Hamburg Institute
of International
Economics

Economic Impacts of Climate Change on Cities

A Survey of the Existing Literature

Georgios Stasinopoulos

HWWI Policy
Paper 1-18
by the
HWWI Research Programme
Hamburg and Regional Development

Hamburg Institute of International Economics (HWWI) | 2009
ISSN 1862-4960

Georgios Stasinopoulos
georgios.stasinopoulos@yale.edu

HWWI Policy Paper
Hamburg Institute of International Economics (HWWI)
Heimhuder Str. 71 | 20148 Hamburg | Germany
Phone +49 (0)40 34 05 76 - 0 | Fax +49 (0)40 34 05 76 - 776
info@hwwi.org | www.hwwi.org
ISSN 1862-4960

Hamburg Institute of International Economics

HWWI

Economic Impacts of Climate Change on Cities

A Survey of the Existing Literature

Georgios Stasinopoulos[1]

[1] Yale College Class of 2012, pursuing a degree in Economics. This paper was written from May to July 2009 during a research stay at the Hamburg Institute of International Economics (HWWI) with the support of the Whitney and Betty MacMillan Center for International and Area Studies and the Leitner Project Awards Program. PO 201651, New Haven, CT 06520 USA. E-mail: georgios.stasinopoulos@yale.edu. I would like to thank Silvia Stiller and Sven Schulze from the Hamburg Institute of International Economics (HWWI) for their helpful comments on the paper.

Abstract

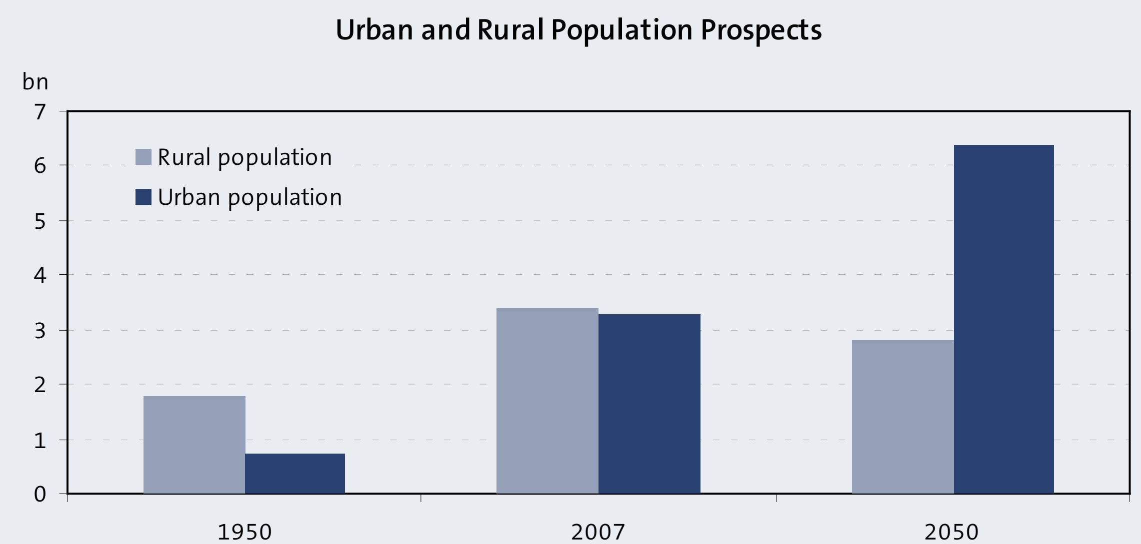
This paper attempts a survey of the existing literature on the direct market impacts of climate change on urban centers. In the first chapter, the argument for the importance of cities as case studies for research on the impacts of climate change is established using current population data and future projections. In the second chapter, a brief overview of how we can go from the global level to the regional level, when we consider the impacts of climate change, is given. In the third chapter, we examine the models and their estimates for the sea level rise impacts on cities. In the fourth chapter, we summarize the impacts of increasing temperature. In the last two chapters, we elaborate on the current limitations and we present some conclusions.

Table of Contents

1. The Importance of Cities

The forecasts regarding the speed and intensity of climate change might vary, but the general consensus is that its consequences would have significant impacts on the world economy. Although there has been no extensive research on the exact measure of the impacts on a monetary scale, the Intergovernmental Panel on Climate Change (IPCC (2007)) predicts that the global mean losses, for a 1 ^{0}C increase in temperature, would range from 1-5% of the global GDP. However, these economic loss predictions vary geographically. Some countries and cities would suffer greater losses, whereas others would probably benefit from the climatic changes. Developing countries, port-cities and urban centers located in low elevation zones are included in the first category. Hence, this survey will focus on the literature concerning the direct market impacts of climate change on cities.

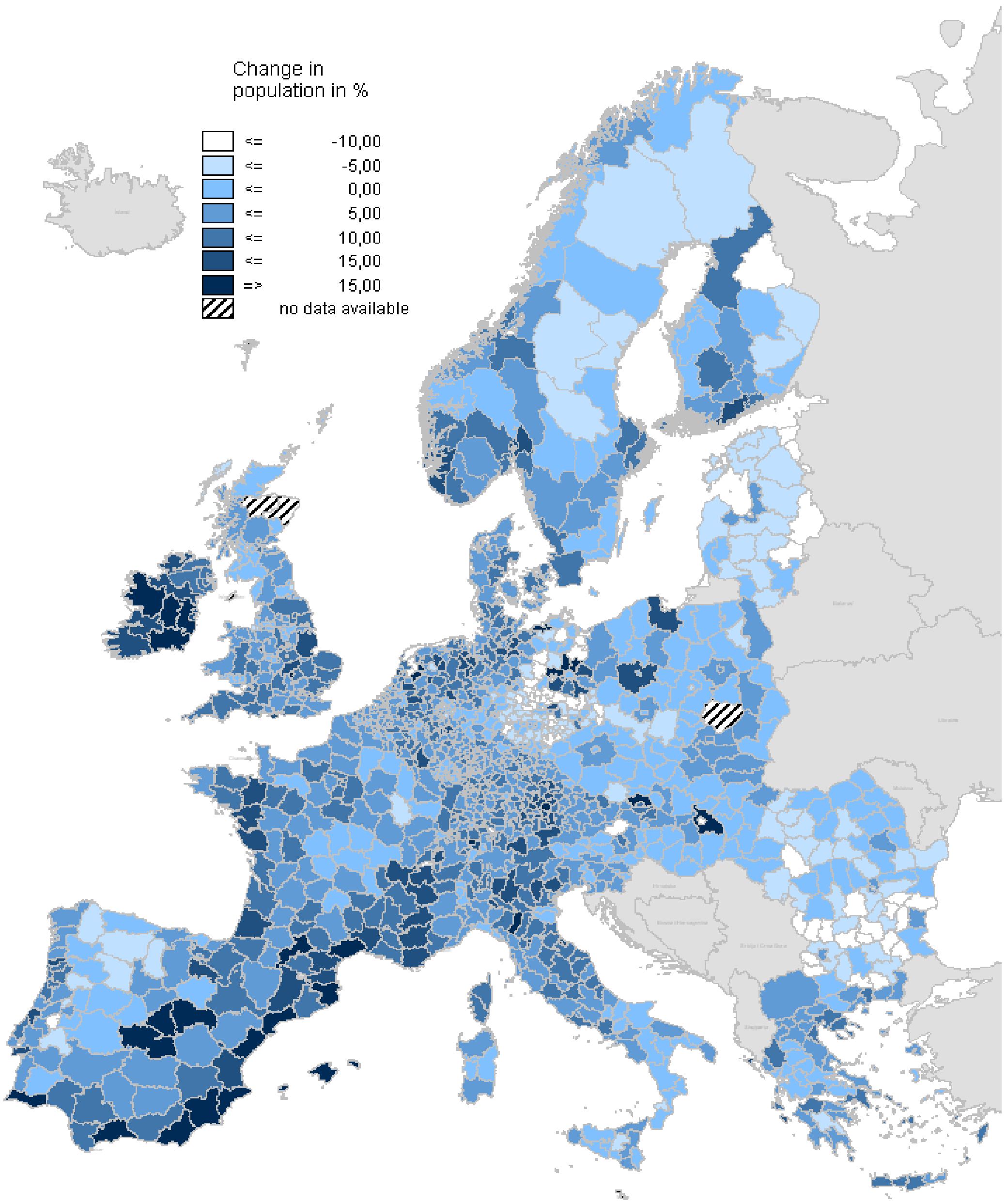
Figure 1



Sources: Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat (2009); HWWI 2009.

