



Empirical Evaluation of Seasonal Adjustment of Time Series For Compiling Quarterly GHG Emissions Account

London Group

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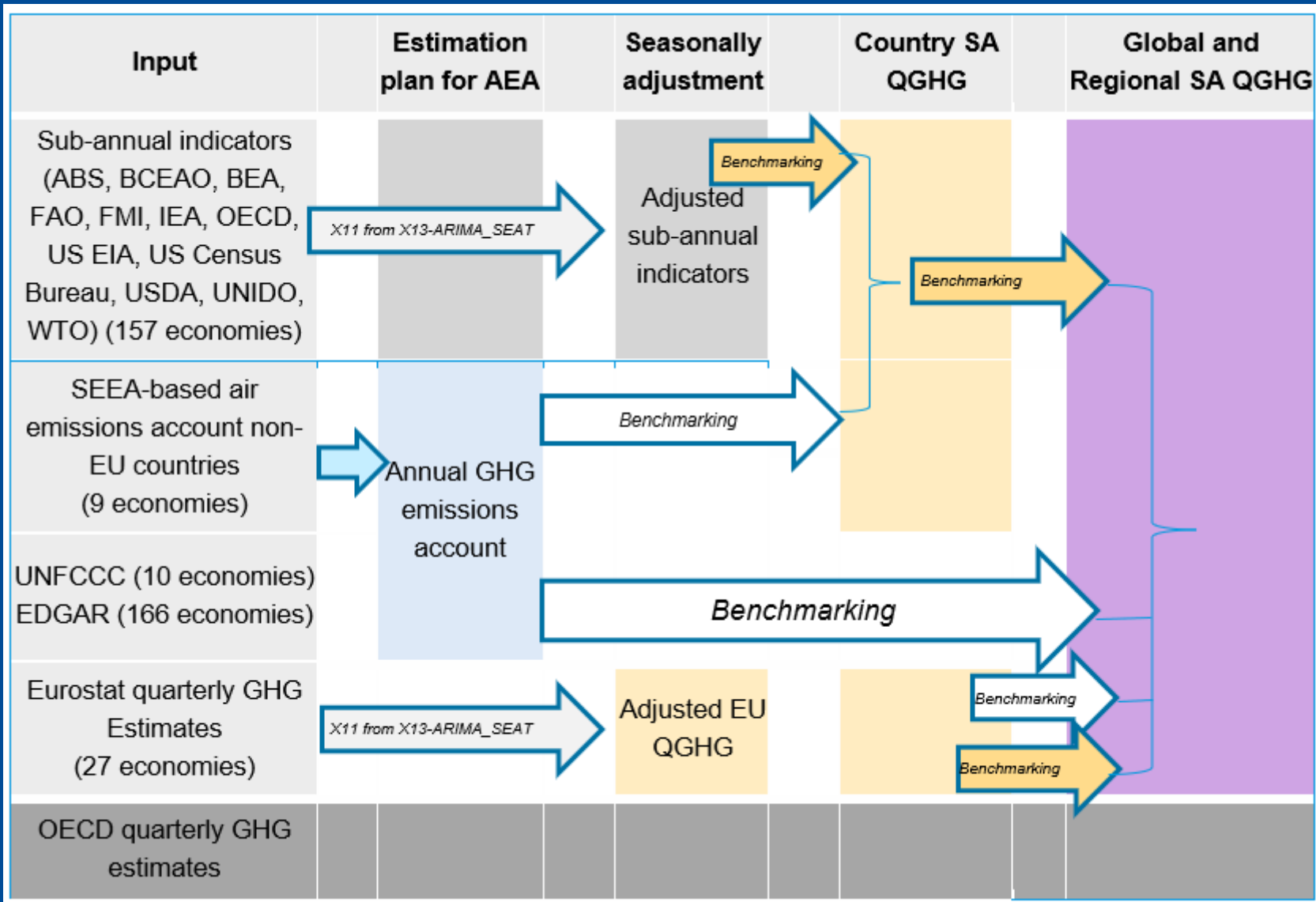
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Outline

- **Background and objective**
- **Design of the study**
- **Some empirical results and discussion**

Background and objective

Gradual implementation of a three-rocket stage strategy for deriving global quarterly GHG emissions



Within the Task Team for measuring quarterly GHG emissions account (Eurostat, IEA, IMF, OECD and UNSD)

Concerns related to X11 seasonal adjustment method

Does X11 work well for climate change related statistics as it does for economic series?

X11: one method of X13-ARIMA-SEATS

Disruption and changes in level modeled in the pre-adjustment phase

Limited choices of length of filters

Economic series have mainly been used for testing

Does X11 with automatic selection model produce acceptable results in a large-scale study?

