

Climate Change Adaptation Economics: Lessons from Free to Choose

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Introduction

Some environmentalists advocate for “degrowth” in order to slow the pace of climate change.² Starting with the work of William Nordhaus, economists have explored different pieces of a three equation model that examines the interplay between climate change and economic growth. Equation (1) models total global greenhouse gas emissions growth as a function of population, per-capital and technological growth. Equation (2) models how greenhouse gas emissions affect global temperature. The final equation in this system, called the climate damage function, explores the economic damage caused by rising global average temperature (see Nordhaus 2019).

My research focuses on the microeconomics of this economic damage equation. Put simply, when it is 100 degrees in Phoenix in July, how much does such an extreme weather event lower our productivity and our quality of life? When a natural disaster hits, why does economic damage occur? Why weren't we ready for the shock? Over time, do such shocks cause more or less damage?

I posit that the climate damage function flattens over time because of free market capitalism. In my own macroeconomic research using data for 174 countries over the years 1960 to 2014, we estimate that under expected climate change scenarios that rising heat could shave off 7% from Global GNP in the year 2100 (Kahn et. al 2021). While I cringe at extrapolating into the distant future from the recent past (and thus violating the Lucas Critique), I view this 7% prediction to be small given ongoing global economic growth and the fact that this prediction does not incorporate the adaptation that will surely take place (Lomborg 2020).

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² The flow of emissions created at time t = global population*GNP per-Capita*(Carbon Emissions per \$ of GNP).

While Milton Friedman would dismiss alarmist concerns, in *Free to Choose*, he did advocate for government to enact cost-effective environmental regulations (see page 214 of *FTC*). His friends Gary Becker and George Schultz endorsed a carbon tax in a well known 2013 *Wall Street Journal* piece.³ The optimal level of such a carbon tax depends on the social costs caused by emitting an extra ton of carbon dioxide.

This damage caused by an extra ton of carbon dioxide is defined to be the “Social Cost of Carbon”. In my two books and several articles, I have argued that the Social Cost of Carbon (SCC) could actually decline over time because free market competition helps us to adapt to the physical risks posed by climate change.⁴ These physical risks include; extreme heat, drought, air pollution spikes associated with wildfires, sea level rise, and natural disaster induced mortality risk and damage to the capital stock.

Measuring the SCC is of both academic interest and policy interest. Terry Anderson has argued that a ramping up of a carbon tax would injure the poor’s quality of life by lowering their real purchasing power (Anderson 2021).

Anticipating the political opposition to a carbon tax, the Biden Administration has focused on subsidies for the green economy as codified in the Inflation Reduction Act. No Republicans voted in favor of the IRA. Many environmental economists endorse this subsidy approach. We do need to encourage basic R&D in decarbonization but I believe that the global free rider problem continues to lurk. I work on the economics of adaptation because I believe that global greenhouse gas production will continue to rise for decades. As the developing world grows richer, the emerging middle class will demand their own American Dream and significant fossil fuels will continue to be consumed.⁵

³ <http://online.wsj.com/article/SB10001424127887323611604578396401965799658.html>

⁴ I am aware that the world’s population is growing and that our value of a statistical life is growing as global per-capita income increases (see Costa and Kahn 2004). Since climate change is a global public bad, these factors should mean that the SCC rises over time. While the SCC reflects the summation of each person’s willingness to pay to not be exposed to the consequences of an extra ton of carbon dioxide emissions, the SCC can decline over time if we make sufficient adaptation progress.

⁵ In my research on the economics of GHG emissions production, I have emphasized three main points. Local government barriers to building housing in low carbon, progressive cities such as Boston and San Fran deflect people to higher carbon cities (Glaeser and Kahn 2010, Kahn 2011). Billion dollar projects in investing in public transit do not encourage more people to use public transit (Baum-Snow and Kahn 2000, 2005). The developing world’s growing middle class are consuming more fossil fuels and thus they oppose introducing carbon pricing (Kahn and Lall 2022). Public finance economists have not been able to figure out a scheme that taxes carbon and recycles the revenue to remove the negative income effects (Sallee 2022).