Urban centers are the pillars of the world economy as they host almost 50% of the world's population. According to the United Nations 2007 Population Report, 3.3 billion people are currently residing in cities, with this figure projected to increase by 3.1 billion by 2050 (see figure 1). When this happens, almost 70% of the world's population will be living in cities. So it is sensible to say that the struggle mitigating and adapting to the climatic changes would be a battle mainly taking place in urban settings. As the first figure suggests, the surge in urban population would be accompanied by a steady decrease in rural population. As the report suggests, this increase will be equally divided between developed and developing countries.

Figure 2: Change in population, 1995 to 2005



Sources: Eurostat (2009); calculations HWWI (2009).

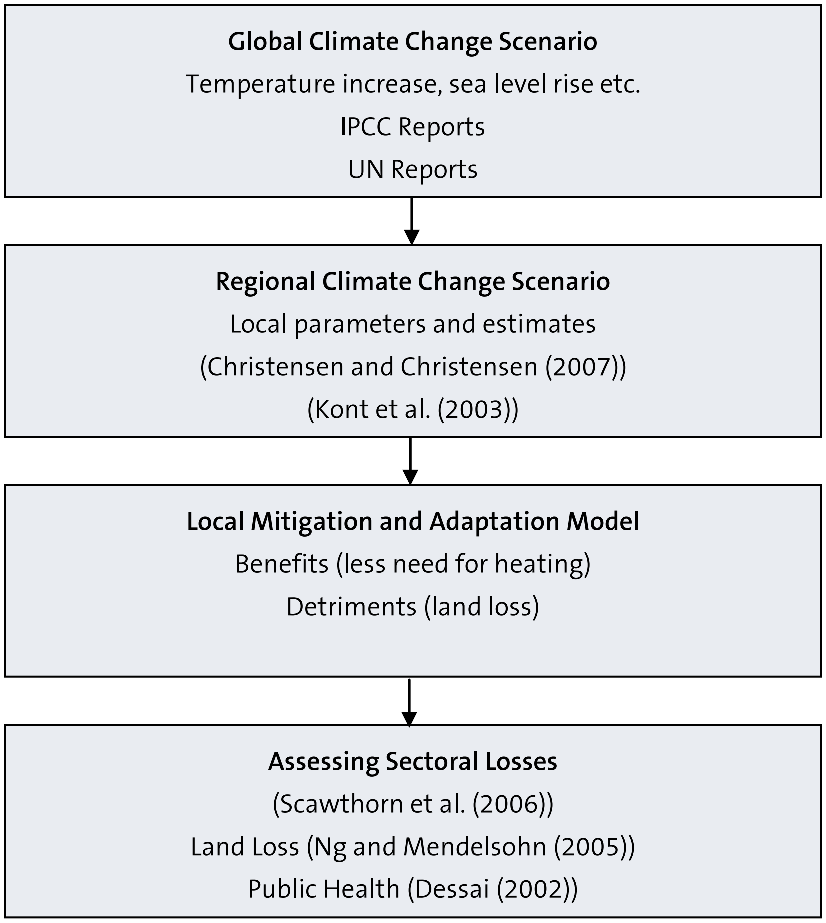
On top of that, we should also point out the tendency of people to agglomerate toward cities located in coastal zones. The population map of Europe can prove this point (see figure 2). We can see how the regions next to the coasts have experienced higher changes in population than the ones in the hinterland. However, the port-cities along with their economic advantages are also really vulnerable to storm surges and changes in the sea level (Nicholls et al. (2007)). McGranahan et al. (2007) calculates that 10% of the world's population and 13% of the world's urban population reside in Low Elevation Coastal Zones (LECZs = elevation less than 10 m). Also according to his research, 8% of the world's urban land is also located in LECZ.

If we combine McGranahan's et al. (2007) results and the UN predictions, we can see how the number of people and land directly endangered by the impacts of climate change would continue to surge in the long term. This is why examining and measuring the economic impacts of climate change on a city level is crucial for raising local awareness and for the developing of effective mitigation and adaptation policies.

2. Climate Change: From the Global to the Regional Level

The economic consequences of climate change differ regionally due to various reasons. Depending on their geography regions are affected differently by the outcomes of climate change, e.g. extreme weather events, rising temperature and desertification. Hence, alongside global climate change scenarios, regional and local models have been developed (see figure 3).

Figure 3: Geographical Dimensions of Climate Change



Source: HWWI (2009).

So far there has been a considerable amount of economic papers regarding the broader, global socio-economic impacts of climate change on countries and regions (see Dorland et al. (1999); Deke et al. (2001); Berrittella et al. (2000)). However, further downscaling and narrowing is needed to capture and quantify the impacts on a city level. Hallegate et al. (2008a) develop a conceptual framework for the study of these impacts. By closely studying the pre-existing literature, they provide an overview of the methodologies used to assess the economic consequences of climate change and particularly the economic costs associated with changes in the intensity of extreme events in cities. By combining Hallegate et al. (2008a) and Dore and Burton (2001) the process of narrowing down generally follows the steps described in the flow-chart (see figure 3).

This process entails many difficulties that make the direct calculation of the economic impacts a challenge. There are currently many global models and diverse climate scenarios so their downscaling is usually complicated. Also, when mitigation and adaptation emerge in the picture, more uncertainty is the result; what determines the level of adaptation and what is the role of regional, national and international measures on the city level. Furthermore, assessing and quantifying the sectoral losses and damages is not always possible. It is comparatively easy to measure the damage costs of land and assets loss (Ng and Mendelsohn (2005); Breil et al. (2005)). Evaluating the loss of human lives due to a heat wave, or the drop in labour productivity because of the dire effects of climate change on public health in economic terms is much more complex and often an ethical issue.

