiple objectives, rather than energy savings only, see for example Haydt et al. 2014. Among the goals of energy policy: reducing dependence on imported energy, preserving natural resources and minimize environmental impacts (reducing CO2 emissions and possible climate changes), reducing dependence on non renewable sources, diversifying sources to reduce dependence on suppliers, increasing national production of energy, improving efficiency. Therefore a complete analysis of effectiveness should consider several measures of "success", rather than the reduction of energy intensity (increase in efficieny) only. In the current dataset we have included the following variables:

- $ed_{00,it}$: energy dependence, source Eurostat, availability 1990-2012, unit Terajoule (2013 has been reconstructed as equal to 2012). We have included in the dataset all variables needed to measure energy dependence, i.e. the extent to which an economy relies upon imports in order to meet its energy needs. The main indicator is calculated as net imports divided by the sum of gross inland energy consumption.[14] Therefore we have collected total import all sources (IE_s0e0), total export all sources (XE_s0e0) ad gross inland energy consumption all sources (GE_s0e0). Energy dependence may be calculated as total imports minus total exports divided by gross inland energy consumption, i.e. (IE_s0e0-XE_s0e0)/GE_s0e0. Energy dependence may be negative in the case of net exporter countries while positive values over 100% indicate the accumulation of stocks during the reference year. We think it is interesting to analyze dependency in greater detail measuring the degree of dependence on each primary source, and how it evolved over time. That is why we have collected time series data on import and export for each energy source, labelled IE_s0ei and XE_s0ei, i=1,...,6. Since import and export figures are essentially irrelevant for sources other than gas, oil and solid fuels, we suggest to construct three disaggregate energy dependency indicators given by (IE_s0ei-XE_s0ei)/GE_s0e0, i=2,3,4. These three indicators almost add up to the total energy dependency indicator (IE_s0e0-XE_s0e0)/GE_s0e0. The second intermediate report provides some descriptive statistics on energy dependence.
- $ed_{0k,it}$: energy dependence for source k (the discussion above)
- $ghge_{it}$: geenhouse gas emission, source Eurostat and United Nations, availability 1990-2012, unit Gg CO2 equivalent (2013 has been reconstructed from 2012 applying the last observed growth rate). This indicator shows trends in total man-made emissions of the “Kyoto basket” of greenhouse gases.

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[14] Gross inland consumption is calculated as follows: primary production + recovered products + total imports + variations of stocks - total exports - bunkers. It corresponds to the addition of final consumption, distribution losses, transformation losses and statistical differences.

Eurostat provides an index representing annual total emissions in relation to 1990 emissions;[15] the absolute values in 1990 (and every 5 years) are provided by UN[16] (the data appear to be coherent, since applying the growth rate derived from Eurostat index to UN 1990 starting poins one gets almost exactly the subsequent UN values). The “Kyoto basket” of greenhouse gases includes: carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), and the so-called F-gases (hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride (SF6)). These gases are aggregated into a single unit using gas-specific global warming potential (GWP) factors. The aggregated greenhouse gas emissions are expressed in units of CO2 equivalents. The indicator does not include emissions and removals related to land use, land-use change and forestry (LULUCF); nor does it include emissions from international maritime transport. It does however include emissions from international aviation. CO2 emissions from biomass with energy recovery are reported as a Memorandum item according to UNFCCC Guidelines and not included in national greenhouse gas totals. The EU as a whole is committed to achieving at least a 20% reduction of its greenhouse gas emissions by 2020 compared to 1990. Enerdata-Odyssee provides also data on emissions per sector.

In the present study these variables have not been used. Several ways to introduce these variables in the model are possible, which are left for further research:

1. The multiple-objectives point of view might be explored by introducing other equations where $ed_{0k,it}$ and $ghge_{it}$ are the dependent variables and suitable EP indicators, along with control variables, are explanatory variables
2. The variables $ed_{0k,it}$ and $ghge_{it}$ might be used as instrumental variables to improve the quality of the estimates of the EP coefficients. In fact, EP indicators are obviously affected by measurement error, which is likely to determine an "attenuation bias" (i.e. a bias towards zero) in the estimates. $ed_{0k,it}$ and $ghge_{it}$ might be consider as valid instruments, since they should be correlated with EP indicators, but uncorrelated with the measurement error, and therefore might be used to obtain unbiased estimates.
3. The variables $ed_{0k,it}$ and $ghge_{it}$ might be used as moderators, by introducing interactions with EP indicators; it might be interesting to explore if energy policy is more aggressive (and therefore more effective) if the country is more dependent on imported energy.

4 The econometric models and results

Our econometric model includes 14 equations. In this study, all equations have been estimated separately using Arellano-Bond (1991) estimator for dynamic panel models, based on differencing to get rid of the bias coming from potential endogeneity of the regressors, and resorting to instrumental variables to deal with the endogeneity of the lagged dependent variable.[17]

The current version is based on four sectors and three sources (electricity, gas, oil). This approach, when compared with the approach based on four sources (including solid fuels), has the disadvantage of a worst coverage (as low as 50% for some countries); however it has the advantage of fewer missing values (prices for solid are incomplete in many countries), and the results seem to be more stable and reliable. Different versions of the EP indicators have been used, corresponding to different choices for the weighting and "delay" schemes. The better results are usually found using the weighting scheme 1 (equal weight, i.e. just count the policy measures) and delay scheme 1 (no delay): all the results below are referred to this case.

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[15] For Norway and Slovenia the index in 2012 is not available. It has been reconstructed using the average growth rate between 2011 and 2012 in the other 27 countries.

[16] See unfccc.int/ghg_data/ghg_data_unfccc/time_series_annex_i/items/3841.php

[17] We have also tried fixed effects and random effects model, with and without lagged dependent variable: the results based on these models/estimation techniques are more puzzling and less stable.

The 14 equations may be grouped, as illustrated in the next Subsections, in three models, labelled "Aggregate Model", "Sectoral Model" and "Disaggregate Model". As will be clear from the discussion, given the quality of the EP indicators available at the moment, the "Sectoral Model" seems the most reliable, since the "Aggregate Model" suffers from measurement error in the EP indicator due to the excess of aggregation which gives rise to a strong attenuation effect in the estimates, while the "Disaggregate Model" gives some puzzling results, quite likely due to the fact that it should be based on more "energy source specific" EP Indicators, which could ideally be derived from the MURE database with some effort, but are not currently available.

4.1 Aggregate model, all sectors all sources

The model has one single equation aimed at measuring the aggregate energy saving induced by policy measures:

$$(1) \qquad ln(q^{3}_{00,it}) = \beta^{00}_{0,i} + \rho^{00} ln(q^{3}_{00,it-1}) + \gamma^{00} pol_{00,it} + \beta^{00}_{1} ln\left(\frac{p^{3}_{00,it}}{def_{it}}\right) + \beta^{00}_{2} other^{3}_{00,it} +$$

$$+\beta^{00}_{3} ln(pop_{it}) + \beta^{00}_{4} ln(rgdp_{it}) + \beta^{00}_{5} ln(hdd_{it}) + \beta^{00}_{6} t + \beta^{00}_{7} t^{2} + \varepsilon^{00}_{i,t}$$

the parameter of interest is γ^{00}. This parameter is expected to be negative. The parameter ρ^{00} also plays an important role: the lagged dependent variable is introduce to get uncorrelated residuals, but also represents the idea that the adjustment of consumption to changes in the policies (and in the other variables) is not instantaneous, but takes time. ρ^{00} is therefore expected to be positive and smaller than one. This corresponds to an assumption of either stationarity of all variables involved (very implausible), or cointegration. A rigorous cointegration analysis has not been performed in this study, but it is required, since if the cointegration assumption is violated then estimates are inconsistent. This analysis is left for future research. The other right hand side variables are essentially the classical variables introduced in energy demand studies. Notice that a quadratic trend has been introduced to account for technical progress, which is assumed to be a smooth function of time, affecting all countries in the same way (it is expected to reduce the energy need). The variable $other^{3}_{00,it}$ is not typical in energy demand equations: it has been introduced because the aggregate $q^{3}_{00,it}$ does not cover all the energy needs in the country, since there are other sources. If a higher fraction of the energy needs is covered by other sources, then everything else being fixed (prices, level of activity, ...) we expect a lower level of demand. Notice that $other^{3}_{00,it}$ is larger than 0.5 in some countries. We expect a negative coefficient, not far from -1.

The results are reported in Table 10.

VARIABLE	MODEL (1)
const	3.49 (8.3)
lagged dep.	.47 (14.7)
$pol_{00,it}$	-.0015 (-1.4)
$\ln\left(\frac{p^{3}_{00,it}}{def_{it}}\right)$	-.029 (-1.3)
$other_{00,it}$	-.48 (-4.9)
$\ln(pop_{it})$	.39 (5.8)
$\ln(rgdp_{it})$	.29 (9.4)
hdd_{it}	.000058 (6.0)
t	.0034 (2.1)
t^{2}	-.00022 (-3.9)

Table 10: Estimates of the aggregate model (t-test in parenthesis).

We have decided to leave in the model all variables whose t-test is larger than 1. The complete results are in Appendix 3. The estimated coefficient $\hat{\gamma}^{00} = -0.0015$ implies that when $pol_{00,it}$ is increased by 1, energy consumption is reduced on average by 1.5 per thousand in the same year (80% significant). To interpret this figure, remind that in this version of the model the variable $pol_{00,it}$ is based on the "no weight - no delay" scheme; therefore, a unit increase in

$$pol_{00,it} = \sum_{h=1}^{4} \delta_{h,it}\, pol_{h0,it} \quad , \quad \delta_{h,it} = \frac{q_{h0,it}}{\sum_{s=1}^{4} q_{s0,it}}$$

does not correspond to a single measure, but rather to a mixture of policies, like for example one measure in each sector (or other mixtures). Due to the autoregressive component, this induces a dynamic adjustment leading to a regime reduction in energy consumption equal to $\frac{\hat{\gamma}^{00}}{1-\hat{\rho}^{00}} = -0.00283$, i.e. about 2.8 per thousand (so that it takes about 12 measures, and some time, to reduce consumption by 1%). The implied step response function is illustrated in Figure 5.

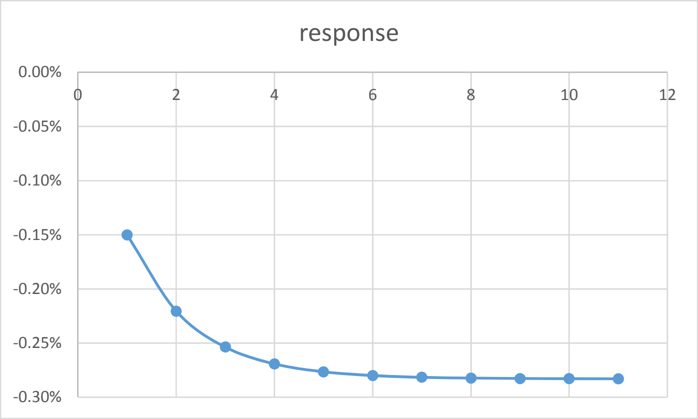


Figure 5: Step response function to energy policy, aggregate model.

Constructing a confidence bound around the step response function would require further computation, which is left for future research.

As a convenient alternative to the computation of the step function, to get a more straightforward interpretation of the practical implications of the model, it is also possible to simulate the total impact of all measures adopted in a given country from 1990 to 2013. To do this one may take the dynamic equation:

$$(2) \qquad y_{it} = \hat{\rho}^{00} y_{it-1} + \hat{\gamma}^{00} pol_{00,it}$$

initialize it at $y_{it} = 0$ and evaluate it dynamically using the actual time series $pol_{00,it}$ for country i and time t=1,...T, where 1 means 1990 and T= 24 means 2013. Assuming that the future values of all regressors, as well as the error term, are not influenced by the current value of the energy policy, this simulation provides a measure, in each year, of the percentage energy saving induced by energy policies adopted in that year and all of the previous years.

As an example, Figure 6 illustrates the dynamic simulation exercise for Germany and France (we have changed the sign from negative to positive for readability):

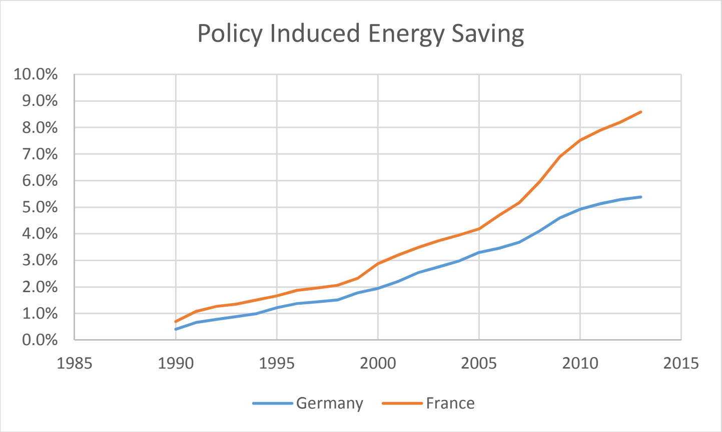


Figure 6: Dynamic simulation exercise for Germany and France.

The point estimates suggest that the consumption of energy in Germany in 2013, due to all policies adopted since the nineties, has been 5.4% lower than what it would have been in the absence of policies. In France the percentage of energy saving has been 8.6%. Of course confidence intervals around this figures would be useful, but the computation is not easy and we leave it for future research. The difference between Germany and France is mainly due to the fact that, according to MURE's database, the number of measures adopted in Germany (81, excluding 14 cross-cutting) is smaller than the number of measures adopted in France (120, excluding 24 cross-cutting); minor differences may arise from the sectors in which the measures are adopted (many measures adopted in sectors of minor importance do not contribute so much to $pol_{00,it}$, and from the timing of adoption of the measures.

It may be worth noticing that these figures are likely to slightly underestimate the effect of policies: it is well known that measurement error in the independent variables determine an "attenuation bias" (i.e. a bias towards zero) in the estimates, and clearly the EP indicators proposed here suffer from measurement errors. Inversting on the indicators to improve their quality might reduce the problem, but one might also consider introducing some instrumental variables. As mentioned before, $ed_{0k,it}$ and $ghge_{it}$ might be consider as candidate instruments, since they should be correlated with EP indicators, but uncorrelated with the measurement error, and therefore might be used to reduce the attenuation (this option is left for future research).

Table 11 reports, for each country, the final value of the simulation, i.e. the percentage policy induced energy saving in 2013 (also in this case we have changed the sign from negative to positive for readability). By multiplying the percentage saving by the actual consumption in 2013 one gets the absolute saving (in TJ), which may then be aggregated to obtain the total saving in 2013 for EU29

COUNTRY	Saving in 2013 (%)	Saving in 2013 (TJ)
Austria	2.2%	18995
Belgium	3.5%	46578
Bulgaria	4.1%	10640
Croatia	4.7%	9529
Cyprus	2.3%	1421
Czech Republic	2.6%	17886
Denmark	1.9%	7572
Estonia	4.3%	3121
Finland	5.4%	33044
France	8.6%	484071
Germany	5.4%	425611
Greece	2.7%	14987
Hungary	3.0%	15082
Ireland	6.2%	25755
Italy	5.5%	237084
Latvia	2.9%	2564
Lithuania	3.3%	3886
Luxembourg	1.8%	3008
Malta	2.5%	493
Netherlands	5.2%	95309
Norway	4.9%	33319
Poland	1.7%	25304
Portugal	3.4%	18712
Romania	2.6%	17037
Slovakia	3.6%	12277
Slovenia	2.6%	4275
Spain	9.4%	295688
Sweden	2.6%	21482
United Kingdom	3.8%	203760
EU29	5.3%	2088492

Table 11: Policy Induced Energy Savings based on the aggregate model.

As discussed above, the total saving in EU29 (5.3%) seems to be low with respect to results obtained in other studies, and that may be partly due to attenuation related to measurement errors, which may be dealt with by improving the quality of the EP indicator and by using more advanced estimation techniques. As we will see in the next Subsection, the evidence from a disaggregate model suggest a higher percentage saving. Another comment on the table is about the comparison among countries, which seems to contradict the common sense on the level of commitment of national governments with respect to energy policies. As we already pointed out, this is mainly related to the number of measures reported in the MURE database for each country, which is sometimes surprising and deserves some investigation. For example, according to the MURE database, the average country has adopted 66 energy policy measures between 1990 and 2013; Spain is reported to have taken 139 measures while Denmark only 27. Even worst if we focus on "high impact" measures: according to the MURE database, the average country has adopted 21 "high impact" energy policy measures between 1990 and 2013; Spain is reported to have taken 91 "high impact" measures while Denmark only 3.

4.2 Sectoral models: four sectors, all sources

In this Subsection we illustrate a more disaggregate model, made up of four equations, one per sector. The structure of the model is similar to equation (1):

$$(3)\qquad ln\left(q^3_{h0,it}\right) = \beta^{h0}_{0,i} + \rho^{h0} ln\left(q^3_{h0,it-1}\right) + \gamma^{h0} pol_{h0,it} + \beta^{h0}_1 ln\left(\frac{p^3_{h0,it}}{def_{it}}\right) + \beta^{h0}_2 other^3_{h0,it} +$$

$$+\beta^{h0}_3 ln(pop_{it}) + \beta^{h0}_4 ln(rgdp_{it}) + \beta^{h0}_5 ln(hdd_{it}) + \beta^{h0}_6 t + \beta^{h0}_7 t^2 + \delta'_{h0} SSV_{h,it} + \varepsilon^{h0}_{i,t}$$

where $SSV_{h,it}$ is a vector of sector specific variables, namely for sector 1 (household): $ln(area\_s1_{it})$, $percequip\_s1_{it}$ and $ln(rcons\_s1_{it})$; for sector 2 (services): $ln(rva\_s2_{it})$ and $ln(empl\_s2_{it})$; for sector 3 (industry): $ln(rva\_s3_{it})$ and $ln(rginv\_s3_{it})$; for sector 4 (transport): $ln(cars\_s4_{it})$ and $ln(goods\_s4_{it})$. The results are summarized in Table 12 (the complete results are in Appendix 3).

VARIABLE	MODEL (3) Hou-Unrestr	MODEL (3) Ser-Unrestr	MODEL (3) Ind-Unrestr	MODEL (3) Tra-Unrestr
const	4.26 (6.9)	-.66 (-.7)	3.72 (4.8)	1.27 (2.2)
lagged dep.	.51 (15.9)	.47 (14.3)	.59 (15.3)	.56 (18.6)
$pol_{h0,it}$	-.0019 (-1.4)	-.00053 (-.26)	-.0083 (-2.7)	-.0025 (-2.3)
$\ln\left(\frac{p^3_{h0,it}}{def_{it}}\right)$	-.11 (-5.2)	-.40 (-11.0)	-.0080 (-2.8)	-.054 (-3.8)
$other_{h0,it}$	-.85 (-8.4)	-.46 (-4.0)	-.55 (-4.2)	-1.43 (-4.5)
$\ln(pop_{it})$	-.17 (-1.4)	.58 (2.3)	.087 (.6)	.44 (5.0)
$\ln(rgdp_{it})$	-.14 (-1.9)	.37 (3.0)	.13 (1.4)	.32 (6.3)
hdd_{it}	.00014 (9.0)	.00013 (4.9)	.000022 (1.0)	.000018 (1.3)
t	-.0035 (-1.3)	-.0085 (-1.8)	.0049 (1.3)	.0023 (.9)
t^2	.00017 (2.0)	.00055 (3.9)	-.00022 (-1.7)	.000033 (.4)
$\ln(area\_s1_{it})$	.059 (1.0)			
$perc\_equip\_s1_{it}$	.20 (1.6)			
$\ln(rcons\_s1_{it})$	.26 (4.2)			
$\ln(rva\_s2_{it})$		.12 (.9)		
$\ln(empl\_s2_{it})$		.16 (1.3)		
$\ln(rva\_s3_{it})$			.027 (.4)	
$\ln(rginv\_s3_{it})$			-.019 (-.7)	
$\ln(cars\_s4_{it})$				-.062 (-1.3)
$\ln(goods\_s4_{it})$				.081 (4.1)

Table 12: Unrestricted estimates of the sectoral model (t-test in parenthesis).

Notice that the EP indicator has a negative coefficient in all four equations, although with different magnitude and significance. Since several parameters are insignificant, we have worked out a restricted version of the models, dropping insignificant variables one at a time starting from the less significant, keeping in the model all variables whose t-test is larger than 1. The restricted models are in Table 13.

All coefficients are correctly signed, with the only exception of the negative sign on $ln(pop_{it})$ and $ln(rgdp_{it})$ in the household equation, although these negative parameters are compensated by the positive parameter on the other "scale" variable $ln(rcons\_s1_{it})$, suggesting that the scale effect in the household sector is small. The EP indicators have negative sign, which supports the effectiveness of energy policies in all sectors except services, where the coefficient was so insignificant that we have dropped it. To interpret the magnitude, notice that the PE indicators in this version of the model are based on the "no weight - no delay" scheme, therefore in the sectoral models a unit increase in $pol_{h0,it}$ corresponds to the adoption of one single policy measure. The estimated coefficients for the EP indicators and the autoregressive coefficients imply the impact and long term saving associated to (the typical) measure reported in Table 14, while the implied step response functions are illustrated in Figure 7.

VARIABLE	MODEL (3) Hou-Restr	MODEL (3) Ser-Restr	MODEL (3) Ind-Restr	MODEL (3) Tra-Restr
const	4.26 (6.9)	-.35 (-.4)	4.16 (6.9)	1.31 (2.3)
lagged dep.	.51 (15.9)	.48 (14.9)	.60 (16.1)	.56 (18.5)
$pol_{h0,it}$	-.0019 (-1.4)		-.0077 (-2.5)	-.0022 (-2.0)
$\ln\left(\frac{p^3_{h0,it}}{def_{it}}\right)$	-.11 (-5.2)	-.40 (-11.0)	-.0077 (-2.7)	-.053 (-3.8)
$other_{h0,it}$	-.85 (-8.4)	-.46 (-4.1)	-.60 (-4.6)	-1.39 (-5.0)
$\ln(pop_{it})$	-.17 (-1.4)	.64 (2.6)		.44 (5.1)
$\ln(rgdp_{it})$	-.14 (-1.9)	.43 (4.6)	.10 (2.1)	.32 (6.5)
hdd_{it}	.00014 (9.0)	.00013 (4.9)	.000024 (1.1)	.000018 (1.4)
t	-.0035 (-1.3)	-.0074 (-1.6)	.0057 (1.7)	.0029 (1.7)
t^2	.00017 (2.0)	.00054 (4.0)	-.00022 (-1.7)	
$\ln(area\_s1_{it})$	.059 (1.0)			
$perc\_equip\_s1_{it}$	.20 (1.6)			
$\ln(rcons\_s1_{it})$	.26 (4.2)			
$\ln(empl\_s2_{it})$		.20 (1.7)		
$\ln(cars\_s4_{it})$				-.062 (-1.3)
$\ln(goods\_s4_{it})$				.081 (4.1)

Table 13: Restricted estimates of the sectoral model (t-test in parenthesis).

SECTOR	IMPACT ELASTICITY	LONG TERM ELASTICITY
Household	-0.19%	-0.39%
Services	0.00%	0.00%
Industry	-0.77%	-1.92%
Transport	-0.22%	-0.50%

Table 14: Impact and long term elasticities of policy measures based on the sectoral model.

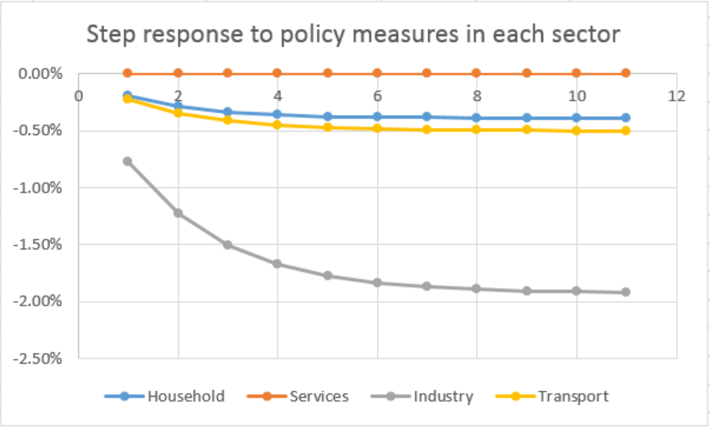


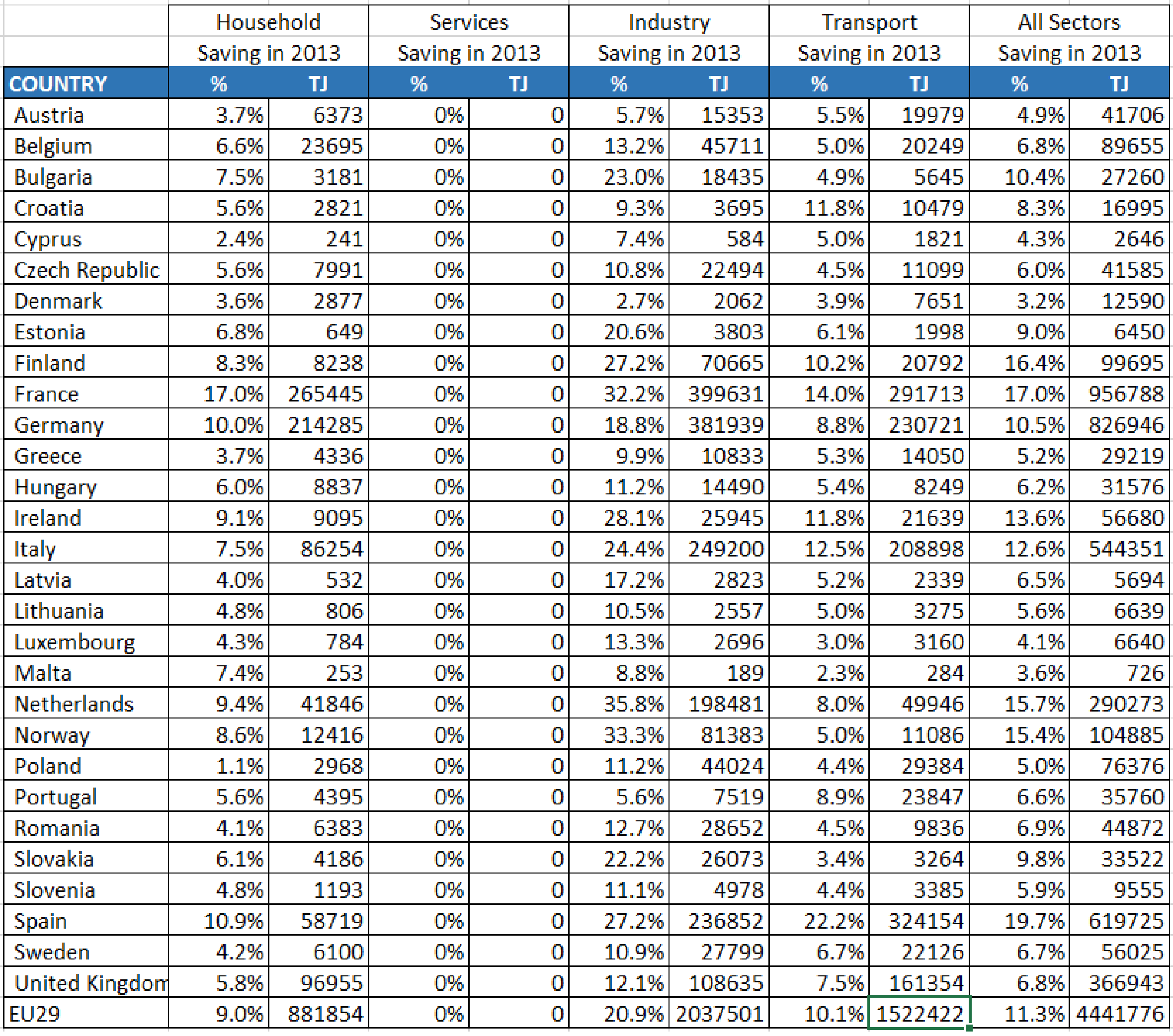
Figure 7: Step responses to policy measures based on the sectoral model.

The estimates suggest a much stronger effectiveness of energy policies adopted in the industrial sector, where the percentage saving associated to each measure is estimated to be, in the long term, almost 2%. This figure is higher than expected; however, as a matter of fact, although there are not so many policies in the industrial sector, they are mainly "Financial/Fiscal/Tarifs" measure (see Table 15), a type of measures that has been found more effective also in other studies using different methodologies (see Filippini et al., 2014).

SECTOR	NUMBER OF MEASURES	% OF FINANCIAL/FISCAL/TARIFS (excluding type "Other")
Household	576	35%
Services	452	35%
Industry	277	63%
Transport	441	45%
Cross-cutting	272	63%

Table 15: Number and type of measures in each sector - all countries.

Table 16 illustrates the implications of the sectoral model (3) when we use it to perform a dynamic simulation along the lines illustrated in the previous Subsection.



