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"Big Push" Green Industrial Policy

KEY MESSAGES

- **Carbon pricing is a central part of climate policy, but is politically difficult while the economy is still reliant on fossil fuels**
- **The long-lived green investments required to break the carbon lock-in depend on expected taxes, not current taxes**
- **Policies which target the expectations of the private sector can shock the economy and move it onto a green path**
- **Green industrial policy can leverage technological/political ~~feedback~~ to kick-start the transition**
- **Fossil ~~fuels~~ bans can help break the technological and political lock-in into carbon reliance**

THE ORTHODOX CLIMATE POLICY PRESCRIPTION: PRICE CARBON!

Economists have been actively engaged with the question of climate policy for at least 30 years (Nordhaus 1991). The main product of this engagement has been vocal and wholehearted support of carbon pricing according to standard economic principles. A carbon price should make the private users of a polluting resource take into account the expected discounted costs they impose on outside parties, by putting an additional price on the use of the good, corresponding to the monetary value of the cost. Such costs to third parties are termed external costs and a carbon price internalizes them as part of the decision of how much carbon-emitting activity to undertake.

Such a price on pollution can be implemented as a Pigouvian tax (Pigou 1920) on polluters equal to the external cost. Alternatively, the policy can impose a cap on total emissions, allocate the right to emit as permits (each allowing the emission of one metric ton of CO_2), and then allow market participants to trade these permits. The price of acquiring a permit on the market (e.g., in the EU Emissions Trading System) then reflects the associated carbon price. If the cap is set correctly, this permit price again equals the external cost of the last (or marginal) unit of emissions. This is also called the social cost of carbon.

We refrain from considering the relative merits of these ways of implementing a carbon price. However, both of these market-based instruments have strong advantages over other ways of controlling pollution (Blanchard et al. 2023). In particular, they ensure that pollution is reduced where it is least costly to do so; they impose small informational requirements on under-resourced public administrators, who do not have to become experts in industrial engineering and economics; and they provide valuable tax revenue for the public treasury. By increasing the cost of using fossil fuels, they also incentivize locking up more fossil fuel in the earth, and pursuing more innovation in green R&D.

This elegant solution to controlling pollution may work when it is easy for emitters to adjust the activity that produces the external cost. For example, congestion charging (here, the external cost is associated with additional traffic congestion) can be avoided by using public transport options or by avoiding entering the congestion charging zone at peak times. Similarly, acid rain-causing sulfur and nitrogen emissions were reduced in the 1990s by installing relatively inexpensive "scrubbers" to existing infrastructure. Unfortunately, avoiding greenhouse gas emissions is less easy,

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making it harder to succeed with ambitious climate policy – such as achieving net zero by 2050 – by relying on market-based instruments alone.

CLIMATE POLICY: NOT YOUR USUAL PUBLIC POLICY PROBLEM

Climate policy is different from many previous environmental problems and requires instruments beyond carbon pricing to bring about the transition needed. We highlight three main issues, and then explain their implications for climate policy.[1]

First, note that climate action is likely to remain policy-driven. The world has relied on fossil fuels because the private costs of using them are very low. If one ignores the external costs – as private agents will do in the absence of carbon pricing – the chemical and physical properties of fossil fuels make them very convenient and effective to use. This translates into low costs per unit of energy, which are further diminished by decades and even centuries of development of advanced fossil energy technologies. To be competitive, renewables (such as solar or wind) must enter a level playing field, one on which carbon pricing policies force users to face the true social cost of fossil fuels.

Second, climate policies involve what economists term strategic complementarities (or positive feedback effects). These are situations in which a private action to shift energy production from fossil to renewable sources will give other agents an additional incentive to follow suit. We highlight a few important channels here (van der Ploeg and Venables 2023).

Technological complementarities arise if the development of green technologies – essentially, new ideas on how to generate cheaper renewable energy – can be further developed by other innovators (Acemoglu et al. 2012; Harstad 2020). There is thus a technological externality in addition to the global warming externality, since green R&D leads to more green R&D. Closely related, network effects are present if deployment of green technologies makes it more convenient for others to adopt the same, or a complementary, technology. For example, a higher penetration of electric vehicles may encourage firms to build more charging stations, which in turn encourages more consumers to switch to electric vehicles, and so on.

Social complementarities follow from the desire of consumers to make consumption or production choices in line with their peers (e.g., Besley and Persson 2023). If consumers are switching to fuel efficient vehicles en masse, large petrol-guzzling sports utility vehicles may become démodé. Thus, green ways of living may sustain themselves by pure social pressure. This is yet another externality stemming from peer effects in consumer demand.

Furthermore, there are likely to be substantial political complementarities. Carbon pricing is costly and unpopular when most people live in energy-inefficient buildings, far from their place of work and from services, to which they drive in large gas-powered vehicles (Douenne and Fabre 2022). In this situation, politicians may refrain from implementing carbon pricing, and in the absence of carbon pricing, people may continue to choose carbon-intensive lifestyles. Moreover, the influence of powerful fossil business interests works to entrench the carbon-intensive status quo. On the other hand, if society adapts to a low-carbon lifestyle, and has large renewable energy producer lobbies, policymakers face little opposition to pricing carbon. A green economy and green politics ~~happily coexist~~.

