Comparing Productivity Across Databases

GGDC Research Memorandum 193

› Reitze Gouma & Robert Inklaar

› University of Groningen

› Groningen Growth and Development Centre

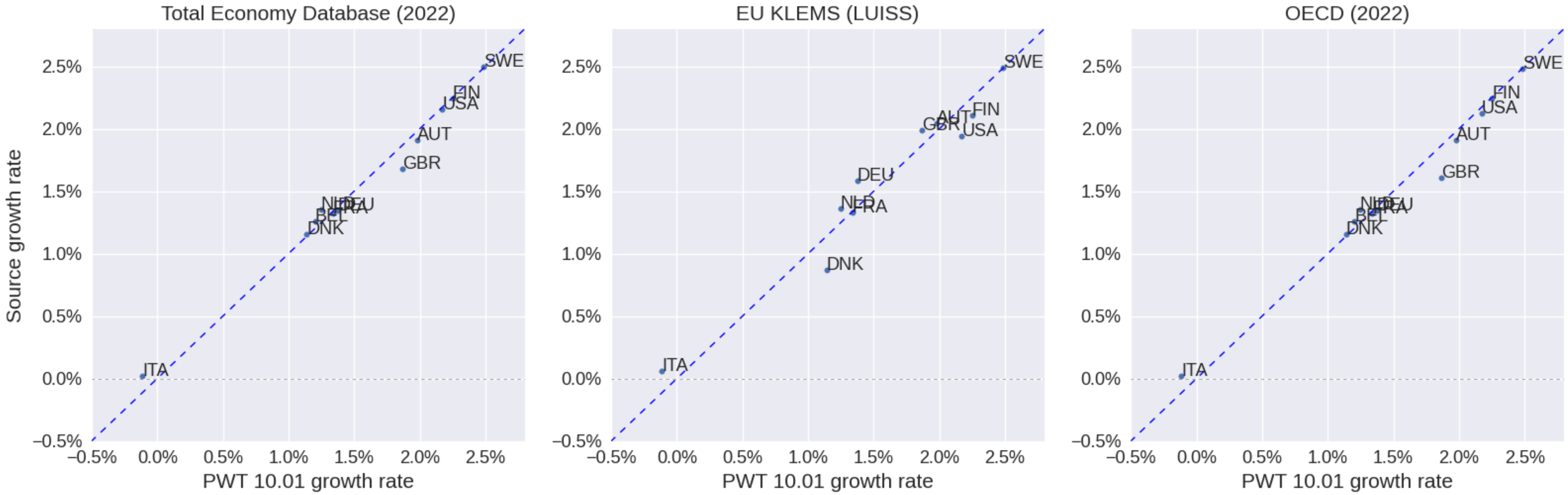
Introduction

- Growth Accounting (GA) Methodology is well established within the statistical and academic communities
- Important and widely used tool for gauging (relative) economic performance
- Fundamental in identifying sources of growth
- While GA has reached maturity, it comes in different flavours (ex-post / ex-ante) and results vary across databases
- Provide context: why does the same question on economic performance have different answers

