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Master Thesis

The Impact of Energy Dependency on the Promotion of Renewable Energy Sources

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1. Introduction

"*Global energy security is a vital part of America's national security.*" (Biden, 2014)

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"*The country that owns green, that dominates that industry, is going to have the most energy security, national security, economic security, [...]*" (Friedman, 2014)

These quotes suggest a superficial relation: Energy security is important and can be improved by promoting renewable energy (RE) sources. The fact that energy security is important becomes clear once highlighting that basically all aspects of modern human life are dependent on energy as a source of power, heat or mobility (Bielecki, 2002) and that a lack of energy supply inevitably leads to severe social and economical disruptions. However, it is questionable whether the interaction of energy security and renewable energy is as straight forward as appearing in these quotes. What are the aspects that have to be considered when judging on the above and what is the actual empirical finding on the topic? Importantly, environmental concerns as potential drivers for the promotion of RE sources are not subject of this paper.

This paper distinguishes between RE based and fossil fuel based approaches to improve the level of energy security. It derives that the current and future level of energy security is insufficient and RE-based measures are best suited to overcome this issue. Finally, the hypothesis that a higher degree of perceived import dependency can be regarded a major determinant of RE promotion is assessed empirically.

Within the subsequent model, values of perceived import dependency are regressed on measures of the promotion of RE sources. In short, the former is calculated by combining approximations for the quality of state relations with energy supply patterns. The latter is utilizing measures for RE-policy implementations and RE-shares. The panel data set contains 32 countries from 1990 to 2010.

Ultimately, this paper does provide evidence for the hypothesis in some cases, whereas the majority of estimations in the main model reject the hypothesis in favour of the null-hypothesis. Still, especially the model extensions prove to be insightful and encourage further research in this field.

The paper is structured according to the following four parts: Firstly, section 2 aims to derive insights on the usage of RE sources as a counter to energy insecurity. This is done two-fold: Considering existing research on the topic and analysing the actual energy concepts of the US and European Union. Secondly, the theoretical and empirical frame (section 3-4) and potential policy options are described (section 5) in order to logically derive the conclusions that are necessary to establish the aforementioned hypothesis. The third part begins with a testable hypothesis (section 6). Further, section 7 describes the respective variables that should be employed in a model, followed by section 8 which depicts the econometrical methodology applied. The last part shows the empirical results of this paper (section 9) and illustrates two extensions of the model (section 10), concludes on the findings (section 11), evaluates a case study for a particular RE-legislation in Germany (section 12) and gives an overview on potential future research (section 13).

2. Review of Existing Research and Contemporary Energy Concepts

This section will provide an overview on the existing research on the topic and examine contemporary energy concepts of major OECD countries. Both is undertaken with the goal to identify (within the literature or within the actual energy concepts) whether RE-based policies are used as a tool to counter energy insecurity.

2.1. Review of Existing Research

Most of the related literature, such as Bird et al., (2005); Gan et al., (2007); Ragwitz et al., (2012) and Harmelink et al., (2006) amongst others, is of qualitative nature and focussed on RE-policy design and policy impact. Further, for example Dijkgraaf et al., (2014); Marques et al., (2012); Carley, (2009); Menz & Vachon, (2006) and Haas et al., (2011) amongst others, estimate the *success* of different RE-policies empirically. However, literature on the actual *determinants*[1] of RE-promotion or RE-usage is scarce, as confirmed by Marques et al., (2010), Aguirre & Ibikunle (2014) and Schaffer & Bernauer (2014). Generally, many authors (for example van Dijk et al., (2003); Menegaki, (2006); Ellabban et al., (2014) and Gan et al., (2007); only to name a few) loosely mention energy security as a general driver for RE utilization, however neither providing a detailed qualitative analysis of the interplay of energy security and RE utilization in particular (as it is done in section 4 of this paper), nor performing a quantitative research focussed on the impact of energy dependency.

In order to keep the literature overview as slim as possible, the following will give an overview only on those papers that are closely related to the subject of this research, namely investigating whether energy security can be regarded as a major driver for the promotion of RE sources. The order of presentation is logically structured from being less closely to being more closely related to the specific subject of this paper.

Marques & Fuinhas (2011)

In a panel data time series with 24 European countries from 1990 to 2006 and employing dynamic estimators, the authors cannot find evidence that "*social awareness about climate change mitigation and CO2 reduction is enough [...] to motivate the switch from traditional to renewable energy sources*" (Marques & Fuinhas, (2011): p.1607). Income and fossil fuel price effects are identified[2] but found to be not decisive due to sign changes across the models. The authors thus conclude that not market-based, but other factors determine the usage of RE sources. This general suggestion is encouraging the research focus of this paper.

Schaffer & Bernauer (2014)

This panel data setup containing IEA member countries, ranging from 1990 to 2010 is not directly aimed at identifying drivers for RE usage, but rather aimed at explaining the choice of policies to promote RE sources (market-based versus non-market-based policies). After including domestic and international factors the authors claim that "*[...] characteristics of the existing*

[1] Some of the aforementioned papers do include controlling variables when analysing the effect of RE policies, but are not focussing their analysis on those other potential drivers [see for example Carley, (2009) or Menz & Vachon, (2006)] and thus not derive general determinants of RE usage.

[2] All effects presented in this section are found to be statistically significant by the authors, if not mentioned otherwise.

energy supply system, a federalist structure of the political system, and EU membership" (Schaffer & Bernauer, (2014): p.25) are main drivers for a market-based policy approach. On the international level, policy diffusion, approximated by the membership status of the EU, is identified to have an effect, whereas trade and proximity measures are considered insignificant.

Both of the above papers do not include import dependency as a potential determinant and thus cannot present a finding on that issue. While still not focussing on it, the following papers do at least consider import dependency as a potential influence and are thus content-wise located more closely to this work.

Popp et al., (2011)

Popp et al. approach the subject from a slightly different perspective than this work and the following papers, as it is approximating investments into RE sources by utilizing data on patent registrations instead of actual RE shares. The model employs a data set on 26 countries from 1991 to 2004 and cannot identify a statistically significant effect of import dependency on the level of RE-focussed patent registrations. Instead, the authors conclude that "*the primary driver behind renewable investments appears to be reducing carbon emissions*" (Popp et al., (2011): p.662).

Jenner et al., (2012)

The authors run a EU27 sample from 1990 to 2010 to identify major determinants of RE policy adoption. The potential determinants included are grouped by private interest determinants (measuring solar-, nuclear- oil-, gas- and coal industry and market concentration), public interest determinants (GDP, Electricity Price, Energy Dependency, Unemployment Rate and Air Pollution) and some controlling variables. The paper finds strong evidence for the hypothesis that private lobbying has an important influence on the development of RE sources – positively (solar industry lobby) as well as negatively (fossil fuel energy lobby). With respect to energy dependency, the results are not significant but suggest a negative relation. The overall conclusion of this paper is that private interests are by trend more important than public interests. However, this conclusion is weakened by the fact that for example the unemployment rate has a statistically significant impact. Also, it is somehow contradicting Popp et al., (2011) who identify public aspects to be more important than private aspects.

Marques et al., (2010)

The authors employ a similar panel set as Marques & Fuinhas, (2011) to identify major determinants of RE use by including political, socioeconomic and country specific factors. Main findings, similar to Jenner et al., (2012), are that lobby pressure from traditional energy sources and CO_2 emissions have a significant effect. The impact of income differs in sign according to membership status with the EU; environmental concerns are found to be insignificant. Effects of fossil fuel prices are visible, but not consistent across different types of fossil fuels. Thus, this paper confirms the findings of Marques & Fuinhas, (2011) in the sense that income and fossil fuel price effects are found to be inconclusive. Relevant for this work is the finding, that energy dependency has a positive impact on the use of RE.

An important consideration presented by the authors is the suggestion that after 2006 changes in the overall background situation have emerged that might be considered in future research (reflected in a model extension in section 10.3.). In addition, they suggest further research to more intensively focus on political reasons, amongst others, which is encouraging the main purpose of this paper.

Aguirre & Ibikunle (2014)

Aguirre & Ibikunle present the paper that is most recent and most closely related to this work. The authors claim to add significant extensions to the existing literature by including a larger sample size of 38 OECD and BRIC countries and 21 years (1990 – 2010), which is intended to address the heterogeneity of countries. By including a longer time horizon, Aguirre & Ibikunle (2014) respond on the research suggestion by Marques et al., (2010) as described above. Also with respect to the range of indicators, the authors claim to be more holistic than previous research for example by including improved approximations for country-level RE potential. The following indicators are employed: A set of political factors (Count of public policies promoting RE, Ratification of the Kyoto protocol, energy import dependency), a set of socioeconomic factors (carbon dioxide emissions, fossil fuel and electricity prices, welfare, contribution of traditional energy sources to electricity generation, energy needs) and finally a set of country specific factors (renewables potential, deregulation of the electricity market an continuous commitment).

The results indicate that "*[...] CO_2 emission levels are significant indicators of renewables participation, while energy import level is not. This suggests that environmental concerns are more relevant than energy security for countries [...]*" (Aguirre & Ibikunle (2014): p.382). It is questionable, to what extent CO_2 emissions can be used as a proxy for environmental concerns, but this does not affect the finding on energy security. Interestingly, "*energy use is negatively linked to renewable energy participation, implying that under high pressure to ensure the energy supply, countries have a tendency to employ less renewable energy* [...]", which provides some implication for the research of this paper as high pressure on energy supply also holds the need to import energy – which in turn would suggest a complementary relation between RE utilization and energy imports. The data set has kindly been provided by the authors and is used to retrieve controlling variables: 12 indicators have showed significant effects across the different estimators and are thus included in the models later on.

Concluding, the papers above have opposing and mostly insignificant results with respect to the impact of energy dependency on RE usage. Thus, the existing literature ultimately does not provide a conclusive evaluation for the topic of this paper. Also, it cannot be derived whether determinants from the public or private space are more important, as some papers identify e.g. environmental concerns (a public interest) to be most relevant, whereas other claim that for example industry lobbying (a private interest) is the most important driver.

2.2. Contemporary Energy Concepts

The following section will give a rough overview on the actual energy concepts that are found in the US and Europe in order to identify whether RE-based measures are seen as a vital tool to improve energy security within the actual existing legislations. This approach is extended within the case study in section 12.

Historically, legislations targeting energy security were subject to changing motivations and drivers. Historic events that pushed energy security in its various facets to the political agenda were for example the shift of power source of the Royal British Navy from domestic coal to imported oil in the eve of World War I (Yergin, 2006). Also, health-related issues such as the 1948 coal-combustion deaths in Pennsylvania and the extreme smog in London in 1952 (Valentine, 2011) played an important role. The oil crises in the 70s again influenced energy security policy making and led to substantial diversification efforts of consumer countries (Bielecki, 2002). RE policies were for the first time more seriously considered a potential solution to energy insecurity during that time (Van Dijk et al., 2003). From the 80s on, increasing price volatility and according economic consequences played a major role for energy security legislations as well (Aguirre & Ibikunle, 2014).

In Europe, a holistic energy concept was not explicitly developed until the Russian-Ukraine gas crisis in 2005, which in turn motivated the setup the “European Energy Action Plan” in 2007. However, this legislation is not solely aimed at promoting energy security, but also concerned with addressing rising concerns on climate change (Umbach, 2010 and Duffield, 2009). Core points were the liberalization and homogenisation of the European internal market for gas and electricity, the definition of a common approach to external energy policy with a global dimension as well as energy efficiency and conservation. With respect to RE sources, the nowadays well-known “20-20-20” aims were born: Emissions should be reduced by 20%, the energy mix should contain 20% RE sources and energy efficiency should be increased by 20%. A review of the aforementioned document in 2008 brought more concrete measures on external energy security, such as diversification of energy supply, focussing on external energy relations and the implementation of oil and gas stocks for short-term responses on energy supply crises (Umbach, 2010). Other European strategy papers such as the “A European Strategy for sustainable, competitive and secure energy” focus on similar measures and combine both, RE-based and non-RE-based measures (Bahgat, 2006).

With respect to the subject of this paper, an analysis of these EU policies is rather ambiguous: On the one hand, they do promote RE-measures as a tool to increase energy-security, which would be in line with the hypothesis stated in section 6. On the other hand, they do explicitly name climate change as a motivation and also promote non-RE-based measures to improve energy security. Consequently, it cannot be clearly derived that RE-based measures are actually implemented due to security concerns or due to environmental concerns. Further, literature is coherent in the evaluation that most European countries are still lacking the political will to implement the agreed policies (Umbach, 2010) – which is making any derivations from these declared intentions difficult anyway.

With respect to energy security legislation in the US, a similar picture emerges. On the one hand, the “Energy Independency and Security Act” of 2007 clearly stated RE-based measures to decrease dependency on foreign energy imports – however, within the final process of deriving concrete legislations, the intended goals were watered down substantially (Bang, 2010). Also, other resolutions that passed congress, such as the “Energy Policy Act” in 2005 tend to promote nuclear and coal-based measures to reduce import dependency. Another example of non-RE-based legislations are relaxed legal requirements for shale gas extraction, which allowed for a boom of shale gas extraction within the US – illustrated by an increased share of shale gas in total US natural gas production from 1.6 percent by 2000 to 23.1 percent by 2010 (Richardson et al., 2013). Interestingly, the federal U.S. department of energy does mention enhanced energy security as one of the main drivers for the intensified extraction of shale gas (U.S. Department of Energy, 2015b).

Within the literature, it is generally undisputed that – unlike for the European Union – dependency on foreign energy imports always played a major role for US energy policy making – which in recent years even increased due to growing hostility of Middle East supplying countries (Bang, 2010). However, consensus on the means how to achieve a decrease of dependency was never existent among the political parties. Consequently, generalised findings with respect to a utilization of RE-based measures against energy import dependency can again not be derived.

Concluding sections 2.1. and 2.2., the interaction of (a lack of) energy security and the promotion of RE sources cannot be evaluated without leaving questions open. This encourages further analysis and research as done subsequently.

3. Theory: Energy Security

To clearly define the core subject of this work, the following section will give an overview on different possible definitions and approaches to measure energy security. Later on, these theoretical considerations play an important role in deriving conclusions that are crucial to the hypothesis.

3.1. Definitions of Energy Security

Existing definitions of energy security can roughly be divided into two groups: A first that is concerned with security of energy supply and a second group that defines energy security via the consequences of (a lack of) energy supply.

(I) A very basic example for the first group is given by the International Energy Agency, (2001) and also employed by numerous authors, e.g. Bielecki, (2002): "*Energy security, the reliable supply of energy at an affordable price*". In general similar but a bit more sophisticated with respect to implicitly involving a free-market component and giving a more detailed price perception is the definition used by the European Commission, (2001): "*ensuring [...] the uninterrupted physical availability of energy products on the markets, at a price which is affordable for all consumers (private and industrial)*''.

(II) The second group is well illustrated by a definition proposed by Löschel et al., (2010): "*energy security exists if the energy sector does not cause major welfare-reducing frictions in the economy at national and global levels*" (Löschel et al., (2010): p.1666). Many similar definitions exist that are also focussing on economic and welfare implications of physical supply or price disruptions. An interesting facet is added by the IEA, as it also involves the *risk* of supply disruptions and potential consequences from the existence of such risk (IEA, 2007a).

None of the definitions stated above can be considered perfect, as some terms always remain rather blurred and leave room for interpretation – but are crucial for the definitions: What exactly is "*reliable*" or "*affordable*"? What is a "*major*" welfare reduction? Another critique is added by Grubb et al., (2006), who claim that most definitions are geared towards the imports of energy sources, thereby overlooking the security of domestic energy infrastructure and supply.

A common ground can be found in all of these definitions: All involve a physical and economic dimension, namely the *availability* and *affordability* of energy sources. Both of these dimensions require a certain balance of supply and demand – importantly, a balance that is not economically induced by unrealistically high or low prices but instead a balance of actual, undisturbed supply and demand.[3]

A first observation important for the subject of this work has to be pointed out here: The concept of energy security is located in different spaces, namely the political and economic space. Standard economics have difficulties incorporating political motives that can be irrational sometimes – whereas strategic-political decisions may fail to account for basic economic requirements (Löschel et al., 2010). Both spaces are subject to very different motives, mechanisms and goals and combining both complicates exact research.

3.2. Evaluating and Measuring Energy Security

Based on the definitions presented above, the level of energy security can be evaluated according to several criteria. According to these criteria, potential threats can be identified.

3.2.1. Evaluating Energy Security: Time Dimension

A first, high-level differentiation of evaluation criteria can be found in the time dimension: Short-term versus long-term energy security. In the short term, main concern is the likelihood of unanticipated, sudden supply disruptions and following sharp increases in market prices, whereas the long-term view is concerned with stability and sustainability of supply flows and long-term price trends (Costantini et al., 2007). Clearly, threats in both time dimensions are relevant for the subject of this work as both would imply potential motivations to set up according policies.

3.2.2. Evaluating Energy Security: Causes and Consequences

Another differentiation of evaluation criteria can be found within the different aspects of energy security: Aspects that *cause* energy (in-)security and aspects that weaken (strengthen) the *consequences* of energy (in-)security.

The first – aspects that cause energy (in-) security – comprises physical and economic aspects. Physical availability may be constrained by exhaustion, production shortfalls or transport interruptions. In turn, these can be caused by physical depletion, technical failure of production and transportation facilities, political-strategic decisions, external attacks on energy infrastructure, natural disasters, etc. Economically, the functioning of energy markets may be limited by erratic price fluctuations (caused by anticipated or actual imbalances of supply and demand) or speculative market agents. Further, political actions such as trade embargoes or direct bilateral negotiations that reduce the overall size of the market can have a direct economic impact. Costantini et al., (2007) point out a connection to the time-dimension outlined above by noting that in the long run, physical aspects tend to dominate economic aspects.

The second set of aspects – consequences of energy (in-) security – covers social and environmental aspects. Measuring the level of vulnerability in the social space is not included into this research, as all countries in the panel are socially highly dependent on a steady supply of energy – thus, a differentiation of this dimension would not add explanatory power to the

[3] Of course, this is blurred and difficult to define again.

model.[4] Environmental aspects of energy security are generally not part of the underlying hypothesis of this (except of being included as a controlling variable), as further elaborated in section 6. Thus, relevant for this research are only aspects that *cause* energy (in-) security.

3.2.3. Measuring Energy Security

As there is no general consensus on the basic definition, also quantifying energy security is difficult. In addition, it is being complicated by a weak data base e.g. with respect to energy trading flows or reserves. Several possible indicators are focussing on different aspects of energy security. The following have been proposed within the literature:

- Implying that large domestic reserves may act as a buffer against disruptions in energy supply, **reserve estimates** may be employed – thereby also implying that domestic production may be subject to less supply disruptions than import flows, which is likely but not necessarily true. Significant drawback of this type of indicators is the high uncertainty that is underlying estimates on reserves and extraction potentials, on which a general consensus has not yet been achieved. Further, the absolute figure on reserves has limited meaning if not set in relation to production or consumption. Due to these drawbacks, the indicator is not employed in the following model.
- Based on a similar rationale – the existence of buffer capacity – **reserve-to-production (R/P)** ratios can be calculated by setting estimates on domestic reserves in relation to estimates on domestic production. Despite being more realistic due to the inherent relativization, uncertainty is even higher, as also production capacities are only estimates in most cases. Further figures on *consumption* may play a more important role than figures on *production* for energy security. Both are employed in a model extension in section 10.
- Also coming from a similar rationale is to employ **import dependency** as a measure of energy security. Usually, the ratio of net energy imports to total energy consumption is employed to track the degree of vulnerability to foreign energy supplies. A related approach is used within the methodology of this research as described in section 7.2.
- Addressing the security of supply, several **diversity indices** have been developed. Diversification of supply is generally – regardless of the respective market – a powerful tool against market power of a single market agent and can thus be utilized as a indicator for security of supply. Due to the complexity in calculating a meaningful diversity index for the energy market,[5] utilizing this indicator to proxy energy security is left for further research, as elaborated in section 13.
- Not tracking the diversity of supply, but tracking the reliability of supply is to incorporate **political stability of supplying countries**. This principle plays a role in the suggested hypothesis and is employed via two different models later on.
- **Energy prices** may be employed as an indicator of the balance of global supply and demand, where high energy prices indicate a shortfall of supply and thus a low level of

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[4] In the sense that the level of social vulnerability is high enough in all countries to create pressure to ensure a secure supply of energy.

[5] Theoretically, any diversity index ideally comprises three aspects: Number of categories (variety), spread across categories (balance) and degree of differences across categories (disparity). The degree of disparity cannot be quantified for the energy market as the substitutability of different energy sources cannot be quantified sufficiently. Therefore, only incomplete diversity indices can potentially be employed (Kruyt, 2009).

energy security. However, next to supply and demand, energy prices are affected by many other factors such as speculation or strategic communication and may thus not properly approximate the true level of energy security of a country. Due to this expected approximation inaccuracy, this indicator is not employed.

- Lastly, **demand-side** indicators – measuring for example the energy intensity of any economy – may quantify the size of the impact of energy shortages (Kruyt, 2009). However, as mentioned in section 3.2.2., the vulnerability to energy supply disruptions is regarded to be sufficiently high to induce policy implementations for all countries in the panel employed. Therefore, demand-side indicators are note utilized in the subsequent model, as they are not regarded to add explanatory power to the model. This could be different in a panel with greater heterogeneity with respect to economic development stage of the included countries – where vulnerability to energy supply is likely to differ more.

A few more complex indicators do exist, as elaborated by Kruyt (2009). However, to the best knowledge of the author, so far no attempt has been made to combine measures on the quality and/or reliability of state relations with import patterns to receive indicators for energy security,[6] as done within the subsequent model.

4. Empirics: Current and Future Energy Situation

After having defined energy security concepts and approaches to measure it, the following sections will give an overview on the current and future situation of the global energy market and resulting challenges.

4.1. Current Situation: Physical, Economic and Political Background

4.1.1. Current Physical Situation: Reserves, Production and Consumption

The most important but very basic physical observation that cannot be overrated in importance is the finding that production and consumption especially of crude oil and natural gas is characterized by an enormous spatial discrepancy. This spatial discrepancy is the driver for the high complexity the global energy trading system has developed to.

As illustrated in table 1 below, the Middle East alone holds 47,7% of crude oil reserves and 42,7% of natural gas reserves – while coal is mostly concentrated in North America, Europe and Eurasia and the Asia Pacific Region. It has to be noted oil and gas shares of the Middle East are even increasing by trend since the 1990s as other regions are depleting their reserves faster (CIEP, 2004).

As a result, the Middle East and Africa are by far the most important regions for crude oil and natural gas not only in terms of physical reserves but also in terms of production capacities. This holds to be true despite the import diversification efforts and increase of domestic production capacities of the consuming countries in the aftermath of the oil crises in the late 70s and early 80s (Costantini et al., 2007). On the consumption side, OECD countries are consuming far more than they are producing which naturally leads to high import volumes of nearly all OECD countries.

[6] Except of the incorporation of state stability as mentioned above.

Table 1 further illustrates the most recent figures (2014) on production and consumption patterns of fossil fuel reserves and makes the enormous global discrepancy in production and consumption visible.

Table 1

Reserve-, Production- and Consumption Estimates for Crude Oil, Natural Gas and Coal

	Crude Oil					
	Reserves		**Production**		**Consumption**	
	Billion Barrels	Share	Thousand Barrels/d	Share	Thousand Barrels/d	Share
Total North America	232,5	13,7%	18721	20,5%	23347	24,3%
Total S. & Cent. America	330,2	19,4%	7613	9,3%	7125	7,8%
Total Europe & Eurasia	154,8	9,1%	17198	19,8%	18252	20,4%
Total Middle East	810,7	47,7%	28555	31,7%	8706	9,3%
Total Africa	129,2	7,6%	8263	9,3%	3800	4,3%
Total Asia Pacific	42,7	2,5%	8324	9,4%	30856	33,9%
Total World	1700,1	100,0%	88673	100,0%	92086	100,0%
of which:						
OECD	248,6	14,6%	22489	24,6%	45057	48,3%
Non-OECD	1451,5	85,4%	66184	75,4%	47029	51,7%
OPEC	1216,5	71,6%	36593	41,0%		
Non-OPEC	341,7	20,1%	38278	43,0%		
European Union #	5,8	0,3%	1411	1,6%	12527	14,1%
Former Soviet Union	141,9	8,3%	13802	16,0%	4443	4,9%

	Natural Gas					
	Reserves		**Production**		**Consumption**	
	Trillion cub. mtr.	Share	Billion cub. mtr.	Share	Billion cub. mtr.	Share
Total North America	12,1	6,5%	948,4	27,7%	949,4	28,3%
Total S. & Cent. America	7,7	4,1%	175,0	5,0%	170,1	5,0%
Total Europe & Eurasia	58,0	31,0%	1002,4	28,8%	1009,6	29,6%
Total Middle East	79,8	42,7%	601,0	17,3%	465,2	13,7%
Total Africa	14,2	7,6%	202,6	5,8%	120,1	3,5%
Total Asia Pacific	15,3	8,2%	531,2	15,3%	678,6	19,9%
Total World	187,1	100,0%	3460,6	100,0%	3393,0	100,0%
of which:						
OECD	19,5	10,4%	1248,2	36,3%	1578,6	46,7%
Non-OECD	167,6	89,6%	2212,4	63,7%	1814,3	53,3%
European Union	1,5	0,8%	132,3	3,8%	386,9	11,4%
Former Soviet Union	54,6	29,2%	760,3	21,9%	568,5	16,7%

	Coal					
	Reserves		**Production**		**Consumption**	
	Million Tonnes	Share	Mtoe	Share	Mtoe	Share
Total North America	12,1	6,5%	948,4	27,7%	949,4	28,3%
Total S. & Cent. America	7,7	4,1%	175,0	5,0%	170,1	5,0%
Total Europe & Eurasia	58,0	31,0%	1002,4	28,8%	1009,6	29,6%
Total Middle East	79,8	42,7%	601,0	17,3%	465,2	13,7%
Total Africa	14,2	7,6%	202,6	5,8%	120,1	3,5%
Total Asia Pacific	15,3	8,2%	531,2	15,3%	678,6	19,9%
Total World	187,1	100,0%	3460,6	100,0%	3393,0	100,0%
of which:						
OECD	19,5	10,4%	1248,2	36,3%	1578,6	46,7%
Non-OECD	167,6	89,6%	2212,4	63,7%	1814,3	53,3%
European Union	1,5	0,8%	132,3	3,8%	386,9	11,4%
Former Soviet Union	54,6	29,2%	760,3	21,9%	568,5	16,7%

Source: BP Statistical Review, (2014)

When considering figures on reserves, production and consumption it has to be highlighted that those figures are only estimations, implying that they do exhibit uncertainty.[7] Especially figures on reserves are highly questionable as firstly the amount of undiscovered reserves is difficult to approximate and secondly figures on proven reserves are influenced by political motives sometimes. In particular, the size of reserves in the Black Sea and Caucasian region are highly disputed – but are politically interesting as they could provide the opportunity for significant supply diversification (Costantini et al., 2007).

4.1.2. Current Physical Situation: Infrastructure

With respect to global energy infrastructure three facts may be important for the subject of this paper. At first, due to technical requirements and the size in volume and geographical reach, the global energy system exhibits an enormous complexity – with respect to technical infrastructure as well as interconnected dependencies and supply chains. This leads to the requirement of capital intensive maintenance and the fact that relatively small interruptions are quickly amplified to a global scale.

Secondly, with respect to market maturity, the global market for crude oil is technically and administratively well established and proven to be functionally working – whereas the global market for natural gas is only in development and cannot be regarded fully mature yet. Liquefaction of natural gas, which is required for international shipment, is technically complex and requires specific Liquefied Natural Gas (LNG) processing stations which have only recently been build in some exporting and importing countries (Umbach, 2010).

[7] A good example to illustrate this uncertainty are reserve estimations published by Costantini et al., 2007, which claim the Middle East to hold roughly 65% of global crude oil reserves in 2002.

Thirdly, spare oil production capacities have significantly decreased from 15% to 2-3% of total production capacity since the mid 80s due to significant underinvestment and constantly increasing demand. During recent years, OPEC production even operated at an average of 99% of total capacity (Umbach, 2010). Next to *production* capacities, also global *refinery* capacity to convert crude oil into middle distillates such as diesel, jet fuel or heating oil, is lacking behind global demand (Yergin, 2006). Both exhibits the risk that future sudden supply disruptions may have significantly more severe impacts than previous disruptions, as there is hardly any buffer left to replace supply shortfalls in the short-term.

4.1.3. Current Economic Situation

Energy prices have remained relatively steady throughout most of the 20s century averaging at roughly 25$ per barrel and encountering major fluctuations only in times of global economic disruptions (e.g. recessions or significant growth periods influencing energy demand) or political and military crises (influencing energy supply). This has changed significantly since the mid 90s at which time prices started to escalate sharply.[8] The US department of energy projects cost of oil to be in range of 135$ per barrel constantly in 2035 (Valentine, 2011 and IEA, 2007a). A generally increasing trend in prices is also confirmed by Shafiee & Topal, (2010). Relevance of high energy prices for the overall economy is illustrated by the fact that the price level as of 2006 resulted in an energy bill of around €250 billion each year for the European Union, which was roughly 2.3% of total GDP by then (Bahgat, 2006).

Further, not only did the level of prices increase significantly, but so did the price volatility, reflecting a high level of uncertainty in the market. This also manifests in the size increase of the futures market for energy products that is used to hedge against price fluctuations (Costantini et al., 2007). The increased volatility in energy prices can partly be explained by the inelasticity of demand for energy products, leading to more pronounced price movements as a result of supply changes. This inelasticity is especially apparent within the transport sector and – coupled with the growth forecasts for the Asian transport sector – expected to intensify in the future (Bielecki, 2002; Costantini et al., 2007 and IEA, 2007a).

Importantly, Umbach (2010) adds the general finding that previous price developments were dominated mainly by temporary supply shortfalls, whereas the recent price increases are induced by structural weaknesses of the energy market – and will thus not be resolved by market forces alone (Umbach, 2010).

4.1.4. Current Political Situation and Threats to Supply

Politically, the global energy system is characterized by a certain degree of polarisation among supplying and receiving countries, institutionalised by the OPEC cartel on the supplying side and the OECD network on the receiving side – of course, important exceptions such as the People's Republic of China, which is among the largest importers but not part of the OECD, do exist. This polarisation leads to an atmosphere of rivalry and competition for resources, firstly among supplying and receiving countries and secondly among OECD and non-OECD receiving countries.

[8] The recent drop in energy prices due to the global economic slowdown in the course of the recent financial crisis is generally not regarded to bring energy prices back to a low level for a longer time and will not break the trend of relatively high energy prices in the future.

Further, some authors identify a tendency to a so-called "petro-authoritarianism" that is apparent among many fossil fuel supplying countries.[9] Petro-authoritarian states are loosely defined to be dependent on revenues from oil exports while at the same time lacking strong institutions – with the effect that a significant loss of oil revenues may lead to severe political and economic repercussions and consequently also unreliability of supply to the world market (Friedman, 2006). Umbach, (2010) showed that the decline in oil prices during the Asian financial crisis in 1998 played a significant role in the regime changes in Algeria, Brunei, Indonesia, Nigeria and Venezuela. This effect may even be exaggerated by higher oil price fluctuations in the future. Authoritarian states also generally exhibit the risk of potential domestic instability and politically motivated export decisions.

Instability of supplying states and regional crises also caused supply disruptions on several other occasions. Only to name a few: Country-wide strikes in Venezuela in 2002-03 led to a decline from 3 million barrel per day to 0.4 million barrel per day, thereby pushing up oil prices above $30 per barrel or the suspension of Iraqi oil exports in 2001 with a gross supply loss of 2.1 million barrel per day (Löschel et al., 2010). Especially Middle Eastern countries are seen as instable and unreliable due to ethnic conflicts or ideological premises (Bahgat, 2006).

Another important strategic issue and source for major disruptions that is apparent in the present global energy system is the general vulnerability of the energy infrastructure to terrorism, especially with respect to transport facilities such as pipelines – which are nearly impossible to protect (Asif & Muneer, 2007). Globally, terrorist attacks on oil and gas infrastructure have increased – the most spectacular example probably being the suicidal attacks on the French super tanker "*Limburg*" – but so far lacking a global impact on supply of fossil fuels (Umbach, 2010).

Other major supply disruptions have been caused by natural disasters in the past, for example did the hurricanes "*Katrina*" and "*Rita*" shut down 27% of oil production and 21% of refinery capacity in the US – resulting in a global price effect (Umbach, 2010).

All of these examples demonstrate that major interruptions in fossil fuel supply have happened in the past and as the underlying reasons are not expected to diminish but will intensify by trend, expectation on future supply interruptions on a global scale are rather certain.

