School of Earth and Environment
FACULTY OF ENVIRONMENT

UNIVERSITY OF LEEDS

# Structural path decomposition analysis and its use in comparing multiregional input-output databases

Anne Owen – University of Leeds, UK

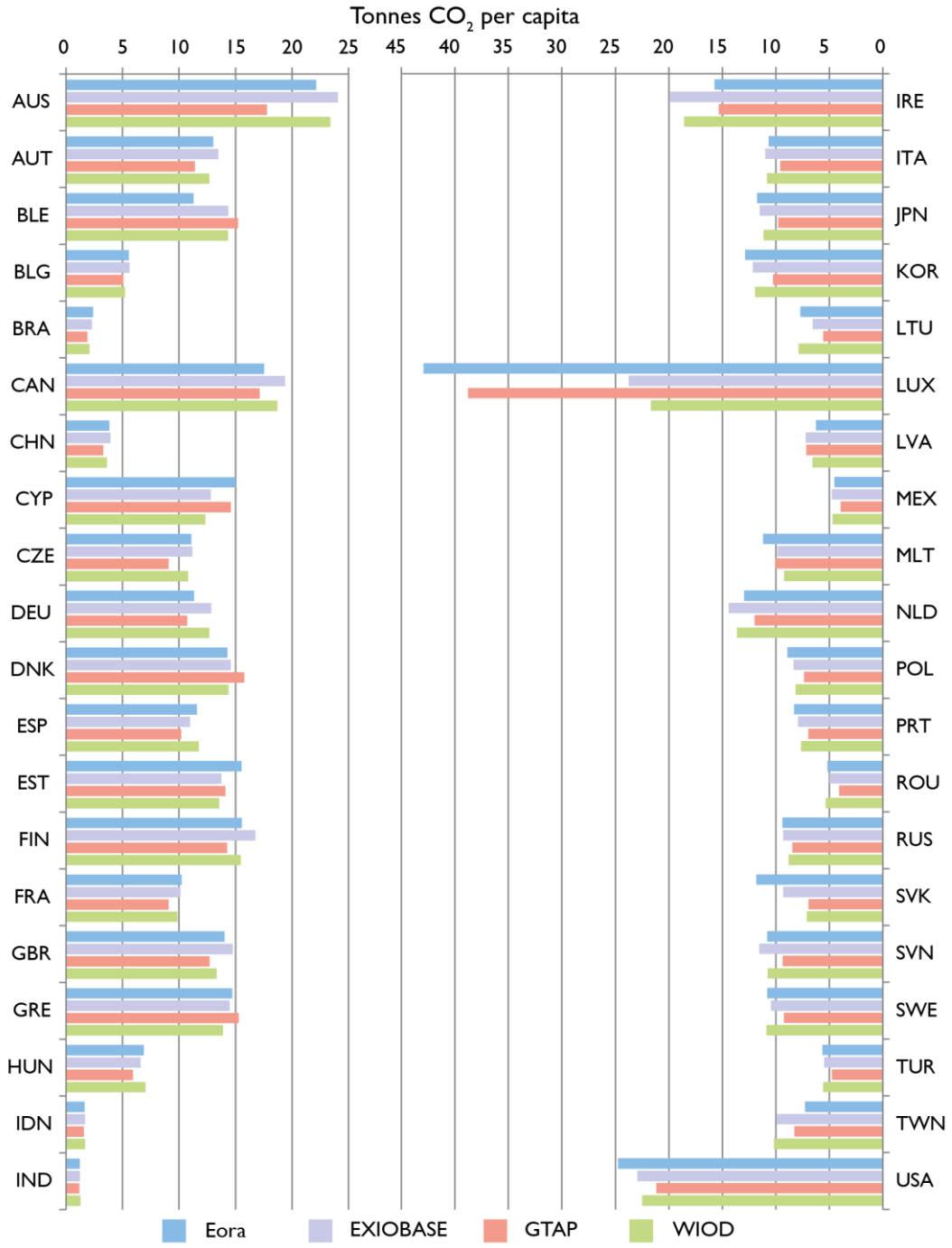
Richard Wood – NTNU, Norway

John Barrett – University of Leeds, UK

Andy Evans – University of Leeds, UK

## Overview

- Rationale & MRIO models investigated
- Structural path analysis (SPA) & structural path decomposition (SPD)
- The Common Classification
- Results
  - UK case study
  - What are the characteristics of paths which contain large differences?
  - Which element in the Taylor's expansion is responsible for the difference?
- Findings and next steps




UNIVERSITY OF LEEDS

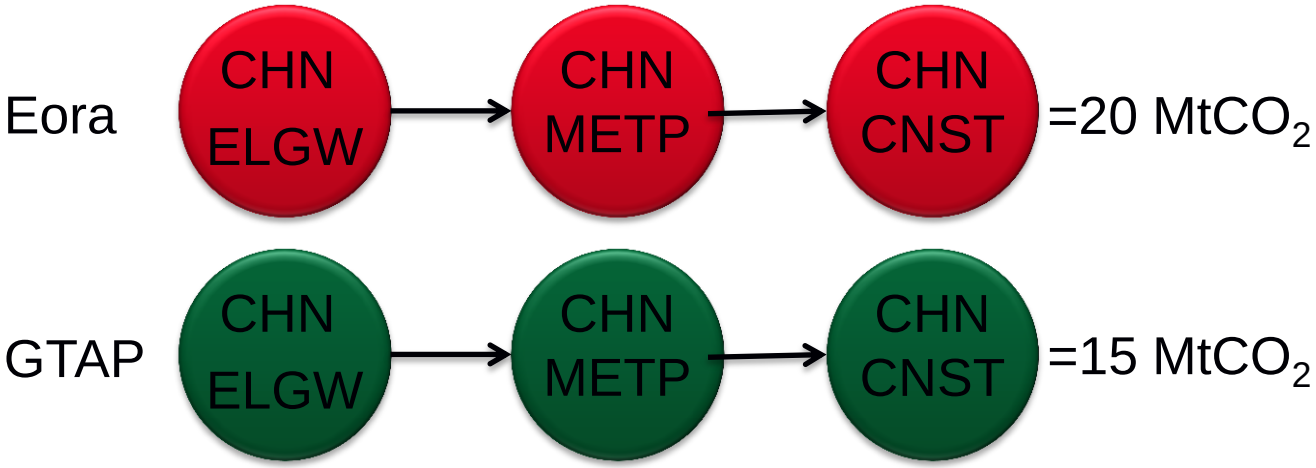
- Choice of MRIO databases available for policy analysis
- Users of MRIO data need to understand the implications of choosing one MRIO database over another
- What is the cause of these differences in $CO_2$ consumption-based accounts?
  - Source data?
  - Structure of the database?
  - Construction techniques?

