

# Syllabus for **Topics in Financial Economics II: Foundations of Climate Finance**

Alex Stomper, HU Berlin

## Course Contents

This course explores the connections between climate change (global warming) and the financial system. It will also contain a few lectures covering the requisite basics from financial economics. As a consequence, the course **can be taken by PhD students who have not yet taken another course on financial economics**.

We will use this course in order to develop our own **research agenda** and/or write **joint pieces for the ISQD blog**. Here are some ideas and questions that should help in getting us started:

### Part I Asset Pricing

1. Climate change causes **risk** and our societies must adapt. This is directly relevant for the financial system because this system connects risk-takers (speculators) with risk-avoiders. How can we use financial markets in order to deal with risks associated with climate change?
2. Economic adaptation to climate change will also involve (precautionary) **saving**. This is another function of the financial system.
3. Given that the financial system performs key functions in economic adaptation to climate change, we can expect that prices in financial markets contain **information** about climate change. Are the prices „right“? Can/should we use price information in order to design policies for mitigating climate change? What does the financial market tell us about the social cost of greenhouse gas emissions?

### Part II Impacts and Imperfections - and Data

1. How can we measure the economic **impacts** of climate change? We can observe economic impacts of weather shocks. These shocks are caused by risks which change over time. What are the consequences, and how can we estimate/predict these consequences?
2. The weather is, by definition, a temporary phenomenon. As such, the weather is likely to cause temporary shocks. These shocks can cause risks of financial and/or economic distress of non-financial firms, where financial distress means a risk of insolvency which is purely caused by a temporary lack of cash („liquidity“) while economic distress means that a certain type of economic activity becomes unsustainable. Sustainable finance requires distinguishing between economic and financial distress, and making sure that **imperfections** of the financial system do not cause insolvencies due to pure liquidity shocks. Is the financial system living up to this ideal? How can we measure **financial constraints** that hinder economic adaptation to climate change?
3. How are **households** affected by climate-related risks? Households could be affected by income shocks (to their income from proprietary businesses or employment relationships), and also by shocks to their assets (e.g., real estate). The latter shocks could be physical shocks (e.g., destruction of **real estate**), but also shocks to asset prices and cash flows generated by households' assets.

### Part III Corporate Finance, and Financial Intermediation

1. Mitigating climate change requires economic policy-making. This can happen at the level of the government, but also at lower levels. For example, investors or firms can have green investment policies. How can **socially responsible investors** achieve (maximum) impact?
2. How do imperfections of the financial system affect government policies to mitigate climate change? Can these imperfections cause **perverse effects** of policies designed to fight climate change? For example, could it be that investors end up allocating too little capital to investments that would reduce the emissions of (potentially stranded) dirty assets? How can we make sure that investors have incentives to fight global warming?

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3. What does the **evidence** say about the effects of **financial structure** and **corporate governance** on firms' greenhouse gas emissions? For example, are publicly listed firms „cleaner“ than other firms?

How to **approach** all these topics and questions? We could simply read the climate finance literature. This would allow us to understand the research agenda of other researchers. How can we get a research agenda of our own? We will have to look **outside** the climate finance literature and aim for insights that seem relevant for thinking about climate change! That's why this course is called „**Foundations** of Climate Finance“ — the reading list includes a number of papers that survey relevant literatures, but without an explicit connection to climate change.

**Micro or macro?** The course has a focus on microeconomics, but there is a lot of macro in it. For example, we will cover papers on **consumption-based asset pricing**. Moreover, we will seek to understand **how macroeconomic shocks come about**. Have a look at Carvalho, V. B., 2014, [From Micro to Macro via Production Networks](#), Journal of Economic Perspectives.

**Climate analytics?** This course will also be a **foundation for work in data science** addressing climate change. We will learn about relevant kinds of data and methods for analyzing the data. If you take this course, be prepared to spend a lot of time learning about data.

**And Theory?** The course will start and end with theory about financial economics and climate change.

### Course format

Every participant of the course has to lead the discussion of one paper which appears below with a number in square brackets (e.g. [1]). These papers must be read by everyone prior to class.

In addition every participant must write one report. The report could be about one of the papers with a number preceded by an „R“ (e.g. R1). Such a report should be a 3-5 page document that does three things: 1. Summarize the paper in such a way that a person who has not read it can understand its contribution and key methods, 2. Discuss any major weaknesses of the paper and how they can be fixed, 3. Describe three extensions that could be come interesting research projects. If you write about a theory paper, think about testable hypotheses (and tests!).

