

# Climate Change and Economics 101: Teaching the Greatest Market Failure

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## 1 Introduction

There is no doubt that economics plays a key role in our understanding and responses to climate change. The economics of climate change, ranging from the quantification of potential impacts to the design of policy instruments, has been a prominent research area, and many scholars emphasize the urgent need to expand relevant research programs (Burke et al. 2016). In the IPCC Assessment Reports, economics dominates the social science perspective, to such extent that scholars even call for attention to the “economic bias” in the process (Bjurström and Polk 2011).

Meanwhile, economics education is also influential in shaping young generations’ views on climate change. While only a small fraction of undergraduate students chooses economics as their major, about forty percent of them—more than one million each year—take some types of introductory economics course in the United States (Allgood et al. 2015, Siegfried and Walstad 2014). Those students’ views on climate change could be affected directly by discussions of climate issues—the focus of this article—or indirectly, for example by introducing students to “the economic way of thinking.” There is even empirical evidence of an “indoctrination effect”—that economics classes can lead students to behave more like self-interested economic agents (Bauman and Rose 2011)—and some critics argue that the current introductory economic curriculum can undermine the pursuit of sustainability (Reardon 2007; Green 2012; 2013). On the other hand, many economists would contend that learning economics is indispensable for understanding why climate change is such a difficult challenge and how individuals and societies might respond.

In this article, we ask the question: how do undergraduate principles of economics courses prepare the coming generations to think about climate change? As these courses are highly standardized and rely heavily on textbooks, we answer this question by surveying the contents of climate change in the textbooks. This analysis was first conceived by economist Yoram

Bauman, in 2000, when he was upset by the discussion of climate change in a textbook published by Addison Wesley. (In a sidebar titled “Global Warming—The Great Debate”, the textbook authors claimed that “The debate over global warming shows that no matter how much contrary evidence is presented, it does not matter” and that “There are in fact very few climatologists in the United States, and the majority of them are skeptical of global warming.”)

Bauman revisited this issue in his online “Grading Economics Textbooks on Climate Change” report in 2010, with three more rounds of updated reviews in 2012, 2014, and 2017. The reviews have led to some lively discussions and, in some cases, to actual changes in textbook contents. (Robert Frank, co-author of the “worst textbook” award winner in 2017 (Frank, Bernanke, Antonovics & Heffetz, 2015), responded by publicly pledging to update the climate change section in the next edition of their text. Other authors, including Gwartney, Stroup, Sobel & Macpherson (2018), a two-time winner of the “worst textbook” award, did not respond directly to the reviews but did update their texts.) Based on his qualitative analyses, Bauman (2017) concludes that “the treatment of climate change in economics textbooks is getting better.”

Building on Bauman’s work, this article takes a deeper dive into this topic. We will use a more comprehensive set of books and go beyond commenting on materials from each textbook. The goal is twofold: 1) to present a comprehensive assessment on how climate change is discussed in introductory economics textbooks and 2) to highlight various ways to engage with climate issues in the curriculum. Our analysis demonstrates that the current coverage of climate change is quite narrowly focused: for most texts, climate change only appears in the “externalities” or “environmental economics” chapters. Some authors, however, have made innovative changes to bring the subject more to the fore throughout the curriculum.

The article will proceed with a section on our research method. We will then discuss the representation of climate science, the externality framework, and other points of engagement in the texts. To conclude, we will provide some thoughts on options for innovation.

## **2 Research method**

### **2.1 Data**

In our analysis, we focus on only the textbooks for traditional 2-semester principles courses that cover both microeconomics and macroeconomics. This means that our selection excludes single-semester “essentials of economics” textbooks, intermediate and advanced textbooks, and textbooks for graduate studies. We also exclude textbooks published outside of the United States.