# Overview

- We propose using SPA and SPD to explore the difference in paired global value chains between:

| | |
|---|---|
| Eora and EXIOBASE | EXIOBASE and GTAP |
| Eora and GTAP | EXIOBASE and WIOD |
| Eora and WIOD | GTAP and WIOD |

- Use the common year 2007




Diff = 5 $MtCO_2$

How much of this difference is due to the emissions data and how much the economic data?

# Structural path analysis

- Taylor's expansion is used to calculate the size of thousands of paths in each database:

$$\mathbf{Q} = \sum_{i=1}^{n} \mathbf{e_i y_i} + \sum_{i=1}^{n} \mathbf{e_i} \sum_{j=1}^{n} \mathbf{A_{ij} y_j} + \sum_{i=1}^{n} \mathbf{e_i} \sum_{k=1}^{n} \mathbf{A_{ik}} \sum_{j=1}^{n} \mathbf{A_{kj} y_j} + \sum_{i=1}^{n} \mathbf{e_i} \sum_{l=1}^{n} \mathbf{A_{il}} \sum_{k=1}^{n} \mathbf{A_{lk}} \sum_{j=1}^{n} \mathbf{A_{kj} y_j} + \cdots \quad (1)$$

- The zeroth, first, second and third value chains can be characterised thus:

$$\mathbf{Q_{0th}} = \mathbf{f_i} \,.\, \mathbf{x_i^{-1}} \,.\, \mathbf{y_i} \quad (2)$$

$$\mathbf{Q_{1st}} = \mathbf{f_i} \,.\, \mathbf{x_i^{-1}} \,.\, \mathbf{Z_{ij}} \,.\, \mathbf{x_j^{-1}} \,.\, \mathbf{y_j} \quad (3)$$

$$\mathbf{Q_{2nd}} = \mathbf{f_i} \,.\, \mathbf{x_i^{-1}} \,.\, \mathbf{Z_{ij}} \,.\, \mathbf{x_j^{-1}} \,.\, \mathbf{Z_{jk}} \,.\, \mathbf{x_k^{-1}} \,.\, \mathbf{y_k} \quad (4)$$

$$\mathbf{Q_{3rd}} = \mathbf{f_i} \,.\, \mathbf{x_i^{-1}} \,.\, \mathbf{Z_{ij}} \,.\, \mathbf{x_j^{-1}} \,.\, \mathbf{Z_{jk}} \,.\, \mathbf{x_k^{-1}} \,.\, \mathbf{Z_{kl}} \,.\, \mathbf{x_l^{-1}} \,.\, \mathbf{y_l} \quad (5)$$

## Structural path analysis (SPA)

- Next we find the size of *path differences* between databases.
- An iterative technique is used until the top 100 largest differences for each country for each database are identified
- Also compile the top 100 overall differences for each pairing

## Structural path decomposition (SPD) (Wood & Lenzen, 2009)

- Use the Shapely-Sun (1998) decomposition approach – equivalent to the additive Dieztenbacher & Los (1998) without the n! combinations
- Identify the contribution each element has to the over all path difference

Dietzenbacher, E., & Los, B. (1998). Structural Decomposition Techniques : Sense and Sensitivity. *Economic Systems Research*, *10*(4), 307–323.

Sun, J. W. (1998). Changes in energy consumption and energy intensity: A complete decomposition model. *Energy Economics*, *20*(1), 85–100. http://doi.org/10.1016/S0140-9883(97)00012-1

Wood, R., & Lenzen, M. (2009). Structural path decomposition. *Energy Economics*, *31*(3), 335–341. http://doi.org/10.1016/j.eneco.2008.11.003

# The common classification (CC)

- As Owen et al. (2014) explain, structural decomposition techniques, used with MRIO databases, will only work when each matrix element has the same meaning and dimensions

- A classification system common to Eora, EXIOBASE, GTAP and WIOD is developed containing 17 common sectors and 40 common countries

- For information on the effect of aggregation see Steen-Olsen et al. (2014)

Owen, A., Steen-Olsen, K., Barrett, J., Wiedmann, T., & Lenzen, M. (2014). A Structural Decomposition Approach To Comparing MRIO Databases. *Economic Systems Research*, 26(3). http://doi.org/10.1080/09535314.2014.9352997

Steen-Olsen, K., Owen, A., Hertwich, E. G., & Lenzen, M. (2014). Effects of Sector Aggregation on CO2 Multipliers in Multiregional Input–Output Analyses. *Economic Systems Research*, *26*(3), 284–302. http://doi.org/10.1080/09535314.2014.934325

# School of Earth and Environment

FACULTY OF ENVIRONMENT

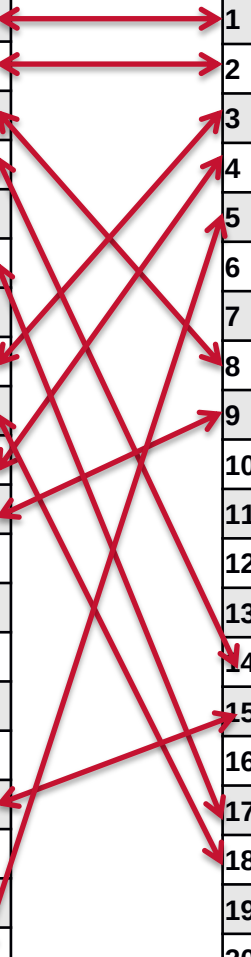
UNIVERSITY OF LEEDS

## Largest UK paths from GTAP

| Rank | $KtCO_2$ | Order | Sector 1 | Sector 2 | % |
|---|---|---|---|---|---|
| 1 | 69,897 | 0 | GBR ELGW | | 11.1% |
| 2 | 36,193 | 0 | GBR TRNS | | 5.7% |
| 3 | 18,872 | 1 | GBR ELGW | GBR PAEH | 3.1% |
| 4 | 12,538 | 1 | GBR ELGW | GBR TRNS | 2.0% |
| 5 | 6,369 | 1 | GBR TRNS | GBR PAEH | 1.0% |
| 6 | 5,804 | 1 | GBR TRNS | GBR TRNS | 0.9% |
| 7 | 5,411 | 1 | GBR ELGW | GBR FOOD | 0.9% |
| 8 | 5,333 | 1 | GBR ELGW | GBR ELGW | 0.8% |
| 9 | 5,232 | 0 | GBR FOOD | | 0.8% |
| 10 | 5,141 | 0 | GBR PAEH | | 0.8% |
| 11 | 4,817 | 0 | GBR PETC | | 0.8% |
| 12 | 4,436 | 1 | GBR ELGW | GBR BSNS | 0.7% |
| 13 | 3,937 | 0 | ROW TRNS | | 0.6% |
| 14 | 3,773 | 0 | GBR BSNS | | 0.6% |
| 15 | 3,594 | 1 | GBR TRNS | GBR BSNS | 0.6% |
| 16 | 3,336 | 1 | GBR TRNS | GBR FOOD | 0.5% |
| 17 | 3,163 | 1 | GBR ELGW | GBR TRAD | 0.5% |
| 18 | 3,011 | 1 | GBR ELGW | GBR PETC | 0.5% |
| 19 | 2,457 | 0 | USA TRNS | | 0.4% |
| 20 | 2,405 | 0 | ROW PETC | | 0.4% |
| Rest | 369,459 | | | | 58.2% |

