The impacts of unusual weather on the Gross Domestic Product (GDP)

UNECE Expert Forum for Producers and Users of Climate Change-Related Statistics
Session 2: Measuring climate change adaptation

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Outline

Econometric model -> Relevant sectors -> Weather variables

Obtained results -> Recommendations for further research

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Report (2014; Pim Ouwehand and Floris van Ruth): to adjust **GDP** also for **unusual weather effects** in order to distinghuish their **irregular behavior** from structural economic changes and to estimate the **magnitude** of unusual weather effects.
https://www.cbs.nl/en-gb/background/2014/12/how-unusual-weather-influences-gdp

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Climate change adaptation: Which sectors are at **risk** and which sectors will **profit** from climate change? -> Update of the former report (2020; Pim Ouwehand), in Dutch:
https://www.cbs.nl/nl-nl/maatwerk/2020/48/klimaatimpact-op-de-economie

The econometric model

ARIMA **A**uto**R**egressive **I**ntegrated **M**oving **A**verage

Is normally used to calculate a **seasonally adjusted GDP** (quarterly time serie per sector).

To include **unusual weather** some extra variables are added. They are transformed from daily to quarterly variables.

Per sector: several **iterations** towards an **optimal model**.

Sectors with significant unusual weather effects

Cold weather increases the heating needs

- B Mining and Quarrying
- D Energy (Electricity, gas, steam and air condition supply)

Severe frost hinders activities

- C Manufacturing
- F Construction

Warm weather leads to a sunny ‘going out’ mood

- I Accommodation and food service activities

Many unusual weather effects will tend to average out over a quarter.

Retail sales will catch up shortly after a very rainy week with less sales.

Unusual weather; available indicators

Unusual weather: deviations from the long term avarage.

Impact on GDP: detectable at sector level on a quarterly basis.

Available weather indicators

Temperature	daily average, min, max
Sunshine	number of hours, day-time %
Rainfall	daily sum, number of hours
Wind speed	daily average, 1h max
Snow	height

Unusual weather; regression variable ‘cold’

Cold weather increases heating needs. Only heating needed when the daily average is below 18 degrees Celsius.

‘Degree days’ = 18 minus ‘daily average’, if it is below 18°C
it is 0, if it is 18°C or higher

Daily average T	…	20	8	-1	-4	-8	…
‘Degree days’	…	0	10	19	22	26	…

From daily to quarterly data: take the sum of ‘degree days’

Unusual weather; regression variable ‘frost’

Severe frost hinders activities. Count the days in a quarter with temperatures below 0°C, below -3°C , or below -7°C.

Daily average T	…	20	8	-1	-4	-8	…
Below 0°C	…	0	0	1	1	1	…
Below -3°C	…	0	0	0	1	1	…
Below -7°C	…	0	0	0	0	1	…
Below 0°C	…	0	0	1	4	8	…
Below -3°C	…	0	0	0	4	8	…
Below -7°C	…	0	0	0	0	8	…

Unusual weather; regression variable ‘warm’

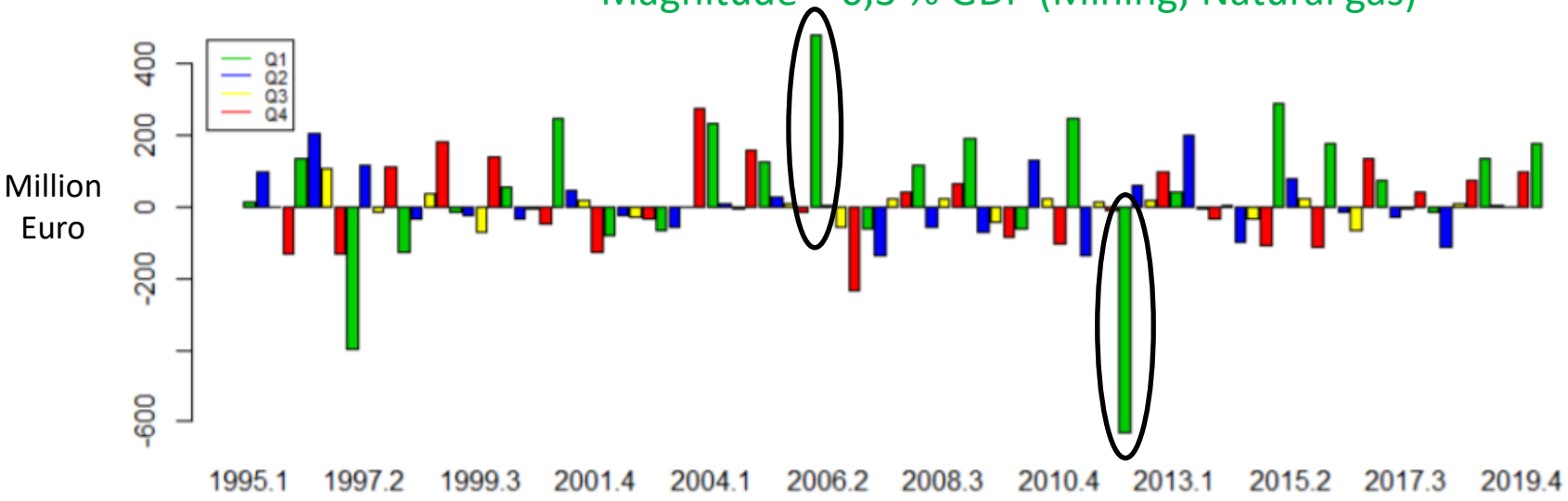
Warm weather leads to a sunny ‘going out’ mood. More drinks, meals, and hotel bookings.