	Household Saving in 2013		Services Saving in 2013		Industry Saving in 2013		Transport Saving in 2013		All Sectors Saving in 2013	
COUNTRY	**%**	**TJ**	**%**	**TJ**	**%**	**TJ**	**%**	**TJ**	**%**	**TJ**
Austria	3.7%	6373	0%	0	5.7%	15353	5.5%	19979	4.9%	41706
Belgium	6.6%	23695	0%	0	13.2%	45711	5.0%	20249	6.8%	89655
Bulgaria	7.5%	3181	0%	0	23.0%	18435	4.9%	5645	10.4%	27260
Croatia	5.6%	2821	0%	0	9.3%	3695	11.8%	10479	8.3%	16995
Cyprus	2.4%	241	0%	0	7.4%	584	5.0%	1821	4.3%	2646
Czech Republic	5.6%	7991	0%	0	10.8%	22494	4.5%	11099	6.0%	41585
Denmark	3.6%	2877	0%	0	2.7%	2062	3.9%	7651	3.2%	12590
Estonia	6.8%	649	0%	0	20.6%	3803	6.1%	1998	9.0%	6450
Finland	8.3%	8238	0%	0	27.2%	70665	10.2%	20792	16.4%	99695
France	17.0%	265445	0%	0	32.2%	399631	14.0%	291713	17.0%	956788
Germany	10.0%	214285	0%	0	18.8%	381939	8.8%	230721	10.5%	826946
Greece	3.7%	4336	0%	0	9.9%	10833	5.3%	14050	5.2%	29219
Hungary	6.0%	8837	0%	0	11.2%	14490	5.4%	8249	6.2%	31576
Ireland	9.1%	9095	0%	0	28.1%	25945	11.8%	21639	13.6%	56680
Italy	7.5%	86254	0%	0	24.4%	249200	12.5%	208898	12.6%	544351
Latvia	4.0%	532	0%	0	17.2%	2823	5.2%	2339	6.5%	5694
Lithuania	4.8%	806	0%	0	10.5%	2557	5.0%	3275	5.6%	6639
Luxembourg	4.3%	784	0%	0	13.3%	2696	3.0%	3160	4.1%	6640
Malta	7.4%	253	0%	0	8.8%	189	2.3%	284	3.6%	726
Netherlands	9.4%	41846	0%	0	35.8%	198481	8.0%	49946	15.7%	290273
Norway	8.6%	12416	0%	0	33.3%	81383	5.0%	11086	15.4%	104885
Poland	1.1%	2968	0%	0	11.2%	44024	4.4%	29384	5.0%	76376
Portugal	5.6%	4395	0%	0	5.6%	7519	8.9%	23847	6.6%	35760
Romania	4.1%	6383	0%	0	12.7%	28652	4.5%	9836	6.9%	44872
Slovakia	6.1%	4186	0%	0	22.2%	26073	3.4%	3264	9.8%	33522
Slovenia	4.8%	1193	0%	0	11.1%	4978	4.4%	3385	5.9%	9555
Spain	10.9%	58719	0%	0	27.2%	236852	22.2%	324154	19.7%	619725
Sweden	4.2%	6100	0%	0	10.9%	27799	6.7%	22126	6.7%	56025
United Kingdom	5.8%	96955	0%	0	12.1%	108635	7.5%	161354	6.8%	366943
EU29	9.0%	881854	0%	0	20.9%	2037501	10.1%	1522422	11.3%	4441776

Table 16: Policy Induced Energy Savings based on the sectoral model.

The percentage policy induced energy saving aggregated on EU29 is about 10% for Household and Transport, about 20% for Industry, and zero for Services, which corresponds to 11.3% when we aggregate all sectors, and is equivalent to about 4.5 millions TJ. These figures double the results obtained in the aggregate model, and seem more in line with other studies and more reliable.

4.3 Sectoral models: three sectors, three sources

To try and explore if energy policies have a different impact on different energy sources, for each of the first three sectors (h=1,...,3, 1=household, 2=services and 3=industry) we have estimated 3 equations k=1,...,3 for electricity, gas and oil. For the fourth sector, i.e. transport, no disaggregate equation has been estimated since oil covers almost 100% of the sources. The equations take on the form

$$(4) \qquad ln(q_{hk,it}) = \beta_{0,i}^{hk} + \rho^{hk} ln(q_{hk,it-1}) + \gamma^{hk} pol_{h0,it} + \beta_1^{hk} ln\left(\frac{p_{hk,it}}{p^3_{h0,it}}\right) + \beta_2^{hk} ln\left(\frac{p^3_{h0,it}}{def_{it}}\right) +$$

$$+\beta_3^{hk} other^3_{h0,it} + \beta_4^{hk} ln(pop_{it}) + \beta_5^{hk} ln(rgdp_{it}) + \beta_6^{hk} ln(hdd_{it}) +$$

$$+\beta_7^{hk} t + \beta_8^{hk} t^2 + \delta'_{hk} SSV_{h,it} + \varepsilon^{hk}_{i,t}$$

The model is very similar to (3), with $ln\left(\frac{p_{hk,it}}{p^3_{h0,it}}\right)$, i.e. the relative price of source k with respect do the average price of energy for the sector, as an additional regressor. Equation (4) is somewhat unbalanced, since the EP indicator included in the source-sector equation is not "source specific", since there is no structured information in the MURE dataset about the target source for policy measures. Indeed many measures are not "source specific", but some are (like standards for electric equipment). A more accurate analysis of the MURE database, aimed at flagging the "source specific" measures, is left for future research.

The results are summarized in Table 17 (Household), Table 18 (Services) and Table 19 (Industry). The complete results are in Appendix 3.

VARIABLE	MODEL (4) Hou-Elec-Unrestr	MODEL (4) Hou-Gas-Unrestr	MODEL (4) Hou-Oil-Unrestr
const	2.96 (6.1)	-.17 (-.1)	2.27 (1.1)
lagged dep.	.62 (20.9)	.86 (62.4)	.77 (24.9)
$pol_{h0,it}$	-.00033 (-.4)	-.0041 (-1.5)	.0025 (.6)
$\ln\left(\frac{p_{hk,it}}{p^3_{h0,it}}\right)$	-.13 (-4.8)	.046 (.8)	-.0084 (-.2)
$\ln\left(\frac{p^3_{h0,it}}{def_{it}}\right)$	-.055 (-3.5)	-.057 (-1.2)	-.090 (-1.3)
$other_{h0,it}$	-.26 (-3.5)	-.41 (-1.8)	-.79 (-2.1)
$\ln(pop_{it})$	-.067 (-.8)	.38 (1.5)	-.46 (-1.2)
$\ln(rgdp_{it})$	-.098 (-2.0)	-.14 (-.9)	-.49 (-1.9)
hdd_{it}	.000046 (4.2)	.00025 (7.5)	.00012 (2.3)
t	.0043 (2.1)	.014 (1.8)	-.010 (-1.0)
t^2	-.000059 (-1.0)	-.00002 (-.1)	-.00034 (-1.2)
$\ln(area\_s1_{it})$	.036 (.8)	-.33 (-2.2)	.88 (3.5)
$perc\_equip\_s1_{it}$	-.060 (-.7)	-.86 (-2.5)	.25 (.6)
$\ln(rcons\_s1_{it})$	.20 (4.6)	.35 (2.4)	.073 (.3)

Table 17: Unrestricted estimates of the disaggregate model - Household (t-test in parenthesis).

Also in this case several parameters are insignificant, therefore we have estimate a restricted version of the models, dropping insignificant variables one at a time starting from the less significant, keeping in the model all variables whose t-test is larger than 1. The restricted models are in Table 20 (Household), Table 21 (Services) and Table 22 (Industry); in the model for Household-Gas we have dropped Bulgaria and Greece, since they affect the results dramatically.

VARIABLE	MODEL (4) Ser-Elec-Unrestr	MODEL (4) Ser-Gas-Unrestr	MODEL (4) Ser-Oil-Unrestr
const	.44 (.6)	-3.45 (-3.0)	.64 (.2)
lagged dep.	.42 (11.8)	.50 (13.5)	.54 (16.8)
$pol_{h0,it}$	-.0029 (-1.6)	-.00052 (-.1)	-.0083 (-1.2)
$\ln\left(\frac{p_{hk,it}}{p^3_{h0,it}}\right)$	-.17 (-2.8)	.66 (5.9)	.11 (1.2)
$\ln\left(\frac{p^3_{h0,it}}{def_{it}}\right)$	-.11 (-3.2)	-.42 (-4.0)	.15 (1.1)
$other_{h0,it}$	-.21 (-2.0)	-1.03 (-4.1)	-1.27 (-3.9)
$\ln(pop_{it})$	-.10 (-.5)	1.38 (1.9)	-.40 (-.5)
$\ln(rgdp_{it})$	.12 (1.2)	.37 (.37)	.20 (.4)
hdd_{it}	.000041 (1.8)	.00034 (4.7)	.00021 (2.3)
t	.0026 (.7)	-.0041 (-.3)	-.011 (-.7)
t^2	.00016 (1.4)	.00055 (1.3)	-.00034 (-.7)
$\ln(rva\_s2_{it})$	.23 (1.9)	-.095 (-.2)	-.33 (-.5)
$\ln(empl\_s2_{it})$	.30 (2.7)	.41 (1.1)	.74 (1.6)

Table 18: Unrestricted estimates of the disaggregate model - Services (t-test in parenthesis).

VARIABLE	MODEL (4) Ind-Elec-Unrestr	MODEL (4) Ind-Gas-Unrestr	MODEL (4) Ind-Oil-Unrestr
const	4.61 (7.6)	4.35 (3.8)	10.91 (5.3)
lagged dep.	.43 (10.9)	.59 (29.5)	.57 (15.1)
$pol_{h0,it}$	-.0062 (-2.8)	-.0086 (-2.0)	.0051 (.7)
$\ln\left(\frac{p_{hk,it}}{p^3_{h0,it}}\right)$	-.15 (-4.0)	.020 (.5)	.13 (2.2)
$\ln\left(\frac{p^3_{h0,it}}{def_{it}}\right)$	-.030 (-1.3)	-.051 (-1.2)	.0062 (.1)
$other_{h0,it}$	.10 (1.0)	-.73 (-4.3)	-1.41 (-4.7)
$\ln(pop_{it})$	-.11 (-1.0)	.26 (1.3)	-1.10 (-3.2)
$\ln(rgdp_{it})$	.032 (.5)	-.020 (-.1)	-.74 (-2.7)
hdd_{it}	9.2e-06 (0.6)	.00013 (4.9)	.000042 (.8)
t	.014 (4.9)	.000064 (2.2)	.0084 (.9)
t^2	-.00046 (-4.8)	-.00020 (-1.2)	-.00081 (-2.8)
$\ln(rva\_s3_{it})$	.23 (4.3)	.00075 (0.0)	.034 (.2)
$\ln(rginv\_s3_{it})$	-.07 (-3.4)	-.0049 (-.1)	.31 (3.9)

Table 19: Unrestricted estimates of the disaggregate model - Industry (t-test in parenthesis).

The results display some inconsistencies with the Sectoral Model, and some puzzling sign. Moreover, we noticed that the sign and magnitude of the estimated coefficients, unlike those of the Aggregate and Sectoral models, are quite unstable, since they sometimes change substantially as one or a few countries are dropped from the analysis. Therefore, we consider this model as extremely preliminary, and the conclusions drawn from it as less reliable than those derived from the Sectoral Model.

	MODEL (4)	MODEL (4)	MODEL (4)
VARIABLE	Hou-Elec-Restr	Hou-Gas-Restr	Hou-Oil-Restr
const	2.92 (6.7)	4.18 (2.8)	1.05 (.6)
lagged dep.	.62 (21.4)	.78 (49.5)	.77 (25.4)
$\ln\left(\frac{p_{hk,it}}{p^3_{h0,it}}\right)$	-.13 (-4.8)		
$\ln\left(\frac{p^3_{h0,it}}{def_{it}}\right)$	-.060 (-4.0)	-.080 (-1.4)	-.13 (-2.0)
$other_{h0,it}$	-.28 (-4.0)	-.77 (-2.7)	-.81 (-2.3)
$\ln\left(pop_{it}\right)$			
$\ln\left(rgdp_{it}\right)$	-.068 (-1.7)	-.17 (-1.0)	-.35 (-2.9)
hdd_{it}	.000046 (4.2)	.00030 (7.2)	.00012 (2.3)
t	.0021 (2.3)	.029 (3.1)	-.017 (-3.2)
t^2		-.00025 (-1.2)	
$\ln\left(area\_s1_{it}\right)$		-.53 (-3.1)	.89 (4.0)
$perc\_equip\_s1_{it}$		-1.0 (-2.4)	
$\ln\left(rcons\_s1_{it}\right)$	.18 (4.4)	.23 (1.5)	

Table 20: Restricted estimates of the disaggregate model - Household (t-test in parenthesis).

	MODEL (4)	MODEL (4)	MODEL (4)
VARIABLE	Ser-Elec-Restr	Ser-Gas-Restr	Ser-Oil-Restr
const	.23 (.4)	-1.60 (-.9)	-3.76 (-1.6)
lagged dep.	.42 (11.6)	.50 (14.1)	.61 (21.4)
$pol_{h0,it}$	-.0029 (-1.7)		-.013 (-1.9)
$\ln\left(\frac{p_{hk,it}}{p^3_{h0,it}}\right)$	-.20 (-3.2)	.66 (6.0)	
$\ln\left(\frac{p^3_{h0,it}}{def_{it}}\right)$	-.12 (-3.5)	-.43 (-4.0)	
$other_{h0,it}$	-.23 (-2.2)	-1.12 (-4.7)	-.91 (-3.1)
$\ln\left(pop_{it}\right)$		.77 (1.5)	
$\ln\left(rgdp_{it}\right)$	.15 (1.9)		
hdd_{it}	.000039 (1.7)	.00032 (4.5)	.00032 (3.6)
t			-.017 (-2.1)
t^2	.00024 (3.2)	.00048 (2.6)	
$\ln\left(rva\_s2_{it}\right)$	.25 (2.2)		
$\ln\left(empl\_s2_{it}\right)$	.26 (2.6)	.68 (2.9)	.87 (2.8)

Table 21: Restricted estimates of the disaggregate model - Services (t-test in parenthesis).

VARIABLE	MODEL (4) Ind-Elec-Restr	MODEL (4) Ind-Gas-Restr	MODEL (4) Ind-Oil-Restr
const	4.78 (9.3)	2.82 (4.4)	11.19 (2.0)
lagged dep.	.43 (11.0)	.69 (27.5)	.57 (15.3)
$pol_{h0,it}$	-.0063 (-2.8)	-.0063 (-1.0)	
$\ln\left(\frac{p_{hk,it}}{p^3_{h0,it}}\right)$	-.15 (-4.0)		.12 (2.1)
$\ln\left(\frac{p^3_{h0,it}}{def_{it}}\right)$	-.030 (-1.3)	-.27 (-4.1)	
$other_{h0,it}$	.10 (1.0)	-1.03 (-4.0)	-1.37 (-5.0)
$\ln(pop_{it})$	-.11 (-1.0)	.67 (2.7)	-1.12 (-3.3)
$\ln(rgdp_{it})$			-.71 (-3.6)
t	.014 (4.9)		.0098 (1.0)
t^2	-.00046 (-4.8)	.00020 (1.8)	-.00078 (-3.1)
$\ln(rva\_s3_{it})$	.23 (4.3)		
$\ln(rginv\_s3_{it})$	-.07 (-3.4)		.30 (3.9)

Table 22: Restricted estimates of the disaggregate model - Industry (t-test in parenthesis).

	Services-Electricity		Services-Gas		Services-Oil		Services	
	Saving in 2013		Saving in 2013		Saving in 2013		Saving in 2013	
COUNTRY	**%**	**TJ**	**%**	**TJ**	**%**	**TJ**	**%**	**TJ**
Austria	4.5%	2165	0.0%	0	28.9%	745	4.4%	2910
Belgium	10.1%	8459	0.0%	0	63.1%	35016	21.9%	43475
Bulgaria	7.5%	2230	0.0%	0	43.6%	567	8.5%	2797
Croatia	8.2%	1658	0.0%	0	49.1%	1698	12.1%	3356
Cyprus	2.4%	158			14.7%	205	4.7%	363
Czech Republic	3.0%	1507	0.0%	0	18.5%	94	1.5%	1602
Denmark	1.5%	556	0.0%	0	9.5%	269	1.7%	825
Estonia	10.3%	989	0.0%	0	64.2%	1486	19.6%	2475
Finland	14.2%	9596	0.0%	0	87.9%	15388	33.2%	24984
France	11.9%	67727	0.0%	0	72.5%	117273	19.5%	185000
Germany	12.2%	67909	0.0%	0	76.1%	374860	34.1%	442769
Greece	4.8%	3003	0.0%	0	28.3%	2648	7.6%	5651
Hungary	2.5%	679	0.0%	0	16.0%	231	1.0%	909
Ireland	11.4%	2764	0.0%	0	72.2%	14261	31.9%	17025
Italy	7.8%	26024	0.0%	0	48.4%	15956	6.5%	41980
Latvia	4.6%	460	0.0%	0	26.7%	574	6.8%	1034
Lithuania	10.5%	1243	0.0%	0	65.1%	161	10.0%	1404
Luxembourg	1.9%	184	0.0%	0	11.1%	373	2.7%	557
Malta	7.6%	172			45.4%	74	10.7%	246
Netherlands	6.4%	8663	0.0%	0	41.4%	6176	4.3%	14839
Norway	10.8%	10610	0.0%	0	68.5%	8110	18.4%	18721
Poland	3.2%	5039	0.0%	0	18.7%	3699	3.5%	8737
Portugal	5.9%	3446	0.0%	0	38.2%	2493	8.4%	5939
Romania	5.9%	1727	0.0%	0	35.7%	1413	4.8%	3140
Slovakia	8.9%	2530	0.0%	0	56.4%	381	4.1%	2911
Slovenia	5.1%	623	0.0%	0	30.3%	1584	12.4%	2207
Spain	18.9%	58058	0.0%	0	113.2%	113102	43.3%	171160
Sweden	2.5%	2785	0.0%	0	16.0%	2067	3.8%	4852
United Kingdom	6.9%	25220	0.0%	0	43.8%	14700	5.6%	39920
EU29	9.7%	316183	0.0%	0	71.8%	735606	17.8%	1051789

Table 23: Policy Induced Energy Savings based on the disaggregate model - Services.

This said, the evidence from the disaggregate model is that energy policy seems ineffective in the household sector for any source (this contradicts the Sectoral Model, where EP is effective for household), effective in the services sector for electricity and (mainly) oil, but not for gas (this also contradicts the Sectoral Model, where EP is ineffective for services), effective in the industry sector for electricity and gas, but not for oil (overall effectiveness seems lower than in the Sectoral Model). Table 23 and Table 24 illustrate the implications of the disaggregate model (4) when we use it to perform a dynamic simulation along the lines previously illustrated.

	Industry-Electricity		Industry-Gas		Industry-Oil		Industry	
	Saving in 2013		Saving in 2013		Saving in 2013		Saving in 2013	
COUNTRY	**%**	**TJ**	**%**	**TJ**	**%**	**TJ**	**%**	**TJ**
Austria	3.3%	3428	5.9%	7987	0.0%	0	4.2%	11414
Belgium	7.8%	10802	13.9%	25498	0.0%	0	10.5%	36300
Bulgaria	15.0%	4978	22.0%	7835	0.0%	0	16.0%	12813
Croatia	5.5%	644	9.7%	1492	0.0%	0	5.4%	2137
Cyprus	4.4%	75			0.0%	0	1.0%	75
Czech Republic	6.5%	5600	11.0%	12120	0.0%	0	8.5%	17720
Denmark	1.7%	529	2.7%	762	0.0%	0	1.7%	1290
Estonia	12.2%	1004	21.4%	1465	0.0%	0	13.4%	2469
Finland	16.4%	24805	27.8%	10973	0.0%	0	13.8%	35778
France	19.3%	88490	33.3%	208691	0.0%	0	23.9%	297180
Germany	11.1%	94486	19.7%	196321	0.0%	0	14.3%	290807
Greece	6.3%	2668	9.5%	2231	0.0%	0	4.5%	4899
Hungary	6.6%	3661	11.7%	7056	0.0%	0	8.3%	10717
Ireland	16.6%	6031	29.3%	8803	0.0%	0	16.0%	14834
Italy	14.4%	64036	25.6%	108494	0.0%	0	16.9%	172530
Latvia	10.8%	741	16.7%	1087	0.0%	0	11.1%	1828
Lithuania	6.5%	721	10.5%	1175	0.0%	0	7.8%	1896
Luxembourg	8.4%	792	13.0%	1339	0.0%	0	10.5%	2131
Malta	5.4%	103			0.0%	0	4.8%	103
Netherlands	21.0%	29401	37.9%	104442	0.0%	0	24.1%	133843
Norway	20.2%	34963	34.4%	6300	0.0%	0	16.9%	41263
Poland	7.3%	12959	10.8%	17979	0.0%	0	7.9%	30939
Portugal	3.3%	1941	5.8%	2733	0.0%	0	3.5%	4674
Romania	7.7%	5426	12.8%	14810	0.0%	0	9.0%	20236
Slovakia	13.2%	5997	23.0%	15410	0.0%	0	18.2%	21407
Slovenia	7.1%	1559	10.8%	1876	0.0%	0	7.6%	3436
Spain	16.3%	44718	28.2%	126290	0.0%	0	19.6%	171008
Sweden	6.6%	12737	11.1%	2253	0.0%	0	5.9%	14990
United Kingdom	7.3%	26626	12.5%	42902	0.0%	0	7.7%	69528
EU29	12.2%	489921	22.0%	938325	0.0%	0	14.7%	1428247

Table 24: Policy Induced Energy Savings based on the disaggregate model - Industry.

5 Conclusion and suggestions for further research

In this study, we have created a dataset and developed econometric models aimed at estimating the impact of energy efficiency policies on energy consumption in the EU Member States in the period 1990-2013. The novelty of the approach is in the use of MURE's database on policy measures to produce panel "energy policy indicators" (EPI's) at the sector level for each European country, possibly aggregated across sectors to produce a country indicator. This indicators are then included, along with usual control variables, in dynamic panel models for each sector and for the whole economy. The estimated models are then used to derive a quantitative measure of the policy induced energy saving from 1990 to 2013, measured as a percentage of the energy consumption as it would have been in the absence of energy policies. The results, although preliminary, seem to be encouraging. In short: (i) Energy policies seems to have an impact in reducing energy consumption. In the absence of energy policies consumption in EU29 countries would have been approximately 11% higher in 2013. However, the statistical significance of this result is sometimes weak, possibly due to the quality of the EP indicators: investing on the development of more accurate indicators might lead to a more reliable estimate. (ii) Effectiveness of energy policies seems to be higher in Industry (20% saving in 2013 for EU29) intermediate for Household and Transport (10%), whereas for Services the magnitude and significance of the effect seems negligible. (iii) The evidence on the impact of policies on different sources provided in this study is extremely preliminary: however, there is no clear evidence of a higher impact on some source with respect to others. (iv) The analysis of individual countries has also to be regarded as preliminary: for most countries the ranking based on energy policy induced energy saving seems in line with expectations, while in some cases we have puzzling results (essentially due to the number of policy measures reported in the MURE database, which for some countries seems too low or too high).

In this study we have provided a framework which seems promising, but deserves to be strengthened in several directions. Below some possible lines for a follow up of this study, which might be focused on one single sector (say, household).

5.1 Improving the EP Indicators

1. Carefully analyze the measures in MURE database in each country: this is important to have a reliable measure of energy policy effectiveness at the country level (Double checking with the IEA "Policies and Measures Database" (www.iea.org/policiesandmeasures/energyefficiency/) might be a starting point to improve the quality of our indicators
2. Check robustness to alternative measures of policy energy intensity, check anomalies and inconsistencies of current results
3. Use the information about cross-cutting measures
4. Use the information about EU measures
5. Use the information about the type of measure (Financial, Standard, ...)
6. Flag each measure's "energy source specificity" (0=unspecific, 1=electricity, ...)

5.2 Addressing further economic issues

1. REBOUND EFFECTS: Almost 40 years ago, Berndt-Wood (1975), pointed out that many empirical studies on energy demand do not consider explicitly that the optimal demand for energy and non energy inputs is the solution of a unique optimization problem, where energy and non-energy inputs are to some extent substitutes (as an example: investing capital in energy saving technology leads to a minor need for energy). Focusing attention on the level of output ignoring the price of other inputs, or analyzing the response of some specific type of energy to its own price (or at most strict energy substitutes) neglecting the price of non energy inputs is therefore not appropriate. The literature on the rebound effect, discussed among others in Bentzen (2004), Birol-Keppler (2000), ..., is essentially pointing out that there is a non negligible substitutability between capital and energy, so that when energy becomes relatively less expensive due to increased efficiency induced by policy measures, the demand for energy increases, partly "backfiring" the effect of policy.
2. INTERFUEL SUBSTITUTION: Another important empirical issue is the analysis of interfuel substitution, see Hall (1986), Urga-Walters (2003), Stern (2009). Interfuel substitutability has been of longstanding interest to the energy economics and policy community and is of critical importance in evaluating sustainability options and in estimating the economic cost of environmental policies such as a carbon tax. Our disaggregate model, where instead of a single energy aggregate several energy sources, such as gas, electricity and oil are separately analyzed, is the right level to discuss the issue, bur specific parameters should be introduced. Results for the shadow elasticities of substitution between coal, oil, gas, and electricity for forty-six primary studies analyzed in Stern (2009) show that at the level of the industrial sector there are easy substitution possibilities between all the fuel pairs with the

exception of gas-electricity and coal-electricity. Substitution possibilities seem more constrained at the macro level and less constrained in sub-industries. Estimates also vary across countries (model and data specification issues very significantly affect the estimates derived by each individual study: estimates from cross-section regressions are generally largest, fixed effects panel estimates intermediate in magnitude, and time-series estimates are mostly much smaller).

3. COMPOSITION EFFECTS: the production function is reasonably well defined at a disaggregate sector level, but when aggregates such as "industrial sector" are considered one should take into account the changes of energy intensity in the industrial sector is also due to the relative decline of heavy manufacturing and low-technology industries which are typically mining and quarrying, construction, non-electrical machinery, stone, clay and glass, wood and wood products, textiles and leather, ship building and the rapid expansion of high technology industries, which are typically electronic components and equipment, office and data processing machines, aerospace industry, pharmaceutics (intermediate technology industries: rubber and plastic industries, automotive industries, chemical industries). This shift has also increased the use of electricity wrt oil, coal, gas. Estimated input demand function at an aggregate level should therefore include an indicator accounting for changes in the weight of heavy industry over time.
4. MULTI OBJECTIVE ENERGY POLICIES: Explore the multiple-objectives point of view in depth (effects of policies on energy dependence and GHG emissions)
5. ADDING CONTROL VARIABLES: Enerdata database should be explored to check for the availability and reliability of more covariates to be introduced in the econometric model.

5.3 Improving the econometric methodology

1. HETEROGENEOUS COEFFICIENTS: The evidence from single country energy demand suggest that own price and substitution elasticities might differ substantially across countries. Hsiao-Pesaran (2008) illustrates how panel models may allow for heterogeneous coefficients (not only the constant term). Allowing for parameters heterogeneity would allow to answer questions like: is energy policy effectiveness equal in all countries?
2. CONFIDENCE BOUNDS: Work out confidence bounds for the estimated policy induced saving based on dynamic simulation
3. DYNAMIC SPECIFICATION, NON STATIONARITY, COINTEGRATION: some important aspects of the dynamic analysis of energy panels, clearly pointed out by existing studies such as Madlener-Bernstein-Alva Gonzales (2013) have been neglected in the study carried on so far. In particular, recent studies have emphasized the non-stationarity of most of the variables involved in energy studies, and therefore to avoid inconsistent estimates and spurious regression problems, it is important to carry out appropriate unit roots and cointegration analysis within the panel framework (see among others Fomby-Hill 2000). One important advantage of cointegration techniques is the possibility to estimate, within a suitable dynamic error correction model, both long- and short-run effects of price and income. Since their popularization by Davidson et al. (1978), and the development of their statistical foundations by Engle and Granger (1987) and Engle et al. (1989), these methods have been widely applied in the academic literature. One early application to the analysis of total energy demand in Denmark is by Bentzen and Engsted (1993). Among other applications , Silk-Joutz (1997), Urga (1999), Urga-Walters (2003), Narayan-Smyth-Prasad (2007).
4. DYNAMIC STOCHASTIC FRONTIER: as clearly illustrated in Greene (2008), the empirical estimation of the production frontier is an extension of the familiar regression model based on the theoretical premise that a production function, or its dual, the cost function, or the convex conjugate of the two, the profit function, represents the maximum output attainable given a set of inputs, the minimum cost of producing that output given the prices of the inputs, or the maximum profit attainable given the inputs, outputs, and prices of the inputs. The estimation of frontier functions is the econometric exercise of making the empirical implementation consistent with the underlying theoretical

proposition that no observed agent can exceed the ideal. Essentially this is achieved by decomposing the error term in two parts: a stochastic error, capturing the effect of noise, and a one-sided nonnegative disturbance capturing the effect of inefficiency. Dynamic Stochastic Frontier models allow the inefficiency component to be autocorrelated (see for example Tsionas, 2006). A methodological discussion of DSF models in panels is found in Cornwell-Schmidt (2008), while applications to energy demand are in Filippini et al (2014) and Saussay et al (2012).

