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Abstract

This paper searches statistical evidence of tax harmonization initiated and motivated by EU Commission since 1980. The purpose of energy tax harmonization is to reach more efficient use of energy among members and thereby to establish more competitive markets in EU. The tax harmonization in EU, in this work, is analyzed through convergence tests to see whether total taxes applied to oil and diesel used by industries and households are adjusted among EU members. This study, therefore, employs minimum Lagrange multiplier unit root tests with structural breaks developed by Lee and Strazicich (2003). Upon observations the data for panels, it is revealed that panels for oil industry tax, diesel industry tax, oil household tax and diesel household tax converge to average total taxes of members. Time series data for individual countries, on the other hand, give both convergence and non-convergence results.

Keywords: Oil and diesel taxes, households and industries, harmonization, convergence, European Union, LM unit root tests with structural breaks
JEL Classification Codes: C22, C33, Q48, H31, H32

1. Introduction

The low of one price has been analyzed with great interest in the economics and/or energy literature. From this perspective, many searches are realized to explore if one price empirically exists through time within cities or states or continents. It seems that the energy products attract more attention than other products in the literature of price convergence due to their more environmental and intertemporal effects on the societies. To this end, the works on energy price convergence seek to explore whether energy prices assemble within time and/or the cross sections especially in EU after Single European Act (1987).

This paper analyzes, on the other hand, energy tax harmonization in EU by two reasons. First, there exists an extensive literature on energy price work such as Bentzen (2003), Dreher and Krieger (2008), Neumann et al. (2006), Zachmann (2008), Vany and Walls (1999), Ma et al. (2009) which conclude mainly price convergence and Robinson (2007) and Siliverstovs (2005) whose findings support both convergence and non-convergence in energy prices. The literature on energy tax harmonization or energy tax convergence, however, is limited in comparison with that of energy price. Secondly, the tax harmonization has been proposed by European Commission (EC) for almost last two decades in order for EU members to reach more efficient use of energy. Then, it is needed to access the empirical result of EC directives ongoing more than 20 years for tax harmonization between members.

EU Council Directive 92/81/EEC, Article 1 states that EU members shall impose a harmonized duty tax on mineral oils (EU Commission, 1992a). EU Council Directive 2003/96/EC, Article 5 points

out that member states may apply differentiated energy tax rates due to energy product quality, energy consumption levels, energy for public use, energy for industry use and energy for non industry use (EU Commission, 2003). EU Council Directive 2003/96/EC, Article 7 indicates that starting from January 2004 and from 2010, the tax level on motor fuels shall be fixed and that European Parliament shall decide on minimum levels of tax for gas oil not later than 1 January 2012 (EU Commission, 2003). These Council directives aim at harmonizing the energy tax rates at a minimum level which is lower than the existing rates in EU members, and thereby, establishing a single market.

Newberry (2001) brings up that, although the existence of EU pressure for harmonizing energy taxes, energy is taxed at different rates within all EU countries. These differences in tax rates brings about cross border fuel tourism (Rietveld et al., 2001, Wlazlowski et al., 2009). Kohlhaas et al. (2004) develop several scenarios on tax harmonization' possible results in EU and conclude that the harmonization might lead to some GDP losses especially in accession economies. Dorigoni and Gull´ı, (2002) claim that tax harmonization seems difficult to be realized, and, therefore, they propose a tax harmonization as a second best solution model considering each member separately and being consistent with EU environmental targets.

This paper specifically carries out the tests for energy tax harmonization in EU by the convergence tests of energy taxes through time and across sections yet the energy taxes practically seem to be subject to change from one member to another member. To this end, this work performs minimum Lagrange Multiplier (LM) unit root tests with structural breaks for four panel data sets consisting of EU members. These panels are light fuel oil taxes for industries, automotive diesel taxes for industries, light fuel oil taxes for households and automotive diesel taxes for households, respectively. Paper's next section describes the data and methodology and Section III gives the results of LM unit root tests of panels and individual members for oil and diesel taxes consumed by industries and households.