Figure 4

<table>
<tr><th colspan="5">Direct and Indirect Economic Impact of Climate Change</th></tr>
<tr><th rowspan="2">Impacts</th><th colspan="3">Direct</th><th rowspan="2">Indirect</th></tr>
<tr><th>Climate Mean Changes</th><th>Climate Variability Changes</th><th>Catastrophic Changes</th></tr>
<tr><td rowspan="4">Market</td><td>Decreased/Increased energy consumption due to heating/cooling demand</td><td rowspan="4">Asset losses due to hurricanes or storm surges (V)</td><td rowspan="4">Major asset losses due to catastrophic sea level rise</td><td>Effect of the decline in tourism on the city economy</td></tr>
<tr><td>Rise/Fall in tourism due to higher temperature</td><td>Fall in worker productivity because of health problems</td></tr>
<tr><td rowspan="2">Asset losses due to mean sea level rise (V)</td><td>Spatial or sectoral diffusion of economic losses into the wider economic system (e.g. through disruption of lifeline services , following a storm surge(V)</td></tr>
<tr><td>Effects on long-term economic development</td></tr>
<tr><td rowspan="3">Non Market</td><td>Increased mortality and morbidity from e.g. development of vector borne diseases due to increase in global mean temperature</td><td>Number of deaths because of more frequent heat waves</td><td rowspan="2">Cultural losses and migration, including ethical aspects induced by natural catastrophe</td><td>Effect of climate change induced water shortages on mortality and morbidity</td></tr>
<tr><td>Loss in thermal comfort in the city</td><td>Population at risk in coastal cities because of storm surge (Q)</td><td>Deepening of inequality; loss of social cohesion and inter-/intra-state conflict</td></tr>
<tr><td>Population at risk because of sea level rise (Q)</td><td colspan="3"></td></tr>
<tr><td colspan="5">Notes: V = valuation in monetary terms; Q = valuation in physical terms</td></tr>
</table>

Sources: OECD (2008); HWWI (2009).

This is why it is useful to break down the different types of impacts on cities. For this objective, Hallegate et al. (2008a) follow a practicable division. Climate change impacts are categorized as direct or indirect, market or non-market impacts (see figure 4). Direct impacts are the short-term and immediate impacts due to weather changes or the surge in the occurrence of extreme events. Indirect impacts are long-term impacts that are by-products of climate change induced by direct impacts. Market and non-market impacts are classified according to their ability to be valuated in purely economical or physical terms.

In this paper, a focus on the direct market impacts will be given. The market impacts, particularly at a city scale, are more easily quantifiable and the direct-short-term ones are also more accessible research-wise. The table in the Appendix summarizes the main conclusions drawn by papers written about the climate change impacts on a city-scale. For every paper, we list the climate change effect and the market impact they examine, the methodology used and the estimates and conclusions drawn. Overall, we distinguish two main categories of impacts: sea level rise impacts and increasing temperature impacts. The rise in the sea level causes flooding, inundation of land, assets losses, private and public infrastructure damages and it affects tourist flows. The increase in the global mean temperature affects the demand for energy and the global tourist flows. In the following chapters, we will examine and summarize the main models and methodologies used to determine the costs of these direct market impacts. Firstly, we will examine the sea level rise impacts and then secondly the increasing temperature impacts.

3. Economic Costs of Sea Level Rise

Following the flow-chart steps we first have to present the different global climate change scenarios. The IPCC (2007) develops nine different scenarios that forecast sea level change as a result of thermal expansion and ocean circulation changes. As the paper reports, the geographical distribution of sea level change is not uniform. Some regions show an increase in the sea level and others a drop. An example of deriving regional sea level scenarios from IPCC (2007) is Ng and Mendelsohn (2005). As they conclude, the higher the sea level scenario the greater the speed of sea level rise. The next step is to develop a local mitigation and adaptation model. Ng and Mendelsohn (2005) use a cost-benefit approach to address the impact of sea level rise on Singapore. In order to address the potential loss of coastal land to rising sea, they build on a method first used by Yohe et al. (1996). Having in mind specific sea level rise scenarios and using the best available contour maps provided by the Singapore Ministry of Defense, they calculate and compare the costs of protection with the benefits of protection. As they assume, the benefit of protecting the coastline is the monetary value of the land that is protected from inundation, whereas the cost of protecting is the cost of constructing and maintaining barriers to hold the sea. Sea level rise is a problem they hold to be an intertemporal and dynamic one that requires dynamic adaptation policies. For that reason, they also incorporate in their method a price function, where p(t) is the rental value of land in a future date t, ρ=2% is the real value increase of land in Singapore per year and p(0) is the current rental value.

$$p(t) = e^{\rho t} - p(0) \tag{1}$$

However, Ng and Mendelsohn (2005) measure the value of the land, assuming that there are no structures on it. As a result, the value of the structures (buildings etc.) is not calculated. On the same note, the true economic depreciation (TED; see Yohe et al. (1996)) is also not measured. The economic value of structures and of land can be expected to depreciate because of the imminent inundation and abandonment. As Yohe et al. (1996) points out structures will be lost at the moment of inundation but their true economic value at that point could be zero if the market has already realized that the property would be inundated and abandoned. So if the value of existing property is included in the analysis, the researchers have to consider whether the market would depreciate the buildings in anticipation of the flooding. Also, in their paper, Ng and Mendelsohn (2005) follow the suggestion made by Neumann and Livesay (2001) that the value of the inundated land is not the value of the beachfront inundated but the value of land located inland from the ocean.

The present value (PV) in t_0 of the benefit of protecting coastland is, according to Ng and Mendelsohn (2005):

$$PV(B(t_0, t_0 + 10) = \int_0^{10} p(t) e^{-rt} dt \tag{2}$$

Where B is the benefit of land protection for the next ten years, p is the rental value of the inundated area and r is the real discount rate (assumed to be 4%). Protection cost is assumed to be the construction and maintenance costs of coastal protective structures.

According to the cost-benefit analysis, we also need a function for the present value of protection:

$$PV\{C[t_0,T]\} = CC(t) + \int_0^{10} 0.04 \cdot CC(t) e^{-rt} dt \qquad (3)$$

Where CC(t) are the additional construction costs needed to update the coastal structures and increase them each decade. H(t+10)-H(t) is the expected sea level rise for this decade and L the length of wall:

$$CC(t) = 5310 \cdot [H(t_0 + 10]^2 - H(t_0)^2] \cdot L \qquad (4)$$

As long as:

$$PV\{B[t_0,T]\} > PV\{C[t_0,T]\} \qquad (5)$$

which means as long as the benefits of protection are greater than the costs of protection, protection will take place. Under this methodology, the damage costs are estimated to range from 0.3 to 5.7 million US$ by 2050 (0.2 m – 0.87 m scenarios). Nevertheless, this paper only examines the adaptation costs for market land inundation. Ng and Mendelsohn (2005), on the other hand, scrutinize the value of non-market land losses. Using various tools, such as a travel cost method (TCM) and a contingent valuation method (CVM-surveys of public opinion), they attempt to deduce the benefits and the costs of protecting Singapore's beaches. TCM attempts to calculate the travel costs to specific beaches and, whereas CVM uses a survey approach in an attempt to evaluate the willingness to pay of a sample population for a specific site. In most cases, the conclusions from TCM and CVM methods agree with each other. Briefly, their methodology entails a total cost function (TC):

$$TC = CS + 50 \cdot VS + MC\,, \qquad (6)$$

where CS is the construction cost of underwater hard structures, 50•VS the cost of sand (VS=volume of sand), and MC the maintenance cost. The benefits of protection are represented by the following function:

$$PV(B_t) = \int_{2040}^{2100} B_t e^{-r(t-2040)} dt = \left(\frac{B_t}{r}\right) \cdot \left[1 - e^{-r(2100-2040)}\right], \qquad (7)$$

which is the present value of the stream of benefits in 2040 in Singapore dollars (r=4%). As they conclude, the benefits offset the protection costs by a lot, making the protection of the non market land in Singapore imperative.