Such policy complementarities imply that our society may be locked into path dependence. Past carbon-intensive consumption and investment choices support carbon-friendly technological development and deployment, and generate political opposition to aggressive mitigation of climate change. This makes fossil fuels cheap to use due to ~~advances~~ in technology and a lack of regulatory measures such as carbon pricing, which in turn perpetuates the carbon-intensive lifestyle.

Third, this path dependence is made worse by the fact that climate policy involves a radical restructuring of our energy infrastructure and the investments required to achieve this. Importantly, a carbon-intensive economy needs many extremely long-lived assets. The mean lifetime of fossil-fuel power plants is close to 40 years (Cui et al. 2019; Tong et al. 2019). The skills built up by a trainee starting their career at an oil refinery can be used for many decades, but are largely useless outside the refinery. ~~An urban layout~~ and a motorway network designed around private motoring persists for many, many decades. Many of these assets would become stranded – their value prematurely reduced – under ambitious carbon pricing policy (von Dulong et al. 2023).

EXPECTATIONS: THE KEY TO ACHIEVING THE GREEN TRANSITION

Together, the presence of long-lived assets and complementarities implies that our future may be a self-fulfilling prophecy – whether green or brown. In the jargon of economics, we face a situation of multiple equilibria. If consumers, workers, and investors expect toothless climate policy, and a continuation of technological development in a carbon-intensive direction, they will continue to invest in long-lived dirty assets and skills (e.g., Kalkuhl et al. 2020; Smulders and Zhou 2023). Looking to the future, political constraints imply that carbon pricing still cannot be implemented in the presence of all these assets (despite

[1] We ignore here the problem of international free riding. Greenhouse gases are global pollutants, and controlling climate change is a global collective action problem. Arguably this is the biggest obstacle to climate action.

earlier, vehement commitments made by previous governments). And this will have justified the investors' decisions – their predictions of a brown future turn out to be correct!

On the other hand, if private agents start expecting – really expecting – the green transition to happen rapidly, they will invest in renewable power generation, electric vehicles, and energy-efficient homes, and they will train as wind power technicians rather than as coal miners. And, in the future, governments will face demands to make the green technology competitive – to level the playing field for green energy, and to make any remaining fossil users face the full external cost of burning carbon.

This situation of different, self-fulfilling futures means that it is crucial to force private agents to shift their expectations – to make them believe that we are now on the verge of a rapid green transition.

Shifting expectations is also essential because the ultimate climate outcome depends less on emissions in the near future – in the next few years – than on emissions in the longer term. Climate change depends on cumulative emissions that we emit until we reach net zero. Emissions in 2024 do not matter much; what matters is how much we continue to emit in the 2030s and 2040s. Moreover, energy demand is not very responsive to prices in the short term: people still have to heat their homes and drive to work, even if doing so is expensive.

This means that carbon pricing in the short term is not only unpopular, but it will also remain an ineffective way to meet our climate goals unless the technological, social, and political externalities are internalized as well. It may be politically easier, and more effective, to focus on policies that will shift expectations in the longer term. We will now turn to recommendations on how policymakers could act to shift expectations – to guide our society onto a trajectory of green transition, rather than staying on a path of continued fossil dependence and climate inaction.

POLICY CONCLUSIONS

Green Industrial Policy to Kick-Start the Transition

The past two years have seen the return of large-scale industrial policy – specifically, "green" industrial policy. The Inflation Reduction Act (IRA) in the United States is intended to channel vast amounts of federal subsidies (in the form of tax credits) into the deployment of renewable electricity technologies and into the production of renewable energy. The European Union's response to the IRA, the Net-Zero Industry Act (NZIA), is intended to open the doors to EU member states providing similar support. While there has been a vocal argument over whether these policy packages are useful or a costly waste, here we emphasize their potential impact in terms of setting these two large economies on green trajectories.

First, it is widely understood that policymakers often find "carrots" easier to implement than "sticks." Subsidies have often been easier to implement than carbon pricing policies: while they are typically at least as costly, these costs are paid for through general taxation and thus may stand out less to voters than carbon prices (Blanchard et al. 2023). Thus, these large-scale industrial policy packages may offer the benefit of being more politically feasible than ambitious near-term tightening of carbon pricing schemes.