2. Data and Methodology

The quarterly data is obtained from International Energy Agency (IEA) and the '*Documentation of IEA, Energy prices and Taxes: Beyond 2020 2Q2008 edition*' explains the details for energy tax data for OECD countries. Energy taxes represent total tax as of US $/unit for each energy product. In this work, EU 15 members are taken into consideration. However, due to data availability, some members are dropped from the related panels and to be able to keep the same relatively longer time horizon in statistical analyses, among other energy products, the energy data for light fuel oil taxes and automotive diesel taxes for industries and households are studied.

The statistical analyses follow the minimum Lagrange Multiplier (LM) unit root test with structural breaks developed by Lee and Strazicich (2003). Their LM unit root tests have some more appropriate statistical properties over other unit root tests with structural break(s) of Perron (1989), Zivot and Andrews (1992), Lumsdaine and Papel (1997) and Perron (1997) as defined in Lee and Strazicich (2003). The LM test performed by Lee and Strazicich (2003) yields unbiased results by the assumption of endogenously determined breaks in null hypothesis of unit root tests. Lee and Strazicich (2001, 2003) follow a data generating process with unit root together with breaks and conclude that when unit root null hypothesis assumes no break, the resulting test statistics provide divergence and significant rejections of the unit root null.

Therefore, the LM convergence tests with two structural breaks are carried out employing time series data for individual countries and the data for panels considering the log relative tax for each country as in Eq. (1).

$$Tax_{it}^{*} = \log\left(Tax_{it} / mean\ Tax_{t}\right) \quad (1)$$

where Tax_{it}^{*}, log, Tax_{it} and $mean\ Tax_{t}$ represent relative total tax of related energy product for country i at time t, natural logarithm, total tax of related energy product for country i at time t and the

mean of total taxes of countries at time t, respectively. The individual LM unit root test with two structural breaks is conducted as

$$\Delta y_t = \delta' \Delta Z_t + \gamma \tilde{S}_{t-1} + \varepsilon_t \quad (2)$$

where $\tilde{S}_t = y_t - Z_t \tilde{\delta} - \tilde{\phi}_x$ as t = 2,3,…,T. The estimator $\tilde{\delta}$ is a vector of coefficients obtained from the regression of Δy_t on ΔZ_t, $\tilde{\phi}_N = y_1 - Z_1 \tilde{\delta}$ and $Z_t = [1, t, D_{1t}, D_{2t}, DT^*_{1t}, DT^*_{2t}]'$, where D_{jt}, j= 1, 2, and DT^*_{jt}, j= 1,2, denote the dummies for level j and trend j, respectively. The augmented terms, $\Delta \tilde{S}_{t-i}$, i=1,2,…k, included in Eq. (2) provide the correction for autocorrelation. The null of unit root hypothesis is $H_0: \gamma = 0$. The panel LM test statistic is performed by Eq. (3) following Im et al. (2002, 2005).

$$\Gamma_{LM} = \sqrt{N}\left[\overline{LM}_{NT} - E(L_T)\right] \Big/ \left(\sqrt{V[L_T]}\right) \quad (3)$$

where Γ_{LM}, N, $\overline{LM}_{NT}$, $E(L_T)$ and $V(L_T)$ denote the standardized LM panel unit root test statistic, the number of cross sections, the mean of individual LM test statistics derived from Eq. (2), the expected value and variance of individual LM test statistics, respectively. *T* represents the number of observations less number of augmented terms less 1, instead of actual number of observations of sample. The values of $E(L_T)$ and $V(L_T)$ are obtained from Table 1 of Im et al. (2002). Im and Lee (2001) indicate that Eq. (3) follows standard normal distribution with the values of 2.326, 1.645 and 1.282 at 1%, 5%, and 10% level, respectively (Strazicich et al. 2001).