4.2. Future Situation: Supply and Demand

This section will give an overview on the expected developments on the supply- as well as the demand side of global fossil fuels.

4.2.1. Future Situation: Supply-Side

With respect to future developments on the supply side of fossil fuels, two main issues are important for this work: How long will fossil fuels be physically available and how will production shares be distributed in the future?

4.2.1.1. Depletion Estimates

With respect to physical availability, it has to be stated that not only reserve estimations exhibit uncertainty. Also scenarios on consumption are highly dependent on future price developments,

[9] As is the case for example for Russia, Iran, Venezuela, Nigeria, Sudan, etc.

economic development, climate saving policies, potential technological efficiency gains and political behaviour of the OPEC cartel (Shafiee & Topal, (2009) and Costantini et al., (2007)). This leads to very different depletion scenarios as illustrated in table 2 below.

However, a certain consensus exists on the fact that oil will be depleted earlier than gas and the utilization of non-conventional reserves[10] will significantly shift the depletion date backwards for both types of fossil fuels. When combining conventional and non-conventional reserves and resources,[11] 12 (11) out of 13 studies focussed on depletion estimates predict a sufficient supply of oil (gas) until 2100, as shown in table 2. This illustrates that physically, oil and gas can continue to supply the world for a long time, however only with remarkable financial and technical efforts – of course, security issues accompanying the growing scarcity will emerge long before the final depletion date. This is illustrated by a considerable amount of studies which predict conventional oil reserves to be depleted by 2030 (10 out of 13 studies).

Global coal depletion scenarios, which are not included in table 2, are more optimistic and lie in a range of up to 155 years. However the reserves-to-production ratio for coal has decreased by more than 40% between 2000 and 2005, mainly due to the increased Chinese and Indian demand for coal as a source of electricity (Valentine, 2011).

<u>Table 2</u>

Breakdown of scenarios by the year until which oil and gas demand would be fulfilled by reserves/resources

Last Year of Availability	Reserves				Resources			
	Conventional		Conventional & Nonconventional		Conventional		Conventional + Nonconventional	
	Oil	Gas	Oil	Gas	Oil	Gas	Oil	Gas
2020	2	–	–	–	–	–	–	–
2025	6	–	–	–	–	–	–	–
2030	2	3	–	–	–	–	–	–
2035	1	4	–	–	–	–	–	–
2040	2	5	–	–	1	–	–	–
2045	–	1	1	1	1	–	–	–
2050	–	–	1	1	4	–	–	–
2055	–	–	1	1	1	1	–	–
2060	–	–	3	1	1	1	–	–
2065	–	–	1	1	2	–	–	–
2070	–	–	1	3	1	3	–	–
2075	–	–	1	–	–	–	–	–
2080	–	–	2	2	–	2	1	1
2085	–	–	–	–	–	–	–	–
2090	–	–	–	1	–	2	–	1
Beyond 2100	–	–	2	2	2	4	12	11
Total # Scenarios	13	13	13	13	13	13	13	13

Source: Costantini et al., (2007)

[10] That are proven reserves which cannot be easily accessed by nowadays conventional extraction techniques and are therefore more expensive to utilize

[11] That are undiscovered reserves that are expected to be economically exploitable

Next to figures on physical availability of fossil fuels, it remains a widespread concern, whether the global energy industry will invest into new and existing production facilities in a timely and adequate manner (Correlje & van der Linde, 2006 and Umbach, 2010). If this fails to be the case, significant physical supply shortages can emerge even without the actual reserves being close to depletion.

4.2.1.2. Development of Production Share

With respect to the development of production shares less uncertainty on the overall trends exist. Consensus exists on the fact that OECD oil and gas production shares will continue to cease, whereas OPEC oil and gas production shares will continue to increase, for oil from 42% in 2006 to 52% in 2030 (Umbach, 2010) – with the result that many players which are relevant today will lose their relevance in the coming 20 years (Asif & Muneer, 2007).[12] Despite opposing views are expressed within the literature as well, some authors even go as far as stating that the Middle East supplying countries will need to accommodate any increase in oil demand (at least in foreseeable future), as it is the only region that possesses large known reserves with the ability to scale up production relatively easy (Bielecki, 2002 and Costantini et al., (2007)).

Most significant increases in production capacity of gas will become manifest in Africa and – given the respective countries are politically stable enough for such long-term and large-scale investments – Middle East again. Some authors even express concerns on the rise of "gas-OPEC" as a consequence of the foreseeable concentration of gas production (Finon, 2007).

Overall, it is undisputed that current importing countries will become *more* dependent on *less* supplying countries (Costantini et al., 2007).

4.2.2. Future Situation: Demand-Side

According to the IEA reference scenario, global energy demand is expected to increase significantly in the future, namely about 55% until 2025/2030 if the present trend continues (IEA, 2007b) – subject to all the uncertainties described in section 4.2.1.1. above. The increase in demand is generally fuelled by the expected growth in global population (Asif & Muneer, 2007) and in particular by the increase of demand from the Asia-Pacific region (Costantini et al., 2007). Especially China and India are of tremendous importance, for example being responsible for 80% of the increase in coal demand until 2030 (Umbach, 2010). In general, shares in energy demand will shift according to overall expected economic development – that is from north to south, OECD becoming less important and the Asia-Pacific region gaining importance. This will most likely develop towards a situation of increasing rivalry and competition for global energy reserves, where receiving countries are not unified and thus cannot make us of their full potential in bargaining power (Bahgat, 2006 and Correlje & van der Linde, 2006).

Speaking in terms of the different types of fossil fuels, oil is expected to remain the fuel of choice for transportation worldwide and will therefore remain to be relatively inelastic. Its demand will thus be heavily dependent on the global development and policies within the transportation sector (Costantini et al., 2007). The market for natural gas will expand significantly in all regions and will most likely become a mature market as the market for oil is today (Umbach, 2010). This is due to new technologies that let natural gas become attractive for electricity generation in recent years – reflected in an increase from 20% to 25% in worldwide

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[12] According to Asif & Muneer (2007), that may be the case for Russia, Mexico, US, Norway, China, Brasil.

energy usage share from 2005 to 2020 (Costantini et al., 2007). Some authors argue that demand for natural gas will outpace supply, then leading to a sharp escalation of gas prices worldwide (Valentine, 2011). Clearly, huge investments into pipelines and LNG harbours will be necessary in any case. However, the largest increase in global energy demand will become manifest for coal, which is expected to increase by 73% between 2005 and 2030, again driven mainly by increased demand from China and India (Umbach, 2010 and Bang, 2010).

Summarizing these figures, fossil fuels will by far remain the most important source of energy, covering approximately 83% of the increase in global energy demand until 2030 (Umbach, 2010). This also implies that RE sources will not play a significant role for global energy supply and demand until 2030 – even in optimistic scenarios, all RE sources (including hydro-energy) will account for only 17% of the global energy mix. Only for the electricity generation sector could RE sources become the second largest contributor (Umbach, 2010). However, predictions on the development of the share of RE sources within the energy mix are explicitly subject to high uncertainty, as RE promoting polices are capable to increase the share of RE sources significantly more than expected (Bielecki, 2002).

4.3. Opposing Concepts of Global Energy Architecture

This section will give an overview on the existing forces and mechanisms shaping the contemporary global energy architecture and the resulting implications for the subject of this work.

Basically all developments of the global energy architecture can be analysed within the dichotomy of “market-based” versus “strategy-based”. The approach of most OECD countries is largely dominated by relying on market forces to balance out supply and demand in the most efficient way possible. This does work considerably well for highly integrated markets such as the European and North American home markets.[13] This market-based policy is regarded to be the outcome of a general global trend of liberalization and in particular a result of the oil crises in the 70s, after which OECD countries aimed at separating energy decisions from political considerations (Correlje & van der Linde, 2006 and Umbach, 2010). Of course, this policy has the consequence that decisions within the energy sector are taken based on profit maximization, thereby not necessarily considering long-term strategic interests and also lacking a single agent that takes up overall responsibility for reliable supply chains (Umbach, 2010).

On the other side, many supplying countries tend to regard energy exports as a tool of foreign policy – thereby denoting those decisions to very different considerations than agents acting according to the market-based approach. This can be illustrated for example by the Russian-Ukrainian gas conflict in 2005 and other blackmailing efforts of Russia against former states of the Soviet Union (Bahgat, 2006 and Umbach, 2010) or the concerted decision of the OPEC to restrain oil production in 1998-1999 (Bielecki, 2002) – only to name a few. The issue becomes even clearer when comparing company ownership structures from receiving and supplying countries. The formerly so powerful privately-owned “seven sisters”[14] nowadays control less than 10% of global oil and gas reserves – Saudi Arabia’s “Aramco” holds 20 times more oil and

[13] However, domestic market structures have not developed away from the existing oligopolistic structure that is still apparent in many OECD energy systems.

[14] After mergers and acquisitions, only six are left today: ExxonMobil, Chevron, BP, Royal Dutch Shell, Conoco Philips, Total1

gas reserves than its biggest private rival, ExxonMobil (Financial Times, 2007). In recent years, state-owned energy companies have increasingly bought energy infrastructure and licences outside of their domestic market without considering economic profitability but instead intending to create pricing power for political forces, which has resulted in an asymmetric power-relation among privately- and state-owned energy companies (Umbach, 2010).

This set-up has several implications relevant for the subject of this work. Firstly, the clash of motivations, market-based on the one side and strategy-based on the other side, results in a market where participants are acting according to different long-term goals and assumptions, which induced unpredictability and potential unreliability to the market. Secondly, the political-strategic orientation of supplier countries led to the effect that important investments into production capacities have been neglected, in part because foreign direct investments and utilization of western extraction know-how have not been accepted due to political reasons (Accenture, 2006).[15] Lastly, transparency has suffered from politically controlled production companies, resulting in overstated reserve figures and minimized production problems (Simmons, 2006).

5. Conclusion and Policy Implications

The following section will provide a conclusion on the current status of energy security of importing countries and further provide an overview and concluding evaluation of potential policy implications.

5.1. Conclusion on Status of Energy Security

The above sections have highlighted several issues that are important for a final conclusion whether importing countries should set up policies to enhance energy security or whether the current level of energy security is sufficient. The following issues may be highlighted as a summary:

Issues within the space of supply and demand:

- Generally, spatial discrepancy of reserves, production and consumption is overwhelming (section 4.1.1.) and is becoming even more significant in the future, subsequently leading to intensified physical dependency of consuming countries (section 4.2.1.2.). In itself, this does not necessarily exhibit adverse effects, but firstly supply disruptions have more severe impacts and secondly, does increased dependency come along with a shift in power-relations and bargaining power.[16]
- Depletion estimates are generally not alarming for the near future – however high uncertainty of scenarios and resulting wide range of predictions (section 4.2.1.1.) do not allow for a qualified risk analysis in that dimension.
- Demand for fossil fuels will undoubtedly continue to increase – mainly in developing countries that do not maintain close political ties with traditional consuming countries, thereby building up a potential rivalry and competition for existing supply (section

[15] Notably, neglecting Western know how does also lead to a decline in technical advantage of Western companies, as largest projects are realized by state-owned companies nowadays – as visible in the deal among Total and Gazprom on the Shtokman gas field (Milov et al., 2008).

[16] This is true for the energy system in particular but also generally holds for any system of relations.

4.2.2.). Thus, consequences for traditional importing countries are two-fold: Firstly, the desired resource is becoming scarcer and secondly, bargaining power is undermined.

Issues within the space of infrastructure and economic background:

- Again more generally, the energy system has become highly complex and interconnected to an extent that minor disruptions can propagate through the system and have implications on a global scale (section 4.1.2.) – increasing the likelihood of events with global impact.
- Spare oil and gas production and refinery capacities have diminished in recent years, leaving no buffer for unexpected supply disruptions and thereby increasing the likelihood of short-term imbalances in the global energy market (section 4.1.2.) – implying obvious adverse effects within the economic and political space.
- Resulting in part from the above, price levels and volatility have increased and will continue to do so in the future (section 4.1.3.),[17] thereby increasing the overall costs of energy supply and affecting energy security adversely in the space of affordability.

Issues within the political space:

- Generally, a far-reaching dichotomy of market participant's motives and long-term goals – market-based versus strategy-based – has been identified (section 4.3.) which holds adverse consequences for market reliability and predictability of other participant's behaviour.
- The tendency to so called "Petro-authoritarianism" (section 4.1.4.) is accompanied with a potential lack of political stability and politically influenced decisions on energy exports.
- The rise of global terrorism poses a thread as energy infrastructure has reportedly been in focus of attacks and even small scale attacks on vulnerable aspects of the global energy systems (such as marine transport routes and pipelines) can have a significant impact[18] (section 4.1.4).

The above illustrates the wide variety of issues the contemporary global energy architecture exhibits. Linking those to the theoretical background presented earlier, it becomes clear that all dimensions of energy security definitions and according evaluation criteria (section 3.1. and 3.2.) are affected adversely for importing countries: Affordability and reliability as desired goals of energy security cannot be assured. Political, physical and economic dimensions as potential sources of energy security cannot be regarded well suited for achieving the aforementioned goals. Also with respect to the time dimension, threads exist for the short- as well as for the long-term horizon.

The following three points have to be noted to present a holistic picture of the current situation of energy security:

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[17] To what extent changes in price level and volatility can be attributed to the aforementioned characteristics or more to the general financialisation of commodity markets shall not be addressed here – important is the identification of these economic developments as an issue to a country's energy security.

[18] This has to be viewed in combination with the increased complexity of energy systems as mentioned earlier.

(I) Vulnerability to energy supply disruptions is differing from sector to sector as for example the transportation sector, which is almost completely dependent on fossil fuels, is more vulnerable to energy supply disruptions than the electricity production sector, which has a more diverse supply base (Bauen, 2006).

(II) Vulnerability is also differing from source to source. This is reflected in the fact that the above issues are mainly concerned with oil and gas supply security, less so with coal. Coal is not considered critical by many authors as it is available plentiful, spread relatively even globally (as illustrated within the reserve figures in section 4.1.1.) and largest reserves are located in politically stable countries.

(III) Two opposing expectations about the future development of the international political atmosphere hold different implications: A trend towards cooperation, multilateralism and functioning energy markets would shift attention of energy security towards the physical availability and affordability as the dependence on other country's exports in itself would not be regarded problematical. Contrary, a trend towards increased competition and rivalry would shift attention more towards independence and long-term accessibility of fossil fuels (Kruyt, 2009 and Correlje & van der Linde, 2006). Sections 4.1.4. and 4.3. have illustrated that the latter describes expectation on international politics more accurately.

Still, in all scenarios a great pressure for improving the (future) energy security situation of consuming countries by setting up according policies can be identified. This concluding analysis is also shared within the literature, for example by the authors Kruyt, (2009); Correlje & van der Linde, (2006); Bielecki, (2002); Yergin, (2006); Costantini et al., (2007) and Umbach, (2010) to name a few.[19]

5.2. Policy Alternatives

After having identified the need to set up policies that enhance energy security, the following sections will present an overview on potential policy options – divided by non-RE-based and RE-based policies – and will finally provide a weighting of advantages and disadvantages of the various options.

5.2.1. Non-RE-Based Policies

Non-RE-based policies can be structured according to the following categories.

Strategic Reserves

A tool that is already commonly used is the setup of strategic reserves. Those can be utilized to substitute short-term supply interruptions and can thus be seen two-fold: As an infrastructural tool that balances out short-term supply interruptions based on technical difficulties, natural disasters, terrorist attacks, etc. and further as a tool of deterrence against politically motivated supply stops (U.S. Department of Energy, 2015a). Strategic reserves are in place for the US as well as for the EU, Asian countries are also starting to build up similar facilities (Bielecki, 2002).

[19] As a side-note to this general conclusion: Even when analysing the need for market-intervening policies based upon *neoclassical, economic* assumptions, a certain degree of market failure can be identified that provides the questioned justification. This becomes apparent for example with respect to monopolistic pricing power of supplying countries or the fact that energy security as a good – just like environmental concerns – is not yet properly priced by the market (Bielecki, 2002; Bauen, 2006 and Löschel et al., 2010).

This tool can clearly only be seen as a short-term measure and thus does not help to significantly improve long-term energy security – except of its function as a deterrence tool, exhibiting the potential to increase long-term reliability of more hostile countries (Bauen, 2006).

Measures to Increase Reliability of Supplying Countries

There is a broad set of potential tools that are designed to ultimately increase the reliability of supply flows. Firstly a set of measures that rely on a general atmosphere of cooperation in international relations is described, followed by a set of measures appropriate for a more rivalling international atmosphere:

Organizations which are supporting or setting rules and norms for the international trade in energy such as the International Energy Forum (IEF), the International Energy Agency (IEA), the World Trade Organization (WTO), amongst others or also more bilateral efforts such as the "EU-Russia Energy Dialogue" or the "Interstate Oil and Gas Transport to Europe Dialogue" with countries neighbouring the Caspian Sea can be strengthened in order to ease the general cooperation.

To increase technical reliability, promoting foreign direct investments is the main tool to disseminate technology and improve production and transportation capacities (Correlje & van der Linde, 2006) – given the target country is economically open.

More designed towards rivalling supply countries, a strategy of creating mutual dependency can be implemented for example by promoting non-energy exports to supplying countries, thereby deterring those from cutting off energy exports as the result would be a mutual trade embargo (Bahgat, 2006 and Costantini et al., 2007).

Further, the establishment of strong national energy companies that can economically compete against the existing national energy companies of supplying countries could help gaining more direct access to reserves (Correlje & van der Linde, 2006). Of course, this strategy is limited by the geographical location of resources as even the strongest company cannot buy oil or gas field licenses if the owning country does not allow such a transaction.

Very drastically, military capacity can be build up and focussed more towards intervening in countries that possess fossil fuel reserves or – more friendly – guaranteeing their safety and stability (Correlje & van der Linde, 2006). Military intervention under the presumption of securing access to energy reserves has been undertaken by the US in the Middle East for a long time – it is difficult to examine whether this strategy has strengthened or weakened the regions stability and could thus be regarded successful or not. However, it has been estimated that it came along with a cost of approximately US $6.8 trillion between 1976 and 2007 for the US (Valentine, 2011), highlighting the tremendous efforts such a strategy is linked with.

Not following the dichotomy of a generally cooperative or rivalling international atmosphere, energy policy can in any case be put more in focus of international foreign relations – especially international trade policies – denoting it to strategic considerations (thereby changing the currently dominating market-based doctrine of the west) (Correlje & van der Linde, 2006).

All those measures to increase reliability of supply flows are unquestionable aimed at increasing long-term energy security and have been used in the last century to a certain degree, varying from country to country – with considerable success, as the overall stable supply of energy demonstrates. However, they are naturally limited by certain boundaries: Ideologically motivated regimes will perhaps not be significantly influenced by mutual trade dependency, international organizations or strong energy companies and will not allow foreign controlled investments into their energy sector – the same limitations arise for ethnically or politically instable countries. Thus, this set of measures is most effective for countries that are requiring a "push to the right direction", but cannot fundamentally change preconditions for reliable supply flows.

Reducing Demand

The most direct way to achieve a lower level of demand for supplies – which is coming along with a lower level of import dependency – would be to increase domestic production, of course subject to the availability of reserves and extraction potential.[20] Further, improvements in energy efficiency and energy conservation can play a significant role in reducing overall demand.[21] For both – improvements in efficiency and conservation – a wide variety of policies are at hand, e.g. insulation improvements for real estate, encouraging mass transit and enhancing industrial efficiency. Related measures have already been widely implemented in the past, showing considerable success (Bahgat, 2006 and Sovakool, 2007). Therefore, it is expected that in the long run, improvements in energy efficiency and conservation will be one of the main pillars of any successful energy security architecture (IEA, 2006).

However, those policies are again subject to technical and social constrains – illustrated for example by the unbroken dependence on fossil fuels of the transportation sector. Also, demand reductions may in part be substituted by higher economic activities and living standards and may also not necessarily reduce demand from the actual source that is problematic in terms of energy security (for example do efficiency gains in electricity devices not decrease dependency on oil for heating and transport) (Hughes, 2009).

Increasing Diversity

Increasing diversity of supply can be done in different dimensions, namely by *origin* and by *source*. The most realistic options for diversification of *origin* is seen by utilizing new oil and gas reserves that are expected within the Caspian Sea and Black Sea, in part also within West Africa and South America (Bielecki, 2002 and Bahgat, 2006). Diversification by *source* would imply utilizing different sources of fossil fuels. This is mainly possible for the electricity generation sector, where technical options are more mature than for other sectors. Especially coal (Umbach, 2010) and uranium (Valentine, 2011) are considered to be the most realistic options, as the former is plentiful available and the latter located in politically stable countries.

Diversification efforts are naturally constrained by the physical availability of fossil fuels, availability and security of transportation and production infrastructure, technical compatibility (especially with respect to refinery capacities as for example oil refineries are highly specialized on the type of crude oil and cannot be easily enhanced to process other types of crude oil) and

[20] The recent boom in shale gas extraction in the US has demonstrated the enormous potential of increasing domestic production.

[21] The example of Denmark illustrates the enormous potential of increased energy efficiency: Over a period of 30 years, GDP has increased by 70% whereas primary energy consumption has remained the same (Liu et al., 2011)

political relations to the supplying countries (Vivoda, 2009).[22] With respect to diversification to coal and uranium, environmental concerns have to be added to the list (Valentine, 2011 and IEA, 2007a). With respect to diversification to gas, the aforementioned development of a global gas market, requiring enormous infrastructural investments, is a precondition for any diversification efforts as the currently prevailing gas trade via pipelines is inflexible and thus not diversifiable (Costantini et al., 2007; Dorian et al., 2006 and Umbach, 2010). Further, among the most important limitations of a diversification strategy is the fact that it cannot provide any safety against economic spill-over effects once the global market for fossil fuels is affected as a whole (Kruyt, 2009).

As the overall reliability of supply genuinely increases if more sources are at hand, diversification efforts can in general be regarded very effective to increase energy security. However, due to the constrains illustrated above, in fact there are very limited options for diversification for most countries – in addition, one should keep in mind that current existing options are even diminishing in the future, as the increasing concentration of global reserves and rising demand is working against the goal of diversification (Umbach, 2010 and Bang, 2010). Also, it has to be noted that the largest oil importers already have sophisticated diversification policies in place but failed to significantly reduce dependency on Middle East oil (Vivoda, 2009).

5.2.2. RE-Based Policies

On the background of this work, RE-based policies are basically regarded to be all those policies that promote the utilization of RE sources for energy production – ranging from economic incentive schemes, support for RE research to legally binding quotas. RE sources differ with respect to their technical characteristics (wind, solar, hydro, geothermal, wave and tide, etc.).[23] To keep the paper slim, please refer to Van Dijk et al., (2003) and Jacobson (2009) for a detailed description of policy-schemes and technical details.

Before analysing pro's and con's of RE sources, the following has to be considered: Almost all economically and technically mature options of RE sources are designed towards generating electricity – which provides substitutive effects for natural gas, coal and uranium as those are heavily used for electricity generation as well, but which does not directly reduce demand for oil imports in the contemporary world, as oil is not significantly used for electricity generation. A substitutive effect for oil would occur, if electricity would become increasingly important for the transportation and heating sector where oil is more heavily used – fostering this can of course be an integral part of a RE-based policy strategy. The only exception is apparent for thermal RE sources (based on solar or geothermal energy), that could directly replace oil as a source for heating. Still, global demand for electricity is expected to increase sharply in the future and energy used for electricity generation is thus of tremendous importance with respect to direct import dependency (Valentine, 2011).

[22] Especially the political situation surrounding the Caspian Sea exhibits high conflict potential, as the legal status of the fossil reserves below the Caspian Sea has remained subject to disputes for decades (Bahgat, 2006).

[23] The different policy-options will not be evaluated in detail, as the subject of this work is not focussing on the effectiveness of the individual policy options, but whether the promotion of RE in general is a vital tool to enhance energy security. Also, the different technical options for RE sources will only be evaluated as far as the technical characteristics have implications for the goal of enhancing energy security.

RE sources exhibit a wide range of advantages and disadvantages. A main argument against the utilization of RE sources are the high costs for infrastructure enhancements,[24] as the electricity system would need to be equipped for balancing out an increasingly dynamic supply[25] that is coming along with a larger share of RE sources[26] – for example by increasing buffer capacities and extending the geographical reach of the grid. Further, a general risk emerges as variations in supply could potentially add up to an extent that cannot be buffered any more, resulting in temporary power shortages. Another disadvantage that is difficult to evaluate is concerning the maturity of technologies, as many RE-based technologies are rather new compared to historically proven fossil-fuel based technologies – the major exception being hydro- and wind-energy, which is regarded to be relatively mature. Finally, a natural limitation for the utilization of RE technologies exists as those also require certain natural preconditions e.g. with respect to the degree of solar radiation or wind intensity. Especially increasing demand for biomass could lead to the moral dilemma of clean energy versus food supply (Johansson, 2013). Related to this point is the fact that some rare elements[27] are increasingly used for RE technologies, having the potential to form a bottleneck if RE capacity is continuously being increased globally.

On the other side, the following major advantages can be identified: Utmost important is the potential to increase domestic supply of energy up to an autarkic supply, thereby directly reducing demand and dependency on foreign energy. A more autarkic energy supply also holds the great advantage that economic spill-over effects of global supply and demand imbalances are to some extent buffered (Kruyt, 2009). Despite the limitation with respect to natural preconditions given above holds to be true, OECD countries do have far more potential to exploit RE sources than they do exhibit fossil fuel reserves. This is illustrated on a global scale in table 3 within the appendix. Also, once developed, RE sources are – unlike fossil fuels – exploitable in an infinite time horizon. Another advantage that shall be highlighted is the decentralised character of an energy system based on many small units of RE-sources.[28] As a consequence of this decentralisation, vulnerability to a wide range of external shocks such as natural disasters, technical failures or terrorist attacks is reduced as the likelihood that all units fail at the same time is drastically reduced (Valentine, 2011; IEA, 2007a and Jacobson, 2009). Economically, incremental production costs for RE sources are trending downwards as technology progresses and no fuels are required during the production, whereas fossil fuel based technologies are trending upwards due to the growing scarcity of their inputs (Asif & Muneer, 2007; Duffield, 2009 and Valentine, 2011). Also, the common argument that utilization of fossil fuels is still cheaper than utilizing RE sources is increasingly challenged by calculating

[24] However, large-scale switches in energy infrastructure have been successfully performed in the past already, as demonstrated for example by the switch from coal to gas and nuclear power in the UK, driven by miners strikes in the early 80s or the global switch from oil to coal and nuclear due to the rising oil costs in the 70s (both with respect to electricity generation) (Hughes, 2009).

[25] Hydro-plants may even hold a RE-based technique to balance out short term supply fluctuations, as hydroelectric power plants have a reaction time of 15-30 seconds when being operated in spinning-reserve mode (Jacobson, 2009).

[26] Despite this being true, it should be mentioned that for example US coal plants are down due to unscheduled maintenance for 6.5% of their producing times. Pure technical availability ratios – not considering low winds – of wind turbines is far better (Jacobson, 2009).

[27] tellurium, ruthenium and indium for solar energy, lithium for batteries, platinum for fuel cell vehicles and neodymium in modern wind power plants (Johansson, 2013)

[28] A major exception here being large hydro-dams, which provide a similar quantity of energy as large conventional power plants and are thus evenly vulnerable to external shocks.

levelized costs – as illustrated in table 4 within the appendix. Pricing in externalities of fossil fuels (such as decommissioning costs of nuclear power plants or adverse environmental effects) further increase economic attractiveness of RE sources (Valentine, 2011). Consequently, Sovakool (2008), concludes that "*...the sheer difficulty with promoting renewables is not economic but social and political.*" (Sovakool, 2008: p.27). This view is also shared by Ernst & Young, (2014).

5.3. Conclusion on Policy Alternatives

To reach a general conclusion on whether RE-based policies provide a more effective tool to improve energy security than non-RE-based policies do, the extent to which the issues summarized in section 5.1. are addressed has to be evaluated.

It is crucial to understand that the effect of both options – RE-based and non-RE-based – is very different in nature. Non-RE-based options may improve one or several of the identified issues, whereas RE-based options open a fundamentally new dimension within the space of energy security: A (potentially) autarkic supply – coming along with great advantages, but also with new challenges. Also, promotion of RE is in fact just a more radical type of diversification (as long as energy supply is not solely based on RE sources).

If achieved, an autarkic energy supply would solve most of the issues mentioned in section 5.1. at once: Issues coming along with spatial discrepancy of supply and demand, depletion of reserves, increasing demand from rivalling countries, to some extent energy price increases and fluctuations and – due to the lack of imports – also all issued from the political space (energy blackmailing, petro-authoritarianism, etc.). On the other side, new issues would be created that in part do replace existing issues, mainly with respect to the infrastructural space: Complexity and vulnerability of the global energy system would be converted into complexity of the domestic or regional energy system. The lack of spare production and refinery capacity would be replaced with an increased fluctuation in supply. Finally, high costs of setting up a new infrastructure (considering RE-based transportation policies) or extending the existing infrastructure (considering enhancements of the electricity system) would need to be accounted for – therefore replacing costs for international military interventions (referring especially to the US) and similar costs for enhancing existing fossil fuel based infrastructure (especially with respect to the developing gas market). Another disadvantage of RE-based policy options clearly is the long time horizon they do require to show significant effects.

On the other side, non-RE-based policies do not have this far reaching potential for improving energy security as all of the options come along with serious shortfalls and limitations, as described in section 5.2.1. Admittedly, a mix of all of these options with a focus on efficiency and conservation gains and diversification of supply may significantly increase energy security in the short- to medium-term, but in the long run, the fundamental aspects will overrule any of such policies.

Following these considerations, RE-based-policies can be regarded superior to non-RE-based policies in terms of enhancing energy security – given the following assumptions:

1. Long-term energy security is valued more than short-term security improvements.
2. Costs for infrastructural changes and incremental production costs of RE sources behave as predicted and stay in acceptable boundaries.

3. Developed and emerging economies as well as supplying and receiving countries keep competing for existing resources and do not reach a status of cooperation and multilateralism.
4. Unexpected[29] fossil fuel reserves that significantly prolong global depletion estimates while being easily exploitable and located in stable countries will not be discovered.

The conclusion that RE-based policies are superior to fossil-fuel-based policies is shared in the literature (e.g. Menegaki, 2011 amongst others) – nicely formulated for example by Valentine (2011): "*Fossil fuel is no longer in a symbiotic relationship with energy security; the relationship has become parasitic*." (Valentine, 2011: p.4577).

6. Hypothesis

The hypothesis of this paper is based upon the following two crucial conclusions, which have been derived in this work and stated in section 5.1. and 5.3.:

1. The current and prospective status of energy security holds sufficient social, economic and political pressure on consuming countries to set up policies targeted at improving energy security.
2. Given the assumptions stated above, RE-based policy measures are superior in reaching this goal than non-RE-based policies.

Based on the above conclusions and the fact that energy supply of the countries in focus is largely achieved by energy imports, the following hypothesis is formulated:

"The more a country is dependent on fossil fuel imports from unreliable countries, the more it will promote RE sources."

The according null-hypothesis:

"The extent to which a country is dependent on fossil fuel imports from unreliable countries has no effect on the promotion of RE sources."

Importantly, the suggested underlying mechanism is of political-strategic nature[30] and involves human decision making: The less reliable energy imports are perceived to be, the more does the political process generate RE-promoting policies. Following this, the dependent variable needs to approximate the promotion of RE sources, whereas the explanatory variable needs to approximate the level of perceived import dependency. Some indicators later on are geared

[29] „Unexpected", not in the sense of not being discovered yet but in the sense of not even being expected to be discovered. Example: Reserves below the Arctic Ocean are expected, but not yet fully discovered.

[30] As a side-note to this: Potential private-economy mechanisms – such as big energy consuming companies participating in wind farms to circumvent expected energy supply shortfalls – could be present as well but are not considered relevant – neither in the literature, nor within this analysis. In fact, from the private-economy perspective import dependency is not considered to be a dramatic issue as otherwise political actions would not be necessary in the first place.

specifically towards detecting *perceived* and not *actual* import dependency[32], which makes it important to highlight the difference of both at this point.

7. Operationalization and Dataset

The following section describes how the variables derived in section 6 will be operationalized. Source references for all data are available in within the bibliography, section 14. Section 7.1. describes the dependent variables employed on the left hand side of the final estimation equation, whereas section 7.2. and 7.3. describe the independent variables employed on the right hand side of the final estimation equation (as defined in the formula in section 8).

All of the variables described have been gathered for 32 OECD countries[34] from 1990 to 2010 and the respective country-pairs evolving from the identified energy trading patterns. A summary of the data is given in table 5 within the appendix.