Through a series of examples, I present my main adaptation arguments. Market forces play a central role in signaling scarcity and pointing entrepreneurs to emerging opportunities. Government regulations often introduce frictions that inhibit adaptation. While Milton Friedman does not discuss climate change in either his book *Capitalism and Freedom* or in *Free to Choose*, his ideas are directly relevant for creating “rules of the game” that would accelerate the pace of adaptation.

Poverty Reduction Fuels Private Adaptation

Richer people live longer, and are healthier than poorer people. They live in higher quality housing, have access to higher quality durables and eat a better diet and have access to higher quality health care. Such microeconomic facts suggest that economic development insulates an economy from extreme weather and natural disaster shocks. In my own research, I have documented that the death toll from natural disasters declines with economic development and the dimming of city lights at night is less severe in richer cities and the richer cities recover more quickly from such shocks than poorer cities (Kahn 2005, Gandhi et. al. 2022).

Friedman’s work on the importance of early education and his work on the permanent income hypothesis are directly relevant here. He emphasized that poverty reduction is crucially linked to early education and that competition among providers would provide the right incentives for educators to provide higher quality education. His agenda dovetails with James Heckman’s dynamic complementarity hypothesis of building up a child’s skill formation (Cuhna and Heckman 2007).

Given that the majority of U.S poor people live in center cities, the public school districts in these big cities have a type of monopoly in choosing what types of education poor children have access to. Friedman’s points about the importance of school choice continue to be crucial in 2023. Urban poverty would be lower under Milton Friedman’s proposed rules for school choice.

Friedman was a leading proponent of using housing and schooling vouchers to increase the poor’s access to quality housing and schooling. Given that the poor often live in the riskiest areas within cities (where rents are low), it is important to consider cost-effective strategies to help them to adapt to the challenges we now face. In the aftermath of the damage caused by Hurricane Katrina back in 2005, Edward Glaeser advocated directly transferring money to the poor people of New Orleans rather than rebuilding the city (Glaeser 2005). The tradeoffs between investing in people versus investing in places will take on a new importance as the spatial challenges posed by rising climate risks manifest themselves.

Adapting to Rising Heat

A recurring theme in Friedman's work is the central role of competition in improving product quality. As a nation's middle and upper class grows, the nation's aggregate purchasing power fuels innovation to produce valued consumer goods (Acemoglu and Linn 2004). Over the 20th century, product makers gained profits from producing ever improved vehicles, computer goods, household entertainment systems, computers and countless other goods that people were willing to pay for. The Boskin Report's insights inform our understanding of how our real wages evolve over time (Boskin 2005).

Going forward, innovation increases our menu of products that allow us to be safe and comfortable in the midst of extreme weather conditions such as high Phoenix heat, or extreme Florida hurricanes or PM2.5 air pollution spikes from Western forest fires. Competition between firms to improve the quality of these various adaptation products yields a new version of the Boskin Report's optimism.

Amazingly, current frontier adaptation economics abstracts away from endogenous innovation and the resulting quality adjusted price declines of such products. Such work assumes a constant production possibility frontier (with safety and comfort being the output variables) that does not shift over time and assumes that as people grow richer that they are increasingly able to buy the best current products (Carleton et. al. 2022).

This incredible stationary adaptation production possibility frontier assumption simplifies economic analysis but contradicts the ideas of Paul Romer and other endogenous innovation scholars. Going forward, countless strategies will be experimented with to beat the heat and to address other emerging challenges we will face. The best ideas will diffuse widely because good ideas are public goods (Jones 2019). If a Phoenix proves to be unlivable in the year 2030 in summer, then either home prices there will decline or people will leave the area during summer. Their self protection efforts help to protect them from suffering losses (Ehrlich and Becker 1972).

While many environmental economists recognize the ability of market products such as the air conditioner to offset extreme weather, they point to the Pigouvian externalities from increased electricity consumption that fuels such air conditioning. Davis and Gertler (2015) is an example of such a study measuring the feedback loop of high temperature leading many people to crank up their air conditioners and this in turn leading to more GHG emissions if the grid is powered by fossil fuels. Due to ongoing technological change, improvements in solar and wind power are greening the grid and this attenuates the concerns raised by the environmentalists.