Another paper (Breil et al. (2005)) employs a different approach to economically valuate on site material damages of sea level rise in the city of Venice. A dose-response-expert-based valuation approach is used, which separates this paper's methodology from Ng and Mendelsohn's (2005) cost and benefit approach. The monetary magnitude of on site damage (OSD) is defined as follows:

$$OSD = L + M + R, \tag{8}$$

where L is the monetary loss of goods due to flooding (i.e. merchandise, products for sale), M is the cost of mitigation measures, and R is the remediation costs (i.e. replacement costs). This paper estimates that the damages of high water on Venetian business activities range from 3.41 to 4.73 million Euros per year as the sea level rise scenarios vary.

The Organization for Economic Cooperation and Development (OECD) has also established a working group to investigate the impacts of climate change on cities. Having published a series of working papers (Hallegatte et al. (2008a); Hallegatte et al. (2008b); Nicholls et al. (2007); de Bruin et al. (2009)), OECD endeavors to highlight the role that cities can play in efficiently responding to the climatic changes. Nicholls et al. (2007) try to estimate the vulnerability and the exposure of 136 port cities around the world to coastal flooding due to sea level rise and storm surge. Assessing physical exposure, the authors derive concrete rankings of the socio-economic exposure. They use an elevation-based Geographical Information Systems (GIS) analysis to calculate the population exposed to coastal flooding. Afterwards, they employ an asset exposure method, using GDP per capita data, in order to calculate the total value of global exposed assets. The formula they employ indicates a simple relationship between exposed population, GDP per capita and exposed assets:

$$\text{Exposed Assets} = \text{Exposed Population} \cdot \text{GDP}_{\text{per capita (PPP)}} \cdot 5, \tag{9}$$

where 5 is a multiplier calculated by the authors, which relates GDP per capita with investment. As they conclude, the top five cities with respect to the assets exposed are Miami, Greater New York, New Orleans, Osaka-Kobe and Tokyo, whereas the top five cities with respect to the population exposed are Mumbai, Guangzhou, Shanghai, Miami and Ho Chi Minh City.

A follow up to this paper is a case study on Copenhagen. Hallegatte et al. (2008b) assesses the sea level rise and storm surge risk in the port city of Copenhagen. The study is based on a statistical analysis of past storm surges along with a geographical information analysis of population and asset exposure. Also, an assessment of the indirect losses is used along with a close study of the storm damages. The authors conclude that Copenhagen is well protected against any surge in storms or in sea level using an adaptive regional input output model (ARIO). ARIO measures the value added changes in specific sectors of the economy in order to measure the indirect losses. The ARIO model was first developed by Hallegatte (2008) to assess the economic cost of hurricane Katrina on the city of New Orleans. Besides that, Hallegatte et al. (2008b) also calculate the total insured value of the exposed assets (commercial, residential, industrial) in order to measure the direct losses. The following table exhibits the total flood losses for different mean levels.

Figure 5

Economic Costs of Sea Level Rise in Copenhagen						
Event Sea Level with respect to current average level (m)	Direct Losses (million EUR)	Indirect Losses			Total Losses (direct + indirect) (million EUR)	Lost Jobs after 3 months (thousands)
		Value added losses (million EUR)				
		Loss in productive sectors	Loss in housing services	Total value added losses		
1	1,668	-58	72	14	1,682	3
2	4,837	-95	257	162	4,999	7
3	9,341	64	682	747	10,088	14
4	14,478	517	1,446	1,964	16,442	21

Sources: Hallegatte (2008b); HWWI (2009).

This paper and other related papers (Dorland et al. (1999); Scawthorn et al. (2006); Christensen and Christensen (2007)), in their attempt to measure the climate change impacts, employ a natural hazard damage assessment. In particular, Christensen and Christensen (2007) have developed a model for the prediction of regional scenarios and uncertainties for defining European climate change risks and effects (PRUDENCE). In addition, Dorland et al. (1999) have developed a model estimating the total damage of a storm surge. Endeavouring to assess the storm damage under climate change for North-Western Europe he uses the following equation relating Total Damage to Objects (TDO) to the number of objects (O) such as businesses and houses in the case of a specific type of storm (t). The rest of the coefficients are calculated from an empirical analysis of the past storm events in the region.

$$\ln TDO_{i,t} = \alpha \cdot \ln O_{i,t} + \beta \cdot A_{i,t} + \chi \cdot \ln \hat{V}_{\max;i,t} + c \quad \textbf{(10)}$$

Possibly a similar approach can be employed when assessing the damage costs of flooding. Past coastal flooding events can be studied, a counting of the buildings can take place and their monetary valuation can either be based on GDP calculations or opinion surveys.

In the past years, there have also been many analyses and estimations for the costs of climate change of cities. Greater London Authority (GLA) (2008) presents an adaptation strategy for the economic impacts of flooding, drought and overheating among others. Also, Kirshen et al. (2008) investigate the climate's long-term impacts on Metro Boston. A 2009 study (Preparing Toronto for Climate Change) outlines specific mitigation and adaptation costs, while giving some estimates. In addition, the Center for Integrative Environmental Research at Maryland University has published studies estimating the regional and state economic impacts for some states in the US. Finally, Jollands et al. (2007) study the climate's long-term impacts on the infrastructure of Hamilton, New Zealand. All these papers, despite the fact that there are easy to understand and accessible to the public, are approaches though, that lack in formal quantitative methodologies. Hence, they cannot be fully trustworthy sources of data, estimates and models.

Regarding the impacts of sea level rise on tourism with respect to the cities, we can distinguish two general equilibrium analysis papers (Berrittela et al. (2006)) and (Bigano et al. (2006)) which predict that there will be a welfare loss unevenly spread among regions. The change in the tourist flows will especially affect cities whose economies depend on tourism. Finally, warmer regions will suffer a decrease in tourism ranging from -8% to -20%, whereas regions of higher latitude will experience an increase ranging from 1.3% to 8%. Overall, studies regarding the effects of climate change and sea level rise on cities have not been developed enough and it is an area where more research can be done.

In conclusion, we can point out specific models and methodologies regarding the economic implications of sea level rise. The cost-benefit approach by Ng and Mendelsohn (2005) and the land damage calculations first used by Yohe et al. (1996) can be succesfully combined with the expert-valuation approach employed by Breil et al. (2005), the input-output model by Hallegate (2008) and the past storm and flooding analyses by Dorland et al. (1999). Furthermore, the public opinion survey to measure the value of non-market land by Ng and Mendelsohn (2005) and a geographical analysis of the exposed assets and population are important so that policy makers and the public can realize the risks and act in a timely manner.

4. Economic Impacts of Increasing Temperature

The global mean temperature is predicted to rise in the following decades. Along with its secondary consequences, overheating will also have immediate economic impacts on a city-level. An increase in the global average temperature will affect the demand for electricity and energy in general, as well as tourist flows. Since Smith and Tirpak (1988) and Nordhaus (1991) there have been estimates and models attempting to calculate the exact energy costs of rising temperatures. Furthermore, the linkage between climatic changes and shifts in energy demand have been well documented and explored by Rosenthal et al. (1995), Lam (1998), Pardo et al. (2002), Bigano et al. (2006) and Isaac and van Vuuren (2009). Amato et al. (2005) present an interesting overview of all the studies related to the sensitivity of electricity demand to changes in temperature. Rosenthal et al. (1995) endeavour to predict, how energy use for space heating and cooling will evolve up to 2010 in the United States. Using a balance point methodology to estimate changes in building energy consumption from global warming, they conclude that a 1 ^{0}C increase in the global temperature will reduce space conditioning costs in the United States by 5.5 bn US-$ by 2010. Balance point temperature (or thermal balance point) is the point of outdoor temperature where the heating (or cooling) capacity of an air-conditioning machine matches the requirement of a building. As the authors note their predicted plummeting of costs contradicts with what Nordhaus (1991) has estimated. However, the next years' subsequent papers and studies challenged his estimates, as the models developed projected cost increases.