Besides tests with two structural breaks, throughout this work, the LM unit root tests with one structural break or with no break, when necessary, are also performed. When LM test of Tax^*_{it} is found stationary, then, one may state that the ratio of ith country's tax implemented on relevant energy product to the average total taxes in panel is converged to its mean. Provided that the panel LM test statistics are found stationary, then, this result would be statistical confirmation (realization) of the energy tax harmonization in Europe as proposed by EU Council Directive.

3. The Unit Root Tests by Minimum LM for Light Fuel Oil and Automotive Diesel Taxes

Tables 1, 2, 3 and 4, show the statistics of LM unit root tests with structural breaks for the total taxes applied to light fuel oil and automotive diesel used by industries and households in EU for the periods of 1981:3-2007:4, 1979:1-2008:1, 1981:1-2008:1 and 1979:1-2008:1, respectively. The second columns from Table 1 to Table 4 denote the LM test statistics of null $H_0: \gamma = 0$ in Eq. (2). The third columns are the critical values of λ_1, = FB/T and λ_2 = SB/T where T is the number of observations in the series. The critical values are symmetric around λ_i = (1- λ_i), i=1,2 as explained in Lee and Strazicich (2003) and Strazicich et al. (2004). The forth columns are the number of lagged first differenced terms employed in Eq. (2) to correct the serial correlation. The last two columns of FB and SB yield the estimated first and second breaks of levels and/or trends in individual tax data.

Table 1: The Unit Root Tests for Light Oil Industry Tax Data (1981:3 - 2007:4)

EU Member	Minimum LM statistic	Critical value break points	L	FB	SB
Belgium	-6.999(*)	(λ_1 =0.4, λ_2=0.8)	1	1994:2(*)	2003:3(*)
Denmark	-9.606(*)	(λ_1 =0.4, λ_2=0.6)	8	1995:3(*)	1998:3(*)
Finland	-4.770	(λ_1 =0.2, λ_2=0.4)	8	1986:1(*)	1993:3(*)
Germany	-8.027(*)	(λ_1 =0.2, λ_2=0.4)	6	1988:3(*)	1991:2(*)
Ireland	-8.247(*)	(λ_1 =0.2, λ_2=0.4)	0	1986:4(*)	1994:1(***)

Italy	-6.563(*)	(λ_1 =0.2, λ_2=0.4)	5	1985:1(*)	1993:3(*)
Luxembourg	-6.408(*)	(λ_1 =0.6, λ_2=0.8)	5	1997:2(*)	2004:3(*)
Netherlands	-5.327(***)	(λ_1 =0.2, λ_2=0.4)	1	1987:1(*)	1992:1(*)
Spain	-9.156(*)	(λ_1 =0.2, λ_2=0.4)	8	1985:3(*)	1988:4(*)
Sweden	-7.647(*)	(λ_1 =0.4, λ_2=0.6)	7	1992:3(*)	1997:3(*)
UK	-4.465	(λ_1 =0.4, λ_2=0.8)	0	1991:4(*)	2001:4(***)
Panel	-28.630(*)				

Note:(*), (**) and (***) denote %1, %5 and % 10 significance level, respectively. The critical values are obtained from Table 2 in Lee and Strazicich (2003).

Table 1 LM statistics find that Belgium, Denmark, Germany, Ireland, Italy, Luxembourg, Netherlands, Spain and Sweden converge in taxes whereas Finland and UK are observed as nonconverged countries. All first breaks (FBs) and second breaks (SBS) are found stationary. The FBs mostly cluster around the second half of 1980s and the first half of 1990s whereas SBs accumulate in 1990s and the first half of 2000s. The Panel LM statistic shows that convergence happens in total taxes applied to light fuel oil used by industries within 11 EU members listed in Table 1.