Competition Facilitates Adapting to Local Flood Risk and Wildfire Risk

The extremely heavy rains in California in 2023 caused significant flooding to occur. Owners of real estate have strong incentives to invest in self protection to reduce their exposure to such events (Ehrlich and Becker 1972). If insurance companies do not face regulation induced price ceilings, they can engage in risk pricing to discourage construction in areas at flood risk and they can offer non-linear contracts that encourage real estate owners to further invest in adaptive investment. Such insurers have strong incentives to research emerging risks.

A competition is emerging to deliver trusted pinpoint climate risk information. This information is used in insurance markets and to educate home buyers about the risks they face (Fairweather et. al. 2023). In a field experiment run by Redfin, the Internet real estate search company, used pinpoint data from First Street Foundation to educate a random sample of home searchers about the flood risks each property they looked at faced. This flood risk information is based on a hydrological flood model that yields an integer from 1 to 10 concerning a property's flood risk. In our 2023 paper, we document that those who were searching in areas where homes face more flood risk and were randomly assigned to the treatment group were subsequently more likely to change their search behavior and look at less risky homes and to bid less aggressively for riskier homes. We fail to reject the hypothesis that there is a differential effect in Red Counties and Blue Counties. This suggests that while many Republicans oppose carbon taxes that in private market transactions they use information to inform their efforts to produce safety and comfort for their families. Going forward as home buyers are better informed about emerging risks, they will demand housing structures that are well adapted to local risks and those firms that have an edge in supplying such differentiated products will be able to sell their products for a price premium (i.e similar to Volvo's reputation for producing safe vehicles).

The “Peltzman Effect” Revisited: Moral Hazard Effects Induced by Federal Spatial Subsidies

Milton Friedman emphasized the importance of decentralizing expenditures to local areas. Local public goods mainly benefit the areas that invest in them. When local infrastructure, whether it is public transit systems, airports, or flood protection, is financed at the national level then this distorts local decision making as it subsidizes such place based investments.

An emerging literature in climate economics is documenting the moral hazard effect induced by subsidies. Free fire fighting services encourage more people to live in fire zones (Baylis and Boomhower 2021). Levee construction attracts people to move to the area (Ouazad and Kahn 2023) and generous farmer subsidies discourage adaptation to rising heat (Annant and Shlenker 2015). In each case, a Peltzman effect emerges such that federal subsidies induce optimizing individuals to take on more risk. Going forward, design issues will arise concerning how to

make federal investments a complement, rather than a substitute, for local and private self-protection investment.

Regulatory Barriers Limit the Pace of Adaptation

In 1993, Milton Friedman wrote;

“In addition, the proliferation all over the country of building regulations, zoning laws, and other governmental actions has raised the cost of housing drastically. A friend in California has been a building contractor since before World War II. I asked him, “Suppose you were to build the identical house today that you built in 1945 in one of your large housing projects, and suppose that the price of labor, material, and so on were the same now as it was then. How much more would it cost you now than it did then because you must get government permits and demonstrate that you have satisfied government requirements?” He thought about it a while and finally concluded, “At least one-quarter of the total cost.””⁶ Recent empirical work by Goolsbee and Syverson (2023) documents the slowdown in American productivity in the construction industry. Regulatory barriers and lawsuits and environmental laws contribute to a rising cost of building new housing and new infrastructure (Brooks and Liscow 2023).

As we learn about which geographic areas are relatively safer, more people can adapt to emerging risks if we can upzone and build taller buildings in these areas. Zoning laws act as a barrier to entry limiting this adaptive path. This point echoes Friedman’s early work focused on occupational licensing’s consequences.

