



Climate Change

Impact on Environment and Society

Manufacturing and Trade

The Impact of Climate Change on Labour Productivity in the Austrian Manufacturing and Trade Sector

Herwig Urban^a, Karl Steininger^a, Matthias Themeßl^b, Angelika Wolf^b, Michael Kriechbaum^b, Michael Pech^b
a University of Graz | b CCCA Service Center

The COIN project evaluates the economic impacts of climate change on labour productivity in the Austrian manufacturing and trade sector.

Main findings

- The analyses of three climate scenarios (mild, moderate, strong) and three socio-economic scenarios (low, medium, high sensitivity) show that in Austria labour productivity losses for the 2016–2045 period are already to be expected under a mild climate change scenario.
- Strong climate change causes annual productivity losses of up to approx. € 40 million (mn) for the 2016–2045 period, and for the 2036–2065 period it will result in losses of up to € 140 mn.
- Vienna, its surrounding areas, and Burgenland will be most strongly affected by productivity losses.
- Due to the interrelations with other sectors, the manufacturing and trade sector's productivity losses will respectively cause three to four times higher damages to the overall economy.

In Austria, climate change affects the manufacturing and trade sector in many ways. The impacts vary considerably across individual branches of industry, and range from changing requirements on cooling measures and cold chains during production and transport, via changing availability of production input from other sectors, to the impact of extreme weather events on the transport infrastructure. Moreover, ever rising temperatures have a significant impact on the productivity of individual workers. A decrease in respective productivity can result in financial losses. The so-called WBGT-Index (»Wet Bulb Globe Temperature«-Index) (ISO 1989) indicates to which extent labour productivity is influenced by changing temperatures and humidity. Additionally, it takes into consideration other factors affecting human beings, such as wind speed and solar insolation. The degrees of exposure to climatic stresses differ between indoor and outdoor work environments.

The interdisciplinary COIN (Cost of Inaction – Assessing Costs of Climate Change for Austria) project evaluates economic impacts of climate change in Austria. For this purpose, a scenario-based analysis of and across twelve key sectors is conducted, which assesses the possible impact of climatic change in combination with socio-economic developments. The main scenario assumes a temperature rise within the two degrees Celsius margin for the period up to 2050. This assumption presupposes stronger climate policies than the ones currently in place. The analyses presented here only show that part of all potential impacts which has already been quantified and takes into consideration individual adjustments made.

Project info box

What has been analysed?

The COIN project has analysed climate change-related changes in labour productivity as the sole effect which could be consistently assessed across the entire sector, using the WBGT index. The latter identifies thresholds beyond which a productivity of 100 % is no longer possible due to the respective temperatures. The threshold for office work (with an assumed work intensity of 200 W) is at approx. 30 °C, that for easy physical labour (300 W) at 28 °C, and that for hard physical labour (400 W) at 27 °C. A temperature rise of »merely« 2 °C on this scale can already reduce productivity by approx. 50 %.

What impacts are to be expected?

Under a moderate climate change scenario¹ and moderate socio-economic developments², the results show productivity losses³ for both the first (2016–2045) and

¹ The calculations were based on daily data and carried out on a regionally disaggregated (NUTS-3) level. The moderate climate change scenario supposes a mean temperature rise of +1.0 °C (+2.0 °C) in Austria and annual changes in relative humidity of +0.1 % (-1 %), comparing the reference period (1981–2010) and the first (second) scenario period 2016–2045 (2036–2065).

² Moderate socio-economic developments (medium sensitivity) suppose a medium-level increase in workforce (+100,000/+150,000 for 2016–2045/2036–2065); changes in labour productivity are effectuated to half their extent in the productivity of other factors of production.

³ The results refer to the comparison of the respective climate scenarios to the reference period of 2003–2012.

Table 1: Average annual climate-related economic impact on labour productivity in the manufacturing and trade sector, based on climate change and socio-economic developments (in million €).

| Future economic impact* relative to Ø 1981–2010 | Climate change | | | | |
|---|--|--------|----------|--------|------|
| | | mild | moderate | strong | |
| Ø 2016–2045 | Socio-economic development (sensitivity**) | low | 2 | -2 | -14 |
| | | medium | 3 | -3 | -24 |
| | | high | 4 | -5 | -35 |
| Ø 2036–2065 | Socio-economic development (sensitivity**) | low | -1 | -12 | -51 |
| | | medium | -1 | -21 | -90 |
| | | high | -2 | -32 | -138 |

* Future economic impact: negative numbers indicate net losses, positive numbers indicate net gains.