According to Table 2 results, EU members in the panel, except Austria, Belgium, Germany, Luxembourg, Spain and UK, converge in diesel industry taxes. The significant FBs assemble often within the periods of 1980-1985 and 1985-1990. The significant SBs cluster in 1990s and initial years of 2000s. LM tests with one structural break are run for Austria and Spain since their FBs are not significant. Austria again does not converge with the significant one break. Spain's one break, however, is found non-significant. Finally Spain does not show convergence in taxes with no break either. Panel LM statistic of -24.956 is found significant at %1 percent level according to the critical values for standard normal distribution as defined in Strazicich et al., (2001) and Jewell et al., (2003). Although 6 of 14 EU members individually do not have evidence of convergence, the panel result is in favor of the realization of tax harmonization for diesel industry taxes between 1979:1 and 2008:1. From this statistical result, then, one may claim that Denmark, Finland, France, Ireland, Italy, Netherlands, Portugal and Sweden are tended to accommodate with energy tax harmonization directive of EC.

Table 3 differs somewhat from Tables 1 and 2 since it deals with consumer behavior rather than producer behavior given in Tables 1 and 2. The harmonization of total taxes implemented on light fuel oil used by households is met by the panel LM statistics of -27.944 at %1 significance level. Austria, France, Sweden and UK seem not to participate in harmonization directive of EC. The FBs and SBs are significant except the second break of Italy. The FBs group in 1980s and the first half of 1990s. As for the SBs, they scatter in a wider distance than the first ones. They are observed to fall in the second half of 1980s, roughly all 1990s and the first half of 2000s.

Table 2: The Unit Root Tests for Diesel Industry Tax Data (1979:1 - 2008:1)

EU Member	Minimum LM statistic	Critical value break points	L	FB	SB
Austria	-4.716	λ_1 =0.4, λ_2=0.6	0	1991:3	1998:3(*)
Austria(1)	-4.008	λ =0.4 ------	0	1990:3(**)	------
Belgium	-4.480	λ_1 =0.4, λ_2=0.6	4	1989:1(*)	1996:1(*)
Denmark	-7.751(*)	λ_1 =0.6, λ_2=0.8	4	1998:3(*)	2001:1(*)
Finland	-5.420(***)	λ_1 =0.2, λ_2=0.4	8	1986:1(*)	1993:1(*)
France	-5.315(***)	λ_1 =0.4, λ_2=0.6	8	1989:3(*)	1994:4(*)
Germany	-4.127	λ_1 =0.4, λ_2=0.8	4	1988:3(*)	2000:3(*)
Ireland	-6.921(*)	λ_1 =0.2, λ_2=0.8	4	1986:2(*)	2000:3(**)
Italy	-8.474(*)	λ_1 =0.2, λ_2=0.4	7	1984:3(*)	1990:3(*)
Luxembourg	-4.284	λ_1 =0.2, λ_2=0.4	6	1984:3(*)	1992:4(*)
Netherlands	-7.173(*)	λ_1 =0.2, λ_2=0.6	7	1986:2(*)	1996:2(*)
Portugal	-6.171(**)	λ_1 =0.2, λ_2=0.8	3	1984:1(*)	1999:1(*)
Spain	-7.250(*)	λ_1 =0.2, λ_2=0.4	7	1986:3	1988:1(**)
Spain(1)	-6.859(*)	λ =0.2 ------	7	1986:4	------
Spain(0)	-0.695	------ ------	8	------	------
Sweden	-6.158(**)	λ_1 =0.2, λ_2=0.6	6	1982:2(*)	1995:2(**)
UK	-3.600	λ_1 =0.2, λ_2=0.6	7	1985:4(**)	1996:4(*)
Panel	-24.956(*)				

Notes: (*), (**) and (***) denote %1, %5 and % 10 significance level, respectively. All individual statistics, except countries denoted by (1) and (0), come from two structural break-LM tests. (1) and (0) indicate LM tests with one structural break and without break, respectively. Lee and Strazicich (2003) Table 2, Lee and Strazicich (2004) and Schmidt and Phillips (1992) Table 1A provide the critical values for two structural breaks, one structural break and with no break, respectively.