7.1. Dependent Variable

As discussed, the promotion of RE sources needs to be tracked as the dependent variable. This is achieved two-fold: Capturing the effect in a direct manner (group I), the implementation of RE-promoting policies is tracked. However, as implementation of policies does not necessarily correctly approximate a country's actual effort – 10 weak policies can be less effective than 1 strong policy – also the share of RE sources (group II) is utilized, assuming that a country's effort manifests in a higher share of RE sources. The latter is tracking the hypothesis more indirectly and exhibits a certain time lag. This time lag is addressed in a model extension in section 10.1.

7.1.1. Group I: Count of Renewable Energy Policies

Data on policies directed towards the promotion of RE sources are extracted from the IEA/IRENA Global Renewable Energy Policies and Measures Database, made available by the International Energy Agency. Two different dependent variables are calculated from that source:

i. The total sum of active RE policies (amount of established minus amount of discontinued policies) for the respective year and country. Henceforth, the variable is named *TOTALPOL.*
ii. The second variable is calculated from the implementation of Feed-in-tariffs or Green Certificates. As soon as one of these types of policies has been implemented, the binary indicator for the respective country switches to one. Henceforth, this variable is named *FITORCERT*.

Both indicators are utilized to allow for the possibility that perhaps not the total amount of policies is correctly approximating a country's effort, but rather the implementation of those

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[32] See for example those indicators capturing differences in culture or religion, which do not necessarily affect the actual import dependency but which potentially influence the import dependency as it is perceived by political decision makers.

[34] Namely Austria, Australia, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Luxembourg, Mexico, Netherlands, Norway, New Zealand, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States

economic incentive schemes which are regarded to be most important within the literature, namely Feed-in-tariffs and Green Certificates (Schaffer & Bernauer, 2014 and REN21, 2012). In particular feed-in-tariffs have proven to be very effective, as shown empirically by Dijkgraaf et al., (2014) and are also mentioned to be the most commonly used incentive scheme globally (van Dijk et al., 2003 and REN21, 2012).

7.1.2. Group II: Share of Renewable Energy Sources

The following indicators are employed in the models capturing the share of RE sources:

i. Contribution of renewables to total primary energy supply. Data are extracted from the OECD Factbook 2010 and OECD Factbook 2011-2012.[35] RE sources include the primary energy equivalent of hydro (excluding pumped storage), geothermal, solar, wind, tide and wave and energy derived from solid biofuels, biogasoline, biodiesels, other liquid biofuels biogases, and the renewable fraction of municipal waste. Henceforth, this variable is called *SUPSHARE*.
ii. Share of renewable energy in electricity consumption. Data are provided by Eurostat utilizing the SHARE (**SH**ort **A**ssessment of **R**enewable **E**nergy **S**ources) tool, which has been designed to achieve a harmonized reporting of RE shares among EU member states. RE source shares have been calculated according to accounting rules defined in the Directive 2009/287EC (European Commission, 2009). The numerator includes electricity generated from hydro, wind, bio liquids, biogases, geothermal, solar, tide and wave, renewable municipal waste and solid bio fuels. The denominator is defined as the gross electricity consumption, which is the total electricity production from all energy sources plus imports and minus exports of electricity. Henceforth, this variable is called *CONSHARE.*

Both RE share indicators are employed, as the former covers a greater set of countries and a larger timeframe and therefore ultimately allows for a larger data sample, whereas the latter provides an advantage in terms of harmonized calculation, thereby decreasing the risk of inconsistent data collection. Utilizing both is also encouraged by the fact that they do exhibit considerable differences for some countries, indicating that the different estimation methodologies do affect the data.

7.2. Independent Variables: Explanatory Variables

The explanatory variables form the core contribution of this work to existing research and vary for each of the models employed in section 8. As discussed in section 6, the explanatory variable ultimately needs to quantify a degree of perceived import dependency for each year and country. Based on the assumption that perceived import dependency is determined by the reliability of energy exports from supplying to receiving countries, quantifying a degree of perceived import dependency is achieved by combining a measure for the quality and/or reliability of state relations (henceforth called “relation indicator”) with energy supply patterns. Every relation indicator will be evaluated within a separate econometric model to avoid inferences.

[35] Both issues of the OECD Factbook have to be utilized, as they provide a broader time horizon when combined. Method of data collection is equal over both issues and therefore data can be combined to one set without problems of consistency.

For the sake of completeness, it has to be mentioned that *quantifying* the *quality* of state relations will be never be flawless, irrespective of the indicator employed. This potential weakness is two-folded: Firstly, it is difficult to define which dimensions are actually relevant for the quality of state relations and secondly, measuring these dimensions is difficult as well. Utilizing different concepts of state relations and employing most reliable data sources is attempting to overcome this potential issue.

7.2.1. Indicators for State Relations

Different relation indicators are employed to account for different possible concepts that may determine the quality of relations among states. All different relation indicators result in a single value per country pair[36] – henceforth called "relation value". To receive the final dependency value, the relation values are ultimately averaged over all country pairs of a single importing country and its supplying countries, weighted by the respective energy import volumes. This process is described in detail in section 7.2.2.

To keep the methodology as simple as possible, the relation values are refined in a way that the final calculation of dependency values is done similar for all indicators. The according refinement is outlined per indicator in sections 7.2.1.1. – 7.2.1.3. below. Further, relation values are consistent in the sense of reflecting weak (strong) or unreliable (reliable) country relations with high (low) values. This allows for a consistent interpretation of signs across different types of indicators in the evaluation of regression results in section 9.

The relation indicators can be roughly grouped into three different types: Stability and reliability of the supplying state (I), trust and social proximity among supplying and receiving country (II) and strength of ties among supplying and receiving country (III).

7.2.1.1. Indicator I: Stability and Reliability

Stability and reliability of the energy supplying country play a crucial role in evaluating whether dependency on energy supply may be perceived to be problematic or not. Potential threads to energy security of the receiving country are explained straight forward: Unexpected supply disruptions that may be caused by social unrest or a lack of investment into production capacities of the supplying country. The hypothesis underlying this group of relation indicators claims that the more politically or socially unstable a country is, the more likely it is that such supply interruptions emerge. Being supplied by very unstable countries thus should increase the pressure to decrease dependency on fossil fuel imports.

To quantify stability and reliability of a country, the following indicators are employed:

<u>Violations of Human Rights</u>

The situation of human rights may very generally track the socioeconomic stability of a country – based on the assumption that the less human rights are respected, the more likely social unrest and resulting domestic crises emerges. Further, a lack of human rights is often coinciding with a lack of functioning institutions – admittedly, there are some major exceptions that do not match these assumptions such as Saudi Arabia or the Russian Federation, which posses a high value for violations of human rights but can generally be considered as relatively stable countries.

[36] In the case of time-variant indicators also varying per year

Data have been obtained from the "CIRI Human Rights Data Project" which provides quantified measures of several dimensions relevant for human rights. Most relevant for the purpose of this paper is the physical integrity index, which is composed from measures on torture, extrajudicial killing, political imprisonment, and disappearance indicators.

The following data refinement has been performed:

1. Scale has been turned around to reflect a bad human rights situation with a high value.
2. To avoid multiplication with zeros, "0"-values have been transformed to ="0,1".
3. To receive relative values, [37] individual observations are divided by the average of observations.
4. 73 missing observations have been replaced with the value of the preceding year.

<u>Country Stability and Governance</u>

This indicator tracks a somehow broader perspective on a country's stability than the human rights situation does, as it takes more dimensions into account and also accounts for the quality of governance. On the one hand this provides the advantage of getting a more holistic view which might be capable of mirroring a country's overall situation more accurately than focusing only on the situation of human rights – and therefore avoids exceptions as appearing within the human rights indicator (such as Saudi Arabia or the Russian Federation, as mentioned). On the other hand, some of the dimensions included – such as "Voice and Accountability" – might not cause a thread to a country's stability per se, as it depicts a rather "soft" dimension.

Data are provided by the Worldbank through the "Worldwide Governance Indicators" project. The following six dimensions are quantified: Voice and Accountability (approximating the extent of freedom of expression, freedom of association, existence of free media and citizens ability to participate in governmental elections), Political Stability and Absence of Violence/Terrorism (approximating the likelihood of political instability or politically-motivated violence), Government Effectiveness (approximating the quality of public services, civil services and policy implementation and its independence of political pressure), Regulatory Quality (approximating the soundness of policies and regulations with respect to private sector development), Rule of Law (approximating the confidence of agents in rules of society, in particular contract enforcement, property rights, the police and courts) and Control of Corruption (approximating the extent to which public power is misused for private gains). A more detailed description on these dimensions can be found online as indicated within the references.

The following data refinement has been performed:

1. The six dimensions mentioned above have been averaged to one value per country and year.
2. Scale has been turned around to reflect a bad stability situation with a high value.
3. To avoid negative values, all values have been increased by two.
4. To receive relative values, individual observations are divided by average observation.

[37] As a side-note to this process of relativization: Of course, referring to McCune & Grace, (2002), different options to achieve a relativization of observations are at hand, however dividing by the average is regarded to be most reasonable as it doesn't flaw the data and creates comparable measures across all indicators.

5. Missing values for 1997, 1999 and 2001 have been replaced with the average of the preceding and succeeding year.

The following table provides an overview of data from indicator group I after the refinements mentioned above (but before calculation of relative values and replacement of missing values):

Indicator	No. of Observations			Min. Value	Max. Value	Avg. Value
	Countries	Time-frame	Total Observations			
Human Rights – Physical Integrity Index	80	For most countries: 1990 – 2011	1687	0,10	8,00	2,85
Country Stability and Governance	83	1996 – 2013	1245	0,01	4,23	1,79

7.2.1.2. Indicator II: Trust and Cultural Proximity

This group of indicators approximate perceived import dependency through a rather indirect mechanism by assuming that a general existence of trust and social or cultural proximity is beneficial for the quality of country relations. This can hold through a variety of channels, may it be ease of political negotiations through better mutual understanding or general strength of public and individual ties that are fostered through trust and cultural proximity. The resulting underlying hypothesis is that countries which do exhibit a high level of trust and cultural proximity amongst each other are less likely to use energy exports as a tool of foreign policy and thus are perceived to be less problematic to be dependent upon. Consequently, being supplied by non-trustworthy and culturally dissimilar countries thus should increase the pressure to decrease dependency on fossil fuel imports.

To quantify trust and cultural proximity of two countries, the following indicators are employed:

Differences in Religion

Potentially a very insightful approximation for differences in values and the perception of mutual trust and cultural proximity is the difference of the religious composition of two societies – not only taking into account different types of faith such as Christianity, Islam or Judaism but also the share of religious versus non-religious population. Advantage of this type of measurement is the relatively simple matter – usually religious affiliation is defined clearly and unquestionable – which should ensure a flawless dataset. Disadvantageous for this indicator is the fact that religious affiliation might only reflect a limited share of what defines a societies set of values and thus might erroneously return high (low) cultural differences for countries with different (similar) religions whereas in reality they have a good (bad) trust base.

Data have been obtained from the “World Religion Project” which provides share-wise information on the composition of religious affiliation of a broad set of countries. To avoid high difference values for different religious streams, the aggregate figures for Christianity, Judaism, Islam and Buddhism have been used – instead of their individual streams such as Catholicism or Evangelism.

The following data refinement has been performed:

1. Hindus and Sikhs have been added to “Other Religions” for simplicity.

2. Five-yearly observations have been averaged for simplicity.[39]
3. The difference value per country pair is calculated by adding up the absolute differences in religious shares according to the following example:

	Christians	Jews	Moslems	Buddhists	Others	Non-Religious
Netherlands	0,68	0,00	0,05	0,01	0,01	0,25
Germany	0,72	0,00	0,04	0,00	0,02	0,22
Absolute Difference	0,04	0,00	0,01	0,01	0,01	0,03
Final Difference Value	Sum of differences = 0,04+0,01+0,01+0,01+0,03 = **0,08**					

4. To receive relative values, individual differences are divided by the average difference.

<u>Cultural Differences</u>
A second indicator employed to measure cultural proximity is the "Gert Hofstede Cultural Dimensions" index. Clear advantage of this indicator is the holistic approach as it attempts to fully capture cultural characteristics within a number of dimensions and thus is potentially able to provide more accurate measures of cultural proximity than religious affiliation. The index exhibits a weakness in terms of country coverage, as not all countries of interest have been fully analyzed, thereby decreasing the sample size of the respective model.

Data have been obtained from the Gert-Hofstede-Centre. Six dimensions that determine a country's culture are quantified according to standardized criteria for a set of countries. These dimensions are Power Distance (approximating "*the degree to which the less powerful members of a society accept and expect that power is distributed unequally*"), Individualism (approximating "*preference for a loosely-knit social framework in which individuals are expected to take care of only themselves and their immediate families*"), Masculinity (approximating "a *preference in society for achievement, heroism, assertiveness and material rewards for success*"), Uncertainty Avoidance (approximating "*the degree to which the members of a society feel uncomfortable with uncertainty and ambiguity*"), Long Term Orientation versus Short Term Normative Orientation (approximating how "*societies prioritize these two existential goals differently*") and Indulgence versus Restraint (approximating the extent to which "*a society [...] allows relatively free gratification of basic and natural human drives*" versus "*a society that suppresses gratification of needs and regulates it by means of strict social norms*") (all quotes of this paragraph: http://geert-hofstede.com/national-culture.html). A detailed description on the composition of the different culture dimensions is provided online as indicated within the references.

The following data refinement has been performed:
1. Arabian countries[40] which do not have their individual measurement have been given the values from the aggregate observation "Arab countries".
2. Final difference value per country pair is calculated similar as for the culture indicator described in above.

[39] This does not significantly reduce explanatory power as religious composition is changing only incrementally over the period covered.
[40] United Arab Emirates, Kuwait, Libya, Oman, Qatar, Yemen, Tunisia, Syrian Arab Republic. For Iraq, Saudi Arabia and Jordan, only the first four dimensions were missing.

3. To receive relative values, individual differences are divided by the average difference.

The following table provides an overview of data of indicator group II after the refinements mentioned above (but before calculation of relative values):

Indicator	No. of Observations			Min. Value	Max. Value	Avg. Value
	Country Pairs[41]	Time-frame	Total Observations			
Religious Composition	2706	Time invariant	2706	0,00	2,54	0,92
Cultural Dimensions	1734	Time invariant	1734	18,88	313,11	154,36

7.2.1.3. Indicator III: Strength of Ties

Whereas indicator group II measures dimensions that may form the foundation for a trustworthy or friendly relation of countries, the following indicator group aims at capturing the actual existence of such relations – not taking into account why these good relations may have developed. Perceived import dependency is thus affected through a straight forward hypothesis: A country is more confident with being dependent on energy supply from a country to which it has good and intense relations with – except of trading fossil fuels.

To quantify strength of ties of two countries, the following indicators are employed:

<u>Trading Volume</u>

Strong economic relations may be an indicator for robust and reliable country relations in a variety of ways. Firstly, trading always comes along with a certain level of trust in the business partner's reliability, e.g. with respect to contractual agreements and functioning of long term supply chains. Further, the existence of large trading volumes is more likely if the economies of both trading partners are generally stable and political relations are not hampering economic activity – the latter being the case for example among Iran and the United States. This indicator exhibits weakness in the sense that high trading volumes may simply have emerged through existing economic opportunities in terms of supply and demand (e.g. cheap manufacturing products from China and respective demand within Europe) and in that case may not accurately express the existence of good and reliable country relations. Also, the sheer size of a country's economy and regional adjacency is influencing the trading volume but does not necessarily express strong country relations as well. To circumvent the trading figure being influenced by the energy trade volume, only exports of the energy receiving country have been utilized.

Data on trading volume is obtained from the "Correlates of War Project's Trade Data Set" that provides trade volumes for a large set of country pairs and time period.

The following data refinement has been performed:

1. To measure the relative importance of the energy supplying country for the energy receiving country, individual export volumes are set in relation to total export volumes according to the following example:[42]

[41] Not all country pairs will be utilized for regression as they don't appear within the energy trade relations.

[42] Only using the exports of the energy receiving country also ensures that the actual energy trade volume is not affecting the trade volume.

Situation: Germany is supplying natural gas to the Netherlands (Year: 2000)
Export volume Netherlands to Germany in 2000: 44109 (current US million $)
Total export volume Netherlands in 2000: 229742 (current US million $)
Relative importance of Germany for Netherlands: 44109 / 229742 = **0,19**

2. To receive higher values for less important countries, the value of relative importance is subtracted from one. Following the example above: 1 - 0,19 = **0,81**

Diplomatic Representation

The most immediate materialization of good relations among two countries is reflected through official diplomatic representation. Countries that recognize each other and dispatch ambassadors or similar high officials to the partner country do have more reliable and functioning relations than countries that do not officially recognize each other. Clear advantage of this relation indicator is, similar to the religious indicator, the unambiguous status and the resulting flawless data set – either two countries dispatch diplomats to each other or they don't, not leaving any room for interpretation. On the contra side it has to be mentioned that firstly, diplomatic representation is a basic requirement of international politics, which only for extremely bad relations or very small countries is not given. This exhibits the econometrical difficulty that only differences on the extreme end are captured, not accounting for any subtleties and thus loosing explanatory power. Secondly, at first sight it should be doubted that two countries that do not even recognize each other would trade significant amounts of fossil fuels, thus inducing a bias in the dataset. However, interestingly the data show that there is a considerable set of country pairs that do not recognize each other but still appear in the set of country pairs trading fossil fuels intensively. Please see table 6 within the appendix for a list of those country pairs.

Data for diplomatic representation have been obtained from the "Correlates of War Diplomatic Exchange Data Set" and capture – amongst others – mutual diplomatic representation in a binary variable turning to one if at least one country has dispatched official diplomatic staff to the respective other country.

The following data refinement has been performed:

1. To receive a higher value for non-existing diplomatic representation, the binary variable has been transformed to 0,5 for existing diplomatic representation and 2 for non-existing diplomatic representation.

The following table provides an overview of data of indicator group III after the refinements mentioned above and before calculation of relative importance in case of trade volumes:

Indicator	No. of Observations			Min. Value	Max. Value	Avg. Value
	Country Pairs	Time-frame	Total Observations			
Trade Volumes	1567	1990 - 2009	29725	0,0	235479	1359
Diplomatic Representation	647	1990, 1995, 2000, 2005	2487[43]	0,5	2	0,68

7.2.2. Combination of Trading Patterns and Relation Value

After having introduced the different relation indicators, the following part is concerned with the combination of the relation value with energy trading patterns. This ultimately aims at creating the final dependency value per receiving country per year. In short, this is achieved by calculating the weighted average of relation values of all country pairs that trade fossil fuels intensively. Weighting is undertaken according to relative import volumes of the five largest supplying countries per type of fossil fuel. Calculation is illustrated in detail in two main steps below. As noted, the following is performed similarly for all relation indicators employed.

For simplicity, only crude oil, natural gas and coal as fossil fuel imports are considered. Data on respective import volumes are obtained from OECDiLibrary. For all types of fossil fuels, import volumes are the result of a flow balance calculation which is described in detail within the OECD statistical documentation. Figures on coal imports are the sum of hard coal and brown coal import volumes.

7.2.2.1. Step 1: Identification of Largest Suppliers and Calculation of Weighed Import Volumes

Based on the raw import volumes, the five largest supplying countries for each type of fossil fuels are identified per destination country and year, which results in a maximum of 15 different country pairs per year per destination country.

To account for their relative importance, each export volume is weighed against the total imports of the five largest importers of the respective type of fossil fuel. This step aims at reflecting the assumption that countries which are providing a relatively large share of another country's energy imports influence the perceived import dependency of that country more than countries with a lower share – as the inherent thread of supply disruptions would cause more severe problems.

In total, 75 different supplying countries appear, combining to 665 individual country pairs with the 32 receiving countries. The following example illustrates the calculation:

[43] The odd number of observations is explained by some countries not having observations for all four years.

Destination Country: Netherlands Year: 2010 Fossil Fuel Type: Crude Oil						
	1st Largest Supplier	2nd Largest Supplier	3rd Largest Supplier	4th Largest Supplier	5th Largest Supplier	Total Supply
Supplying Country	Russian Federation	United Kingdom	Norway	Saudi Arabia	Nigeria	/
Export Volume (000 metric tons)	16.939	6.351	5.869	4.202	3.675	37.036
Relative Weight (Formula)	16.939/ 37.036	6.351/ 37.036	5.869/ 37.036	4.202/ 37.036	3.675/ 37.036	37.036/ 37.036
Relative Weight (Value)	**0,46**	**0,17**	**0,16**	**0,11**	**0,10**	**1**

7.2.2.2. Step 2: Calculation of Relation Value

Subsequently, the relation indicators measuring the quality of state relations as described in sections 7.2.1.1. – 7.2.1.3. are included into the calculation in two steps of aggregation. First, the relation value is multiplied with the respective weight of the country pair and summed up per type of fossil fuel. The following example illustrates the calculation for crude oil (calculation for natural gas and coal is done in a similar manner).

Destination Country: Netherlands Year: 2010 Fossil Fuel Type: Crude Oil Relation Indicator: Human Rights					
Country Pair	NL – Russian Federation	NL – United Kingdom	NL – Norway	NL – Saudi Arabia	NL – Nigeria
Relative Weight (copied from table above)	0,46	0,17	0,16	0,11	0,10
Relation Value (example: Human Rights)	2,17	0,36	0,36	2,53	2,17
Weighed Relation Value (Formula)	2,17*0,46	0,36*0,17	0,36*0,16	2,53*0,11	2,17*0,10
Weighed Relation Value (Value)	1,00	0,06	0,06	0,28	0,22
Crude Oil Relation Value	Sum of Results = (1,00+0,06+0,06+0,28+0,22) = **1,62**				

Secondly, the resulting final relation values for the three types of fossil fuel are averaged to receive one single value for the relative import dependency per destination country per year, as following:

	Relation Value		
Fossil Fuel Type	Crude Oil	Natural Gas	Coal
Relation Value (see table above)	1,62	0,65	1,00
Final Relation Value	Average of Relation Values = (1,62+0,65+1,00)/3 = **1,09**		

Consequently, 1,09 is included into the regression model to quantify the perceived import dependency for the Netherlands in 2010 when considering the situation of Human Rights as a proxy for the quality of state relations. This value changes if a different indicator for the quality of state relations is employed. In case of missing observations[44] or no imports at all, a "1" has been included. Due to the relativization, this is a neutral number in the framework of this paper. If an observation is missing systemically for specific years, the observation is left out from the analysis.

The methodology outlined above allows for quantification of perceived import dependencies, weighed by the relative importance of supplying countries. Core advantages are that on the one hand it reflects that some countries are more or less problematic in terms of strategic dependency than others by including a proxy for the quality of a relation between two countries. On the other hand, it accounts for the relative importance the respective country possesses in the supply mix of the destination country – in our example, the human rights situation within the Russian Federation is influencing the relation value for oil imports for the Netherlands much stronger than the human rights situation within Saudi Arabia, as the Russian Federation supplies much more oil to the Netherlands than Saudi Arabia.

For completeness, it has to be mentioned that data on energy import patterns exhibit a potential weakness as they are suspected to be influenced by political considerations that could avoid transparent documentation of international energy flows. Still, the data employed are the most reliable source available.

7.2.2.3. Combination of Relation Value and Import Volumes: Formula

The following describes the methodology in formula.

$$Perceived\ Import\ Dependency = \frac{RV\ Coal + RV\ Oil + RV\ Gas}{3}$$

with:

$$Relation\ Value\ (RV) Coal = (RV_{A,C_1}W_{C_1}) + (RV_{A,C_2}W_{C_2}) + (RV_{A,C_3}W_{C_3}) + (RV_{A,C_4}W_{C_4}) + (RV_{A,C_5}W_{C_5})$$

$$Relation\ Value\ (RV)\ Oil = (RV_{A,O_1}W_{O_1}) + (RV_{A,O_2}W_{O_2}) + (RV_{A,O_3}W_{O_3}) + (RV_{A,O_4}W_{O_4}) + (RV_{A,O_5}W_{O_5})$$

$$Relation\ Value\ (RV)\ Gas = (RV_{A,G_1}W_{G_1}) + (RV_{A,G_2}W_{G_2}) + (RV_{A,G_3}W_{G_3}) + (RV_{A,G_4}W_{G_4}) + (RV_{A,G_5}W_{G_5})$$

with:

$$RV_{A,X_i} = Relation\ Value\ for\ Countrypair\ A\ and\ X\ (determined\ by\ relation\ indicator)$$

[44] Importantly, replacement of missing values at this stage is not to be confused with replacement of missing values at the indicator-stage (as described in the respective sections in detail). Here, for some country-pairs the respective indicator has just not been defined at all, which is why the true value cannot be approximated – as is done for the missing observations within the indicator values.

$$W_{X_i} = \frac{EV_{X_i}}{\sum_{k=1}^{5} EV_{X_k}} = Weight\ of\ Country\ X\ among\ Top\ Five\ Suppliers\ of\ Country\ A$$

with:

$EV_{X_i} = Export\ Volume\ Country\ i\ to\ Country\ A\ for\ Fossil\ Fuel\ X$

$i \in (1, \dots, 5) = Top\ Five\ Supply\ Countries$

$X \in (C, O, G) = Different\ Types\ of\ Fossil\ Fuels$

7.3. Independent Variables: Controlling Variables

As mentioned in section 2.1., the paper from Aguirre & Ibikunle, 2014 which is most closely related to this work, is used to retrieve controlling variables. All predictor variables that have showed a significant impact on RE utilization are being incorporated into all of the models employed. These are (variable names in brackets): CO_2 emissions (*CO2*), ratification of the Kyoto protocol (*KYOTO*), energy use (*ENEUSE*), contribution of traditional energy sources to the energy mix (coal (*COALPART*), gas (*GASPART*), nuclear (*NUCLEARPART*) and oil (*OILPART*)), country-specific RE potential (biomass (*BIOMASS*), solar (*SOLAR*) and wind (*WIND*)), industrial electricity prices (*INDUSTRY*) and continuous commitment (*CONTCOM*). For a more detailed description on their composition, please refer to Aguirre & Ibikunle, (2014).

8. Model Specification and Testing Procedure

As the data set covers multiple countries over multiple years, panel data techniques can be employed. This allows controlling for unobservable characteristics that differ across countries as well as unobservable effects that change over time and affect all countries simultaneously (Torres-Reyna, 2007). Further, the utilization of panel data naturally leads to a higher number of observations and thus higher robustness of results and also reduces the problem of multicollinearity (Caporale & Cerrato, 2004).

The final regression equation is dependent on the respective indicator and dependent variable that is employed. The general form is as following:

$$\gamma_{it} = \beta_0 + \beta_1 x_{it} + \beta_2 z_{it}^{'} + \alpha_i + b_t + u_{it}$$

γ_{it} = dependent variable:
CONSHARE, *SUPSHARE*, *TOTALPOL* **or** *FITORCERT*
β_0 = intercept (not used for Fixed Effect estimator)
β_1 = coefficient for explanatory variable
x_{it} = explanatory variable according to indicator:
CULTUREDIF, *RELIGIOUSDIF*, *STABILITY*, *HUMANRIGHTS*, *TRADE* **or** *DIPLOMREP*
β_2 = coefficient for controlling variables
$z_{it}^{'}$ = vector of controlling variables as defined in section 7.3.
α_i = country random or fixed effects (not used for OLS estimator)
b_t = year fixed effect
u_{it} = error term (refined according to section 7.1.3.)

To avoid any interference, all of the dependent and explanatory variables are employed separately which results in a total number of 24 models being regressed. Taking into account the different estimators, a total of 72 regressions have been performed in the main model.

8.1. Testing Procedure

The following econometric tests have been performed.

8.1.1. Multicollinearity

The appearance of multicollinearity has adverse effects on reliability of the regression output, as it inflates the variance of estimated coefficients. Multicollinearity is present, if independent variables are highly correlated among each other (Harshada, 2012 and Menz & Vachon, 2006). Testing for multicollinearity is usually done by checking Variance Inflation Factors, which is not possible for the particular type of regression employed in the models later on.[45] Therefore, a correlation matrix of all involved explanatory and controlling variables has been created. Based on the correlation figures presented in table 7 within the appendix, the presence of multicollinearity can be rejected, as none of the correlation coefficients is sufficiently high enough.[46]

8.1.2. Unit Roots

As correct estimation of coefficients requires the data series to be stationary, the dependent variables are being tested for the presence of unit roots. For panel data, several specific unit root tests have been developed according to different asymptotic assumptions. For the data employed in this paper, the Harris-Tzavalis fits best, as it assumes a higher number of entities (in this case 32 countries) than time horizon (in this case 21 years). The results as presented in table 8 in the appendix indicate the presence of a unit root for *TOTALPOL* and *CONSHARE*, whereas the other variables are found to be stationary.

To solve the issue of unit roots, first differences of the affected variables are created (*D_TOTALPOL* and *D_CONSHARE*). Another Harris-Tzavalis test (appendix: table 8) with *D_TOTALPOL* and *D_CONSHARE* shows that the problem of unit root has indeed been solved by this procedure

Further, the detection of unit roots in the data sample has motivated the utilization of a First-Difference estimator for the affected variables.

8.1.3. Heteroskedasticity and Autocorrelation

Heteroskedasticity is present, if the variation of the error term differs across the observations. While the estimator still remains unbiased, heteroskedasticity may lead to flawed significance levels. All of the models applied later on have positively been tested for the presence of heteroskedasticity by using a modified Wald-test for group wise heteroskedasticity.[47]

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[45] For the Random Effects and Fixed Effects models, a “xtreg” regression is employed in Stata, which does not allow for a subsequent analysis of Variance Inflation Factors.

[46] „Close to unity“ is used in the literature as indicating a critical correlation value for multicollinearity (Harshada, 2012).

[47] Stata procedure: xttest3

Autocorrelation is present, if co-variances of the different error terms are not equal to zero, again with adverse effect on significance levels (Hoechle, 2007). By applying the Wooldridge-test[48], some of the models are positively tested for the presence of autocorrelation.

To avoid the adverse effects of heteroskedastic and autocorrelated error terms, models have been calculated either with "clustered" standard errors[49] (solving for both, heteroskedasticity and autocorrelation) or "robust" standard errors[50] (solving only for heteroskedasticity) where necessary as indicated in the table of results below. As a side-note: Utilization of robust and clustered standard errors has decreased the amount of significant coefficients remarkably.

8.2. Estimators

The following different estimators are utilized to calculate the variables coefficients.

The Fixed Effects (FE) estimator automatically controls for effects of time-invariant characteristics on predictor variables and thus ignores characteristics that differ statically from country to country, such as political system or geographical location (Torres-Reyna, 2007). Therefore, "*estimated coefficients cannot [...] be biased because of omitted time-invariant characteristics.*" (Torres-Reyna, 2007: p.23). As a consequence, all of the time-invariant control variables that are included (namely potential for wind, solar radiation and biomass) are automatically ignored in the Fixed Effects estimations later on.

The Random Effects (RE) estimator assumes instead that the variation across entities is random and uncorrelated with the independent variables. Therefore, time-invariant characteristics are allowed to play a role as independent variables. Of course, this is only possible if those characteristics are specified, as is the case for controlling variables approximating the RE potential.

Lastly, a simple pooled Ordinary Least Squares (OLS) estimator may be employed. In this procedure, all observations are regarded to be originating from the same entity and thus the data set is treated as a cross-section data set. This may potentially cause the coefficients to be biased.

To identify which of the different estimators is most applicable for the individual models employed later on, a Hausman-test[51] and a Breusch-Pagan[52] test have been performed for every model. The results are being indicated in table of results below.

Lastly, a fourth estimator is employed in order to account for the detection of unit-roots in the variables *TOTALPOL* and *CONSHARE.* The first-differences (FD) estimator calculates the first differences of all variables before applying a standard OLS estimation on the differenced variables. The FD estimator is only employed for the affected variables[53] as indicated below.

[48] Stata procedure: xtserial
[49] Stata option: cluster ()
[50] Stata option: robust
[51] Stata procedure: hausman
[52] Stata procedure: xttest0
[53] Of course, the FD estimator has been employed on the original, un-differenced variable as the differencing is inherent in the estimation process, as described.

9. Results

To keep the presentation of results slim, coefficients of controlling variables as well as t-statistics are not displayed. Significance levels are indicated with stars (*). The full results of the main model can be found in the appendix.

The following table shows the regression results for dependent variable group I and all groups of indicators.