## Largest UK paths from WIOD

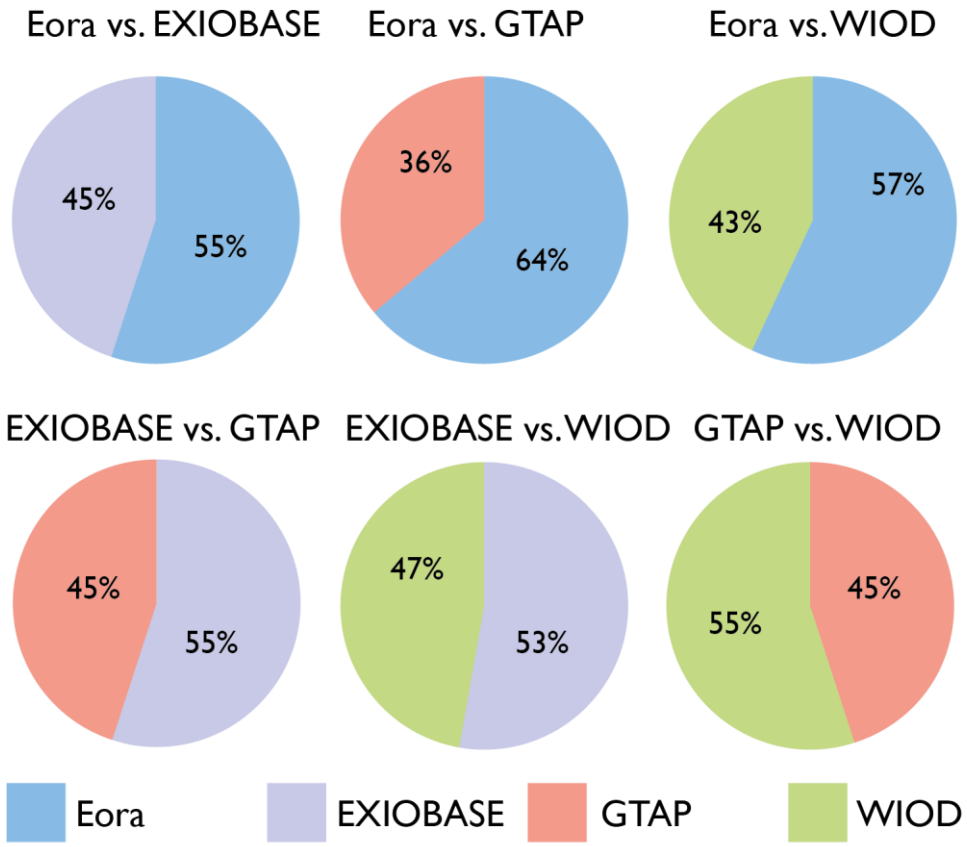
| Rank | $KtCO_2$ | Order | Sector 1 | Sector 2 | Sector 3 | % |
|---|---|---|---|---|---|---|
| 1 | 72,326 | 0 | GBR ELGW | | | 10.9% |
| 2 | 20,941 | 0 | GBR TRNS | | | 3.2% |
| 3 | 19,673 | 1 | GBR ELGW | GBR ELGW | | 3.0% |
| 4 | 15,471 | 0 | GBR PAEH | | | 2.3% |
| 5 | 13,045 | 0 | ROW PETC | | | 2.0% |
| 6 | 11,195 | 1 | GBR TRNS | GBR TRAD | | 1.7% |
| 7 | 9,717 | 0 | GBR TRAD | | | 1.5% |
| 8 | 9,517 | 1 | GBR ELGW | GBR PAEH | | 1.4% |
| 9 | 6,566 | 0 | GBR PETC | | | 1.0% |
| 10 | 6,443 | 0 | ROW CNST | | | 1.0% |
| 11 | 5,680 | 0 | GBR METP | | | 0.9% |
| 12 | 5,351 | 2 | GBR ELGW | GBR ELGW | GBR ELGW | 0.8% |
| 13 | 4,705 | 1 | GBR PETC | GBR PDEH | | 0.7% |
| 14 | 4,545 | 1 | GBR TRNS | GBR PDEH | | 0.75 |
| 15 | 4,414 | 1 | GBR ELGW | GBR TRAD | | 0.7% |
| 16 | 3,905 | 0 | ROW MANU | | | 0.6% |
| 17 | 3,469 | 1 | GBR TRNS | GBR TRNS | | 0.5% |
| 18 | 3,400 | 0 | GBR FOOD | | | 0.5% |
| 19 | 2,589 | 2 | GBR ELGW | GBR ELGW | GBR PAEH | 0.4% |
| 20 | 2,496 | 0 | GBR AGRI | | | 0.4% |
| Rest | 375,879 | | | | | 56.7% |