5. FUNCTIONAL FORM: Other functional forms are sometimes used for theoretical or empirical reasons, like Cobb-Douglas, CES (Constant Elasticity of Substitution), linear logit, ... See among others Urga-Walters (2003), Tompson (2014). The appropriate functional form will be explored empirically.
6. MEASUREMENT ERROR: A well-known drawback of the Ordinary Least Squares (OLS) method when there are random measurement errors (errors-in-variables, EIV) in the regressors is that the coefficient estimators are inconsistent. Essentially, under measurement errors the slope coefficients are biased towards zero, a property often referred to as attenuation. A discussion of the issue in the setting of panel data models is in Biørn-Krishnakumar (2008). Several studies have applied EIV methods to energy demand, reporting that when measurement errors are accounted for, elasticities estimates are substantially higher. In our framework error in variables are expected to be important especially in the policy variables, whose proposed numerical measures admittedly an approximation of the true intensity.
7. POLICY ENDOGENEITY: Policy makers consider the state of the economy when setting policies, which may lead to endogeneity bias in regression models that estimate relationships between economic variables and policy variables. The Blundell and Bond (1998) GMM estimator instruments the endogenous variable with lags of itself.
8. SINGLE EQUATION VS SYSTEM ESTIMATION: Kamerschen and Porter (2004) estimates residential and industrial electricity demand by a simultaneous equation approach, exploiting the plausible correlation of the error terms, reporting a gain in efficiency of estimates achieved by exploiting the covariance among the error terms of the two equations through the SURE estimator. In our study we might benefit by the adoption of the same estimation technique.

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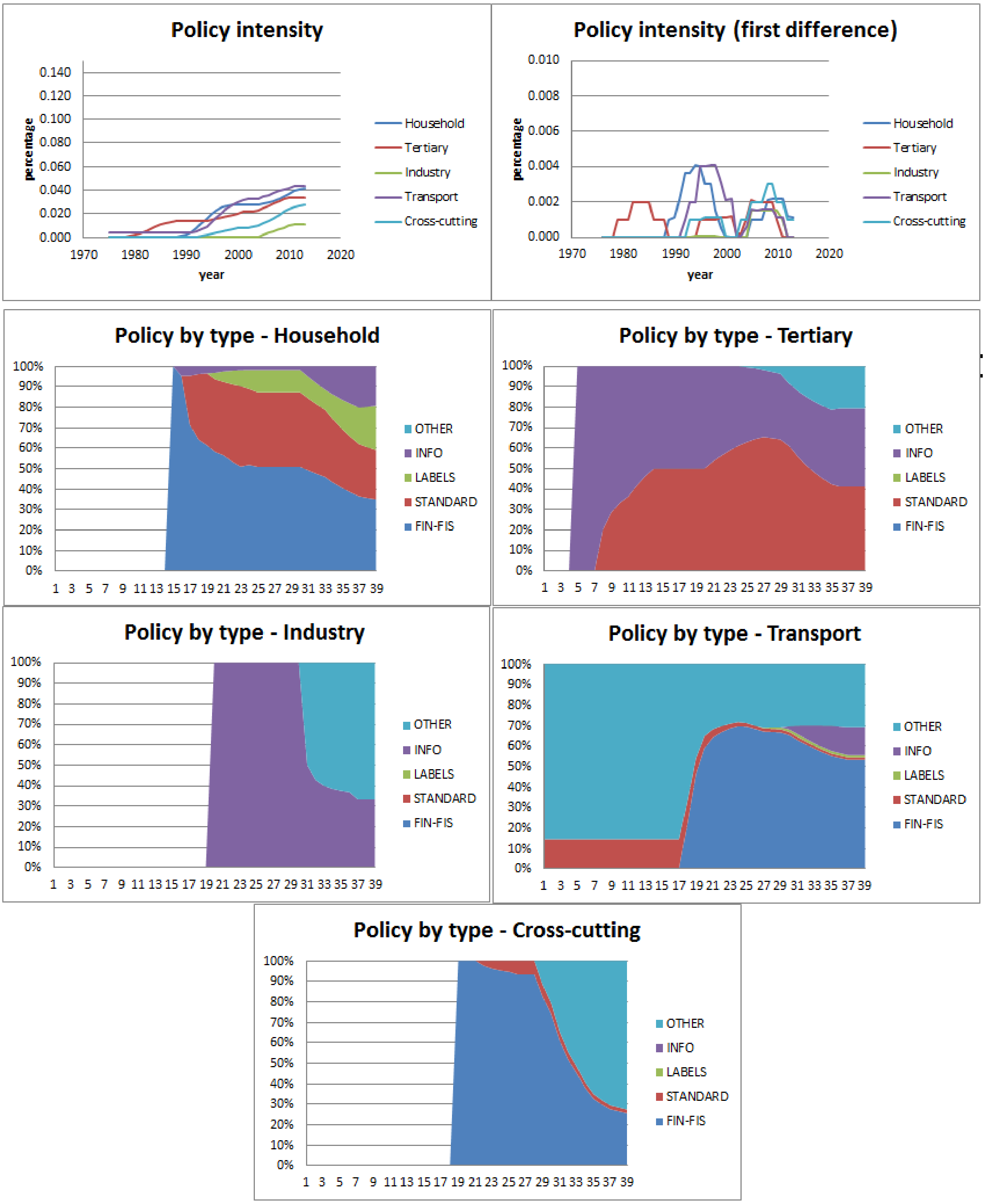
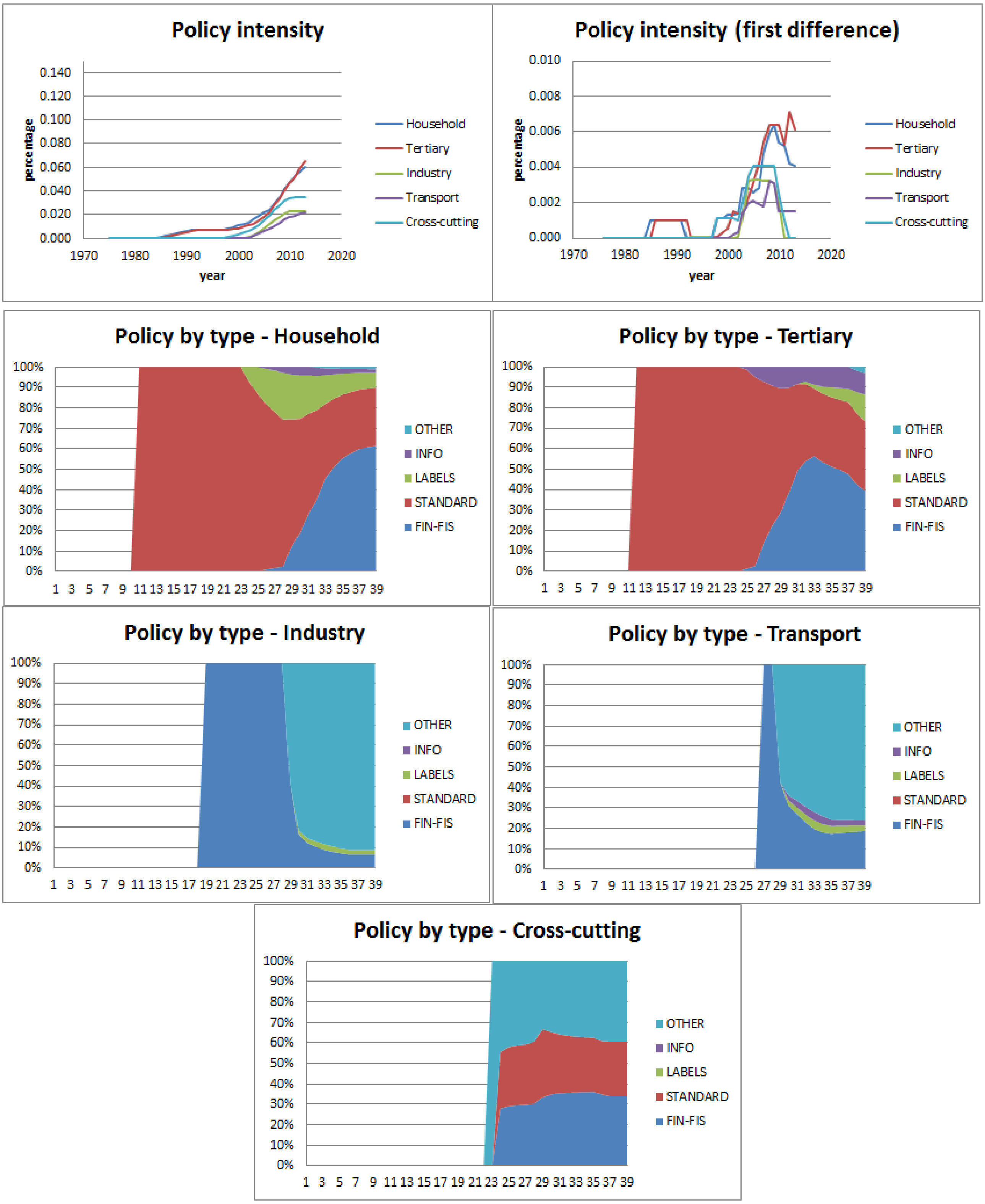
7 APPENDIXES

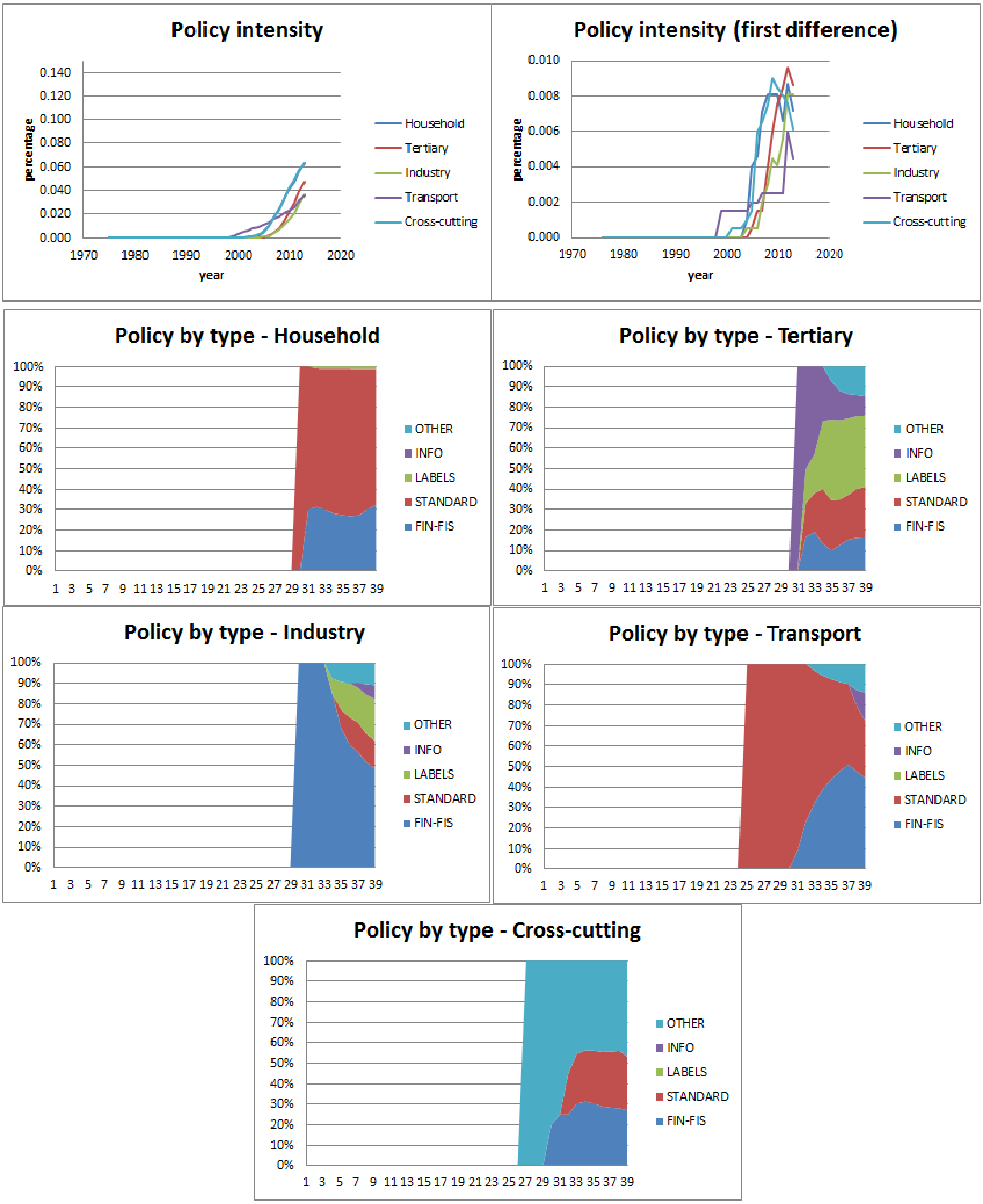
7.1 APPENDIX 1: Analysis of the energy policies for each country



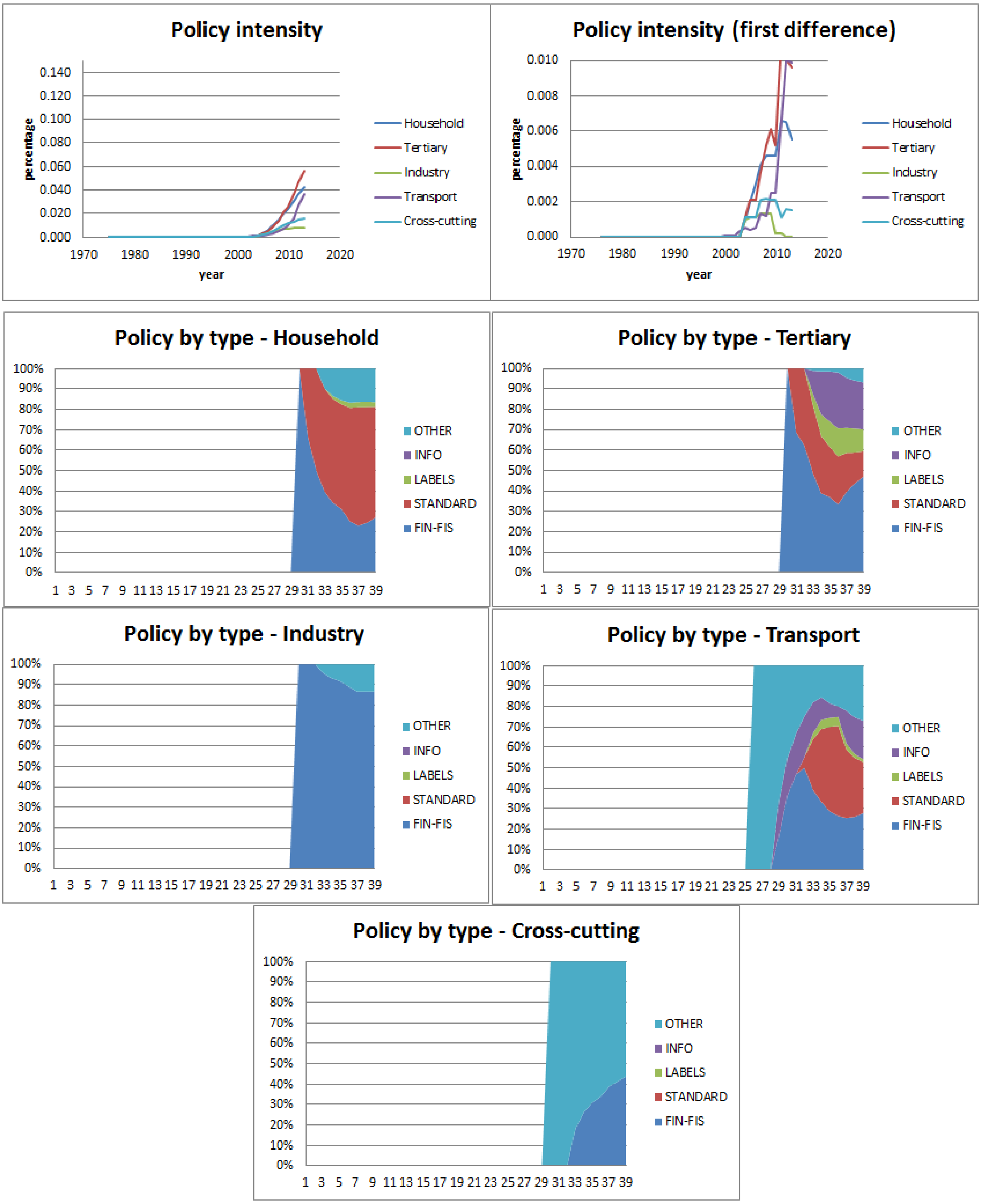
Austria - Policy intensity indicators



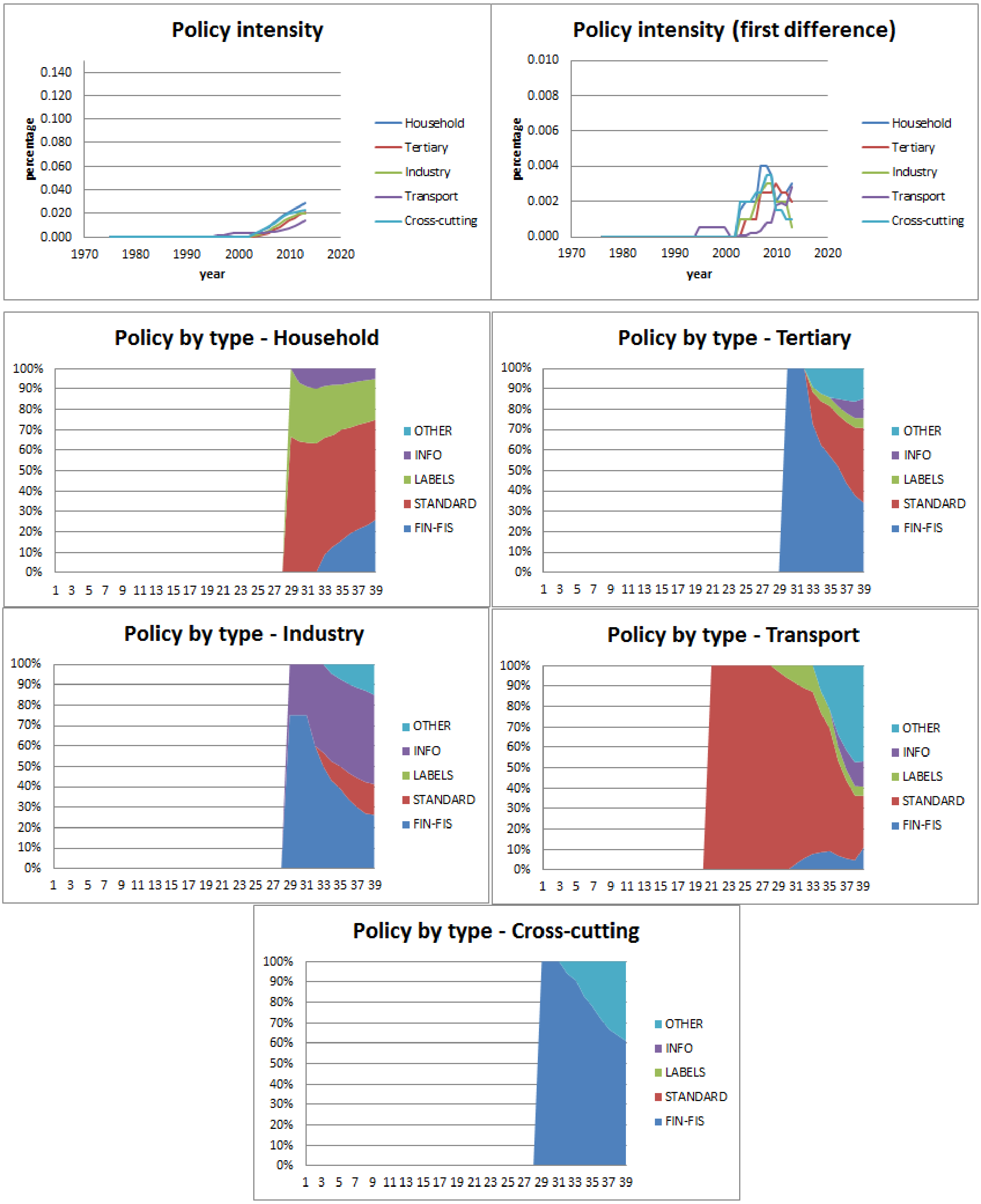
Belgium - Policy intensity indicators



Bulgaria - Policy intensity indicators



Croatia - Policy intensity indicators



Policy intensity

Policy intensity (first difference)