Table of Results – 1 (Main Model)

Explanatory Variables \ Dependent Variables		D_CONSHARE				SUPSHARE		
		OLS	FE	RE	FD	OLS	FE	RE
Indicator Group A	**CULTUREDIF**	-0,960	**-2,995***	-1,048	1,889	**2,903*** **	-1,127	-1,360
	RELIGIOUSDIF	-0,714	-0,161	-0,766	-0,980	-0,413	0,726	-0,017
Indicator Group B	**STABILITY**	-0,867	-0,708	**-0,883***	0,262	0,814	**-2,710*** **	**-2,200** **
	HUMANRIGHTS	-0,337	0,184	-0,337	0,361	**0,573***	-0,325	-0,425
Indicator Group C	**TRADE**	-10,501	5,372	-9,687	-18,379	7,146	2,666	3,907
	DIPLOMREP	0,327	/	/	/	-0,090	0,309	0,096

* = significant (10% level), ** = significant (5% level), *** = significant (1% level)
0,322 = estimator suggested by Hausmann-test or Breusch-Pagan-test
/ = stata error: insufficient observations
Standard errors employed, equally for all indicators: "robust" for D_CONSUMPTION, "clustered" for OECDSHARE

The results show inconsistent pattern. Most coefficients of the different indicators are insignificant, thus suggesting a rejection of the hypothesis and instead supporting the null hypothesis, namely that there is no effect of the relation of supplying and receiving states on the share of RE sources.

Significant coefficients can be found for *CULTUREDIF* and *STABILITY* for both dependent variables, *D_CONSHARE* ad *SUPSHARE.* However, their negative signs suggest a mechanism opposite as is proposed by the hypothesis, namely that the more the energy supplying countries exhibit instability or show larger cultural differences to the receiving county, the less does the receiving country utilize RE sources. Positive, significant coefficients of *CULTUREDIF* and *HUMANRIGHTS* are not indicated to be the preferred model and thus exhibit limited relevance.

The following table displays regression results for dependent variable group II and all groups of indicators.

Table of Results – 2 (Main Model)

Explanatory Variables \ Dependent Variables		D_TOTALPOL				FITORCERT		
		OLS	FE	RE	FD	OLS	FE	RE
Indicator Group A	CULTUREDIF	0,135	3,409	0,429	4,102	**-0,284****	0,240	0,155
	RELIGIOUSDIF	-0,521	-1,222	-0,508	2,267	**-0,158*****	**-0,286****	**-0,204****
Indicator Group B	STABILITY	-0,301	1,812	-0,088	4,322	-0,082	0,268	0,120
	HUMANRIGHTS	0,365	1,455	0,547	**1,173***	0,055	**0,102***	**0,103***
Indicator Group C	TRADE	-8,493	**58,353***	-0,327	-18,379	0,017	-1,113	-0,932
	DIPLOMREP	1,179	3,343	1,179	/	**0,333*****	-0,149	**0,252****

* = significant (10% level), ** = significant (5% level), *** = significant (1% level)
0,322 = estimator suggested by Hausmann-test **or** Breusch-Pagan-test
0,322 = estimator suggested by Hausmann-test **and** Breusch-Pagan-test
/ = stata error: insufficient observations

Coefficients for almost all indicators with respect to *D_TOTALPOL* are insignificant and thus reject the hypothesis and support the null-hypothesis. Significant results for *TRADE* (Fixed Effects) are significant, but are not indicated to be the preferred model and are thus limited in relevance. Only *HUMANRIGHTS* with a First Differences estimator is with a significant positive coefficient supporting the hypothesis when utilizing *D_TOTALPOL* as the dependent variable.

For *FITORCERT* a lot more significant coefficients can be found. For indicator group A – that are *CULTUREDIF* and *RELIGIOUSDIF* – the results suggest a relation opposite to the hypothesis. Contrary to that, *HUMANRIGHTS* and *DIPLOMREP* show a positive and significant coefficient for *FITORCERT,* thereby supporting the hypothesis. Their relevance is strengthened by the fact that they are also tested to be the preferred models.

Summarizing the above, it can be concluded that the results only provide limited evidence of any effect of the relation indicators – neither on the share of RE sources, nor on the total number of RE policies implemented. For RE shares, significant results even suggest a relation opposite to the hypothesis. The hypothesis is thus rejected in the majority of models.

The only evidence to support the hypothesis can be found for *FITORCERT*, suggesting that the implementation of the most important RE policies is influenced by *HUMANRIGHTS* and *DIPLOMREP.* However, as other significant results support an opposite relation for *FITORCERT*, further research is needed.

Further, it shall be highlighted that *HUMANRIGHTS* also exhibits a significant positive relation with *TOTALPOL*, encouraging further research also with respect to that particular indicator.

10. Model Extensions

As the following considerations only depict additions to the more extensive research design above, subsequent description of the econometric models and testing is kept at a minimum.

10.1. Including a Time-Lag

The motivation for this extension is as following: The hypothesis described in section 6 does involve a political aspect, namely the setup of RE-promoting policies as a response to weak or unreliable relations to energy supplying countries. To account for the time consuming process that is accompanying the implementation of policies (e.g. identifying the issue, creation of a political will to solve the issue, the definition of a useful policy design and subsequently passing respective laws in parliament does consume considerable time), the model has been designed with a time lag for explanatory variables.

This setup implies that earlier observations of explanatory variables are regressed on later observations of dependent variables. A time lag of five years has been included, which is regarded a reasonable timing for the implementation of energy policies by the author of this paper.

Table of Results – 3 (Model Extension: Time Lag)

Explanatory Variables \ Dependent Variables		D_CONSHARE			SUPSHARE		
		OLS	FE	RE	OLS	FE	RE
Indicator Group A	**L5_CULTUREDIF**	3,228	-6,433	3,228	-1,121	3,150	2,044
	L5_RELIGIOUSDIF	0,702	3,590	0,702	-0,568	**10,477****	0,145
Indicator Group B	**L5_STABILITY**	-3,346	**16,593****	-3,346	4,176	-11,139	-0,652
	L5_HUMANRIGHTS	0,207	**9,891*****	0,207	-1,760	2,190	0,773
Indicator Group C	**L5_TRADE**	-25,261	**382,125*****	-25,261	27,214	26,074	30,678
	L5_DIPLOMREP	-0,193	1,565	-0,193	0,555	1,984	0,790

* = significant (10% level), ** = significant (5% level), *** = significant (1% level)

The results are mostly insignificant and are therefore mainly not supporting the hypothesis with respect to RE shares. However, *L5_STABILITY, L5_HUMANRIGHTS* and *L5_TRADE* are significant and positive for *D_CONSHARE* when applying a Fixed Effects model and thus provide some evidence to support the hypothesis. The same applies for *L5_RELIGIOUSDIF,* being regressed on *SUPSHARE*, again within a Fixed Effects model.

Table of Results – 4 (Model Extension: Time Lag)

Explanatory Variables \ Dependent Variables		D_TOTALPOL			FITORCERT		
		OLS	FE	RE	OLS	FE	RE
Indicator Group A	**L5_CULTUREDIF**	**-9,905***	-5,665	**-9,905*****	0,307	-0,722	0,515
	L5_RELIGIOUS DIF	-0,291	2,569	-0,291	0,157	**1,867*****	0,179
Indicator Group B	**L5_STABILITY**	3,313	-13,721	3,313	0,267	-0,428	0,553
	L5_HUMAN RIGHTS	0,018	4,267	0,018	-0,273	0,060	-0,349
Indicator Group C	**L5_TRADE**	6,552	-337,266	6,552	-2,721	3,561	-2,577
	L5_DIPLOMREP	0,025	2,805	0,025	**0,459*****	0,149	**0,401****

* = significant (10% level), ** = significant (5% level), *** = significant (1% level)

Results for the dependent variables measuring the implementation of RE promoting policies are, similar to above, often non-significant and thus mostly promote a rejection of the hypothesis and support the according null-hypothesis of no effect at all. The existing significant coefficients of *L5_CULTUREDIF* on *D_TOTALPOL* suggest a relation opposite as proposed by the hypothesis. *L5_RELIGIOUSDIF* and *L5_DIPLOMREP* show significant, positive coefficients for *FITORCERT*, thereby supporting the hypothesis.

Concluding the results for this model extension, the hypothesis is again mostly rejected in favour of the null-hypothesis. However, all indicators except of *L5_CULTUREDIF* show significant positive coefficients for at least one of the dependent variable employed, thereby generally supporting the hypothesis. This model extension thus proves to be slightly more promising to support the hypothesis than the main research design presented before. Also, similar as in the main model, *FITORCERT* confirms to be a promising dependent variable, as it again shows significant positive coefficients.

10.2. Using Reserve, Consumption and Production Statistics

Another extension to the model has been estimated based on a different approach to measure the perceived import dependency. The indicators utilized within the main research design are “outward-looking” as they are considering the quality of relations with supplier states. However, it could be argued that a more “inward-looking” indicator could be reasonable to be employed as well, as the perceived import dependency may also be influenced by the degree to which a country has the possibility to switch from imports to domestic supply.

Country-specific figures on reserves, production and consumption (as displayed in table 1) have been used to calculate Reserve-to-Production and Reserve-to-Consumption ratios for Crude Oil and Natural Gas for all 11 OECD countries that do exhibit resources.[54] In a second step, the two ratios calculated for crude oil and natural gas have been aggregated to one average ratio per country. Thus, the ability to meet domestic energy demand with domestic energy production is

[54] Namely Australia, Canada, Denmark, Germany, Italy, Mexico, Netherlands, Norway, Poland United Kingdom and United States.

approximated by a Reserve-to-Consumption (*CONSRATIO*) and a Reserve-to-Production (*PRODRATIO*) ratio for each country. Testing procedures with respect to heteroskedasticity and autocorrelation as described in section 8.1. have been executed and robust standard errors have been applied accordingly where necessary. The same applies for utilizing Hausman- and Breusch-Pagan tests.

The following table presents the regression results.

Table of Results – 5 (Model Extension: Reserve-Ratios)

	TOTALPOL				**FITORCERT**			
	OLS	FE	RE	FD	OLS	FE	RE	FD
PROD RATIO	<u>**0,480*****</u>	<u>**0,977*****</u>	**0,480*****	-0,014	<u>**0,015*****</u>	<u>**0,014*****</u>	**0,015*****	0,001
CONS RATIO	<u>0,011</u>	<u>-0,052</u>	0,011	-0,022	<u>**-0,003*****</u>	<u>-0,002</u>	**-0,003*****	0,000
	CONSHARE				**SUPSHARE**			
PROD RATIO	<u>**-0,377*****</u>	<u>**-0,262****</u>	**-0,378*****	-0,008	<u>-0,038</u>	<u>0,031</u>	-0,038	0,026
CONS RATIO	<u>**0,165*****</u>	<u>**0,097*****</u>	**0,165*****	-0,031	<u>**0,029*****</u>	<u>0,02</u>	**0,029*****	-0,008

* = significant (10% level), ** = significant (5% level), *** = significant (1% level)
<u>0,322</u> = estimator suggested by Hausmann-test **or** Breusch-Pagan-test

The results indicate a positive and highly significant effect of *PRODRATIO* on both measures of the implementation of RE-policies. With respect to RE share measures as the dependent variable, the effect of *PRODRATIO* on *CONSHARE* is highly significant as well, but negative, whereas it does not prove any effect on *SUPSHARE*.

The effect of *CONSRATIO* is similarly inconsistent: Significant negatively on *FITORCERT*, but significantly positive on *CONSHARE* and *SUPSHARE.*

It has to be highlighted that all coefficients that have been estimated with the First-Differences-Estimator are insignificant, suggesting that the presence of unit root indeed induces a bias into the other coefficients. Further, this setup exhibits an important limitation with respect to the hypothesis of this paper: The presence of domestic reserves does affect the utilization of RE sources through several channels, out of which perceived import dependency is only one. For example, it is reasonable to claim that the sheer existence of fossil fuel based alternatives to RE sources does affect the utilization of RE sources simply due to private-economy driven decisions.[55] Consequently, despite the availability of domestic reserves may play a role in the level of perceived import dependency, it is difficult to assess its true impact.

Overall, the highly significant results for this model extension are not providing a clear conclusion with respect to the hypothesis of this paper but are at least promising in the sense

[55] Based on the assumption that currently, real (not levelized) fossil fuel based energy is still cheaper than RE based energy

that applying reserve related ratios to investigate the effect of energy security on the development of RE sources may be promising for further research.

Following the above research suggestion, a further extension of the model is prepared. Driven by the assumption that countries that do exhibit fossil fuel reserves may react differently to perceived import dependency than those countries without fossil fuel reserves, the following model is created.

The group of countries in focus is split up in two groups according to the existence of fossil fuel reserves: The 11 countries exhibiting fossil fuel reserves (as included above) form group I, whereas the remaining 21 countries[56] without fossil fuel reserves form group II. Then, the same regressions as in the main model are performed for each group separately, trying to identify differences in the response to perceived import dependency.

The following table shows the regression results for countries having reserves:

Table of Results – 6 (Model Extension: Countries with Reserves)

Explanatory \ Dependent		D_CONSHARE			SUPSHARE		
		OLS	FE	RE	OLS	FE	RE
Indicator Group A	CULTUREDIF	-3,092	1,251	**-3,092***	-0,672	**-6,820*****	-0,672
	RELIGIOUSDIF	-0,784	**-5,283*****	-0,784	**-3,705*****	-0,639	**-3,705*****
Indicator Group B	STABILITY	-0,524	-0,252	-0,524	**-7,647*****	**-7,969****	**-7,647*****
	HUMANRIGHTS	2,631	2,747	2,631	**1,834*****	**1,444***	**1,834*****
Indicator Group C	TRADE	-77,181	**-92,424****	**-77,181*****	**-51,090*****	0,453	**-51,090*****
	DIPLOMREP	/	/	/	/	/	/
		D_TOTALPOL			**FITORCERT**		
		OLS	FE	RE	OLS	FE	RE
Indicator Group A	CULTUREDIF	12,046	3,876	12,046	0,139	0,657	0,139
	RELIGIOUSDIF	2,459	1,146	2,459	0,102	**1,230***	0,102
Indicator Group B	STABILITY	3,398	-1,033	3,398	0,902	0,666	**0,902*****
	HUMANRIGHTS	-0,949	-2,864	-0,949	-0,492	-0,237	**-0,492****
Indicator Group C	TRADE	7,225	248,979	7,225	19,067	-1,260	**19,067*****
	DIPLOMREP	/	/	/	/	/	/

* = significant (10% level), ** = significant (5% level), *** = significant (1% level)
/ = stata error: insufficient observations

[56] Namely Austria, Belgium, Czech Republic, Finland, France, Greece, Hungary, Iceland, Ireland, Israel, Japan, Korea, Luxembourg, New Zealand, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey

Regression results for the group of countries possessing fossil fuel reserves show many significant negative coefficients for *SUPSHARE* and *D_CONSHARE,* namely from *CULTUREDIF, RELIGIOUSDIF, STABILITY* and *TRADE,* thereby rejecting the hypothesis in favour of the opposite relation. Only *HUMANRIGHTS* supports the hypothesis by showing significant positive coefficients.

For the dependent variables tracking the implementation of RE promoting policies, far less significant coefficients appear, in turn suggesting no relation among the relation indicators and the promotion of RE source. Only for *FITORCERT*, some coefficients are significant, however showing inconsistent sign.

Overall, the results do mostly reject the hypothesis. For those dependent variables tracking the RE share of receiving countries (*D_CONSHARE* and *SUPSHARE)* even a relation opposite to the hypothesis is suggested. On the policy side, only *FITORCERT* shows some measurable influence, whereas the majority of results are more supporting the null-hypothesis of no influence.

Table of Results – 7 (Model Extension: Countries without Reserves)

Explanatory Variables \ Dependent Variables		**D_CONSHARE**			**SUPSHARE**		
		OLS	FE	RE	OLS	FE	RE
Indicator Group A	**CULTUREDIF**	0,029	-1,284	0,029	**7,102*** **	**5,322***	**6,205****
	RELIGIOUSDIF	0,673	0,855	**0,672****	**-1,448*****	0,534	0,272
Indicator Group B	**STABILITY**	1,040	0,248	1,040	**3,070****	-0,577	0,451
	HUMANRIGHTS	0,790	0,901	0,790	-0,0363	0,288	0,157
Indicator Group C	**TRADE**	**42,151****	40,370	**42,151*****	**67,411*****	10,104	**15,544***
	DIPLOMREP	/	/	/	/	/	/
		D_TOTALPOL			**FITORCERT**		
		OLS	FE	RE	OLS	FE	RE
Indicator Group A	**CULTUREDIF**	-2,636	-4,718	**-2,636*****	-0,292	-0,007	-0,049
	RELIGIOUSDIF	-0,426	0,154	-0,426	**-0,119****	-0,505	**-0,403***
Indicator Group B	**STABILITY**	**-3,726***	0,680	**-3,726****	**-0,461***	-0,764	-0,200
	HUMANRIGHTS	1,877	1,195	1,877	**0,375****	0,244	**0,257***
Indicator Group C	**TRADE**	28,771	**53,496****	**28,771*****	**-4,623*****	-3,611	**-3,916****
	DIPLOMREP	/	/	/	/	/	/

* = significant (10% level), ** = significant (5% level), *** = significant (1% level)
/ = stata error: insufficient observations

Results for the group of countries possessing no fossil fuel reserves are rather ambiguous. Interestingly, *TRADE* shows many significant positive coefficients, thereby supporting the hypothesis – the only outlier here is *FITORCERT*. Except of the aforementioned effect of *TRADE* and one other estimation of *RELIGIOUSDIF*, no significant coefficient appears for *D_CONSHARE*. For *SUPSHARE, D_TOTALPOL* and *FITORCERT,* many significant coefficients throughout all indicators appear.

Among those significant coefficients, a general pattern is visible with respect to being mostly positive for the dependent variables tracking RE shares (*D_CONSHARE and SUPSHARE)*, whereas most significant coefficients for the policy variables (*D_TOTALPOL* and *FITORCERT*) are negative. This provides evidence that this particular model extension weakly supports the hypothesis for actual RE shares, whereas it suggests an opposite relation for the implementation of RE policies.

Comparing the results for the group of countries exhibiting reserves to the group of countries which do not exhibit reserves, it shall be highlighted that most of the significant coefficients of the relation indicators differ in sign for the dependent variables tracking the RE shares (*D_CONSHARE* and *SUPSHARE*) – consistently across the two country groups: Negative for countries with reserves and positive for countries without reserves. This supports the conclusion that countries which do exhibit their own fossil fuel reserves react on high energy insecurity with a lower share of RE sources, whereas countries without domestic reserves show the opposite pattern. In turn, this suggests that once a country has the option to support domestic fossil fuels to counter energy insecurity, it will do so. Only countries without domestic reserves fall back to promoting RE sources. This result could be taken as an indication that RE sources are indeed seen as a potential solution to energy insecurity, however only as soon as the option to promote domestic fossil fuels is not available. A good example for this would be the recent promotion of shale gas production within the US, as mentioned in section 2.2.

With respect to the implementation of RE-based policies, the two country groups differ in the sense that there is nearly no effect of the relation indicators for the group of countries with domestic reserves whereas the group of countries without domestic reserves does show an effect, but with inconsistent sign. This does not allow for a clear evaluation and further research is needed.

10.3. Testing for Time Consistent Parameters

The last model extension is testing whether the relation of energy dependency and the promotion of RE sources is characterized by a break or trend over time. The underlying assumption claims that the fundamental aspects that shape the energy market and also the implementation of energy security policies might have altered over time. This could be characterized either by abrupt events, inducing a break into the relation, or by developments over time, inducing a trend into the relation.

Indication for the existence of the former – a break of the relation at a certain point in time – is to be found for example within the case study in section 12, which claims that the general energy policy focus of the German parliament did change drastically towards focussing more on the issue of import dependency between the debates in 2000 and 2006. As elaborated more in section 12, this is most certainly due to an increased awareness of the threats of politically motivated supply interruptions due to the Russian-Ukrainian gas crises 2005/2006. This event is likely to be influencing enough to have an impact on the whole sample of countries in the dataset as well. Further, as mentioned in section 2.1., Marques et al., (2010) more generally suggest further research to focus on the post-2005 period as important aspects such as the "*(i) oil price boom and bust; (ii) increase of social and political pressure for fast developments in clean energy; and (iii) financial crisis which requires adequate government measures to stimulate the economy.*" (Marques et al., (2010): p.6885) did significantly gain importance after 2005.

Indication for the existence of the latter – a trend in the relation over time – can be found for example within the slowly increasing rivalry for supplies on the global energy market, induced by rapidly developing economies such as China and India (as mentioned in section 4.2.2.). Also the rise in energy prices (as mentioned in section 4.1.3.) or the increasing utilization of energy exports as a tool of foreign policy (as mentioned in section 4.3.) can more be regarded a trending development rather than a certain event in time, in slight contrast to above.

To test for the former, the data of the six relation indicators have been refined to show the value "0" for all years up to 2005 and the original value for the years thereafter. This new variable is then regressed together with the original variable containing all the original values in order to compare the results.

To test for the latter, a similar approach is performed. This time, the observations of the six relation indicators are multiplied with a factor increasing steadily over time – from "1" in 1990 to "2" in 2010. This attributes to the assumption that the more recent any given observation of an explanatory variable is, the stronger is its effect on the dependent variables.

The following results have been estimated. All six indicators – this time with two different data series as described above – are regressed separately on the four dependent variables. Therefore, similar to the main model, a total of 72 regressions have been performed. Variables with data only after 2005 are named *2005_"Original Variable"*, so e.g. *2005_CULTREDIF.*

Table of Results – 8 (Model Extension: Testing for a Break in the Relation)

Explanatory Variables \ Dependent Variables		D_CONSHARE			SUPSHARE		
		OLS	FE	RE	OLS	FE	RE
Indicator Group A	**CULTUREDIF**	-1,009	-2,953	-1,114	**2,796*** **	-1,295	-1,408
	2005_ CULTUREDIF	0,074	-0,029	0,052	0,389	**0,372***	0,111
	RELIGIOUSDIF	**-0,854***	-0,295	**-0,895***	-0,508	0,676	-0,034
	2005_ RELIGIOUSDIF	0,201	0,153	0,182	0,468	0,097	0,104
Indicator Group B	**STABILITY**	**-0,998***	-0,826	**-1,001****	0,618	**-2,722*****	**-2,219****
	2005_ STABILITY	0,161	0,109	0,160	**0,761****	0,213	0,134
	HUMANRIGHT	-0,544	0,070	**-0,544****	0,371	-0,356	-0,433
	2005_ HUMANRIGHT	**0,181***	0,073	**0,181****	0,667	0,084	0,023

Indicator Group C	**TRADE**	-10,648	5,419	-9,782	6,725	2,066	3,655
	2005_TRADE	0,188	-0,033	0,147	0,459	0,277	0,107
	DIPLOMREP	/	/	0,326	-0,090	0,308	0,095
	2005_ DIPLOMREP	/	/	/	/	/	/
		D_TOTALPOL			**FITORCERT**		
		OLS	FE	RE	OLS	FE	RE
Indicator Group A	**CULTUREDIF**	-0,183	3,024	0,072	**-0,288****	0,215	0,124
	2005_ CULTUREDIF	**1,134***	0,899	**1,113***	0,019	0,055	0,070
	RELIGIOUSDIF	**-,734****	-1,698	**-,716****	**-0,169*****	**-0,345****	**-0,240****
	2005_ RELIGIOUSDIF	**1,000***	0,885	0,980	0,053	**0,118*****	**0,112*****
Indicator Group B	**STABILITY**	-0,618	1,740	-0,389	-0,090	0,261	0,177
	2005_ STABILITY	**1,237****	**1,231****	**1,264****	0,033	**0,117*****	**0,115*****
	HUMANRIGHT	0,037	1,062	0,230	0,052	0,083	0,082
	2005_ HUMANRIGHT	**1,039****	**0,989***	**1,048****	0,009	**0,053***	**0,058***
Indicator Group C	**TRADE**	-10,366	**52,130****	-2,377	-0,017	-1,280	-1,121
	2005_TRADE	**1,550****	1,304	**1,535***	0,037	0,077	**0,085***
	DIPLOMREP	1,178	3,343	1,178	**0,333*****	-0,149	**0,251****
	2005_ DIPLOMREP	/	/	/	/	/	/

* = significant (10% level), ** = significant (5% level), *** = significant (1% level)
/ = stata error: insufficient observations

Analysing the results with respect to shares of RE as dependent variables (*D_CONSHARE* and *SUPSHARE*), the different data series of the relation indicators do not exhibit a consistently differing pattern. *CULTUREDIF*, *STABILITY* and *HUMANRIGHTS* and their respective *2005_*er-counterparts all show significances, without a clear distribution of these significances at either of the series. A possible outlier is the finding that the significant estimation of *2005_STABLITY* is supporting the hypothesis (positive coefficient), whereas the significant estimations of *STABILITY* are all rejecting the hypothesis (negative coefficient) with respect to *SUPSHARE.* For *RELIGIOUSDIF*, only the original data series shows significances. *TRADE* shows no significances at all, *DIPLOMREP* does consistently not have enough observations to be employed in a regression.

The analysis is quite different when taking the promotion of RE policies as dependent variables (*D_TOTALPOL* and *FITORCERT*). Very consistently, *2005_STABILITY* and *2005_HUMANRIGHTS* exhibit positive significances and thus support the hypothesis for both, *D_TOTALPOL* and

FITORCERT, whereas their original counterparts, *STABILITY* and *HUMANRIGHTS* are insignificant throughout the different estimators. This strongly suggests that indicator group B, which is approximating the stability of the supplying countries, does indeed have an effect only when measured after 2005. Further, all significant coefficients of *2005_RELIGIOUSDIF* are positive, whereas all significant coefficients of *RELIGIOUSDIF* are negative, indicating that the hypothesis is supported only for observations after 2005. Both, the effect of indicator group B as well as the effect of religious differences do support that 2005 marks a break in the proposed relation and thus support the assumption of this model extension. Again similar to above, the other relation indicators do not show a clearly differing pattern among original and amended data series and are thus not interpreted in further detail.

The following table shows results for the data structure that is testing for the existence of a trend within the relation of import dependency and RE promotion:

Table of Results – 9 (Model Extension: Testing for a Trend in the Relation)

Explanatory Variables \ Dependent Variables		D_CONSHARE			SUPSHARE		
		OLS	FE	RE	OLS	FE	RE
Indicator Group A	**CULTUREDIF**	0,434	2,439	0,768	**3,412****	-2,001	-1,096
	TREND_ CULTUREDIF	-0,759	**-2,421***	-1,012	-0,317	0,502	-0,153
	RELIGIOUSDIF	-0,684	3,352	-0,258	-1,159	0,645	-0,147
	TREND_ RELIGIOUSDIF	-0,016	-1,869	-0,283	0,485	0,055	0,103
Indicator Group B	**STABILITY**	-0,456	2,637	-0,456	**-4,388****	**-4,538*****	**-4,128*****
	TREND_ STABILITY	-0,220	-1,696	-0,220	**3,104*****	**1,136***	**1,158***
	HUMANRIGHT	-0,483	3,406	-0,450	-0,999	-0,314	-0,188
	TREND_ HUMANRIGHT	0,074	-1,556	0,060	**0,945***	-0,006	-0,133
Indicator Group C	**TRADE**	**-15,765****	1,521	**-15,029***	7,241	1,585	4,977
	TREND_TRADE	**2,683*****	1,453	**2,596****	-0,051	0,244	-0,266
	DIPLOMREP	/	/	/	0,404	-0,670	0,232
	TREND_ DIPLOMREP	0,186	/	/	-0,343	0,693	-0,094

* = significant (10% level), ** = significant (5% level), *** = significant (1% level)
/ = stata error: insufficient observations

Results for those models using data series that are increasing by trend show less significant coefficients than the models before – thereby rejecting the hypothesis in general. Relevant to be mentioned is the fact that *TREND_TRADE* and *TREND_STABILITY* do support the hypothesis with significant positive coefficients, whereas *TRADE* and *STABILITY* suggest the opposite relation with significant negative coefficients (for *D_CONSHARE* and *SUPSHARE*, respectively). This is strengthening the assumption that the relation of energy dependency and RE promotion did change by trend over time. However, the underlying considerations do not provide an explanation why the relation should actually be *turned around* over time, thereby weakening the relevance of this particular finding to some extent.

Results for the dependent variables tracking the implementation of RE policies (*D_TOTALPOL* and *FITORCERT*) are not displayed as they are consistently highly significant – mostly at the 1%-level – for *all* different indicators across *all* different estimators. This overwhelming significance is highly unrealistic and most certainly due to the fact that also *FITOCERT* and *TOTALPOL*[57] are increasing by trend over time, leading to a correlation with the new data series now trending over time as well. A similar result emerges when utilizing a trend up to the factor five at 2010.

Summarizing the third model extension, it can be said that especially those time series incorporating only observations from 2005 on clearly support the existence of a break in the relation of energy dependency and RE promotion in the sense that the stability of supplying countries does play a more important role after 2005 than before.

11. Conclusion

After a detailed analysis of the current situation of energy security and according potential solutions, the first part of this paper concludes that the current and prospective level of energy security is insufficient and that RE-based policies show the most desirable characteristics to address this issue. The second part of this paper developed several indicators to quantify the quality of state relations and tested whether countries which are dependent on relatively unreliable supplying countries are promoting RE sources with greater efforts than other countries. The models employ a panel data set with 32 countries over a maximum of 21 years, differing from model to model.

Within the main research, the majority of results do reject the hypothesis and support the null-hypothesis with respect to RE shares as the dependent variable (*D_CONSHARE* and *SUPSHARE*). Further, some estimations even suggest a relation opposite as proposed by the hypothesis. Also, the relation indicators do not show any evidence to have an effect on the total number of RE policies being implemented (*D_TOTALPOL*).

In slight contrast to that, the results for those regressions using the implementation of the most important RE policies as their dependent variable (*FITORCERT*) do support the hypothesis in some cases: The variable tracking the status of diplomatic representation among supplying and receiving countries (*DIPLOMREP*) as well as the variable tracking the situation of human rights within the supplying country (*HUMANRIGHTS*) show significant positive coefficients.

To shed further light on the issue, three model extensions have been performed: Including a lag for the independent variable, taking into account that a country’s reaction on an insufficient level of energy security requires a certain time period (i), analysing the effect of the existence of

[57] As I am employing first differenced *D_TOTALPOL* and not *TOTALPOL*, it has to be mentioned that not only the absolute number of total policies does increase over time, but also does the growth appear mostly in recent years, thus exhibiting a weak trend as well. Consequently, significances are less prominent (but still highly unrealistic) for *D_TOTALPOL* than they are for *FITORCERT*.

domestic fossil fuel reserves (ii) and testing for the presence of a break or trend in the relation among energy dependency and RE promotion (iii)

Concluding the first model extension, the results are again mostly insignificant and thus promote the null-hypothesis. However, evidence to support the hypothesis is sounder than in the main model, as most indicators show significant positive coefficients at least once. Especially the effect of relation indicators on the implementation of the most important RE policy types (*FITORCERT*) is again being confirmed. All in all, this model extension proves the inclusion of a time lag a promising aspect for further research.

With respect to the second model extension, the results are inconsistent, but promising. Regressing the level of Reserve-to-Consumption/Production on RE shares and RE policy implementation showed many highly significant coefficients – despite the inconsistent sign, these results are promising in the sense that there is a measurable effect within the data.

Based on the above, a further analysis compares countries with and without domestic fossil fuel reserves. The results indicate that countries with domestic reserves are reacting in an opposite manner on a higher level of energy insecurity than countries without domestic reserves: RE sources are only promoted, if the utilization of domestic fossil fuel reserves does not provide an alternative solution. Again, this proves to be a promising field for further research related to the determinants of RE promotion.

The last model extension revealed strong support for the assumption that the relation of import dependency and RE promotion did change significantly after 2005 with respect to the stability of supplying countries. The results testing for a trend in the aforementioned relation are less clear but still do support the existence of such a trend for some cases.

As an overall summary, the hypothesis is being supported by some particular cases within the main model, whereas being rejected in the majority of cases. The model extensions, especially testing for the existence of a break in the relation and also the utilization of information on domestic reserves, do show promising results to further solve the puzzle. Also, the effect of the relation indicators employed on the implementation of most important RE policies (*FITORCERT*) could be confirmed in different setups.

It has to be added that the rejection of the hypothesis in favour of the null-hypothesis in many cases of the main model – as mentioned above – is not sufficiently *proving,* but only *suggesting* this relation does in fact not exist. This is due to the issue that a "non-existent" relation is theoretically difficult to prove, as it ultimately cannot be confirmed based on evidence unless one takes all possible observations into account.