# Top 20 path differences between GTAP & WIOD for the UK

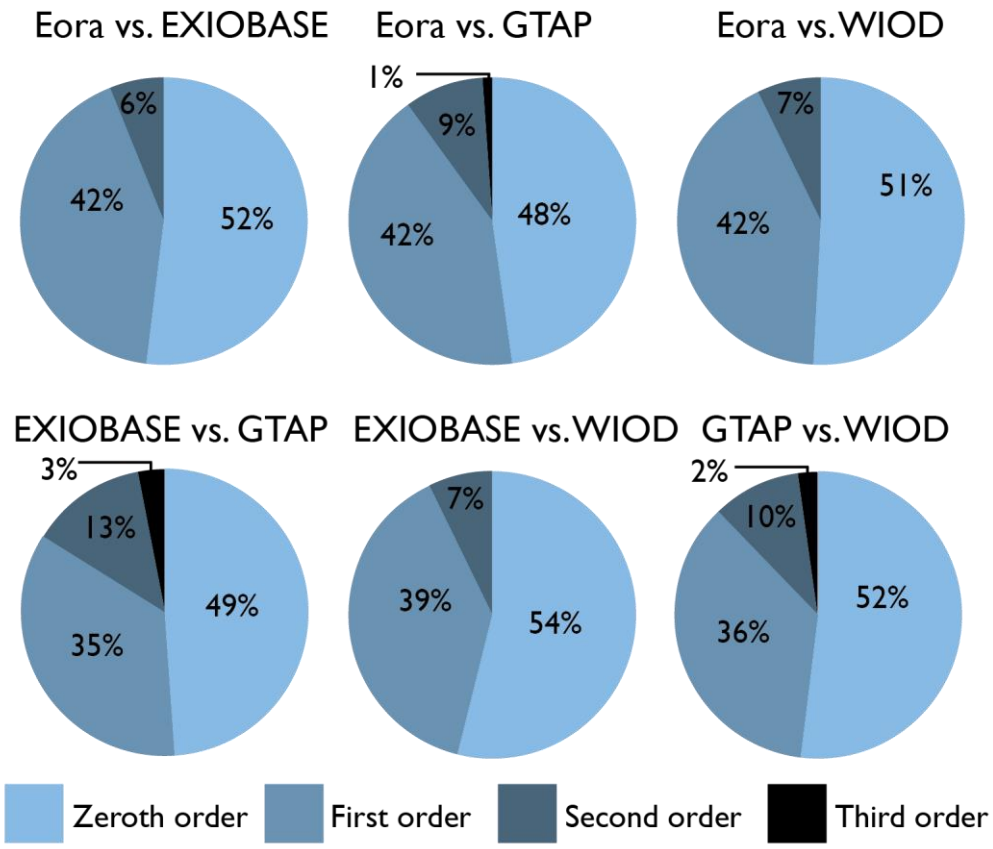
| Rank | $KtCO_2$ Diff | Order | Sector 1 | Sector 2 | Sector 3 | f effect | $x^{-1}$ effect | Z effect | $x^{-1}$ effect | Z effect | $x^{-1}$ effect | y effect |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 15,252 | 0 | GBR TRNS | | | 10133 | -7092 | | | | | 12212 |
| **2** | -14,340 | 1 | GBR ELGW | GBR ELGW | | 1700 | 10304 | -25312 | 10304 | | | -14340 |
| **3** | -10,640 | 0 | ROW PETC | | | -3264 | -3150 | | | | | -4226 |
| **4** | -10,330 | 0 | GBR PAEH | | | -10896 | 947 | | | | | -381 |
| **5** | 10,121 | 1 | GBR ELGW | GBR PAEH | | 1511 | 8575 | -731 | 1297 | | | -532 |
| **6** | -8,290 | 0 | GBR TRAD | | | -9897 | 2012 | | | | | -404 |
| **7** | -4,944 | 2 | GBR ELGW | GBR ELGW | GBR ELGW | 382 | 2380 | -5022 | 2380 | -5022 | 2380 | -2424 |
| **8** | -4,688 | 0 | GBR CNST | | | -4730 | -42 | | | | | 84 |
| **9** | -4,381 | 0 | GBR METP | | | -3358 | -944 | | | | | -79 |
| **10** | 4,020 | 1 | GBR ELGW | GBR FOOD | | 344 | 1905 | 71 | -112 | | | 2812 |
| **11** | -4,000 | 1 | ROW PETC | GBR PAEH | | -1120 | -1081 | -1927 | 214 | | | -86 |
| **12** | 3,644 | 0 | ROW TRNS | | | 457 | -402 | | | | | 3589 |
| **13** | -3,419 | 0 | ROW MANU | | | -2743 | -496 | | | | | -180 |
| **14** | 2,741 | 1 | GBR TRNS | GBR FOOD | | 643 | -472 | 1642 | -637 | | | 1566 |
| **15** | 2,443 | 1 | GBR ELGW | GBR BSNS | | 334 | 1891 | 701 | 500 | | | -983 |
| **16** | -2,429 | 0 | GBR ELGW | | | 8114 | 47465 | | | | | -58008 |
| **17** | 2,335 | 1 | GBR TRNS | GBR TRNS | | 1665 | -1164 | 990 | -1164 | | | 2007 |
| **18** | -2,276 | 0 | GBR AGRI | | | -1518 | 590 | | | | | -1347 |
| **19** | -2,258 | 1 | GBR MINQ | GBR ELGW | | -1083 | 462 | -1665 | 786 | | | -758 |
| **20** | 1,958 | 1 | GBR ELGW | GBR PETC | | 205 | 1146 | 437 | -499 | | | 669 |

# In the top 100 Global path differences, how often does a particular database contain the larger of the two paths?



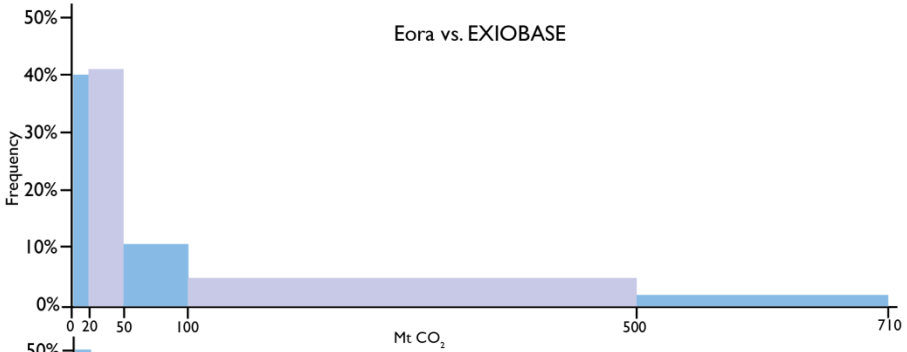

- Eora paths tend to be larger
- EXIOBASE paths tend to be larger than GTAP and WIOD
- WIOD paths tend to be larger than GTAP

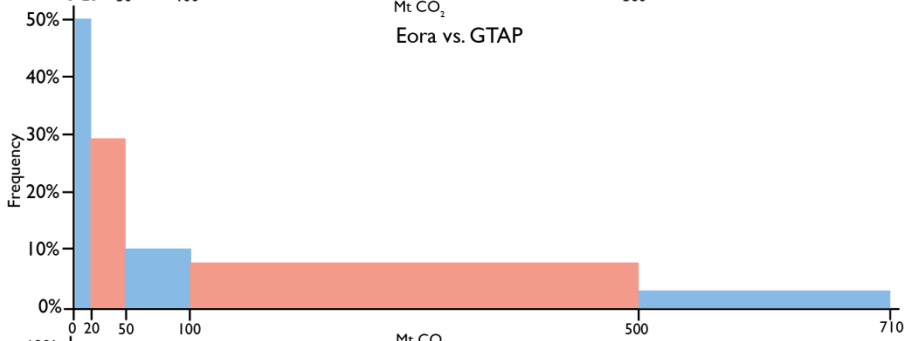
# What orders of paths make up the top 100 differences?

