

**Annex to the paper**

**Structural Change and Convergence of Energy Intensity  
across OECD Countries, 1970–2005**

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forthcoming in *Energy Economics* (2012)

doi: <http://dx.doi.org/10.1016/j.eneco.2012.07.023>

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## 1. Introduction

This Annex provides detailed evidence on historic trends in the relationship between energy use and economic activity for the period 1980–2005. Underlying data are taken from the recently launched ‘EU KLEMS Growth and Productivity Accounts’ database (O’Mahony and Timmer 2009), which we linked to physical energy data from the International Energy Agency (IEA). The tables presented are additional to the paper Mulder, P. and H.L.F. de Groot (2012), Structural Change and Convergence of Energy Intensity across OECD Countries, 1970–2005.

## 2. Data

Table A.1 summarizes the country coverage of our dataset

*Table A.1 List of countries in the database*

| Data availability  |      |           |  | Grouping used in this study |      |     |
|--------------------|------|-----------|--|-----------------------------|------|-----|
| Country            | Code | Years     |  | OECD18                      | EU10 | EU4 |
| 1 Austria          | AUT  | 1980–2005 |  | ✓                           | ✓    |     |
| 2 Belgium          | BEL  | 1980–2005 |  | ✓                           | ✓    |     |
| 3 Czech Republic   | CZE  | 1995–2005 |  | ✓                           |      | ✓   |
| 4 Denmark          | DNK  | 1970–2005 |  | ✓                           | ✓    |     |
| 5 Finland          | FIN  | 1970–2005 |  | ✓                           | ✓    |     |
| 6 France           | FRA  | 1978–2005 |  | ✓                           | ✓    |     |
| 7 Germany          | GER  | 1978–2005 |  | ✓                           | ✓    |     |
| 8 Hungary          | HUN  | 1995–2005 |  | ✓                           |      | ✓   |
| 9 Italy            | ITA  | 1970–2005 |  | ✓                           |      |     |
| 10 Japan           | JPN  | 1980–2005 |  | ✓                           |      |     |
| 11 South Korea     | KOR  | 1970–2005 |  | ✓                           |      |     |
| 12 The Netherlands | NLD  | 1987–2005 |  | ✓                           | ✓    |     |
| 13 Poland          | POL  | 1995–2005 |  | ✓                           |      | ✓   |
| 14 Spain           | SPA  | 1980–2005 |  | ✓                           | ✓    |     |
| 15 Slovakia        | SVK  | 1995–2005 |  | ✓                           |      | ✓   |
| 16 Sweden          | SWE  | 1993–2005 |  | ✓                           | ✓    |     |
| 17 United Kingdom  | UKD  | 1970–2005 |  | ✓                           | ✓    |     |
| 18 United States   | USA  | 1970–2005 |  | ✓                           |      |     |

Table A.2 lists the sectors in our dataset, including higher aggregates, classified according to the European NACE revision 1 classification.

Table A.2 Sector classification

| Sector  | NACE rev1 code          |
|---|-------------------------|
| <b>MANUFACTURING</b>  | <b>15t22, 24t37</b>     |
| FOOD, BEVERAGES AND TOBACCO   | 15t16                   |
| Food and beverages  | 15                      |
| Tobacco   | 16                      |
| TEXTILES, LEATHER AND FOOTWEAR  | 17t19                   |
| Textiles  | 17t18                   |
| Leather and footwear  | 19                      |
| WOOD AND CORK   | 20                      |
| PULP, PAPER, PRINTING AND PUBLISHING  | 21t22                   |
| Pulp and paper  | 21                      |
| Printing, publishing and reproduction   | 22                      |
| CHEMICALS   | 24                      |
| NON-METALLIC MINERALS   | 26                      |
| BASIC METALS  | 27                      |
| MACHINERY   | 28t32                   |
| Fabricated metal  | 28                      |
| Machinery not elsewhere classified (nec)  | 29                      |
| Office, accounting and computing machinery  | 30                      |
| Electrical engineering  | 31t32                   |
| TRANSPORT EQUIPMENT   | 34t35                   |
| Motor vehicles, trailers and semi-trailers  | 34                      |
| Other transport equipment   | 35                      |
| NON-SPECIFIED INDUSTRY  | 25,33,36t37             |
| Rubber and plastics   | 25                      |
| Medical, precision and optical instruments  | 33                      |
| Manufacturing not elsewhere classified (nec); recycling                             | 36t37                   |
| <b>SERVICES</b>   | <b>GtH, J, LtO, 64,</b> |
| WHOLESALE AND RETAIL TRADE  | G                       |
| Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of fuel | 50                      |
| Wholesale trade and commission trade, except of motor vehicles and motorcycles      | 51                      |
| Retail trade, except of motor vehicles and motorcycles; repair of household goods   | 52                      |
| HOTELS AND RESTAURANTS  | H                       |
| POST AND TELECOMMUNICATIONS   | 64                      |
| FINANCIAL INTERMEDIATION  | J                       |
| Financial intermediation, except insurance and pension funding                      | 65                      |
| Insurance and pension funding, except compulsory social security                    | 66                      |
| Activities related to financial intermediation                                      | 67                      |
| RENTING, COMPUTER, R&D and OTHER BUSINESS   | 71t74                   |
| Renting of machinery and equipment  | 71                      |
| Computer and related activities   | 72                      |
| Research and development  | 73                      |
| Other business activities   | 74                      |
| PUBLIC ADMIN AND DEFENCE; COMPULSORY SOCIAL SECURITY                                | L                       |
| EDUCATION   | M                       |
| HEALTH AND SOCIAL WORK  | N                       |
| OTHER COMMUNITY, SOCIAL AND PERSONAL SERVICES                                       | O                       |
| Sewage and refuse disposal, sanitation and similar activities                       | 90                      |
| Activities of membership organizations nec  | 91                      |
| Recreational, cultural and sporting activities                                      | 92                      |
| Other service activities  | 93                      |
| <b>TRANSPORT</b>  | <b>60t62</b>            |
| <b>AGRICULTURE, HUNTING, FORESTRY AND FISHING</b>                                   | <b>AtB</b>              |
| <b>CONSTRUCTION</b>   | <b>F</b>                |

### 3. Trends

Table A.3 present average annual growth rates energy intensity by main sector for the periods 1980–2005, 1980–1995 and 1995–2005.