With these criteria, we follow Lopus and Paringer’s (2012) collection—the most comprehensive list of principles of economics textbooks—to construct our dataset. We include all books in Lopus and Paringer’s list except Taylor & Weerapana, as we failed to obtain an instructor’s copy. We also added two new textbooks: Acemoglu, Laibson & List (2015) and Karlan & Morduch (2018) to our data. In total, we have the latest version of twenty-seven textbooks, all but

Samuelson & Nordhaus published after 2013. It is also worth noting that several texts are written by prominent economists such as Daron Acemoglu, Paul Krugman, Gregory Mankiw, and William Nordhaus.

We also obtained rough estimates of market share data from a publisher. The usage and popularity of these textbooks vary significantly. Most notably, two texts—McConnell, Brue & Flynn and Mankiw—comprise about forty percent of the market; another four texts (by Bade & Parker, Case, Fair & Oster, Krugman & Wells, and Hubbard & O'Brien) account for an additional 27 percent; the remaining texts have market shares under five percent.

Table 1 summarizes basic information about the textbooks in our analysis.

[Insert Table 1 here]

## **2.2 Content analysis**

Following the origin of this project, we present an assessment of these textbooks based on their coverage of climate change. In Table 1, we include the grades that Bauman assigned to a portion of our dataset during his four rounds of review in 2010, 2012, 2014, and 2017. In the first three rounds of grading, books with a solid treatment of environmental economics but no mention of climate change would receive a C. Grades went down for books that misrepresented the basics of environmental economics or that presented a view of climate science or climate economics that was misleading or out of date; grades went up for books with a treatment of climate science and economics that was up to date, accurate, and thought provoking. In the 2017 update, an even stricter grading scale was used. The grades are necessarily subjective, but nevertheless serve as useful indices to gauge the quality of the content and how they change over time.

In addition, we also outline the various thematic categories under which climate change appears in these texts, as show in Table 2. This is done through keyword searches using the Bookshelf software from VitalSource. We searched for terms like “climate change,” “global warming,” “carbon,” “emission,” “pollution,” “ecological,” and “sustainability” to identify relevant sections of each book. We also used the table of contents and the index in each textbook. To interpret what counts as “relevant” to climate change, we look at the coverage of climate change science, the economic analysis of climate change, as well as segments that relates to climate policies. We are confident that we captured the sections related to climate change in the texts. To ensure the accuracy of the coding process, two of the authors conducted coding separately, and then compared results to detect discrepancies.

[Insert Table 2 here]

## **3 Representation of climate change science**

The fourth Intergovernmental Panel on Climate Change (IPCC) report (2007) states that “most of the observed increase in global average

temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations.” The latest IPCC report (2014) further strengthened the above language from “very likely” to “extremely likely”—the scientific consensus has been established for quite a long time. A review of various studies shows that 90%–100% of publishing climate scientists endorse the consensus position that humans are the dominant cause of global warming (Cook et al. 2016). The public, however, is less certain. According to Leiserowitz et al. (2013), only about half of Americans believe that global warming – if it is happening – is caused mostly by human activities. This gap between climate scientists and the general public has troubled policymakers and stirred lively scholarly debates.

In our analysis, we first ask whether economics textbooks help narrow or widen this divide. Besides the economics of climate change, many texts include some brief language to convey the science of climate change. In our audit, 10 out of the 27 books clearly present the idea of a scientific consensus about climate change; thirteen books do not discuss climate science. Somewhat alarmingly, there are four texts that allude to the idea that climate science is not settled. For example:

*“There is disagreement on whether humans have contributed to the problem...”*

Tucker (2014), pp.391

*“Though the science is not yet fully resolved, fossil fuel used to power the likes of automobiles and electricity generators produces carbon dioxide, which mixes with other greenhouse gases that could contribute to climate change.”*

McEachern (2017), pp.377

*“While there is general agreement among scientists that higher levels of carbon dioxide contribute to global warming, there is continuing debate about the form of the relationship.”*

Gwartney, Stroup, Sobel & Macpherson (2018), pp.693

*“In recent years, certain scientific research has suggested that emissions of carbon dioxide and various other so-called greenhouse gases might be contributing to atmospheric warming.”*