Potential explanations for the rejection of the hypothesis in most of the models could be the following four points:

1. The hypothesis of this paper involves political mechanisms, whereas official, quantifiable policies are not necessarily the result of political-strategic decisions. For example,

energy security could also be enhanced by non-official measures or agreements which are not captured within the policy-variables.[59]

2. The true underlying mechanism could be of such nature that countries with a generally large energy demand will show both: Large energy imports as well as a large share of RE sources.[60] This would provide an explanation especially for those cases, where coefficients are significant but negative.
3. The majority of countries in the sample employed are members of the European Union which is attempting to influence the domestic energy policies of its member states.[61] If this supranational agenda setting is dominating the domestic agenda setting, the perceived import dependency of the European Union as a whole would be relevant, rather than the dependency of the individual countries.
4. Contrary to one of the assumptions stated in section 5.3., short term improvements in energy security could be valued over long term security improvements within democracies, which is disadvantaging RE-based measures that require a long time horizon to become effective. This point is strengthens by a comment from Mathews & Tan, (2007), who claims that China is using RE sources much more with the long term goal to increase energy security than other countries do.

12. Case Study: German RE legislation

The following case study is performed to gain further insights into the topic in addition to the conclusion presented above. Subject is the introduction and various amendments of the German "Erneuerbare-Energien-Gesetz (EEG)", one of the main RE-promoting legislations within Germany. In order to gain insights on whether reducing energy import dependency has been one of the motivations to set up the EEG, the respective public debate in parliament has been analysed. To capture potential changes of motivations over time, three debates in parliament have been analysed: 25.2.2000 (Introduction), 28.9.2006 (Amendment) and 27.6.2014 (Amendment). In total, 29 speeches have been analysed – held by politicians of all parties in parliament (Deutscher Bundestag, 2000; Deutscher Bundestag, 2006 and Deutscher Bundestag, 2014)

As expected, a large share of the discussions is concerning party-related conflicts, usually along the line of governing and opposing parties. Further, another major share of the individual speeches is concerned with detailed, content-related considerations, varying in focus from debate to debate depending on the actual matter.[62] A third topic that is appearing frequently in all debates is the interaction of German and European norms. All of those aspects are not relevant for the topic of this paper and have thus been ignored in the following evaluation.

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[59] To some extent, that effect is captured by also including the actual share of RE sources (which would increase, if those non-official measures would be aimed at promoting RE sources, in line with the hypothesis of this paper), however some uncertainty remains.

[60] For completeness, it has to be added that this point does not directly affect the methodology of this paper as not the *level* of imports but the *quality and reliability* of relations among the supplying and receiving states is approximated. Still, it induces a factor which is originally not considered to be relevant within the framework of this paper.

[61] At least since the European Energy Action Plan in 2007, as discussed in section 2.2.

[62] To illustrate this point: The 2000er debate is largely concerned with the interplay of the EEG and the existing „Energieeinspeisegesetz", on which the EEG is build upon. Contrary to that, the 2014er debate is more focussed on how to distribute the increased costs of EEG related RE-promotion.

A first finding is that for all three debates, environmental- and climate change concerns have consistently been stated as the most important driver by every speaker who contemplates motivations behind the EEG – notably similar across all parties.[63] Secondly, with similar consistency, almost all speakers have stressed the opportunity of job creation[64] – within the domestic economy, but also with respect to a future technology leadership and accompanying export revenues. These two motivations can be regarded to be the most important drivers of this legislation in Germany.[65]

With respect to dependency on imported fossil fuels, an interesting and very significant finding can be pointed out: In the 2000er and 2014er debate, reducing fossil fuel import dependency as a motivation is not mentioned at all - only the goal of reducing dependency on fossil fuels in general is mentioned rarely,[66] however not clarifying if the underlying driver is of environmental or of security-related nature. However, this is fundamentally different in the 2006er debate where half of the speakers (three out of six)[67] explicitly mention the achievements of the existing EEG legislation with respect to reducing fossil fuel import dependency and also clearly express their concerns on the current level of German energy security. A potential explanation of such an isolated, short term attention on this particular aspect is likely to be explained with the Russian-Ukrainian gas crisis in 2005/2006, as mentioned earlier in section 2.2. The following quote accurately illustrates this circumstance: "*But only in the aftermath of the winter 2005–2006 gas conflict between Russia and Ukraine, the future security of European energy supplies has become the focus of a broader debate*" (Umbach, 2010: p. 1230). This is clearly supported in the EEG debate 2006.

Ultimately concluding this case study, one can claim that RE-based approaches are indeed regarded to be suitable to address an insufficient level of energy security among the leading politicians – thereby confirming the factual analysis in sections 4 and 5. However, as this aspect did not play a role for the initial establishment of the law in 2000, it remains disputable on how influential this aspect may be for policy creation. In general, this case study does to some extent confirm the econometrical result that energy security cannot generally be regarded as a important driver for RE-promotion – possibly, except of the era after 2005, which is left for future research.

13. Future Research

As the literature review already revealed and as confirmed again by this work, additional research is needed on this topic.

Incorporating any measure on the quality of relations among supplying and receiving countries does appear promising to me – potentially it proves to be even more insightful in different setups, with respect to time horizon or countries included. Also, the relation indicators and the

[63] 2000er debate: Mosdorf, Grill, Hustedt, Bullinger-Schröter, Scheer, Ruck, Fell, Flach, Jung, Schauerte, Trittin, Austermann, Möller; 2006er debate: Gabriel, Kauch, Flachsbarth, Hill, Fell, Bülow; 2014er debate: Gabriel, Heil, Pfeiffer, Nüßlein

[64] 2000er debate: Mosdorf, Grill, Hustedt, Scheer, Ruck, Trittin, Möller; 2006er debate: Garbiel, Kauch, Flachsbarth, Fell, Bülow; 2014er debate: Gabriel, Pfeiffer, Nüßlein

[65] Assuming the parliamentary debate actually reflects the true motivations.

[66] 2014er debate: Mosdorf, Grill, Schröter, 2014er debate: Gabriel

[67] Namely Gabriel, Flachsbarth & Hill

methodologies of refinement employed in this analysis exhibit room for further refinements. A quick example would be to get more detailed data on diplomatic representation, e.g. with respect to the size of embassies rather than having a binary variable on the status of representation. But there are many other details that can improve the indicators to more accurately approximate the quality of state relations. Also, the model extensions provided indicate where intensified research could be worthwhile. Finally, the methodology of aggregation could be amended, for example with respect to relativization and weightings.

Great potential for improvements exist on the data side. Transparent and holistic databases on energy flows would surely proof to be helpful in that context – at least for confirming, that import dependency cannot be regarded to be one of the main determinants of RE promotion.

Further, as described in section 3.2.3., there are other indicators of a country's level of energy security which might be more accurate and could thus be employed to determine a country's efforts towards the promotion of RE. In particular, deriving a meaningful indicator of supply diversity incorporating one of the relation indicators employed in this paper is promising.

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15. Appendix

Table 3

Worldwide available energy potential

Technology	Available energy / PWh yr	Technical potential energy / PWh yr	Current Installed power (GW)	Worldwide capacity factor of technology in place	Current electricity generation / TWh yr
Solar PV	14.900	< 3.000	8.7	0.1–0.2	11.4
CSP	9250 – 11.800	1.05–7.8	0.354	0.13–0.25	0.4
Wind	630	410	94.1	0.205–0.42	173
Geothermal	1390	0.57–1.21	9	0.73	57.6
Hydroelectric	16.5	< 16.5	778	0.416	2840
Wave	23.6	4.4	0.00075	0.21–0.25	0.0014
Tidal	7	0.18	0.26	0.2–0.35	0.565
Nuclear	4.1–122 for 90–300 yrs	< 4.1–122	371	0.808	2630
Coal-CCS	11 for 200 yrs	< 11	0	0.65–0.85	0

Source: Jacobson, (2009)

Table 4

Levelized Cost of Electricity (LCOE) for the United States

Technology	LCOE (before internalizing externalities) US¢/kWh ($2007)	LCOE (after internalizing externalities) US¢/kWh ($2007)
Offshore wind	2.6	3.0
Onshore wind	5.6	6.0
Geothermal	6.4	7.1
Hydroelectric	2.8	7.8
Landfill Gas	4.1	10.8
Biomass (combustion)	6.9	13.6
Advanced Nuclear	4.9	16.0
Advanced Gas and Oil Combined Cycle (AGOCC)	8.2	20.2
AGOCC with Carbon Capture	12.8	24.8
Integrated Gasification Combined Cycle (IGCC)	6.7	25.9
Scrubbed Coal	7.2	26.3
IGCC with carbon capture	8.8	27.9
Solar photovoltaic	39.0	39.9

Source: Valentine, (2011)

Table 5

Summary of Data

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
CULTUREDIF	768	0,9298105	0,1684679	0,3472345	1,284701
RELIGIOUSDIF	768	0,8554563	0,4319569	0,2020674	2,511745
STABILITY	480	0,996298	0,2903079	0,3509558	1,596638
HUMANRIGHTS	704	1,173025	0,420739	0,2377723	2,49891
DIPLOMATICREP	128	0,895168	0,3564806	0,5	1,882922
TRADE	640	0,9882758	0,0218418	0,8520163	1
CONSHARE	200	15,658	15,53826	0,9	65,9
SUPSHARE	672	12,50497	15,21384	0,2	85,3
TOTALPOL	672	18,09077	24,16712	0	193
FITORCERT	672	0,4151786	0,4931198	0	1
CONTCOM	672	0,1875	0,3906031	0	1
CO2	672	9,437104	4,292753	2,694517	27,51671
ENEUSE	672	4306,137	2203,489	945,8874	16904,9
OILPART	672	7,248518	10,99137	0	53,57701
GASPART	672	16,61139	17,97181	0	93,90463
COALPART	672	31,02406	25,74621	0	97,49284
NUCLEARPART	672	18,44953	21,15373	0	79,07605
WIND	672	192686,5	598405,3	0	2712417
SOLAR	672	2,80E+09	6,82E+09	4484425	2,51E+10
BIOMASS	672	19470,6	32180,96	1,428571	171760,2
KYOTO	672	0,3839286	0,4867031	0	1
INDUSTRY	672	76,89437	36,44683	8,4	289,8

Source: Stata Output

Please note: The summary of data presented above shows the final variables as used in the models. Figures for independent variables are not equal to the figures presented within section 8.2., as those depict preliminary data, as indicated in the text.

Table 6

Country pairs that trade fossil fuels intensively but do not maintain diplomatic relations.

Country pair	Year	Country pair	Year
Australia & United Arab Emirates	1990	Italy & Iraq	2000
Australia & United Arab Emirates	1995	Luxembourg & South Africa	1990
Chile & Angola	2000	Luxembourg & South Africa	1995
Chile & Angola	2005	Luxembourg & South Africa	2000
Chile & Congo	2005	Luxembourg & South Africa	2005
Chile & Gabon	2005	New Zealand & Qatar	2000
Chile & Nigeria	2000	New Zealand & United Arab Emirates	1990
Chile & Nigeria	2005	New Zealand & United Arab Emirates	2000
Czech Republic & Azerbaijan	2005	New Zealand & United Arab Emirates	2005
Denmark & Colombia	2005	Norway & Algeria	1995
Finland & Kazakhstan	1995	Norway & Colombia	1995
Finland & Kazakhstan	2005	Norway & Colombia	2000
Finland & Oman	1990	Poland & Uzbekistan	2000
France & Iraq	2000	Portugal & Indonesia	2000
Hungary & Turkmenistan	2005	Portugal & Malaysia	2000
Iceland & Colombia	2000	Slovenia & Algeria	1995
Iceland & Poland	1995	Slovenia & Algeria	2000

Iceland & Poland	2000	Slovenia & Algeria	2005
Iceland & Poland	2005	Slovenia & Indonesia	1995
Ireland & Colombia	1990	Slovenia & Indonesia	2000
Ireland & Colombia	1995	Slovenia & Indonesia	2005
Ireland & Colombia	2000	Spain & Trinidad and Tobago	2000
Ireland & Colombia	2005	Switzerland & Kazakhstan	2005
Ireland & Indonesia	2000	Turkey & Colombia	2005
Ireland & Indonesia	2005	Turkey & South Africa	1990

Source: Own Calculations

Table 7

Correlation Matrix

	CULTUREDIF	RELIGIOUSDIF	STABILITY	HUMANRIGHTS	DIPLOMATICREP	TRADE	CONTCOM	CO2	ENEUSE	OILPART	GASPART	COALPART	NUCLEARPART	WIND	SOLAR	BIOMASS	KYOTO	INDUSTRY
CONT-COM	0,18	0,01	0,08	0,02	-0,08	0,13	1,00											
CO2	-0,17	-0,12	-0,17	-0,11	-0,06	-0,20	-0,16	1,00										
ENEUSE	-0,09	-0,29	-0,38	-0,36	-0,06	-0,15	0,12	0,63	1,00									
OILPART	0,14	0,16	0,02	0,03	0,00	0,18	-0,14	-0,27	-0,46	1,00								
GASPART	0,11	-0,02	-0,08	0,01	0,07	0,17	0,12	0,24	-0,06	0,16	1,00							
COAL PART	-0,11	0,24	0,37	0,33	-0,06	-0,06	-0,23	0,21	-0,30	0,07	-0,20	1,00						
NUCLEAR PART	0,04	-0,10	-0,06	-0,08	0,11	-0,20	-0,16	-0,18	0,00	-0,30	-0,32	-0,25	1,00					
WIND	-0,55	-0,29	-0,28	-0,12	-0,27	-0,44	-0,14	0,58	0,47	-0,13	-0,14	0,06	-0,05	1,00				
SOLAR	-0,29	-0,12	-0,17	-0,08	-0,25	-0,37	-0,17	0,61	0,36	-0,05	-0,13	0,27	-0,13	0,82	1,00			
BIOMASS	-0,11	-0,23	-0,15	-0,02	-0,08	-0,69	-0,17	0,36	0,22	-0,02	-0,12	0,19	0,13	0,58	0,62	1,00		
KYOTO	0,18	-0,03	-0,03	0,03	0,05	0,09	0,03	-0,11	-0,02	0,04	0,12	-0,14	0,04	-0,12	-0,18	-0,11	1,00	
INDUS-TRY	0,26	0,36	0,13	0,17	-0,10	0,09	0,04	-0,07	-0,05	0,12	0,49	-0,15	-0,10	-0,21	-0,22	-0,19	0,53	1,00

Source: Stata Output

Table 8

Results of Harris-Tzavalis Unit Root Tests

H_0=Panels contain unit roots

H_a= Panels are stationary

	Statistic	**z**	**p-value**
Dependent Variables			
FITORCERT	0,560	-3,187	0,001
TOTALPOL	0,757	2,328	0,990
CONSHARE	1,011	7,966	1,000
SUPSHARE	0,368	-8,528	0,000
Independent Variables			
CULTUREDIF	0,766	-5,165	0,000
RELIGIOUSDIF	0,783	-4,384	0,000
STABILITY	0,512	-8,839	0,000
HUMANRIGHTS	0,555	-13,148	0,000
TRADE	0,522	-12,837	0,000
DIPLOMATICREP	0,613	-10,325	0,000
Test after taking first differences			
D_CONSHARE	-0,115	-5,049	0,000
D_TOTALPOL	0,201	-12,264	0,000

Source: Stata Output

Full Results of Main Model

Full results are displayed sorted by dependent variable employed. Next level sorting is according to the relation indicator employed.

Dependent Variable: D_CONSHARE

CULTUREDIF

Linear regression

Number of obs =	120
F(11, 107) =	.
Prob > F =	.
R-squared =	0.1335
Root MSE =	.78516

D_CONSHARE	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
CULTUREDIF	-.9595368	.7714225	-1.24	0.216	-2.488792	.5697183
CONTCOM	.1512981	.2101145	0.72	0.473	-.2652293	.5678255
CO2	-.0140524	.0743811	-0.19	0.851	-.1615043	.1333995
ENEUSE	-.0000406	.0001748	-0.23	0.817	-.000387	.0003059
OILPART	-.028422	.0208312	-1.36	0.175	-.0697175	.0128735
GASPART	-.0122928	.0062962	-1.95	0.054	-.0247743	.0001886
COALPART	-.0128143	.0055898	-2.29	0.024	-.0238954	-.0017332
NUCLEARPART	-.0106808	.0047644	-2.24	0.027	-.0201256	-.0012359
WIND	-1.42e-06	2.63e-06	-0.54	0.590	-6.63e-06	3.79e-06
SOLAR	-5.85e-11	2.13e-10	-0.28	0.784	-4.80e-10	3.63e-10
BIOMASS	4.98e-06	5.30e-06	0.94	0.349	-5.52e-06	.0000155
KYOTO	0	(omitted)				
INDUSTRY	.0035315	.0019346	1.83	0.071	-.0003036	.0073666
_cons	2.420331	1.066688	2.27	0.025	.305747	4.534915

Fixed-effects (within) regression	Number of obs = 120
Group variable: Country	Number of groups = 20
R-sq: within = 0.2235	Obs per group: min = 6
between = 0.0036	avg = 6.0
overall = 0.0005	max = 6
	F(9,19) = 18.02
corr(u_i, Xb) = -0.9896	Prob > F = 0.0000

(Std. Err. adjusted for 20 clusters in Country)

D_CONSHARE	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
CULTUREDIF	-2.994986	1.659777	-1.80	0.087	-6.468939	.4789659
CONTCOM	.852595	.4253384	2.00	0.059	-.0376485	1.742838
CO2	.5121748	.5042636	1.02	0.323	-.543261	1.567611
ENEUSE	-.0024137	.0016642	-1.45	0.163	-.0058968	.0010694
OILPART	-.0300742	.0196673	-1.53	0.143	-.0712383	.0110899
GASPART	-.0024037	.0398127	-0.06	0.952	-.0857326	.0809252
COALPART	.0270202	.0382003	0.71	0.488	-.0529341	.1069744
NUCLEARPART	.0313198	.0831987	0.38	0.711	-.1428172	.2054567
WIND	0	(omitted)				
SOLAR	0	(omitted)				
BIOMASS	0	(omitted)				
KYOTO	0	(omitted)				
INDUSTRY	.00512	.0030805	1.66	0.113	-.0013275	.0115676
_cons	7.035255	4.155242	1.69	0.107	-1.661767	15.73228
sigma_u	3.3460471					
sigma_e	.7389218					
rho	.95349994	(fraction of variance due to u_i)				

```
Random-effects GLS regression                   Number of obs      =       120
Group variable: Country                         Number of groups   =        20

R-sq:  within  = 0.0876                         Obs per group: min =         6
       between = 0.4541                                        avg =       6.0
       overall = 0.1326                                        max =         6

                                                Wald chi2(11)      =         .
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =         .

                               (Std. Err. adjusted for 20 clusters in Country)
```

D_CONSHARE	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
CULTUREDIF	-1.04812	.7015973	-1.49	0.135	-2.423225	.3269859
CONTCOM	.1708365	.0993841	1.72	0.086	-.0239528	.3656258
CO2	.0023389	.0701326	0.03	0.973	-.1351184	.1397962
ENEUSE	-.0000831	.0001912	-0.43	0.664	-.0004579	.0002917
OILPART	-.0317235	.0178247	-1.78	0.075	-.0666593	.0032122
GASPART	-.013654	.0042444	-3.22	0.001	-.0219729	-.0053351
COALPART	-.0143279	.006381	-2.25	0.025	-.0268345	-.0018213
NUCLEARPART	-.0107604	.0030402	-3.54	0.000	-.0167191	-.0048017
WIND	-1.26e-06	1.30e-06	-0.97	0.333	-3.82e-06	1.29e-06
SOLAR	-6.88e-11	1.58e-10	-0.44	0.662	-3.78e-10	2.40e-10
BIOMASS	5.37e-06	3.17e-06	1.69	0.090	-8.42e-07	.0000116
KYOTO	0	(omitted)				
INDUSTRY	.0038248	.001684	2.27	0.023	.0005242	.0071255
_cons	2.57583	1.136724	2.27	0.023	.3478924	4.803767
sigma_u	.22165233					
sigma_e	.7389218					
rho	.08255226	(fraction of variance due to u_i)				

RELIGIOUSDIF

```
Linear regression                                      Number of obs =     120
                                                       F( 11,    107) =      .
                                                       Prob > F       =      .
                                                       R-squared      =  0.1336
                                                       Root MSE       =   .7851
```

D_CONSHARE	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
RELIGIOUSDIF	-.7140909	.524308	-1.36	0.176	-1.75347	.3252886
CONTCOM	.1336198	.1972058	0.68	0.500	-.2573177	.5245574
CO2	.0514634	.0743205	0.69	0.490	-.0958683	.198795
ENEUSE	-.0001448	.000171	-0.85	0.399	-.0004838	.0001942
OILPART	-.0126424	.0225237	-0.56	0.576	-.0572931	.0320083
GASPART	-.0191031	.0065582	-2.91	0.004	-.032104	-.0061022
COALPART	-.0122702	.0054418	-2.25	0.026	-.0230578	-.0014825
NUCLEARPART	-.0110932	.004434	-2.50	0.014	-.0198832	-.0023032
WIND	-2.50e-06	3.04e-06	-0.82	0.414	-8.53e-06	3.53e-06
SOLAR	3.49e-10	2.95e-10	1.18	0.239	-2.35e-10	9.33e-10
BIOMASS	-1.87e-06	5.91e-06	-0.32	0.752	-.0000136	9.84e-06
KYOTO	0	(omitted)				
INDUSTRY	.0049648	.0022014	2.26	0.026	.0006007	.0093289
_cons	1.788268	.7357225	2.43	0.017	.3297836	3.246752

```
Fixed-effects (within) regression               Number of obs      =       120
Group variable: Country                         Number of groups   =        20

R-sq:  within  = 0.2122                         Obs per group: min =         6
       between = 0.0040                                        avg =       6.0
       overall = 0.0004                                        max =         6

                                                F(9,19)            =     18.95
corr(u_i, Xb)  = -0.9896                        Prob > F           =    0.0000

                               (Std. Err. adjusted for 20 clusters in Country)
```

D_CONSHARE	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
RELIGIOUSDIF	-.1607554	1.382005	-0.12	0.909	-3.053325	2.731814
CONTCOM	.6125068	.2692406	2.27	0.035	.0489796	1.176034
CO2	.5634838	.5524208	1.02	0.321	-.5927462	1.719714
ENEUSE	-.0025819	.0017761	-1.45	0.162	-.0062994	.0011355
OILPART	-.0267259	.0218306	-1.22	0.236	-.0724177	.018966
GASPART	-.0045422	.0401245	-0.11	0.911	-.0885238	.0794394
COALPART	.026684	.039592	0.67	0.508	-.0561831	.1095511
NUCLEARPART	.0314797	.0861293	0.37	0.719	-.148791	.2117503
WIND	0	(omitted)				
SOLAR	0	(omitted)				
BIOMASS	0	(omitted)				
KYOTO	0	(omitted)				
INDUSTRY	.0052307	.0031463	1.66	0.113	-.0013547	.011816
_cons	4.594788	3.839229	1.20	0.246	-3.440811	12.63039
sigma_u	3.3067995					
sigma_e	.74424231					
rho	.95178821	(fraction of variance due to u_i)				

```
Random-effects GLS regression                   Number of obs      =       120
Group variable: Country                         Number of groups   =        20

R-sq:  within  = 0.0882                         Obs per group: min =         6
       between = 0.4395                                        avg =       6.0
       overall = 0.1327                                        max =         6

                                                Wald chi2(11)      =         .
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =         .

                              (Std. Err. adjusted for 20 clusters in Country)
```

D_CONSHARE	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
RELIGIOUSDIF	-.7656392	.5852445	-1.31	0.191	-1.912697	.3814189
CONTCOM	.1193367	.0966887	1.23	0.217	-.0701697	.308843
CO2	.0685155	.0950661	0.72	0.471	-.1178107	.2548417
ENEUSE	-.0001965	.0002216	-0.89	0.375	-.0006309	.0002379
OILPART	-.018353	.0175094	-1.05	0.295	-.0526708	.0159649
GASPART	-.0204689	.0076153	-2.69	0.007	-.0353946	-.0055432
COALPART	-.0138834	.0060783	-2.28	0.022	-.0257966	-.0019701
NUCLEARPART	-.0116613	.0033115	-3.52	0.000	-.0181517	-.0051708
WIND	-2.63e-06	1.88e-06	-1.40	0.161	-6.31e-06	1.04e-06
SOLAR	3.83e-10	2.48e-10	1.54	0.123	-1.04e-10	8.70e-10
BIOMASS	-2.24e-06	4.29e-06	-0.52	0.602	-.0000106	6.17e-06
KYOTO	0	(omitted)				
INDUSTRY	.0051145	.0017322	2.95	0.003	.0017194	.0085096
_cons	1.977408	.8650417	2.29	0.022	.281958	3.672859
sigma_u	.21792378					
sigma_e	.74424231					
rho	.07896869	(fraction of variance due to u_i)				

STABILITY

```
Linear regression                                      Number of obs =       120
                                                       F( 11,    107) =        .
                                                       Prob > F       =        .
                                                       R-squared      =   0.1557
                                                       Root MSE       =   .77502
```

D_CONSHARE	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
STABILITY	-.8668337	.5286915	-1.64	0.104	-1.914903	.1812355
CONTCOM	.1057807	.19305	0.55	0.585	-.2769183	.4884798
CO2	.0227404	.0674246	0.34	0.737	-.110921	.1564017
ENEUSE	-.0001202	.0001664	-0.72	0.471	-.0004501	.0002096
OILPART	-.0249919	.0201149	-1.24	0.217	-.0648674	.0148835
GASPART	-.0190963	.0053607	-3.56	0.001	-.0297233	-.0084692
COALPART	-.0127014	.0054888	-2.31	0.023	-.0235824	-.0018204
NUCLEARPART	-.0131292	.0043827	-3.00	0.003	-.0218173	-.0044411
WIND	-4.35e-06	3.78e-06	-1.15	0.253	-.0000118	3.15e-06
SOLAR	2.79e-10	2.52e-10	1.11	0.271	-2.20e-10	7.78e-10
BIOMASS	-1.37e-06	5.21e-06	-0.26	0.794	-.0000117	8.97e-06
KYOTO	0	(omitted)				
INDUSTRY	.0037807	.0019047	1.98	0.050	4.77e-06	.0075566
_cons	2.649644	1.053324	2.52	0.013	.561553	4.737736

```
Fixed-effects (within) regression               Number of obs      =       120
Group variable: Country                         Number of groups   =        20

R-sq:  within  = 0.2140                         Obs per group: min =         6
       between = 0.0032                                        avg =       6.0
       overall = 0.0006                                        max =         6

                                                F(9,19)            =     20.34
corr(u_i, Xb)  = -0.9889                        Prob > F           =    0.0000

                               (Std. Err. adjusted for 20 clusters in Country)
```

D_CONSHARE	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
STABILITY	-.7079262	1.217731	-0.58	0.568	-3.256666	1.840814
CONTCOM	.5519712	.2228394	2.48	0.023	.0855629	1.018379
CO2	.5423468	.5187123	1.05	0.309	-.5433306	1.628024
ENEUSE	-.0025253	.001709	-1.48	0.156	-.0061023	.0010517
OILPART	-.0318949	.0192571	-1.66	0.114	-.0722005	.0084106
GASPART	-.0043932	.0397851	-0.11	0.913	-.0876645	.078878
COALPART	.0276866	.0393955	0.70	0.491	-.0547692	.1101424
NUCLEARPART	.0293528	.0849312	0.35	0.733	-.1484102	.2071158
WIND	0	(omitted)				
SOLAR	0	(omitted)				
BIOMASS	0	(omitted)				
KYOTO	0	(omitted)				
INDUSTRY	.0051302	.0030339	1.69	0.107	-.0012199	.0114803
_cons	5.225976	4.132029	1.26	0.221	-3.42246	13.87441
sigma_u	3.1965201					
sigma_e	.74342456					
rho	.94868538	(fraction of variance due to u_i)				

```
Random-effects GLS regression                   Number of obs      =       120
Group variable: Country                         Number of groups   =        20

R-sq:  within  = 0.0941                         Obs per group: min =         6
       between = 0.5761                                        avg =       6.0
       overall = 0.1556                                        max =         6

                                                Wald chi2(11)      =         .
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =         .

                               (Std. Err. adjusted for 20 clusters in Country)
```

D_CONSHARE	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
STABILITY	-.8834427	.4848186	-1.82	0.068	-1.83367	.0667843
CONTCOM	.1027763	.1219348	0.84	0.399	-.1362116	.3417642
CO2	.0276963	.06486	0.43	0.669	-.0994269	.1548194
ENEUSE	-.0001356	.0001714	-0.79	0.429	-.0004715	.0002003
OILPART	-.026985	.0155011	-1.74	0.082	-.0573666	.0033967
GASPART	-.019565	.0053226	-3.68	0.000	-.0299972	-.0091329
COALPART	-.0131977	.0053835	-2.45	0.014	-.0237493	-.0026462
NUCLEARPART	-.0133235	.0032712	-4.07	0.000	-.0197349	-.0069121
WIND	-4.40e-06	2.24e-06	-1.96	0.049	-8.80e-06	-1.08e-08
SOLAR	2.87e-10	1.72e-10	1.67	0.095	-4.99e-11	6.23e-10
BIOMASS	-1.44e-06	2.45e-06	-0.59	0.556	-6.24e-06	3.35e-06
KYOTO	0	(omitted)				
INDUSTRY	.0038633	.0014567	2.65	0.008	.0010082	.0067184
_cons	2.712188	1.149844	2.36	0.018	.4585339	4.965841
sigma_u	.12257422					
sigma_e	.74342456					
rho	.02646525	(fraction of variance due to u_i)				

HUMANRIGHTS

```
Linear regression                                      Number of obs =       120
                                                       F( 11,    107) =         .
                                                       Prob > F      =         .
                                                       R-squared     =    0.1307
                                                       Root MSE      =    .78642
```

D_CONSHARE	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
HUMANRIGHTS	-.3370871	.3613796	-0.93	0.353	-1.05348	.3793059
CONTCOM	.0697535	.2006515	0.35	0.729	-.3280147	.4675217
CO2	.0020023	.0691172	0.03	0.977	-.1350144	.1390191
ENEUSE	-.0000825	.0001636	-0.50	0.615	-.0004068	.0002418
OILPART	-.025237	.0207993	-1.21	0.228	-.0664692	.0159952
GASPART	-.0141743	.0054807	-2.59	0.011	-.0250391	-.0033094
COALPART	-.0113656	.0057771	-1.97	0.052	-.022818	.0000869
NUCLEARPART	-.0111262	.0044956	-2.47	0.015	-.0200383	-.0022142
WIND	-2.94e-06	3.82e-06	-0.77	0.443	-.0000105	4.63e-06
SOLAR	1.33e-10	2.40e-10	0.56	0.580	-3.42e-10	6.09e-10
BIOMASS	1.46e-06	5.11e-06	0.29	0.776	-8.67e-06	.0000116
KYOTO	0	(omitted)				
INDUSTRY	.00334	.0019682	1.70	0.093	-.0005618	.0072418
_cons	2.065537	.980353	2.11	0.037	.1221015	4.008973

```
Fixed-effects (within) regression               Number of obs      =       120
Group variable: Country                         Number of groups   =        20

R-sq:  within  = 0.2133                         Obs per group: min =         6
       between = 0.0057                                        avg =       6.0
       overall = 0.0002                                        max =         6

                                                F(9,19)            =     20.99
corr(u_i, Xb)  = -0.9898                        Prob > F           =    0.0000

                               (Std. Err. adjusted for 20 clusters in Country)
```

D_CONSHARE	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
HUMANRIGHTS	.1842833	.5997108	0.31	0.762	-1.070926	1.439492
CONTCOM	.6312985	.2616618	2.41	0.026	.0836342	1.178963
CO2	.580432	.5480913	1.06	0.303	-.5667363	1.7276
ENEUSE	-.0025995	.0018336	-1.42	0.172	-.0064372	.0012382
OILPART	-.0247595	.0212586	-1.16	0.259	-.0692543	.0197353
GASPART	-.0029339	.0430586	-0.07	0.946	-.0930565	.0871887
COALPART	.0259826	.0391022	0.66	0.514	-.0558591	.1078244
NUCLEARPART	.0347704	.0923707	0.38	0.711	-.1585636	.2281044
WIND	0	(omitted)				
SOLAR	0	(omitted)				
BIOMASS	0	(omitted)				
KYOTO	0	(omitted)				
INDUSTRY	.0051294	.0030988	1.66	0.114	-.0013565	.0116154
_cons	4.053926	4.320888	0.94	0.360	-4.989796	13.09765
sigma_u	3.342683					
sigma_e	.74374853					
rho	.95282882	(fraction of variance due to u_i)				

Random-effects GLS regression	Number of obs = 120
Group variable: Country	Number of groups = 20
R-sq: within = 0.0546	Obs per group: min = 6
between = 0.5657	avg = 6.0
overall = 0.1307	max = 6
	Wald chi2(11) = .
corr(u_i, X) = 0 (assumed)	Prob > chi2 = .