The question Rosenthal et al. (1995) set is whether the money saved due to less demand for heating will eventually offset the extra amount spent on cooling. According to Aebischer et al. (2007) in Europe until 2035 a reduction in heating costs would offset increases in cooling costs. Mendelsohn et al. (2000) also employ a global cost-benefit analysis and Tol (2002) uses a model describing a linear relationship between space conditioning costs and global mean temperature. On a more regional level, we distinguish Pardo et al. (2002), Giannakopoulos and Psiloglu (2006) and Lam (1998), exploring the influences and the costs caused by climatic changes in electricity demand for Spain, Athens and Hong Kong respectively.

Before we proceed with analyzing the models and presenting the estimates, we should first define some key terms and concepts that are used by the vast majority of the papers on the topic of electricity demand. Many studies employ in their research the calculation of Heating Degree Days (HDDs) and Cooling Degree Days (CDDs). A degree day is a common indicator and measures the difference between an average temperature and a base temperature. Base temperature is the temperature for which energy demand, use and costs are minimal. For different regions this temperature can be measured empirically. For the US and Europe it is commonly calculated to be 65 F (18 ^{0}C). However, other values are also used. For instance, Giannakopoulos and Psiloglu (2006) use 22 ^{0}C as a base temperature for Athens, Greece. Giving an example will illustrate this concept better. Let us assume that the average temperature for the 16th of January, 1996 in Athens is 10 ^{0}C. Since, base temperature is 22 ^{0}C HDD for this day will be 22-10 = 12 HDDs. If HDDs of all the days of a year are added we can roughly estimate seasonal and yearly heating requirements.

Having defined HDD, which is a centerpiece in modelling energy demand, we can now explore the different methodologies used to project electricity demand and its elasticity to temperature changes under climate change. Firstly, we should focus on Isaac and van Vuuren (2009) who define energy demand as a function of three variables (Activity, Structure and Energy Intensity). In order to formalize the HDD calculation, we suppose:

If T<18°C then HDD=(18-T). Otherwise, HDD=0. **(11a)**

If T>18°C then CDD=(T-18). Otherwise, CDD=0. **(11b)**

Afterwards, a calculation of the average HDD and CDD for a region over a period of time is needed. Then, the authors model the heating and the cooling energy demand by incorporating the size of the population, their spatial requirements and some technological parameters. Finally, some climate change scenarios are taken into account so that the future energy demand is projected. Similar methods are used by Hadley et al. (2006). After the results regarding energy demand are found, we also need a projection of energy prices so that we can calculate the future costs. Since most studies calculate that energy demand will increase in the future and that air conditioning surge will offset heating demand decrease, we can say that energy costs will also increase as energy prices are projected to rise.

An alternative approach for capturing the costs of temperature increases is a dynamic panel analysis developed by Bigano et al. (2006). The authors attempt a consistent evaluation of the impact of climate change on consumption goods and primary factors. Using a generalized method of moments estimation of dynamic homogeneous panel data models with unobserved fixed effects, they study the relation between energy demand and temperature for different sectors of the economy. Hansen (1982) first developed this method. The results of the analysis project a negative response of energy demand to temperature for the residential sector, while the industrial sector demand is insensitive to temperature changes.

However, we can see how a retrospective analysis of HDD and CDD, along with a projection of the future trends for the global and regional temperature can be beneficial in assessing the future of energy demand for multiple sectors of the economy. Lam (1998) performs regression and correlation analyses to investigate residential electricity consumption over a 23-year period. As he concludes, residential electricity use is based on household income, household size, and electricity price and cooling/heating degree-days. When studying the future trends of energy use and energy costs, a study of all the aforementioned variables should be combined with the formalized methodology presented by Isaac and van Vuuren (2009).

5. Limitations of the Current Studies

To sum up, we can distinguish specific techniques and methods that are particularly useful and successful in assessing the potential direct market impacts of climate change on a city level. Regarding sea level rise, the cost and benefit approach used by Ng and Mendelsohn (2005, 2006) to formalize the policy dilemma of protection vs. mitigation stands out. However, past events analysis by Dorland et al. (1999) along with the precision brought by the study of the high waters damage in Venice by Breil et al. (2005) are also noteworthy. As new terms such as remediation and adaptation costs are added to the vocabulary of policy makers and politicians there is an imperative need to further the study and the calculation of market impacts on cities. The study of the impacts on Copenhagen based on an input-output analysis is an interesting study that makes estimates for different sectors of the economy and provides the policy makers with specific scenarios.

The development of specific economic scenarios for cities will be a crucial step to a better understanding of climate change impacts on them. The general public cannot realize the importance of acting, unless it is provided with information and scenarios that it can relate itself with. For this reason, papers concerning the impacts on an urban level need to gain more rigidity and more precision in developing scenarios and assessing the benefits of reacting timely to climatic changes. Nonetheless, it is sensible to say that the estimation of damage costs due to climate change can be easier on a more regional level than on a worldwide one. On the same note, the global scientific community should also continue pursuing the development of more detailed, sophisticated and up-to-date geographical information systems that can estimate the assets and population exposed to risks due to sea level rise, storm surge and coastal flooding.

Regarding the impacts of overheating, more studies are needed. Having in mind the difficulties of projecting due to the uncertainty related to energy prices, the investigation of the relationship between energy demand and temperature for different regions and sectors of the economy should keep on. Probably, economists might focus more on the industrial and transportation sectors that currently demand a lot of electricity and are comparably less able to adjust to new technologies or renewable energy sources.

As far as the development of tourist flows is concerned, more research should be done focusing on the various methods of forecasting used in the past years. Calantone et al. (1987) and Witt and Witt (1992) offer comprehensive reviews of the models and methods used in the past to predict changes in global tourism. Further studies can adapt these methods to the new data and circumstances in order to project future trends regarding tourism and climate change.

6. Conclusion

As global warming will continue to increasingly be an issue of intense public debate, it can be expected that the studying of the economic impacts of climate change on cities will become a topic of even more research. Along the lines of the current limitations, a greater number of papers specializing on regional impacts will be published. More direct impacts would be quantified and more sophisticated models are to be developed. Politicians and economists will realize the importance of cities and policy following research's direction will increasingly focus on applying measures on the urban level.

The current papers and those to come will gradually pose more specific policy dilemmas on politicians, policy makers and citizens. What are the benefits and what are the costs of mitigation and adaptation? As it can be seen from the current studies, mitigation is a measure that needs global coordination, whereas adaptation is more applicable on the regional level. Cities can adapt more easily than nations or states. Because of climate change, economic advantages of cities will gradually disappear and the local authorities will have to assess the new situation. How should cities adapt to the new economic settings and how should economic activity be re-oriented? For all these reasons, further studies on the economic impacts of climate change on cities are needed to assist the public officials in responding successfully to these questions.

.