Policy by type - Household

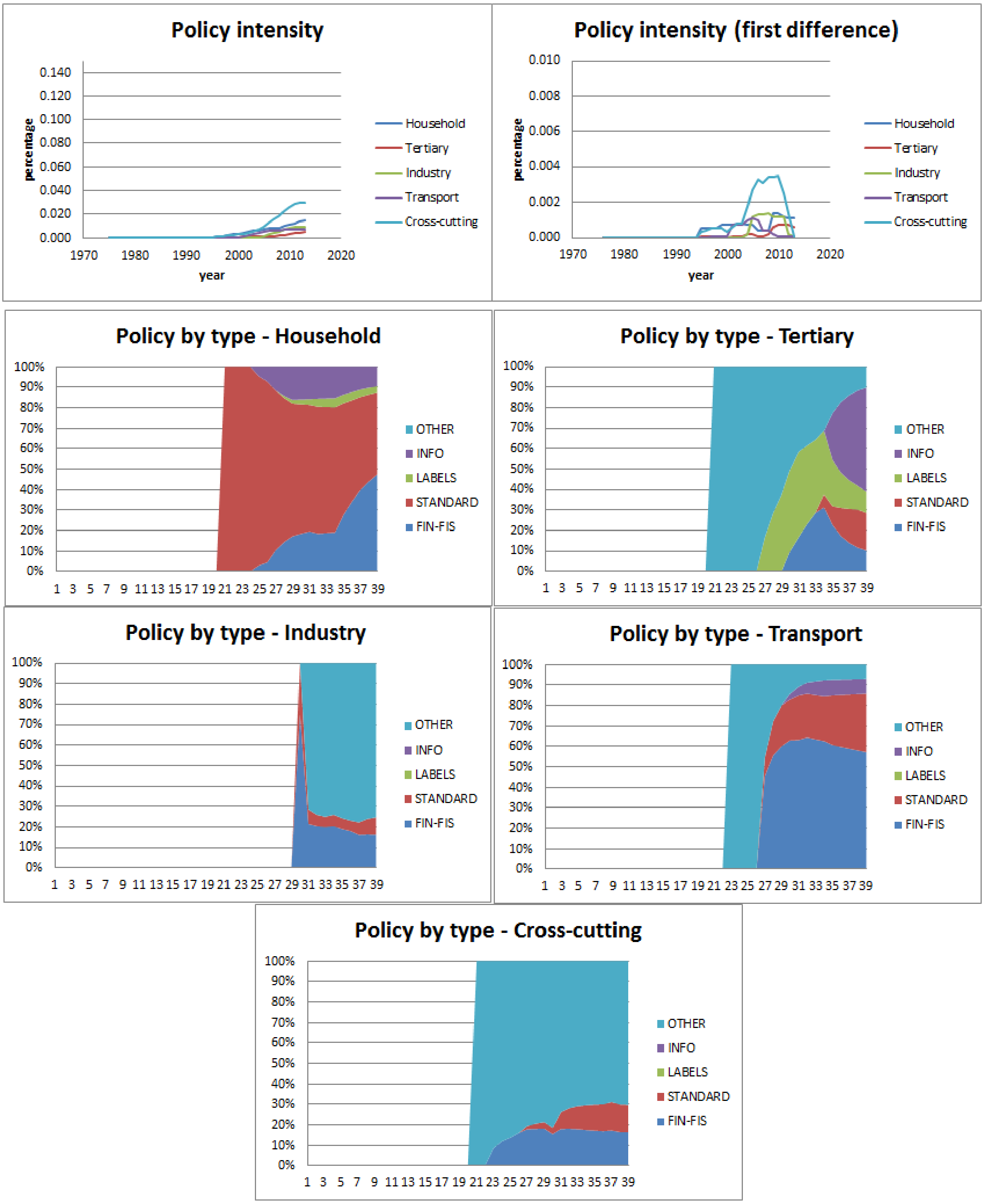
Policy by type - Tertiary

Policy by type - Industry

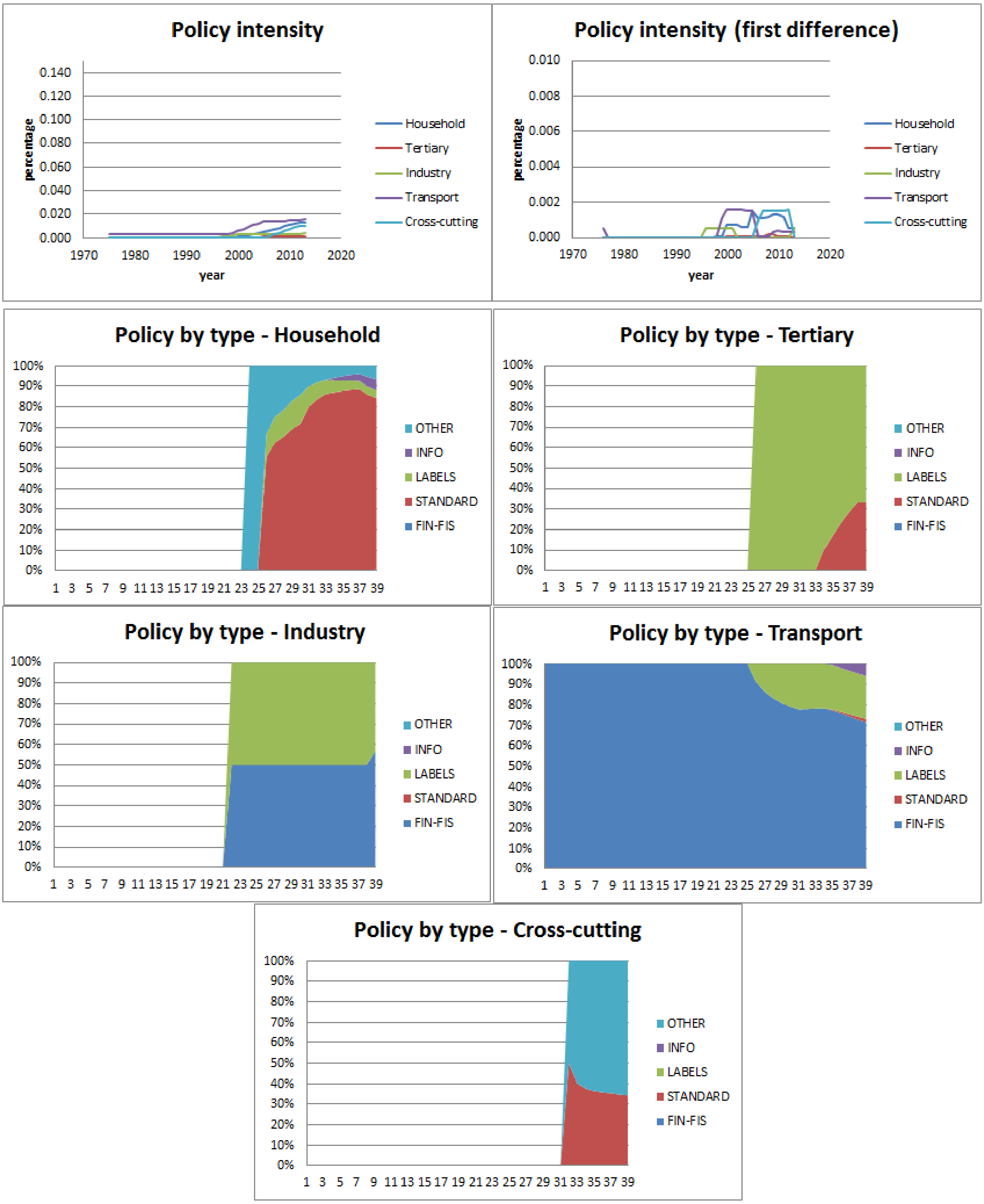
Policy by type - Transport

Policy by type - Cross-cutting

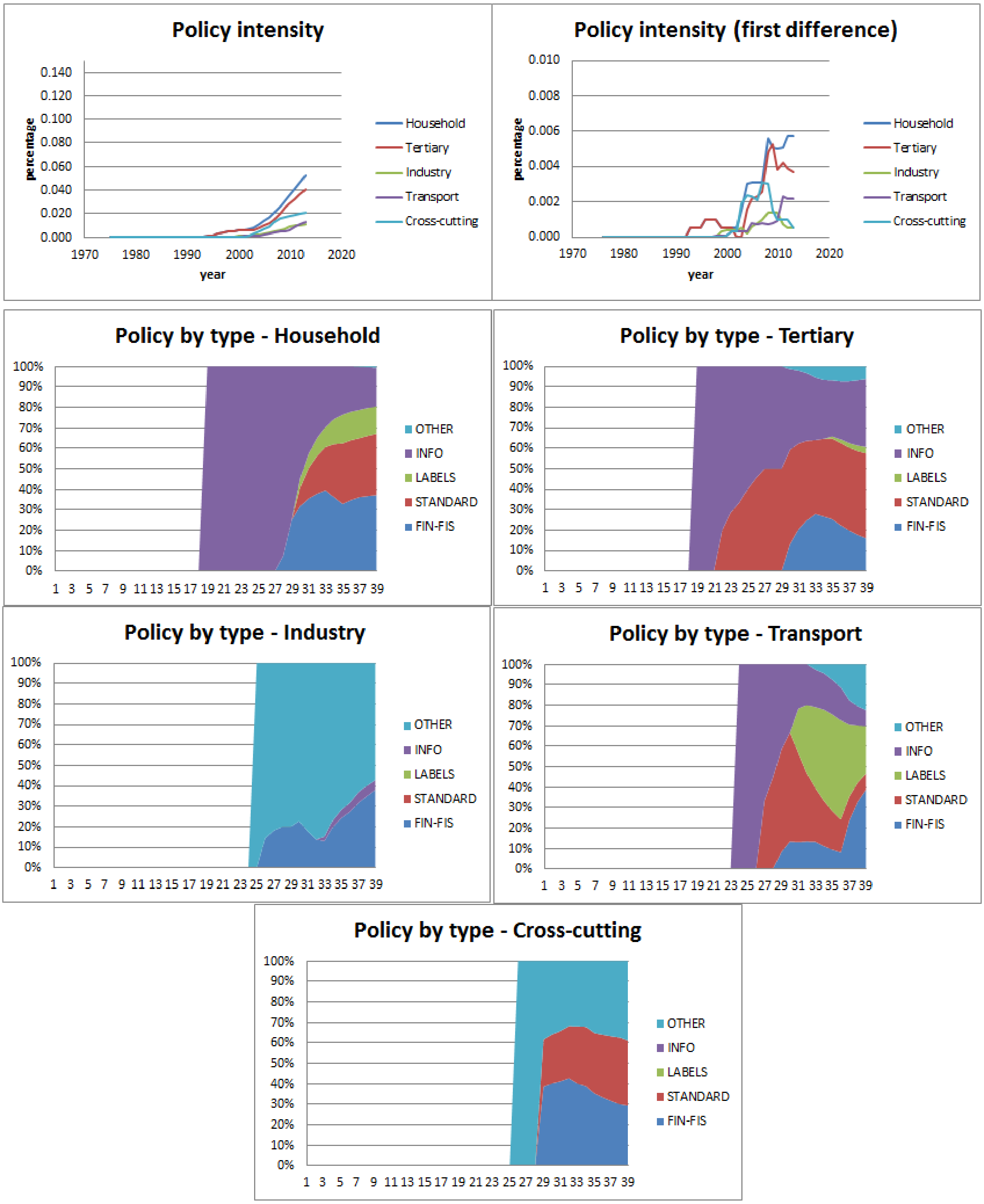
Cyprus - Policy intensity indicators



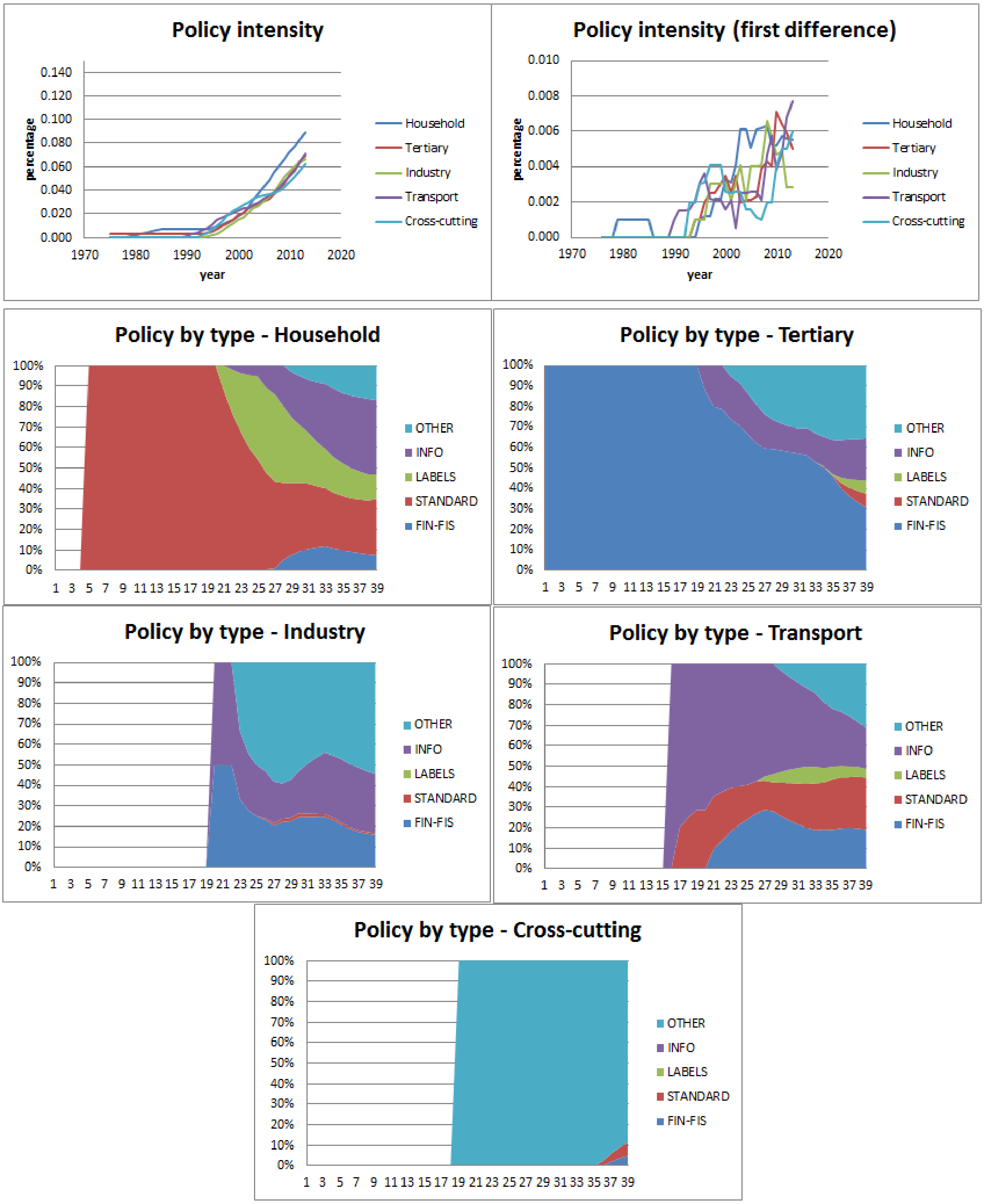
Czech Republic - Policy intensity indicators