Miller (2016), pp.723

These quotes, though not denying climate change, do not accurately represent the level of consensus in the scientific community. Tucker (2014) even includes a passage on the Climategate incident but does not mention that multiple investigations found no evidence of fraud or scientific misconduct:

*“And this was even before the incident that has become known as*

*Climategate, whereby intercepted emails of climate change scientists showed the likely suppression of evidence not favorable to their view and obstacles put in the way of those more skeptical of climate science...*

Tucker (2014), pp.391

From a longitudinal perspective, textbook authors are taking climate change more seriously and covering it more accurately since the first audit in 2010. The grades in Table 1 can serve as some evidence for such improvement. Outright climate skepticism, such as the following quotes, were removed in more recent versions.

*“Other scientists are skeptical about both the temperature change and its causes . . . Skeptics also point out that the same computer models predicting global warming in the next generation predicted a much larger increase in temperature for the previous century than actually occurred.”*

Shiller (2009)

*“[T]he earth has experienced both warming and cooling trends in the past, and the current warming trend may well be unrelated to the emissions of carbon dioxide and other greenhouse gases into the atmosphere.”*

Gwartney, Stroup, Sobel & Macpherson (2008), pp.777-778

Overall, there is still room for improving the science contents of climate change in most of these books. A clear statement on the anthropogenic causes would help students conceptualize climate change as a serious social problem.

## **4 Climate change economics: the externality framework**

Now we turn to the treatment of climate change economics in these books. Although the terms “climate change” or “global warming” appear in all textbooks, the depth of the coverage varies significantly. In Arnold (2016), for example, the word “climate change” only has one trivial appearance in the entire text; other texts engage the topic at length in multiple chapters. Despite the difficulty in generalizing across these texts, we do observe some overarching patterns.

Nicholas Stern once described climate change as “the greatest market failure the world has ever seen.” All textbooks use the framework of “externalities”—a form of market failure—to conceptualize climate change. The externality framework places climate change in chapters such as “Externalities: When the Price Is Not Right” in Cowen & Tabarrok (2015), “Externalities, Environmental Policy, and Public Goods” in Hubbard & O’Brien (2015), and “Market Failures: Public Goods and Externalities” in McConnell, Brue & Flynn (2015). In the few cases where textbooks are organized by substantive concerns, climate change usually falls into the chapter on “environmental economics,” (e.g. Tucker (2014) and Miller

(2016)), which again mainly deals with externalities.

This arrangement has two implications. The first is about the overall coverage of climate change in these textbooks. Among the texts, Colander (2013) is the anomaly where global warming appears in Chapter 1 (p.18) in an “Economics and Global Warming” text box. Colander explains how the policy debate about global warming is an example of economists engaging in “normative economics” to study what the goals of economic policy should be. Other than Colander, climate change is relegated to later chapters after the introduction of markets in perfect competition. To be clear, this situation is not unique to climate change. Introductory textbooks are often organized by economic concepts—supply and demand, elasticity, preferences, etc.—not by social issues. Yet, this design has pedagogical implications. The sequence may inadvertently lead students to think of climate change as a minor aberration in an otherwise perfectly functioning efficient economic system; it may also allow climate change to be easily skipped by instructors due to its location in the textbook.

Secondly, the externality framing focuses on the idea that societies do not pay the “true” costs of burning fossil fuels. The related chapters often start by discussing that the optimal level of pollution should not be zero, but should be determined by using marginal analysis to compare the benefits and costs of emissions. Once we know the optimal emission level, the economic solution is to “internalize” the externalities, leaving market forces to achieve the policy goal. In the case of climate change, this means putting a price on carbon. In this regard, all textbooks stress the key message that incentive-based regulations are more efficient than command-and-control regulations.

Almost all texts devote significant attention to the two most common incentive-based regulations: tradable emission rights (cap-and-trade) and Pigouvian tax. This treatment is in line with the consensus of environmental economists (Howard and Sylvan 2015; Habb and Whitehead 2017). Besides tradable pollution rights and Pigouvian taxes, 21 of the 27 books also cover the Coase Theorem, in which designating property rights serves as a powerful tool to solve environmental problems.