Good seasonal adjustment requires knowledge about the series to customize the procedure

Difficult to customize large-scale study: 157 countries and 5 thousand series

Automatic model selection relies on computer to make good choices

Design

Data structure

Data sources

IMF sub-annual series: *ABS, BCEAO, BEA, EIA, IEA, IMF, OCDE, UNIDO*

Eurostat quarterly GHG estimates

IMF series with at least one zero value

Series types

Economic series
(energy, external trade, GVA, IIP, labor force, deflated turnover and transportation)

Climate change related series (emissions and heating degree days)

Methodology

Proportions of series with presence of seasonality.

- Null hypothesis of Chi-square (QS) tests: no seasonality
- Rejection : QS larger than 6 or significance level of 0.05.
- Performed on unadjusted and adjusted series.

Proportions of series passing quality control for suitability of X11

- M7 diagnostics measures the relationship between moving and stable seasonality
- QM2 diagnostics is a weighted average of M1 and M3-M11 diagnostics
- Warning if M7 and QM2 exceed 1

Metrics for deviation between two series

- Mean Absolute Percentage Deviation (MAPD)
- Root Mean Square Percentage Deviation (RMSPD)
- Year-on-year (y-on-y) and quarter-to quarter (q-to-q) coincidence

Proportion test for comparing proportions between groups

Empirical Results and Discussion

All types of series are prone to seasonality

Proportion of unadjusted series with QS greater than 6

| Economic series | Overall (IMF sub-annual) | Climate change related series |
|-----------------|--------------------------|-------------------------------|
| 76.5% | 77.7% | 94.3% |

Significant difference across types, but unclear dominance

| | |
|----------------------|-------|
| External trade (min) | 62.3% |
| Labor force (max) | 88.6% |

| | |
|----------------------------|-------|
| <i>Emissions</i> | 78.0% |
| <i>Heating degree Days</i> | 98.5% |

- **Series without seasonal pattern should not be adjusted:** *But, grey area of uncertainty of statistical tests*
- **Exclusion of 1/4 of series might allow more analytical work to examine the diagnostic test and quality control**
- **Further investigation needed for Eurostat series benchmarked with sub-annual emissions data: only 6.7% show presence of seasonality**

Almost all series passing quality control

Proportion of seasonal series with M7 smaller than 1

| Economic series | Overall (IMF sub-annual) | Climate change related series |
|-----------------|--------------------------|-------------------------------|
| 96.1% | 96.7% | 99.6% |

Unsignificant difference across types

| | |
|-------------------|--------|
| Energy (min) | 95.1% |
| Labor force (max) | 100.0% |

| | |
|----------------------------|-------|
| <i>Emissions</i> | 97.6% |
| <i>Heating degree Days</i> | 99.5% |

IMF to dedicate more time on M-diagnostics for 200 series to identify

- Seasonal breaks
- Calendar effects

Airline model can be used as a simpler model for all series

RMSPD metric for seasonal series adjusted with airline VS automatic model selection

| Economic series | Overall (IMF sub-annual) | Climate change related series |
|-----------------|--------------------------|-------------------------------|
| 0.2% | 1.0% | 2.3% |

Unclear dominance

Gross value added (min) 0.1%

Energy (max) 1.4%

Emissions 1.3%

Heating degree Days 2.4%

- Specification of airline model saves time (1/3 less compilation time)
- Airline model barely selected for heating degree days series and series with at least one zero value
- Poor MAPD and RMSPD for series with at least one zero: Will continue to be excluded from the IMF system

Acceptable percentage of residual seasonality in all types of series

Proportion of adjusted series with QS greater than 6

| Economic series | Overall (IMF sub-annual) | Climate change related series |
|-----------------|--------------------------|-------------------------------|
| 1.2% | 1.3% | 2.2% |

Unsignificant difference across types

| | | | |
|--------------------------------------|------|----------------------------|------|
| Labor force (min) | 0.0% | <i>Emissions</i> | 0.0% |
| Index of industrial production (max) | 1.6% | <i>Heating degree days</i> | 2.6% |

- High percentage of residual seasonality associated with exceedance of M-diagnostics
- Evaluation of all M diagnostics to reduce the proportion of series displaying residual seasonality is desirable, but might be unrealistic in a large-scale study

Good news: No induced seasonality with X11 i.e. no presence of residual seasonality into the seasonally adjusted series when the unadjusted series has no seasonal pattern

Series adjusted with X11 comparable to series collected from data providers

RMSPD metric for seasonal series adjusted with automatic model selection VS by countries

| Economic series | Overall (IMF sub-annual) | Climate change related series |
|-----------------|--------------------------|-------------------------------|
| 3.6% | 3.6% | Benchmarks unavailable |

Gross value added (min) 0.7%

External trade (max) 4.9%

- **Expert knowledge and experience not required in a first approach**
- **Knowledge of series and customization of X11 can improve the adjusted estimates**
- **Need for more resources to be allocated to countries to enable them to play a leading role in the driver's seat in the compilation of adjusted series**

Contributions & Questions