Table 3: The Unit Root Tests for Oil Household Tax Data (1981:1 - 2008:1)

EU Member	Minimum LM statistic	Critical value break points	L	FB	SB
Austria	-3.966	λ1 =0.2, λ2=0.4	7	1988:2(**)	1992:1(*)
Belgium	-5.487(***)	λ1 =0.2, λ2=0.4	3	1985:4(*)	1988:3(*)
Denmark	-9.469(*)	λ1 =0.2, λ2=0.4	8	1986:1(*)	1990:3(*)
Finland	-7.584(*)	λ1 =0.4, λ2=0.8	0	1993:1(**)	2001:2(*)
France	-5.062	λ1 =0.4, λ2=0.8	1	1992:3(*)	2001:3(**)
Germany	-7.230(*)	λ1 =0.2, λ2=0.4	8	1985:4(*)	1991:3(*)
Ireland	-5.924(**)	λ1 =0.2, λ2=0.4	1	1985:2(*)	1987:2(**)
Italy	-7.084(*)	λ1 =0.2, λ2=0.4	5	1985:3(*)	1990:3
Italy(1)	-6.038(*)	λ =0.4 ------	5	1993:2 (*)	------
Luxembourg	-5.472(***)	λ1 =0.2, λ2=0.4	3	1986:1(*)	1993:3(*)
Netherlands	-5.752(**)	λ1 =0.2, λ2=0.6	1	1987:2(*)	1997:1(*)
Spain	-12.147(*)	λ1 =0.2, λ2=0.4	8	1983:4(*)	1987:4(*)
Sweden	-5.104	λ1 =0.2, λ2=0.4	8	1984:4(*)	1989:4(*)
UK	-4.259	λ1 =0.4, λ2=0.8	4	1994:1(*)	2002:2(*)
Panel	-27.944(*)				

Notes: (*), (**) and (***) denote %1, %5 and % 10 significance level, respectively. All individual statistics, except country denoted by (1), come from two structural break-LM tests. (1) indicates LM tests with one structural break. Lee and Strazicich (2003) Table 2 and Lee and Strazicich (2004) provide the critical values for two structural breaks and one structural break, respectively.

Finally Table 4 accounts for total taxes for automotive diesel consumed by households between the first quarters of 1979 and 2008. Germany, Luxembourg and UK say 'no' for the convergence while other nine individual members agree with EC Directives. Then, expected outcome of panel, together with the nine 'yes', would be most likely 'yes' too. The statistical reveal of LM with -22.515 confirms this agreement of panel with the announcement of tax harmonization by EC in automotive diesel for households. The FBs and SBs of household diesel taxes' scatter points bear no resemblance, on the

other hand, to those of household fuel oil, yet both of household total taxes crowd around same time intervals.

Table 4: The Unit Root Tests for Diesel Household Tax Data (1979:1 - 2008:1)

EU Member	Minimum LM statistic	Critical value break points	L	FB	SB
Austria	-5.676(**)	λ1 =0.4, λ2=0.8	5	1990:3(*)	2004:4(*)
Finland	-5.777(**)	λ1 =0.2, λ2=0.4	1	1986:1(*)	1992:1(*)
France	-5.759(**)	λ1 =0.4, λ2=0.6	7	1989:3(*)	1994:3(*)
Germany	-4.417	λ1 =0.2, λ2=0.8	5	1987:1(**)	2000:3(*)
Ireland	-7.354(*)	λ1 =0.2, λ2=0.8	4	1985:1(*)	2002:4(*)
Italy	-5.992(**)	λ1 =0.4, λ2=0.6	6	1989:4(**)	1994:2(*)
Luxembourg	-5.069	λ1 =0.4, λ2=0.6	8	1988:4(*)	1993:3
Luxembourg(1)	-2.733	λ =0.4 ------	0	1992:4(*)	------
Netherlands	-6.877(*)	λ1 =0.2, λ2=0.4	1	1985:3(*)	1993:1(*)
Portugal	-5.639(***)	λ1 =0.2, λ2=0.8	7	1985:3(*)	1999:2(*)
Spain	-7.088(*)	λ1 =0.2, λ2=0.4	7	1985:3(*)	1989:2(*)
Sweden	-5.817(**)	λ1 =0.2, λ2=0.4	6	1982:2(*)	1989:4(*)
UK	-3.579	λ1 =0.2, λ2=0.6	7	1985:3(**)	1996:4(*)
Panel	-22.515(*)				