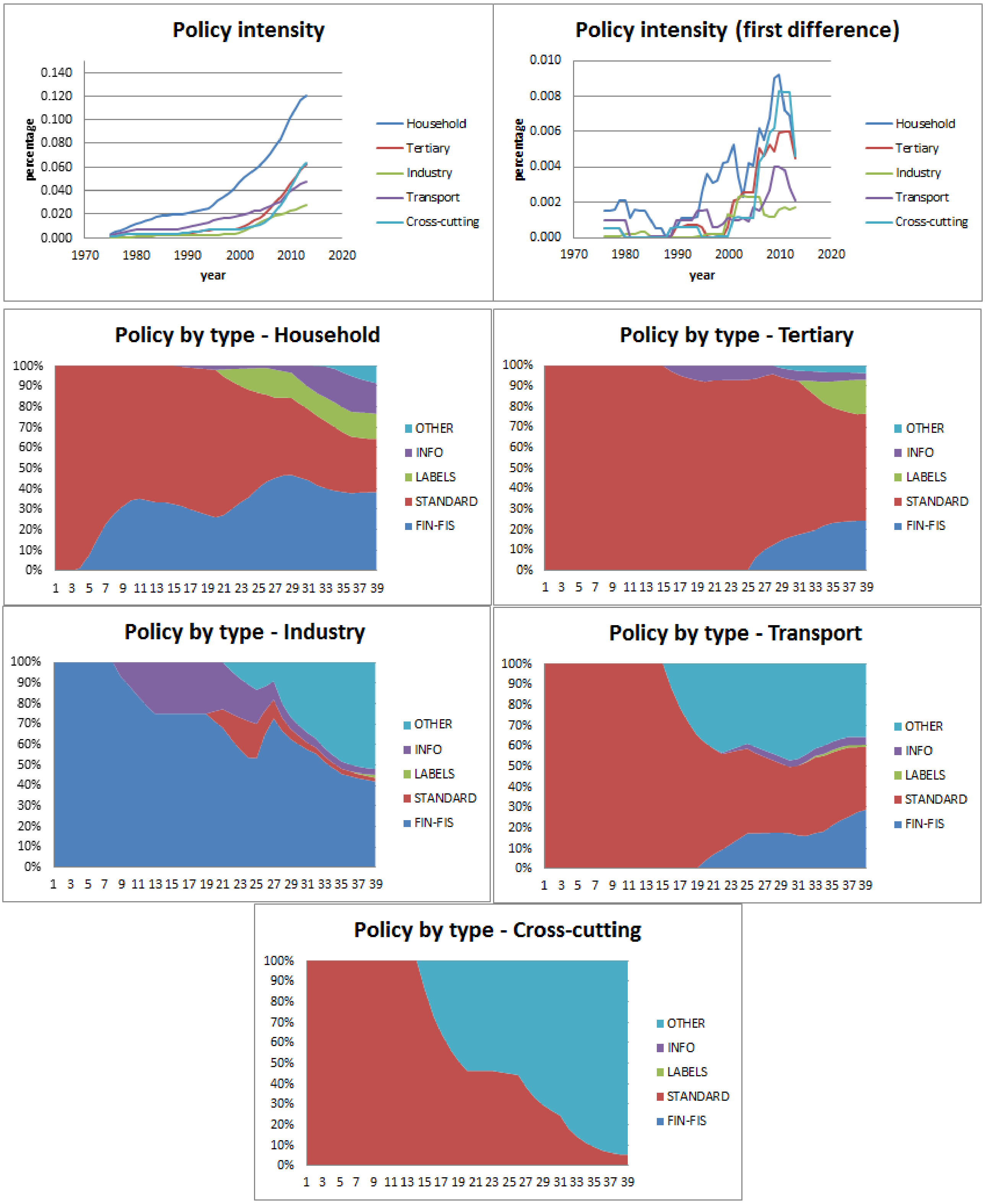
Denmark - Policy intensity indicators



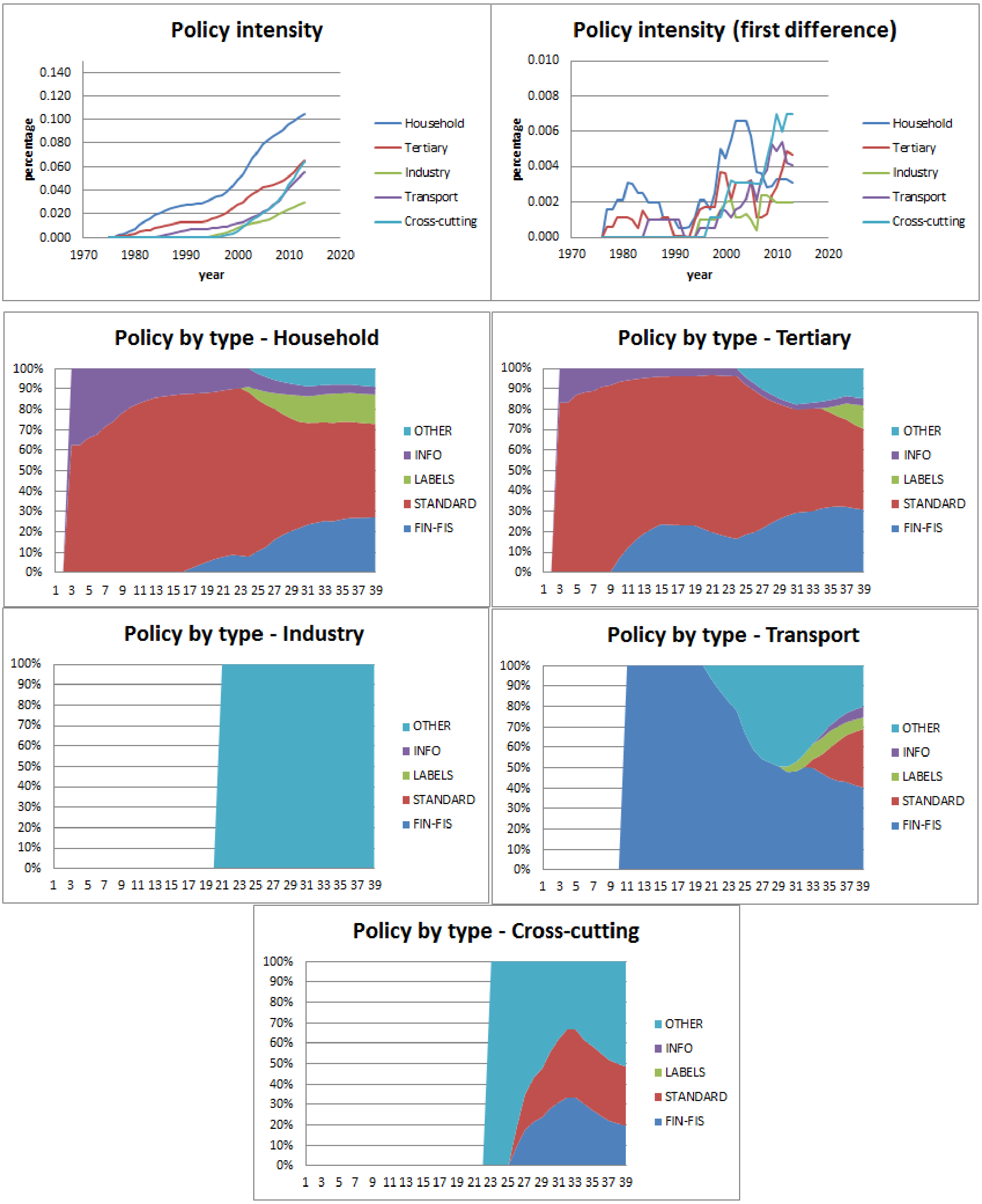
Estonia - Policy intensity indicators



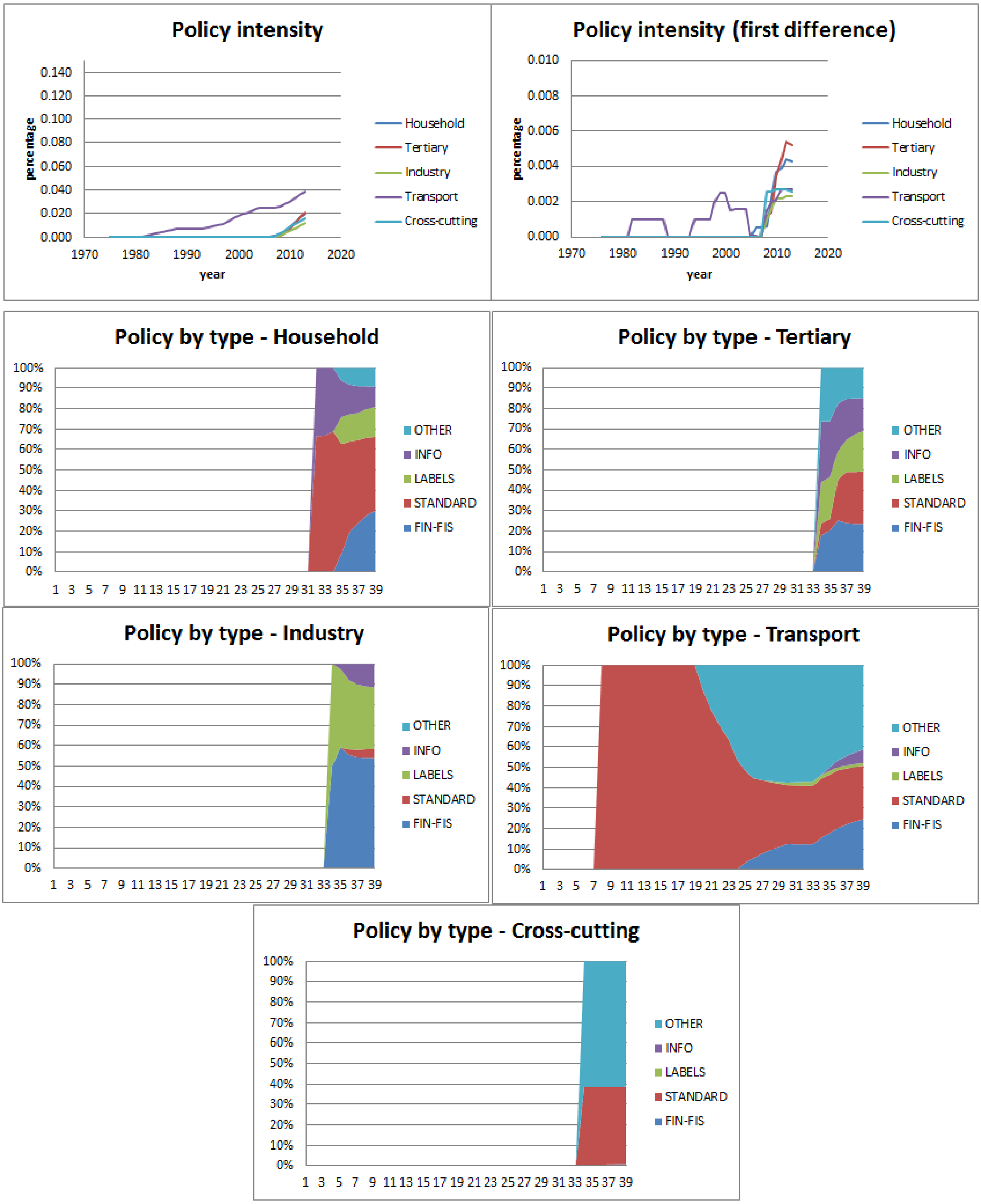
Finland - Policy intensity indicators



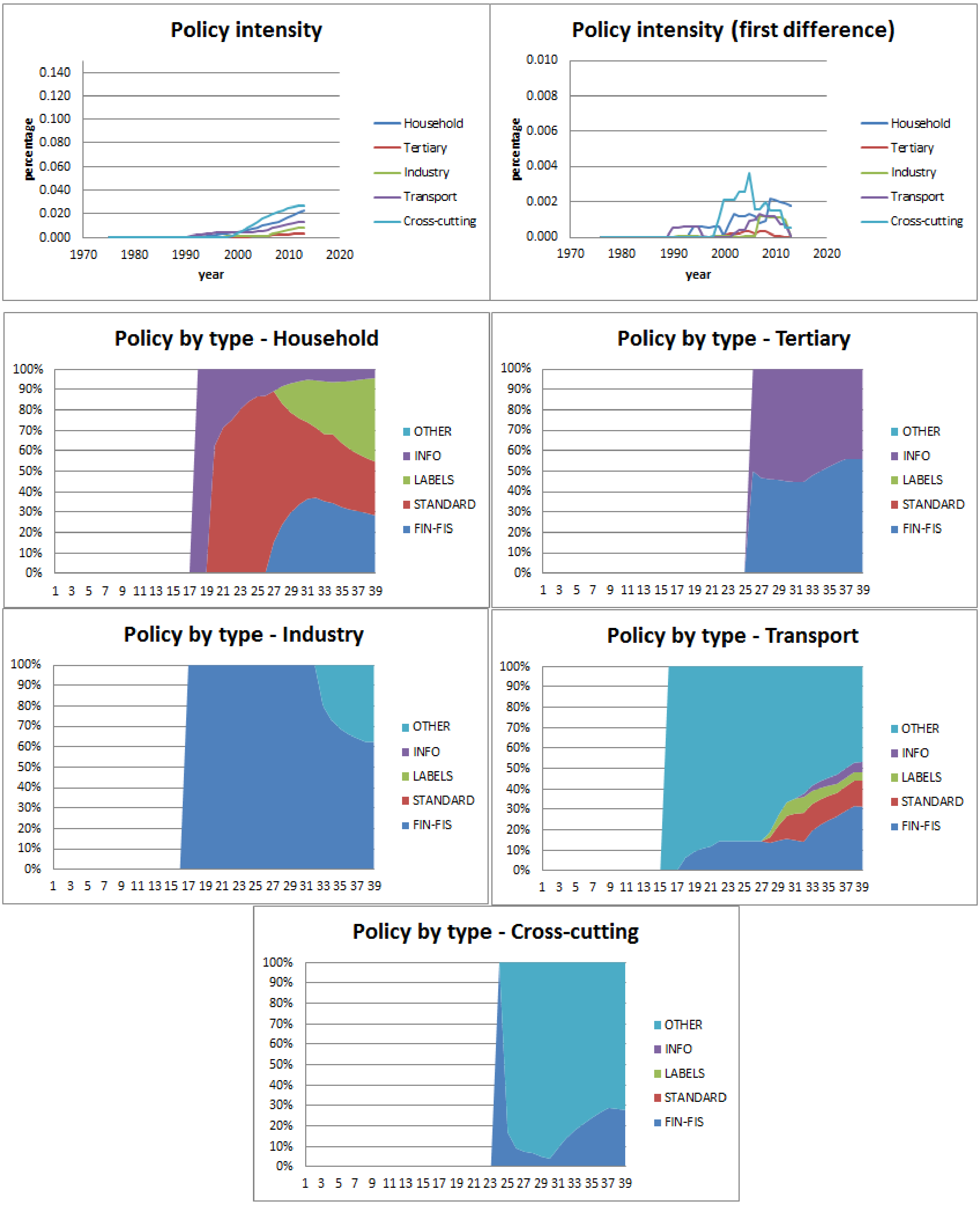
France - Policy intensity indicators



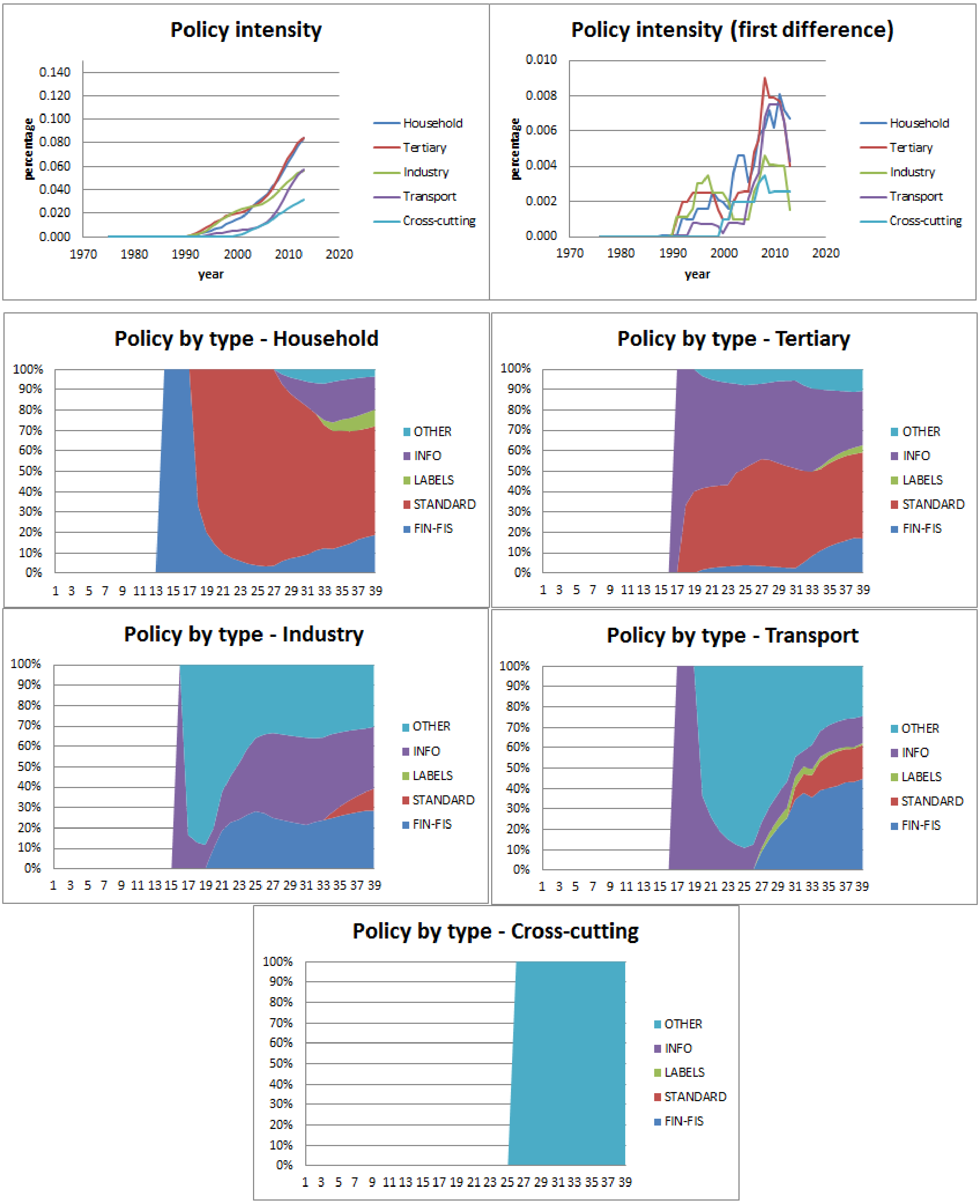
Germany - Policy intensity indicators



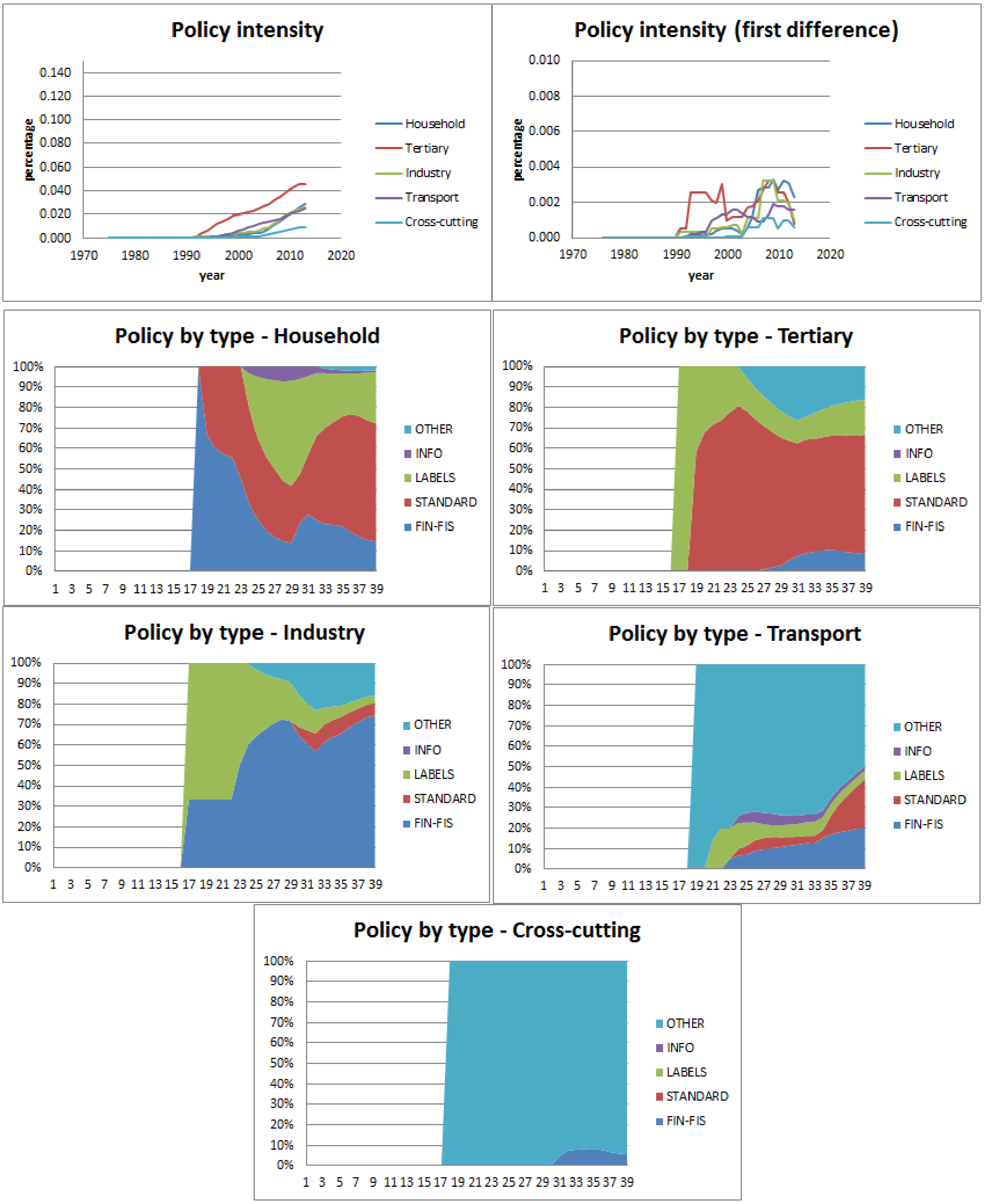
Greece - Policy intensity indicators



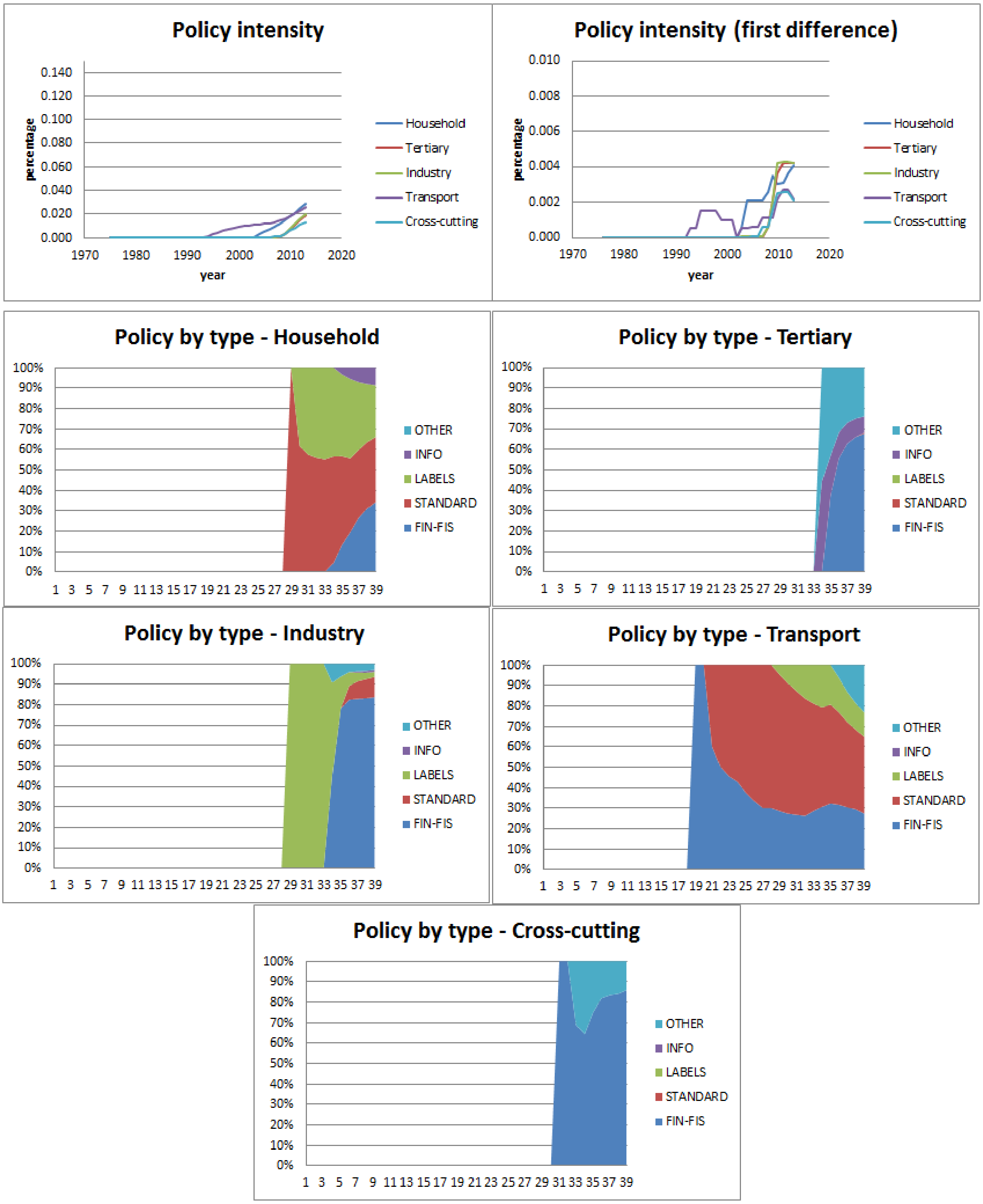
Hungary - Policy intensity indicators



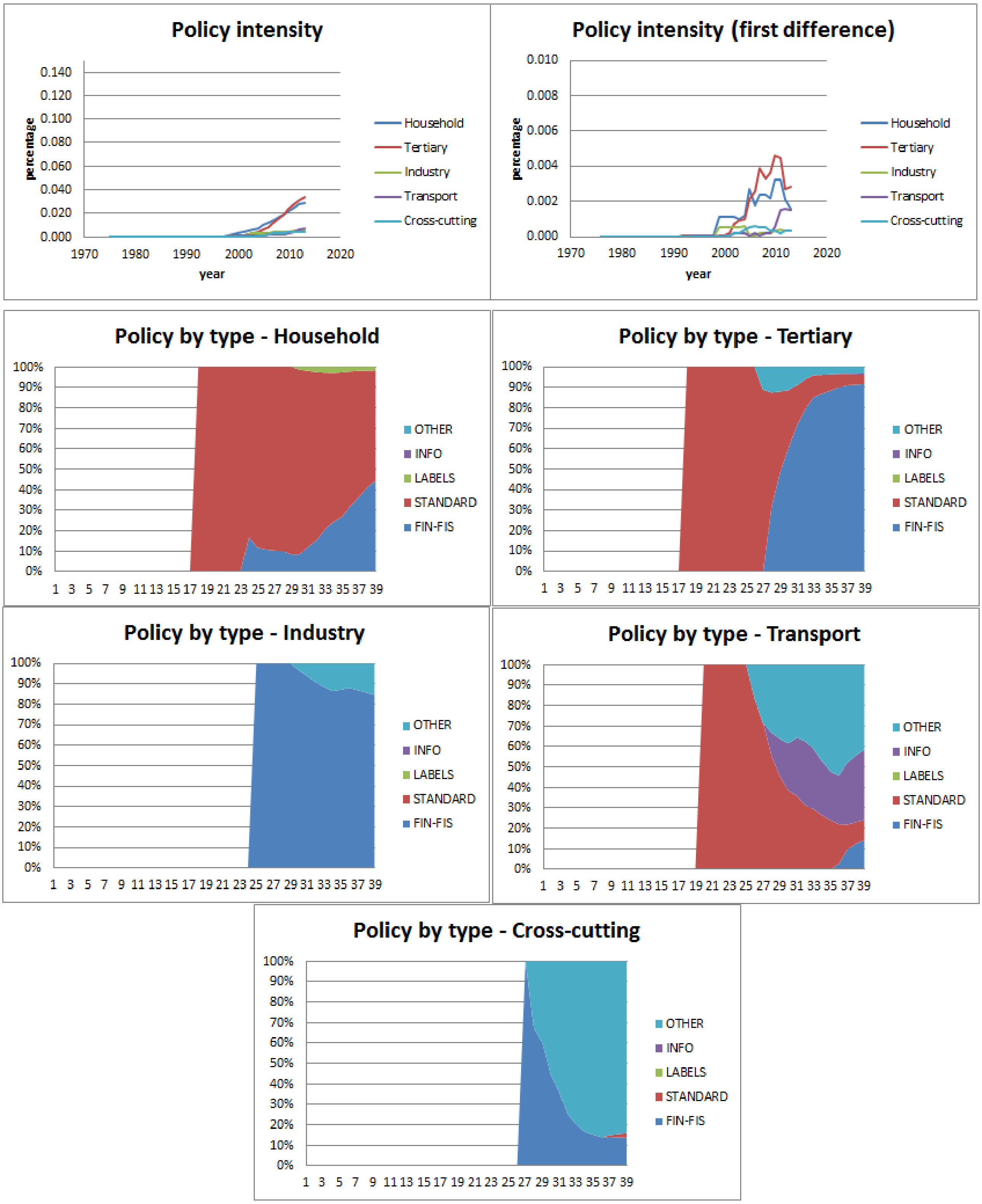
Ireland - Policy intensity indicators



Italy - Policy intensity indicators

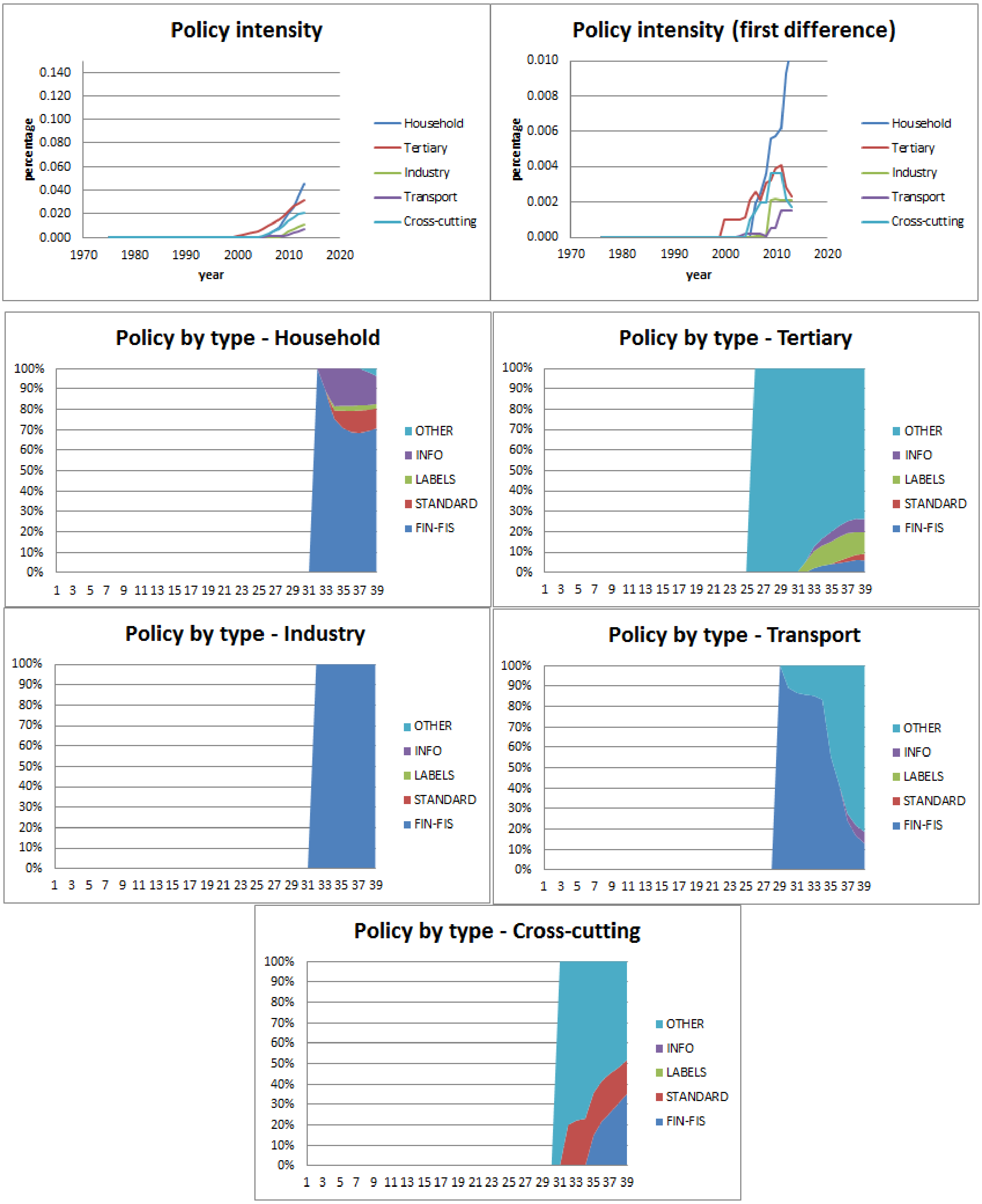


Latvia - Policy intensity indicators

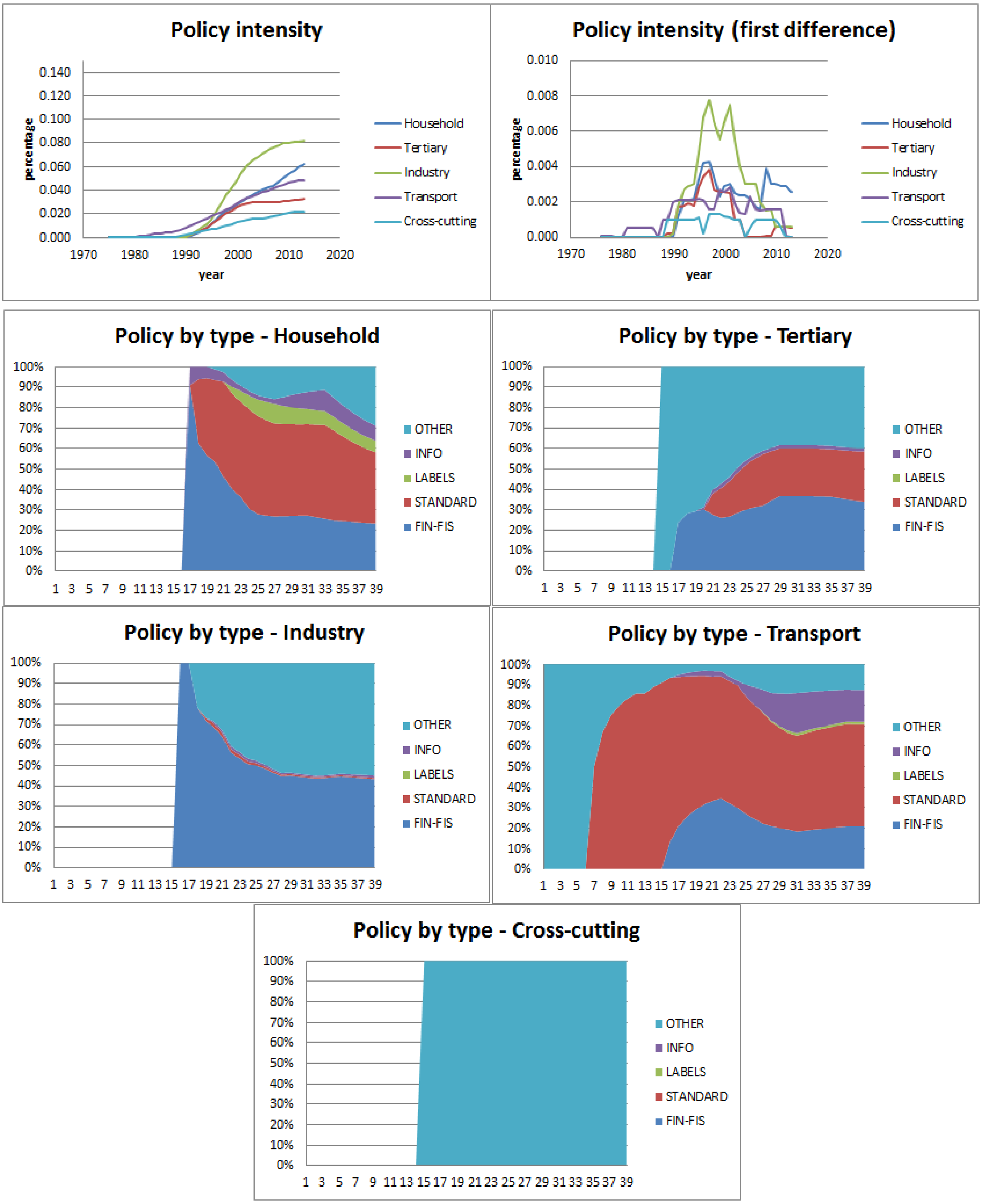


Lithuania - Policy intensity indicators

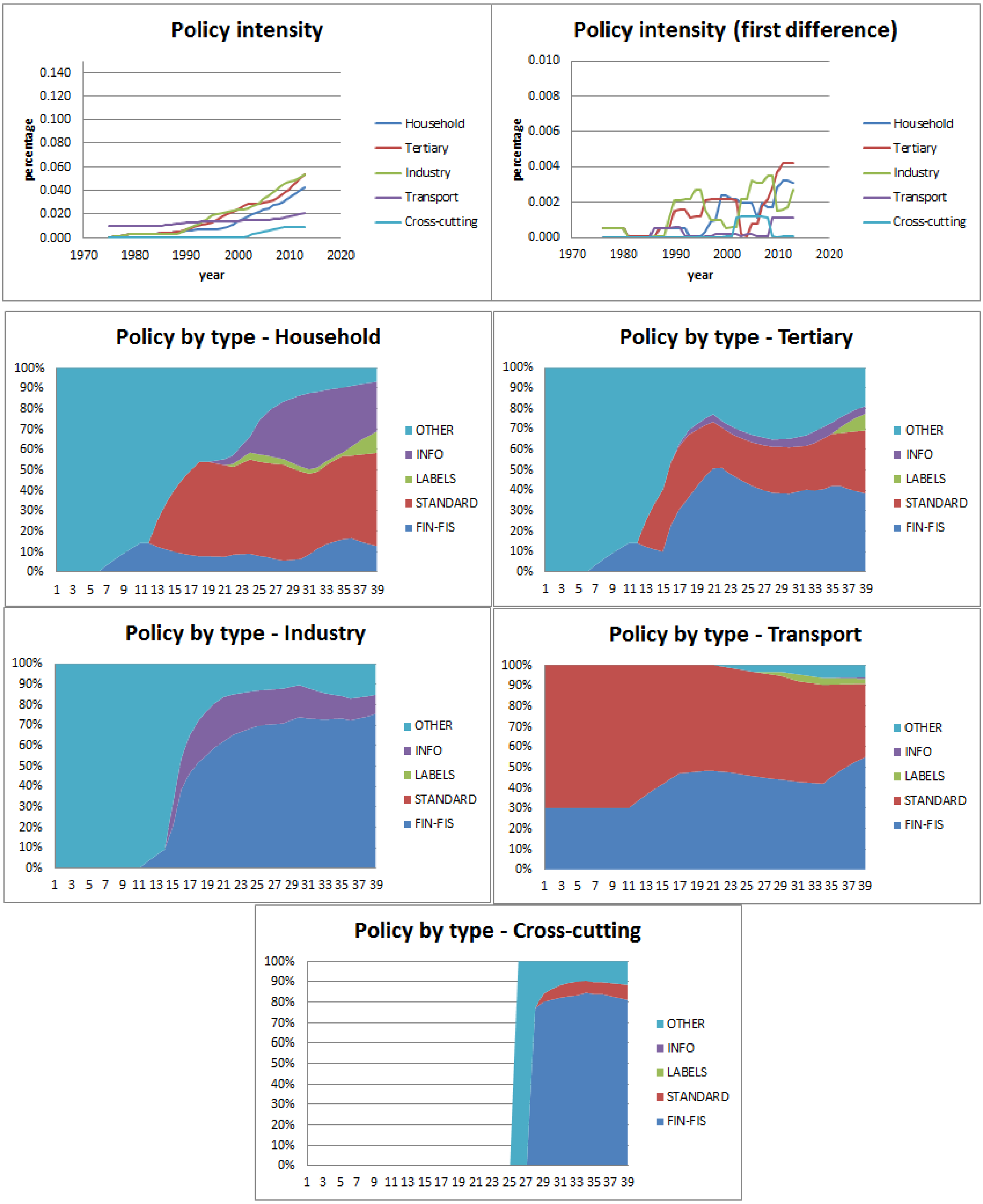
Luxembourg - Policy intensity indicators



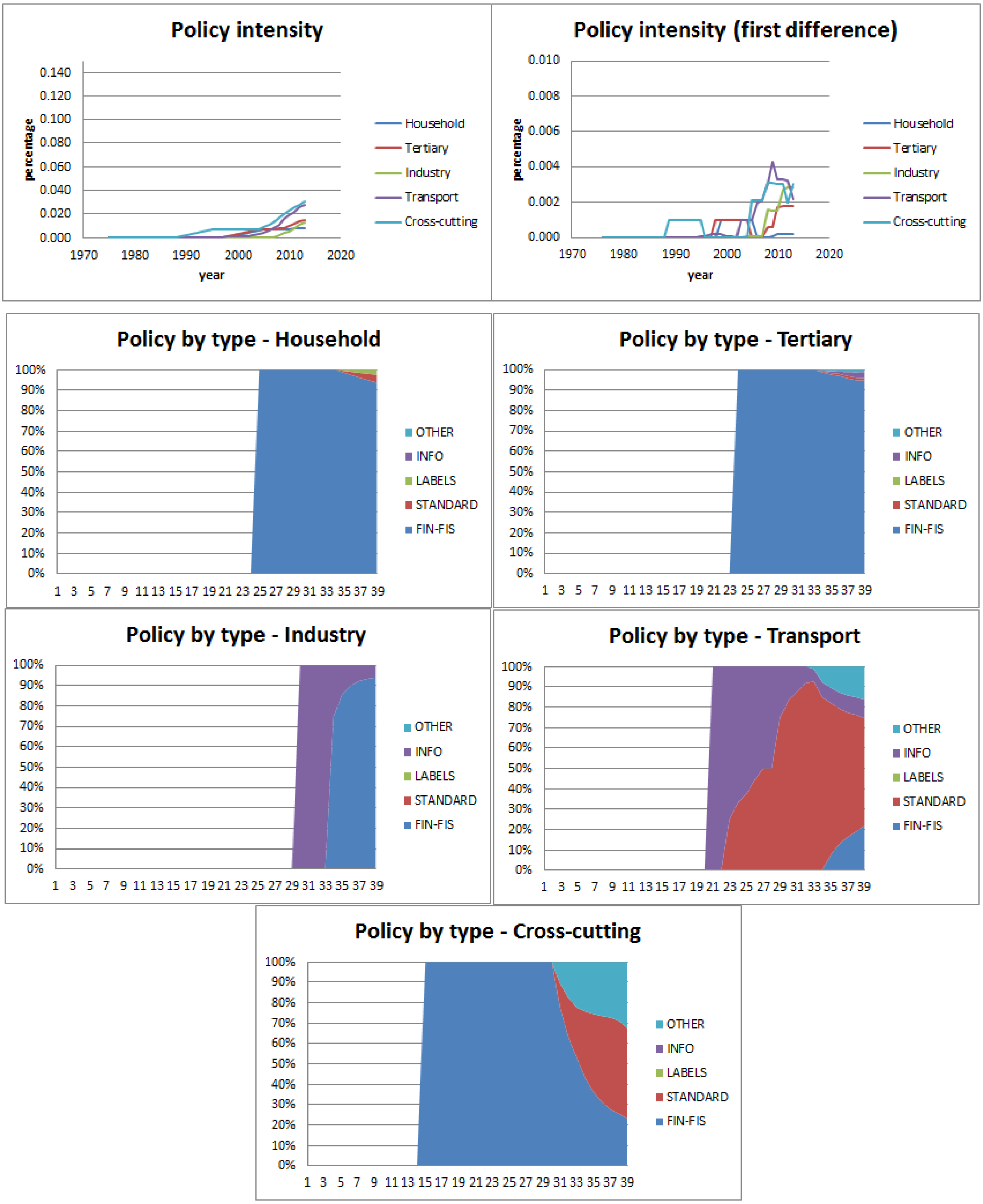
Malta - Policy intensity indicators



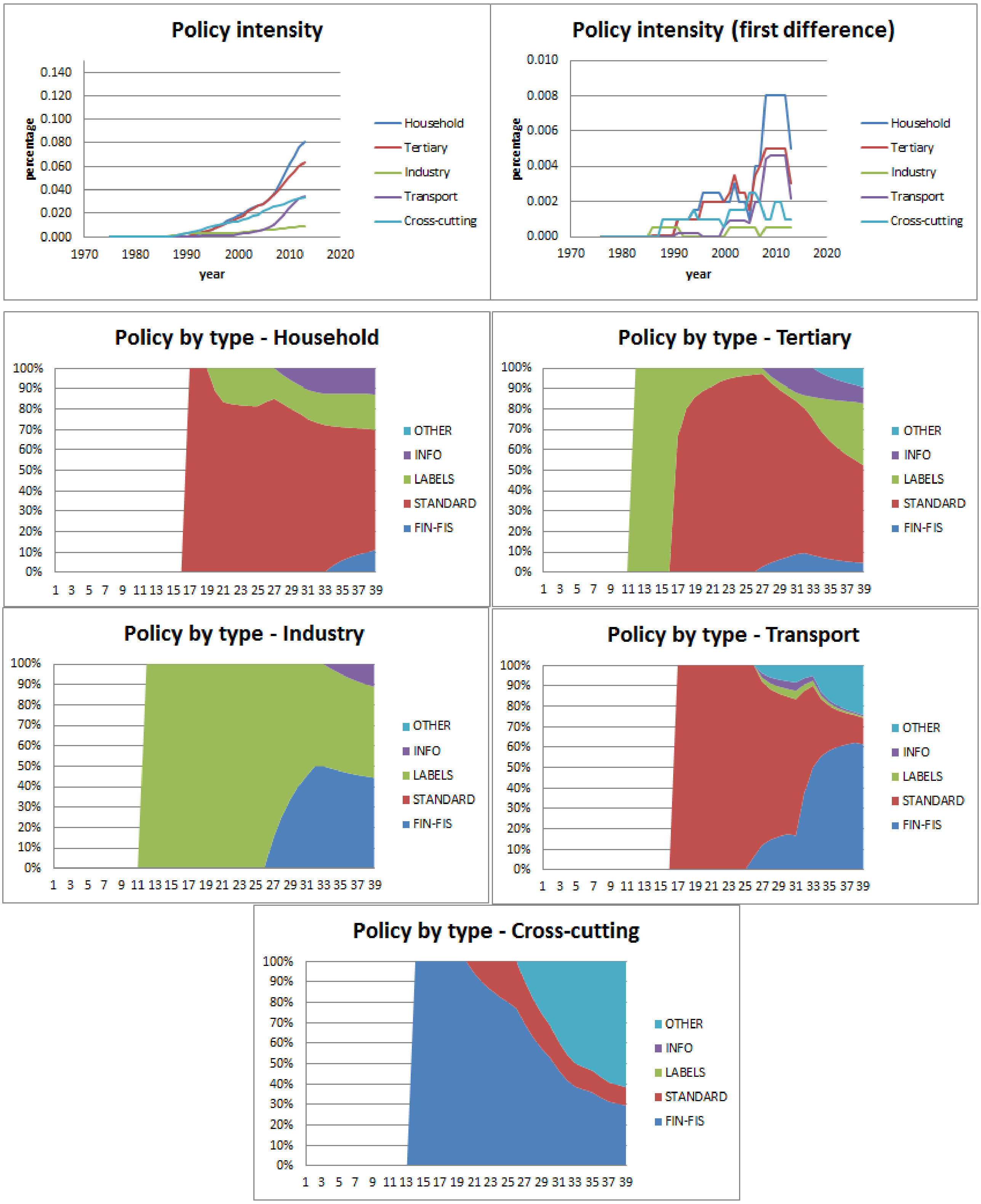
Netherlands - Policy intensity indicators