Today, such licensing restrictions continue to introduce frictions that lower the likelihood that entrepreneurs enter certain industries. Thus, such frictions transfer income to incumbents away from entrants. Incumbents in center cities have used environmental and real estate laws to block the entry of new construction (Glaeser, Gyourko and Sachs 2000). This has pushed housing construction to take place at the exurban fringe. In the American West, these areas are increasingly fire zones and this increases one’s risk exposure.

Regulatory barriers inhibit mutually beneficial trade in water in the American West (Libecap 2007, Anderson et. al. 2019). Why are Arizona farmers growing alfalfa when this increasingly valuable water could be sold to urbanites in growing cities such as Phoenix?

Government Decentralization Fuels Spatial Competition and Experimentation

⁶Friedman, Milton. Why Government is the Problem.* Essays in Public Policy, no. 39. Stanford, California: Hoover Institution Press, 1993.
<https://www.hoover.org/sites/default/files/uploads/documents/friedman-government-problem-1993.pdf>

Every locality wrestles with providing good schools, street safety and good quality of life. Successful people “vote with their feet” and avoid areas with low and declining quality of life. Place based weather shocks introduce new push and pull factors.

On a daily basis, the New York Times and other media outlets publish new climate science findings concerning the causal effects of extreme weather on a variety of different outcomes such as what happens to learning at school if students attend schools that do not have air conditioning and local temperatures are rising (Park et. al 2020). Such climate “Freakonomics” style research helps to expand our collective imagination about the new risks we face. In my popular writing, I have called this the “Paul Revere” effect. We can only adapt to “known knowns” and “known unknowns”. Empirical climate social science teaches us about “unknown unknowns” and this is a necessary condition for engaging in costly adaptation.

Reducing natural disaster risk exposure is another component of delivering good quality of life. Pro-active local leaders will use real time sensor information to monitor emerging challenges and take proactive steps to mitigate them. Such local experimentation offers adaptation possibilities and as local leaders learn what strategies are cost-effective the good ideas can diffuse broadly. In this sense, Paul Romer’s work on ideas as public goods is directly related to adaptation progress. Areas that perform relatively better in adapting will gain as footloose workers and firms will move to these places.

If a locality fails to adapt, then people will vote with their feet and move away from the area to an area that offers better quality of life (Rosen 1979). Given the durability of the housing capital stock, home prices will decline in areas that fail to adapt. Our experience with Detroit in recent decades previews what could happen to a Phoenix if it fails to adapt (Glaeser and Gyourko 2005). High climate risk areas could become poverty magnets and this creates the potential of a “death spiral” for a city. This multiple equilibria point merits more work. Mayors of such cities should an incentive to be proactive here to avoid becoming the “Next Detroit”.

Since local real estate owners are the residual claimants on bad “new news”, they have strong incentives to work together to push local elected officials to be proactive in tackling the local emerging climate risks. Sherwin Rosen’s (1979, 2002) work on spatial equilibrium is directly relevant here. He studied the cross-sectional spatial equalizing differences model arguing that real estate prices will be lower in areas with worse quality of life. Climate change introduces local amenity dynamics here as an attractive city such as Miami or Phoenix can become “too risky” if it fails to adapt to emerging risks. Friedman and Sherwin Rosen recognized our diversity. Even if a Miami’s flood risk increases or Phoenix is extremely hot part of the year,

risk lovers can prosper in Miami and Phoenix may attract people who only live there 8 months a year and avoid the summers.

Decentralized competition between cities also reduces the risk of Weitzman's climate "rare disasters". His macro research abstracted from spatial considerations. The U.S features hundreds of cities and this diversified portfolio approach reduces rare disaster risk.

The Central Role of Expectations Formation

In his work on the Permanent Income hypothesis, Friedman had to grapple with how people form expectations of their future earnings. Doctors expect that their earnings will be high and that their earnings volatility will be low. Farmers expect that their earnings will be more volatile. Thus, doctors should consume a larger share of their current earnings than farmers.

Expectations play a central role in adapting to climate change. Donald Rumsfeld's points about "unknown, unknowns" and "known unknowns" take on a new importance. In recent work, Hansen and Sargent have explored robust decision making as decision makers have a gnawing sense that they do not know the probability of worst case scenarios. These decision makers may choose to play it safe by holding a range of real options such as renting rather than owning a home. Home buyers will be compensated with a lower purchase price if there is uncertainty about future uncertainty regarding shocks to a Miami or a Phoenix.