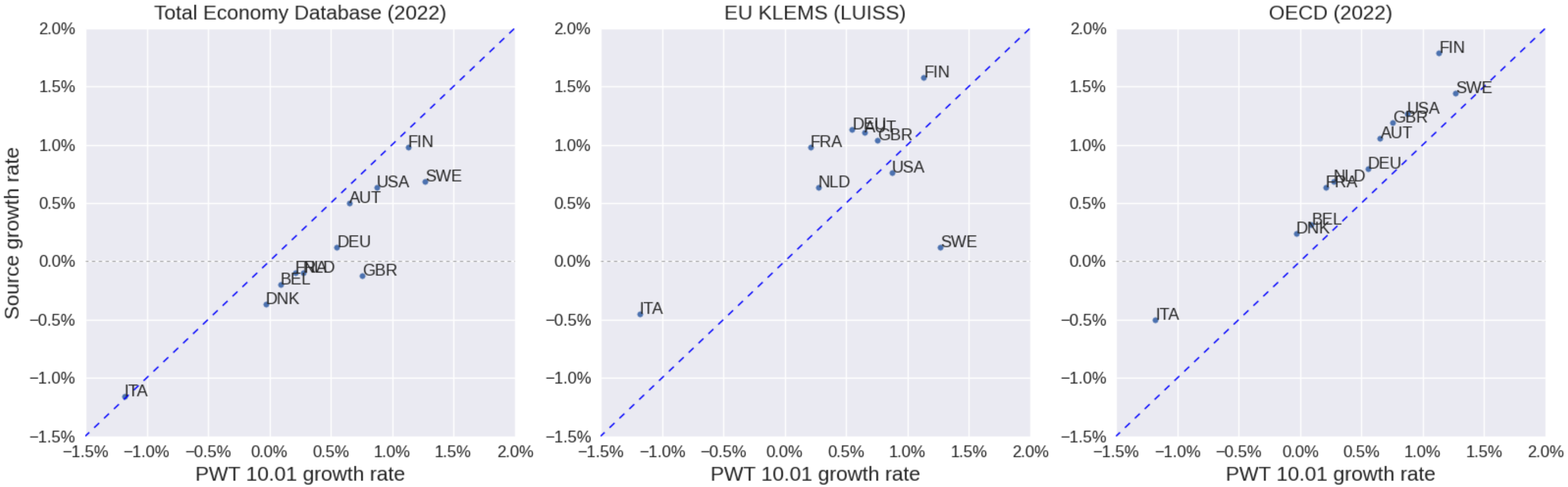
4 Growth Accounting Databases

- Penn World Table (PWT), by GGDC → Adjusted version of the PWT 10 release
- Total Economy Database (TED), by TCB → April 2022 version
- The EU KLEMS database (EU KLEMS), LUISS Lab of European Economics → 2021 version
- OECD Productivity Statistics (OECD), by OECD → Data downloaded on 19-05-2022

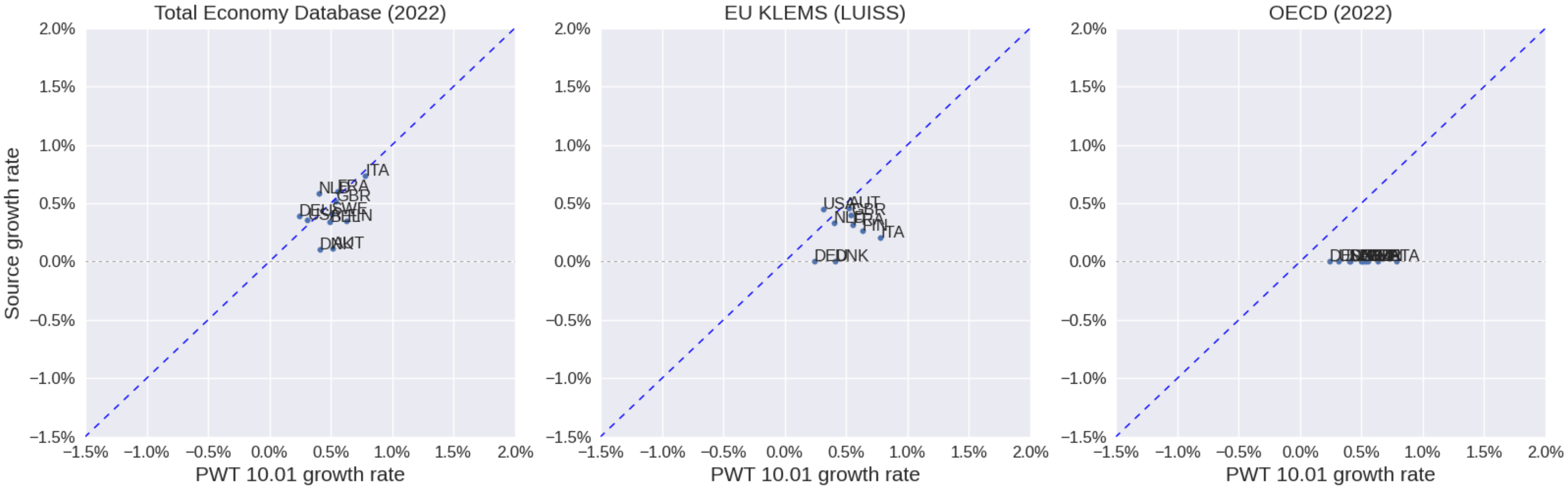
Average 2000-2007 Labour Productivity Growth