**Result sensitivity with respect to socio-economic development parameters.

the second (2036–2065) period, estimated at an annual average of approx. € 3 mn for the first, and € 21 mn for the second period (see Table 1).

Are there regional variations in Austria?

The results also show strong regional variations of labour productivity losses in Austria: overall, Vienna and its southern and northern surrounding areas, Burgenland, and the Weinviertel region will be most strongly affected both on individual days and on annual average. Under moderate climate change, these regions may suffer a labour productivity decrease in outdoor work environments (at 400 W) of approx. 70 % over the 2016–2045 period. On individual days, losses in labour productivity of up to 40 % are also possible in the regions of St. Pölten, Linz-Wels, Eastern Styria, and Graz.

Do alternative projections for the future change the results?

To illustrate the uncertainties as to which climate scenario will occur, additional scenarios assuming mild and strong climate change⁴ were carried out for both periods. Under mild climate change and moderate socio-economic developments over the 2016–2045 period, the results show average annual productivity gains of approx. € 2 mn. However, the findings for the 2036–2065 period already show net losses of approx. € 1 mn. Under a strong climate change scenario, the losses are significantly higher: they amount to € 24 mn in the first, and to € 90 mn in the second period. As socio-economic developments may likewise influence the

⁴ As compared to the moderate climate change scenario, the mild (strong) scenario supposes a mean temperature rise of 0.5 °C (+2.6 °C) for the 2016–2045 period and of 0.5 °C (+3.6 °C) for the 2036–2065 period. The assumed data concerning humidity corresponds to that of the moderate climate scenario.

⁵ Higher sensitivity: stronger increase in workforce (+207,000/+401,000 for 2016–2045/2036–2065), the changes in labour productivity are proportional to changing productivity in other factors of production; lower sensitivity: less increase in workforce (+93,000/+85,000 for 2016–2045/2036–2065), the changes in labour productivity do not affect the productivity of other factors of production.

⁶ The result is based on comparing the respective climate scenarios to a baseline scenario (which interprets socio-economic development without climate change at a medium sensitivity level of the manufacturing and trade sector).

sector's sensitivity to climate change, the current study also takes into consideration different socio-economic scenarios. Those assume different employment growth rates throughout Austria as well as varying mutual impacts of changes in productivity of labour and other factors of production, eventuating in scenarios that assume a higher and lower sensitivity⁵ of the sector. The respective findings deviate substantially from those obtained under medium sensitivity. Strong climate change and low sensitivity, for instance, result in losses of € 51 mn over the 2036–2065 period; higher sensitivity even leads to losses of € 138 mn (see Table 1). Overall, Table 1 indicates that the variability of the climate scenario-related findings is much higher than that of the results relating to socio-economic developments. Therefore, strong climate change would affect the manufacturing and trade sector more strongly than a higher sensitivity to climatic changes.

What impacts on the Austrian national economy can be expected?

The above findings do not yet take into consideration the manufacturing and trade sector's interrelations with other sectors. When taking into account respective feedback effects, the gross national product (GNP) is estimated to decrease⁶ by an annual average of approx. € 10 mn (€ 65 mn) over the 2016–2045 (2036–2065) period under a mild climate change scenario and medium sensitivity of the sector. These losses are three to four times higher than the ones estimated to occur in the manufacturing and trade sector itself. The damages to the overall economy will most strongly affect the health, retail, and real estate sectors as well as the public sector.

References

ISO, International Standards Organization. 1989. Hot environments: Estimation of the heat stress on working man, based on the WBGT-index (wet bulb globe temperature), ISO Standard 7243. Genf.

Urban H, Steiningger KW. 2015. Manufacturing and Trade Services, Chapter 16 in: Steiningger KW, et al. (eds.), Economic Evaluation of Climate Change Impacts: Development of a Cross-Sectoral Framework and Results for Austria. Vienna, Springer.



The project is funded by:

Imprint
CCCA

Servicezentrum
Krenngasse 37
A-8010 Graz
ZVR: 664173679

Projekt leader

Karl Steiningger

Wegener Center for Climate
and Global Change/Uni Graz
<http://coin.ccca.at/>

servicezentrum@ccca.ac.at

www.ccca.ac.at

Last amended: September 2015

ISSN 2410-096X