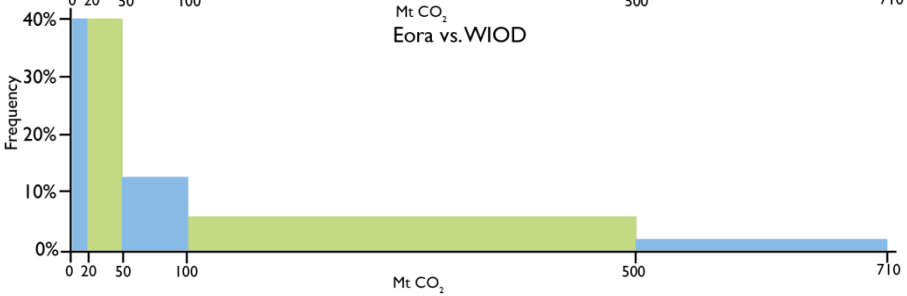


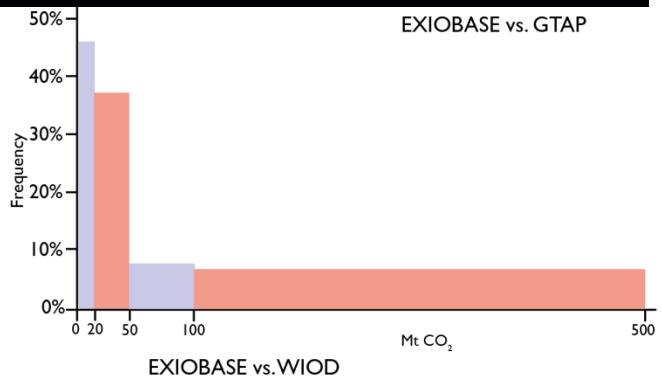

- Most large path differences are zeroth order paths
- Only the pairings involving GTAP have large third order path differences, indicating the difference lies in **Z**

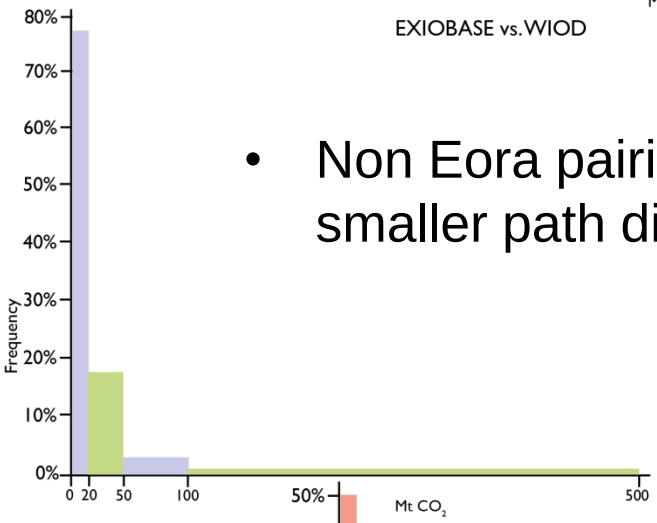
# What is the frequency distribution by size of path difference?