Table A.4 presents for all countries in our dataset and for different time periods the average annual growth rate of *Manufacturing* energy intensity and its components: energy use and value added. To facilitate comparison and interpretation of our data, the Table also provides the average annual growth rates of, respectively, energy use according to IEA data, value added according to STAN data, and energy intensity according to the combination of these two data sources. As regards the different data sources, Table A.4 reveals that for most countries the use of EU KLEMS compared to IEA leads to considerably different trends in energy use, without a clear cross-country pattern; notable exceptions include Japan and to a lesser extent France. These differences are likely due to the fact that non-energy use of fuel is included in EU KLEMS intermediate energy inputs but excluded from IEA final energy consumption data. In contrast to the aggregate economy level, for various countries substantial differences exist between value added series derived from the EU KLEMS and STAN databases. This is particularly true for Finland, Hungary, Japan, South Korea, Sweden and the USA. These differences arise from the fact that STAN and EU KLEMS employ different vintages of National Accounts as well as different sector classifications. Furthermore, for the Manufacturing sector EU KLEMS provides a more extensive coverage than the IEA-STAN combination in terms of internationally comparable energy intensity series, notably for Belgium, France and Germany before 1995 – this is primarily due to better coverage of value added data by EU KLEMS as compared to STAN.

Table A.5 presents for all countries in our dataset and for different time periods the average annual growth rate of *Services* energy intensity and its components: energy use and value added. To facilitate comparison and interpretation of our data, we also provide the average annual growth rates of, respectively, energy use according to IEA data, value added according to STAN data, and energy intensity according to the combination of these two data sources. As regards the different data sources, Table A.5 reveals that for most countries the use of EU KLEMS or IEA leads to considerably different trends in energy use, with differences being larger than in Manufacturing. This is remarkable since they cannot be assigned to non-energy use of fuel as was the case in Manufacturing. In contrast to Manufacturing, in terms of value added differences between series derived from the EU KLEMS and STAN database are very small. Fourth, also at the level of the aggregate Service sector EU KLEMS provides a more extensive coverage than the IEA-STAN combination in terms of internationally comparable energy intensity series, notably for Belgium, Germany and United Kingdom before 1995 – which is again principally due to better coverage of value added data by EU KLEMS as compared to STAN. In contrast, the poor quality of EU KLEMS energy data for Italy (particularly in the sectors Community/Social/Personal Services, Public Administration and Defense, and Education) forced us to drop Italy from our sample.

Table A.3 Average annual growth rates energy intensity by main sector for the periods 1980–2005, 1980–1995 and 1995–2005.