(Std. Err. adjusted for 20 clusters in Country)

D_CONSHARE	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
HUMANRIGHTS	-.3368246	.2558879	-1.32	0.188	-.8383557	.1647065
CONTCOM	.0697658	.1110863	0.63	0.530	-.1479594	.2874909
CO2	.0020537	.0574458	0.04	0.971	-.1105381	.1146455
ENEUSE	-.0000826	.0001475	-0.56	0.575	-.0003717	.0002064
OILPART	-.0252542	.0154175	-1.64	0.101	-.055472	.0049636
GASPART	-.0141764	.0039376	-3.60	0.000	-.021894	-.0064588
COALPART	-.0113703	.0042889	-2.65	0.008	-.0197764	-.0029642
NUCLEARPART	-.0111257	.0026665	-4.17	0.000	-.0163518	-.0058995
WIND	-2.94e-06	1.97e-06	-1.49	0.136	-6.80e-06	9.23e-07
SOLAR	1.33e-10	1.43e-10	0.93	0.352	-1.48e-10	4.14e-10
BIOMASS	1.46e-06	2.17e-06	0.67	0.502	-2.80e-06	5.72e-06
KYOTO	0	(omitted)				
INDUSTRY	.0033411	.001489	2.24	0.025	.0004226	.0062596
_cons	2.065349	.8587171	2.41	0.016	.3822948	3.748404
sigma_u	.01130929					
sigma_e	.74374853					
rho	.00023116	(fraction of variance due to u_i)				

TRADE

Source	SS	df	MS		
Model	17.3422057	12	1.44518381	Number of obs =	100
Residual	30.2393938	87	.347579239	F(12, 87) =	4.16
Total	47.5815995	99	.480622217	Prob > F =	0.0000
				R-squared =	0.3645
				Adj R-squared =	0.2768
				Root MSE =	.58956

D_CONSHARE	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
TRADE	-10.50069	6.541807	-1.61	0.112	-23.50324	2.501857
CONTCOM	-.0328022	.2225999	-0.15	0.883	-.4752436	.4096392
CO2	-.0090702	.0598509	-0.15	0.880	-.1280304	.10989
ENEUSE	-.000065	.0001341	-0.48	0.629	-.0003315	.0002015
OILPART	-.036532	.0241871	-1.51	0.135	-.0846064	.0115424
GASPART	-.0152089	.0054442	-2.79	0.006	-.0260297	-.004388
COALPART	-.019419	.0060561	-3.21	0.002	-.0314562	-.0073819
NUCLEARPART	-.0166527	.0046765	-3.56	0.001	-.0259477	-.0073577
WIND	-7.98e-07	1.82e-06	-0.44	0.663	-4.42e-06	2.83e-06
SOLAR	-2.16e-11	2.26e-10	-0.10	0.924	-4.71e-10	4.27e-10
BIOMASS	5.33e-06	4.59e-06	1.16	0.249	-3.80e-06	.0000145
KYOTO	0	(omitted)				
INDUSTRY	.0032599	.0020023	1.63	0.107	-.00072	.0072398
_cons	12.47642	6.60146	1.89	0.062	-.6446947	25.59754

```
Fixed-effects (within) regression               Number of obs      =       100
Group variable: Country                         Number of groups   =        20

R-sq:  within  = 0.2559                         Obs per group: min =         5
       between = 0.2811                                        avg =       5.0
       overall = 0.1376                                        max =         5

                                                F(8,72)            =      3.10
corr(u_i, Xb)  = -0.9720                        Prob > F           =    0.0047
```

D_CONSHARE	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
TRADE	5.371663	25.29386	0.21	0.832	-45.05073	55.79406
CONTCOM	0	(omitted)				
CO2	.2175652	.4279781	0.51	0.613	-.6355936	1.070724
ENEUSE	-.0005922	.0011674	-0.51	0.614	-.0029194	.0017351
OILPART	-.0286261	.0470484	-0.61	0.545	-.1224154	.0651632
GASPART	-.0749225	.0403267	-1.86	0.067	-.1553122	.0054672
COALPART	-.0889925	.045278	-1.97	0.053	-.1792525	.0012675
NUCLEARPART	-.1007738	.0552137	-1.83	0.072	-.2108404	.0092927
WIND	0	(omitted)				
SOLAR	0	(omitted)				
BIOMASS	0	(omitted)				
KYOTO	0	(omitted)				
INDUSTRY	.0069097	.0034602	2.00	0.050	.0000118	.0138075
_cons	1.556601	25.60148	0.06	0.952	-49.47902	52.59222
sigma_u	1.8736897					
sigma_e	.56072139					
rho	.91780432	(fraction of variance due to u_i)				

```
F test that all u_i=0:     F(19, 72) =     1.40              Prob > F = 0.1538
```

```
Random-effects GLS regression                   Number of obs      =       100
Group variable: Country                         Number of groups   =        20

R-sq:  within  = 0.1995                         Obs per group: min =         5
       between = 0.7000                                        avg =       5.0
       overall = 0.3624                                        max =         5

                                                Wald chi2(11)      =         .
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =         .
```

D_CONSHARE	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
TRADE	-9.687316	8.252456	-1.17	0.240	-25.86183	6.487201
CONTCOM	-.0553878	.2724011	-0.20	0.839	-.5892841	.4785084
CO2	-.0097627	.0761061	-0.13	0.898	-.1589279	.1394025
ENEUSE	-.0000731	.000171	-0.43	0.669	-.0004083	.0002621
OILPART	-.0428147	.0273891	-1.56	0.118	-.0964964	.0108671
GASPART	-.0161729	.0068583	-2.36	0.018	-.0296149	-.0027309
COALPART	-.0201959	.0076748	-2.63	0.009	-.0352382	-.0051535
NUCLEARPART	-.0177537	.0057639	-3.08	0.002	-.0290507	-.0064566
WIND	-8.93e-07	2.26e-06	-0.40	0.692	-5.32e-06	3.53e-06
SOLAR	4.57e-12	2.87e-10	0.02	0.987	-5.58e-10	5.68e-10
BIOMASS	5.27e-06	5.89e-06	0.89	0.371	-6.28e-06	.0000168
KYOTO	0	(omitted)				
INDUSTRY	.0041688	.0022552	1.85	0.065	-.0002513	.0085888
_cons	11.69278	8.340787	1.40	0.161	-4.654864	28.04042
sigma_u	.22713927					
sigma_e	.56072139					
rho	.14096214	(fraction of variance due to u_i)				

DIPLOMREP

```
Linear regression                                      Number of obs =        20
                                                       F( 11,      7) =         .
                                                       Prob > F      =         .
                                                       R-squared     =    0.7662
                                                       Root MSE      =    .45694
```

D_CONSHARE	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
DIPLOMREP	.3267701	.364508	0.90	0.400	-.5351544	1.188695
CONTCOM	.2600318	.4390608	0.59	0.572	-.778182	1.298246
CO2	.0502117	.1340221	0.37	0.719	-.2667002	.3671235
ENEUSE	-.0000713	.0003422	-0.21	0.841	-.0008803	.0007378
OILPART	-.0114765	.043212	-0.27	0.798	-.1136566	.0907036
GASPART	-.0183335	.0099323	-1.85	0.107	-.0418197	.0051527
COALPART	-.013989	.0102203	-1.37	0.213	-.0381562	.0101782
NUCLEARPART	-.0115163	.0098648	-1.17	0.281	-.0348428	.0118103
WIND	5.58e-06	4.91e-06	1.14	0.293	-6.02e-06	.0000172
SOLAR	-3.94e-10	2.73e-10	-1.44	0.192	-1.04e-09	2.51e-10
BIOMASS	.0000104	7.53e-06	1.39	0.208	-7.37e-06	.0000283
KYOTO	0	(omitted)				
INDUSTRY	.0059277	.0054841	1.08	0.316	-.0070402	.0188955
_cons	.3558646	1.564672	0.23	0.827	-3.343996	4.055725

```
. xtreg $ylist $xlist, fe robust
insufficient observations
```

```
. xtreg $ylist $xlist, re robust
note: KYOTO omitted because of collinearity
insufficient observations
```

Dependent Variable: SUPSHARE

CULTUREDIF

```
. reg $ylist $xlist, cluster ()
```

Source	SS	df	MS
Model	149421.401	13	11493.9539
Residual	5888.92471	658	8.94973361
Total	155310.325	671	231.460992

Number of obs =	672
F(13, 658) =	1284.28
Prob > F =	0.0000
R-squared =	0.9621
Adj R-squared =	0.9613
Root MSE =	2.9916

SUPSHARE	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
CULTUREDIF	2.902763	1.01472	2.86	0.004	.9102837	4.895243
CONTCOM	.3338696	.3543095	0.94	0.346	-.361844	1.029583
CO2	-1.967828	.0607158	-32.41	0.000	-2.087048	-1.848608
ENEUSE	.0043037	.0000999	43.08	0.000	.0041075	.0044998
OILPART	-.3508242	.0134944	-26.00	0.000	-.3773214	-.3243269
GASPART	-.3603681	.0100004	-36.04	0.000	-.3800048	-.3407315
COALPART	-.2589376	.0076485	-33.85	0.000	-.273956	-.2439192
NUCLEARPART	-.4452494	.0071699	-62.10	0.000	-.459328	-.4311708
WIND	-3.90e-06	4.91e-07	-7.94	0.000	-4.86e-06	-2.94e-06
SOLAR	2.19e-10	3.48e-11	6.30	0.000	1.51e-10	2.88e-10
BIOMASS	.0000242	5.10e-06	4.73	0.000	.0000141	.0000342
KYOTO	.4017016	.2866062	1.40	0.162	-.1610714	.9644745
INDUSTRY	-.0080819	.0039639	-2.04	0.042	-.0158653	-.0002985
_cons	34.7014	1.030689	33.67	0.000	32.67756	36.72523

```
Fixed-effects (within) regression               Number of obs      =       672
Group variable: Country                         Number of groups   =        32

R-sq:  within  = 0.5607                         Obs per group: min =        21
       between = 0.9324                                        avg =      21.0
       overall = 0.9176                                        max =        21

                                                F(10,630)          =     80.42
corr(u_i, Xb)  = 0.8513                         Prob > F           =    0.0000
```

SUPSHARE	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
CULTUREDIF	-1.127016	1.196267	-0.94	0.346	-3.47617	1.222137
CONTCOM	1.22993	.7454893	1.65	0.099	-.2340151	2.693874
CO2	-.7014779	.0866111	-8.10	0.000	-.8715592	-.5313966
ENEUSE	.0015862	.0001006	15.77	0.000	.0013887	.0017837
OILPART	-.1736743	.0177774	-9.77	0.000	-.2085844	-.1387642
GASPART	-.2008854	.0144577	-13.89	0.000	-.2292765	-.1724944
COALPART	-.1863393	.0160222	-11.63	0.000	-.2178027	-.1548759
NUCLEARPART	-.2399087	.0237504	-10.10	0.000	-.2865482	-.1932693
WIND	0	(omitted)				
SOLAR	0	(omitted)				
BIOMASS	0	(omitted)				
KYOTO	.5979297	.1694997	3.53	0.000	.265077	.9307824
INDUSTRY	.012839	.0025943	4.95	0.000	.0077444	.0179335
_cons	26.69489	1.634188	16.34	0.000	23.48578	29.90401
sigma_u	8.0225317					
sigma_e	1.416569					
rho	.96976438	(fraction of variance due to u_i)				

```
F test that all u_i=0:     F(31, 630) =    86.12             Prob > F = 0.0000
```

```
Random-effects GLS regression                   Number of obs      =       672
Group variable: Country                         Number of groups   =        32

R-sq:  within  = 0.5455                         Obs per group: min =        21
       between = 0.9423                                        avg =      21.0
       overall = 0.9296                                        max =        21

                                                Wald chi2(12)      =         .
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =         .
```

SUPSHARE	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
CULTUREDIF	-1.359584	1.328555	-1.02	0.306	-3.963504	1.244336
CONTCOM	2.037435	.709732	2.87	0.004	.6463857	3.428484
CO2	-.7789055	.0858673	-9.07	0.000	-.9472024	-.6106087
ENEUSE	.0020706	.0001126	18.39	0.000	.0018499	.0022913
OILPART	-.2892883	.0173267	-16.70	0.000	-.323248	-.2553285
GASPART	-.3090572	.013429	-23.01	0.000	-.3353776	-.2827368
COALPART	-.2874904	.0140094	-20.52	0.000	-.3149483	-.2600325
NUCLEARPART	-.3633324	.018434	-19.71	0.000	-.3994624	-.3272025
WIND	-3.05e-06	1.34e-06	-2.27	0.023	-5.67e-06	-4.21e-07
SOLAR	8.29e-11	1.15e-10	0.72	0.472	-1.43e-10	3.09e-10
BIOMASS	.0000126	.0000173	0.73	0.466	-.0000213	.0000466
KYOTO	.5309421	.1969608	2.70	0.007	.144906	.9169782
INDUSTRY	.0088741	.0030258	2.93	0.003	.0029437	.0148046
_cons	33.89346	1.701772	19.92	0.000	30.55804	37.22887
sigma_u	1.9410783					
sigma_e	1.416569					
rho	.65249212	(fraction of variance due to u_i)				

RELIGIOUSDIF

Source	SS	df	MS
Model	149363.073	13	11489.4672
Residual	5947.25226	658	9.0383773
Total	155310.325	671	231.460992

```
Number of obs =      672
F( 13,    658) = 1271.19
Prob > F      =   0.0000
R-squared     =   0.9617
Adj R-squared =   0.9610
Root MSE      =   3.0064
```

SUPSHARE	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
RELIGIOUSDIF	-.4126399	.3212626	-1.28	0.199	-1.043463	.2181835
CONTCOM	.6485276	.3489444	1.86	0.064	-.0366511	1.333706
CO2	-1.915123	.0591835	-32.36	0.000	-2.031334	-1.798911
ENEUSE	.004279	.0001015	42.16	0.000	.0040797	.0044783
OILPART	-.3403973	.01318	-25.83	0.000	-.3662774	-.3145173
GASPART	-.3690833	.0099408	-37.13	0.000	-.3886028	-.3495639
COALPART	-.2643416	.0074271	-35.59	0.000	-.2789253	-.2497579
NUCLEARPART	-.4456668	.0072085	-61.83	0.000	-.4598213	-.4315123
WIND	-4.94e-06	3.83e-07	-12.89	0.000	-5.69e-06	-4.18e-06
SOLAR	2.55e-10	3.45e-11	7.38	0.000	1.87e-10	3.23e-10
BIOMASS	.0000271	5.00e-06	5.42	0.000	.0000173	.0000369
KYOTO	.4819831	.2864617	1.68	0.093	-.0805062	1.044472
INDUSTRY	-.0043712	.0042052	-1.04	0.299	-.0126283	.003886
_cons	37.26689	.6786151	54.92	0.000	35.93437	38.5994

```
Fixed-effects (within) regression               Number of obs      =       672
Group variable: Country                         Number of groups   =        32

R-sq:  within  = 0.5610                         Obs per group: min =        21
       between = 0.9321                                        avg =      21.0
       overall = 0.9171                                        max =        21

                                                F(10,630)          =     80.50
corr(u_i, Xb)  = 0.8515                         Prob > F           =    0.0000
```

SUPSHARE	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
RELIGIOUSDIF	.7255812	.6527883	1.11	0.267	-.556323	2.007485
CONTCOM	1.211212	.7443364	1.63	0.104	-.2504686	2.672893
CO2	-.6992203	.086537	-8.08	0.000	-.8691561	-.5292844
ENEUSE	.0015908	.0001005	15.83	0.000	.0013935	.0017882
OILPART	-.1711657	.0179157	-9.55	0.000	-.2063474	-.135984
GASPART	-.1996768	.0143665	-13.90	0.000	-.2278888	-.1714647
COALPART	-.1870446	.0160513	-11.65	0.000	-.2185651	-.1555241
NUCLEARPART	-.2386598	.023606	-10.11	0.000	-.2850157	-.1923039
WIND	0	(omitted)				
SOLAR	0	(omitted)				
BIOMASS	0	(omitted)				
KYOTO	.5564952	.1639683	3.39	0.001	.2345047	.8784856
INDUSTRY	.0126656	.0025842	4.90	0.000	.0075908	.0177403
_cons	24.98072	1.209182	20.66	0.000	22.60621	27.35523
sigma_u	8.0552196					
sigma_e	1.4161786					
rho	.97001797	(fraction of variance due to u_i)				

```
F test that all u_i=0:     F(31, 630) =   101.39             Prob > F = 0.0000
```

Random-effects GLS regression			Number of obs	=	672
Group variable: Country			Number of groups	=	32
R-sq:	within = 0.5457		Obs per group: min	=	21
	between = 0.9417		avg	=	21.0
	overall = 0.9289		max	=	21
			Wald chi2(12)	=	.
corr(u_i, X)	= 0 (assumed)		Prob > chi2	=	.

SUPSHARE	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
RELIGIOUSDIF	-.0173893	.6346721	-0.03	0.978	-1.261324	1.226545
CONTCOM	1.968413	.7120202	2.76	0.006	.5728786	3.363946
CO2	-.7714329	.086024	-8.97	0.000	-.9400369	-.6028289
ENEUSE	.0020463	.0001122	18.24	0.000	.0018264	.0022661
OILPART	-.2847049	.0174162	-16.35	0.000	-.3188401	-.2505697
GASPART	-.3026735	.013363	-22.65	0.000	-.3288644	-.2764825
COALPART	-.282362	.0141411	-19.97	0.000	-.3100782	-.2546459
NUCLEARPART	-.3568419	.0186271	-19.16	0.000	-.3933503	-.3203334
WIND	-2.54e-06	1.34e-06	-1.90	0.058	-5.16e-06	8.16e-08
SOLAR	6.57e-11	1.19e-10	0.55	0.581	-1.68e-10	2.99e-10
BIOMASS	9.33e-06	.0000179	0.52	0.601	-.0000257	.0000443
KYOTO	.4857117	.1904284	2.55	0.011	.1124788	.8589445
INDUSTRY	.0087838	.0029934	2.93	0.003	.0029168	.0146509
_cons	32.31638	1.268504	25.48	0.000	29.83016	34.80261
sigma_u	2.0249002					
sigma_e	1.4161786					
rho	.67153074	(fraction of variance due to u_i)				

STABILITY

Source	SS	df	MS			
Model	108566.506	13	8351.26972	Number of obs	=	480
Residual	3877.91402	466	8.32170391	F(13, 466)	=	1003.55
Total	112444.42	479	234.748268	Prob > F	=	0.0000
				R-squared	=	0.9655
				Adj R-squared	=	0.9646
				Root MSE	=	2.8847

SUPSHARE	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
STABILITY	.8137951	.5408815	1.50	0.133	-.2490737	1.876664
CONTCOM	.1674849	.4029407	0.42	0.678	-.6243209	.9592906
CO2	-1.861766	.0691173	-26.94	0.000	-1.997587	-1.725946
ENEUSE	.0041798	.0001069	39.08	0.000	.0039696	.0043899
OILPART	-.3389777	.0180688	-18.76	0.000	-.374484	-.3034713
GASPART	-.3546064	.0113528	-31.24	0.000	-.3769154	-.3322975
COALPART	-.2644769	.0085701	-30.86	0.000	-.2813176	-.2476362
NUCLEARPART	-.4399553	.0083417	-52.74	0.000	-.4563472	-.4235633
WIND	-4.69e-06	4.28e-07	-10.97	0.000	-5.53e-06	-3.85e-06
SOLAR	2.34e-10	3.92e-11	5.96	0.000	1.57e-10	3.11e-10
BIOMASS	.0000293	5.62e-06	5.21	0.000	.0000182	.0000403
KYOTO	.6760188	.3100489	2.18	0.030	.0667517	1.285286
INDUSTRY	-.0073361	.0045709	-1.60	0.109	-.0163183	.001646
_cons	35.78857	.9196698	38.91	0.000	33.98136	37.59578

```
Fixed-effects (within) regression               Number of obs      =       480
Group variable: Country                         Number of groups   =        32

R-sq:  within  = 0.5360                         Obs per group: min =        15
       between = 0.8792                                        avg =      15.0
       overall = 0.8679                                        max =        15

                                                F(10,438)          =     50.60
corr(u_i, Xb)  = 0.7684                         Prob > F           =    0.0000
```

SUPSHARE	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
STABILITY	-2.710097	.8676601	-3.12	0.002	-4.415392	-1.004803
CONTCOM	1.113807	.7295405	1.53	0.128	-.3200281	2.547642
CO2	-.7518864	.1224395	-6.14	0.000	-.9925284	-.5112444
ENEUSE	.0015759	.0001241	12.69	0.000	.0013319	.0018199
OILPART	-.1256847	.0250969	-5.01	0.000	-.1750099	-.0763594
GASPART	-.1432888	.0194163	-7.38	0.000	-.1814494	-.1051282
COALPART	-.1852688	.022836	-8.11	0.000	-.2301505	-.140387
NUCLEARPART	-.2189262	.0298762	-7.33	0.000	-.2776446	-.1602077
WIND	0	(omitted)				
SOLAR	0	(omitted)				
BIOMASS	0	(omitted)				
KYOTO	.4905319	.1788393	2.74	0.006	.139042	.8420218
INDUSTRY	.0123112	.0029967	4.11	0.000	.0064215	.0182009
_cons	27.11054	1.690377	16.04	0.000	23.78828	30.4328
sigma_u	8.5883181					
sigma_e	1.3618359					
rho	.97547277	(fraction of variance due to u_i)				

F test that all u_i=0:   F(31, 438) =   72.26   Prob > F = 0.0000

Random-effects GLS regression — Number of obs = 480
Group variable: Country — Number of groups = 32

R-sq: within = 0.5059 — Obs per group: min = 15
between = 0.9322 — avg = 15.0
overall = 0.9209 — max = 15

Wald chi2(12) = .
corr(u_i, X) = 0 (assumed) — Prob > chi2 = .

SUPSHARE	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
STABILITY	-2.200228	.9228399	-2.38	0.017	-4.008961	-.3914948
CONTCOM	1.726547	.7476608	2.31	0.021	.2611584	3.191935
CO2	-.7721841	.1148852	-6.72	0.000	-.9973551	-.5470132
ENEUSE	.0022331	.0001395	16.00	0.000	.0019596	.0025065
OILPART	-.2789502	.0240642	-11.59	0.000	-.3261151	-.2317853
GASPART	-.2851223	.0174972	-16.30	0.000	-.3194163	-.2508284
COALPART	-.2969314	.0183191	-16.21	0.000	-.3328362	-.2610267
NUCLEARPART	-.3671376	.0217826	-16.85	0.000	-.4098308	-.3244444
WIND	-3.67e-06	1.44e-06	-2.55	0.011	-6.49e-06	-8.51e-07
SOLAR	1.02e-10	1.30e-10	0.79	0.430	-1.52e-10	3.56e-10
BIOMASS	.0000162	.0000192	0.84	0.398	-.0000214	.0000537
KYOTO	.5770333	.2184039	2.64	0.008	.1489696	1.005097
INDUSTRY	.0065527	.0036098	1.82	0.069	-.0005223	.0136277
_cons	33.99844	1.701046	19.99	0.000	30.66445	37.33243
sigma_u	2.0489383					
sigma_e	1.3618359					
rho	.69359406	(fraction of variance due to u_i)				

HUMANRIGHTS

Source	SS	df	MS
Model	149374.591	13	11490.3531
Residual	5935.73467	658	9.02087336
Total	155310.325	671	231.460992

Number of obs = 672
F(13, 658) = 1273.75
Prob > F = 0.0000
R-squared = 0.9618
Adj R-squared = 0.9610
Root MSE = 3.0035

SUPSHARE	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
HUMANRIGHTS	.5729657	.3347451	1.71	0.087	-.0843317	1.230263
CONTCOM	.4964603	.34849	1.42	0.155	-.1878262	1.180747
CO2	-1.930808	.0590448	-32.70	0.000	-2.046747	-1.814869
ENEUSE	.0043408	.0001033	42.03	0.000	.004138	.0045435
OILPART	-.3398822	.0131737	-25.80	0.000	-.3657498	-.3140147
GASPART	-.3647073	.0098588	-36.99	0.000	-.3840658	-.3453489
COALPART	-.2659514	.007459	-35.65	0.000	-.2805978	-.251305
NUCLEARPART	-.4448152	.0072059	-61.73	0.000	-.4589645	-.430666
WIND	-4.82e-06	3.72e-07	-12.95	0.000	-5.55e-06	-4.09e-06
SOLAR	2.45e-10	3.37e-11	7.28	0.000	1.79e-10	3.12e-10
BIOMASS	.0000277	4.94e-06	5.60	0.000	.000018	.0000374
KYOTO	.4480272	.2877215	1.56	0.120	-.1169358	1.01299
INDUSTRY	-.0082526	.0040943	-2.02	0.044	-.0162921	-.0002132
_cons	36.42865	.7285093	50.00	0.000	34.99816	37.85913

```
Fixed-effects (within) regression               Number of obs      =       672
Group variable: Country                         Number of groups   =        32

R-sq:  within  = 0.5611                         Obs per group: min =        21
       between = 0.9344                                        avg =      21.0
       overall = 0.9195                                        max =        21

                                                F(10,630)          =     80.55
corr(u_i, Xb)  = 0.8549                         Prob > F           =    0.0000
```

SUPSHARE	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
HUMANRIGHTS	-.3259161	.270747	-1.20	0.229	-.8575919	.2057597
CONTCOM	1.193029	.7439774	1.60	0.109	-.267947	2.654004
CO2	-.6942177	.0865995	-8.02	0.000	-.8642764	-.5241591
ENEUSE	.0015854	.0001005	15.77	0.000	.0013881	.0017828
OILPART	-.1750872	.017808	-9.83	0.000	-.2100574	-.140117
GASPART	-.1999243	.0143688	-13.91	0.000	-.2281409	-.1717078
COALPART	-.1862421	.0160048	-11.64	0.000	-.2176712	-.154813
NUCLEARPART	-.236645	.0235701	-10.04	0.000	-.2829304	-.1903595
WIND	0	(omitted)				
SOLAR	0	(omitted)				
BIOMASS	0	(omitted)				
KYOTO	.5986668	.1674462	3.58	0.000	.2698466	.9274869
INDUSTRY	.0133558	.0026532	5.03	0.000	.0081456	.018566
_cons	25.85627	1.123189	23.02	0.000	23.65062	28.06191
sigma_u	8.0086403					
sigma_e	1.4159391					
rho	.96968875	(fraction of variance due to u_i)				

```
F test that all u_i=0:     F(31, 630) =   101.04             Prob > F = 0.0000
```

```
Random-effects GLS regression                   Number of obs      =       672
Group variable: Country                         Number of groups   =        32

R-sq:  within  = 0.5465                         Obs per group: min =        21
       between = 0.9415                                        avg =      21.0
       overall = 0.9288                                        max =        21

                                                Wald chi2(12)      =         .
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =         .
```

SUPSHARE	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
HUMANRIGHTS	-.4251291	.3135842	-1.36	0.175	-1.039743	.1894847
CONTCOM	1.989274	.7095547	2.80	0.005	.5985725	3.379976
CO2	-.775103	.0858229	-9.03	0.000	-.9433128	-.6068932
ENEUSE	.0020478	.0001124	18.22	0.000	.0018276	.0022681
OILPART	-.2875482	.0173432	-16.58	0.000	-.3215402	-.2535562
GASPART	-.304431	.0133095	-22.87	0.000	-.3305172	-.2783448
COALPART	-.2833642	.0139777	-20.27	0.000	-.31076	-.2559684
NUCLEARPART	-.3587369	.0184965	-19.39	0.000	-.3949895	-.3224844
WIND	-2.63e-06	1.30e-06	-2.01	0.044	-5.18e-06	-6.99e-08
SOLAR	7.01e-11	1.17e-10	0.60	0.548	-1.59e-10	2.99e-10
BIOMASS	.0000101	.0000175	0.58	0.563	-.0000242	.0000445
KYOTO	.5419966	.1953051	2.78	0.006	.1592057	.9247875
INDUSTRY	.0096744	.0030824	3.14	0.002	.0036329	.0157159
_cons	32.8272	1.176588	27.90	0.000	30.52113	35.13327
sigma_u	1.988704					
sigma_e	1.4159391					
rho	.6636004	(fraction of variance due to u_i)				

TRADE

Source	SS	df	MS
Model	141297.721	13	10869.0555
Residual	5455.07823	626	8.71418247
Total	146752.799	639	229.660092

```
Number of obs =      640
F( 13,    626) = 1247.28
Prob > F       =  0.0000
R-squared      =  0.9628
Adj R-squared  =  0.9621
Root MSE       =   2.952
```

SUPSHARE	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
TRADE	7.145976	7.390407	0.97	0.334	-7.367015	21.65897
CONTCOM	.4995636	.352197	1.42	0.157	-.1920671	1.191194
CO2	-2.000719	.0607117	-32.95	0.000	-2.119942	-1.881496
ENEUSE	.0044698	.0001061	42.11	0.000	.0042613	.0046782
OILPART	-.3375056	.0132973	-25.38	0.000	-.3636184	-.3113928
GASPART	-.3638379	.0100248	-36.29	0.000	-.3835242	-.3441516
COALPART	-.2577578	.0075718	-34.04	0.000	-.272627	-.2428885
NUCLEARPART	-.4440984	.0072489	-61.26	0.000	-.4583336	-.4298632
WIND	-4.82e-06	3.83e-07	-12.59	0.000	-5.57e-06	-4.07e-06
SOLAR	2.47e-10	3.44e-11	7.19	0.000	1.80e-10	3.15e-10
BIOMASS	.0000302	5.92e-06	5.11	0.000	.0000186	.0000419
KYOTO	.4670262	.288581	1.62	0.106	-.0996778	1.03373
INDUSTRY	-.0072445	.0040604	-1.78	0.075	-.0152182	.0007293
_cons	29.67055	7.371869	4.02	0.000	15.19396	44.14714

```
Fixed-effects (within) regression               Number of obs      =       640
Group variable: Country                         Number of groups   =        32

R-sq:  within  = 0.5458                         Obs per group: min =        20
       between = 0.9387                                        avg =      20.0
       overall = 0.9235                                        max =        20

                                                F(10,598)          =     71.86
corr(u_i, Xb)  = 0.8756                         Prob > F           =    0.0000

------------------------------------------------------------------------------
    SUPSHARE |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       TRADE |   2.666251   6.415344     0.42   0.678    -9.933093    15.26559
     CONTCOM |   1.074486    1.00479     1.07   0.285    -.8988603    3.047833
         CO2 |  -.7136067   .0859373    -8.30   0.000    -.8823824    -.544831
      ENEUSE |   .0015894   .0001043    15.24   0.000     .0013845    .0017942
     OILPART |  -.1551663   .0180415    -8.60   0.000    -.1905987   -.1197339
     GASPART |  -.1864771   .0143832   -12.96   0.000    -.2147249   -.1582293
    COALPART |  -.1677089   .0162834   -10.30   0.000    -.1996885   -.1357294
 NUCLEARPART |  -.2261301   .0234842    -9.63   0.000    -.2722516   -.1800085
        WIND |          0  (omitted)
       SOLAR |          0  (omitted)
     BIOMASS |          0  (omitted)
       KYOTO |   .5766958   .1585433     3.64   0.000     .2653265    .8880651
    INDUSTRY |   .0124908   .0025527     4.89   0.000     .0074775    .0175041
       _cons |    21.9539   6.494546     3.38   0.001     9.199006    34.70879
-------------+----------------------------------------------------------------
     sigma_u |  8.3769158
     sigma_e |  1.3377492
         rho |   .9751318   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(31, 598) =   107.39             Prob > F = 0.0000
```

```
Random-effects GLS regression                   Number of obs      =       640
Group variable: Country                         Number of groups   =        32

R-sq:  within  = 0.5289                         Obs per group: min =        20
       between = 0.9385                                        avg =      20.0
       overall = 0.9266                                        max =        20

                                                Wald chi2(12)      =         .
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =         .
```