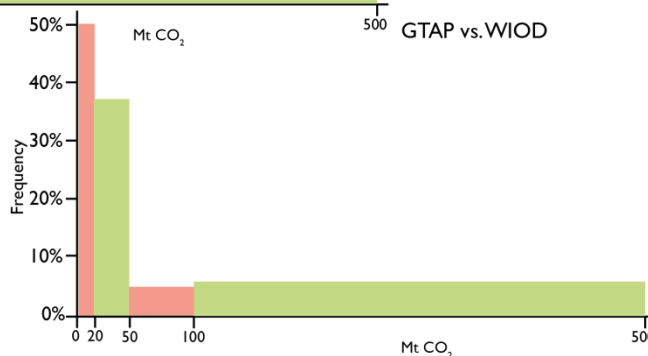



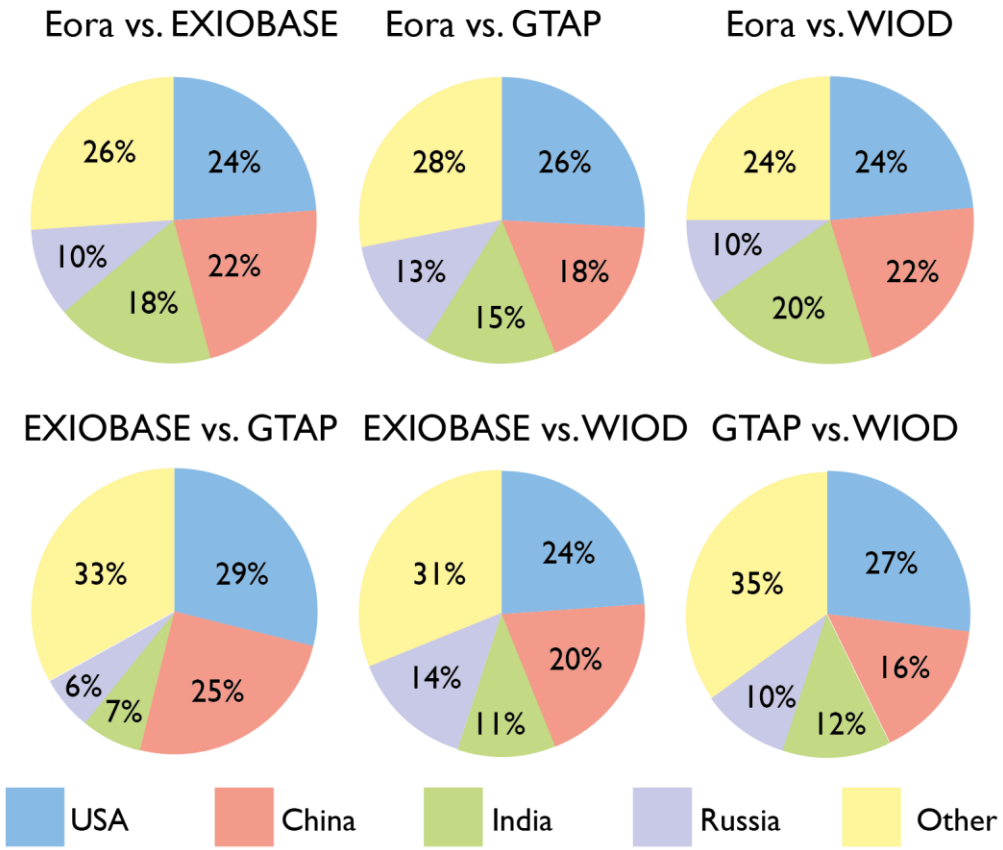




- Non Eora pairings have smaller path differences

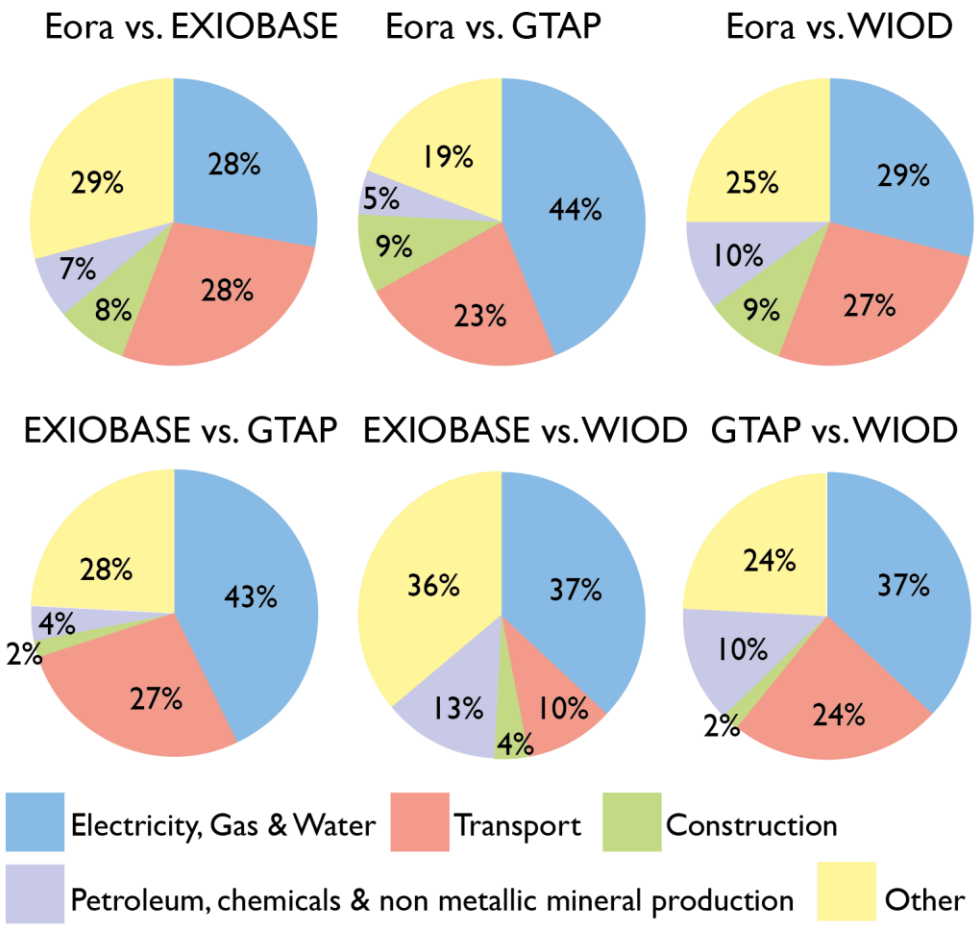


# Are there particular countries that tend to produce large path differences?



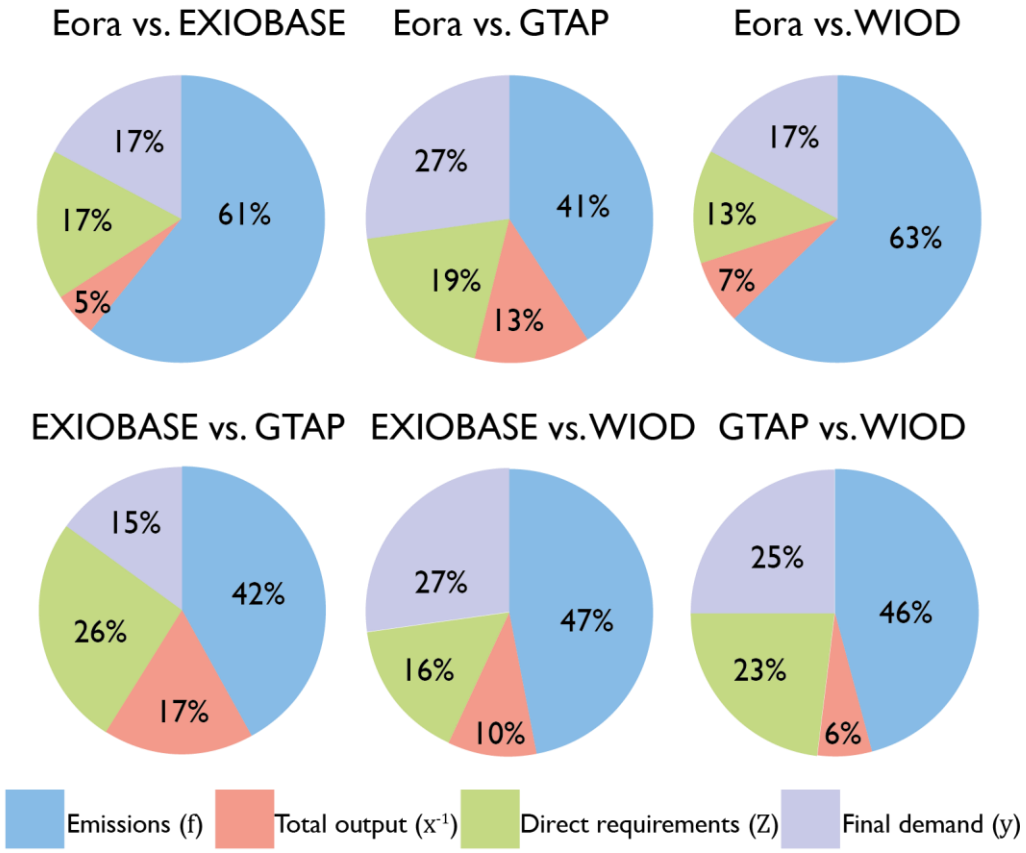

- There are no paths in the top 100 path differences where a path crosses a country border
- The USA, China, India and Russia have the largest path differences

# Are there particular sectors that tend to produce large path differences?




- Path differences involving GTAP feature the Electricity, Gas and Water section for a larger proportion of the paths
- There are fewer transport path differences when EXIOBASE and WIOD are compared

# Are there particular elements with the Taylors equation that tend to be responsible for most of the difference between paths?