Most texts do not express a preference between cap-and-trade and carbon taxes. Notable exceptions are McConnell, Brue & Flynn (2015), which claims that “many economists have concluded that a cap-and-trade system would not be the best way to curb CO<sub>2</sub> emissions in the United States” and Karlan & Morduch (2018), which claims that “most economists, regardless of political philosophy, believe that a carbon tax is a simpler and more transparent and efficient solution than cap-and-trade.”

The policy discussions in these chapters are often significantly outdated. For example, Hall & Lieberman (2013) still talks about the Kyoto Protocol; McConnell, Brue & Flynn (2015) claims that the SO<sub>2</sub> cap-and-trade system is working well even though the market collapsed in the early 2010s (Schmalensee & Stavins 2013). Most texts give students little if any exposure to the real-world climate policies in effect, for example, in California, which started its cap-and-trade program in 2013 and recently extended it beyond

2020; in China, which has piloted regional carbon markets since 2013 and announced a national system in 2017; or in British Columbia, which has had a carbon tax since 2008.

## 5 Climate change beyond externalities

The externality framework provides a coherent and powerful way to think about the climate. But such an all-encompassing issue also intersects with many other economic theories and practical concerns. As shown in Table 2, some books already include various useful points of engagement. Here we discuss additional topics that some textbook authors have used to engage with climate change beyond the typical “externalities” and “environmental economics” chapters.

### 5.1 GDP accounting, economic growth, and climate change

Climate change is arguably as much as a macroeconomic issue as a microeconomic one. The externality framework, however, mostly features in the micro section, leaving climate issues absent in the macro section. The section on GDP accounting is a natural place to bring climate change into the macroeconomic curriculum. Although many textbooks include a few paragraphs on how GDP does not include external costs such as pollution, the language is usually quite vague. In contrast, Case, Fair & Oster (2014), Krugman & Wells (2015), and McEachern (2017) present a good treatment of this topic by referencing Muller, Mendelsohn, and Nordhaus’s (2011) seminal paper on environmental accounting in national accounts:

*“[F]or some industries in the United States, like stone mining and coal-powered electricity generation, including properly valued air pollution in the national income and product accounts as an offset to the value of the marketed goods produced by these industries would make the contribution of these industries to our nation’s GDP negative!” (Case, Fair & Oster 2014, pp.436)*

Parkin (2016) also has a good treatment of the “Green GDP” debate between Joseph Stiglitz and the mainstream of the economics profession. While Stiglitz gives more emphasis to the consequences of an inappropriate accounting framework, both sides agree that carbon emissions should be taken into accounts.

GDP accounting leads us to the topic of economic growth. About half of the textbooks grapple with the question of whether economic growth is compatible with fighting climate change. Many books specifically devote a few paragraphs to reject the Malthusian view on the limits to growth. For example, Krugman & Wells (2015) argue that long-run economic growth and curbing greenhouse gas emissions can go hand in hand. The popular textbook by McConnell, Brue & Flynn (2015) dedicates a specific section to the question “Is Growth Desirable and Sustainable?” (pp.585), in which they lay out the anti-growth argument and then defend growth:

*“The connection between growth and environment is tenuous, say growth proponents. Increases in economic growth need not mean increases in pollution..... limiting growth is the wrong solution. Growth has allowed economies to reduce pollution, be more sensitive to environmental considerations...”*

On the other hand, a few authors are more cautious about the desirability of economic growth. They stress that the type of economic growth matters, as shown in the following quotes:

*“Yet the desirability of further economic growth for a society that is already quite wealthy has been questioned on several grounds.”* (Baumol and Blinder 2016)

*“Growth has costs, and economics requires us to look at both costs and benefits ... the wrong type of growth may produce undesirable side effects, including global warming and polluted rivers, land, and air.”* (Colander 2013)

## **5.2 Climate change as a collective action problem**

Economics can yield valuable insights to examine climate change through the lens of collective action. Both Colander (2013) and Hall & Lieberman (2013) note that international actions are constrained by the free-rider problem. Colander argues that climate actions often fall short: “because there is no world government that can force countries to comply with any global effort to address carbon emissions, any policy has to be voluntary, making it easy for one country to opt out (free ride).” From another angle, Parkin (2016) describes cutting global carbon emissions as a “prisoners’ dilemma” and notes that the Nash equilibrium is for all countries to keep increasing their emissions even though everyone would be better off if everyone cut their emissions. Many texts also introduce the concept of “the tragedy of the commons”: that individuals’ self-interested behaviors can lead to the demise of common goods such as the climate.