The author of a report on a paper will also present the paper in class. Each presentation will run for 30 minutes, including 10 minutes for questions/discussion. -this is typical for presentations at conferences. You need to come up with a well-organized, visually clear presentation which 1. Motivates the research question, 2. Describes the methods in detail, with intuition, 3. Shows the main results, 4. Says how the methods and/or results are related to other papers we cover in class, and 5. Concludes with what distinguishes the paper from earlier work and we can learn from it.

Some students will survey a set of papers, rather than writing a report on one paper. This will involve a bit of literature search. The result should be 3-5 pages discussing 1. The motivation of the literature, 2. The specific contributions of the various papers, 3. The data and methods used, 4. The main results, 5. Research gaps and potential contradictions between the papers' findings, and 6. Three specific ideas for addressing research gaps using existing or unexplored data.

The author of a survey will also present the survey in class. Each presentation will run for 30 minutes, including 10 minutes for questions/discussion. You need to come up with a well-organized, visually clear presentation which 1. Motivates the literature, 2. Contrasts the various papers in terms of their research questions, data, and methods, 3. Describes the state of knowledge and unresolved puzzles/contradictions, and 4. Describes research gaps, and 5. Concludes by describing a follow-up project.

### Where, when?

Thursday 10:15-11:45, with a coffee meeting before and after class. We will meet in the common room on the 4<sup>th</sup> floor of HU's building in Dorotheenstrasse 1. The class itself will be in room 405.

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## Reading list:

[0] Before the first meeting of the course (on April 21), please all read the following papers:  
Merton, R.C., 1995, [A Functional Perspective of Financial Intermediation](#), Financial Analysts Journal. Hsiang, S., and R. E. Kopp, 2018, [An Economist's Guide to Climate Change Science](#), Journal of Economic Perspectives.  
Stavins, R., 2019, [The Future of US Carbon-Pricing Policy](#), NBER.

## Part I: Climate Change and Asset Pricing

### 1. Some Asset Pricing

The first four papers are „inspiration“ for a lecture I will give at the start of the course. The last two papers are core papers which will be discussed in class.

Cochrane, J. H., 1999, [Portfolio Advice for a Multifactor World](#), Economic Perspectives.  
Cochrane, J. H., 2022, [Portfolios for Long-Term Investors](#), Review of Finance.  
Randl, O., A. Westerkamp, and J. Zechner, 2019, [Equilibrium Policy Portfolios when some Assets are Non-Tradable](#), Working Paper.  
Mendel, B., and A. Shleifer, 2021, [Chasing Noise](#), Journal of Financial Economics.

[1] Giglio, S., B. Kelly, and J. Stroebe, 2021, [Climate Finance](#), Annual Reviews of Financial Economics.

[2] Pastor, L., R. F. Stambaugh, and L. A. Taylor, 2021, [Sustainable Investing in Equilibrium](#), Journal of Financial Economics.

R1 Bolton, P., and M. Kacperczyk, 2022, [Net-Zero Carbon Portfolio Alignment](#), Financial Analysts Journal.

### 2. Long-Run Discounting and the Asset Class of Real Estate

The first of the papers listed below argues that the asset class of real estate is exposed to climate risk, so that housing markets contain information relevant for valuing investments in climate change abatement. (Unfortunately, hedging against real estate risk is almost as difficult as hedging against climate-related risks.) Real estate is also the focus of a literature on physical risks of climate change. We will not cover this literature (but it is surveyed in [1]). We instead conclude this section with a paper about the effects of a climate-related risk to real estate on portfolio choice. Are people managing the risk by holding suitable portfolios?

[3] Giglio, S., M. Maggiori, K. Rao, J. Stroebe, and A. Weber, 2021, [Climate Change and Long-Run Discount Rates: Evidence from Real Estate](#), The Review of Financial Studies.

Could insurance against climate change be based on real estate? If you are interested in this question, you may want to read the following paper. This paper will be discussed during an after-class coffee meeting:

Fabozzi, F. J., R. J. Shiller, and R. S. Tunaru, 2020, [A 30-Year Perspective on Property Derivatives: What can be Done to Tame Property Price Risk?](#), Journal of Economic Perspectives.

## Part II: Impacts and Imperfections - and Data, May 19 - June ?

We start by laying some foundations regarding data and basic methods for measuring effects of physical risks related to climate change. The focus will be on natural disasters, but we will also consider the broader literature on physical risks.