- The emissions vector is the largest source of difference for over half the paths for the ‘Eora and EXIOBASE’ and ‘Eora and WIOD’ pairings

# Top 10 path differences where emissions is the largest contributor to the overall difference

| Rank | Eora & EXIOBASE | Diff $MtCO_2$ | Eora & GTAP | Diff $MtCO_2$ | Eora & WIOD | Diff $MtCO_2$ | EXIOBASE & GTAP | Diff $MtCO_2$ | EXIOBASE & WIOD | Diff $MtCO_2$ | GTAP & WIOD | Diff $MtCO_2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | USA TRNS | 631 | CHN CNST | 604 | USA TRNS | 659 | USA PAEH | 175 | USA PAEH | -81 | USA PAEH | -258 |
| **2** | CHN CNST | 594 | USA TRNS | 564 | CHN CNST | 597 | CHN METP > CHN CNST | 77 | USA BSNS | 66 | USA TRAD | -108 |
| **3** | USA TRNS > USA PAEH | 301 | USA PAEH | 134 | USA TRNS > USA PAEH | 295 | USA TRAD | 71 | JPN ELGW | 62 | USA TRNS | 95 |
| **4** | IND CNST > IND TRNS | 116 | USA TRNS > IND TRNS | 120 | USA PAEH | -123 | USA TRNS | -67 | CHN METP > CHN CNST | 46 | USA BSNS | -56 |
| **5** | CHN METP > CHN CNST | -112 | IND CNST > IND TRNS | 115 | IND CNST > IND TRNS | 115 | USA CNST | 49 | CHN PETC > CHN CNST | -45 | CHN PETC > CHN CNST | -49 |
| **6** | MEX TRNS | 88 | USA TRNS > USA TRAD | 80 | USA TRAD | -100 | JPN ELGW | 42 | USA POST | 24 | USA PETC | -41 |
| **7** | USA TRNS > USA TRAD | 86 | USA BSNS | 62 | CHN PETC > CHN CNST | -98 | MEX TRNS | -41 | CHN METP > CHN ELGW | 24 | USA CNST | -36 |
| **8** | USA TRAD | -68 | IND ELGW > IND AGRI | -57 | MEX TRNS | 82 | FRA TRNS | -38 | JPN PAEH | -21 | DEU TRNS | 36 |
| **9** | IND CNST > IND BSNS | 68 | USA TREQ | 55 | USA TRNS > USA TRAD | 73 | USA POST | 35 | DEU ELGW | -21 | MEX TRNS | 36 |
| **10** | USA BSNS | -60 | USA CNST | 54 | IND CNST > IND BSNS | 68 | USA BSNS > USA PAEH | 32 | RUS PETC > RUS CNST | -19 | FRA TRNS | 35 |

- Transport, construction and public administration, education, heath and defence are where the emissions vectors disagree

# Top 10 path differences where emissions is the largest contributor to the overall difference

| Rank | Eora & EXIOBASE | Diff $MtCO_2$ | Eora & GTAP | Diff $MtCO_2$ | Eora & WIOD | Diff $MtCO_2$ | EXIOBASE & GTAP | Diff $MtCO_2$ | EXIOBASE & WIOD | Diff $MtCO_2$ | GTAP & WIOD | Diff $MtCO_2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | USA TRNS | 631 | CHN CNST | 604 | USA TRNS | 659 | USA PAEH | 175 | USA PAEH | -81 | USA PAEH | -258 |
| 2 | CHN CNST | 594 | USA TRNS | 564 | CHN CNST | 597 | CHN METP > CHN CNST | 77 | USA BSNS | 66 | USA TRAD | -108 |
| 3 | USA TRNS > USA PAEH | 301 | USA PAEH | 134 | USA TRNS > USA PAEH | 295 | USA TRAD | 71 | JPN ELGW | 62 | USA TRNS | 95 |
| 4 | IND CNST > IND TRNS | 116 | USA TRNS > USA TRNS | 120 | USA PAEH | -123 | USA TRNS | -67 | CHN METP > CHN CNST | 46 | USA BSNS | -56 |
| 5 | CHN METP > CHN CNST | -112 | IND CNST > IND TRNS | 115 | IND CNST > IND TRNS | 115 | USA CNST | 49 | CHN PETC > CHN CNST | -45 | CHN PETC > CHN CNST | -49 |
| 6 | MEX TRNS | 88 | USA TRNS > USA TRAD | 80 | USA TRAD | -100 | JPN ELGW | 42 | USA POST | 24 | USA PETC | -41 |
| 7 | USA TRNS > USA TRAD | 86 | USA BSNS | 62 | CHN PETC > CHN CNST | -98 | MEX TRNS | -41 | CHN METP > CHN ELGW | 24 | USA CNST | -36 |
| 8 | USA TRAD | -68 | IND ELGW > IND AGRI | -57 | MEX TRNS | 82 | FRA TRNS | -38 | JPN PAEH | -21 | DEU TRNS | 36 |
| 9 | IND CNST > IND BSNS | 68 | USA TREQ | 55 | USA TRNS > USA TRAD | 73 | USA POST | 35 | DEU ELGW | -21 | MEX TRNS | 36 |
| 10 | USA BSNS | -60 | USA CNST | 54 | IND CNST > IND BSNS | 68 | USA BSNS > USA PAEH | 32 | RUS PETC > RUS CNST | -19 | FRA TRNS | 35 |

- **Transport**, **construction** and **public administration, education, heath and defence** are where the emissions vectors disagree

# Top 10 path differences where total output, the transactions matrix or final demand is the largest contributor to the overall difference