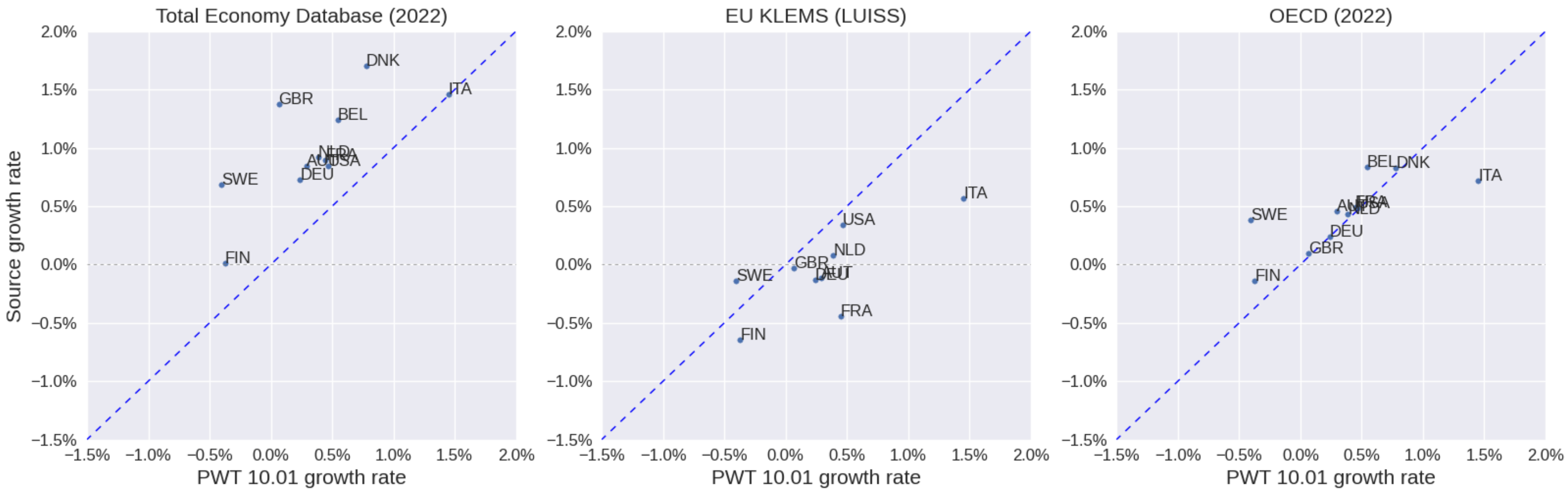
Average 2000-2007 MFP growth



Average 2000-2007 growth contribution of labour



Average 2000-2007 growth contribution of capital



Capital measurement

Applied by all databases in some form:

- PIM Stocks: $$K_{ait} = (1-\delta_a) K_{ait-1} + I_{ait} - \delta I_{ait}/2$$
- Capital Services: $$dk = \sum_a \bar{v}_{ait} \triangle \log K_{ait}$$
- Contribution per unit of output: $$con_k = \frac{\alpha}{1-\alpha} dk - dy$$

Capital measurement implementations

- Taking stocks from statistical sources (EU KLEMS)
  - Problems with consistency across countries
  - Use of wealth stocks
  - Consistency depreciation rates when calculating user cost
- Creating harmonized estimates
  - How to estimate initial stocks?
  - Build of capital stocks → Geometric depreciation rates
  - Price deflators: Hedonic adjustments for ICT (TED uses adjusted method, based on Byrne and Corrado, 2019)

Stock estimation methodology

	PWT	TED	OECD*	EU KLEMS
Initial capital stock	1950 capital/ output ratio with long run PIM approach	Harberger steady-state assumption	Long run PIM approach, based on (confidential) historical GFCF data	EUKLEMS takes the investment and capital stock series directly from EUROSTAT, for the derivation of the rental price, geometric depreciation is used, see table 3
Build up capital stock	Geometric depreciation rates, see table 3; half of current year's investment is depreciated	Geometric depreciation rates, see table 3	Hyperbolic age-efficiency profile; retirement profile normal distribution; average service life, see table 3.	
Deflators	Investment prices, hedonic adjustments for ICT	Investment prices, special hedonic adjustments for ICT	Investment prices, hedonic ICT deflators	

Depreciation rates

Asset	code	OECD*	EU KLEMS	TED	PWT
Information Technology	IT	31.2	31.5	31.5	31.5
Communication Technology	CT	11.0	11.5	11.5	11.5
Software	SOFT	33.3	31.5	31.5	31.5
Other Machinery	OMach	11.4	13.1	12.6	12.6
Transportation Equipment	TraEq	11.0	18.9	18.9	18.9
Residential Structures	RStruc	n.a.	1.1	2.5	1.1
Other Construction	OCon	2.5	3.2	2.5	3.1
Cultivated Assets	CULT	n.a.	20	n.a.	12.6
Research & Development	RD	10.0	20	n.a.	15
Other Intellectual Property Products.	OIPP	14.3	13.1	n.a.	15

*For the purposes of this note, service lives are converted to geometric rates using the Declining Balance Rates (DBR) from Fraumeni (1997)

Approach

- Using a step-wise harmonization approach, we recalculate capital services contributions for each of the 4 databases, averaged for 2000-2007
- 10 European countries and the U.S., averaged for the period 2000-2007
- We identify where the differences in the results for each of these databases orginates