Best proxy	maximum Temperature

Alternatives	
Sunny days	count 1 if ‘day-time % sun’ > 50%, otherwise 0
Nice days	count 1 if sunny day AND average T > 18°C
Rainy days	count 1 if ‘number of hours rain’ > 6

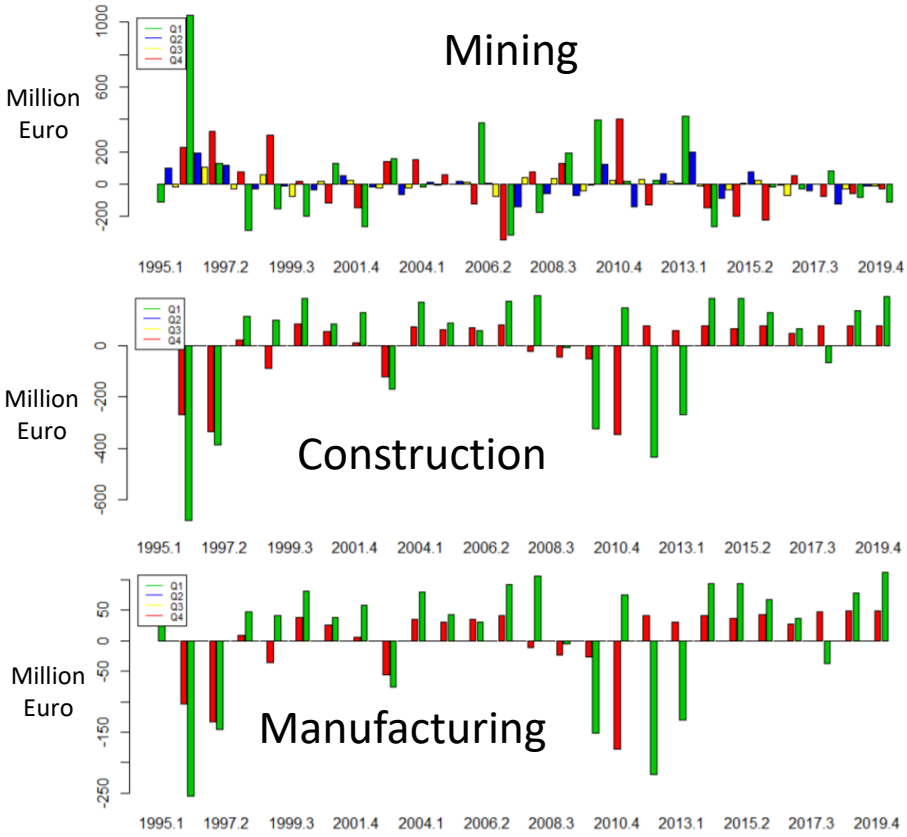
Impact unusual weather on GDP

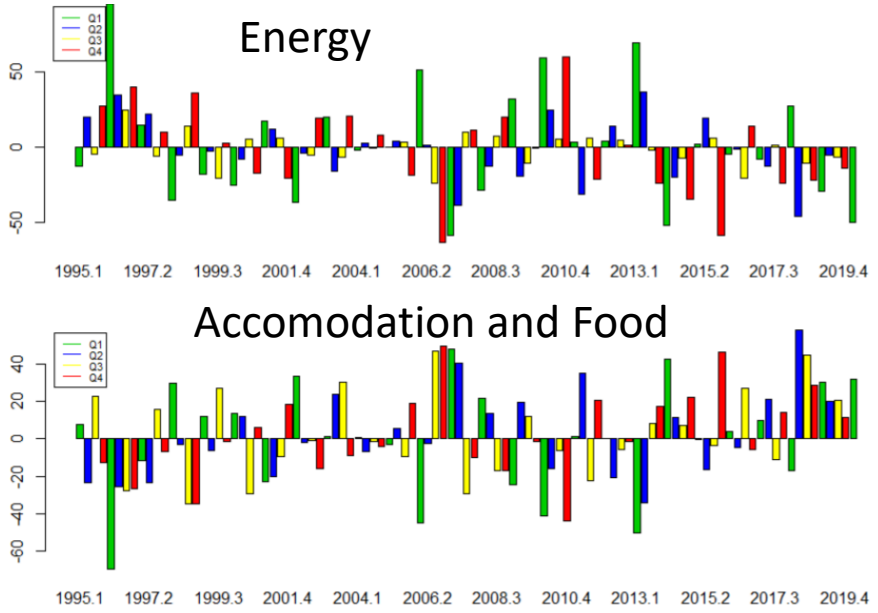
Magnitude = 0,3 % GDP (Mining; Natural gas)



Magnitude = -0,4 % GDP
(Construction and Manufacturing)

Impact unusual weather on GDP (sectors)





Different y-axis values

Mining	-200	1000	Energy	-50	50
Construction	-600	0	Acc. & Food	-60	40
Manufacturing	-250	50	**GDP**	**-600**	**400**

Recommendations

- The transformation from weather indicators (daily) to regression variables (quarterly) is **not trivial**. Also the iteration process towards an optimal model needs **more standardisation**. Future models should also take into account the **Covid-19** effects.
- **More sectors** should be investigated, like **Agriculture** (drought effects). For the already investigated sectors the modeling could also be done for **lower aggregates**, where unusual weather effects might be more prominent (bottom-up approach).
- Unusual weather has both **positive** and **negative** effects on economic growth (GDP). Adaptation measures should not only be focused on sectors at **risk** (minimizing damages), but also on sectors that **profit** from unusual weather (maximizing economic opportunities).
- **More budget** is needed for additional (academic) research. The obtained results are not mature and should be seen as an **inspiring** first exercise.