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Assessment of the economic impacts of heat waves: A case study of Nanjing, China

Yang Xia, Yuan Li, Dabo Guan, David Mendoza Tinoco, Jiangjiang Xia, Zhongwei Yan, Jun Yang, Qiyong Liu, Hong Huo

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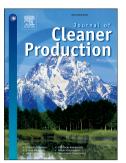
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## ACCEPTED MANUSCRIPT

- 1 Assessment of the Economic Impacts of Heat Waves: A Case Study of Nanjing, China 2 Yang Xia<sup>1</sup>, Yuan Li<sup>1,2,\*</sup>, Dabo Guan<sup>1</sup>, David Mendoza Tinoco<sup>1</sup>, Jiangjiang Xia<sup>3</sup>, Zhongwei Yan<sup>3</sup>, Jun Yang<sup>4</sup>, Qiyong 3 Liu<sup>4</sup>, Hong Huo<sup>5,\*</sup> 4 <sup>1</sup>Water Security Research Centre, School of International Development, University of East Anglia, 5 Norwich NR4 7TJ, UK 6 <sup>2</sup> State Key Joint Laboratory of Environmental Simulation and Pollution Control, School of 7 Environment, Tsinghua University, Beijing 100084, China 8 <sup>3</sup> Institute of Atmospheric Physics, Chinese Academy of Sciences, Beijing, China 9 <sup>4</sup> Chinese Centre for Disease Control and Prevention, Beijing, China 10 <sup>5</sup> Institute of Energy, Environment and Economy, Tsinghua University, Beijing 100084, China 11 \* Correspondence email: y.li4@uea.ac.uk and hhuo@mail.tsinghua.edu.cn 12 13 Abstract 14 The southeast region of China is frequently affected by summer heat waves. Nanjing, a metropolitan 15 city in Jiangsu Province, China, experienced an extreme 14-day heat wave in 2013. Extreme heat can not only induce health outcomes in terms of excess mortality and morbidity (hospital admissions) 16 17 but can also cause productivity losses for self-paced indoor workers and capacity losses for outdoor 18 workers due to occupational safety requirements. All of these effects can be translated into 19 productive working time losses, thus creating a need to investigate the macroeconomic implications 20 of heat waves on production supply chains. Indeed, industrial interdependencies are important for 21 capturing the cascading effects of initial changes in factor inputs in a single sector on the remaining 22 sectors and the economy. To consider these effects, this paper develops an interdisciplinary 23 approach by combining meteorological, epidemiological and economic analyses to investigate the 24 macroeconomic impacts of heat waves on the economy of Nanjing in 2013. By adopting a supply-25 driven input-output (IO) model, labour is perceived to be a key factor input, and any heat effect on 26 human beings can be viewed as a degradation of productive time and human capital. Using this 27 interdisciplinary tool, our study shows a total economic loss of 27.49 billion Yuan for Nanjing in 2013 28 due to the heat wave, which is equivalent to 3.43% of the city's gross value of production in 2013. 29 The manufacturing sector sustained 63.1% of the total economic loss at 17.34 billion Yuan. Indeed, 30 based on the ability of the IO model to capture indirect economic loss, our results further suggest 31 that although the productive time losses in the manufacturing and service sectors have lower 32 magnitudes than those in the agricultural and mining sectors, they can entail substantial indirect 33 losses because of industrial interdependencies. This important conclusion highlights the importance 34 of incorporating industrial interdependencies and indirect economic assessments in disaster risk 35 studies.
- Keywords: Heat Wave, Health, Productivity, Capacity, Macroeconomic, Input-output Analysis,
  Indirect Loss, Nanjing, China
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