Appendix

Papers	Climate Effect	Market Impact	Method	Estimates
OVERALL EFFECTS				
A General Equilibrium Analysis of Climate Change: Impacts on Tourism, Berrittella et al. (2006)	Overall Climate Shock	Changing Tourist Flows, Changing Tourist Expenditure	Computable General Equilibrium Analysis	Welfare Loss Unevenly Spread Across Regions (especially cities depending on tourism)
Climate Change Will Impact the Seattle Department of Transportation, Soo Hoo et al. (2005)	Overall Effects	Damages to Infrastructure	Qualitative Analysis	Not Applicable
Climate Change and London's Transport Systems, GLA (2005)	Flooding, Temperature Increase	Infrastructure Damage	Qualitative, Statistical Analysis	Damage Estimations
AHEAD OF THE STORM… Preparing Toronto for Climate Change – Development of a Climate Change Adaptation Strategy 18 Apr 2008, City of Toronto (2009)	Natural Disasters, Flooding, Wildfires, Sea Level Rise	Infrastructure	Qualitative	Number of Hot Days in Toronto, Number of Natural Disasters, Temporal Trend
Climate change and coastal flooding in Metro Boston: impacts and adaptation strategies, Kirshen et al. (2008)	Higher Sea Levels, Increase in Temperature	Damages in Buildings due to Sea Level Rise and River Flooding, Electricity Demand Surge	Qualitative Analysis	Approximately $7-8,000 of damage per building, electricity demand increases over 24% →$94 billion
The London Climate Change Adaptation Strategy, GLA (2008)	Overall Effects	Overall Economic Costs	Qualitative Analysis	Not Applicable
Future Sea Level Rise and the New Jersey Coast: Assessing Potential Impacts and Opportunities, Cooper et al. (2005)	Overall Effects	Overall Economic Costs	Qualitative Analysis	Not Applicable
The Economics of Climate Change Impacts and Policy Benefits at City Scale: A Conceptual Framework, Hallegatte et al. (2008a)	Overall Effects	Overview of Impacts	Not Applicable	Not Applicable
Economic Aspects of Adaptation to Climate Change: Integrated Assessment Modeling of Adaptation Costs and Benefits, de Bruin et al. (2009)	All the Effects, Sea Level Rise, Increase in Temperature	Mitigation, Residual Damage and Adaptation Impacts	Policy Simulations with AD-Dice, Rice Integrated Assessment Modeling	Not Applicable
SEA LEVEL RISE-STORM SURGE-COASTAL FLOODING				
Vulnerability of the Netherlands and NW Europe to Storm Damage under Climate Change, Dorland et al. (1999)	Storms Surge	Damage on Residential and Commercial Infrastructure	Geographic statistical models (2) based off past storms	As wind power increases (2%) due to climate change, average annual damage increase (50%)
Economic Valuation of On Site Material Damages of High Water on Venice: Results from a Dose-Response-Expert-Based Valuation Approach, Breil et al. (2005)	Sea Level Rise, Flooding, Remediation Costs	Monetary, Short-period, on-site damages OSD=L+M+R	Integrated Dose Response Modeling, Expert-based Valuation	Welfare Loss (3.41-4.73 m/year), climate change/protection scenario, public policy scenario-2.85 m/year
The Economic Impact of Sea-Level Rise on Nonmarket Lands in Singapore, Ng and Mendelsohn (2006)	Coastal Flooding of Beaches	Economic Costs of the Loss of Non-Market Land	Contingent Valuation Method Travel Cost Method	Non market land of high value should be protected

Future Sea Level Rise and the New Jersey Coast: Assessing Potential Impacts and Opportunities, Cooper et al. (2005)	Sea Level Rise, Inundation, Flooding	Permanent Inundation of Land of Commercial Use	Data Analysis	1-3 % inundation 6.5-9 % coastal flooding
The Impact of Sea Level Rise on Singapore, Ng and Mendelsohn (2005)	Sea Level Rise	Loss of Land, Protection Costs	Present Value, Construction Cost Cost Benefit Analysis	Economic Impacts for Three Different Sea Level Rise Scenarios
Financial Risks of Climate Change, ABI (2005)	Extreme Weather, Flooding	Damage on Insured Property	Insurance Industry Catastrophe Models	Small increases in storms' intensity→damage costs' increase by 2/3
Economy-Wide Impacts of Climate Change: A Joint Analysis for Sea-Level Rise and Tourism, Bigano et al. (2008)	Sea Level Rise	Effect on Tourism Flows	Computable General Equilibrium Model	Warmer Regions (-8% and -20%) Advantage for regions of higher latitude (1.3% and 8%)
Ranking port cities with high exposure and vulnerability to climate extremes exposure estimates, Nicholls et al. (2007)	Coastal Flooding, Storm Surge, High Winds	Exposure of Assets	Exposure not Risk, Metric Approach	US$ 3,000 billion 5% of Global GDP value of exposed assets (2050) US$ 35,000 billion 9% of Global GDP (2070)
The rising tide: assessing the risks of climate change and human settlements in low elevation coastal zones, McGranahan et al. (2007)	Sea Level Rise, Storm Surges	Exposed Population and Cities	Review of the Population and Urban Settlement Patterns in the Low Elevation Coastal Zones	13 % of the world urban population in LECZ (<10 m)
Assessing Climate Change Impacts, Sea Level Rise and Storm Surge Risk in Port Cities: A Case Study on Copenhagen, Hallegatte et al. (2008b)	Sea Level Rise, Storm Surge	Exposure of Land (Total Insured Value)	Statistical Analysis of Past Storm Surges, Assessment of Direct and Indirect Losses, Input-Output Analysis	25-100 cm 3-8 billion total asset losses 120-year period
An Adaptive Regional Input-Output Model and its Application to the Assessment of the Economic Cost of Katrina, Hallegatte (2008)	Flooding, Natural Hazard	Loss of Assts and Jobs	ARIO Input-Output Model	Estimation of value added due to the damages induced by the Katrina hurricane
INCREASING TEMPERATURE				
Effects of Global Warming on Energy Use for Space Heating and Cooling in the United States, Rosenthal et al. (1995)	Increase in Temperature (1 centigrade increase)	Energy Demand Surge	1. Global Circulation Models 2. Mapping of change 3. Calculation of Expenditure	Projected U.S. expenditures would be reduced in 2010 by $ 5.5 billion
Trends in energy load demand in Athens, Greece: weather and non-weather related factors, Giannakopoulos and Psiloglou (2006)	Increase in Temperature	Future Air Conditioning Demand from Climate Change	Not Applicable	Large increase in cooling related energy expenditures by 2070
Responses of energy use to climate change: A climate modeling study, Hadley et al. (2006)	Increase in Temperature, Extreme Weather Events	Surge in Electricity Demand	General Circulation Climate Model→Energy Use model	Cost Increase $6.1-14.8 bn
Energy Demand and Temperature: A Dynamic Panel Analysis, Bigano et al. (2006)	Temperature Increase and Decrease	Energy Demand (electricity)	Dynamic Panel Analysis	Residential Demand Relates Negatively, Industrial Demand Insensitive
Modeling Global Residential Sector Energy Demand for Heating and Air Conditioning in the Context of Climate Change, Isaac and van Vuuren (2009)	Temperature Increase	Energy Demand (Heating and Cooling)	Cooling Degree Days, Heating Degree Days	Heating Energy Demand Increase (34%) Cooling Energy Demand Increase (72%) by 2100
Climate Change and Electricity Demand in California, Franco and Sanstad (2006)	Increase in Temperature	Energy Demand Surge	Atmosphere Ocean General Circulation Models	Electricity Demand will challenge supply capacities

References

Aebischer, B.; Henderson, G.; Jakob, M.; Catenazzi, G. (2007): Impact of climate change on thermal comfort, heating and cooling energy demand in Europe, in: eceee (ed.), eceee 2007 Summer Study, pp. 859-870, http://www.cepe.ethz.ch/publications/Aebischer_5_110.pdf, Download 3 July 2009.