|               | AUT  | BEL  | CZE  | DNK  | FIN  | FRA  | GER  | HUN   | ITA  | JPN  | KOR  | NLD  | POL  | SPA  | SVK  | SWE  | UKD  | USA  |
|---------------|------|------|------|------|------|------|------|-------|------|------|------|------|------|------|------|------|------|------|
| MANUFACTURING |      |      |      |      |      |      |      |       |      |      |      |      |      |      |      |      |      |      |
| 1980-2005     | -0.2 | -0.2 | --   | -1.4 | -3.8 | -1.0 | -2.4 | --    | --   | -2.5 | -2.2 | -0.2 | --   | -0.9 | --   | --   | -0.9 | -3.7 |
| 1980-1995     | 0.0  | 0.3  | --   | -2.0 | -0.1 | 0.9  | -2.2 | --    | --   | -2.5 | -2.8 | 1.1  | --   | -4.0 | --   | --   | -0.9 | -2.0 |
| 1995-2005     | -0.6 | -1.0 | -4.6 | -0.5 | -7.8 | -3.1 | -2.6 | -7.8  | 0.5  | -2.5 | -1.4 | -1.3 | -3.4 | 3.8  | -8.8 | -8.4 | -0.9 | -6.4 |
| SERVICES      |      |      |      |      |      |      |      |       |      |      |      |      |      |      |      |      |      |      |
| 1980-2005     | 3.0  | 0.8  | --   | -3.6 | 1.5  | -1.7 | -2.5 | --    | -6.5 | 1.8  | 0.4  | 0.4  | --   | 0.9  | --   | --   | 1.0  | -1.8 |
| 1980-1995     | 3.4  | 2.9  | --   | -3.1 | 1.7  | -2.7 | -3.1 | --    | -2.6 | 2.5  | -2.4 | 2.7  | --   | -2.1 | --   | --   | 1.6  | -2.2 |
| 1995-2005     | 2.4  | -2.5 | 1.8  | -4.3 | 1.3  | -0.3 | -1.6 | -6.6  | --   | 0.8  | 4.4  | -1.4 | 0.2  | 5.5  | -5.7 | -3.1 | 0.1  | -1.3 |
| TRANSPORT     |      |      |      |      |      |      |      |       |      |      |      |      |      |      |      |      |      |      |
| 1980-2005     | 4.2  | 1.0  | --   | -0.5 | 1.3  | -6.1 | -1.5 | --    | -2.9 | 0.6  | -1.0 | -2.3 | --   | -1.2 | --   | --   | 2.5  | -1.5 |
| 1980-1995     | 0.8  | 3.2  | --   | 2.6  | 3.8  | -4.6 | -1.6 | --    | -3.9 | 0.5  | -3.2 | 0.4  | --   | -1.8 | --   | --   | 3.7  | -2.1 |
| 1995-2005     | 9.3  | -2.5 | -1.9 | -5.2 | -2.3 | -8.4 | -1.2 | 3.2   | -1.5 | 0.7  | 2.3  | -4.5 | 7.6  | -0.3 | 7.7  | -0.6 | 0.6  | -0.7 |
| AGRICULTURE   |      |      |      |      |      |      |      |       |      |      |      |      |      |      |      |      |      |      |
| 1980-2005     | -1.9 | -0.3 | --   | -3.6 | -1.7 | -2.2 | -4.5 | --    | -2.9 | 0.9  | 1.2  | -1.1 | --   | -0.8 | --   | --   | 1.8  | -5.3 |
| 1980-1995     | -1.0 | -2.0 | --   | -3.8 | 0.0  | -2.3 | -3.5 | --    | -0.8 | 1.8  | 1.2  | -2.4 | --   | -1.1 | --   | --   | 2.1  | -7.4 |
| 1995-2005     | -3.2 | 2.3  | -5.7 | -3.1 | -4.2 | -2.0 | -6.0 | -10.1 | -6.0 | -0.4 | 1.3  | -0.1 | -2.8 | -0.2 | -5.1 | 3.4  | 1.3  | -2.3 |
| CONSTRUCTION  |      |      |      |      |      |      |      |       |      |      |      |      |      |      |      |      |      |      |
| 1980-2005     | -0.5 | -3.2 | --   | -5.2 | 2.4  | -3.0 | -2.7 | --    | -0.9 | 1.9  | 0.2  | 2.8  | --   | -1.8 | --   | --   | 2.6  | 0.6  |
| 1980-1995     | 0.4  | 1.0  | --   | -7.8 | 2.7  | -3.8 | -2.3 | --    | -1.9 | 1.0  | -1.4 | 6.2  | --   | -4.0 | --   | --   | 3.7  | 0.4  |
| 1995-2005     | -1.8 | -9.5 | -0.5 | -1.3 | 2.0  | -1.7 | -3.4 | -0.5  | 0.5  | 3.3  | 2.7  | 0.2  | -0.3 | 1.4  | -8.7 | -1.0 | 0.8  | 0.8  |

Table A.4 Change in energy use, value added and energy intensity at the aggregate Manufacturing level.