4 methods of harmonization

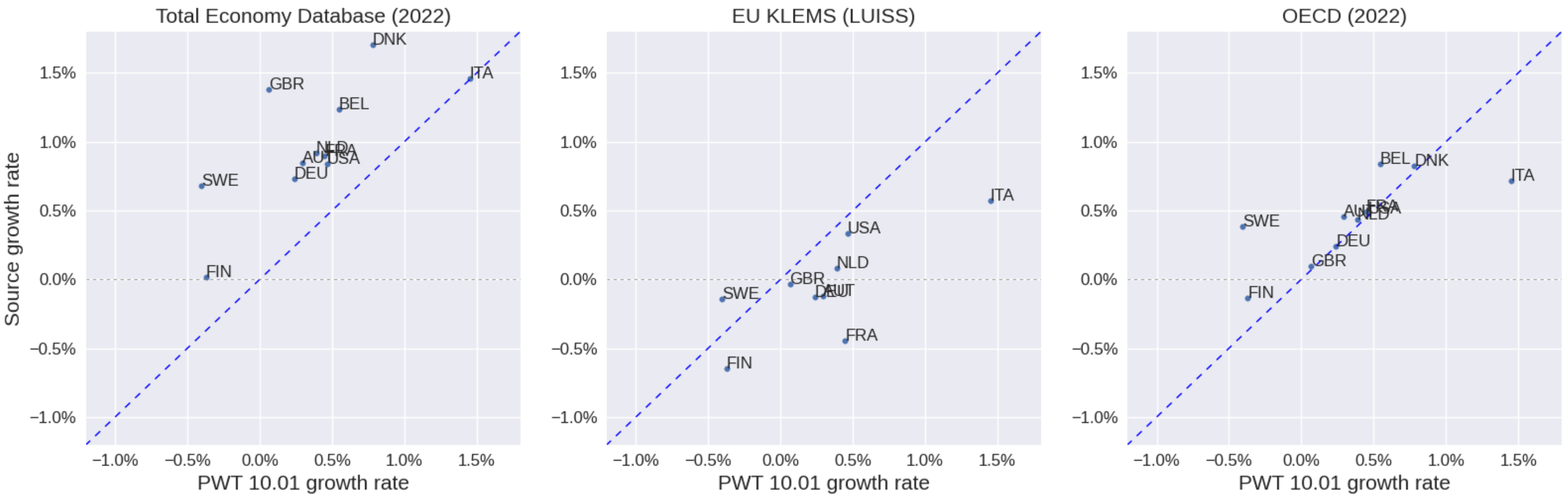
- Method 1 → Comparing capital services contributions directly based on reported capital services index and labour share
- Method 2 → Harmonized Ex-Post recalculation of capital services, based on reported stocks
- Method 3 → Method 2, using recalculated capital stocks from reported investment using PIM, with PWT 10.01 depreciation rates
- Method 4 → Method 3, using PWT capital compensation shares

Capital measurement

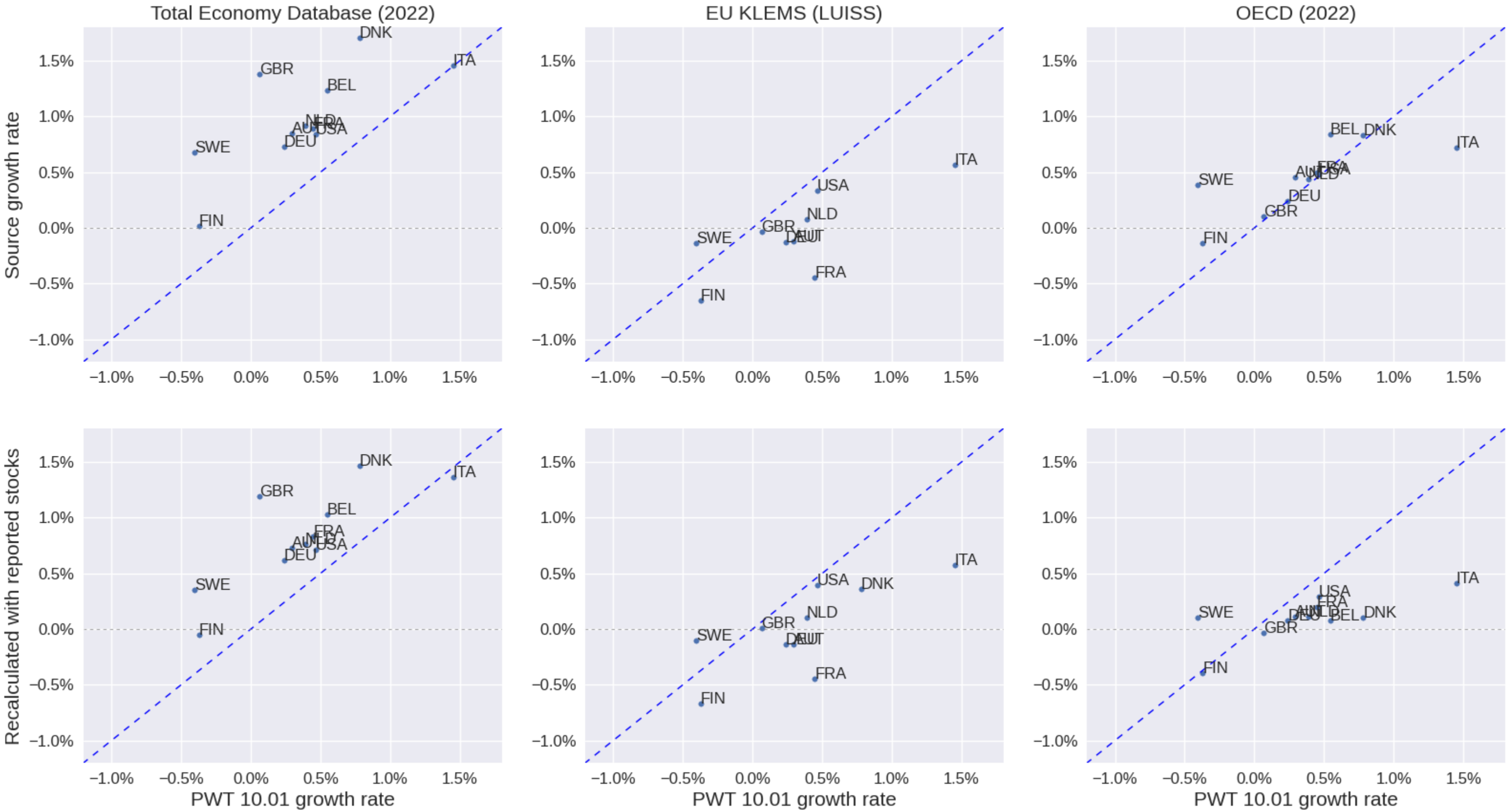
Applied by all databases in some form:

- PIM Stocks: $K_{ait} = (1-\delta_a) K_{ait-1} + I_{ait} - \delta I_{ait}/2$
- Capital Services: $dk = \sum_a \bar{v}_{ait} \triangle \log K_{ait}$
- Contribution per unit of output: $con_k = \frac{\alpha}{1-\alpha} dk - dy$

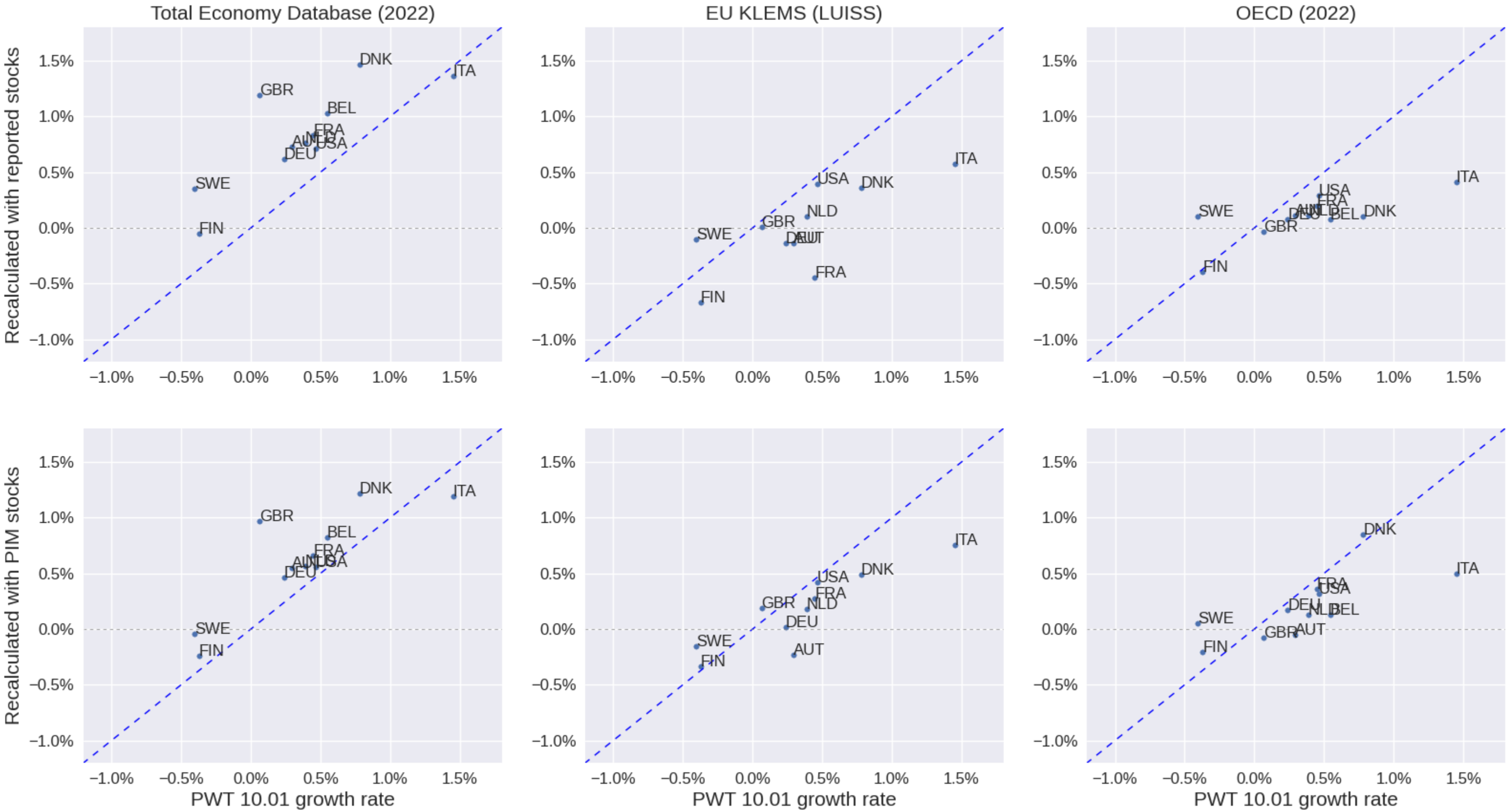
Method 1: No harmonization



Method 2: Ex post capital services



Method 3: PIM stocks

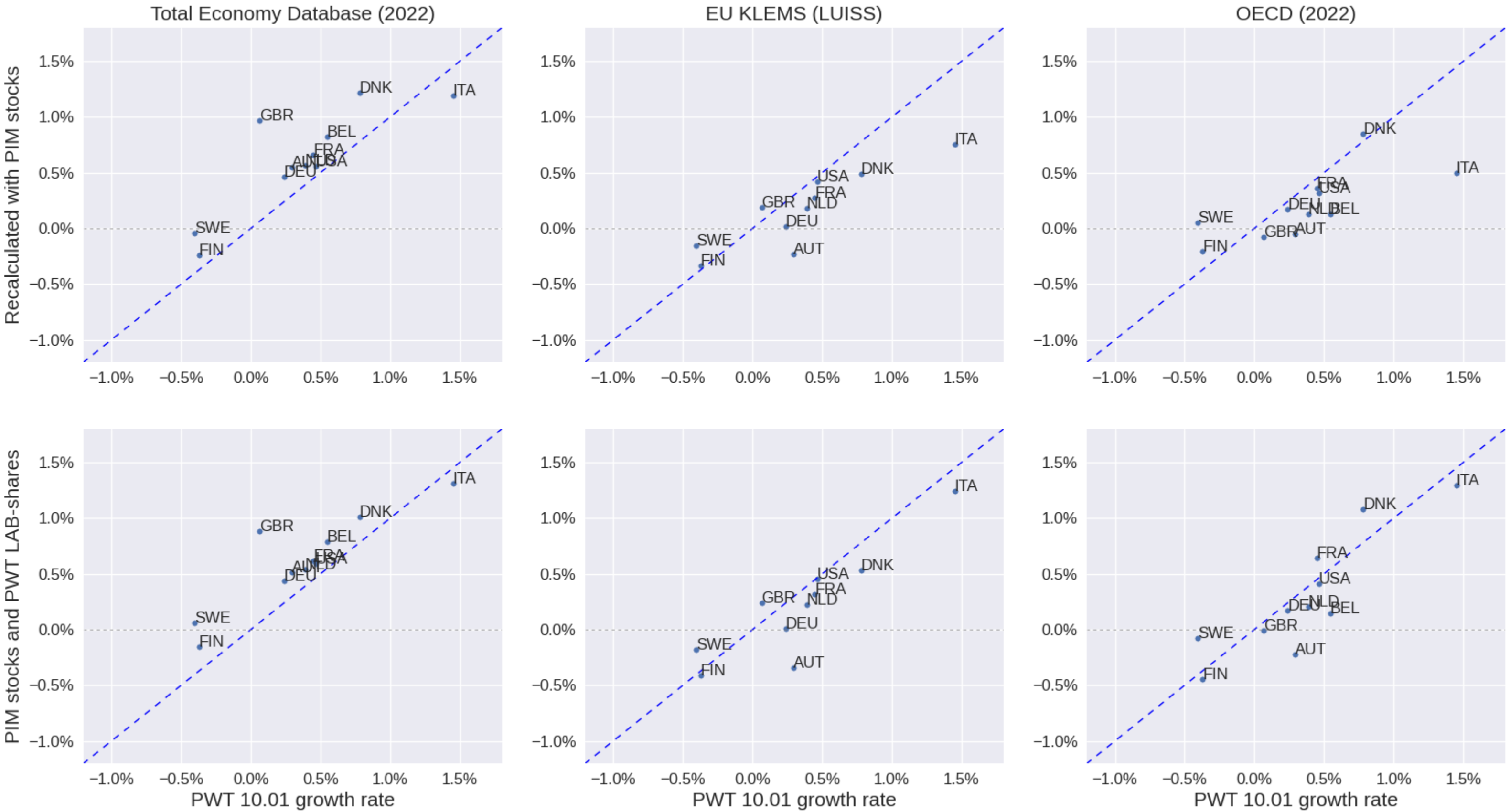


Labour compensation shares