SUPSHARE	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
TRADE	3.907369	7.480913	0.52	0.601	-10.75495	18.56969
CONTCOM	2.608324	.8560671	3.05	0.002	.930463	4.286185
CO2	-.7635741	.0870573	-8.77	0.000	-.9342033	-.592945
ENEUSE	.0020741	.0001188	17.46	0.000	.0018413	.002307
OILPART	-.274241	.0177647	-15.44	0.000	-.3090592	-.2394227
GASPART	-.2968704	.0134672	-22.04	0.000	-.3232656	-.2704752
COALPART	-.27368	.0143728	-19.04	0.000	-.3018502	-.2455099
NUCLEARPART	-.3496776	.0188841	-18.52	0.000	-.3866897	-.3126655
WIND	-2.37e-06	1.34e-06	-1.78	0.076	-5.00e-06	2.47e-07
SOLAR	5.63e-11	1.20e-10	0.47	0.638	-1.78e-10	2.91e-10
BIOMASS	9.58e-06	.0000182	0.53	0.599	-.0000262	.0000453
KYOTO	.5178109	.1877458	2.76	0.006	.1498359	.885786
INDUSTRY	.0091068	.003021	3.01	0.003	.0031858	.0150278
_cons	27.50612	7.579742	3.63	0.000	12.6501	42.36214
sigma_u	2.0088449					
sigma_e	1.3377492					
rho	.69277882	(fraction of variance due to u_i)				

DIPLOMREP

Source	SS	df	MS
Model	29018.1258	13	2232.16352
Residual	1080.53104	114	9.47834246
Total	30098.6568	127	236.997298

```
Number of obs =      128
F( 13,   114) =   235.50
Prob > F      =   0.0000
R-squared     =   0.9641
Adj R-squared =   0.9600
Root MSE      =   3.0787
```

SUPSHARE	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
DIPLOMREP	-.0901813	.8380889	-0.11	0.914	-1.750429	1.570066
CONTCOM	.1479224	.812322	0.18	0.856	-1.461281	1.757126
CO2	-2.391134	.1581834	-15.12	0.000	-2.704494	-2.077774
ENEUSE	.0053555	.000302	17.73	0.000	.0047571	.0059538
OILPART	-.3146588	.029369	-10.71	0.000	-.3728385	-.2564791
GASPART	-.3625074	.0256313	-14.14	0.000	-.4132829	-.3117319
COALPART	-.2435887	.0181946	-13.39	0.000	-.2796321	-.2075454
NUCLEARPART	-.4544389	.0168365	-26.99	0.000	-.4877919	-.4210859
WIND	-5.20e-06	8.96e-07	-5.80	0.000	-6.97e-06	-3.42e-06
SOLAR	2.94e-10	7.97e-11	3.69	0.000	1.36e-10	4.52e-10
BIOMASS	.0000265	.0000116	2.28	0.024	3.49e-06	.0000496
KYOTO	.6996078	.7134953	0.98	0.329	-.7138209	2.113036
INDUSTRY	-.0143971	.0108129	-1.33	0.186	-.0358174	.0070231
_cons	36.71711	1.685844	21.78	0.000	33.37746	40.05675

```
Fixed-effects (within) regression               Number of obs      =       128
Group variable: Country                         Number of groups   =        32

R-sq:  within  = 0.4412                         Obs per group: min =         4
       between = 0.9039                                        avg =       4.0
       overall = 0.8930                                        max =         4

                                                F(9,87)            =      7.63
corr(u_i, Xb)  = 0.8380                         Prob > F           =    0.0000
```

SUPSHARE	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
DIPLOMREP	.3089716	.8557404	0.36	0.719	-1.391905	2.009848
CONTCOM	0	(omitted)				
CO2	-.5331178	.2663801	-2.00	0.048	-1.062577	-.0036584
ENEUSE	.0017147	.0004228	4.06	0.000	.0008742	.0025551
OILPART	-.1581212	.0480031	-3.29	0.001	-.2535325	-.0627099
GASPART	-.1893849	.0396066	-4.78	0.000	-.2681072	-.1106626
COALPART	-.1773269	.040069	-4.43	0.000	-.2569684	-.0976854
NUCLEARPART	-.2013429	.0640003	-3.15	0.002	-.3285505	-.0741353
WIND	0	(omitted)				
SOLAR	0	(omitted)				
BIOMASS	0	(omitted)				
KYOTO	.3195071	.446906	0.71	0.477	-.5687669	1.207781
INDUSTRY	.0135731	.0088607	1.53	0.129	-.0040385	.0311846
_cons	22.26792	2.764329	8.06	0.000	16.77351	27.76232
sigma_u	9.063787					
sigma_e	1.4703771					
rho	.97435773	(fraction of variance due to u_i)				

```
F test that all u_i=0:     F(31, 87) =    18.50             Prob > F = 0.0000
```

```
Random-effects GLS regression                   Number of obs      =       128
Group variable: Country                         Number of groups   =        32

R-sq:  within  = 0.4062                         Obs per group: min =         4
       between = 0.9645                                        avg =       4.0
       overall = 0.9514                                        max =         4

                                                Wald chi2(12)      =         .
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =         .
```

SUPSHARE	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
DIPLOMREP	.0958603	.9891949	0.10	0.923	-1.842926	2.034647
CONTCOM	1.723379	1.617873	1.07	0.287	-1.447593	4.894351
CO2	-1.540971	.233684	-6.59	0.000	-1.998983	-1.082959
ENEUSE	.0038481	.0004278	9.00	0.000	.0030097	.0046866
OILPART	-.3204506	.040691	-7.88	0.000	-.4002035	-.2406978
GASPART	-.3503942	.0311873	-11.24	0.000	-.4115203	-.2892681
COALPART	-.2794529	.0285889	-9.77	0.000	-.3354862	-.2234196
NUCLEARPART	-.4238855	.0322407	-13.15	0.000	-.487076	-.360695
WIND	-4.42e-06	1.86e-06	-2.39	0.017	-8.06e-06	-7.89e-07
SOLAR	1.91e-10	1.64e-10	1.16	0.244	-1.30e-10	5.13e-10
BIOMASS	.0000219	.0000245	0.89	0.371	-.0000261	.0000698
KYOTO	.3756815	.5681297	0.66	0.508	-.7378323	1.489195
INDUSTRY	.0071873	.0108012	0.67	0.506	-.0139827	.0283573
_cons	33.95695	2.563207	13.25	0.000	28.93316	38.98074
sigma_u	2.2620589					
sigma_e	1.4703771					
rho	.70297667	(fraction of variance due to u_i)				

Dependent Variable: D_TOTALPOL

CULTUREDIF

Linear regression

Number of obs	=	640
F(12, 626)	=	.
Prob > F	=	.
R-squared	=	0.1227
Root MSE	=	4.1323

D_TOTALPOL	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
CULTUREDIF	.1352945	1.334387	0.10	0.919	-2.485123	2.755712
CONTCOM	-.4063238	.4408657	-0.92	0.357	-1.272079	.4594309
CO2	-.0269929	.0694725	-0.39	0.698	-.1634202	.1094345
ENEUSE	-.0000169	.0000798	-0.21	0.832	-.0001736	.0001398
OILPART	-.0373304	.0136299	-2.74	0.006	-.0640963	-.0105645
GASPART	.0285297	.0139106	2.05	0.041	.0012126	.0558469
COALPART	.0007939	.0087298	0.09	0.928	-.0163494	.0179372
NUCLEARPART	.0165838	.0089526	1.85	0.064	-.0009969	.0341645
WIND	-1.31e-07	1.05e-06	-0.12	0.901	-2.20e-06	1.93e-06
SOLAR	1.39e-10	9.46e-11	1.47	0.141	-4.62e-11	3.25e-10
BIOMASS	.0000218	.0000112	1.95	0.052	-1.85e-07	.0000439
KYOTO	.2738517	.4254664	0.64	0.520	-.5616625	1.109366
INDUSTRY	.0053585	.0048032	1.12	0.265	-.0040737	.0147908
_cons	.4941653	1.269855	0.39	0.697	-1.999525	2.987856

Fixed-effects (within) regression		Number of obs	= 640
Group variable: Country		Number of groups	= 32
R-sq:	within = 0.0327	Obs per group: min	= 20
	between = 0.0043	avg	= 20.0
	overall = 0.0011	max	= 20
		F(10,31)	= 5.28
corr(u_i, Xb)	= -0.7393	Prob > F	= 0.0002

(Std. Err. adjusted for 32 clusters in Country)

D_TOTALPOL	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
CULTUREDIF	3.409485	4.61379	0.74	0.465	-6.000401	12.81937
CONTCOM	.5126905	1.159004	0.44	0.661	-1.851114	2.876495
CO2	.1063052	.2584487	0.41	0.684	-.4208044	.6334148
ENEUSE	.0002574	.0002298	1.12	0.271	-.0002112	.0007261
OILPART	-.0669674	.0507596	-1.32	0.197	-.1704923	.0365575
GASPART	.0129117	.0575426	0.22	0.824	-.1044472	.1302706
COALPART	-.0368966	.0453634	-0.81	0.422	-.1294158	.0556227
NUCLEARPART	-.0627831	.084917	-0.74	0.465	-.2359724	.1104062
WIND	0	(omitted)				
SOLAR	0	(omitted)				
BIOMASS	0	(omitted)				
KYOTO	-.1374244	.4256641	-0.32	0.749	-1.005572	.7307232
INDUSTRY	.0062352	.0074332	0.84	0.408	-.0089248	.0213953
_cons	-1.171943	4.900948	-0.24	0.813	-11.16749	8.823607
sigma_u	2.7300634					
sigma_e	4.1046588					
rho	.30669939	(fraction of variance due to u_i)				

```
Random-effects GLS regression                   Number of obs      =       640
Group variable: Country                         Number of groups   =        32

R-sq:  within  = 0.0264                         Obs per group: min =        20
       between = 0.6900                                        avg =      20.0
       overall = 0.1226                                        max =        20

                                                Wald chi2(12)      =         .
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =         .

                               (Std. Err. adjusted for 32 clusters in Country)
```

D_TOTALPOL	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
CULTUREDIF	.4294389	1.977526	0.22	0.828	-3.44644	4.305318
CONTCOM	-.4408081	.5184868	-0.85	0.395	-1.457024	.5754073
CO2	-.0397386	.084468	-0.47	0.638	-.2052928	.1258155
ENEUSE	4.41e-06	.0000894	0.05	0.961	-.0001708	.0001796
OILPART	-.0390458	.0204215	-1.91	0.056	-.0790713	.0009797
GASPART	.0311001	.0220996	1.41	0.159	-.0122143	.0744144
COALPART	.0017047	.0105151	0.16	0.871	-.0189045	.0223139
NUCLEARPART	.0161499	.0096946	1.67	0.096	-.0028512	.0351511
WIND	-5.03e-08	9.15e-07	-0.05	0.956	-1.84e-06	1.74e-06
SOLAR	1.38e-10	3.72e-11	3.71	0.000	6.50e-11	2.11e-10
BIOMASS	.0000216	9.24e-06	2.34	0.019	3.48e-06	.0000397
KYOTO	.245343	.3396785	0.72	0.470	-.4204146	.9111006
INDUSTRY	.0054029	.0057226	0.94	0.345	-.0058131	.016619
_cons	.2066665	1.628979	0.13	0.899	-2.986074	3.399408
sigma_u	.73381543					
sigma_e	4.1046588					
rho	.03097108	(fraction of variance due to u_i)				

RELIGIOUSDIF

```
Linear regression                                      Number of obs =       640
                                                       F( 12,    626) =         .
                                                       Prob > F      =         .
                                                       R-squared     =    0.1245
                                                       Root MSE      =     4.128
```

D_TOTALPOL	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
RELIGIOUSDIF	-.5205861	.3388846	-1.54	0.125	-1.186074	.1449022
CONTCOM	-.311006	.4076206	-0.76	0.446	-1.111475	.4894633
CO2	-.015292	.0605088	-0.25	0.801	-.1341169	.1035329
ENEUSE	-.0000412	.0000787	-0.52	0.601	-.0001957	.0001134
OILPART	-.0354751	.0123053	-2.88	0.004	-.0596397	-.0113105
GASPART	.0253185	.0126915	1.99	0.046	.0003954	.0502416
COALPART	.0008891	.0078258	0.11	0.910	-.0144788	.016257
NUCLEARPART	.0162308	.0089047	1.82	0.069	-.001256	.0337176
WIND	-3.19e-07	9.47e-07	-0.34	0.736	-2.18e-06	1.54e-06
SOLAR	1.52e-10	9.43e-11	1.62	0.107	-3.28e-11	3.37e-10
BIOMASS	.0000208	.0000112	1.85	0.065	-1.28e-06	.0000429
KYOTO	.2349871	.418365	0.56	0.575	-.5865817	1.056556
INDUSTRY	.00788	.004787	1.65	0.100	-.0015205	.0172806
_cons	.92685	.7774571	1.19	0.234	-.5998897	2.45359

```
Fixed-effects (within) regression               Number of obs      =       640
Group variable: Country                         Number of groups   =        32

R-sq:  within  = 0.0319                         Obs per group: min =        20
       between = 0.0010                                        avg =      20.0
       overall = 0.0041                                        max =        20

                                                F(10,31)           =      6.09
corr(u_i, Xb)  = -0.7410                        Prob > F           =    0.0000

                                 (Std. Err. adjusted for 32 clusters in Country)
```

D_TOTALPOL	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
RELIGIOUSDIF	-1.221782	1.351034	-0.90	0.373	-3.977235	1.533671
CONTCOM	.5945815	1.087302	0.55	0.588	-1.622985	2.812148
CO2	.1032972	.2605129	0.40	0.694	-.4280223	.6346167
ENEUSE	.0002452	.0002298	1.07	0.294	-.0002235	.000714
OILPART	-.0706992	.0517646	-1.37	0.182	-.1762738	.0348755
GASPART	.0084663	.0572428	0.15	0.883	-.1082812	.1252139
COALPART	-.0373605	.0449212	-0.83	0.412	-.1289779	.0542568
NUCLEARPART	-.0694928	.0834563	-0.83	0.411	-.2397031	.1007176
WIND	0	(omitted)				
SOLAR	0	(omitted)				
BIOMASS	0	(omitted)				
KYOTO	-.0092679	.4684138	-0.02	0.984	-.9646042	.9460684
INDUSTRY	.0069095	.0067461	1.02	0.314	-.0068492	.0206681
_cons	3.235852	3.125457	1.04	0.309	-3.138559	9.610264
sigma_u	2.7086022					
sigma_e	4.1063881					
rho	.3031754	(fraction of variance due to u_i)				

```
Random-effects GLS regression                   Number of obs      =       640
Group variable: Country                         Number of groups   =        32

R-sq:  within  = 0.0261                         Obs per group: min =        20
       between = 0.7047                                        avg =      20.0
       overall = 0.1245                                        max =        20

                                                Wald chi2(12)      =         .
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =         .

                              (Std. Err. adjusted for 32 clusters in Country)
```

D_TOTALPOL	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
RELIGIOUSDIF	-.5083024	.3436487	-1.48	0.139	-1.181842	.1652367
CONTCOM	-.3385955	.427882	-0.79	0.429	-1.177229	.5000377
CO2	-.0253448	.0628719	-0.40	0.687	-.1485715	.097882
ENEUSE	-.0000206	.0000835	-0.25	0.805	-.0001842	.000143
OILPART	-.0365574	.0194199	-1.88	0.060	-.0746197	.001505
GASPART	.0278128	.0194486	1.43	0.153	-.0103058	.0659314
COALPART	.0013559	.0087854	0.15	0.877	-.0158631	.018575
NUCLEARPART	.0159261	.0094418	1.69	0.092	-.0025794	.0344316
WIND	-3.25e-07	5.65e-07	-0.58	0.565	-1.43e-06	7.83e-07
SOLAR	1.53e-10	3.20e-11	4.79	0.000	9.04e-11	2.16e-10
BIOMASS	.0000209	9.07e-06	2.31	0.021	3.14e-06	.0000387
KYOTO	.2355051	.3577585	0.66	0.510	-.4656888	.9366989
INDUSTRY	.0074542	.0048426	1.54	0.124	-.0020371	.0169454
_cons	.9137792	.9105122	1.00	0.316	-.8707919	2.69835
sigma_u	.63932028					
sigma_e	4.1063881					
rho	.0236655	(fraction of variance due to u_i)				

STABILITY

```
Linear regression                                      Number of obs =       480
                                                       F( 12,    466) =         .
                                                       Prob > F      =         .
                                                       R-squared     =    0.1182
                                                       Root MSE      =    4.5738
```

D_TOTALPOL	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
STABILITY	-.3012969	.7777461	-0.39	0.699	-1.829621	1.227027
CONTCOM	-.3421973	.5212259	-0.66	0.512	-1.366442	.682047
CO2	-.0787662	.0776484	-1.01	0.311	-.2313505	.0738181
ENEUSE	-.0000507	.0000952	-0.53	0.594	-.0002378	.0001363
OILPART	-.0463417	.0216226	-2.14	0.033	-.0888316	-.0038518
GASPART	.0297776	.015777	1.89	0.060	-.0012251	.0607804
COALPART	.0011211	.0106056	0.11	0.916	-.0197195	.0219617
NUCLEARPART	.0232431	.0116466	2.00	0.047	.0003567	.0461295
WIND	-2.06e-07	1.22e-06	-0.17	0.866	-2.60e-06	2.19e-06
SOLAR	2.07e-10	1.20e-10	1.72	0.086	-2.93e-11	4.43e-10
BIOMASS	.0000173	.0000142	1.22	0.221	-.0000105	.0000452
KYOTO	-.3065319	.4988995	-0.61	0.539	-1.286903	.6738394
INDUSTRY	.0061903	.0056927	1.09	0.277	-.0049962	.0173769
_cons	1.877106	1.316551	1.43	0.155	-.7100062	4.464218

```
Fixed-effects (within) regression               Number of obs      =       480
Group variable: Country                         Number of groups   =        32

R-sq:  within  = 0.0220                         Obs per group: min =        15
       between = 0.1742                                        avg =      15.0
       overall = 0.0172                                        max =        15

                                                F(10,31)           =      1.61
corr(u_i, Xb)  = -0.8503                        Prob > F           =    0.1515

                               (Std. Err. adjusted for 32 clusters in Country)
```

D_TOTALPOL	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf. Interval]	
STABILITY	1.812202	2.341916	0.77	0.445	-2.964167	6.58857
CONTCOM	.6016716	.9952966	0.60	0.550	-1.428249	2.631593
CO2	-.3601205	.355327	-1.01	0.319	-1.084815	.3645736
ENEUSE	.0002138	.000198	1.08	0.289	-.0001901	.0006176
OILPART	-.020653	.0631651	-0.33	0.746	-.149479	.1081731
GASPART	.0522289	.0569915	0.92	0.367	-.0640061	.1684639
COALPART	-.05695	.0761748	-0.75	0.460	-.2123096	.0984096
NUCLEARPART	-.0512647	.1043501	-0.49	0.627	-.2640882	.1615588
WIND	0	(omitted)				
SOLAR	0	(omitted)				
BIOMASS	0	(omitted)				
KYOTO	-.5094472	.4833726	-1.05	0.300	-1.495292	.4763976
INDUSTRY	.0012143	.0079389	0.15	0.879	-.0149772	.0174057
_cons	4.987692	4.164073	1.20	0.240	-3.504991	13.48038
sigma_u	3.8081786					
sigma_e	4.5324973					
rho	.41380829	(fraction of variance due to u_i)				

```
Random-effects GLS regression                   Number of obs      =       480
Group variable: Country                         Number of groups   =        32

R-sq:  within  = 0.0126                         Obs per group: min =        15
       between = 0.6414                                        avg =      15.0
       overall = 0.1180                                        max =        15

                                                Wald chi2(12)      =         .
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =         .

                               (Std. Err. adjusted for 32 clusters in Country)
```

D_TOTALPOL	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
STABILITY	-.0880647	.8655195	-0.10	0.919	-1.784452	1.608322
CONTCOM	-.3978988	.5306578	-0.75	0.453	-1.437969	.6421713
CO2	-.102285	.1124103	-0.91	0.363	-.3226051	.1180351
ENEUSE	-.0000198	.0000922	-0.22	0.830	-.0002006	.0001609
OILPART	-.0461203	.0334007	-1.38	0.167	-.1115845	.0193439
GASPART	.033946	.0205793	1.65	0.099	-.0063888	.0742808
COALPART	.0006527	.0121375	0.05	0.957	-.0231364	.0244418
NUCLEARPART	.023321	.0118728	1.96	0.050	.0000508	.0465912
WIND	-1.79e-07	7.04e-07	-0.25	0.799	-1.56e-06	1.20e-06
SOLAR	2.11e-10	4.92e-11	4.30	0.000	1.15e-10	3.08e-10
BIOMASS	.0000175	.0000108	1.62	0.106	-3.72e-06	.0000387
KYOTO	-.2982614	.4346629	-0.69	0.493	-1.150185	.5536622
INDUSTRY	.0053953	.0057392	0.94	0.347	-.0058533	.0166439
_cons	1.73288	1.56804	1.11	0.269	-1.340423	4.806182
sigma_u	.92229076					
sigma_e	4.5324973					
rho	.03975947	(fraction of variance due to u_i)				

HUMANRIGHTS

```
Linear regression                                      Number of obs =       640
                                                       F( 12,    626) =         .
                                                       Prob > F      =         .
                                                       R-squared     =    0.1235
                                                       Root MSE      =    4.1303
```

D_TOTALPOL	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
HUMANRIGHTS	.3652356	.4948081	0.74	0.461	-.6064492	1.33692
CONTCOM	-.4495193	.4050027	-1.11	0.267	-1.244848	.3458092
CO2	-.029647	.0613059	-0.48	0.629	-.1500371	.0907432
ENEUSE	9.57e-06	.0000849	0.11	0.910	-.0001572	.0001764
OILPART	-.0358545	.0124653	-2.88	0.004	-.0603333	-.0113757
GASPART	.029584	.0128056	2.31	0.021	.0044369	.054731
COALPART	-.0003836	.0080227	-0.05	0.962	-.0161382	.0153711
NUCLEARPART	.0169535	.0088997	1.90	0.057	-.0005235	.0344304
WIND	-1.74e-07	9.34e-07	-0.19	0.852	-2.01e-06	1.66e-06
SOLAR	1.41e-10	9.32e-11	1.51	0.131	-4.22e-11	3.24e-10
BIOMASS	.0000218	.0000109	1.99	0.047	3.10e-07	.0000433
KYOTO	.2400663	.4386752	0.55	0.584	-.6213868	1.101519
INDUSTRY	.0042135	.0045446	0.93	0.354	-.0047111	.0131381
_cons	.2248548	.945602	0.24	0.812	-1.632081	2.081791

```
Fixed-effects (within) regression               Number of obs      =       640
Group variable: Country                         Number of groups   =        32

R-sq:  within  = 0.0362                         Obs per group: min =        20
       between = 0.0086                                        avg =      20.0
       overall = 0.0009                                        max =        20

                                                F(10,31)           =      6.60
corr(u_i, Xb)  = -0.7403                        Prob > F           =    0.0000

                               (Std. Err. adjusted for 32 clusters in Country)
```

D_TOTALPOL	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
HUMANRIGHTS	1.455328	.9173594	1.59	0.123	-.4156386	3.326295
CONTCOM	.6132282	.9700297	0.63	0.532	-1.365161	2.591617
CO2	.0789412	.2655129	0.30	0.768	-.4625759	.6204583
ENEUSE	.0002636	.0002302	1.15	0.261	-.0002059	.000733
OILPART	-.0601539	.0486852	-1.24	0.226	-.1594479	.0391401
GASPART	.0103469	.052122	0.20	0.844	-.0959567	.1166504
COALPART	-.0363209	.0441959	-0.82	0.417	-.1264591	.0538173
NUCLEARPART	-.0764603	.0827768	-0.92	0.363	-.2452848	.0923641
WIND	0	(omitted)				
SOLAR	0	(omitted)				
BIOMASS	0	(omitted)				
KYOTO	-.1825645	.4724904	-0.39	0.702	-1.146215	.781086
INDUSTRY	.0038986	.0067435	0.58	0.567	-.0098549	.017652
_cons	.9466843	2.78042	0.34	0.736	-4.72402	6.617388
sigma_u	2.7604035					
sigma_e	4.0972011					
rho	.31219993	(fraction of variance due to u_i)				

```
Random-effects GLS regression                   Number of obs      =       640
Group variable: Country                         Number of groups   =        32

R-sq:  within  = 0.0295                         Obs per group: min =        20
       between = 0.6780                                        avg =      20.0
       overall = 0.1233                                        max =        20

                                                Wald chi2(12)      =         .
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =         .

                             (Std. Err. adjusted for 32 clusters in Country)
```

D_TOTALPOL	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
HUMANRIGHTS	.5468585	.5521871	0.99	0.322	-.5354083	1.629125
CONTCOM	-.4790895	.442021	-1.08	0.278	-1.345435	.3872557
CO2	-.0377256	.0727098	-0.52	0.604	-.1802342	.1047829
ENEUSE	.0000378	.0001017	0.37	0.710	-.0001615	.0002371
OILPART	-.0362728	.0186274	-1.95	0.052	-.0727819	.0002363
GASPART	.0315365	.0206974	1.52	0.128	-.0090296	.0721025
COALPART	-.000612	.0095951	-0.06	0.949	-.019418	.018194
NUCLEARPART	.01663	.009982	1.67	0.096	-.0029344	.0361944
WIND	-1.83e-07	5.23e-07	-0.35	0.726	-1.21e-06	8.42e-07
SOLAR	1.42e-10	3.12e-11	4.55	0.000	8.06e-11	2.03e-10
BIOMASS	.0000218	8.02e-06	2.72	0.007	6.10e-06	.0000375
KYOTO	.1973953	.397115	0.50	0.619	-.5809359	.9757264
INDUSTRY	.0039754	.0044163	0.90	0.368	-.0046803	.0126312
_cons	-.0078622	1.165891	-0.01	0.995	-2.292966	2.277241
sigma_u	.68981381					
sigma_e	4.0972011					
rho	.02756449	(fraction of variance due to u_i)				

TRADE

```
Linear regression                                      Number of obs =     608
                                                       F( 12,   594) =       .
                                                       Prob > F      =       .
                                                       R-squared     =  0.1552
                                                       Root MSE      =  4.0485
```

D_TOTALPOL	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
TRADE	-8.493144	12.10165	-0.70	0.483	-32.26036	15.27408
CONTCOM	-.5313005	.4085132	-1.30	0.194	-1.333606	.2710054
CO2	-.0371532	.0635563	-0.58	0.559	-.1619756	.0876692
ENEUSE	.0000218	.0000838	0.26	0.795	-.0001427	.0001864
OILPART	-.0363443	.0127382	-2.85	0.004	-.0613617	-.0113269
GASPART	.0328205	.0133637	2.46	0.014	.0065746	.0590664
COALPART	.0016918	.0081575	0.21	0.836	-.0143291	.0177128
NUCLEARPART	.0184269	.0092834	1.98	0.048	.0001947	.0366591
WIND	-4.56e-07	9.33e-07	-0.49	0.626	-2.29e-06	1.38e-06
SOLAR	1.83e-10	9.02e-11	2.03	0.043	6.06e-12	3.60e-10
BIOMASS	.0000194	.0000113	1.71	0.089	-2.93e-06	.0000416
KYOTO	.4481711	.4084303	1.10	0.273	-.3539719	1.250314
INDUSTRY	.004814	.004851	0.99	0.321	-.0047131	.0143411
_cons	8.867396	12.08256	0.73	0.463	-14.86233	32.59712

```
Fixed-effects (within) regression               Number of obs      =       608
Group variable: Country                         Number of groups   =        32

R-sq:  within  = 0.0464                         Obs per group: min =        19
       between = 0.1693                                        avg =      19.0
       overall = 0.0113                                        max =        19

                                                F(9,31)            =         .
corr(u_i, Xb)  = -0.8546                        Prob > F           =         .

                              (Std. Err. adjusted for 32 clusters in Country)
```

D_TOTALPOL	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
TRADE	58.3525	28.95999	2.01	0.053	-.7118027	117.4168
CONTCOM	1.756727	.3052134	5.76	0.000	1.13424	2.379214
CO2	.0007499	.2712659	0.00	0.998	-.5525005	.5540003
ENEUSE	.0002392	.0002467	0.97	0.340	-.000264	.0007423
OILPART	-.0689394	.0501971	-1.37	0.179	-.1713171	.0334382
GASPART	.0123724	.0586276	0.21	0.834	-.1071992	.1319441
COALPART	-.0296449	.0355734	-0.83	0.411	-.1021973	.0429074
NUCLEARPART	-.0826836	.0786039	-1.05	0.301	-.2429972	.07763
WIND	0	(omitted)				
SOLAR	0	(omitted)				
BIOMASS	0	(omitted)				
KYOTO	.1396367	.5331844	0.26	0.795	-.9478001	1.227074
INDUSTRY	.0081987	.007329	1.12	0.272	-.0067489	.0231464
_cons	-54.84298	29.36321	-1.87	0.071	-114.7296	5.043693
sigma_u	3.8626576					
sigma_e	3.993162					
rho	.48339214	(fraction of variance due to u_i)				

Random-effects GLS regression — Number of obs = 608
Group variable: Country — Number of groups = 32

R-sq: within = 0.0322 — Obs per group: min = 19
between = 0.7160 — avg = 19.0
overall = 0.1544 — max = 19

Wald chi2(12) = .
corr(u_i, X) = 0 (assumed) — Prob > chi2 = .