| Average annual growth rates | Energy Intensity |              |           |              |           |              | Energy Use |      |           |      |           |      | Value Added |      |           |      |           |      |
|-----------------------------|------------------|--------------|-----------|--------------|-----------|--------------|------------|------|-----------|------|-----------|------|-------------|------|-----------|------|-----------|------|
|                             | 1980–2005        |              | 1980–1995 |              | 1995–2005 |              | 1980–2005  |      | 1980–1995 |      | 1995–2005 |      | 1980–2005   |      | 1980–1995 |      | 1995–2005 |      |
|                             | EUK              | IEA/<br>STAN | EUK       | IEA/<br>STAN | EUK       | IEA/<br>STAN | EUK        | IEA  | EUK       | IEA  | EUK       | IEA  | EUK         | STAN | EUK       | STAN | EUK       | STAN |
|                             |                  |              |           |              |           |              |            |      |           |      |           |      |             |      |           |      |           |      |
| Austria                     | -0.2             | -1.2         | 0.0       | -1.4         | -0.6      | -0.9         | 2.2        | 1.1  | 2.1       | 0.4  | 2.4       | 2.0  | 2.5         | 2.3  | 2.1       | 1.9  | 3.0       | 2.9  |
| Belgium                     | -0.2             | --           | 0.3       | --           | -1.0      | -1.5         | 1.9        | 0.3  | 2.6       | 0.4  | 0.8       | 0.2  | 2.1         | --   | 2.3       | --   | 1.8       | 1.8  |
| Czech Republic              | --               | --           | --        | --           | -4.6      | -6.5         | --         | -3.1 | --        | -3.7 | 1.0       | -2.3 | --          | --   | --        | --   | 5.7       | 4.5  |
| Denmark                     | -1.4             | -1.1         | -2.0      | -1.5         | -0.5      | -0.5         | -1.1       | -0.5 | -1.6      | -0.6 | -0.5      | -0.5 | 0.2         | 0.6  | 0.4       | 1.0  | -0.1      | 0.1  |
| Finland                     | -3.8             | -0.7         | -0.1      | 0.7          | -7.8      | -2.9         | 1.5        | 2.7  | 2.9       | 3.3  | -0.6      | 1.8  | 4.5         | 3.4  | 3.1       | 2.5  | 6.6       | 4.9  |
| France                      | -1.0             | --           | 0.9       | --           | -3.1      | --           | -1.2       | -0.8 | -1.3      | -1.1 | -1.1      | -0.4 | -0.5        | --   | -2.2      | --   | 2.2       | --   |
| Germany                     | -2.4             | --           | -2.2      | --           | -2.6      | -0.7         | -1.4       | -1.2 | -1.5      | -2.4 | -1.4      | 0.6  | 1.0         | --   | 0.8       | --   | 1.2       | 1.3  |
| Hungary                     | --               | --           | --        | --           | -7.8      | -6.1         | --         | -3.3 | --        | -4.6 | -0.6      | -1.3 | --          | --   | --        | --   | 7.4       | 5.2  |
| Italy                       | --               | --           | --        | --           | 0.5       | 1.2          | --         | 0.2  | --        | -0.3 | 0.9       | 1.0  | 1.2         | --   | 2.0       | --   | 0.1       | -0.3 |
| Japan                       | -2.5             | -1.1         | -2.5      | -1.0         | -2.5      | -1.2         | 0.6        | 0.6  | 1.4       | 1.1  | -0.6      | -0.2 | 3.1         | 1.7  | 4.0       | 2.1  | 1.9       | 1.0  |
| South Korea                 | -2.2             | -3.0         | -2.8      | -3.4         | -1.4      | -2.4         | 7.8        | 5.5  | 8.8       | 7.1  | 6.4       | 3.1  | 10.3        | 8.8  | 11.9      | 10.9 | 7.9       | 5.7  |
| Netherlands*                | -0.2             | -1.5         | 1.1       | -3.7         | -1.3      | 0.2          | 2.1        | 0.6  | 3.8       | -1.2 | 0.8       | 2.1  | 2.3         | 2.2  | 1.4       | 1.4  | 2.1       | 1.8  |
| Poland                      | --               | --           | --        | --           | -3.4      | --           | --         | -2.6 | --        | -2.4 | 5.7       | -2.9 | --          | --   | --        | --   | 9.3       | --   |
| Spain                       | -0.9             | -0.1         | -4.0      | -1.1         | 3.8       | 1.4          | 1.4        | 1.9  | -1.8      | 0.4  | 6.4       | 4.2  | 2.3         | 2.1  | 2.2       | 1.5  | 2.4       | 2.8  |
| Slovakia                    | --               | --           | --        | --           | -8.8      | -7.2         | --         | -2.3 | --        | -3.9 | -1.1      | 0.3  | --          | --   | --        | --   | 7.8       | 8.0  |
| Sweden                      | --               | --           | --        | --           | -8.4      | -4.7         | --         | 0.0  | --        | 0.8  | 1.1       | -1.1 | --          | --   | --        | --   | 10.0      | 3.8  |
| United Kingdom              | -0.9             | --           | -0.9      | --           | -0.9      | 0.0          | -0.1       | -0.7 | 0.4       | -1.4 | -0.8      | 0.4  | 0.8         | --   | 1.2       | --   | 0.2       | 0.3  |
| USA                         | -3.7             | -2.9         | -2.0      | -4.3         | -6.4      | -0.7         | -1.1       | -1.3 | -0.3      | -2.4 | -2.3      | 0.5  | 2.6         | 1.7  | 1.7       | 2.0  | 4.1       | 1.2  |

Notes: \*Initial year 1987 instead of 1980.

Table A.5 Change in energy use, value added and energy intensity at the aggregate Services level.