Amato, A.; Ruth, M.; Kirshen, P.; Horwitz, J. (2005): Regional Energy Demand responses to Climate Change: Methodology and Application to the Commonwealth of Massachusetts, Climatic Change, Vol. 71, pp. 175-201.

Association of British Insurers (ABI) (2005): Financial Risks of Climate Change, London.

Berrittella, M.; Bigano, A.; Roson, R.; Tol, R. S. J. (2006): A General Equilibrium Analysis of Climate Change Impacts on Tourism, in: Tourism Management, Vol. 27, No. 5, pp. 913-924.

Bigano, A.; Bosello, F.; Marano, G. (2006): Energy Demand and Temperature: A Dynamic Panel Analysis, http://www.feem.it/NR/rdonlyres/1A83E059-FFA2-4735-AABF-15F32548D99A/2097/11206.pdf, Download 3 Jul 2009.

Bigano, A.; Bosello, F.; Roson, R.; Tol, R. S. (2008): Economy-Wide Impacts of Climate Change: a Joint Analysis for Sea Level Rise and Tourism, in: Mitigation and Adaptation Strategies for Global Change, Vol. 13, No. 8, pp. 765-791.

Breil, M.; Nunes, P. A. L. D.; Gambarelli, G. (2005): Economic Valuation of On Site Material Damages of High Water on Economic Activities based in the City of Venice: Results from a Dose-Response-Expert-Based Valuation Approach, FEEM Working Paper, No. 53.05, http://www.feem.it/Feem/Pub/Publications/WPapers/default.htm, Download 3 July 2009.

Calantone, R.; Di Benedetto, A.; Bojanic, D. (1987): A Comprehensive Review of the Tourism Forecasting Literature, in: Journal of Travel Research, Vol. 26, No. 2, pp. 28-39.

Christensen, J.; Christensen, O.: A Summary of the PRUDENCE Model Projections of Changes in European Climate by the End of This Century, in: Climatic Change, Vol. 81, Suppl. 1, pp. 7-30.

City of Toronto (2009): AHEAD OF THE STORM... Preparing Toronto for Climate Change – Development of a Climate Change Adaptation Strategy 18 Apr 2008, http://www.toronto.ca/teo/pdf/ahead_of_the_storm.pdf, Download 3. July 2009.

Cooper, M. J. P.; Beevers, M. D.; Oppenheimer, M. (2005): Future Sea Level Rise and the New Jersey Coast: Assessing Potential Impacts and Opportunities, http://www.princeton.edu/~cmi/news/Future%20of%20Sea%20Level%20Rise%20and%20the%20New%20Jersey%20Coast.pdf, Download 3. July 2009.

CSIRO Marine and Atmospheric Research; Maunsell Australia Pty Ltd; Phillips Fox (Firms) (2006): Infrastructure and Climate Change Risk Assessment for Victoria, Report to the Victorian Government, Aspendale.

de Bruin, K.; Dellink, R.; Agrawala, S. (2009): Economic Aspects of Adaptation to Climate Change: Integrated Assessment Modelling of Adaptation Costs and Benefits, OECD Environment Working Papers, No. 6.

Deke, O.; Hooss, K. G.; Kasten, C.; Klepper, G.; Springer, K. (2001): Economic Impact of Climate Change: Simulations with a Regionalized Climate-Economy Model, Kiel Working Paper, Kiel Institute of World Economics, No. 1065, Kiel.

Dessai, S. (2002): Heat stress and mortality in Lisbon Part I. model construction and validation, in: International Journal of Biometeorology, Vol. 47, No. 1, pp. 6-12.

Dore, M. H. I.; Burton, I. (2001): The Costs of Adaptation to Climate Change in Canada: A Stratified Estimate by Sectors and Regions – Social Infrastructure, http://www.adaptation.nrcan.gc.ca/projdb/pdf/crosscutting4a_e.pdf, Download 3 July 2009.

Dorland, C., Tol, R. S. J.; Palutikof, J. P. (1999): Vulnerability of the Netherlands and Northwest Europe to Storm Damage under Climate Change, in: Climatic Change, Vol. 43, No. 3, pp. 513-535.

Franco, G.; Sanstad, A. H. (2006): Climate Change and Electricity Demand in California, White Paper, http://www.energy.ca.gov/2005publications/CEC-500-2005-201/CEC-500-2005-201-SF.PDF, Download 3 July 2009.

Giannakopoulos, C.; Psiloglou, B. E. (2006): Trends in energy load demand for Athens, Greece: weather and non-weather related factors, in: Climate Research, Vol. 31, No. 1, pp. 97-108.

Greater London Authority (GLA) (2008): The London Climate Change Adaptation Strategy, Summary Draft Report, London.

Greater London Authority (GLA) (2005): Climate Change and London's Transport Systems, Technical Report, London.

Hadley, S. W; Erickson III, D. J; Hernandez, J. L.; Broniak, C. T; Blasing, T. J. (2006): Responses of energy use to climate change: A climate modeling study, in: Geophysical Research Letters, Vol. 33, No. 17.

Hallegatte, S.; Patmore, N.; Mestre, O.; Dumas, P.; Morlot, J. C.; Herweijer, C.; Wood, R. M. (2008b): Assessing Climate Change Impacts, Sea Level Rise and Storm Surge Risk in Port Cities: A Case Study on Copenhagen, OECD Environment Working Papers, No. 3, Paris.

Hallegatte, S. (2008): An Adaptive Regional Input-Output Model and its Application to the Assessment of the Economic Cost of Katrina, in: Risk Analysis, Vol. 28, No. 3, pp. 779-799.

Hallegatte, S.; Henriet, F.; Corfee-Morlot, J. (2008a): The Economics of Climate Change Impacts and Policy Benefits at City Scale: A Conceptual Framework, OECD Environment Working Papers, No. 4, Paris.

Hallegatte, S.; Patmore, N.; Mestre, O.; Dumas, P.; Morlot, J. C.; Herweijer, C.; Wood, R. M. (2008b): Assessing Climate Change Impacts, Sea Level Rise and Storm Surge Risk in Port Cities: A Case Study on Copenhagen, OECD Environment Working Papers, No. 3, Paris.

Hansen, L.P. (1982): Large Sample Properties of the Generalized Methods of Moments Estimators, in: Econometrica, Vol. 50, No. 4, pp. 1029-1054.

Intergovernmental Panel on Climate Change (IPCC) (2007): IPCC Fourth Assessment Report Climate Change 2007.

Isaac, M.; van Vuuren, D. P. (2009): Modeling Global Residential Sector Energy Demand for Heating and Air Conditioning in the Context of Climate Change, in: Energy Policy, Vol. 37, No. 2, pp. 507-521.

Jollands, N; Ruth, M; Bernier, C; Golubiewski, N. (2007): The climate's long-term impact on New Zealand infrastructure (CLINZI) project – A case study of Hamilton City, New Zealand, in: Journal of Environmental Management, Vol. 83, No. 4, pp. 460-477.

Kirshen, P.; Knee, K.; Ruth, M. (2008): Climate change and coastal flooding in Metro Boston: impacts and adaptation strategies, in: Climatic Change, Vol. 90, No. 4, pp. 453-473.

Kont, A.; Jaagus, J.; Aunap, R. (2003): Climate Change Scenarios and the Effect of Sea-Level Rise for Estonia, in: Global and Planetary Change, Vol. 36, No. 1, pp. 1-15.

