



Analysis

Identifying Links between Economic Opportunities and Climate Change Adaptation: Empirical Evidence of 63 Cities



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ABSTRACT

This paper empirically explores the linkage between the economic opportunities and climate adaptation and other antecedents in cities. Our dependent variable includes the economic opportunities identified by the cities; our independent variables are the adaptation plans, adaptation actions, climate change risks, incentive types, and incentivized stakeholders. To explore the effects of climate change risks, adaptation plans, adaptation actions, incentive types, and incentivized stakeholders, we used polychoric factor analysis and logistic regression analysis. The results show that a city's climate change adaptation plan and GDP have significant positive relationships with the economic opportunities present in the cities. Meanwhile, climate change risks also have a positive relationship with economic opportunities. Furthermore, economic opportunities present in cities have a negative relationship with three variables: one group of climate actions and two groups of stakeholders. This paper also further discusses the possible effects of incentives in the case of climate change in cities.

1. Introduction

Many of the climate risks encountered in cities require a successful climate change adaptation, and IPCC calls for efforts to ensure efficient and cost-effective adaptation actions (IPCC, 2014). Adaptation is emphasized as one of the essential climate change measures by the United Nations Framework Convention on Climate Change (UNFCCC, 2007) and it is considered relevant for policy-makers (Vale, 2016). The definition of adaptation recognized by the UNFCCC and recorded in the Fifth Assessment Report of IPCC reads as “the process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects” (IPCC, 2014, p.118). Climate change adaptation planning is the phase preceding implementation. Policy is a vision of decision-makers and a plan is the realization of the vision of decision making (Haasnoot et al., 2013). A climate change adaptation plan is a strategic plan with the overarching objective to reduce vulnerability and climate change impacts. Climate change actions are the practices of the adaptation plans (IPCC, 2014).

Climate change adaptation is critical for long-term sustainability of economies, societies, and environments (O'Brien et al., 2012). It is crucial for cities and city-level climate change adaptation to address

impacts and economic costs across different sectors due to climate change (Hunt and Watkiss, 2011). Recognizing its importance, local governments have started to initiate climate change adaptation plans and invest in adaptation (Woodruff and Stults, 2016).

In this paper we analyze the adaptation actions from an economic perspective. For this purpose they can be categorized according to three economic principles: no-regret, low-regret, and win-win adaptation (Sainz de Murieta et al., 2014; UKCIP, 2007). Besides possible benefits, adaptation can sometimes also have trade-off effects with mitigation, such as installing air conditioning to adapt to a warmer climate could result in higher carbon emissions and urban heat island effects. The costs and benefits are also described in a trade-off relationship whose benefits include the potential damage savings (every increased expectation of disaster adds to the present value of benefits, as a calculation of the damages avoided) and potential gains, together with a calculation of costs associated with the adaptation measures (Heuson et al., 2014). Research on the economics of climate change adaptation often focuses more on costs rather than benefits, including costs of adaptation measures and costs of damage prevention in the future (Heuson et al., 2014; Hübler et al., 2008; Stern, 2007). Adaptation sometimes requires initial capital investments; therefore, there are different ways to calculate the economic outcomes of adaptation: cost-benefit analysis, net present value calculation, or cost-effectiveness

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analysis. Studies on payments or valuations of ecosystem services are emerging (Brink et al., 2016; Dawson and Martin, 2015; De Groot et al., 2002; Derbek et al., 2015; Farley and Costanza, 2010; Grêt-Regamey and Kytzia, 2007; Gutman, 2007), for instance, which study the effect of ecosystem service valuations on mitigation efforts (Balderas Torres et al., 2015). Comparatively, there is less focus in empirical studies on finding relationships between economic benefits and climate change adaptation. The existing empirical case studies focusing on benefits mainly address agriculture, presenting results where adaptation measures show positive gains in farm net returns and losses due to inaction towards climate change (Singh et al., 2015).

Our sample questionnaire was addressed to local governments to provide information on the incentives to climate change efforts (CDP, 2012); in academic literature, there is a gap in research regarding the effects of these incentives on climate change efforts in cities. What we do not know are the effects of incentives on local climate change policy implementation in cities. But why is it important to study the impacts of incentives on climate change policy in local governments? The topic of assessing the effects of incentives is important because economic incentives are widely applied and it is especially relevant for topics regarding environmental issues (Neuteleers and Engelen, 2015). In fact, studies have shown that there are both negative and positive effects, namely crowding-out and crowding-in effects of economic incentives (Rode et al., 2015). It is important to know whether the effects of such incentives encourage or discourage motivations to ensure efficient investments. The effects have been studied and categorized into two main effects: crowding-in and crowding-out effects (Neuteleers and Engelen, 2015; Rode et al., 2015; Sandel, 2013; Varghese et al., 2013). Crowding-out effects describe the fact, that economic incentives undermine or reduce motivation of people to engage, while crowding-in effects reinforce or strengthen people's motivation to devote their efforts (Neuteleers and Engelen, 2015; Rode et al., 2015; Sandel, 2013). Even though there are researchers studying the crowding-out effects in the areas of resource use, mobility, consumption decisions, and pollution, there is relatively little literature focusing on incentives and economic instruments in climate change adaptation (there are, however, some studies focusing on insurance and trade-related instruments) (IPCC, 2014; Rode et al., 2015; Sainz de Murieta et al., 2014).