| Average annual growth rates | Energy Intensity |              |           |              |           |              | Energy Use |      |           |      |           |      | Value Added |      |           |      |           |      |
|-----------------------------|------------------|--------------|-----------|--------------|-----------|--------------|------------|------|-----------|------|-----------|------|-------------|------|-----------|------|-----------|------|
|                             | 1980–2005        |              | 1980–1995 |              | 1995–2005 |              | 1980–2005  |      | 1980–1995 |      | 1995–2005 |      | 1980–2005   |      | 1980–1995 |      | 1995–2005 |      |
|                             | EUK              | IEA/<br>STAN | EUK       | IEA/<br>STAN | EUK       | IEA/<br>STAN | EUK        | IEA  | EUK       | IEA  | EUK       | IEA  | EUK         | STAN | EUK       | STAN | EUK       | STAN |
|                             |                  |              |           |              |           |              |            |      |           |      |           |      |             |      |           |      |           |      |
| Austria                     | 3.0              | -0.1         | 3.4       | -0.9         | 2.4       | 1.3          | 5.3        | 2.3  | 5.9       | 1.5  | 4.4       | 3.4  | 2.2         | 2.3  | 2.4       | 2.5  | 1.9       | 2.1  |
| Belgium                     | 0.8              | --           | 2.9       | --           | -2.5      | -0.4         | 2.6        | 1.3  | 4.6       | 1.0  | -0.3      | 1.8  | 1.9         | --   | 1.6       | --   | 2.3       | 2.3  |
| Czech Republic              | --               | --           | --        | --           | 1.8       | 0.9          | --         | 3.0  | --        | 2.8  | 3.4       | 3.1  | --          | --   | --        | --   | 1.6       | 2.2  |
| Denmark                     | -3.6             | -0.4         | -3.1      | 0.4          | -4.3      | -1.5         | -1.3       | 1.9  | -1.0      | 2.7  | -1.8      | 0.8  | 2.3         | 2.3  | 2.1       | 2.3  | 2.5       | 2.4  |
| Finland                     | 1.5              | 3.2          | 1.7       | 3.6          | 1.3       | 2.6          | 3.6        | 5.4  | 3.2       | 5.3  | 4.1       | 5.5  | 2.0         | 2.1  | 1.5       | 1.6  | 2.8       | 2.8  |
| France                      | -1.7             | --           | -2.7      | --           | -0.3      | --           | 0.5        | -1.4 | -0.4      | -2.5 | 1.7       | 0.3  | 2.2         | --   | 2.4       | --   | 2.0       | --   |
| Germany                     | -2.5             | --           | -3.1      | --           | -1.6      | -1.5         | -0.3       | -0.5 | -0.3      | -0.8 | -0.1      | -0.1 | 2.3         | --   | 2.8       | --   | 1.5       | 1.4  |
| Hungary                     | --               | --           | --        | --           | -6.6      | -0.3         | --         | 3.7  | --        | 4.1  | -2.6      | 3.0  | --          | --   | --        | --   | 4.0       | 3.4  |
| Italy                       | --               | --           | -2.6      | --           | --        | 2.2          | --         | 7.8  | -0.7      | 10.4 | --        | 4.1  | 2.0         | --   | 2.0       | --   | 2.0       | 1.8  |
| Japan                       | 1.8              | 1.9          | 2.5       | 2.8          | 0.8       | 0.7          | 4.9        | 5.0  | 6.3       | 6.8  | 2.8       | 2.3  | 3.0         | 3.0  | 3.7       | 3.9  | 1.9       | 1.6  |
| South Korea                 | 0.4              | 2.0          | -2.4      | 5.6          | 4.4       | -3.2         | 6.3        | 8.4  | 5.0       | 14.1 | 8.4       | 0.4  | 5.9         | 6.3  | 7.5       | 8.0  | 3.7       | 3.6  |
| Netherlands*                | 0.4              | 3.2          | 2.7       | 9.5          | -1.4      | -1.5         | 3.1        | 6.2  | 5.1       | 12.3 | 1.6       | 1.5  | 2.7         | 2.9  | 1.2       | 1.4  | 3.1       | 3.1  |
| Poland                      | --               | --           | --        | --           | 0.2       | --           | --         | -1.0 | --        | -4.0 | 4.1       | 3.6  | --          | --   | --        | --   | 4.0       | --   |
| Spain                       | 0.9              | 2.3          | -2.1      | 1.7          | 5.5       | 3.1          | 4.0        | 5.6  | 0.4       | 4.7  | 9.7       | 6.9  | 3.1         | 3.2  | 2.6       | 2.9  | 3.9       | 3.7  |
| Slovakia                    | --               | --           | --        | --           | -5.7      | -7.2         | --         | -1.8 | --        | -0.3 | -2.6      | -4.1 | --          | --   | --        | --   | 3.2       | 3.3  |
| Sweden                      | --               | --           | --        | --           | -3.1      | -3.9         | --         | 4.7  | --        | 8.9  | -0.2      | -1.2 | --          | --   | --        | --   | 3.0       | 2.8  |
| United Kingdom              | 1.0              | --           | 1.6       | --           | 0.1       | -3.5         | 4.1        | 1.0  | 4.1       | 1.7  | 4.2       | 0.0  | 3.1         | --   | 2.5       | --   | 4.1       | 3.7  |
| USA                         | -1.8             | -1.6         | -2.1      | -1.4         | -1.3      | -1.8         | 1.3        | 1.4  | 0.8       | 1.3  | 2.1       | 1.5  | 3.2         | 3.0  | 3.0       | 2.8  | 3.5       | 3.3  |

Notes: \*Initial year 1987 instead of 1980.



## 4. Structural Change

Table A.6a. Percentage contributions of sector-specific efficiency effects (EFF) and structure effects (STR) to aggregate energy intensity change (TOT)

| % contribution                                | USA         |     |      |             |     |      | JAPAN       |     |      |             |      |      |
|---|-------------|-----|------|-------------|-----|------|-------------|-----|------|-------------|------|------|
|   | 1980 – 2005 |     |      | 1995 – 2005 |     |      | 1980 – 2005 |     |      | 1995 – 2005 |      |      |
|   | EFF         | STR | TOT  | EFF         | STR | TOT  | EFF         | STR | TOT  | EFF         | STR  | TOT  |
| Agriculture                                   | -6          | 2   | -4   | -2          | 0   | -2   | 7           | -26 | -19  | -2          | -14  | -17  |
| Construction                                  | 0           | 0   | 0    | 0           | 0   | 0    | 6           | -9  | -3   | 9           | -11  | -2   |
| Manufacturing                                 | -57         | -23 | -80  | -71         | -16 | -87  | -71         | -60 | -131 | -9          | -110 | -118 |
| Food, Beverages and Tobacco                   | -5          | -2  | -6   | -3          | -2  | -6   | 9           | -7  | 2    | 5           | -8   | -3   |
| Textiles, Leather and Footwear                | -2          | -2  | -4   | -2          | -2  | -4   | 6           | -11 | -5   | 7           | -18  | -11  |
| Wood and Cork                                 | -2          | -1  | -3   | -1          | -2  | -2   | 0           | 0   | 0    | 0           | 0    | 0    |
| Pulp, Paper and Printing                      | -10         | -6  | -16  | -16         | -6  | -22  | 4           | -9  | -5   | 0           | -19  | -19  |
| Chemicals                                     | -15         | -6  | -21  | -24         | -7  | -31  | -42         | 43  | 1    | 3           | -3   | 0    |
| Non-Metallic Minerals                         | -5          | -1  | -6   | -3          | 0   | -3   | -17         | -13 | -30  | -7          | -15  | -22  |
| Basic Metals                                  | -9          | -6  | -15  | -8          | -1  | -10  | -32         | -64 | -96  | -5          | -34  | -38  |
| Machinery                                     | -6          | 2   | -5   | -9          | 4   | -5   | -9          | 10  | 1    | -17         | 11   | -6   |
| Transport Equipment                           | -1          | 0   | -2   | -2          | 1   | -2   | -1          | 1   | 0    | -2          | 2    | 0    |
| Non-Specified Industry                        | -2          | 0   | -2   | -2          | 0   | -2   | 12          | -11 | 1    | 9           | -28  | -19  |
| Services                                      | -21         | 5   | -17  | -12         | 0   | -12  | 53          | 1   | 53   | 28          | 9    | 37   |
| Wholesale and Retail Trade                    | -16         | 6   | -11  | -10         | 3   | -6   | 0           | 2   | 2    | -5          | -8   | -13  |
| Hotels and Restaurants                        | 0           | -1  | -2   | -1          | -1  | -2   | 14          | -8  | 6    | 18          | -8   | 10   |
| Post and Telecommunications                   | -1          | 0   | 0    | -1          | 0   | 0    | 2           | 4   | 6    | 5           | 7    | 12   |
| Financial Intermediation                      | 0           | 1   | 0    | -1          | 0   | 0    | -1          | 1   | 0    | 0           | 0    | 0    |
| Renting, Computer, R&D and Other Business     | -1          | 1   | 0    | 0           | 1   | 1    | 2           | 4   | 6    | -3          | 8    | 5    |
| Public Administration and Defence             | 1           | -3  | -2   | 1           | -3  | -2   | 10          | 0   | 10   | -3          | 0    | -3   |
| Education                                     | 0           | 0   | 0    | 0           | 0   | 0    | 6           | -2  | 4    | 6           | -2   | 5    |
| Health and Social Work                        | 0           | 0   | 0    | -1          | 0   | -1   | 10          | 2   | 12   | 3           | 13   | 16   |
| Other Community, Social and Personal Services | -3          | 1   | -2   | -1          | 0   | -1   | 11          | -3  | 7    | 6           | -2   | 5    |
| TOTAL   | -84         | -16 | -100 | -84         | -16 | -100 | -5          | -95 | -100 | 26          | -126 | -100 |