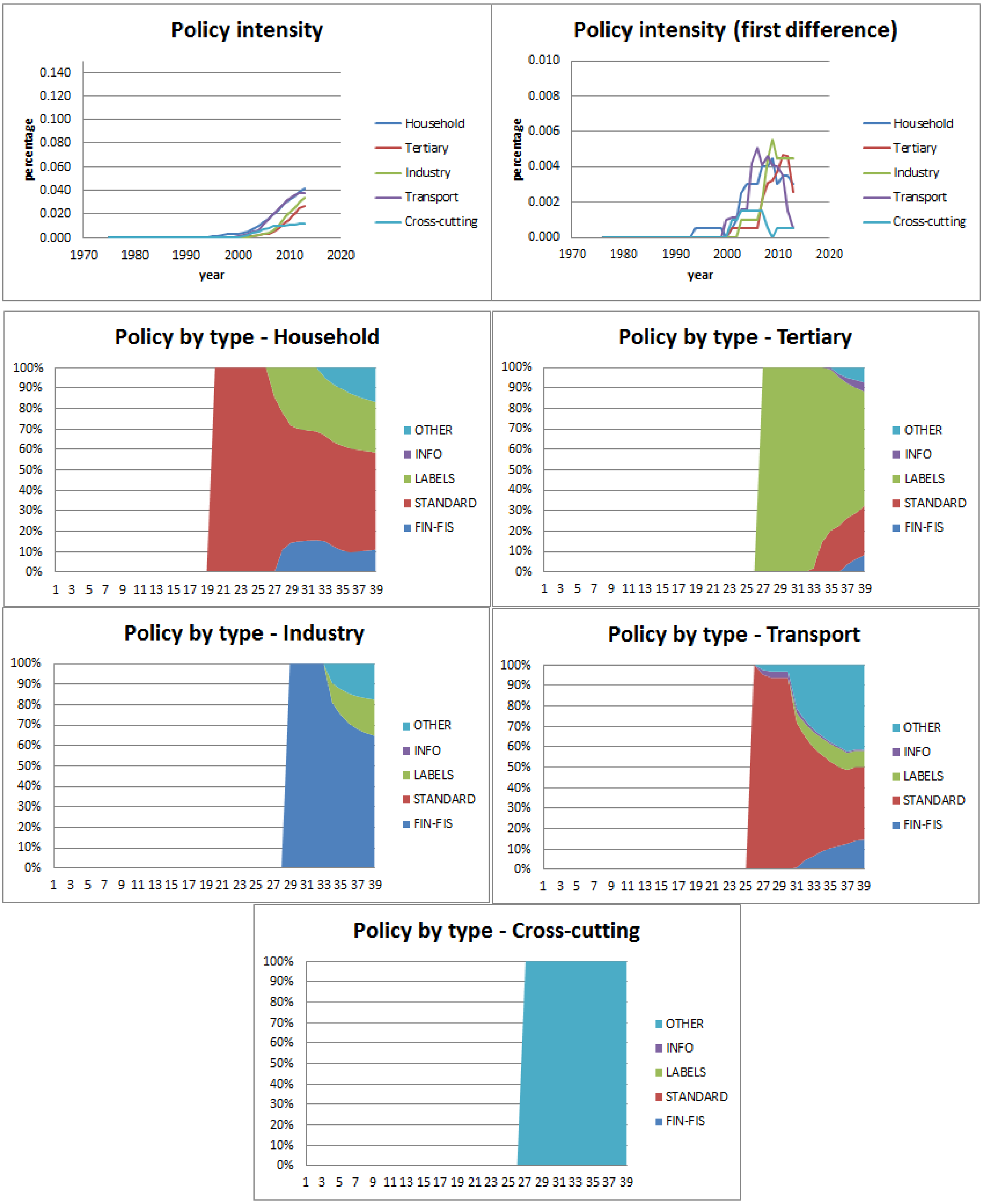
Norway - Policy intensity indicators



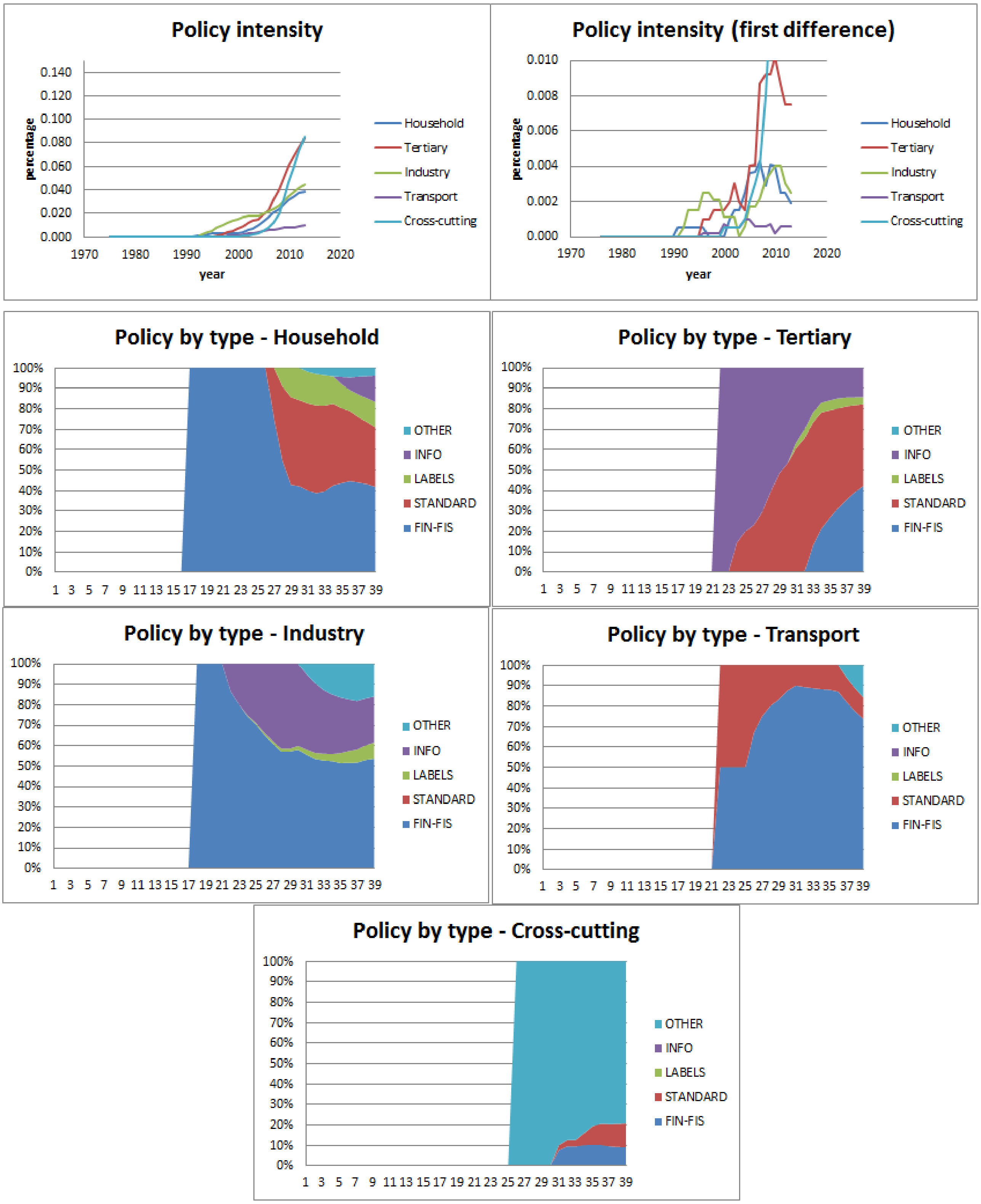
Poland - Policy intensity indicators



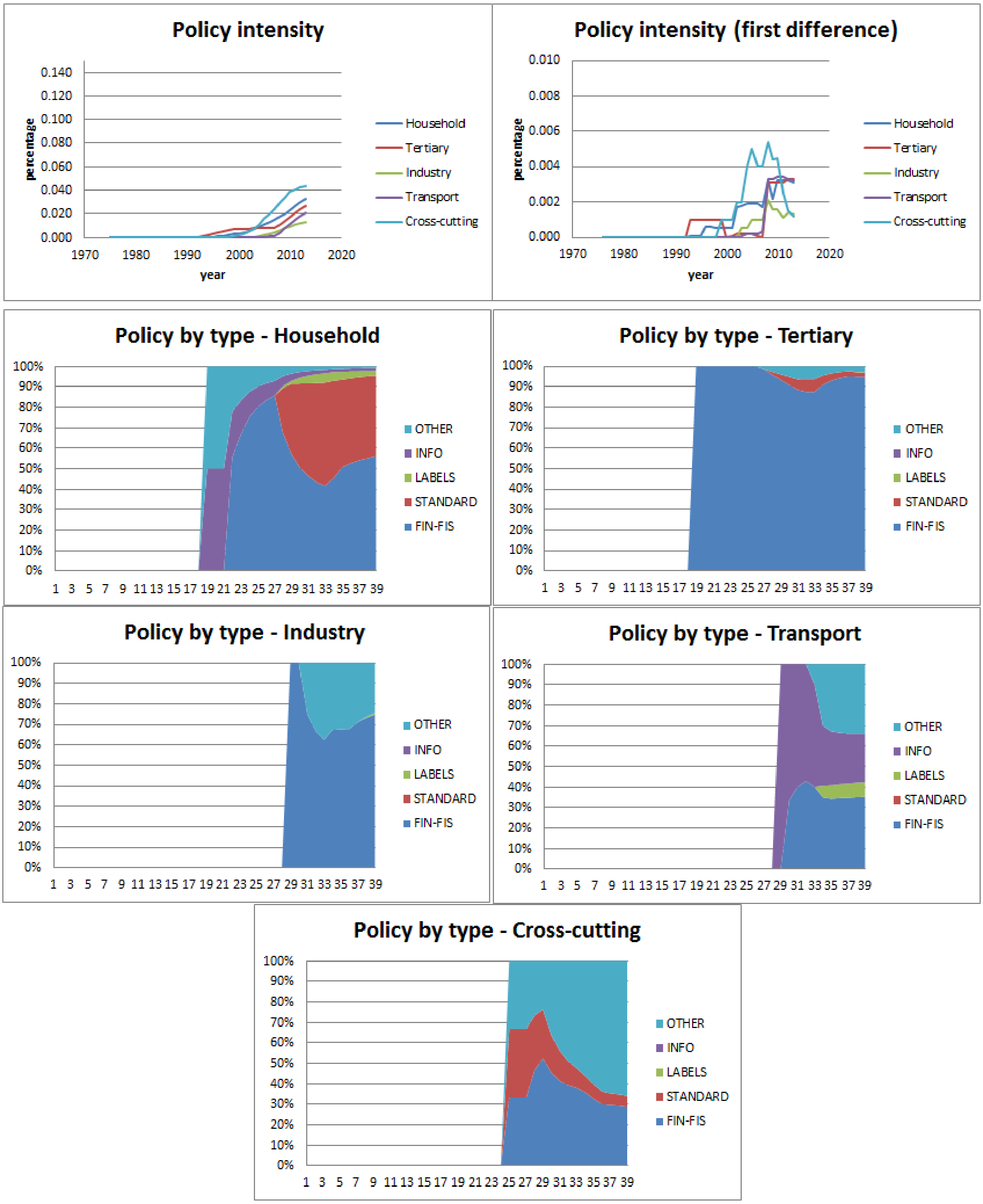
Portugal - Policy intensity indicators



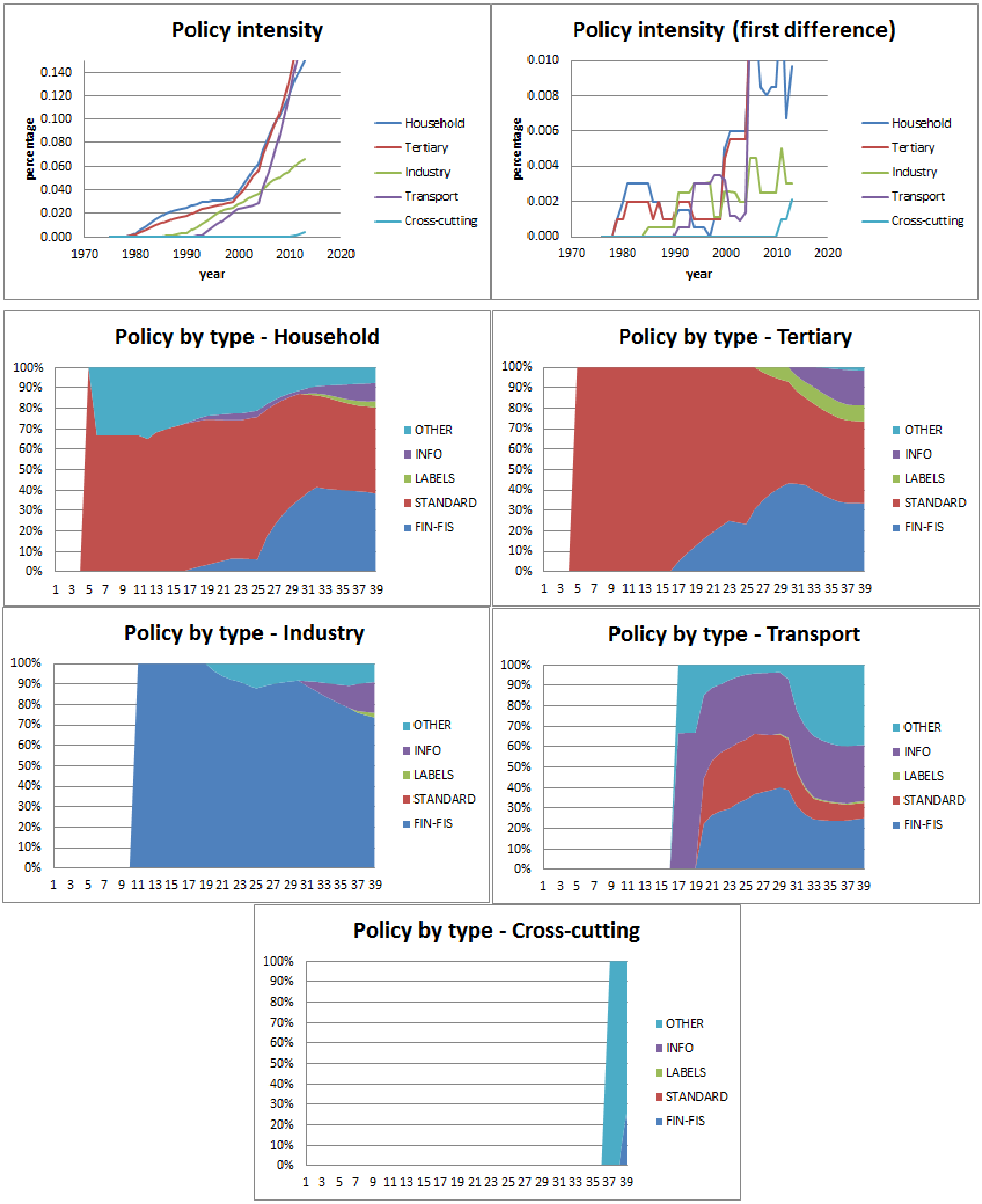
Romania - Policy intensity indicators



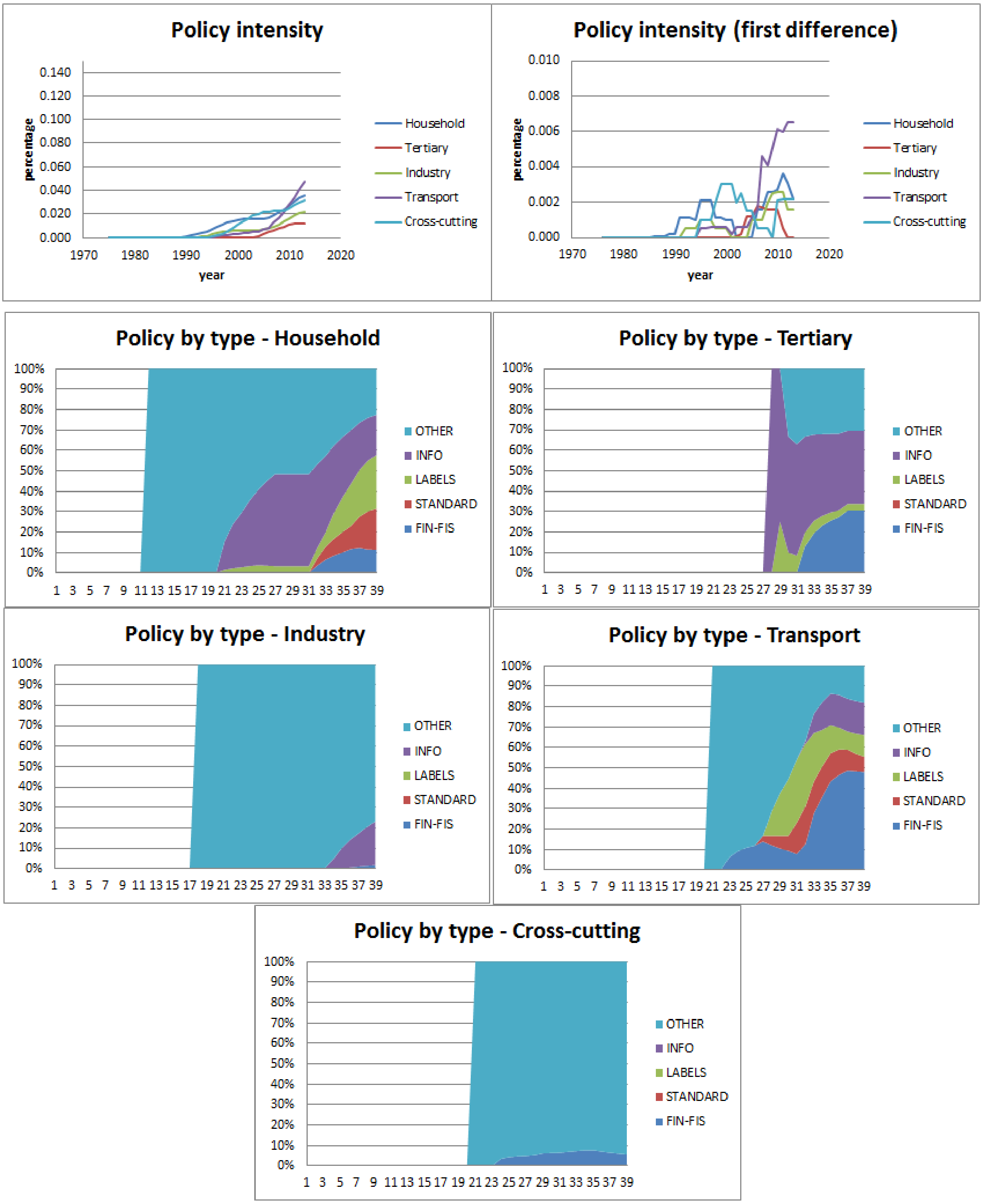
Slovakia - Policy intensity indicators



Slovenia - Policy intensity indicators



Spain - Policy intensity indicators



Sweden - Policy intensity indicators

United Kingdom - Policy intensity indicators

7.2 APPENDIX 2: Descriptive statistics for all variables in the dataset

7.2.1 Quantities

```
Variable         |      Mean   Std. Dev.       Min        Max |    Observations
-----------------+--------------------------------------------+----------------
qe_s1e1  overall |  96344.93    134908.6        943     599774 |     N =     696
         between |              135796.5   1826.708     482990 |     n =      29
         within  |              19232.68  -29838.07   221066.9 |     T =      24
                 |                                            |
qe_s1e2  overall |  151714.6    286317.9          0    1284371 |     N =     696
         between |              288285.3          0    1145149 |     n =      29
         within  |              40247.34  -151645.5   390923.6 |     T =      24
                 |                                            |
qe_s1e3  overall |   79688.8    163239.7        175    1031133 |     N =     696
         between |              161614.3   816.7083   788769.9 |     n =      29
         within  |              37314.56  -238291.1   322051.9 |     T =      24
                 |                                            |
qe_s1e4  overall |  21824.06    59124.01          0     406055 |     N =     696
         between |              55265.88          0   288036.6 |     n =      29
         within  |              23289.68  -87346.52   336444.5 |     T =      24
                 |                                            |
qe_s2e1  overall |  84701.01      121727         58     554670 |     N =     696
         between |                120370   1665.583   451493.7 |     n =      29
         within  |              28425.81  -50431.65   219742.6 |     T =      24
                 |                                            |
qe_s2e2  overall |  57566.11    98811.53          0     475789 |     N =     696
         between |              96223.47          0   318536.7 |     n =      29
         within  |              28481.11  -201709.3   214818.4 |     T =      24
                 |                                            |
qe_s2e3  overall |  34214.64    78734.25          0     520109 |     N =     696
         between |              78134.67     16.125   395918.3 |     n =      29
         within  |              17207.31  -87965.65   158405.4 |     T =      24
                 |                                            |
qe_s2e4  overall |  4339.125    15326.19          0     233301 |     N =     696
         between |              10374.53          0   44302.63 |     n =      29
         within  |              11437.79  -26220.38   205183.6 |     T =      24
                 |                                            |
qe_s3e1  overall |  133755.9    178985.1          0     861505 |     N =     696
         between |              181081.1   1632.042   783273.1 |     n =      29
         within  |              18178.32   65841.82   229531.6 |     T =      24
                 |                                            |
qe_s3e2  overall |  148183.6    218335.8          0     939823 |     N =     696
         between |              216779.5          0   893211.3 |     n =      29
         within  |              47247.71  -55950.61   676176.3 |     T =      24
                 |                                            |
qe_s3e3  overall |  70743.47    86976.23          0     378729 |     N =     696
         between |              83768.74   108.9583   260380.4 |     n =      29
         within  |              27926.45  -58269.24   189092.1 |     T =      24
                 |                                            |
qe_s3e4  overall |  70267.33    103047.2          0     880700 |     N =     696
         between |              98120.98          0   419043.5 |     n =      29
         within  |              36188.68  -78739.17   531923.8 |     T =      24
                 |                                            |
qe_s4e1  overall |  8397.632    12868.86          0      60692 |     N =     696
         between |              12864.81          0   50937.54 |     n =      29
         within  |              2362.456  -2446.909   18153.67 |     T =      24
                 |                                            |
qe_s4e2  overall |  2302.259    5893.078          0      43161 |     N =     696
         between |              4365.419          0   17666.29 |     n =      29
         within  |              4037.592  -10640.32   28077.68 |     T =      24
                 |                                            |
qe_s4e3  overall |  480881.7    693327.5       7881    2777039 |     N =     696
         between |              701163.2   10861.75    2527749 |     n =      29
         within  |              73095.54   73865.62   882219.6 |     T =      24
                 |                                            |
qe_s4e4  overall |  49.95402    397.9251          0       7361 |     N =     696
         between |              161.9071          0    853.375 |     n =      29
         within  |              364.6889   -803.421   6557.579 |     T =      24
                 |                                            |
```

```
Variable          |      Mean   Std. Dev.       Min        Max |    Observations
------------------+--------------------------------------------+----------------
qe_s1e0   overall |  429528.4   623499.6       2321    3028113 |     N =     696
          between |             631412.8   3087.208    2675239 |     n =      29
          within  |             57126.78   33327.69   782402.7 |     T =      24
                  |                                            |
qe_s1e0_4 overall |  349572.4   553938.1       2321    2628359 |     N =     696
          between |             560610.4       3060    2261584 |     n =      29
          within  |             54444.55   -39581.1   716347.9 |     T =      24
                  |                                            |
qe_s1e0_3 overall |  327748.4   537723.1       2321    2525951 |     N =     696
          between |             543792.8       3060    2181876 |     n =      29
          within  |             56758.93  -17373.62   671823.4 |     T =      24
                  |                                            |
qe_s2e0   overall |  194632.1   290445.5         58    1505569 |     N =     696
          between |             291321.1   1683.875    1260468 |     n =      29
          within  |             47949.92  -91289.51     439733 |     T =      24
                  |                                            |
qe_s2e0_4 overall |  180820.9   280905.6         58    1378990 |     N =     696
          between |               282639   1681.708    1198405 |     n =      29
          within  |             40826.99    -103266   361405.7 |     T =      24
                  |                                            |
qe_s2e0_3 overall |  176481.8     277207         58    1375144 |     N =     696
          between |             278445.3   1681.708    1165949 |     n =      29
          within  |             43332.88  -106963.8   385677.1 |     T =      24
                  |                                            |
qe_s3e0   overall |  469464.8   581883.6          0    3021494 |     N =     696
          between |             585420.3   1741.083    2515697 |     n =      29
          within  |              84930.7   105699.6    1055835 |     T =      24
                  |                                            |
qe_s3e0_4 overall |  422950.3   553599.9          0    2887438 |     N =     696
          between |             556424.7       1741    2355908 |     n =      29
          within  |             84323.05  -9310.914    1061190 |     T =      24
                  |                                            |
qe_s3e0_3 overall |    352683   467860.4          0    2015185 |     N =     696
          between |             470561.9       1741    1936865 |     n =      29
          within  |             69229.36  -29892.04     940539 |     T =      24
                  |                                            |
qe_s4e0   overall |    497723   717211.6       7881    2839459 |     N =     696
          between |             725402.7   10875.92    2642612 |     n =      29
          within  |             74817.24   71981.46   895828.5 |     T =      24
                  |                                            |
qe_s4e0_4 overall |  491631.6   707188.1       7881    2834096 |     N =     696
          between |             715291.3   10861.75    2591843 |     n =      29
          within  |             73521.25   81910.55   889864.5 |     T =      24
                  |                                            |
qe_s4e0_3 overall |  491581.6   707164.3       7881    2834045 |     N =     696
          between |             715260.8   10861.75    2591629 |     n =      29
          within  |             73579.47   81860.59   889814.6 |     T =      24
                  |                                            |
qe_s0e0   overall |   1649640    2228948      14014    9674875 |     N =     696
          between |              2260510   18011.29    9224883 |     n =      29
          within  |             165560.2   739903.2    2455673 |     T =      24
                  |                                            |
qe_s0e0_4 overall |   1444975    2061506      11739    8882772 |     N =     696
          between |              2090254   17344.46    8407740 |     n =      29
          within  |             158851.8   588002.3    2227860 |     T =      24
                  |                                            |
qe_s0e0_3 overall |   1348495    1960128      11739    8323214 |     N =     696
          between |              1986331   17344.46    7876318 |     n =      29
          within  |             164814.8     432025    2144238 |     T =      24
                  |                                            |
```

7.2.2 Prices

```
Variable         |      Mean   Std. Dev.       Min        Max |    Observations
-----------------+--------------------------------------------+----------------
pe_s1e1  overall |  32.30138   14.40277        1.5       82.8 |     N =     652
         between |             10.64632      17.05    59.8375 |     n =      29
         within  |              9.92616   6.654713   66.75471 | T-bar = 22.4828
                 |                                            |
pe_s1e2  overall |   12.2029   6.704462         .2       37.7 |     N =     551
         between |             4.556602   4.008333   21.23333 |     n =      26
         within  |             4.930192    2.16957    31.5382 | T-bar = 21.1923
                 |                                            |
pe_s1e3  overall |  18.11316   9.691495         .8       56.9 |     N =     585
         between |             4.912189   12.02083       29.4 |     n =      29
         within  |              8.43133   -.757671   52.14233 | T-bar = 20.1724
                 |                                            |
pe_s1e4  overall |  9.845226   6.321035         .2       30.5 |     N =     398
         between |             5.475536   1.333333    18.8375 |     n =      17
         within  |              3.38963   2.249393   24.44939 | T-bar = 23.4118
                 |                                            |
pe_s2e1  overall |  26.09828   10.66703        2.1       68.2 |     N =     641
         between |             7.029936   16.19474   40.32083 |     n =      29
         within  |              8.18432   5.298284   54.59828 | T-bar = 22.1034
                 |                                            |
pe_s2e2  overall |  9.644383   4.752925        1.1       27.3 |     N =     543
         between |             2.708611     5.4875   15.33333 |     n =      26
         within  |             3.931363    2.11105   22.46791 | T-bar = 20.8846
                 |                                            |
pe_s2e3  overall |  14.28287    7.87039        1.4       52.6 |     N =     572
         between |             3.748568   9.554167   22.59167 |     n =      29
         within  |             6.982137  -1.625466   46.47453 | T-bar = 19.7241
                 |                                            |
pe_s2e4  overall |  6.171654   3.782207         .1       17.4 |     N =     381
         between |             3.195775     1.1375    11.3375 |     n =      16
         within  |             2.184474   1.884154   14.48415 | T-bar = 23.8125
                 |                                            |
pe_s3e1  overall |  19.63354   8.766329        2.8       67.3 |     N =     650
         between |             5.220876   9.291667    35.8125 |     n =      29
         within  |             7.029097   .6210378   51.12104 | T-bar = 22.4138
                 |                                            |
pe_s3e2  overall |  6.911786   3.434319        1.5       17.4 |     N =     543
         between |             1.596351   4.670833     10.725 |     n =      26
         within  |             3.055889    1.54512   15.11595 | T-bar = 20.8846
                 |                                            |
pe_s3e3  overall |  10.20648   6.272007        1.9       48.4 |     N =     586
         between |             2.788444   7.066667   17.94583 |     n =      29
         within  |             5.658578  -2.739349   40.66065 | T-bar = 20.2069
                 |                                            |
pe_s3e4  overall |  2.875381   1.779537         .1        9.8 |     N =     459
         between |             1.261313   .9583333     6.1375 |     n =      20
         within  |              1.26711  -1.162119   8.112882 | T-bar =   22.95
                 |                                            |
pe_s4e1  overall |         .          .          .          . |     N =       0
         between |                    .          .          . |     n =       0
         within  |                    .          .          . |     T =       .
                 |                                            |
pe_s4e2  overall |         .          .          .          . |     N =       0
         between |                    .          .          . |     n =       0
         within  |                    .          .          . |     T =       .
                 |                                            |
pe_s4e3  overall |  29.43678   11.76789   5.163896   181.9395 |     N =     655
         between |             4.641815   19.68572   37.68541 |     n =      29
         within  |             10.84934   2.637799   173.6909 | T-bar = 22.5862
                 |                                            |
pe_s4e4  overall |         .          .          .          . |     N =       0
         between |                    .          .          . |     n =       0
         within  |                    .          .          . |     T =       .
                 |                                            |
```

```
Variable          |      Mean   Std. Dev.       Min        Max |    Observations
------------------+--------------------------------------------+----------------
pe_s1e0_4 overall |   20.8297    10.44432       .57      58.08 |     N =     560
          between |              7.741494    9.0905     39.166 |     n =      28
          within  |              7.393878  3.193697   43.48928 | T-bar =      20
                  |                                            |
pe_s1e0_3 overall |  21.24019    10.08884       .62      58.08 |     N =     584
          between |              7.147295  9.482632     39.166 |     n =      29
          within  |              7.437262  3.604189   43.89977 | T-bar = 20.1379
                  |                                            |
pe_s2e0_4 overall |  19.94086    9.004129       .76      61.19 |     N =     584
          between |               5.97777  11.78125   37.08133 |     n =      28
          within  |              6.911898  1.809524   44.04952 | T-bar = 20.8571
                  |                                            |
pe_s2e0_3 overall |  20.14892    8.862602      1.67      61.19 |     N =     595
          between |              5.734162  11.81125   37.08133 |     n =      29
          within  |              6.902678  2.017592   44.25759 | T-bar = 20.5172
                  |                                            |
pe_s3e0_4 overall |  11.76172    6.620967      1.82      47.07 |     N =     535
          between |              4.092922  6.484583   26.97913 |     n =      28
          within  |              5.178332  .8842197   32.64422 | T-bar = 19.1071
                  |                                            |
pe_s3e0_3 overall |  12.81846    6.420802      2.59      47.07 |     N =     598
          between |               3.49379  9.358333   26.97913 |     n =      29
          within  |              5.367983  1.631795   32.90933 | T-bar = 20.6207
                  |                                            |
pe_s4e0_4 overall |   29.3188    11.83333      5.16     181.94 |     N =     643
          between |              4.730472  19.68583   37.98333 |     n =      29
          within  |              10.88348  2.225469   173.2755 | T-bar = 22.1724
                  |                                            |
pe_s4e0_3 overall |   29.3188    11.83333      5.16     181.94 |     N =     643
          between |              4.730472  19.68583   37.98333 |     n =      29
          within  |              10.88348  2.225469   173.2755 | T-bar = 22.1724
                  |                                            |
pe_s0e0_4 overall |  21.31259    8.708658      2.61       45.8 |     N =     495
          between |              6.092172  9.576923     34.521 |     n =      27
          within  |              7.080669  7.041157   42.39384 | T-bar = 18.3333
                  |                                            |
pe_s0e0_3 overall |  22.14717    8.348072      3.81      46.05 |     N =     559
          between |              4.894663  11.62769     34.521 |     n =      29
          within  |              7.186479  9.440091   43.05009 | T-bar = 19.2759
                  |                                            |
```