In order to have a worldwide sample, the CDP (Carbon Disclosure Project) database is chosen as the questionnaires answered by cities worldwide in 2012 provided answers concerning cities' climate change risks, plans, adaptation actions and incentives. Furthermore, data concerning cities' temperature and precipitation are obtained from the World Meteorological Organization database. Data of GDP estimates are from several city-level reports and databases. In the end, 63 cities fit these requirements.

The following section reviews the literature on the economics of climate change adaptation, incentives and theoretical foundation of motivation crowding theory. Section 3 illustrates our research methods and data, followed by Section 4 which discusses the results and is followed by the discussion of limitations of this research and hints for future research in Section 5. The last section concludes our paper with our main findings.

2. Literature Review and Theoretical Considerations

The discipline of economics plays a key role in the field of climate change adaptation due to its contribution of tools and methods which provide potential answers and solutions which are crucial to the adaptation policy (IPCC, 2014). However, the economics of climate change adaptation is still a relatively young field of research and currently is growing at a considerable pace, already exhibiting a wide range of methodological approaches and research questions (Heuson et al., 2014). Further advances in the understanding of consequences of climate adaptation policy are especially needed in research (Burke et al., 2016). This has generated the motivation of this research to use

empirical data from cities to better understand the outcomes of climate change adaptation to answer the main research question: How are climatic, demographic, and economic variables associated with economic opportunities in terms of climate change adaptation in cities? To answer the research question, the following section of the paper deduces a series of hypotheses along with descriptions of each variable.

Current climate change adaptation literature focuses on physical impacts of potential adaptation responses, such as protection measures against storm surges and floods. For instance, the empirical results link past flood damage experience and damage expectations to climate change actions (Osberghaus, 2015). The existing research rarely uses risks as a function in the analysis (Lasage et al., 2014). Two opposing theories concerning risks explain different effects they could have on the cities. First, the risks could cause possible economic and ecological damages due to the experienced hazards. However, the experienced hazards could better prepare cities for future climate change planning and thus make them more resilient in their local economy due to their preparedness for climate change (Huang-Lachmann and Lovett, 2015). We are eager to determine whether risks themselves have any effects, especially in the form of damage to local economies. Therefore, climate change risks are also chosen as a variable in our regression analysis, to test the hypothesis whether a city's climate change risks are associated with its economic opportunities.

When it comes to adaptation as a variable, the studies usually analyze adaptation as one general variable. However, there are different kinds of adaptation actions with different functions. According to IPCC, adaptation actions present diverse options in cities: sea level rise, water, urban flooding, energy, health, and combined sectors of the adaptation options (IPCC, 2014). It is important to distinguish these and investigate the details of different adaptation actions in order to provide more precise information for policymaking and implementation efforts due to budget allocation at the national or local levels (Trærup and Stephan, 2015). Therefore, in our study we differentiate between the adaptation plans and actions by coding them separately to firstly test whether a city's climate change adaptation plan is associated with its economic opportunities. Then, to explore the details of adaptation actions carried out in cities, a factor analysis is used to allocate the actions to different groups for our analysis. There are several ways to categorize actions of adaptation, and IPCC (2014) differentiates three main categories: physical, social and institutional. For instance, physical actions include the engineered and built environment, technological and ecosystem based adaptation, and services (IPCC, 2014). Social actions include educational, informational, and behavioral actions while institutional adaptation includes economic, legal and governmental actions (IPCC, 2014). This categorization is used to test whether a city's climate change adaptation actions are associated with its economic opportunities. Climate adaptation actions could sometimes provide short-term benefits but nevertheless, lead to adverse consequences in the long run (Warner et al., 2012; Warner and van der Geest, 2013).

Furthermore, economic studies focusing on climate change adaptation tend to focus more on the hard adaptation measures and may lead to a bias which neglects potentially critical soft measures needed to facilitate adaptation (Agrawala and Fankhauser, 2008). Investments in soft measures are rarely assessed in the literature. Other relevant indicators related to human, social, natural, physical, and financial capitals should also be considered (Brown et al., 2015). Economic viability, individual or institutional variables, and benefits should also be included in variables to be assessed (Nambi et al., 2015). Therefore, economic opportunities are chosen as the dependent variable.

In addition to climate change risks, climate adaptation plan, and actions, it is also pointed out that information, incentives, and resources are also very important for decision making regarding adaptation policy (Markandya et al., 2014). The proper information is needed for the local governments to understand the climate change impacts. The costs and benefits of available adaptation options should be made available to the local governments for their implementation. However, the

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