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Protocol for Systematic review based on PROSPERO guidelines (adapted) V.1

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This protocol sets out the approach taken for the systematic review: the causal effect of the Chinese pilot emission trading scheme on CO2 emissions.

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Protocol for Systematic review
based on PROSPERO guidelines (adapted)

1. Review title

Systematic review on the causal effect of the Chinese pilot emission trading scheme on CO2 emissions

2. Original language title

3. Anticipated or actual start date.
22.03.2022

4. Anticipated completion date
31.10.2022

5. Stage of review at time of submission

Review stage	Started	Completed
Preliminary Searches	Yes	Yes
Piloting of the study selection process	Yes	Yes
Formal screening of search results against eligibility criteria	Yes	No
Data extraction	Yes	No
Risk of bias (quality) assessment	Yes	No
Data analysis	No	No

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11. Review team members and their organisational affiliations
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12. Funding sources/sponsors
Lehrstuhl für Ökonometrie, Universität Mannheim, Germany

13. Conflicts of interest
There are no known conflicts of interest.

14. Collaborators
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15. Review question
Did the pilot emission trading scheme (ETS) in China successfully reduce CO2 emissions? If so, by how much? Is there evidence of publication bias and if so, what is the corrected estimate of the effectiveness of the Chinese ETS?

16. Searches
The sources are the following: CNKI, EBSCO GreenFile, EBSCO EconLit, EBSCO Academic Search, Web of Science, RePEc EconPapers, RePEc IDEAS, Lens, Science Direct,
And the reference lists of the included papers found by the previous sources, as well as the papers citing the included papers found by the previous sources (forward and backward snowballing). Any additional studies found via snowballing will also be used as a basis for forward and backward snowballing until no further relevant studies are found.
Search dates were from 24.03.2022 – 12.04.2022
Searches were restricted to studies in English and in Chinese, published on or after 01.01.2015. The searches will be re-run prior to the final analysis if possible. Unpublished studies were actively searched for.

17. URL to search strategy
Search strategy is available upon reasonable request.

18. Condition or domain being studied
CO2 market introduction

19. Participants/population
Chinese pilots for emissions trading; Beijing, Tianjin, Shanghai, Chongqing, Guangdong, Hubei and Shenzhen

20. Intervention(s), exposure(s)
Introduction of CO2 emission trading

21. Comparator(s)/control
Chinese regions without emission trading (studies could also be at a different level, e.g. cities)

22. Types of studies to be included
Quantitative studies that measure a causal effect, e.g. DID methodology. We expect only quasi-natural experiment methodology

23. Context

This systematic review focuses only on the Chinese emission trading scheme, as the context there is quite different than in western countries where CO2 markets are more established. The pilot phase gave researchers the opportunity to conduct quasi-experimental research on the effectiveness of such an intervention. As we aim to calculate an effect size, studies that only supply graphical evidence without stating precise regression results will not be included.

24. Main outcome(s)
Initially absolute and logarithmic carbon emissions, carbon intensity and carbon productivity. However there were so many studies that this exceeds the scope of this review, which is why the analysis will limit itself to logarithmic carbon emissions as a main outcome from the stage of data extraction onwards.

25. Additional outcome(s)
Potentially absolute carbon emissions, carbon intensity or carbon productivity, depending on the availability of further resources.

26. Data extraction (selection and coding)
The study selection will be conducted using EPPI reviewer 4. All coding will be done by two people when the language allows for it (i.e. studies in english) and disagreements will be resolved by discussion. For the double screening, coders are blind to the other's decision until both have been submitted for each paper. Therefore 63.9% of papers were double screened at title abstract level, and 44.2% at full text level. Additional checks were performed for the studies in Chinese using online translation tools as a quality control method. Disagreements were very limited and few.
Data extraction will include the reduction effect based on the regression coefficient and other statistical information, the method used, which pilots were included in the analyses, the time frame of the data the analysis is based on, which control variables were included in the regression, and other information that could be relevant to explaining differences between the results of studies.
Ideally data extraction would be conducted by two independent people for each paper, however due to time constraints, only around 55% of papers will be double screened. When studies don't report regression results, they will be excluded. For other missing data or when something is unclear, study investigators will be contacted. Data extraction will function via an online data extraction form that functions as a survey (Microsoft Forms), so that results can be downloaded into an Excel file, which can easily be imported into Stata 17 for data analysis.

27. Risk of bias (quality) assessment
The risk of bias assessment will be part of the data extraction. Multiple potential sources of bias – especially those that could lead to publication bias – will be described. This includes sampling frame and sampling process, transparency, attrition, missing data, spill-overs, whether outcomes are clearly defined, baseline balance, for DiD: whether parallel trends assumption is tested, conflict of interest and references stated, model selection, data source used and author affiliation in terms of risk of bias via career incentives.

28. Strategy for data synthesis
Data synthesis will be conducted if at least 10 studies with comparable outcomes (e.g. no mixing absolute and logarithmic CO2 emissions) are found. Ideally the studies will mention average effects

over the multiple years of measurement they have, but potentially (given the availability of data) this could also be done for individual years post-implementation.
A large part of the systematic review will be the investigation of potential publication bias and its correction. A finalized decision on the methods to be used for correction hasn't been made yet, but might include Egger-tests, p-value test, selection model(s) and/or other methods.

29. Analysis of subgroups or subsets
Subgroup analysis could be conducted by differentiating between language of study, whether studies were published in journals or not, by methods, data source, or timing. The possibility of different subgroup analyses depends on whether more than 10 studies are found in corresponding subgroups to be compared.
In principle, the studies investigated are all trying to measure the effect of one single intervention. Their approaches differ, and so do the data they base their analyses on. However, if one assumes a theoretical distribution of effect sizes an intervention could have, the Chinese emission trading scheme is one realization from this distribution, meaning any differences between studies should be due to methodology, measuring errors, or other intrinsic factors, and not due to an actual distribution of effect sizes.

30. Type and method of review
This review is a systematic review with meta-analysis.

31. Language
The review will be written in English.

32. Country
The review is being carried out in Germany

33. Other registration details
None

34. Reference and/or URL for published protocol

35. Dissemination plans
Additionally to being submitted to the university of Mannheim as part of my degree, the report may be adapted into a paper and submitted to a leading journal in this field.

36. Keywords
Systematic review, meta-analysis, China, ETS, carbon, GHG, emissions, emission trading, CO2, carbon market, pilot

37. Details of any existing review of the same topic by the same authors
"ATTRIBUTES OF TRANSFORMATIONAL CHANGE IN THE ENERGY AND PUBLIC HEALTH SECTORS" by C4ED on behalf of Green Climate Fund and Climate Investment Fund. Publication imminent.

38. Current review status
Ongoing

39. Any additional information

40. Details of final report/publication(s)