Educational attainment makes one more patient and better able to understand complex emerging scenarios (Becker and Mulligan 1998). This means that more educated people will be more likely to be able to adapt to medium term challenges as they have sufficient imagination to see how shocks can impact their life and are patient enough to make plans to mitigate their effects.

Among adaptation pessimists, there is a strong behavioral worldview that embraces a benevolent paternalistic mindset focused on protecting people from making their mistakes (Kahn 2015). Manski (2004) has researched eliciting subjective expectations and the climate change challenge brings this issue to the forefront.

One Question for Friedman Concerning the Dynamics of Policy Reform

Federal subsidies to farmers and flood zone real estate owners become more costly as weather volatility increases. Will such distortionary policies be phased out? University of Chicago economists such as Becker and Friedman embrace the optimistic logic of the Coase Theorem (Becker 1984, 1985). If the inefficiency of existing policies is rising and if property rights are

well defined, the status quo losers should be able to buy the property rights from the incumbents and a more efficient allocation of resources would ensue. In the case of Arizona drought, urban real estate developers would buy the water rights from Arizona alfalfa farmers. In reality, we do not see such a Political Coase Theorem play out (Acemoglu 2002). This political market failure will slow down the pace of adaptation.

While the Coase Theorem's logic makes an optimistic adaptation prediction, we continue to pay farmers when crop failures occur. We continue to pay disaster relief when extreme weather events destroy coastal housing. A simple Mancur Olson asymmetric interest group model of transaction costs explains how distorting Federal subsidies persist. The winners from status quo policies are tightly organized and their ex-post suffering allows them to continue to be paid with "Other People's Money". How would Milton Friedman predict that this distortion will be phased out? A rising national deficit could force the Federal government to reoptimize.

Competition between jurisdictions is another way to accelerate policy reform. If a Arizona stubbornly does not adjust its water laws to account for new realities then the state's economy will suffer a decline as its cities stop growing as new housing developments will be blocked because they do not have water permits to proceed with the construction. In this case, government created "limits to growth" cause "degrowth". Governors will observe this economic decline and will have strong incentives to introduce policy reforms to help their state compete. In this sense, the logic of Tiebout "voting with your feet" facilitates policy reform. Competition limits policy inefficiency.

The Empirical Adaptation Research Agenda Going Forward

As exemplified by his research on the effects of monetary policy and his work on the consumption function, Milton Friedman emphasized the importance of careful statistical analysis and measurement. Today, an active research field estimates statistical models in an effort to establish the causal effects of climate shocks such as extreme temperature events, natural disasters and droughts on different micro and macro outcome variables such as survival, national economic growth, migration propensities and many other outcome variables. One recent example of such work is Barker (2023).

Consider economic unit of analysis i at time t . A "damage function" can be written as;

$$\text{Economics Indicator}_{it} = a + b_t * \text{Climate Shocks}_{it} + U_{It}$$

The reduced form climate change adaptation hypothesis posits that b_t is converging to zero over time as our economy reorganizes to be better able to “take a punch from Mother Nature”. In my own academic and popular writing, I have emphasized a new Lucas Critique. While Robert Lucas focused on consumers and producers reoptimizing as a function of government policy shifts such as tax cuts, in my twist on the Lucas Critique, I argue that as changes in the stochastic weather process become common knowledge that more and more self interested decision makers reoptimize to invest more effort in adapting to the risks we face. Such an attenuation of the damage function means that the core equations in William Nordhaus’s IAM models are mis-specified because he assumes a stationary damage function (Nordhaus 2019). In contrast, I have argued that the work of Paul Romer highlights that the damage function is continuously flattening over time.

A growing group of empirical researchers are testing this optimistic hypothesis in different settings for families, firms and farms around the world. If the pace of adaptation accelerates, then the Social Cost of Carbon could decline in the near future.

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