| Rank | Eora & EXIOBASE | Diff $MtCO_2$ | Eora & GTAP | Diff $MtCO_2$ | Eora & WIOD | Diff $MtCO_2$ | EXIOBASE & GTAP | Diff $MtCO_2$ | EXIOBASE & WIOD | Diff $MtCO_2$ | GTAP & WIOD | Diff $MtCO_2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | USA ELGW | 393 | USA ELGW | 685 | USA ELGW | 382 | USA ELGW | 292 | CHN ELGW | 126 | USA ELGW | -303 |
| **2** | IND CNST | 116 | CHN ELGW | -180 | IND CNST | 112 | USA TRNS > USA PAEH | -181 | RUS ELGW > RUS PAEH | 47 | CHN ELGW | 285 |
| **3** | USA ELGW > USA TRAD | -75 | RUS ELGW | -159 | CHN ELGW | 103 | CHN ELGW | -158 | USA ELGW > USA PAEH | 47 | USA TRNS > USA PAEH | 176 |
| **4** | IND ELGW | -58 | IND CNST | 119 | IND ELGW | -88 | RUS ELGW | -137 | CHN ELGW > CHN ELGW | 47 | USA ELGW > USA PAEH | 154 |
| **5** | CHN ELGW > CHN ELGW | -46 | USA ELGW > USA PAEH | -166 | RUS ELGW > RUS PAEH | 75 | USA BSNS | 121 | USA ELGW > USA TRAD | 45 | RUS ELGW | 153 |
| **6** | IND ELGW > IND CNST | -44 | IND ELGW | -111 | CHN ELGW > CHN PAEH | -40 | USA ELGW > USA PAEH | -107 | USA TRAD | -31 | USA ELGW > USA ELGW | 89 |
| **7** | CHN ELGW > CHN PAEH | -36 | USA ELGW > USA ELGW | -89 | IND ELGW > IND CNST | -40 | USA ELGW > USA ELGW | -87 | USA ELGW > USA BSNS | 29 | CHN ELGW > CHN CNST | -65 |
| **8** | ROW PETC | -29 | RUS ELGW > RUS PAEH | 87 | USA ELGW > USA PAEH | 37 | RUS ELGW > RUS PAEH | 60 | USA TRNS | 28 | USA ELGW > USA TRAD | 56 |
| **9** | RUS ELGW > RUS ELGW | 27 | USA ELGW > USA TRAD | -86 | USA ELGW > USA TRAD | -30 | USA ELGW > USA BSNS | 60 | USA MINQ | -24 | DEU ELGW | -45 |
| **10** | USA PETC > USA CNST | -26 | USA PETC | 64 | ROW PETC | -29 | CHN ELGW > CHN ELGW | 54 | KOR ELGW | 23 | CHN TRNS | 43 |

- The electricity, gas and water sector features highly here, particularly for pairings involving GTAP

# Top 10 path differences where total output, the transactions matrix or final demand is the largest contributor to the overall difference

| Rank | Eora & EXIOBASE | Diff $MtCO_2$ | Eora & GTAP | Diff $MtCO_2$ | Eora & WIOD | Diff $MtCO_2$ | EXIOBASE & GTAP | Diff $MtCO_2$ | EXIOBASE & WIOD | Diff $MtCO_2$ | GTAP & WIOD | Diff $MtCO_2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | USA ELGW | 393 | USA ELGW | 685 | USA ELGW | 382 | USA ELGW | 292 | CHN ELGW | 126 | USA ELGW | -303 |
| 2 | IND CNST | 116 | CHN ELGW | -180 | IND CNST | 112 | USA TRNS > USA PAEH | -181 | RUS ELGW > RUS PAEH | 47 | CHN ELGW | 285 |
| 3 | USA ELGW > USA TRAD | -75 | RUS ELGW | -159 | CHN ELGW | 103 | CHN ELGW | -158 | USA ELGW > USA PAEH | 47 | USA TRNS > USA PAEH | 176 |
| 4 | IND ELGW | -58 | IND CNST | 119 | IND ELGW | -88 | RUS ELGW | -137 | CHN ELGW > CHN ELGW | 47 | USA ELGW > USA PAEH | 154 |
| 5 | CHN ELGW > CHN ELGW | -46 | USA ELGW > USA PAEH | -166 | RUS ELGW > RUS PAEH | 75 | USA BSNS | 121 | USA ELGW > USA TRAD | 45 | RUS ELGW | 153 |
| 6 | IND ELGW > IND CNST | -44 | IND ELGW | -111 | CHN ELGW > CHN PAEH | -40 | USA ELGW > USA PAEH | -107 | USA TRAD | -31 | USA ELGW > USA ELGW | 89 |
| 7 | CHN ELGW > CHN PAEH | -36 | USA ELGW > USA ELGW | -89 | IND ELGW > IND CNST | -40 | USA ELGW > USA ELGW | -87 | USA ELGW > USA BSNS | 29 | CHN ELGW > CHN CNST | -65 |
| 8 | ROW PETC | -29 | RUS ELGW > RUS PAEH | 87 | USA ELGW > USA PAEH | 37 | RUS ELGW > RUS PAEH | 60 | USA TRNS | 28 | USA ELGW > USA TRAD | 56 |
| 9 | RUS ELGW > RUS ELGW | 27 | USA ELGW > USA TRAD | -86 | USA ELGW > USA TRAD | -30 | USA ELGW > USA BSNS | 60 | USA MINQ | -24 | DEU ELGW | -45 |
| 10 | USA PETC > USA CNST | -26 | USA PETC | 64 | ROW PETC | -29 | CHN ELGW > CHN ELGW | 54 | KOR ELGW | 23 | CHN TRNS | 43 |

- The **electricity, gas and water** sector features highly here, particularly for pairings involving GTAP

# The emissions vector and the residence principle

| | Eora | EXIOBASE | GTAP | WIOD |
|---|---|---|---|---|
| **Total Global emissions 2007 ($MtCO_2$)** | 30,431 | 28,975 | 26,524 | 29,218 |
| **Industrial** | 28,237 | 24,757 | 22,800 | 25,261 |
| **Household** | 2,194 | 4,218 | 3,724 | 3,957 |

- Eora has largest total emissions and uses territorial principle to emissions allocation. This reduces size of household component, increases industrial and effects the transport industrial emissions. We find large path differences for Eora pairs
- EXIOBASE & WIOD use residence principle – we find transport is not a major source of difference for this pairing but it is for other pairings

## Monetary data and electricity prices

- Closer inspection of the $\mathbf{A}$ matrix shows Eora, EXIOBASE and WIOD roughly agree on what proportion of the production recipe for ELGW is supplied by the sector itself - GTAP is the outlier

- Different industrial sectors spend different amounts of money to receive the same KWh of electricity because the price per KWh differs by sector

- GTAP does not rely on user submitted values in the energy rows of the IO tables. Physical data on energy use is taken from the IEA, converted to monetary values and placed in the IO tables – explains the major differences cause by this sector for GTAP pairings

## In conclusion and next steps

- Findings are useful to researchers who construct MRIO databases and want to understand the implications of assumptions made in the construction stages

- Findings may also be of use to the policy maker deciding which model is most applicable to a particular question e.g. – electricity tracing through supply chain

- SPD is a useful technique to explain the source of difference in product supply chains from different MRIO databases

- We recommend that this work be extended to include future MRIO systems and to consider data from different years.

School of Earth and Environment
FACULTY OF ENVIRONMENT

UNIVERSITY OF LEEDS

# Thank you

Anne Owen

a.owen@leeds.ac.uk