Notes: (*), (**) and (***) denote %1, %5 and % 10 significance level, respectively. All individual statistics, except country denoted by (1), come from two structural break-LM tests. (1) indicates LM tests with one structural break. Lee and Strazicich (2003) Table 2 and Lee and Strazicich (2004) provide the critical values for two structural breaks and one structural break, respectively.

The time intervals covering the structural breaks determined throughout this paper imply the years of 1980s, 1990s and 2000s, albeit they vary in exact data points. This may recall independent, to the some degree, national fiscal policies of the members. All four panels, however, give the evidence of statistical significances of tax convergence initiated and motivated by the propose of '*Report from the Commission to the Council on the scope for convergence of tax system in the Community*' in 1980 (EU Commission, 1980) declaring EEC's fundamental objectives as;

i. Establishment a common market by free movement of economic agents, production factors, commodities and services and a whole system providing a not distorted competition,
ii. The ongoing adjustment of the members' economic policies,
iii. The association of prevalent policies of energy, environment, regional policies, external trade, agriculture and transport.

After EU Commission 1980 report, The EU energy tax policy becomes more decisive with the *Proposal for a Council Directive on the approximation of the rates of excise duty on mineral oils* (EU Commission, 1987), *Council Directive on the approximation of the rates of excise duties on mineral oils* (EU Commission, 1992a) and *Proposal for a Council Directive amending Directive 92/81/EEC with regard to the possibility of applying a reduced rate of excise duty on certain mineral oils containing biofuels and on biofuels* (EU Commission, 2002). From 1980s to 2000s, throughout all these reports and/proposals, a common system of excise tax for harmonization including fuels was submitted by EC in 1994, and till 1997 harmonizing direct tax was moderate as explained in Kesner-Škreb (2007). What about 2000s? Kesner-Škreb (2007) seems EU 25 tax harmonization program circuitous. This view, of course, considers heterogeneous economic policy structures of 25 EU members. Kohlhaas et al. (2004), in general, sees tax harmonization for new members costly together with some potential gains for them in the future. The paper handled here, on the other hand, approaches more homogeneous EU members rather than EU 25 and finds and empirical evidence of harmonization in panels as well as the majority of individual traditional EU members. One may apply the same LM tests for EU 25 to reveal the possibility of tax harmonization for today's EU. Inserting relatively more heterogeneous structure of new members into the system, the resulting point is less likely to be

identical to this paper. The comparison of traditional members with new members is, of course, another subject of interest.

4. Conclusion

This work seeks energy tax harmonization in EU considering total taxes on light fuel oil and automotive diesel used by both industries and households. The quarterly data for the panels of oil industry, diesel industry, oil household and diesel household cover the periods of 1981:3 – 2007:4, 1979:1 – 2008:1, 1981:1 – 2008:1 and 1979:1 – 2008:1, respectively. Time series data on individual countries give mix output from the LM unit root tests with two structural breaks. When two structural break tests for countries are considered not significant, LM tests with one break and without break are performed. Finland and UK, Austria, Belgium, Germany, Luxembourg, Spain and UK, Austria, France, Sweden and UK and Germany, Luxembourg and UK do not converge in oil industry taxes, diesel industry taxes, oil household taxes and diesel household taxes, respectively. The panels for the taxes implemented on oil and diesel consumption of industries and households, on the other hand, give the same results of convergence. These statistical findings support, on average, the accomplishment of tax harmonization of European Union through time although some individual members resist the convergence within given period.