	AUT	BEL	DEU	DNK	FIN	FRA	GBR	ITA	NLD	SWE	USA	Average
PWT10.01	57.5	61.5	62.3	63.6	56.7	61.7	59.6	50.5	60.9	53.0	62.0	59.0
Total Economy Database (2022)	54.9	59.7	59.9	56.3	52.1	58.7	56.0	53.2	57.5	49.1	65.8	56.6
EU KLEMS (LUISS)	66.0		67.1	65.9	63.2	67.1	64.5	62.8	67.3	54.7	65.0	64.4
OECD (2022)	72.0	75.6	71.4	72.1	74.8	76.1	78.7	72.7	74.6	69.1	77.0	74.0

university of groningen / groningen growth and development centre

Method 4: PWT capital shares

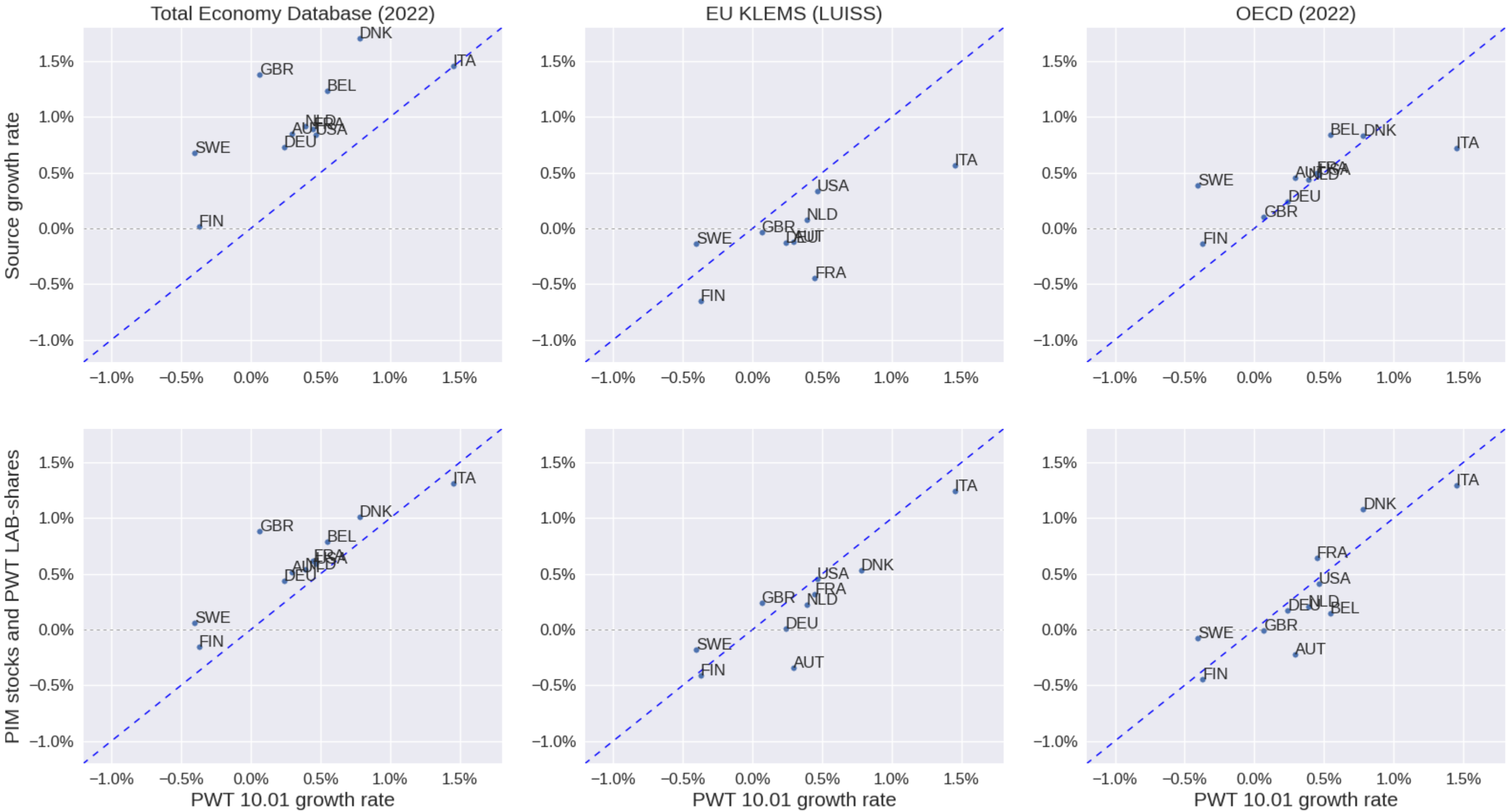


Convergence statistics

Summary statistic:	Total Economy Database (2022) Average difference	(Mean sq. differences)$^{0.5}$	EU KLEMS (LUISS) Average difference	(Mean sq. differences)$^{0.5}$	OECD (2022) Average difference	(Mean sq. differences)$^{0.5}$
Method 1	-0.62	0.71	0.34	0.44	-0.09	0.35
Method 2	-0.47	0.55	0.34	0.46	0.26	0.45
Method 3	-0.26	0.37	0.18	0.31	0.16	0.38
Method 4	-0.25	0.33	0.13	0.25	0.06	0.26