Table A.6b. Percentage contributions of sector-specific efficiency effects (EFF) and structure effects (STR) to aggregate energy intensity change (TOT)

| % contribution                                | EU10        |            |             |             |            |             | EU4         |           |             | OECD18      |            |             |
|---|-------------|------------|-------------|-------------|------------|-------------|-------------|-----------|-------------|-------------|------------|-------------|
|   | 1980 – 2005 |            |             | 1995 – 2005 |            |             | 1995 – 2005 |           |             | 1995 – 2005 |            |             |
|   | EFF         | STR        | TOT         | EFF         | STR        | TOT         | EFF         | STR       | TOT         | EFF         | STR        | TOT         |
| Agriculture                                   | -4          | -2         | -6          | -6          | -5         | -11         | -22         | -8        | -30         | -5          | -1         | -6          |
| Construction                                  | -2          | -1         | -3          | -1          | -1         | -3          | -1          | -1        | -2          | 0           | -1         | -1          |
| Manufacturing                                 | -59         | -25        | -83         | -44         | -39        | -82         | -58         | 24        | -34         | -64         | -22        | -86         |
| Food, Beverages and Tobacco                   | 1           | -5         | -4          | 1           | -7         | -7          | -7          | 0         | -7          | -2          | -4         | -6          |
| Textiles, Leather and Footwear                | 0           | -5         | -5          | 0           | -5         | -5          | -2          | -3        | -5          | -1          | -4         | -5          |
| Wood and Cork                                 | -1          | 0          | -1          | 1           | -1         | 0           | 0           | 2         | 2           | -1          | -1         | -1          |
| Pulp, Paper and Printing                      | -3          | -4         | -7          | -6          | -8         | -13         | 0           | 2         | 2           | -12         | -8         | -20         |
| Chemicals                                     | -23         | 8          | -15         | -26         | 1          | -25         | 18          | -5        | 13          | -23         | -2         | -25         |
| Non-Metallic Minerals                         | -12         | -6         | -17         | 0           | -6         | -6          | -40         | 32        | -9          | -4          | -1         | -5          |
| Basic Metals                                  | -12         | -10        | -22         | 0           | -15        | -16         | 1           | -25       | -24         | -6          | -7         | -14         |
| Machinery                                     | -1          | -5         | -6          | -7          | 0          | -7          | -15         | 11        | -5          | -10         | 5          | -5          |
| Transport Equipment                           | -1          | 0          | -2          | -2          | 1          | -1          | -8          | 6         | -2          | -2          | 1          | -1          |
| Non-Specified Industry                        | -6          | 1          | -4          | -5          | 2          | -3          | -6          | 5         | 0           | -4          | -1         | -4          |
| Services                                      | -13         | 6          | -7          | -8          | 3          | -4          | -32         | -2        | -34         | -6          | -1         | -7          |
| Wholesale and Retail Trade                    | -6          | 2          | -4          | -4          | 1          | -3          | -25         | 5         | -20         | -8          | 1          | -6          |
| Hotels and Restaurants                        | 1           | -1         | 0           | 0           | -1         | 0           | -1          | -3        | -4          | 0           | -1         | -1          |
| Post and Telecommunications                   | -1          | 2          | 1           | -2          | 3          | 1           | -4          | 2         | -2          | 0           | 2          | 1           |
| Financial Intermediation                      | 0           | 0          | 0           | 0           | 1          | 0           | 0           | 2         | 2           | 0           | 0          | 0           |
| Renting, Computer, R&D and Other Business     | -4          | 4          | 0           | -2          | 3          | 2           | -7          | 1         | -6          | 0           | 2          | 1           |
| Public Administration and Defence             | 0           | -1         | -2          | 3           | -3         | 0           | 0           | -1        | -1          | 1           | -3         | -2          |
| Education                                     | -1          | -1         | -2          | 2           | -2         | 0           | 2           | -1        | 1           | 1           | -1         | 0           |
| Health and Social Work                        | -1          | 1          | -1          | -5          | 1          | -4          | 0           | -3        | -3          | 0           | 0          | 0           |
| Other Community, Social and Personal Services | 0           | 0          | 0           | 0           | 0          | 0           | 3           | -3        | -1          | 0           | -1         | -1          |
| <b>TOTAL</b>                                  | <b>-78</b>  | <b>-22</b> | <b>-100</b> | <b>-58</b>  | <b>-42</b> | <b>-100</b> | <b>-112</b> | <b>12</b> | <b>-100</b> | <b>-75</b>  | <b>-25</b> | <b>-100</b> |