Lam, J. C. (1998): Climatic and economic influences on residential electricity consumption, in: Energy Conversion and Management, Vol. 39, No. 7, pp. 623-629.

Mendelsohn, W. M.; Schlesinger, M. E.; Andronova, N. G. (2000): Country-specific market impacts of climate change, in: Climatic Change, Vol. 45, No. 3-4, pp. 553-569.

McGranahan, G.; Balk, D.; Anderson, B. (2007): The rising tide: assessing the risks of climate change and human settlements in low elevation coastal zones, in: Environment and Urbanization, Vol. 19, No. 1, pp. 17-37.

Neumann, J. E.; Livesay, N. D. (2001): Coastal structures: dynamic economic modeling, in: Mendelsohn, R. (ed.), Global Warming and the American Economy – A Regional Assessment of Climate Change Impacts (New Horizons in Environmental Economics Series), Cheltenham, pp. 132-148.

Ng, W.-S.; Mendelsohn, R. (2006): The Economic Impact of Sea-Level Rise on Nonmarket Lands in Singapore, in: Ambio, Vol. 35, No. 6, p. 289.

Ng, W.-S.; Mendelsohn, R. (2005): The Impact of Sea Level Rise on Singapore, in: Environment and Development Economics, Vol. 10, No. 2, pp. 201-215.

Nicholls, R. J.; Hanson, S.; Herweijer, C.; Patmore, N.; Hallegatte, S.; Corfee-Morlot, J. (2007): Ranking port cities with high exposure and vulnerability to climate extremes exposure estimates, Environment Working Papers, No. 1, Organisation for Economic Co-operation and Development (OECD), Paris.

Nordhaus, W. D. (1991): The cost of slowing climate change: a survey, in: The Energy Journal, Vol. 12, No. 1, pp. 37-65.

Pardo, A.; Meneu, V.; Valor, E. (2002): Temperature and seasonality influences on spanish electricity load, in: Energy Economics, Vol 24, No. 1, pp. 55-70.

Rosenthal, D. H.; Gruenspecht, H.; Moran, E. A. (1995): Effects of global warming on energy use for space heating and cooling in the United States, in: The Energy Journal, Vol. 16, No. 2, pp. 77-96.

Scawthorn, C.; Blais, N.; Seligson, H.; Tate, E.; Mifflin, E.; Thomas, W.; Murphy, J.; Jones, C. (2006): HAZUS-MH Flood Loss Estimation Methodology. I: Overview and Flood Hazard Characterization, in: Natural Hazards Review, Vol. 7, No. 2, pp. 60-71.

Smith, J. B.; Tirpak, D. A. (1988): The Potential Effects of Global Climate Change on the United States, Report to Congress, U.S. Environmental Protection Agency (EPA).

Soo Hoo, W. K.; Sumitani, M.; Cohen, S. (2005): Climate Change Will Impact the Seattle Department of Transportation, Seattle.

Tol, R. S. J. (2002): Estimates of the Damage Costs of Climate Change, Part II. Dynamic Estimates, in: Environmental and Resource Economics, Vol. 21, No. 2, pp. 135-160.

United Nations Population Fund (2007): UNFPA State of World Population, 2007: Unleashing the Potential of Urban Growth, New York.

Witt, S. F.; Witt, C. A. (1992): Modeling and Forecasting Demand in Tourism, London / San Diego.

Yohe, G. W.; Schlesinger, Michael E. (1998): Sea-Level Change: The Expected Economic Cost of Protection or Abandonment in the United States, in: Climatic Change, Vol. 38, No. 4, pp. 447-472.

Yohe, G.; Neumann, J.; Marshal, P.; Ameden, H. (1996): The economic cost of greenhouse-induced sea-level rise for developed property in the United States, in: Climatic Change, Vol. 32, No. 4, pp. 387-410.

HWWI Policy Papers
by the HWWI Research Programmes „Economic Trends“ and „Hamburg and Regional Development “

17. Implikationen steigender Energie- und Transportkosten für die künftige Stadtentwicklung – eine globale Perspektive
Ingrid Ott et al., Hamburg, Juni 2009
16. Hamburger Wirtschaft im Sinkflug
Michael Bräuninger, Eckhardt Wohlers, Hamburg, Juni 2009
15. Der Automobilmarkt in Deutschland
Michael Bräuninger, Daniel Schneider, Hamburg, Juni 2009
14. Implications of rising energy and transportation costs for future urban development – a global perspective
Ingrid Ott, Alkis Henri Otto, Silvia Stiller, Hamburg, Juni 2009
13. Wissen schafft Wachstum. Wirtschaftspolitische Handlungsoptionen für Innovation und Fortschritt
Henning Vöpel, Hamburg, Juni 2009
12. Altersvorsorge und Konsumverhalten von Frauen in Deutschland
Henning Vöpel, Hamburg, Mai 2009
11. Biokraftstoffe: Ziele, Chancen und Risiken
Michael Bräuninger, Sebastian Schröer, Sven Schulze,
Hamburg, Januar 2009
10. Das Bundeselterngeld- und Elternzeitgesetz in Deutschland: Analyse potenzieller Effekte auf Geburtenzahl und Fertilitätsstruktur
Nora Reich, Hamburg, Dezember 2008
9. Champions des Sports 2008 - Ein empirischer Vergleich deutscher Sportstädte
Max Steinhardt, Henning Vöpel, Hamburg, November 2008
8. Regionale Unternehmens- und Beschäftigungsdynamik
Michael Bräuninger, Friso Schlitte, Hamburg, Dezember 2007
7. Erbschaftssteuer – Abschaffen ist besser als revidieren
Thomas Straubhaar, Hamburg, Dezember 2007
6. Gesundheitsentwicklung in Deutschland bis 2037 – Eine volkswirtschaftliche Kostensimulation
Michael Bräuninger et al., Hamburg, Dezember 2007
5. Ökologische Steuerreform in der Schweiz
Michael Bräuninger, Sven Schulze, Thomas Straubhaar
Hamburg, Oktober 2007
4. Champions des Sports – Ein empirischer Vergleich deutscher Sportstädte
Max Steinhardt, Henning Vöpel, Hamburg, Oktober 2007
3. Wirtschaftsfaktor Erdgasbranche
Michael Bräuninger et al., Hamburg, August 2007
2. Auswirkungen von Strompreiserhöhungen auf Preise, Wachstum und Wettbewerbsfähigkeit
Michael Bräuninger, Jörg Hinze, Norbert Kriedel, Henning Vöpel
Hamburg, April 2007
1. Demographische Entwicklung: Problem oder Phantom?
Sebastian Schröer, Thomas Straubhaar, Hamburg, November 2006

The **Hamburg Institute of International Economics (HWWI)** is an independent economic research institute, based on a non-profit public-private partnership, which was founded in 2005. The University of Hamburg and the Hamburg Chamber of Commerce are shareholders in the Institute .

The HWWI's main goals are to:
• Promote economic sciences in research and teaching;
• Conduct high-quality economic research;
• Transfer and disseminate economic knowledge to policy makers, stakeholders and the general public.

The HWWI carries out interdisciplinary research activities in the context of the following research programmes: Economic Trends, Hamburg and Regional Development, World Economy and Migration Research Group.

Hamburg Institute of International Economics (HWWI)

Heimhuder Str. 71 | 20148 Hamburg | Germany
Phone +49 (0)40 34 05 76 - 0 | Fax +49 (0)40 34 05 76 - 776
info@hwwi.org | www.hwwi.org