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### **3. Using weather data to measure effects of climate change**

S1 A survey of survey papers about weather data, climate forecasts, etc. Auffhammer, M., S. M. Hsiang, W. Schlenker, and A. Sobel, 2013, [Using Weather Data and Climate Model Output in Economic Analyses of Climate Change](#), Review of Environmental Economics and Policy. Brönnimann, S., et al., 2018, [Historical Weather Data for Climate Risk Assessment](#), Annals of the New York Academy of Sciences

S2 A survey of survey papers about methods for using weather data in order to analyze various economic effects of climate change: Dell, M., B. F. Jones, and B. A. Olken, 2014, [What do we learn from the Weather? The New Climate-Economy Literature](#), Journal of Economic Literature. Auffhammer, M., 2018, [Quantifying Economic Damages from Climate Change](#), Journal of Economic Perspectives. Kolstad, C. and F. Moore, 2020, [Estimating the Economic Impacts of Climate Change using Weather Observations](#), Review of Environmental Economics and Policy.

### **4. How climate change affects firms — and their production networks**

We start this section by taking an engineering-perspective. How can firms obtain insurance against weather risk? Here is a paper we could read in order to discover lots of things we would like to know about:

R2 Chen, Z., Y. Lu, J. Zhang, and W. Zhu, 2022, [Managing Weather Risk with a Neural-Network based Index Insurance](#), Working Paper.

The above-stated paper motivates further studies with respect to AI used in finance, and with respect to the design of insurance. We will, however, start by building our understanding for the economic effects of weather risk. The next papers are about the effects of the weather on the cross-section of firms.

S3 Addoum, J. M., D. T. Ng, and A. Ortiz-Bobea, 2021, [Temperature Shocks and Industry Earnings News](#), Working Paper. Addoum, J. M., D. T. Ng, and A. Ortiz-Bobea, 2020, [Temperature Shocks and Establishment Sales](#), The Review of Financial Studies. Pankratz, N. M. C., R. Bauer, and J. Derwall, 2021, [Climate Change, Firm Performance, and Investor Surprises](#), Working Paper.

The following paper will not be discussed in class, but it should be read as an introductory survey to the literature on natural disasters: Boutzenm W. J. W., O. Deschenes, and M. Sanders, 2019, [The Economic Impacts of Natural Disasters: A Review of Models and Empirical Studies](#), Review of Environmental Economics and Policy.

With respect to natural disasters, there is a growing literature on shock propagation through production networks. Natural disasters tend to disrupt supply chains. To start thinking about the effects (and their macroeconomic implications!), we start with papers on production networks:

[4] Grassi, B., and J. Sauvagnat, 2019, Production Networks and Economic Policy, Oxford Review of Economic Policy.

What else do we need to know about production networks? Here are two other surveys, - what are they adding to the material in S3?

S4 Carvalho, V. B., 2014, [From Micro to Macro via Production Networks](#), Journal of Economic Perspectives. Carvalho, V. M., and A. Tahbaz-Salehi, 2019, Production-Networks: A Primer, Annual Reviews of Economics.

A landmark paper on the propagation of a natural disaster through production networks is Carvalho et al., 2021, [Supply Chain Disruptions: Evidence from the Great East Japan Earthquake](#), The Quarterly Journal of Economics. There does not seem to be a paper looking at effects of weather shocks. We will look at papers which analyze production networks from a finance perspective. Before we do this, we read a survey on customer-supplier relationships:

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[5] Chen, L, and S. Dasgupta, 2021, [The Economics and Finance of Customer-Supplier Relationships](#), Oxford Research Encyclopedia of Economics and Finance.

R3 Bernile, G., S. Delikouras, G. M. Korniotis, A. Kumar, 2021, Geography of Firms and Propagation of Local Economic Conditions, Working Paper.

R4 Pankratz, N. M. C., and C. Schiller, 2021, [Climate Change and Adaptation in Global Supply-Chain Networks](#), Working Paper.

R5 Herskovic, B., 2018, Networks in Production: Asset Pricing Implications, The Journal of Finance.

### **5. Climate change and households**

The next papers talk about labor and households. We start with an empirical paper, which also talks about migration:

[6] Jin, Z., F. W. Li, Y. Lin, and Z. Zhang, 2021, [Do Firms Adapt to Rising Temperatures: Evidence from Establishment-Level Data](#), Working Paper.

[7] A paper I saw when I had to review papers for the meetings of the European Finance Association: Too hot to work: Labor Exposure to Climate Risk and Adaptation in Production.