Some textbooks go beyond explaining why countries are slow to take action and also discuss why countries can cooperate on some occasions. In our dataset, there are 6 books that mention the contribution of Elinor Ostrom, the 2009 Nobel Laureate who wrote extensively (Ostrom 2010, 2012) about the polycentric model of climate governance. This treatment complicates the narrowly-defined rational actor model by bringing norms and institutions into economic analysis. While relating climate change to the tragedy of commons, for example, Chiang (2014) cites Ostrom to suggest that tragedy is not always destiny. The key message is that when certain institutional conditions are met, user management of common pool resources typically is successful.

## **5.3 Climate change and global inequality**

In recent years, many scholars and activists have adopted a “climate justice” framework (Roberts and Parks 2006; Grasso 2007), going so far as to argue

that equity should be fundamental in climate change policy research (Klinsky et al. 2016). This topic is uncommon in the textbooks, but those that do discuss it take one of two different approaches.

The first approach concerns the fact that countries have made, and continue to make, vastly unequal contributions to the problem. Krugman & Wells (2015) note this issue in one succinct sentence: “historically, the wealthy nations have been responsible for the bulk of these emissions because they have consumed far more energy per person than poorer countries.” Focusing on trade, Case, Fair & Oster (2014) have a thoughtful discussion linking carbon emissions to consumption, not just production:

*“[A recent study] found that in 2004, 23 percent of the greenhouse gas emissions produced by China were created in the production of exports. In other words, these emissions come not as a result of goods that China’s population is enjoying as its income rises, but as a consequence of the consumption of the United States and Europe . . . trade with China may be a way for developed nations to avoid their commitments to pollution reduction.”* (pp.680)

In contrast, a couple of books (e.g. Slavin (2014) and Tucker (2014)) hint at the argument that the U.S. should act only when China also acts.

A second approach to inequality is to note that countries face different impacts from climate change and possess different capacities to adapt. O’Sullivan, Sheffrin & Perez (2014) bring home the message that poor populations and countries are, and will be, hurt the most by referencing Dell, Jones, and Olken (2012) on climate change’s unequal impact on economic development.

*“[T]he adverse effects of increases in temperature seem to afflict mainly the poor countries, most of whom are dependent on agriculture. Rich countries do not suffer from increases in temperature.”* (pp.164)

The majority of texts, however, simply do not link climate change with inequality.

## **5.4 Climate change and cost-benefit analysis**

*The Stern Review* (2007) is arguably the most significant analysis of the economics of climate change in this century. The *Review* has been cited more than 10,000 times and generated a great number of responses and critiques. In a nutshell, Nicholas Stern endorsed strong climate action, arguing that the costs can be kept to 1 percent of global income, while the benefits are at least 5 percent and possibly 20 percent of global income.

Despite its high visibility, we only found four textbooks that mention this report. Among them, Parkin (2016) has the most thoughtful treatment, in which he juxtaposes the *Stern Review* with contrarian views from Bjørn Lomborg. The topic is a suitable place to introduce students to the logic of

cost-benefit analysis, as well as environmental economists' efforts to quantify the impacts of climate change (Tol 2005, Weitzman 2009, Nordhaus 2013).

The cost-benefit analysis of climate change is in part a question of how today's society, through the choice of the discount rates, weighs the costs and benefits to be realized by future generations. Chiang (2014) discusses this intergenerational perspective by saying that "...small changes in emissions today may have little effect on the current generation, but will have sizable effects many decades out." He also taps into the behavioral economics literature to describe that we tend to overvalue present benefits relative to future costs, thus not taking enough action.