7.2.3 Policy

```
Variable         |      Mean   Std. Dev.       Min        Max |    Observations
-----------------+--------------------------------------------+----------------
po_s1e0  overall |  7.237069    7.688905         0         47 |     N =     696
         between |              4.775764         1   22.66667 |     n =      29
         within  |              6.088196 -7.429598    31.5704 |     T =      24
                 |                                            |
po_s2e0  overall |  5.808908    6.792673         0         41 |     N =     696
         between |              3.959673  1.208333   13.95833 |     n =      29
         within  |              5.565993 -5.107759   32.89224 |     T =      24
                 |                                            |
po_s3e0  overall |  4.045977    4.699078         0         19 |     N =     696
         between |              3.418523  .7916667   13.95833 |     n =      29
         within  |              3.283561 -7.912356   16.33764 |     T =      24
                 |                                            |
po_s4e0  overall |  6.102011    6.736325         0         48 |     N =     696
         between |              3.735564  1.333333   16.08333 |     n =      29
         within  |              5.646719 -9.981322   38.01868 |     T =      24
                 |                                            |
po_s0e0  overall |  5.828054    6.107933         0   35.10716 |     N =     696
         between |              3.629654  1.785149    14.7068 |     n =      29
         within  |              4.956657 -6.247658   27.64914 |     T =      24

                 |                                            |
```

7.2.4 Other variables

```
Variable         |      Mean   Std. Dev.       Min        Max |    Observations
-----------------+--------------------------------------------+----------------
hdd      overall |  2974.243    1221.512      306.6     5994.3 |     N =     696
         between |              1227.443   485.4708   5576.579 |     n =      29
         within  |              187.9751   2597.513   3727.934 |     T =      24
                 |                                             |
rgdp     overall |  20125.81    13843.83   1239.023      70400 |     N =     642
         between |              13460.41   2678.797    55580.3 |     n =      29
         within  |              3446.849   1714.412   34945.51 | T-bar = 22.1379
                 |                                             |
ngdp     overall |  19335.19    14534.32        400      83400 |     N =     642
         between |              12790.18       2575   54004.17 |     n =      29
         within  |               6965.51  -11768.98   52397.69 | T-bar = 22.1379
                 |                                             |
defl     overall |  .9346651    .2258277       .125      1.634 |     N =     642
         between |              .0418058   .8096956   1.005833 |     n =      29
         within  |              .2219864   .1322484   1.641248 | T-bar = 22.1379
                 |                                             |
pop      overall |  17.02324     21.6782       .354     82.534 |     N =     696
         between |              22.01647   .3900417   81.00358 |     n =      29
         within  |              1.122755  -.7783392   21.57537 |     T =      24
                 |                                             |
ed_s0e0  overall |  .3466092    1.362517      -8.24       2.51 |     N =     696
         between |               1.36617  -6.534583   1.665833 |     n =      29
         within  |              .2275934  -1.358807   2.421192 |     T =      24
                 |                                             |
ed_s0e2  overall |  .1784339    2.615854     -20.23        1.3 |     N =     696
         between |              2.507117  -12.61333   1.009583 |     n =      29
         within  |              .8746808  -7.438232   6.921767 |     T =      24
                 |                                             |
ed_s0e3  overall |   .454569    2.605848     -19.21       2.52 |     N =     696
         between |              2.525696  -12.51042   1.668333 |     n =      29
         within  |              .7889298  -6.245013   6.834986 |     T =      24
                 |                                             |
ed_s0e4  overall |   .561092    .4587988      -2.02       1.32 |     N =     696
         between |              .4152485    -.20375   1.015417 |     n =      29
         within  |              .2092162  -1.317241   1.552759 |     T =      24
                 |                                             |
ghge     overall |  179528.3    246246.5       1992    1248049 |     N =     696
         between |              249251.5   2718.625    1057281 |     n =      29
         within  |              23812.36   50795.38   370296.4 |     T =      24
                 |                                             |
dwell_s1 overall |  7460.527    9846.588      155.2      41550 |     N =     696
         between |              9971.117   167.3825   38233.39 |     n =      29
         within  |              906.8478   2563.554   11975.92 |     T =      24
                 |                                             |
floor_s1 overall |  85.62892    21.39124      33.55        146 |     N =     696
         between |              20.87398   36.37625     134.98 |     n =      29
         within  |              6.023443   63.72851   125.0456 |     T =      24
                 |                                             |
area_s1  overall |  635.0116    873.1024      14.67    3614.85 |     N =     696
         between |              882.0089   17.80917   3246.518 |     n =      29
         within  |              100.5627   161.3033    1071.93 |     T =      24
                 |                                             |
perc_f~1 overall |  49.47974    24.34864       1.93     102.13 |     N =     696
         between |              23.86845   4.968333   97.82833 |     n =      29
         within  |              6.481253   30.00599   77.79974 |     T =      24
                 |                                             |
perc_w~1 overall |  83.10853    13.66711      32.04     101.57 |     N =     696
         between |              11.57215    56.4075   97.90417 |     n =      29
         within  |              7.570139   55.13145   114.3577 |     T =      24
                 |                                             |
perc_d~1 overall |  28.51991    22.98835          0      88.05 |     N =     696
         between |              20.40572   .3191667   64.65625 |     n =      29
         within  |              11.21832  -.7550863   66.71491 |     T =      24
                 |                                             |
perc_e~1 overall |  53.70251    16.45822      17.58       91.7 |     N =     696
         between |              15.21437   27.94292   82.65208 |     n =      29
         within  |              6.859755    33.3121   77.65543 |     T =      24
                 |                                             |
rcons_s1 overall |  206760.6    338983.1    1610.84    1403250 |     N =     696
         between |              340848.8   2722.704    1263778 |     n =      29
         within  |              50758.38  -108832.2   438355.9 |     T =      24
                 |                                             |
rva_s2   overall |  227670.8    371820.1    1014.81    1587843 |     N =     696
```

```
         between |              371977.6   2180.775    1334318 |     n =      29
         within  |              66797.51  -122433.3   538123.2 |     T =      24
                 |                                             |
empl_s2  overall |  4824.063    7043.071       51.2      30642 |     N =     696
         between |              7104.441   93.51875   27160.05 |     n =      29
         within  |              895.6034   927.2235   8306.013 |     T =      24
                 |                                             |
rva_s3   overall |  86726.26    136777.9     1310.2   658167.1 |     N =     696
         between |              138371.9   1589.296   583004.8 |     n =      29
         within  |              13965.95   32187.59   161888.6 |     T =      24
                 |                                             |
rginv_s3 overall |  70811.73    107704.7     322.98   458343.9 |     N =     696
         between |              107706.7   810.1062   412521.3 |     n =      29
         within  |              19582.27  -28041.64   175711.3 |     T =      24
                 |                                             |
cars_s4  overall |  6.924971    10.47796        .15      42.93 |     N =     696
         between |              10.53462   .1941667   38.90042 |     n =      29
         within  |              1.575519  -5.715445    14.2258 |     T =      24
                 |                                             |
goods_s4 overall |  79.66981    115.1939        .92        647 |     N =     696
         between |              113.9328   1.164583   507.0096 |     n =      29
         within  |              26.80552  -124.0998   219.6602 |     T =      24
                 |                                             |
othe~0e0 overall |  .2334666    .1393518          0   .6506361 |     N =     696
         between |              .1352108   .0391265   .5067368 |     n =      29
         within  |               .041737   .1361917    .396833 |     T =      24
                 |                                             |
othe~1e0 overall |  .3300669    .2439217          0   .8733782 |     N =     696
         between |              .2417453   .0082297   .8183834 |     n =      29
         within  |              .0546903   .1854771   .6712666 |     T =      24
                 |                                             |
othe~2e0 overall |  .1549618    .1732727  -.0000513    .792227 |     N =     696
         between |              .1584254   .0009164   .5208599 |     n =      29
         within  |              .0758645   -.060101   .5734233 |     T =      24
                 |                                             |
othe~3e0 overall |  .2519938    .1330988          0   .6763006 |     N =     695
         between |              .1233306   .0000341   .5255227 |     n =      29
         within  |              .0554831   .1175381   .5034897 | T-bar = 23.9655
                 |                                             |
othe~4e0 overall |  .0084913     .014706  -.0000319   .0845945 |     N =     696
         between |              .0052561   .0011674   .0195823 |     n =      29
         within  |              .0137679  -.0108748    .074563 |     T =      24
```

7.3 APPENDIX 3: Estimates of the econometric models

```
  ___  ____  ____  ____  ____ (R)
 /__    /   ____/   /   ____/
___/   /   /___/   /   /___/   13.1   Copyright 1985-2013 StataCorp LP
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Arellano-Bond dynamic panel-data estimation  Number of obs         =       490
Group variable: country                      Number of groups      =        29
Time variable: year
                                             Obs per group:    min =         2
                                                               avg =  16.89655
                                                               max =        22

Number of instruments =    262               Wald chi2(9)          =   2223.30
                                             Prob > chi2           =    0.0000
One-step results
------------------------------------------------------------------------------
   l_qe_s0e0 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   l_qe_s0e0 |
         L1. |   .4709992   .0319832    14.73   0.000     .4083133     .533685
             |
     po_s0e0 |  -.0014956   .0010953    -1.37   0.172    -.0036422    .0006511
  l_rpe_s0e0 |  -.0287105   .0213717    -1.34   0.179    -.0705982    .0131773
  other_s0e0 |  -.4763166   .0968753    -4.92   0.000    -.6661887   -.2864446
       l_pop |   .3928043   .0679881     5.78   0.000       .25955    .5260586
      l_rgdp |   .2876344   .0307651     9.35   0.000     .2273359    .3479329
         hdd |   .0000583   9.66e-06     6.03   0.000     .0000393    .0000772
        time |    .003356    .001638     2.05   0.040     .0001456    .0065663
       time2 |  -.0002153   .0000546    -3.94   0.000    -.0003223   -.0001083
       _cons |   3.493327    .419087     8.34   0.000     2.671932    4.314723
------------------------------------------------------------------------------
Instruments for differenced equation
        GMM-type: L(2/.).l_qe_s0e0
        Standard: D.po_s0e0 D.l_rpe_s0e0 D.other_s0e0 D.l_pop D.l_rgdp D.hdd
                  D.time D.time2
Instruments for level equation
        Standard: _cons
```

Aggregate model (1) – Energy Consumption

```
Arellano-Bond dynamic panel-data estimation  Number of obs         =       515
Group variable: country                      Number of groups      =        29
Time variable: year
                                             Obs per group:    min =         9
                                                               avg =  17.75862
                                                               max =        22

Number of instruments =    265               Wald chi2(12)         =   1125.24
                                             Prob > chi2           =    0.0000
One-step results
------------------------------------------------------------------------------
     l_qe_s1e0 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
---------------+--------------------------------------------------------------
     l_qe_s1e0 |
           L1. |   .5191974   .0326003    15.93   0.000      .455302    .5830928
               |
       po_s1e0 |  -.0018146   .0013111    -1.38   0.166    -.0043844    .0007552
     l_rpe_s1e0 |  -.1093106   .0211299    -5.17   0.000    -.1507244   -.0678968
    other_s1e0 |  -.8545367   .1017359    -8.40   0.000    -1.053935   -.655138
         l_pop |  -.1703357   .1233664    -1.38   0.167    -.4121294     .071458
        l_rgdp |  -.1434192   .0744281    -1.93   0.054    -.2892956    .0024572
           hdd |   .0001357   .0000152     8.95   0.000     .0001059    .0001654
     l_area_s1 |   .0587232   .0578421     1.02   0.310    -.0546453    .1720916
pperc_equip_s1 |   .1998776    .123381     1.62   0.105    -.0419448    .4416999
    l_rcons_s1 |   .2629875   .0631694     4.16   0.000     .1391777    .3867973
          time |  -.0035416   .0028077    -1.26   0.207    -.0090445    .0019614
         time2 |   .0001725   .0000852     2.02   0.043     5.49e-06    .0003395
         _cons |   4.257953   .6215699     6.85   0.000     3.039699    5.476208
------------------------------------------------------------------------------
Instruments for differenced equation
        GMM-type: L(2/.).l_qe_s1e0
        Standard: D.po_s1e0 D.l_rpe_s1e0 D.other_s1e0 D.l_pop D.l_rgdp D.hdd
                  D.l_area_s1 D.pperc_equip_s1 D.l_rcons_s1 D.time D.time2
Instruments for level equation
        Standard: _cons
```

Sectoral model (3) – Household (unrestricted)

```
Arellano-Bond dynamic panel-data estimation  Number of obs         =       521
Group variable: country                      Number of groups      =        29
Time variable: year
                                             Obs per group:    min =         2
                                                               avg =  17.96552
                                                               max =        22

Number of instruments =    264               Wald chi2(11)         =   2001.89
                                             Prob > chi2           =    0.0000
One-step results
------------------------------------------------------------------------------
   l_qe_s2e0 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   l_qe_s2e0 |
         L1. |   .4699305   .0329085    14.28   0.000      .405431    .5344301
             |
     po_s2e0 |  -.0005311   .0020249    -0.26   0.793    -.0044999    .0034377
  l_rpe_s2e0 |  -.3991428   .0362704   -11.00   0.000    -.4702316   -.328054
  other_s2e0 |  -.4592064   .1136586    -4.04   0.000    -.6819732   -.2364396
       l_pop |   .5844977   .2539446     2.30   0.021     .0867755     1.08222
      l_rgdp |   .3684866    .123287     2.99   0.003     .1268486    .6101246
         hdd |    .000133   .0000275     4.85   0.000     .0000792    .0001869
    l_rva_s2 |    .124284   .1416827     0.88   0.380    -.153409     .401977
   l_empl_s2 |   .1596041   .1274023     1.25   0.210    -.0900998     .409308
        time |  -.0084899    .004743    -1.79   0.073    -.0177859    .0008061
       time2 |   .0005546   .0001441     3.85   0.000     .0002723     .000837
       _cons |  -.6626868   .9742943    -0.68   0.496    -2.572269    1.246895
------------------------------------------------------------------------------
Instruments for differenced equation
        GMM-type: L(2/.).l_qe_s2e0
        Standard: D.po_s2e0 D.l_rpe_s2e0 D.other_s2e0 D.l_pop D.l_rgdp D.hdd
                  D.l_rva_s2 D.l_empl_s2 D.time D.time2
Instruments for level equation
        Standard: _cons
```

Sectoral model (3) – Services (unrestricted)

```
Arellano-Bond dynamic panel-data estimation  Number of obs         =       522
Group variable: country                      Number of groups      =        29
Time variable: year
                                             Obs per group:    min =         2
                                                               avg =        18
                                                               max =        22

Number of instruments =    264               Wald chi2(11)         =    996.94
                                             Prob > chi2           =    0.0000
One-step results
------------------------------------------------------------------------------
   l_qe_s3e0 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   l_qe_s3e0 |
         L1. |   .5856988   .0382775    15.30   0.000     .5106763    .6607213
             |
     po_s3e0 |  -.0082658   .0030826    -2.68   0.007    -.0143076    -.002224
    l_rpe_s3e0 |  -.0797227   .0288199    -2.77   0.006    -.1362087   -.0232367
  other_s3e0 |  -.5546603   .1326482    -4.18   0.000    -.8146459   -.2946747
       l_pop |   .0865186     .14211     0.61   0.543    -.1920119    .3650491
      l_rgdp |   .1316808   .0934896     1.41   0.159    -.0515555    .3149171
         hdd |   .0000224   .0000213     1.05   0.294    -.0000194    .0000641
    l_rva_s3 |   .0270736   .0651694     0.42   0.678    -.1006562    .1548033
  l_rginv_s3 |  -.0188944    .026823    -0.70   0.481    -.0714666    .0336777
        time |   .0049284   .0037385     1.32   0.187    -.0023989    .0122556
       time2 |  -.0002184   .0001295    -1.69   0.092    -.0004723    .0000355
       _cons |    3.72625   .7737739     4.82   0.000     2.209681    5.242819
------------------------------------------------------------------------------
Instruments for differenced equation
        GMM-type: L(2/.).l_qe_s3e0
        Standard: D.po_s3e0 D.l_rpe_s3e0 D.other_s3e0 D.l_pop D.l_rgdp D.hdd
                  D.l_rva_s3 D.l_rginv_s3 D.time D.time2
Instruments for level equation
        Standard: _cons
```

Sectoral model (3) – Industry (unrestricted)

```
Arellano-Bond dynamic panel-data estimation  Number of obs         =       565
Group variable: country                      Number of groups      =        29
Time variable: year
                                             Obs per group:    min =         8
                                                               avg =  19.48276
                                                               max =        22

Number of instruments =    264               Wald chi2(11)         =   4258.94
                                             Prob > chi2           =    0.0000
One-step results
------------------------------------------------------------------------------
   l_qe_s4e0 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   l_qe_s4e0 |
         L1. |    .564986     .03044    18.56   0.000     .5053247    .6246474
             |
     po_s4e0 |  -.0025729   .0011064    -2.33   0.020    -.0047415   -.0004043
  l_rpe_s4e0 |  -.0540901   .0141167    -3.83   0.000    -.0817584   -.0264219
  other_s4e0 |  -1.435512   .3206418    -4.48   0.000    -2.063958   -.8070654
       l_pop |   .4442818   .0883687     5.03   0.000     .2710824    .6174813
      l_rgdp |   .3181037   .0503177     6.32   0.000     .2194828    .4167246
         hdd |   .0000179   .0000133     1.35   0.178    -8.14e-06    .0000439
   l_cars_s4 |  -.0624874   .0493144    -1.27   0.205    -.1591419    .0341671
  l_goods_s4 |   .0811223   .0197783     4.10   0.000     .0423576     .119887
        time |   .0023395   .0025262     0.93   0.354    -.0026119    .0072908
       time2 |   .0000325    .000079     0.41   0.681    -.0001223    .0001872
       _cons |   1.268266    .588518     2.16   0.031     .1147917     2.42174
------------------------------------------------------------------------------
Instruments for differenced equation
        GMM-type: L(2/.).l_qe_s4e0
        Standard: D.po_s4e0 D.l_rpe_s4e0 D.other_s4e0 D.l_pop D.l_rgdp D.hdd
                  D.l_cars_s4 D.l_goods_s4 D.time D.time2
Instruments for level equation
        Standard: _cons
```

Sectoral model (3) – Transport (unrestricted)

```
Arellano-Bond dynamic panel-data estimation  Number of obs         =       521
Group variable: country                      Number of groups      =        29
Time variable: year
                                             Obs per group:    min =         2
                                                               avg =  17.96552
                                                               max =        22

Number of instruments =    262               Wald chi2(9)          =   1991.52
                                             Prob > chi2           =    0.0000
One-step results
------------------------------------------------------------------------------
   l_qe_s2e0 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   l_qe_s2e0 |
         L1. |   .4784649   .0320738    14.92   0.000     .4156013    .5413285
             |
  l_rpe_s2e0 |  -.3977747   .0362535   -10.97   0.000    -.4688302   -.3267192
  other_s2e0 |  -.4640613   .1125173    -4.12   0.000    -.6845913   -.2435314
       l_pop |   .6383215   .2414645     2.64   0.008     .1650598    1.111583
      l_rgdp |   .4262451   .0919882     4.63   0.000     .2459516    .6065386
         hdd |    .000134   .0000275     4.87   0.000       .00008    .0001879
   l_empl_s2 |   .1997626   .1184303     1.69   0.092    -.0323565    .4318817
        time |  -.0074127   .0047788    -1.55   0.121     -.016779    .0019536
       time2 |    .000538   .0001332     4.04   0.000     .0002769    .0007991
       _cons |  -.3537051   .9654427    -0.37   0.714    -2.245938    1.538528
------------------------------------------------------------------------------
Instruments for differenced equation
        GMM-type: L(2/.).l_qe_s2e0
        Standard: D.l_rpe_s2e0 D.other_s2e0 D.l_pop D.l_rgdp D.hdd
                  D.l_empl_s2 D.time D.time2
Instruments for level equation
        Standard: _cons
```

Sectoral model (3) – Services (restricted)

```
Arellano-Bond dynamic panel-data estimation  Number of obs         =       522
Group variable: country                      Number of groups      =        29
Time variable: year
                                             Obs per group:    min =         2
                                                               avg =        18
                                                               max =        22

Number of instruments =    261               Wald chi2(8)          =    990.49
                                             Prob > chi2           =    0.0000
One-step results
------------------------------------------------------------------------------
   l_qe_s3e0 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   l_qe_s3e0 |
         L1. |   .5956787   .0370914    16.06   0.000     .5229809    .6683765
             |
     po_s3e0 |  -.0076712   .0030904    -2.48   0.013    -.0137284   -.0016141
  l_rpe_s3e0 |  -.0773029   .0283249    -2.73   0.006    -.1328187   -.0217871
  other_s3e0 |   -.599325   .1300139    -4.61   0.000    -.8541474   -.3445025
      l_rgdp |    .101205   .0487015     2.08   0.038     .0057519    .1966581
         hdd |   .0000235   .0000213     1.11   0.269    -.0000182    .0000651
        time |   .0057276   .0033905     1.69   0.091    -.0009177     .012373
       time2 |  -.0002181    .000126    -1.73   0.084    -.0004651    .0000289
       _cons |   4.166022   .6037604     6.90   0.000     2.982673    5.349371
------------------------------------------------------------------------------
Instruments for differenced equation
        GMM-type: L(2/.).l_qe_s3e0
        Standard: D.po_s3e0 D.l_rpe_s3e0 D.other_s3e0 D.l_rgdp D.hdd D.time
                  D.time2
Instruments for level equation
        Standard: _cons
```

Sectoral model (3) – Industry (restricted)

```
Arellano-Bond dynamic panel-data estimation  Number of obs         =       565
Group variable: country                      Number of groups      =        29
Time variable: year
                                             Obs per group:    min =         8
                                                               avg =  19.48276
                                                               max =        22

Number of instruments =    263               Wald chi2(10)         =   4252.78
                                             Prob > chi2           =    0.0000
One-step results
------------------------------------------------------------------------------
   l_qe_s4e0 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   l_qe_s4e0 |
         L1. |   .5615451   .0302906    18.54   0.000     .5021766    .6209137
             |
     po_s4e0 |  -.0022104    .001127    -1.96   0.050    -.0044193   -1.54e-06
  l_rpe_s4e0 |  -.0533577   .0139006    -3.84   0.000    -.0806023   -.0261131
  other_s4e0 |  -1.388176   .2793552    -4.97   0.000    -1.935702   -.8406494
       l_pop |   .4360698   .0853277     5.11   0.000     .2688305    .6033091
      l_rgdp |   .3186061   .0494334     6.45   0.000     .2217185    .4154937
         hdd |   .0000182   .0000132     1.38   0.167    -7.65e-06    .0000441
   l_cars_s4 |  -.0615234   .0481844    -1.28   0.202     -.155963    .0329162
  l_goods_s4 |   .0813612   .0196673     4.14   0.000      .042814    .1199085
        time |   .0028948   .0016869     1.72   0.086    -.0004115    .0062011
       _cons |   1.314266   .5687992     2.31   0.021     .1994398    2.429092
------------------------------------------------------------------------------
Instruments for differenced equation
        GMM-type: L(2/.).l_qe_s4e0
        Standard: D.po_s4e0 D.l_rpe_s4e0 D.other_s4e0 D.l_pop D.l_rgdp D.hdd
                  D.l_cars_s4 D.l_goods_s4 D.time
Instruments for level equation
        Standard: _cons
```

Sectoral model (3) – Transport (restricted)

```
Arellano-Bond dynamic panel-data estimation  Number of obs         =       515
Group variable: country                      Number of groups      =        29
Time variable: year
                                             Obs per group:    min =         9
                                                               avg =  17.75862
                                                               max =        22

Number of instruments =    266               Wald chi2(13)         =   3771.16
                                             Prob > chi2           =    0.0000
One-step results
--------------------------------------------------------------------------------
     l_qe_s1e1 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
---------------+----------------------------------------------------------------
     l_qe_s1e1 |
           L1. |    .617856   .0295824    20.89   0.000     .5598756    .6758365
               |
        po_s1e0 |  -.0003274   .0009431    -0.35   0.728    -.0021759    .0015211
     l_rpe_s1e1 |  -.1290145    .027052    -4.77   0.000    -.1820354   -.0759937
     l_rpe_s1e0 |  -.0547156   .0154756    -3.54   0.000    -.0850471    -.024384
    other_s1e0 |  -.2599075   .0736436    -3.53   0.000    -.4042463   -.1155687
         l_pop |  -.0665835   .0888747    -0.75   0.454    -.2407747    .1076077
        l_rgdp |  -.0978864   .0487511    -2.01   0.045    -.1934367   -.0023361
           hdd |    .000046   .0000109     4.24   0.000     .0000247    .0000673
     l_area_s1 |   .0357877   .0457353     0.78   0.434     -.053852    .1254273
pperc_equip_s1 |  -.0603057   .0842954    -0.72   0.474    -.2255217    .1049102
     l_rcons_s1 |   .1984687   .0430513     4.61   0.000     .1140897    .2828476
          time |   .0042949    .002083     2.06   0.039     .0002123    .0083774
         time2 |  -.0000592   .0000616    -0.96   0.337      -.00018    .0000616
         _cons |   2.955716   .4841186     6.11   0.000     2.006861    3.904571
--------------------------------------------------------------------------------
Instruments for differenced equation
        GMM-type: L(2/.).l_qe_s1e1
        Standard: D.po_s1e0 D.l_rpe_s1e1 D.l_rpe_s1e0 D.other_s1e0 D.l_pop
                  D.l_rgdp D.hdd D.l_area_s1 D.pperc_equip_s1 D.l_rcons_s1
                  D.time D.time2
Instruments for level equation
        Standard: _cons
```

Disaggregate model (4) – Household/Electricity (unrestricted)

```
Arellano-Bond dynamic panel-data estimation  Number of obs         =       465
Group variable: country                      Number of groups      =        26
Time variable: year
                                             Obs per group:    min =         9
                                                               avg =  17.88462
                                                               max =        22

Number of instruments =    266               Wald chi2(13)         =   5250.03
                                             Prob > chi2           =    0.0000
One-step results
--------------------------------------------------------------------------------
     l_qe_s1e2 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
---------------+----------------------------------------------------------------
     l_qe_s1e2 |
           L1. |    .859439   .0137632    62.44   0.000     .8324636    .8864144
               |
       po_s1e0 |  -.0040998     .00266    -1.54   0.123    -.0093133    .0011136
    l_rpe_s1e2 |   .0456692   .0584203     0.78   0.434    -.0688324    .1601708
    l_rpe_s1e0 |  -.0570669   .0464246    -1.23   0.219    -.1480574    .0339235
    other_s1e0 |  -.4052414    .229993    -1.76   0.078    -.8560194    .0455366
         l_pop |   .3814473   .2618807     1.46   0.145    -.1318294    .8947239
        l_rgdp |  -.1444983   .1632684    -0.89   0.376    -.4644985    .1755019
           hdd |   .0002504   .0000336     7.45   0.000     .0001845    .0003162
     l_area_s1 |  -.3344769    .150454    -2.22   0.026    -.6293613   -.0395925
pperc_equip_s1 |  -.8649171   .3496263    -2.47   0.013    -1.550172   -.1796621
    l_rcons_s1 |   .3538526   .1450417     2.44   0.015     .0695761    .6381292
          time |   .0141383   .0080309     1.76   0.078     -.001602    .0298786
         time2 |  -.0000207   .0001932    -0.11   0.915    -.0003995     .000358
         _cons |  -.1677792   1.388803    -0.12   0.904    -2.889784    2.554226
--------------------------------------------------------------------------------
Instruments for differenced equation
        GMM-type: L(2/.).l_qe_s1e2
        Standard: D.po_s1e0 D.l_rpe_s1e2 D.l_rpe_s1e0 D.other_s1e0 D.l_pop
                  D.l_rgdp D.hdd D.l_area_s1 D.pperc_equip_s1 D.l_rcons_s1
                  D.time D.time2
Instruments for level equation
        Standard: _cons
```