## 5. Convergence

Table A.7  $\beta$ -convergence(unconditional)

|   | 1970-2005 |        |                | 1980-2005 |        |                | 1995-2005 |        |                |
|---|-----------|--------|----------------|-----------|--------|----------------|-----------|--------|----------------|
|   | $\beta$   | t-stat | R <sup>2</sup> | $\beta$   | t-stat | R <sup>2</sup> | $\beta$   | t-stat | R <sup>2</sup> |
| TOTAL   | -0.097    | -1.128 | 0.037          | -0.086    | -1.465 | 0.035          | -0.199    | -3.094 | 0.172          |
| Agriculture                                   | -0.130    | -2.464 | 0.155          | -0.085    | -1.826 | 0.054          | -0.121    | -1.840 | 0.067          |
| Construction                                  | -0.072    | -1.462 | 0.061          | -0.069    | -2.022 | 0.065          | -0.124    | -2.924 | 0.154          |
| Manufacturing                                 | -0.115    | -1.418 | 0.057          | -0.123    | -2.219 | 0.077          | -0.252    | -4.043 | 0.262          |
| Food, Beverages and Tobacco                   | -0.316    | -3.536 | 0.275          | -0.205    | -3.419 | 0.165          | -0.307    | -3.949 | 0.249          |
| Textiles, Leather and Footwear                | -0.114    | -1.505 | 0.064          | -0.164    | -2.860 | 0.122          | -0.238    | -3.218 | 0.181          |
| Wood and Cork                                 | -0.077    | -1.587 | 0.083          | -0.119    | -2.456 | 0.110          | -0.077    | -1.294 | 0.038          |
| Pulp, Paper and Printing                      | -0.025    | -0.663 | 0.013          | -0.046    | -1.574 | 0.040          | -0.082    | -2.146 | 0.089          |
| Chemicals                                     | -0.073    | -0.945 | 0.026          | -0.212    | -4.081 | 0.220          | -0.085    | -1.052 | 0.023          |
| Non-Metallic Minerals                         | -0.253    | -2.985 | 0.213          | -0.191    | -3.313 | 0.157          | -0.344    | -3.798 | 0.235          |
| Basic Metals                                  | -0.218    | -2.699 | 0.181          | -0.272    | -5.423 | 0.333          | -0.282    | -6.162 | 0.452          |
| Machinery                                     | -0.037    | -0.325 | 0.003          | -0.127    | -1.634 | 0.043          | -0.081    | -0.903 | 0.017          |
| Transport Equipment                           | -0.290    | -2.054 | 0.113          | -0.297    | -4.170 | 0.228          | -0.362    | -6.411 | 0.467          |
| Non-Specified Industry                        | -0.003    | -0.050 | 0.000          | -0.038    | -0.904 | 0.014          | -0.011    | -0.178 | 0.001          |
| Services                                      | -0.206    | -2.784 | 0.190          | -0.154    | -2.812 | 0.118          | -0.326    | -5.836 | 0.420          |
| Wholesale and Retail Trade                    | -0.175    | -3.265 | 0.244          | -0.183    | -4.299 | 0.239          | -0.350    | -6.213 | 0.451          |
| Hotels and Restaurants                        | -0.117    | -2.414 | 0.150          | -0.089    | -2.237 | 0.078          | -0.066    | -1.265 | 0.033          |
| Post and Telecommunications                   | -0.096    | -1.112 | 0.036          | -0.139    | -2.073 | 0.068          | -0.142    | -1.929 | 0.073          |
| Financial Intermediation                      | -0.189    | -1.590 | 0.071          | -0.172    | -2.768 | 0.115          | -0.346    | -3.582 | 0.214          |
| Renting, Computer, R&D and Other Business     | -0.207    | -2.097 | 0.118          | -0.199    | -2.921 | 0.126          | -0.357    | -5.509 | 0.392          |
| Public Administration and Defense             | -0.298    | -6.057 | 0.526          | -0.231    | -5.781 | 0.362          | -0.376    | -6.815 | 0.497          |
| Education                                     | -0.180    | -2.000 | 0.108          | -0.197    | -3.476 | 0.170          | -0.392    | -6.262 | 0.455          |
| Health and Social Work                        | -0.156    | -1.711 | 0.082          | -0.132    | -2.044 | 0.066          | -0.270    | -4.066 | 0.260          |
| Other Community, Social and Personal Services | -0.143    | -2.018 | 0.110          | -0.108    | -1.941 | 0.060          | -0.145    | -2.613 | 0.127          |
| # countries (cross section)                   | 5         |        |                | 11        |        |                | 18        |        |                |
| # of observations                             | 35        |        |                | 61        |        |                | 49        |        |                |