## **5.5 Climate change adaptation**

Finally, while policy responses to climate change have two dimensions—mitigation and adaptation—most texts focus only on the former. Only two books mention adaptation as a viable response. Tucker (2014) describes adaptation as a last resort of inaction, noting that "in the end, we may find ourselves left to adapt to climate change, abandoning low-lying lands, accepting millions of immigrants from those countries, switching to hot weather crops..." Gwartney, Stroup, Sobel & Macpherson (2018), on the other hand, argue that adaptation is the superior strategy, as mitigation is expensive. Neither book faithfully reflects the current literature on the economics of climate adaptation. At the macro-level, economists have been studying the vulnerability of various countries, and at the micro-level, they look into how people adapt to heat stress, rising food prices, and natural disasters, etc. (See the recent literature reviews by Fankhauser (2016) and Kahn (2016)).

## **6 Conclusion**

In this paper, we collected a comprehensive list of twenty-seven introductory economics textbooks and analyzed their coverage of climate change. Our finding shows that not all texts touch upon climate science, and a small subset exhibits significantly less confidence on the human causes of climate change than the scientific consensus. Regarding the treatment of climate change economics, the texts adopt the "externality framework" to conceptualize climate change as a problem of carbon emission's negative externalities. The preferred solutions are market-based policies—such as cap-and-trade or carbon taxes—to internalize the external costs. Beyond externalities, some authors link climate change with macroeconomics (e.g. GDP accounting or economic growth), collective action problems, and cost-benefit analysis. Only a few authors go beyond mitigation to consider adaptation. Overall, we may have seen a gradual improvement over time, both qualitatively and quantitatively, in the coverage of climate change. Yet many texts remain unsatisfactory: the second-biggest seller in the United States, the book by McConnell, Brue & Flynn, is a notable example that contains mistakes and outdated information.

This paper ultimately relates to a deeper question—how should we teach

introductory economics courses? This issue is certainly outside the scope of this article, but in this conclusion we offer some brief suggestions that don't necessitate a radical change in the curriculum.

A first step would be giving more prominence to climate change in introductory texts. This requires going beyond the basics of the externality framework and featuring climate change more broadly. Section 5 highlights many useful points for further engagement through which students can obtain a more sophisticated understanding of climate change.

A second step would be to update the textbooks to better reflect state-of-art economic knowledge (Colander 2005; Ferguson 2011). One practical way to do this is to incorporate more empirical results from climate change economics. On this point, Acemoglu's (2013) call for strong emphasis on growth and development in principles courses is instructive. Climate change, like growth and development, is an area that many economists are researching and debating right now. By highlighting these topics, textbook authors and instructors can relate to students' concerns, spark new interests, and motivate students to pursue further knowledge.

A third step is to focus more on the connection between inequality and climate issues. Discussions of global mitigation efforts could be informed by information about different countries' historical responsibility for carbon emissions, as well as the unequal burden born by the poor people in the developing countries. Issues of free-riding and the tragedy of the commons are indeed relevant, as demonstrated in section 5.2, but this storyline fails to recognize that inequality has always been a focal point in international climate politics. From "common but differentiated responsibilities" to "loss and damage" to "green climate fund," the most contentious debates in climate change negotiation revolve around global inequality. The current silence in textbooks misses the chance to showcase the important findings from the economics literature, such as uneven damages (Hsiang et al. 2017), conflicts (Hsiang and Burke 2014), sea level rise (Dasgupta et al. 2009), and infectious disease (Tol, Ebi, & Yohe 2007).

A final step borrows from Robert Schiller's (2010) discussion on how to teach economics in response to the financial crisis. He envisions an economic education that recognizes more interdisciplinary perspectives including "[those] promoted by the other social sciences: psychology, sociology, political science, and anthropology." Climate change is an even more interdisciplinary subject than financial crises, so the same reasoning applies. These curricular changes will better prepare students to meet climate change challenges in the years to come.