References

[1] Bentzen, Jan, 2003. "An Empirical Analysis of Gasoline Price Convergence for 20 OECD Countries", Working Paper 03-19, Department of Economics, Aarhus School of Business.

[2] Dreher, Axel, and Tim Krieger, 2008. "Do Prices for Petroleum Products Converge in a Unified Europe with Non-Harmonized Tax Rates?", *The Energy Journal* 29, pp. 61-88.

[3] Dorigoni Susanna, and Francesco Gull´ı, 2002. "Energy Tax Harmonization in the European Union: A Proposal Based on the Internalization of Environmental External Costs", *European Environment* 12, pp. 17–34.

[4] EU Commission, 2003. "Council Directive 2003/96/Ec of Restructuring the Community Framework for the Taxation of Energy Products and Electricity", *Official Journal,L*283/51,URL:http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:283:0051:0070:EN:PDF

[5] EU Commission, 2002. "Council Directive Amending Directive 92/81/EEC with Regard to the Possibility of Applying a Reduced Rate of Excise Duty on Certain Mineral Oils Containing Biofuels and on Biofuels (2002/C 103 E/15) ", *Official Journal of EC*, C103/51,E/217, URL : http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2002:103E:0217:0220:EN:PDF

[6] EU Commission, 1992a. "Council Directive 92/82/EEC on the Approximation of the Rates of Excise Duties on Mineral Oils, COM (95) 285 Final", *AEI, Archive of European Integration*, University of Pittsburgh, URL: http://aei.pitt.edu/6188/

[7] EU Commission, 1992b. "Council Directive 92/81/EEC on the Harmonization of the Structures of Excise Duties on Mineral Oils", *Official Journal* L 316, P. 0012 – 0015, URL:http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31992L0081:EN:HTML

[8] EU Commission, 1987. "Proposal for a Council Directive on the Approximation of the Rates of Excise Duty on Mineral Oils. COM (87) 327 Final/2", *AEI, Archive of European Integration*, University of Pittsburgh, URL: http://aei.pitt.edu/11972/

[9] EU Commission, 1980. "Report from the Commission to the Council on the Scope for Convergence of Tax Systems in the Community, COM (80) 139 Final", *AEI, Archive of European Integration,* University of Pittsburgh, URL: http://aei.pitt.edu/8583/

[10] IEA, International Energy Agency, 2008. The Documentation of IEA, Energy Prices and Taxes: Beyond 2020, 2Q2008 Edition, France.

[11] Im, Kyung So, Junsoo Lee, and Margie Tieslau, 2005. "Panel LM Unit-Root Tests with Level Shifts", *Oxford Bulletin of Economics and Statistics* 67, pp. 393-419.

[12] Im, Kyung So, Junsoo Lee, and Margie Tieslau, 2002. "Panel LM Unit Root Tests with Level Shifts", Mimeo, Department of Economics, University of Central Florida. URL: http://web.bus.ucf.edu/documents/economics/workingpapers/2002-39.pdf

[13] Jewell, Todd, Junsoo Lee, Margie Tieslau, and Mark C. Strazicich, 2003. "Stationarity of Health Expenditures and GDP: Evidence from Panel Unit Root Tests with Heterogeneous Structural Breaks", *Journal of Health Economics* 22, pp. 313–323.

[14] Kesner-Škreb, Marina, 2007. "Tax Harmonization", *Financial Theory and Practice* 31, pp. 309-311.

[15] Lau, Evan, Ahmad Z. Baharumshah, and Chan T. Haw, 2006. "Current Account: Mean-Reverting or Random Walk Behavior?", *Japan and the World Economy* 18, pp. 90–107.

[16] Lee, Junsoo, and Mark C. Strazicich, 2001. "Break Point Estimation and Spurious Rejections with Endogenous Unit Root Tests", *Oxford Bulletin of Economics and Statistics* 63, pp. 535-558.