(Std. Err. adjusted for 32 clusters in Country)

D_TOTALPOL	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
TRADE	-.3268433	12.74071	-0.03	0.980	-25.29817	24.64449
CONTCOM	-.5348771	.5101508	-1.05	0.294	-1.534754	.4650001
CO2	-.0531536	.0783328	-0.68	0.497	-.2066832	.1003759
ENEUSE	.0000388	.0001008	0.39	0.700	-.0001587	.0002364
OILPART	-.0405372	.0213448	-1.90	0.058	-.0823722	.0012978
GASPART	.0346787	.023854	1.45	0.146	-.0120743	.0814317
COALPART	.002675	.0088954	0.30	0.764	-.0147596	.0201096
NUCLEARPART	.0178688	.0095195	1.88	0.061	-.0007891	.0365267
WIND	-3.75e-07	6.05e-07	-0.62	0.536	-1.56e-06	8.12e-07
SOLAR	1.79e-10	3.62e-11	4.93	0.000	1.08e-10	2.49e-10
BIOMASS	.0000231	.0000127	1.82	0.068	-1.72e-06	.000048
KYOTO	.3917507	.441765	0.89	0.375	-.4740928	1.257594
INDUSTRY	.0055449	.0055971	0.99	0.322	-.0054253	.016515
_cons	.7432732	12.68387	0.06	0.953	-24.11665	25.6032
sigma_u	.79502337					
sigma_e	3.993162					
rho	.03812793	(fraction of variance due to u_i)				

DIPLOMREP

Linear regression

Number of obs = 96
F(12, 82) = .
Prob > F = .
R-squared = 0.1574
Root MSE = 3.927

D_TOTALPOL	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
DIPLOMREP	1.178855	1.099567	1.07	0.287	-1.008535	3.366245
CONTCOM	-.3065116	1.039717	-0.29	0.769	-2.374841	1.761817
CO2	-.1289541	.1433927	-0.90	0.371	-.4142078	.1562996
ENEUSE	-.0000278	.0002636	-0.11	0.916	-.0005523	.0004967
OILPART	-.050371	.0325348	-1.55	0.125	-.115093	.014351
GASPART	.0379145	.0306583	1.24	0.220	-.0230746	.0989036
COALPART	.0069999	.0198694	0.35	0.726	-.0325266	.0465265
NUCLEARPART	.0398075	.0214066	1.86	0.067	-.0027771	.0823921
WIND	-1.37e-06	2.94e-06	-0.47	0.643	-7.23e-06	4.49e-06
SOLAR	2.13e-10	3.68e-10	0.58	0.564	-5.20e-10	9.46e-10
BIOMASS	.0000178	.000022	0.81	0.420	-.0000259	.0000616
KYOTO	.2300262	.672428	0.34	0.733	-1.107647	1.5677
INDUSTRY	-.0072243	.0118334	-0.61	0.543	-.0307646	.016316
_cons	1.052392	2.007626	0.52	0.602	-2.941416	5.0462

```
Fixed-effects (within) regression               Number of obs      =        96
Group variable: Country                         Number of groups   =        32

R-sq:  within  = 0.0491                         Obs per group: min =         3
       between = 0.0443                                        avg =       3.0
       overall = 0.0213                                        max =         3

                                                F(9,31)            =      1.90
corr(u_i, Xb)  = -0.8368                        Prob > F           =    0.0899

                                (Std. Err. adjusted for 32 clusters in Country)
```

D_TOTALPOL	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
DIPLOMREP	3.343411	2.805768	1.19	0.242	-2.378991	9.065812
CONTCOM	0	(omitted)				
CO2	-.427247	1.224764	-0.35	0.730	-2.92517	2.070676
ENEUSE	.0012645	.0016789	0.75	0.457	-.0021596	.0046885
OILPART	-.1009827	.1156654	-0.87	0.389	-.3368837	.1349184
GASPART	.0039345	.1176135	0.03	0.974	-.2359398	.2438088
COALPART	-.0172911	.1299541	-0.13	0.895	-.2823343	.2477521
NUCLEARPART	.081046	.1542846	0.53	0.603	-.2336196	.3957115
WIND	0	(omitted)				
SOLAR	0	(omitted)				
BIOMASS	0	(omitted)				
KYOTO	-.1674787	.7980562	-0.21	0.835	-1.795125	1.460168
INDUSTRY	-.0047911	.0200859	-0.24	0.813	-.0457566	.0361744
_cons	-2.128256	5.985135	-0.36	0.725	-14.33502	10.07851
sigma_u	4.0140214					
sigma_e	4.305202					
rho	.46504189	(fraction of variance due to u_i)				

```
Random-effects GLS regression                   Number of obs      =        96
Group variable: Country                         Number of groups   =        32

R-sq:  within  = 0.0308                         Obs per group: min =         3
       between = 0.4793                                        avg =       3.0
       overall = 0.1574                                        max =         3

                                                Wald chi2(12)      =         .
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =         .

                              (Std. Err. adjusted for 32 clusters in Country)
```

D_TOTALPOL	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
DIPLOMREP	1.178855	.9764765	1.21	0.227	-.7350035	3.092714
CONTCOM	-.3065116	.9900215	-0.31	0.757	-2.246918	1.633895
CO2	-.1289541	.1366313	-0.94	0.345	-.3967466	.1388384
ENEUSE	-.0000278	.0002485	-0.11	0.911	-.000515	.0004593
OILPART	-.050371	.0316217	-1.59	0.111	-.1123484	.0116065
GASPART	.0379145	.0286497	1.32	0.186	-.0182379	.0940669
COALPART	.0069999	.0178713	0.39	0.695	-.0280271	.042027
NUCLEARPART	.0398075	.0217894	1.83	0.068	-.002899	.082514
WIND	-1.37e-06	6.65e-07	-2.06	0.039	-2.67e-06	-6.75e-08
SOLAR	2.13e-10	5.31e-11	4.01	0.000	1.09e-10	3.17e-10
BIOMASS	.0000178	7.57e-06	2.36	0.018	3.00e-06	.0000327
KYOTO	.2300262	.6428407	0.36	0.720	-1.029918	1.489971
INDUSTRY	-.0072243	.0127574	-0.57	0.571	-.0322284	.0177798
_cons	1.052392	1.961689	0.54	0.592	-2.792449	4.897233
sigma_u	0					
sigma_e	4.305202					
rho	0	(fraction of variance due to u_i)				

Dependent Variable: FITORCERT

CULTUREDIF

Source	SS	df	MS
Model	59.2784994	13	4.55988457
Residual	103.886679	658	.157882491
Total	163.165179	671	.243167181

Number of obs = 672
F(13, 658) = 28.88
Prob > F = 0.0000
R-squared = 0.3633
Adj R-squared = 0.3507
Root MSE = .39734

FITORCERT	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
CULTUREDIF	-.2836051	.1347746	-2.10	0.036	-.5482453	-.0189649
CONTCOM	-.1146777	.0470592	-2.44	0.015	-.207082	-.0222733
CO2	.0226787	.0080642	2.81	0.005	.0068439	.0385134
ENEUSE	-.0000392	.0000133	-2.96	0.003	-.0000653	-.0000132
OILPART	-.0053839	.0017923	-3.00	0.003	-.0089033	-.0018646
GASPART	.004212	.0013283	3.17	0.002	.0016038	.0068201
COALPART	-.0009285	.0010159	-0.91	0.361	-.0029232	.0010662
NUCLEARPART	.0029637	.0009523	3.11	0.002	.0010938	.0048337
WIND	-1.15e-07	6.52e-08	-1.76	0.079	-2.43e-07	1.34e-08
SOLAR	3.25e-12	4.62e-12	0.70	0.482	-5.83e-12	1.23e-11
BIOMASS	-5.14e-07	6.78e-07	-0.76	0.448	-1.85e-06	8.17e-07
KYOTO	.3801967	.0380669	9.99	0.000	.3054494	.4549439
INDUSTRY	.0019419	.0005265	3.69	0.000	.0009081	.0029757
_cons	.3253927	.1368956	2.38	0.018	.0565877	.5941977

Fixed-effects (within) regression
Group variable: Country

Number of obs = 672
Number of groups = 32

R-sq: within = 0.4110
between = 0.0073
overall = 0.0865

Obs per group: min = 21
avg = 21.0
max = 21

F(10,630) = 43.96

corr(u_i, Xb) = -0.5406

Prob > F = 0.0000

FITORCERT	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
CULTUREDIF	.2399771	.2605342	0.92	0.357	-.2716435	.7515977
CONTCOM	-.3165513	.1623596	-1.95	0.052	-.6353828	.0022803
CO2	.0117246	.018863	0.62	0.534	-.0253173	.0487665
ENEUSE	-9.58e-06	.0000219	-0.44	0.662	-.0000526	.0000334
OILPART	-.0125551	.0038717	-3.24	0.001	-.0201581	-.004952
GASPART	-.0020837	.0031487	-0.66	0.508	-.008267	.0040995
COALPART	-.0104558	.0034895	-3.00	0.003	-.0173082	-.0036034
NUCLEARPART	-.0137419	.0051726	-2.66	0.008	-.0238995	-.0035843
WIND	0	(omitted)				
SOLAR	0	(omitted)				
BIOMASS	0	(omitted)				
KYOTO	.3540285	.0369152	9.59	0.000	.2815367	.4265203
INDUSTRY	.0008438	.000565	1.49	0.136	-.0002658	.0019533
_cons	.6854311	.3559087	1.93	0.055	-.0134798	1.384342
sigma_u	.43973078					
sigma_e	.30851359					
rho	.67013452	(fraction of variance due to u_i)				

F test that all u_i=0: F(31, 630) = 15.28 Prob > F = 0.0000

```
Random-effects GLS regression                   Number of obs      =       672
Group variable: Country                         Number of groups   =        32

R-sq:  within  = 0.4040                         Obs per group: min =        21
       between = 0.1232                                        avg =      21.0
       overall = 0.2949                                        max =        21

                                                Wald chi2(12)      =         .
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =         .
```

FITORCERT	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
CULTUREDIF	.1549765	.2313152	0.67	0.503	-.298393	.608346
CONTCOM	-.2680246	.1148452	-2.33	0.020	-.4931171	-.0429321
CO2	.0073848	.0143711	0.51	0.607	-.0207821	.0355517
ENEUSE	-.0000241	.0000198	-1.21	0.225	-.000063	.0000148
OILPART	-.0075507	.0029135	-2.59	0.010	-.013261	-.0018403
GASPART	.0034526	.0022099	1.56	0.118	-.0008787	.0077838
COALPART	-.0040906	.0022458	-1.82	0.069	-.0084924	.0003112
NUCLEARPART	-.0021632	.0028223	-0.77	0.443	-.0076947	.0033684
WIND	-5.97e-08	1.91e-07	-0.31	0.755	-4.34e-07	3.15e-07
SOLAR	2.27e-12	1.60e-11	0.14	0.888	-2.92e-11	3.37e-11
BIOMASS	8.03e-08	2.41e-06	0.03	0.973	-4.64e-06	4.80e-06
KYOTO	.3662475	.0354196	10.34	0.000	.2968262	.4356687
INDUSTRY	.0009275	.0005446	1.70	0.089	-.0001399	.0019948
_cons	.3115499	.2824304	1.10	0.270	-.2420035	.8651033
sigma_u	.31547928					
sigma_e	.30851359					
rho	.51116169	(fraction of variance due to u_i)				

RELIGIOUSDIF

Source	SS	df	MS
Model	60.7783483	13	4.67525756
Residual	102.38683	658	.155603086
Total	163.165179	671	.243167181

```
Number of obs =       672
F( 13,    658) =    30.05
Prob > F       =   0.0000
R-squared      =   0.3725
Adj R-squared  =   0.3601
Root MSE       =   .39447
```

FITORCERT	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
RELIGIOUSDIF	-.1584614	.0421526	-3.76	0.000	-.2412312	-.0756917
CONTCOM	-.1137165	.0457847	-2.48	0.013	-.2036181	-.0238148
CO2	.021091	.0077654	2.72	0.007	.0058431	.036339
ENEUSE	-.0000462	.0000133	-3.47	0.001	-.0000724	-.0000201
OILPART	-.0058976	.0017293	-3.41	0.001	-.0092933	-.0025019
GASPART	.0039897	.0013043	3.06	0.002	.0014286	.0065509
COALPART	-.0002758	.0009745	-0.28	0.777	-.0021893	.0016377
NUCLEARPART	.0028684	.0009458	3.03	0.003	.0010112	.0047256
WIND	-6.90e-08	5.03e-08	-1.37	0.170	-1.68e-07	2.97e-08
SOLAR	4.29e-12	4.53e-12	0.95	0.344	-4.61e-12	1.32e-11
BIOMASS	-1.26e-06	6.56e-07	-1.93	0.055	-2.55e-06	2.46e-08
KYOTO	.3554526	.0375864	9.46	0.000	.2816489	.4292563
INDUSTRY	.0025002	.0005518	4.53	0.000	.0014168	.0035836
_cons	.2014331	.0890405	2.26	0.024	.0265954	.3762708

Fixed-effects (within) regression — Number of obs = 672
Group variable: Country — Number of groups = 32

R-sq: within = 0.4140 — Obs per group: min = 21
between = 0.0012 — avg = 21.0
overall = 0.0893 — max = 21

F(10,630) = 44.51
corr(u_i, Xb) = -0.5765 — Prob > F = 0.0000

FITORCERT	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
RELIGIOUSDIF	-.286218	.1418476	-2.02	0.044	-.5647694	-.0076667
CONTCOM	-.3163516	.1617406	-1.96	0.051	-.6339675	.0012643
CO2	.0113458	.0188041	0.60	0.546	-.0255804	.048272
ENEUSE	-.0000109	.0000218	-0.50	0.619	-.0000538	.000032
OILPART	-.0135454	.003893	-3.48	0.001	-.0211902	-.0059006
GASPART	-.0022852	.0031218	-0.73	0.464	-.0084156	.0038451
COALPART	-.0100433	.0034879	-2.88	0.004	-.0168926	-.0031941
NUCLEARPART	-.0137433	.0051295	-2.68	0.008	-.0238162	-.0036704
WIND	0	(omitted)				
SOLAR	0	(omitted)				
BIOMASS	0	(omitted)				
KYOTO	.3630553	.0356295	10.19	0.000	.2930884	.4330222
INDUSTRY	.000874	.0005615	1.56	0.120	-.0002287	.0019768
_cons	1.154125	.2627491	4.39	0.000	.6381547	1.670095
sigma_u	.45234336					
sigma_e	.3077285					
rho	.68361765	(fraction of variance due to u_i)				

F test that all u_i=0: F(31, 630) = 15.00 — Prob > F = 0.0000

Random-effects GLS regression		Number of obs =	672
Group variable: Country		Number of groups =	32
R-sq: within = 0.4065		Obs per group: min =	21
between = 0.1620		avg =	21.0
overall = 0.3099		max =	21
		Wald chi2(12) =	.
corr(u_i, X) = 0 (assumed)		Prob > chi2 =	.

FITORCERT	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
RELIGIOUSDIF	-.204364	.1011519	-2.02	0.043	-.402618	-.00611
CONTCOM	-.2549096	.1125784	-2.26	0.024	-.4755591	-.03426
CO2	.0073952	.0141669	0.52	0.602	-.0203715	.0351619
ENEUSE	-.0000265	.0000198	-1.34	0.179	-.0000652	.0000122
OILPART	-.0077151	.0028857	-2.67	0.008	-.0133709	-.0020592
GASPART	.0035	.0021567	1.62	0.105	-.0007271	.0077271
COALPART	-.0036095	.0022053	-1.64	0.102	-.0079318	.0007128
NUCLEARPART	-.002088	.0027555	-0.76	0.449	-.0074886	.0033126
WIND	-1.64e-07	1.76e-07	-0.93	0.351	-5.08e-07	1.81e-07
SOLAR	8.14e-12	1.56e-11	0.52	0.602	-2.24e-11	3.87e-11
BIOMASS	-2.64e-07	2.33e-06	-0.11	0.910	-4.83e-06	4.30e-06
KYOTO	.3710828	.0344811	10.76	0.000	.303501	.4386646
INDUSTRY	.0010421	.0005411	1.93	0.054	-.0000184	.0021026
_cons	.6220714	.1997346	3.11	0.002	.2305989	1.013544
sigma_u	.30542605					
sigma_e	.3077285					
rho	.49624498	(fraction of variance due to u_i)				

STABILITY

Source	SS	df	MS		
				Number of obs =	480
				F(13, 466) =	17.24
Model	38.719097	13	2.97839207	Prob > F =	0.0000
Residual	80.5288197	466	.172808626	R-squared =	0.3247
				Adj R-squared =	0.3059
Total	119.247917	479	.248951809	Root MSE =	.4157

FITORCERT	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
STABILITY	-.0819273	.0779433	-1.05	0.294	-.2350911	.0712365
CONTCOM	-.103418	.0580654	-1.78	0.076	-.2175206	.0106845
CO2	.0180083	.0099601	1.81	0.071	-.0015639	.0375806
ENEUSE	-.0000463	.0000154	-3.00	0.003	-.0000766	-.000016
OILPART	-.0075105	.0026038	-2.88	0.004	-.0126271	-.0023939
GASPART	.005507	.001636	3.37	0.001	.0022922	.0087218
COALPART	.0000902	.001235	0.07	0.942	-.0023366	.0025171
NUCLEARPART	.0052399	.0012021	4.36	0.000	.0028777	.007602
WIND	-2.66e-08	6.17e-08	-0.43	0.666	-1.48e-07	9.46e-08
SOLAR	5.84e-12	5.65e-12	1.03	0.302	-5.26e-12	1.69e-11
BIOMASS	-2.16e-06	8.10e-07	-2.66	0.008	-3.75e-06	-5.66e-07
KYOTO	.2717186	.0446793	6.08	0.000	.1839207	.3595166
INDUSTRY	.001814	.0006587	2.75	0.006	.0005196	.0031084
_cons	.2492984	.1325283	1.88	0.061	-.0111286	.5097254

```
Fixed-effects (within) regression               Number of obs      =       480
Group variable: Country                         Number of groups   =        32

R-sq:  within  = 0.3241                         Obs per group: min =        15
       between = 0.0075                                        avg =      15.0
       overall = 0.0799                                        max =        15

                                                F(10,438)          =     21.00
corr(u_i, Xb)  = -0.4497                        Prob > F           =    0.0000
```

FITORCERT	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
STABILITY	.2679839	.189507	1.41	0.158	-.1044721	.6404399
CONTCOM	-.2446821	.1593401	-1.54	0.125	-.5578482	.0684841
CO2	-.0237144	.0267422	-0.89	0.376	-.0762734	.0288445
ENEUSE	-.0000362	.0000271	-1.34	0.182	-.0000895	.0000171
OILPART	-.0048336	.0054814	-0.88	0.378	-.0156068	.0059396
GASPART	.0032267	.0042407	0.76	0.447	-.0051081	.0115614
COALPART	-.0082622	.0049876	-1.66	0.098	-.0180649	.0015405
NUCLEARPART	-.0073489	.0065253	-1.13	0.261	-.0201737	.0054759
WIND	0	(omitted)				
SOLAR	0	(omitted)				
BIOMASS	0	(omitted)				
KYOTO	.2912662	.0390606	7.46	0.000	.2144967	.3680356
INDUSTRY	.000364	.0006545	0.56	0.578	-.0009223	.0016504
_cons	.8637221	.3691978	2.34	0.020	.1381026	1.589342
sigma_u	.43737791					
sigma_e	.29744068					
rho	.68377298	(fraction of variance due to u_i)				

F test that all u_i=0:   F(31, 438) =   15.76   Prob > F = 0.0000

Random-effects GLS regression		Number of obs	=	480
Group variable: Country		Number of groups	=	32
R-sq: within	= 0.3172	Obs per group: min	=	15
between	= 0.1842	avg	=	15.0
overall	= 0.2473	max	=	15
		Wald chi2(12)	=	.
corr(u_i, X)	= 0 (assumed)	Prob > chi2	=	.

FITORCERT	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
STABILITY	.1995355	.1523545	1.31	0.190	-.0990738	.4981449
CONTCOM	-.2215779	.1219664	-1.82	0.069	-.4606277	.0174719
CO2	-.0040998	.0186211	-0.22	0.826	-.0405965	.0323968
ENEUSE	-.0000387	.0000236	-1.64	0.101	-.000085	7.51e-06
OILPART	-.0048733	.0039631	-1.23	0.219	-.0126408	.0028941
GASPART	.004949	.0028343	1.75	0.081	-.000606	.010504
COALPART	-.0041208	.0028915	-1.43	0.154	-.009788	.0015464
NUCLEARPART	.0015207	.0033558	0.45	0.650	-.0050566	.0080979
WIND	-1.57e-08	2.10e-07	-0.07	0.940	-4.27e-07	3.95e-07
SOLAR	1.17e-11	1.89e-11	0.62	0.536	-2.53e-11	4.87e-11
BIOMASS	-1.31e-06	2.78e-06	-0.47	0.637	-6.76e-06	4.14e-06
KYOTO	.2894023	.0378116	7.65	0.000	.2152929	.3635116
INDUSTRY	.0006242	.0006234	1.00	0.317	-.0005976	.0018461
_cons	.4102273	.2743272	1.50	0.135	-.1274441	.9478987
sigma_u	.36830776					
sigma_e	.29744068					
rho	.60525459	(fraction of variance due to u_i)				

HUMANRIGHTS

Source	SS	df	MS		
				Number of obs =	672
				F(13, 658) =	28.54
Model	58.8251213	13	4.52500933	Prob > F =	0.0000
Residual	104.340057	658	.158571516	R-squared =	0.3605
				Adj R-squared =	0.3479
Total	163.165179	671	.243167181	Root MSE =	.39821

FITORCERT	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
HUMANRIGHTS	.0552486	.0443816	1.24	0.214	-.031898	.1423951
CONTCOM	-.1473073	.0462039	-3.19	0.001	-.2380321	-.0565824
CO2	.0174521	.0078284	2.23	0.026	.0020805	.0328237
ENEUSE	-.0000347	.0000137	-2.53	0.012	-.0000615	-7.77e-06
OILPART	-.0061494	.0017466	-3.52	0.000	-.009579	-.0027198
GASPART	.0050527	.0013071	3.87	0.000	.0024861	.0076193
COALPART	-.0005055	.0009889	-0.51	0.609	-.0024474	.0014364
NUCLEARPART	.0030318	.0009554	3.17	0.002	.0011558	.0049077
WIND	-2.42e-08	4.93e-08	-0.49	0.624	-1.21e-07	7.27e-08
SOLAR	7.05e-13	4.47e-12	0.16	0.875	-8.08e-12	9.49e-12
BIOMASS	-9.33e-07	6.55e-07	-1.42	0.155	-2.22e-06	3.54e-07
KYOTO	.3622681	.038147	9.50	0.000	.2873636	.4371727
INDUSTRY	.0015762	.0005428	2.90	0.004	.0005103	.0026421
_cons	.0449678	.096588	0.47	0.642	-.1446901	.2346257

Fixed-effects (within) regression　　Number of obs = 672
Group variable: Country　　Number of groups = 32

R-sq: within = 0.4131　　Obs per group: min = 21
between = 0.0094　　avg = 21.0
overall = 0.0846　　max = 21

F(10,630) = 44.34
corr(u_i, Xb) = -0.5417　　Prob > F = 0.0000

FITORCERT	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
HUMANRIGHTS	.1027287	.0588897	1.74	0.082	-.0129152	.2183725
CONTCOM	-.3089671	.1618212	-1.91	0.057	-.6267412	.0088071
CO2	.0097245	.0188361	0.52	0.606	-.0272646	.0467137
ENEUSE	-9.05e-06	.0000219	-0.41	0.679	-.000052	.0000339
OILPART	-.0121102	.0038734	-3.13	0.002	-.0197165	-.0045039
GASPART	-.0022316	.0031253	-0.71	0.475	-.0083689	.0039057
COALPART	-.0104108	.0034812	-2.99	0.003	-.0172469	-.0035747
NUCLEARPART	-.0144939	.0051267	-2.83	0.005	-.0245614	-.0044264
WIND	0	(omitted)				
SOLAR	0	(omitted)				
BIOMASS	0	(omitted)				
KYOTO	.3496737	.0364209	9.60	0.000	.2781526	.4211948
INDUSTRY	.0006594	.0005771	1.14	0.254	-.0004739	.0017926
_cons	.8328755	.2443029	3.41	0.001	.353129	1.312622
sigma_u	.44137915					
sigma_e	.30797836					
rho	.67255185	(fraction of variance due to u_i)				

F test that all u_i=0: F(31, 630) = 15.39　　Prob > F = 0.0000

```
Random-effects GLS regression                   Number of obs      =       672
Group variable: Country                         Number of groups   =        32

R-sq:  within  = 0.4063                         Obs per group: min =        21
       between = 0.1318                                        avg =      21.0
       overall = 0.3011                                        max =        21

                                                Wald chi2(12)      =         .
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =         .
```

FITORCERT	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
HUMANRIGHTS	.1032933	.0562927	1.83	0.067	-.0070384	.213625
CONTCOM	-.2672769	.1149313	-2.33	0.020	-.4925381	-.0420157
CO2	.0081127	.0143653	0.56	0.572	-.0200428	.0362683
ENEUSE	-.0000213	.0000199	-1.07	0.284	-.0000603	.0000177
OILPART	-.0073753	.0029204	-2.53	0.012	-.0130991	-.0016514
GASPART	.0031139	.0021907	1.42	0.155	-.0011798	.0074077
COALPART	-.0045709	.0022377	-2.04	0.041	-.0089567	-.000185
NUCLEARPART	-.0024384	.0028346	-0.86	0.390	-.0079941	.0031174
WIND	-9.99e-08	1.80e-07	-0.55	0.580	-4.54e-07	2.54e-07
SOLAR	3.20e-12	1.61e-11	0.20	0.842	-2.83e-11	3.48e-11
BIOMASS	2.75e-07	2.41e-06	0.11	0.909	-4.45e-06	5.00e-06
KYOTO	.3572853	.0353501	10.11	0.000	.2880004	.4265703
INDUSTRY	.0007234	.0005562	1.30	0.193	-.0003668	.0018136
_cons	.3628729	.1908826	1.90	0.057	-.0112502	.7369959
sigma_u	.31994917					
sigma_e	.30797836					
rho	.51905708	(fraction of variance due to u_i)				

TRADE

Source	SS	df	MS
Model	52.5986878	13	4.04605291
Residual	100.595062	626	.160694987
Total	153.19375	639	.239739828

```
Number of obs =      640
F( 13,    626) =   25.18
Prob > F      =   0.0000
R-squared     =   0.3433
Adj R-squared =   0.3297
Root MSE      =   .40087
```

FITORCERT	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
TRADE	.016929	1.00359	0.02	0.987	-1.953881	1.987739
CONTCOM	-.1527413	.047827	-3.19	0.001	-.2466621	-.0588204
CO2	.0175969	.0082444	2.13	0.033	.0014068	.033787
ENEUSE	-.0000361	.0000144	-2.50	0.013	-.0000644	-7.76e-06
OILPART	-.0062236	.0018057	-3.45	0.001	-.0097696	-.0026776
GASPART	.0050302	.0013613	3.70	0.000	.0023569	.0077035
COALPART	-.0002476	.0010282	-0.24	0.810	-.0022668	.0017716
NUCLEARPART	.0029112	.0009844	2.96	0.003	.0009781	.0048443
WIND	-2.84e-08	5.20e-08	-0.55	0.585	-1.30e-07	7.37e-08
SOLAR	1.30e-13	4.67e-12	0.03	0.978	-9.05e-12	9.31e-12
BIOMASS	-7.40e-07	8.04e-07	-0.92	0.358	-2.32e-06	8.39e-07
KYOTO	.3596865	.0391882	9.18	0.000	.2827303	.4366428
INDUSTRY	.0018016	.0005514	3.27	0.001	.0007188	.0028844
_cons	.0729588	1.001072	0.07	0.942	-1.892908	2.038825

```
Fixed-effects (within) regression               Number of obs      =       640
Group variable: Country                         Number of groups   =        32

R-sq:  within  = 0.3890                         Obs per group: min =        20
       between = 0.0079                                        avg =      20.0
       overall = 0.0747                                        max =        20

                                                F(10,598)          =     38.08
corr(u_i, Xb)  = -0.5472                        Prob > F           =    0.0000

------------------------------------------------------------------------------
   FITORCERT |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       TRADE |  -1.113243   1.487754    -0.75   0.455    -4.035101    1.808616
     CONTCOM |  -.3333034   .2330165    -1.43   0.153    -.7909335    .1243267
         CO2 |   .0081962   .0199294     0.41   0.681    -.0309438    .0473362
      ENEUSE |  -2.24e-06   .0000242    -0.09   0.926    -.0000498    .0000453
     OILPART |  -.0123248   .0041839    -2.95   0.003    -.0205418   -.0041079
     GASPART |  -.0018644   .0033356    -0.56   0.576    -.0084152    .0046864
    COALPART |  -.0101747   .0037762    -2.69   0.007     -.017591   -.0027585
 NUCLEARPART |  -.0137358   .0054461    -2.52   0.012    -.0244317     -.00304
        WIND |          0  (omitted)
       SOLAR |          0  (omitted)
     BIOMASS |          0  (omitted)
       KYOTO |   .3520778   .0367671     9.58   0.000     .2798695    .4242861
    INDUSTRY |   .0009173    .000592     1.55   0.122    -.0002454    .0020799
       _cons |   1.992431   1.506122     1.32   0.186    -.9654994    4.950362
-------------+----------------------------------------------------------------
     sigma_u |  .44025567
     sigma_e |  .31023152
         rho |  .66820407   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(31, 598) =    14.54             Prob > F = 0.0000
```

```
Random-effects GLS regression                   Number of obs      =       640
Group variable: Country                         Number of groups   =        32

R-sq:  within  = 0.3823                         Obs per group: min =        20
       between = 0.1428                                        avg =      20.0
       overall = 0.2885                                        max =        20

                                                Wald chi2(12)      =         .
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =         .
```

FITORCERT	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
TRADE	-.9315776	1.393123	-0.67	0.504	-3.662049	1.798893
CONTCOM	-.2819708	.1342261	-2.10	0.036	-.5450491	-.0188926
CO2	.005272	.0150266	0.35	0.726	-.0241796	.0347235
ENEUSE	-.000017	.0000219	-0.78	0.436	-.0000599	.0000258
OILPART	-.0070871	.0030701	-2.31	0.021	-.0131045	-.0010698
GASPART	.0038385	.0022664	1.69	0.090	-.0006036	.0082806
COALPART	-.0037658	.0023339	-1.61	0.107	-.0083402	.0008085
NUCLEARPART	-.0019569	.002916	-0.67	0.502	-.0076721	.0037583
WIND	-1.14e-07	1.83e-07	-0.62	0.534	-4.72e-07	2.45e-07
SOLAR	4.10e-12	1.63e-11	0.25	0.801	-2.79e-11	3.61e-11
BIOMASS	-8.17e-08	2.51e-06	-0.03	0.974	-5.01e-06	4.84e-06
KYOTO	.3594656	.0355321	10.12	0.000	.289824	.4291072
INDUSTRY	.0009784	.0005704	1.72	0.086	-.0001395	.0020963
_cons	1.349097	1.405568	0.96	0.337	-1.405767	4.10396
sigma_u	.32336265					
sigma_e	.31023152					
rho	.52071593	(fraction of variance due to u_i)				

DIPLOMREP

Source	SS	df	MS
Model	10.4303897	13	.802337671
Residual	17.0696103	114	.149733423
Total	27.5	127	.216535433

```
Number of obs =      128
F( 13,   114) =     5.36
Prob > F      =   0.0000
R-squared     =   0.3793
Adj R-squared =   0.3085
Root MSE      =   .38695
```

FITORCERT	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
DIPLOMREP	.3333512	.1053376	3.16	0.002	.1246783	.5420241
CONTCOM	-.1357165	.102099	-1.33	0.186	-.3379738	.0665408
CO2	.005074	.0198817	0.26	0.799	-.0343115	.0444596
ENEUSE	-.0000355	.000038	-0.94	0.352	-.0001107	.0000397
OILPART	-.0069573	.0036913	-1.88	0.062	-.0142698	.0003552
GASPART	.006763	.0032215	2.10	0.038	.0003812	.0131449
COALPART	-2.98e-06	.0022868	-0.00	0.999	-.0045332	.0045272
NUCLEARPART	-.0005509	.0021161	-0.26	0.795	-.004743	.0036411
WIND	7.67e-08	1.13e-07	0.68	0.498	-1.47e-07	3.00e-07
SOLAR	-3.48e-12	1.00e-11	-0.35	0.729	-2.33e-11	1.64e-11
BIOMASS	-3.86e-07	1.46e-06	-0.26	0.792	-3.28e-06	2.51e-06
KYOTO	.3861219	.0896777	4.31	0.000	.2084711	.5637726
INDUSTRY	.001549	.001359	1.14	0.257	-.0011432	.0042413
_cons	-.0811811	.21189	-0.38	0.702	-.5009336	.3385714

```
Fixed-effects (within) regression               Number of obs      =       128
Group variable: Country                         Number of groups   =        32

R-sq:  within  = 0.4065                         Obs per group: min =         4
       between = 0.0520                                        avg =       4.0
       overall = 0.0226                                        max =         4

                                                F(9,87)            =      6.62
corr(u_i, Xb)  = -0.7431                        Prob > F           =    0.0000

------------------------------------------------------------------------------
   FITORCERT |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   DIPLOMREP |  -.1494942   .2039412    -0.73   0.466    -.5548494     .255861
     CONTCOM |          0  (omitted)
         CO2 |  -.0217182   .0634841    -0.34   0.733    -.1478997    .1044632
      ENEUSE |   .0000503   .0001008     0.50   0.619      -.00015    .0002506
     OILPART |  -.0151658   .0114402    -1.33   0.188    -.0379044    .0075727
     GASPART |  -.0020024   .0094391    -0.21   0.832    -.0207636    .0167588
    COALPART |  -.0123906   .0095493    -1.30   0.198    -.0313709    .0065897
 NUCLEARPART |  -.0054353   .0152526    -0.36   0.722    -.0357516     .024881
        WIND |          0  (omitted)
       SOLAR |          0  (omitted)
     BIOMASS |          0  (omitted)
       KYOTO |   .4643437   .1065072     4.36   0.000      .252649    .6760383
    INDUSTRY |  -.0018733   .0021117    -0.89   0.377    -.0060705    .0023239
       _cons |   1.108267   .6587985     1.68   0.096    -.2011663    2.417701
-------------+----------------------------------------------------------------
     sigma_u |  .54001809
     sigma_e |  .35042219
         rho |  .70368921   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(31, 87) =     1.77              Prob > F = 0.0203
```

```
Random-effects GLS regression                   Number of obs      =       128
Group variable: Country                         Number of groups   =        32

R-sq:  within  = 0.3480                         Obs per group: min =         4
       between = 0.4336                                        avg =       4.0
       overall = 0.3731                                        max =         4

                                                Wald chi2(12)      =         .
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =         .
```

FITORCERT	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
DIPLOMREP	.2517975	.122174	2.06	0.039	.0123408	.4912541
CONTCOM	-.1562477	.1287208	-1.21	0.225	-.4085359	.0960405
CO2	.0024153	.0239823	0.10	0.920	-.0445891	.0494197
ENEUSE	-.0000276	.0000458	-0.60	0.547	-.0001174	.0000622
OILPART	-.0062028	.0043878	-1.41	0.157	-.0148026	.0023971
GASPART	.0076657	.0036523	2.10	0.036	.0005072	.0148241
COALPART	-.0002624	.0028073	-0.09	0.926	-.0057646	.0052398
NUCLEARPART	-.0004888	.0026797	-0.18	0.855	-.005741	.0047634
WIND	4.80e-08	1.44e-07	0.33	0.739	-2.34e-07	3.30e-07
SOLAR	-3.42e-12	1.28e-11	-0.27	0.789	-2.85e-11	2.16e-11
BIOMASS	-2.44e-07	1.88e-06	-0.13	0.897	-3.92e-06	3.44e-06
KYOTO	.4052769	.0882409	4.59	0.000	.2323279	.578226
INDUSTRY	.0005534	.0014882	0.37	0.710	-.0023635	.0034704
_cons	.0408097	.2573312	0.16	0.874	-.4635502	.5451696
sigma_u	.16968115					
sigma_e	.35042219					
rho	.1899346	(fraction of variance due to u_i)				