Table A.8  $\beta$ -Decomposition of aggregate energy intensity convergence (unconditional)

|   | 1970-2005 |         |        |                | 1980-2005 |         |        |                | 1995-2005 |         |        |                |
|---|-----------|---------|--------|----------------|-----------|---------|--------|----------------|-----------|---------|--------|----------------|
|   | %         | $\beta$ | t-stat | R <sup>2</sup> | %         | $\beta$ | t-stat | R <sup>2</sup> | %         | $\beta$ | t-stat | R <sup>2</sup> |
| Efficiency effect per sector                  |           |         |        |                |           |         |        |                |           |         |        |                |
| Agriculture                                   | 8%        | -0.007  | -0.836 | 0.021          | 13%       | -0.011  | -1.550 | 0.039          | 6%        | -0.011  | -1.182 | 0.029          |
| Construction                                  | -2%       | 0.002   | 0.362  | 0.004          | 2%        | -0.001  | -0.253 | 0.001          | 1%        | -0.002  | -0.368 | 0.003          |
| Food, Beverages and Tobacco                   | 9%        | -0.008  | -1.396 | 0.056          | 11%       | -0.009  | -2.277 | 0.081          | 7%        | -0.014  | -2.903 | 0.155          |
| Textiles, Leather and Footwear                | 8%        | -0.008  | -1.471 | 0.062          | 6%        | -0.005  | -1.248 | 0.026          | 4%        | -0.008  | -2.876 | 0.152          |
| Wood and Cork                                 | 1%        | 0.000   | -0.214 | 0.002          | 4%        | -0.004  | -1.855 | 0.066          | 2%        | -0.004  | -2.178 | 0.101          |
| Pulp, Paper and Printing                      | 26%       | -0.025  | -0.998 | 0.029          | 32%       | -0.028  | -2.673 | 0.108          | 13%       | -0.026  | -2.157 | 0.092          |
| Chemicals                                     | 0%        | 0.000   | 0.026  | 0.000          | -7%       | 0.006   | 0.463  | 0.004          | -7%       | 0.015   | 1.107  | 0.026          |
| Non-Metallic Minerals                         | 6%        | -0.006  | -0.909 | 0.024          | 7%        | -0.006  | -0.781 | 0.010          | 11%       | -0.023  | -2.151 | 0.091          |
| Basic Metals                                  | 17%       | -0.017  | -1.410 | 0.057          | 14%       | -0.012  | -0.765 | 0.010          | 22%       | -0.044  | -2.822 | 0.148          |
| Machinery                                     | 8%        | -0.007  | -1.636 | 0.075          | 6%        | -0.005  | -1.437 | 0.034          | 8%        | -0.016  | -3.925 | 0.251          |
| Transport Equipment                           | 3%        | -0.003  | -1.291 | 0.048          | 2%        | -0.002  | -0.987 | 0.016          | 4%        | -0.008  | -3.877 | 0.246          |
| Non-Specified Industry                        | 19%       | -0.018  | -1.928 | 0.101          | 14%       | -0.012  | -1.772 | 0.051          | 10%       | -0.019  | -2.437 | 0.114          |
| Wholesale and Retail Trade                    | 6%        | -0.006  | -0.718 | 0.015          | 11%       | -0.010  | -1.259 | 0.026          | 18%       | -0.035  | -2.378 | 0.109          |
| Hotels and Restaurants                        | -1%       | 0.001   | 0.233  | 0.002          | 1%        | -0.001  | -0.236 | 0.001          | 0%        | 0.000   | 0.028  | 0.000          |
| Post and Telecommunications                   | 0%        | 0.000   | 0.038  | 0.000          | 0%        | 0.000   | -0.216 | 0.001          | 0%        | -0.001  | -0.504 | 0.005          |
| Financial Intermediation                      | -1%       | 0.001   | 0.530  | 0.008          | 0%        | 0.000   | 0.050  | 0.000          | -1%       | 0.001   | 0.414  | 0.004          |
| Renting, Computer, R&D and Other Business     | 2%        | -0.002  | -0.394 | 0.005          | 3%        | -0.003  | -0.967 | 0.016          | 6%        | -0.011  | -2.796 | 0.145          |
| Public Administration and Defense             | 5%        | -0.005  | -1.294 | 0.048          | 5%        | -0.005  | -1.661 | 0.045          | 6%        | -0.011  | -0.853 | 0.016          |
| Education                                     | 3%        | -0.003  | -0.713 | 0.015          | 4%        | -0.004  | -1.202 | 0.024          | 4%        | -0.009  | -1.689 | 0.058          |
| Health and Social Work                        | 2%        | -0.002  | -0.344 | 0.004          | 1%        | -0.001  | -0.169 | 0.000          | 1%        | -0.001  | -0.154 | 0.001          |
| Other Community, Social and Personal Services | 1%        | -0.001  | -0.406 | 0.005          | 3%        | -0.002  | -1.115 | 0.021          | 1%        | -0.002  | -0.800 | 0.014          |
| Total efficiency effect                       | 117%      | -0.113  | -1.390 | 0.055          | 133%      | -0.114  | -1.933 | 0.060          | 115%      | -0.229  | -3.846 | 0.243          |
| Total structure effect                        | -17%      | 0.016   | 0.518  | 0.008          | -33%      | 0.028   | 1.269  | 0.027          | -15%      | 0.030   | 1.352  | 0.038          |
| Aggregate energy intensity                    | 100%      | -0.097  | -1.128 | 0.037          | 100%      | -0.086  | -1.465 | 0.035          | 100%      | -0.199  | -3.094 | 0.172          |
| # countries (cross section)                   |           | 5       |        |                |           | 11      |        |                |           | 18      |        |                |
| # of observations                             |           | 35      |        |                |           | 61      |        |                |           | 48      |        |                |