Average difference: contribution from PWT 10.01 minus contribution from the comparison database
(Mean sq. differences)$^{0.5}$: square root of mean squared differences

Comparing Methods 1 and 4



Other sources of discrepancies

› Price deflators (TED) Table 6
  - Example of a conscious methodological choice, we'll see more of this with the inclusion intangible assets

› UK NA revisions (already included in TED and OECD)
  - Example of country specific statistical reasons and vintage issues, despite country and period selection

› Labour composition (LUISS, TED, PWT)
  - This should have a limited effect, clearly a problem with Sweden

2000-2007 aggregate growth in investment prices

	AUT	BEL	DEU	DNK	FIN	FRA	GBR	ITA	NLD	SWE	USA
PWT10.01	0.8	1.0	0.0	1.3	1.9	1.8	1.9	2.0	1.7	0.8	2.1
Total Economy Database (2022)	0.7	0.4	0.0	0.1	2.1	1.5	-0.7	1.1	0.6	-0.6	1.5
EU KLEMS (LUISS)	1.5		0.3	2.1	2.3	2.3	2.2	2.5	2.2	1.4	2.1
OECD (2022)	1.5	1.7	0.3	2.1	2.3	2.3	2.7	2.5	2.2	1.5	2.1

Growth contribution differences of labour composition (in %)

	AUT	BEL	DEU	DNK	FIN	FRA	GBR	ITA	NLD	SWE	USA	Average difference	(Mean sq. differences)
Total Economy Database (2022)	0.41	0.15	-0.15	0.30	0.28	-0.04	0.02	0.04	-0.19	0.10	-0.04	0.08	0.20
EU KLEMS (LUISS)	0.06		0.24	0.41	0.36	0.24	0.13	0.57	0.07	**-1.90**	-0.14	0.00	0.66

Country rankings method 1

	PWT10.01		Total Economy Database (2022)		EU KLEMS (LUISS)		OECD (2022)	
	rank	MFP	rank	MFP	rank	MFP	rank	MFP
SWE	1	1.3	2	0.7	**8**	0.1	2	1.4
FIN	2	1.1	1	1.0	1	1.6	1	1.8
USA	3	0.9	3	0.6	**6**	0.8	3	1.3
GBR	4	0.8	**8**	-0.1	4	1.0	4	1.2
AUT	5	0.7	4	0.5	3	1.1	5	1.1
DEU	6	0.5	5	0.1	2	1.1	6	0.8
NLD	7	0.3	6	-0.1	7	0.6	7	0.7
FRA	8	0.2	7	-0.1	5	1.0	8	0.6
BEL	9	0.1	9	-0.2			9	0.3
DNK	10	0.0	10	-0.4			10	0.2
ITA	11	-1.2	11	-1.2	9	-0.4	11	-0.5

Country rankings method 4

	PWT10.01		Total Economy Database (2022)		EU KLEMS (LUISS)		OECD (2022)	
	rank	MFP	rank	MFP	rank	MFP	rank	MFP
SWE	1	1.3	2	1.1	**9**	0.1	2	1.4
FIN	2	1.1	1	1.2	1	1.3	1	1.5
USA	3	0.9	3	0.8	5	0.6	4	1.1
GBR	4	0.8	6	0.2	4	0.8	5	1.0
AUT	5	0.7	4	0.7	2	1.1	**3**	1.2
DEU	6	0.5	5	0.3	**3**	1.0	6	0.7
NLD	7	0.3	7	0.1	6	0.5	7	0.7
FRA	8	0.2	9	0.1	7	0.4	9	0.4
BEL	9	0.1	8	0.1			8	0.7
DNK	10	0.0	10	0.0	8	0.2	10	0.0
ITA	11	-1.2	11	-1.0	10	-0.7	11	-0.6

Conclusions

- Methodological choices matter, GA-methodology is not entirely robust in terms of level contributions, but more so in the results for comparative productivity
- This type of exercise is useful:
  - For the KLEMS community to spot mistakes and anomalies
  - For users of KLEMS databases, in order to make it clear where differences originate
  - To make it clear what database to use when answering a particular research question
- Whenever a database gets updated, we should be mindful of differences (methodological and statistical) with earlier vintages, and similar related databases

Thank you for your attention!