Second, by supporting the deployment of renewable energy production, the improvement of energy efficiency, the expansion of electric vehicles, and so on, these industrial policy measures will ~~lead to~~ interest groups that in the future will work to defend their own interests while also slowly eroding the constituency that opposes carbon pricing. This is the process that has made Germany a leader in the production of renewable energy: early subsidies to a fledgling industry turned into investment, which turned into political power, which helped the industry resist later attempts by conventional utilities to strangle the sector (Jacobsson and Lauber 2006). The choice is therefore not between efficient carbon pricing versus costly subsidies. Rather, subsidies paid today can act as the key to open the political lock on more ambitious carbon pricing in the future (broadening the scope and raising the carbon price level). This argument about policy sequencing has been made by, for example, Meckling et al. (2017).

Third, it is important to understand that, with multiple equilibria, it is not sufficient to pursue marginal climate policies. Because the different equilibria are stable – that is why they are equilibria – small adjustments are unlikely to fundamentally change the trajectory of the politico-economic system. Rather, to give the system a push big enough to shift it to a different trajectory, climate policies must be radical (van der Ploeg and Venables 2023). For example, carbon prices may have to be larger – at least for some time – than the Pigouvian price, and/or supplemented with large enough renewable subsidies to shift the economy from a carbon-intensive to a green equilibrium. The recent green transition policy packages, some implemented (NextGenerationEU, IRA), others under discussion (NZIA), are hopefully large enough to sufficiently shock private sector expectations and actions in order to shift the economy into a green direction.

Fourth, to maximize their impact on expectations as well as on the future path of climate policies and economic decisions, these green industrial policies should be designed consciously with the intent of pushing the various complementarities over the hump to where the green equilibrium outcome becomes self-sustaining. Such strategic policy design must consider where the most likely social, technological,

and political complementarities and tipping points are. The policies should be designed with an eye on building up future political coalitions in favor of, and disarming political resistance toward, carbon pricing policies. Such political strategies would have to be designed jointly by economic and political experts (Acemoglu and Robinson 2013) to take into account both the economic effects and political consequences of green industrial policies. Because resources are limited, policymakers must also think about how to achieve ~~biggest~~ "bang for the buck" – taking into account not only the direct economic and environmental impact of, say, subsidizing renewables, but also the subsequent effects on political constraints that future policymakers must contend with.

Fifth, economists realize that poorly designed industrial policies can turn into costly "white elephants," swallowing more and more public money. Supporting some projects that turn out to be disappointing is to be expected when optimally investing in the development of new technologies. The larger problem is that industrial policy is "sticky," because of political capture of the regulators. Thus, green industrial policy must be designed with a set of institutions that allow support to be terminated according to well-defined conditions and by technocratic program managers isolated from political pressure (Rodrik 2014).

Technological, social, and political complementarities also mean that support can be removed once the transition becomes self-sustaining. It is unclear how to identify when a particular technology has crossed the tipping point, but some indicators include observing an acceleration of the transition without an accompanying increase in policy support – which could indicate that expectations are starting to drive the transition by themselves – or an increase in unsubsidized investments into capital that is complementary to the supported investment.

The End of the Fossil Era Must Start Now

In addition to nurturing green technologies and giving the related special interest groups space to develop, policymakers should also ensure that the dirty technologies of the past, and their associated interest groups, are no longer allowed to recreate themselves. This will reduce future resistance to carbon pricing, which is at least as important as allowing support to grow.

Carbon pricing is politically difficult, and part of the reason is collaboration among well-resourced ~~fossil sector and labor interest groups~~ in opposing climate action (e.g., Mildenberger 2020). Existing vested interests will naturally be defended. However, it may be easier to limit the continued reproduction of such interest groups by banning new investment into fossil fuels. This is because of sunk investment costs. Before investment, the holder of a fossil asset (such as a plot of land containing a fossil deposit) stands to lose the net profit they could gain from this investment, i.e., in terms of revenue, operating profits, and investment costs. Once the investment cost is sunk, the value at risk of stranding is then the gross profit – revenues minus operating profit. The owner of a developed fossil fuel asset will hence resist a carbon pricing policy much more fiercely than the owner of an undeveloped asset. To the extent that banning further fossil development generates temporary scarcity, which pushes prices up, the owners of operating fossil assets could even support a ban on further development (Baldwin et al. 2020).

CONCLUSIONS

While carbon pricing is a central tool to achieving the green transition, attempts to implement it to date have been limited in both scope and level, largely for political reasons. We argue that short-term carbon pricing is the wrong focus if we want to pursue effective climate policies: it is both politically difficult, and not the main determinant of the degree of climate change that we will end up suffering.

The green transition requires large and long-lived private investments, which take account of technological, political, and social complementarities. This means that there are multiple possible future trajectories that our politico-economic systems can take. Which one is chosen depends largely on private sector expectations. The implication is that effective climate policy needs to be radical enough to fundamentally shock climate policy expectations onto a new trajectory. Green industrial policy can help by laying down undeniable facts on the ground, e.g., by supporting rapid green technology development, or strategically supporting renewable energy deployment to create interest groups. In the future, these groups will then lobby for ambitious carbon pricing. Once private sector agents at large appreciate that these new facts on the ground spell the imminent end of fossil fuels, they will take care of the remaining green transition, even without additional support.

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