[17] Lee, Junsoo, and Mark C. Strazicich, 2003. "Minimum Lagrange Multiplier Unit Root Test with Two Structural Breaks", *Review of Economics and Statistics* 85, pp. 1082-1089.

[18] Ma, Hengyun, Les Oxley, and John Gibson, 2009. "Gradual Reforms and the Emergence of Energy Market in China: Evidence From Tests for Convergence of Energy Prices", *Energy Policy* 37, pp. 4834–4850.

[19] Neumann Anne, Boriss Siliverstovs and Christian von Hirschhausen, 2006. "Convergence of European Spot Market Prices for Natural Gas? A Real-Time Analysis of Market Integration Using the Kalman Filter", *Applied Economics Letters* 13, pp. 727–732.

[20] Kohlhaas, Michael, Katja Schumacher, Jochen Diekmann, Dieter Schumacher, and Martin Cames, 2004. "Economic, Environmental and International Trade Effects of the EU Directive on Energy Tax Harmonization", DIV Berlin German Institute for Economic Research, Discussion Papers 462, December, Berlin.

[21] Perron, Pierre, 1997. "Further Evidence on Breaking Trend Functions in Macroeconomic Variables", *Journal of Econometrics* 80, pp. 355-385.

[22] Perron, Pierre, 1989. "The Great Crash, the Oil Price Shock, and the Unit Root Hypothesis", *Econometrica* 57, pp. 1361-1401.

[23] Rietveld, Piet, Frank Bruinsma, and Daniël van Vuuren, 2001. "Spatial Graduation of Fuel Taxes", Tinbergen Institute Discussion Papers, 99-048/3, URL: http://www.tinbergen.nl/ti-publications/discussion-papers.php?list=41&jaar=1999

[24] Robinson, Terry, 2007. "Have European Gas Prices Converged?", *Energy Policy* 35, pp. 2347–2351.

[25] Siliverstovs Boriss, Guillaume L'Hégaret, Anne Neumann and Christian von Hirschhausen, 2005. "International Market Integration for Natural Gas? A Cointegration Analysis of Prices in Europe, North America and Japan", *Energy Economics* 27, pp. 603– 615.

[26] Schmidt, Peter, and Peter C. B. Phillips, 1992. "LM Tests for a Unit Root in the Presence of Deterministic Trends", *Oxford Bulletin of Economics and Statistics* 54, pp. 3, 257-287.

[27] Strazicich, Mark C., Margie Tieslau, and Junsoo Lee, 2001. "Hysteresis in Unemployment? Evidence from Panel Unit Root Tests with Structural Change", Mimeo, Department of Economics, University of North Texas.

[28] Strazicich, Mark C., Junsoo Lee, and Edward Day, 2004. "Are Incomes Converging Among OECD Countries? Time Series Evidence with Two Structural Breaks", *Journal of Macroeconomics* 26, pp. 131-145.

[29] Vany, Arthur S. De, and W. David Walls, 1999. "Cointegration Analysis of Spot Electricity Prices: Insights on Transmission Efficiency in the Western US", *Energy Economics* 21, pp. 435-448.

[30] Wlazlowski Szymon, Monica Giulietti, Jane Binner and Costas Milas, 2009. "Price Dynamics in European Petroleum Markets", *Energy Economics* 31, pp. 99–108.

[31] Zachmann, Georg, 2008. "Electricity Wholesale Market Prices in Europe: Convergence?" *Energy Economics* 30, pp. 1659–1671.

[32] Lumsdaine, Robin L., and David H. Papell, 1997. "Multiple Trend Breaks and the Unit Root Hypothesis", *Review of Economics and Statistics* 79, pp. 212-218.

[33] Zivot, Eric and Donald W. K. Andrews, 1992. "Further Evidence on the Great Crash, the Oil-Price Shock and the Unit Root Hypothesis", *Journal of Business and Economic Statistics* 10, pp. 251-270.