Disaggregate model (4) – Household/Gas (unrestricted)

```
Arellano-Bond dynamic panel-data estimation  Number of obs         =       515
Group variable: country                      Number of groups      =        29
Time variable: year
                                             Obs per group:    min =         9
                                                               avg =  17.75862
                                                               max =        22

Number of instruments =    266               Wald chi2(13)         =   2190.55
                                             Prob > chi2           =    0.0000
One-step results
--------------------------------------------------------------------------------
     l_qe_s1e3 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
---------------+----------------------------------------------------------------
     l_qe_s1e3 |
           L1. |   .7725767    .031021    24.90   0.000     .7117767    .8333767
               |
      po_s1e0 |   .0025043   .0043504     0.58   0.565    -.0060222    .0110309
    l_rpe_s1e3 |  -.0083704   .0561912    -0.15   0.882    -.1185032    .1017623
    l_rpe_s1e0 |  -.0900077   .0718128    -1.25   0.210    -.2307581    .0507427
   other_s1e0 |   -.790091    .374219    -2.11   0.035    -1.523547   -.0566352
         l_pop |  -.4624768   .3929911    -1.18   0.239    -1.232725    .3077716
        l_rgdp |  -.4915123   .2571156    -1.91   0.056    -.9954497     .012425
           hdd |   .0001194   .0000525     2.27   0.023     .0000165    .0002223
     l_area_s1 |   .8824871   .2510718     3.51   0.000     .3903954    1.374579
pperc_equip_s1 |    .254068   .4098528     0.62   0.535    -.5492288    1.057365
    l_rcons_s1 |   .0732942    .224043     0.33   0.744    -.3658221    .5124104
          time |  -.0099669   .0102007    -0.98   0.329      -.02996    .0100261
         time2 |  -.0003372    .000282    -1.20   0.232      -.00089    .0002156
         _cons |   2.269512   2.007208     1.13   0.258    -1.664543    6.203566
--------------------------------------------------------------------------------
Instruments for differenced equation
        GMM-type: L(2/.).l_qe_s1e3
        Standard: D.po_s1e0 D.l_rpe_s1e3 D.l_rpe_s1e0 D.other_s1e0 D.l_pop
                  D.l_rgdp D.hdd D.l_area_s1 D.pperc_equip_s1 D.l_rcons_s1
                  D.time D.time2
Instruments for level equation
        Standard: _cons
```

Disaggregate model (4) – Household/Oil (unrestricted)

```
Arellano-Bond dynamic panel-data estimation  Number of obs         =       521
Group variable: country                      Number of groups      =        29
Time variable: year
                                             Obs per group:    min =         2
                                                               avg =  17.96552
                                                               max =        22

Number of instruments =    265               Wald chi2(12)         =   3395.58
                                             Prob > chi2           =    0.0000
One-step results
------------------------------------------------------------------------------
   l_qe_s2e1 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   l_qe_s2e1 |
         L1. |    .422783   .0358634    11.79   0.000      .352492     .493074
             |
     po_s2e0 |    -.00292   .0017874    -1.63   0.102    -.0064232    .0005832
  l_rpe_s2e1 |  -.1787149   .0640178    -2.79   0.005    -.3041875   -.0532423
  l_rpe_s2e0 |   -.112774   .0355107    -3.18   0.001    -.1823737   -.0431744
  other_s2e0 |   -.209549   .1051738    -1.99   0.046    -.4156858   -.0034121
       l_pop |  -.1004203   .2128937    -0.47   0.637    -.5176843    .3168436
      l_rgdp |     .12182   .1003296     1.21   0.225    -.0748225    .3184624
         hdd |   .0000407   .0000233     1.75   0.081    -4.96e-06    .0000865
    l_rva_s2 |   .2330672   .1204376     1.94   0.053    -.0029862    .4691207
   l_empl_s2 |   .3047407   .1136286     2.68   0.007     .0820328    .5274486
        time |    .002573   .0039519     0.65   0.515    -.0051725    .0103185
       time2 |   .0001631   .0001209     1.35   0.177    -.0000738       .0004
       _cons |    .439609   .7967983     0.55   0.581    -1.122087    2.001305
------------------------------------------------------------------------------
Instruments for differenced equation
        GMM-type: L(2/.).l_qe_s2e1
        Standard: D.po_s2e0 D.l_rpe_s2e1 D.l_rpe_s2e0 D.other_s2e0 D.l_pop
                  D.l_rgdp D.hdd D.l_rva_s2 D.l_empl_s2 D.time D.time2
Instruments for level equation
        Standard: _cons
```

Disaggregate model (4) – Services/Electricity (unrestricted)

```
Arellano-Bond dynamic panel-data estimation  Number of obs         =        442
Group variable: country                      Number of groups      =         26
Time variable: year
                                             Obs per group:    min =          2
                                                               avg =         17
                                                               max =         22

Number of instruments =    265               Wald chi2(12)         =     924.72
                                             Prob > chi2           =     0.0000
One-step results
------------------------------------------------------------------------------
   l_qe_s2e2 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   l_qe_s2e2 |
         L1. |   .5039576    .037379    13.48   0.000     .4306962     .577219
             |
     po_s2e0 |  -.0005165   .0052618    -0.10   0.922    -.0108295    .0097964
  l_rpe_s2e2 |   .6603008   .1128529     5.85   0.000     .4391131    .8814885
  l_rpe_s2e0 |  -.4286906   .1073398    -3.99   0.000    -.6390728   -.2183085
  other_s2e0 |  -1.033831   .2523451    -4.10   0.000    -1.528418   -.5392433
       l_pop |   1.382082   .7247333     1.91   0.057    -.0383688    2.802534
      l_rgdp |   .3747153   .3703749     1.01   0.312    -.3512061    1.100637
         hdd |    .000342   .0000735     4.66   0.000      .000198     .000486
    l_rva_s2 |  -.0948464   .4615819    -0.21   0.837    -.9995302    .8098374
   l_empl_s2 |   .4090289   .3596849     1.14   0.255    -.2959406    1.113998
        time |  -.0040918   .0135745    -0.30   0.763    -.0306973    .0225136
       time2 |   .0005507   .0004243     1.30   0.194    -.0002809    .0013823
       _cons |  -3.449672   2.959035    -1.17   0.244    -9.249275     2.34993
------------------------------------------------------------------------------
Instruments for differenced equation
        GMM-type: L(2/.).l_qe_s2e2
        Standard: D.po_s2e0 D.l_rpe_s2e2 D.l_rpe_s2e0 D.other_s2e0 D.l_pop
                  D.l_rgdp D.hdd D.l_rva_s2 D.l_empl_s2 D.time D.time2
Instruments for level equation
        Standard: _cons
```

Disaggregate model (4) – Services/Gas (unrestricted)

```
Arellano-Bond dynamic panel-data estimation  Number of obs         =        480
Group variable: country                      Number of groups      =         29
Time variable: year
                                             Obs per group:    min =          1
                                                               avg =   16.55172
                                                               max =         22

Number of instruments =    265               Wald chi2(12)         =     630.18
                                             Prob > chi2           =     0.0000
One-step results
------------------------------------------------------------------------------
   l_qe_s2e3 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   l_qe_s2e3 |
         L1. |   .5423501   .0322217    16.83   0.000     .4791968    .6055035
             |
     po_s2e0 |   -.008305   .0070737    -1.17   0.240    -.0221693    .0055592
  l_rpe_s2e3 |   .1050613    .089646     1.17   0.241    -.0706416    .2807643
  l_rpe_s2e0 |   .1469129   .1273309     1.15   0.249    -.1026512    .3964769
  other_s2e0 |   -1.26623   .3277256    -3.86   0.000     -1.90856   -.6238995
       l_pop |  -.4015314    .886239    -0.45   0.650    -2.138528    1.335465
      l_rgdp |   .1960929   .4532389     0.43   0.665    -.6922391    1.084425
         hdd |   .0002077   .0000921     2.26   0.024     .0000272    .0003881
    l_rva_s2 |  -.3251106   .6206667    -0.52   0.600    -1.541595    .8913738
   l_empl_s2 |   .7372593   .4575459     1.61   0.107    -.1595141    1.634033
        time |  -.0109193   .0165197    -0.66   0.509    -.0432974    .0214588
       time2 |  -.0003448   .0004819    -0.72   0.474    -.0012894    .0005997
       _cons |   .6355373   3.693581     0.17   0.863    -6.603749    7.874824
------------------------------------------------------------------------------
Instruments for differenced equation
        GMM-type: L(2/.).l_qe_s2e3
        Standard: D.po_s2e0 D.l_rpe_s2e3 D.l_rpe_s2e0 D.other_s2e0 D.l_pop
                  D.l_rgdp D.hdd D.l_rva_s2 D.l_empl_s2 D.time D.time2
Instruments for level equation
        Standard: _cons
```

Disaggregate model (4) – Services/Oil (unrestricted)

```
Arellano-Bond dynamic panel-data estimation  Number of obs         =       522
Group variable: country                      Number of groups      =        29
Time variable: year
                                             Obs per group:    min =         2
                                                               avg =        18
                                                               max =        22

Number of instruments =    265               Wald chi2(12)         =    807.53
                                             Prob > chi2           =    0.0000
One-step results
------------------------------------------------------------------------------
    l_qe_s3e1 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    l_qe_s3e1 |
          L1. |   .4310291   .0396692    10.87   0.000     .3532789    .5087792
             |
      po_s3e0 |  -.0061513   .0022231    -2.77   0.006    -.0105086    -.001794
    l_rpe_s3e1 |  -.1509294   .0376375    -4.01   0.000    -.2246976   -.0771613
    l_rpe_s3e0 |  -.0304619   .0226745    -1.34   0.179    -.0749032    .0139793
    other_s3e0 |   .1004295   .0978616     1.03   0.305    -.0913756    .2922346
        l_pop |  -.1114238   .1066893    -1.04   0.296     -.320531    .0976835
       l_rgdp |   .0315883   .0676055     0.47   0.640    -.1009161    .1640926
          hdd |   9.23e-06   .0000158     0.58   0.560    -.0000218    .0000403
     l_rva_s3 |   .2274672   .0531861     4.28   0.000     .1232244      .33171
   l_rginv_s3 |  -.0701439   .0205067    -3.42   0.001    -.1103363   -.0299515
         time |    .014409   .0029228     4.93   0.000     .0086804    .0201375
        time2 |  -.0004648   .0000971    -4.79   0.000    -.0006551   -.0002745
        _cons |    4.61228   .6058981     7.61   0.000     3.424741    5.799818
------------------------------------------------------------------------------
Instruments for differenced equation
        GMM-type: L(2/.).l_qe_s3e1
        Standard: D.po_s3e0 D.l_rpe_s3e1 D.l_rpe_s3e0 D.other_s3e0 D.l_pop
                  D.l_rgdp D.hdd D.l_rva_s3 D.l_rginv_s3 D.time D.time2
Instruments for level equation
        Standard: _cons
```

Disaggregate model (4) – Industry/Electricity (unrestricted)

```
Arellano-Bond dynamic panel-data estimation  Number of obs         =       459
Group variable: country                      Number of groups      =        26
Time variable: year
                                             Obs per group:    min =         2
                                                               avg =  17.65385
                                                               max =        22

Number of instruments =    265               Wald chi2(12)         =   1339.49
                                             Prob > chi2           =    0.0000
One-step results
------------------------------------------------------------------------------
    l_qe_s3e2 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    l_qe_s3e2 |
          L1. |   .5924363   .0201012    29.47   0.000     .5530387    .6318339
             |
      po_s3e0 |   -.008569   .0042627    -2.01   0.044    -.0169237   -.0002143
    l_rpe_s3e2 |   .0204382   .0420771     0.49   0.627    -.0620314    .1029079
    l_rpe_s3e0 |  -.0511157   .0441806    -1.16   0.247    -.1377081    .0354766
    other_s3e0 |  -.7267173    .169471    -4.29   0.000    -1.058874   -.3945604
        l_pop |   .2635674   .1993464     1.32   0.186    -.1271443     .654279
       l_rgdp |  -.0199591   .1526583    -0.13   0.896    -.3191638    .2792456
          hdd |   .0000635   .0000293     2.17   0.030     6.14e-06    .0001209
     l_rva_s3 |   .0007456   .0925939     0.01   0.994    -.1807351    .1822264
   l_rginv_s3 |  -.0049034   .0445223    -0.11   0.912    -.0921656    .0823587
         time |   .0077164   .0052649     1.47   0.143    -.0026026    .0180353
        time2 |  -.0001985    .000163    -1.22   0.223     -.000518     .000121
        _cons |   4.348282   1.134862     3.83   0.000     2.123994     6.57257
------------------------------------------------------------------------------
Instruments for differenced equation
        GMM-type: L(2/.).l_qe_s3e2
        Standard: D.po_s3e0 D.l_rpe_s3e2 D.l_rpe_s3e0 D.other_s3e0 D.l_pop
                  D.l_rgdp D.hdd D.l_rva_s3 D.l_rginv_s3 D.time D.time2
Instruments for level equation
        Standard: _cons
```

Disaggregate model (4) – Industry/Gas (unrestricted)

```
Arellano-Bond dynamic panel-data estimation  Number of obs         =       507
Group variable: country                      Number of groups      =        29
Time variable: year
                                             Obs per group:    min =         2
                                                               avg =  17.48276
                                                               max =        22
Number of instruments =    265               Wald chi2(12)         =   1697.51
                                             Prob > chi2           =    0.0000
One-step results
------------------------------------------------------------------------------
   l_qe_s3e3 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   l_qe_s3e3 |
         L1. |   .5675773   .0376578    15.07   0.000     .4937693    .6413853
             |
      po_s3e0 |   .0051415    .007748     0.66   0.507    -.0100443    .0203273
   l_rpe_s3e3 |   .1267256   .0579899     2.19   0.029     .0130675    .2403837
   l_rpe_s3e0 |   .0061794   .0642522     0.10   0.923    -.1197526    .1321114
   other_s3e0 |  -1.412483   .2988531    -4.73   0.000    -1.998224   -.8267418
        l_pop |  -1.101758   .3437696    -3.20   0.001    -1.775534   -.4279821
       l_rgdp |  -.7379623      .2746    -2.69   0.007    -1.276168   -.1997562
          hdd |   .0000415     .00005     0.83   0.406    -.0000564    .0001394
     l_rva_s3 |   .0345733   .1685061     0.21   0.837    -.2956925    .3648391
   l_rginv_s3 |    .308871   .0801006     3.86   0.000     .1518768    .4658652
         time |   .0084248   .0094802     0.89   0.374     -.010156    .0270057
        time2 |  -.0008141   .0002957    -2.75   0.006    -.0013937   -.0002344
        _cons |    10.9074   2.047143     5.33   0.000     6.895078    14.91973
------------------------------------------------------------------------------
Instruments for differenced equation
        GMM-type: L(2/.).l_qe_s3e3
        Standard: D.po_s3e0 D.l_rpe_s3e3 D.l_rpe_s3e0 D.other_s3e0 D.l_pop
                  D.l_rgdp D.hdd D.l_rva_s3 D.l_rginv_s3 D.time D.time2
Instruments for level equation
        Standard: _cons
```

Disaggregate model (4) – Industry/Oil (unrestricted)

```
Arellano-Bond dynamic panel-data estimation  Number of obs         =       515
Group variable: country                      Number of groups      =        29
Time variable: year
                                             Obs per group:    min =         9
                                                               avg =  17.75862
                                                               max =        22
Number of instruments =    261               Wald chi2(8)          =   3652.10
                                             Prob > chi2           =    0.0000
One-step results
------------------------------------------------------------------------------
   l_qe_s1e1 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   l_qe_s1e1 |
         L1. |   .6211209   .0290278    21.40   0.000     .5642275    .6780142
             |
  l_rpe_s1e1 |  -.1282081   .0267236    -4.80   0.000    -.1805853   -.0758309
  l_rpe_s1e0 |  -.0599174   .0148875    -4.02   0.000    -.0890963   -.0307385
  other_s1e0 |  -.2768269   .0694079    -3.99   0.000    -.4128639   -.1407898
      l_rgdp |  -.0675256   .0398205    -1.70   0.090    -.1455724    .0105211
         hdd |   .0000459   .0000108     4.23   0.000     .0000247    .0000672
   l_rcons_s1 |   .1778039   .0408361     4.35   0.000     .0977666    .2578412
         time |   .0020557   .0008768     2.34   0.019     .0003371    .0037742
        _cons |   2.921208   .4237549     6.89   0.000     2.090663    3.751752
------------------------------------------------------------------------------
Instruments for differenced equation
        GMM-type: L(2/.).l_qe_s1e1
        Standard: D.l_rpe_s1e1 D.l_rpe_s1e0 D.other_s1e0 D.l_rgdp D.hdd
                  D.l_rcons_s1 D.time
Instruments for level equation
        Standard: _cons
```

Disaggregate model (4) – Household/Electricity (restricted)

```
Arellano-Bond dynamic panel-data estimation  Number of obs         =       484
Group variable: country                      Number of groups      =        27
Time variable: year
                                             Obs per group:    min =         9
                                                               avg =  17.92593
                                                               max =        22

Number of instruments =    263               Wald chi2(10)         =   3287.40
                                             Prob > chi2           =    0.0000
One-step results
--------------------------------------------------------------------------------
     l_qe_s1e2 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
---------------+----------------------------------------------------------------
     l_qe_s1e2 |
           L1. |   .7791359   .0157417    49.50   0.000     .7482827    .8099891
               |
    l_rpe_s1e0 |  -.0800171   .0555652    -1.44   0.150     -.188923    .0288887
    other_s1e0 |  -.7670054   .2870655    -2.67   0.008    -1.329643   -.2043674
        l_rgdp |  -.1698047   .1726839    -0.98   0.325     -.508259    .1686496
           hdd |   .0002979   .0000414     7.20   0.000     .0002168     .000379
     l_area_s1 |  -.5301851   .1688776    -3.14   0.002    -.8611792    -.199191
pperc_equip_s1 |  -1.011714    .429119    -2.36   0.018    -1.852772   -.1706566
    l_rcons_s1 |   .2391566   .1634367     1.46   0.143    -.0811735    .5594867
          time |   .0292663   .0094751     3.09   0.002     .0106955    .0478372
         time2 |   -.000251   .0002169    -1.16   0.247    -.0006761     .000174
         _cons |   4.180764   1.484568     2.82   0.005     1.271063    7.090464
--------------------------------------------------------------------------------
Instruments for differenced equation
        GMM-type: L(2/.).l_qe_s1e2
        Standard: D.l_rpe_s1e0 D.other_s1e0 D.l_rgdp D.hdd D.l_area_s1
                  D.pperc_equip_s1 D.l_rcons_s1 D.time D.time2
Instruments for level equation
        Standard: _cons
```

Disaggregate model (4) – Household/Gas (restricted)

```
Arellano-Bond dynamic panel-data estimation  Number of obs         =       515
Group variable: country                      Number of groups      =        29
Time variable: year
                                             Obs per group:    min =         9
                                                               avg =  17.75862
                                                               max =        22

Number of instruments =    260               Wald chi2(7)          =   2203.70
                                             Prob > chi2           =    0.0000
One-step results
------------------------------------------------------------------------------
   l_qe_s1e3 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   l_qe_s1e3 |
         L1. |   .7660075   .0301532    25.40   0.000     .7069083    .8251068
             |
  l_rpe_s1e0 |  -.1276933   .0653216    -1.95   0.051    -.2557213    .0003348
  other_s1e0 |   -.809025    .351884    -2.30   0.021    -1.498705   -.1193449
      l_rgdp |  -.3510425   .1213719    -2.89   0.004     -.588927    -.113158
         hdd |   .0001213   .0000521     2.33   0.020     .0000191    .0002235
   l_area_s1 |   .8854972   .2195659     4.03   0.000      .455156    1.315839
        time |  -.0169285   .0053095    -3.19   0.001    -.0273349   -.0065221
       _cons |    1.04939   1.789923     0.59   0.558    -2.458795    4.557575
------------------------------------------------------------------------------
Instruments for differenced equation
        GMM-type: L(2/.).l_qe_s1e3
        Standard: D.l_rpe_s1e0 D.other_s1e0 D.l_rgdp D.hdd D.l_area_s1
                  D.time
Instruments for level equation
        Standard: _cons
```

Disaggregate model (4) – Household/Oil (restricted)

```
Arellano-Bond dynamic panel-data estimation  Number of obs         =       521
Group variable: country                      Number of groups      =        29
Time variable: year
                                             Obs per group:    min =         2
                                                               avg =  17.96552
                                                               max =        22

Number of instruments =    263               Wald chi2(10)         =   3404.63
                                             Prob > chi2           =    0.0000
One-step results
------------------------------------------------------------------------------
   l_qe_s2e1 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   l_qe_s2e1 |
         L1. |   .4169808   .0358643    11.63   0.000     .3466881    .4872735
             |
     po_s2e0 |  -.0028937   .0017393    -1.66   0.096    -.0063027    .0005154
    l_rpe_s2e1 |  -.2035812   .0638206    -3.19   0.001    -.3286672   -.0784952
  l_rpe_s2e0 |  -.1239304   .0352162    -3.52   0.000    -.1929529   -.0549079
  other_s2e0 |  -.2320494   .1039442    -2.23   0.026    -.4357764   -.0283225
      l_rgdp |    .154546   .0801992     1.93   0.054    -.0026416    .3117336
         hdd |   .0000394   .0000232     1.70   0.090    -6.12e-06     .000085
    l_rva_s2 |   .2491804   .1131618     2.20   0.028     .0273874    .4709734
   l_empl_s2 |   .2550678   .0990155     2.58   0.010      .061001    .4491345
       time2 |   .0002407   .0000758     3.18   0.001     .0000922    .0003892
       _cons |   .2337835   .5929186     0.39   0.693    -.9283157    1.395883
------------------------------------------------------------------------------
Instruments for differenced equation
        GMM-type: L(2/.).l_qe_s2e1
        Standard: D.po_s2e0 D.l_rpe_s2e1 D.l_rpe_s2e0 D.other_s2e0 D.l_rgdp
                  D.hdd D.l_rva_s2 D.l_empl_s2 D.time2
Instruments for level equation
        Standard: _cons
```

Disaggregate model (4) – Services/Electricity (restricted)

```
Arellano-Bond dynamic panel-data estimation  Number of obs         =       442
Group variable: country                      Number of groups      =        26
Time variable: year
                                             Obs per group:    min =         2
                                                               avg =        17
                                                               max =        22

Number of instruments =    261               Wald chi2(8)          =    926.00
                                             Prob > chi2           =    0.0000
One-step results
------------------------------------------------------------------------------
   l_qe_s2e2 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   l_qe_s2e2 |
         L1. |   .5050218   .0357545    14.12   0.000     .4349442    .5750994
             |
  l_rpe_s2e2 |   .6640458   .1107111     6.00   0.000     .4470559    .8810356
  l_rpe_s2e0 |  -.4324035   .1070877    -4.04   0.000    -.6422915   -.2225154
  other_s2e0 |  -1.122961   .2387773    -4.70   0.000    -1.590956   -.6549664
       l_pop |   .7681559   .5258113     1.46   0.144    -.2624153    1.798727
         hdd |    .000322   .0000718     4.48   0.000     .0001813    .0004627
   l_empl_s2 |   .6843347   .2360118     2.90   0.004     .2217601    1.146909
       time2 |    .000477   .0001842     2.59   0.010      .000116    .0008381
       _cons |  -1.601214   1.711769    -0.94   0.350     -4.95622    1.753791
------------------------------------------------------------------------------
Instruments for differenced equation
        GMM-type: L(2/.).l_qe_s2e2
        Standard: D.l_rpe_s2e2 D.l_rpe_s2e0 D.other_s2e0 D.l_pop D.hdd
                  D.l_empl_s2 D.time2
Instruments for level equation
        Standard: _cons
```

Disaggregate model (4) – Services/Gas (restricted)

```
Arellano-Bond dynamic panel-data estimation  Number of obs         =       572
Group variable: country                      Number of groups      =        29
Time variable: year
                                             Obs per group:    min =         1
                                                               avg =  19.72414
                                                               max =        22

Number of instruments =    259               Wald chi2(6)          =    877.34
                                             Prob > chi2           =    0.0000
One-step results
------------------------------------------------------------------------------
   l_qe_s2e3 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   l_qe_s2e3 |
         L1. |   .6099446   .0284325    21.45   0.000     .5542179    .6656712
             |
     po_s2e0 |  -.0126013   .0064834    -1.94   0.052    -.0253085    .0001059
  other_s2e0 |  -.9124344   .2969144    -3.07   0.002    -1.494376   -.3304928
         hdd |   .0003218   .0000904     3.56   0.000     .0001445    .0004991
   l_empl_s2 |   .8705329   .3163189     2.75   0.006     .2505593    1.490507
        time |  -.0172615   .0083356    -2.07   0.038    -.0335989   -.0009241
       _cons |  -3.755544   2.342239    -1.60   0.109    -8.346247    .8351602
------------------------------------------------------------------------------
Instruments for differenced equation
        GMM-type: L(2/.).l_qe_s2e3
        Standard: D.po_s2e0 D.other_s2e0 D.hdd D.l_empl_s2 D.time
Instruments for level equation
        Standard: _cons
```

Disaggregate model (4) – Services/Oil (restricted)

```
Arellano-Bond dynamic panel-data estimation  Number of obs         =       522
Group variable: country                      Number of groups      =        29
Time variable: year
                                             Obs per group:    min =         2
                                                               avg =        18
                                                               max =        22

Number of instruments =    263               Wald chi2(10)         =    809.97
                                             Prob > chi2           =    0.0000
One-step results
------------------------------------------------------------------------------
   l_qe_s3e1 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   l_qe_s3e1 |
         L1. |   .4342585   .0394248    11.01   0.000     .3569872    .5115297
             |
     po_s3e0 |  -.0062659   .0022113    -2.83   0.005    -.0106001   -.0019318
  l_rpe_s3e1 |  -.1485241   .0374529    -3.97   0.000    -.2219305   -.0751178
  l_rpe_s3e0 |  -.0299524   .0225976    -1.33   0.185     -.074243    .0143381
  other_s3e0 |   .1024754    .097602     1.05   0.294    -.0888209    .2937717
       l_pop |  -.1266005   .1005973    -1.26   0.208    -.3237675    .0705664
    l_rva_s3 |   .2424961   .0418692     5.79   0.000      .160434    .3245582
  l_rginv_s3 |  -.0702865   .0203661    -3.45   0.001    -.1102033   -.0303697
        time |   .0148847   .0026729     5.57   0.000      .009646    .0201234
       time2 |  -.0004702   .0000967    -4.86   0.000    -.0006597   -.0002806
       _cons |   4.780622   .5148336     9.29   0.000     3.771566    5.789677
------------------------------------------------------------------------------
Instruments for differenced equation
        GMM-type: L(2/.).l_qe_s3e1
        Standard: D.po_s3e0 D.l_rpe_s3e1 D.l_rpe_s3e0 D.other_s3e0 D.l_pop
                  D.l_rva_s3 D.l_rginv_s3 D.time D.time2
Instruments for level equation
```

```
        Standard: _cons
```

Disaggregate model (4) – Industry/Electricity (restricted)

```
Arellano-Bond dynamic panel-data estimation  Number of obs         =       486
Group variable: country                      Number of groups      =        27
Time variable: year
                                             Obs per group:    min =         2
                                                               avg =        18
                                                               max =        22

Number of instruments =    259               Wald chi2(6)          =   1226.70
                                             Prob > chi2           =    0.0000
One-step results
------------------------------------------------------------------------------
   l_qe_s3e2 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   l_qe_s3e2 |
         L1. |    .687368   .0249523    27.55   0.000     .6384625    .7362736
             |
     po_s3e0 |  -.0063353   .0063287    -1.00   0.317    -.0187394    .0060688
  l_rpe_s3e0 |  -.2656941    .065079    -4.08   0.000    -.3932465   -.1381417
  other_s3e0 |  -1.034235   .2602718    -3.97   0.000    -1.544358   -.5241116
       l_pop |   .6736464   .2525859     2.67   0.008     .1785871    1.168706
       time2 |   .0002615   .0001439     1.82   0.069    -.0000207    .0005436
       _cons |   2.818551   .6354994     4.44   0.000     1.572995    4.064107
------------------------------------------------------------------------------
Instruments for differenced equation
        GMM-type: L(2/.).l_qe_s3e2
        Standard: D.po_s3e0 D.l_rpe_s3e0 D.other_s3e0 D.l_pop D.time2
Instruments for level equation
        Standard: _cons
```

Disaggregate model (4) – Industry/Gas (restricted)

```
Arellano-Bond dynamic panel-data estimation  Number of obs         =       507
Group variable: country                      Number of groups      =        29
Time variable: year
                                             Obs per group:    min =         2
                                                               avg =  17.48276
                                                               max =        22

Number of instruments =    261               Wald chi2(8)          =   1702.78
                                             Prob > chi2           =    0.0000
One-step results
------------------------------------------------------------------------------
   l_qe_s3e3 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   l_qe_s3e3 |
         L1. |    .569067   .0372546    15.28   0.000     .4960493    .6420847
             |
  l_rpe_s3e3 |   .1198489   .0560108     2.14   0.032     .0100698     .229628
  other_s3e0 |  -1.368572    .271976    -5.03   0.000    -1.901635    -.835509
       l_pop |  -1.119465   .3360178    -3.33   0.001    -1.778048   -.4608827
      l_rgdp |  -.7100252   .1979473    -3.59   0.000    -1.097995   -.3220557
  l_rginv_s3 |   .3048168   .0783889     3.89   0.000     .1511775    .4584562
        time |   .0098426   .0093302     1.05   0.291    -.0084443    .0281295
       time2 |   -.000781   .0002524    -3.09   0.002    -.0012758   -.0002862
       _cons |   11.19407   2.004237     5.59   0.000     7.265841    15.12231
------------------------------------------------------------------------------
Instruments for differenced equation
        GMM-type: L(2/.).l_qe_s3e3
        Standard: D.l_rpe_s3e3 D.other_s3e0 D.l_pop D.l_rgdp D.l_rginv_s3
                  D.time D.time2
Instruments for level equation
        Standard: _cons
```

Disaggregate model (4) – Industry/Oil (restricted)

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