R6 Albert, C. P. Bustos, and J. Ponticelli, 2021, [The Effects of Climate Change on Labor and Capital Reallocation](#), Working Paper.

Now, we go to the household-level. We start with an empirical paper on the impacts of weather shocks on household consumption, - it turns out that this depends on households' access to credit:

R7 Dobridge, C. L., 2018, [High-Cost Credit and Consumption Smoothing](#), Journal of Money, Credit and Banking.

The above-stated paper motivates us to think more deeply about households. We will therefore read the following survey:

[8] Gomes, F., M. Haliassos, and T. Ramadorai, 2021, [Household Finance](#), Journal of Economic Literature.

The next paper provides a rich framework for thinking about household insolvencies. This framework is used in the paper following [9] which shows that the US mortgage markets is based on substantial government subsidies reducing the market price of mortgage credit risk due to hurricanes.

[9] Campbell, J. Y., and J. F. Cocco, 2015, [A Model of Mortgage Defaults](#), The Journal of Finance.

R8 Gete, P., and A. Tsouderou, 2021, [Climate Risk and Mortgage Markets: Evidence from Hurricanes Harvey and Irma](#), Working Paper.

## **Part III: Climate Change, Corporate Finance, and Financial Intermediation, June/July**

### **6. Empirical analyses**

We start this last part of the course with another good survey of climate finance:

[10] Furukawa, K., H. Ichiue, and N. Shiraki, 2020, [How Does Climate Change interact with the Financial System: A Survey](#), Working Paper.

Many empirical studies analyse firm-level emissions. What sample selection issues arise if we analyze data about publicly listed firms (rather than private firms), parent companies (rather than subsidiaries), multinationals (rather than firms operating in a single country), etc

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S5 Shive, S., and M. Forster, 2020, [Corporate Governance and Pollution Externalities of Public and Private Firms](#), The Review of Financial Studies. Akey, P., and I. Appel, 2020, [The Limits of Limited Liability: Evidence from Industrial Pollution](#), The Journal of Finance. Itzhak, B.-D., S. Kleimeiner, and M. Viehs, 2020, [Exporting Pollution: Where do Multinational Firms Emit CO2](#), Working Paper.

We end this section with a literature on effects of climate policy in a setting with financial imperfections. A number of papers study this based on the California cap-and-trade program. This literature is the subject of S6:

S6 Bartram, S. M., K. Hou, and S. Kim, 2022, [Real Effects of Climate Policy: Financial Constraints and Spillovers](#), Journal of Financial Economics. Ivanov, I. T., M. S. Kruttli, and S. W. Watugala, 2021, [Banking on Carbon: Corporate Lending and Cap-and-Trade Policy](#), Working Paper.

Most of the above-stated references are empirical papers. At this point, the empirical literature on climate finance is much larger than the theoretical literature. The latter literature is what we turn to next.

## 7. Theoretical analyses

The first three references are contributions which proved to be very useful for theorizing on corporate finance and financial intermediation. The other papers mostly build on one of these theoretical foundations. These will be discussed in class, while the foundational papers will be the subject of a lecture.

Homström, B., and J. Tirole, 1997, [Financial Intermediation, Loanable Funds, and the Real Sector](#), The Quarterly Journal of Economics.

Homström, B., and J. Tirole, 1998, [Private and Public Supply of Liquidity](#), The Quarterly Journal of Economics.

Tirole, 2010, Boosting the Ability to Borrow: Diversification and its Limits, in The Theory of Corporate Finance, Princeton University Press.

[12] Roth Tran, B., 2019, [Divest, Disregard, or Double Down? Philanthropic Endowment Investments in Objectionable Firms](#), AER: Insights.

R9 Öhmke, M., and M. Opp, 2020, [A Theory of Socially Optimal Investment](#), Working Paper.

R10 Inderst, R., and F. Heider, 2022, [A Corporate Finance Perspective on Environmental Policy](#), Working Paper.

R11 Öhmke, M., and M. Opp, 2022, [Green Capital Requirements](#), Working Paper.

**What's not included in the course? The literature on climate finance is already too big to be covered in a single course. I suggest that all course participants think about their interests and use scholar google to find interesting<sup>1</sup> papers.**

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<sup>1</sup> What makes an interesting paper? There is no single answer. Does the paper combine some theory and evidence? Does it use a cool identification strategy? Do we learn something about effects of financial „friction“ on the effects of government policies? Is the paper based on some cool financial engineering?