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Finance, money, and climate change

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Fighting climate change has become the major priority of public policy in a great number of countries, and all institutions responsible for implementing those policies have been called to contribute. Financial intermediaries, their regulators and central banks themselves are no exceptions. Some have shown an inclination to internalize climate change in their policy objectives and frameworks. Others are more reluctant. This paper explores the scope and limits of green finance and the possibility of "greening" monetary policies. It does not come to definite conclusions or policy proposals. Rather, it presents a framework to think about the issue and identify some major trade-offs and choices.

Section I - basic conceptual issues

When considering how financial activities and Central Banking relate to climate change, three central conceptual issues must be considered: The question of the horizon, the question of the function, and the question of the instruments.

A. The question of the horizon

There is no doubt that climate may ultimately influence inflation and financial stability. And that – as a consequence – financial markets, regulators and central banks should take those effects into account and internalize them in devising policies. However, time scales are important to consider.

When pondering “green” policy shifts, three distinct horizons are analytically relevant:

- *The horizon of climate change:* The effects of climate change are likely to manifest themselves in the span of several decades. Indeed, the scientific community defines changes in climate over at least thirty years, and because of such long-term nature of the problem, political inaction would inevitably make global warming a progressive, but nonetheless cumulative and irreversible process. The need for public intervention is especially pressing due to the failure of private agents (from all sectors of the economy) and financial intermediaries to internalize the costs associated to the climate crisis, an outcome mostly ascribable to what former governor of the Bank of England Mark Carney

referred to as the "tragedy of the horizon":[1] While the consequences of climate change are likely to be most tangible in the future and thus suffered by younger generations, the time horizon of today's pivotal actors is much shorter.

- *The horizon of financial risk and stability*: The evolution of the financial conditions of an economic system can be interpreted through the lenses of financial cycles, which feature a succession of peaks and troughs in the main indicators of financial activity. While typical cycles span over a period of eight to ten years, one of their key features is that financial risk can build up during times of low volatility (through, for instance, unobservable off-equilibrium dynamics) and erupt when crises occur – a phenomenon known as the "volatility paradox".

- *The horizon of monetary policy*: Policies implemented by the monetary authorities are usually evaluated over a time window of around two years. In fact, beyond that term, money is described as "neutral", i.e., having no effect on real variables such as output or employment, by most macroeconomic models based on price and wage rigidities as primary frictions driving the business cycle.[2]

Although a key policy question arises about how these horizons articulate and overlap, there is no agreement on the answer. In fact, consider the following illustrative examples:

Financial stability and monetary policy. There exists a long-standing debate over whether monetary policy should aim at financial stability, for example by influencing risk-taking behavior of financial markets participants. Adopting this new goal would then imply that central banks should look at a horizon longer than usual in setting, for instance, the key policy interest rates.

Climate change and financial stability. We see already local draughts and flooding, but the significant and disruptive climate-related events are likely so far away in the future that they do not pose significant risks to financial stability in current times.[3] However, two elements have sparked a serious debate on this issue. First, it will be crucial to determine the time horizon at which climate will have a significant adverse impact on the economy. Second, global warming and its ramifications could result in the emergence of large quantities of so-called "stranded assets", i.e., assets whose value suddenly drops. These losses in value can occur due to climate change directly, but more likely and earlier due to shifts in policy. For instance, sites for the extraction of non-renewable sources of energy might turn into stranded assets if energy policy curbs the relevant markets. This, in turn, generates questions about the role of markets for insurance against such transformations, and that of decision-makers in limiting costly policy uncertainty.

Climate and monetary policy: These are the most disconnected horizons, since they refer to the very long- and short-term, respectively. Therefore, prima facie, it is hard to conceive channels through which monetary policy could act on climate change. However, two nuances should be noted. First, the evolution of climate may affect real parameters of the economy

[1] See Carney (2015).
[2] In models with financial frictions, however, inflation driven by steady state monetary policy affects agents' portfolio choices, the risk premia on assets and hence long-term growth. See e.g. Brunnermeier and Sannikov (2016).
[3] See e.g. Cochrane (July 2021).

into which monetary policy is devised. For example, we will argue below that climate policy may affect the neutral interest rate r* and hence the room for effective monetary policy. Second, central banks may want to promote an extended and modified version of what monetary policy is in their operative framework. For instance, they could explicitly acknowledge to undertake the allocation of resources in the economy towards "green" sectors, and channel credit and refinancing accordingly.

B. The question of the function

To explore the potential role of monetary and financial policy in tackling climate change, it is useful to refer to the classical distinction, first proposed in 1959 by public finance theorist Richard Musgrave, between the three distinct functions public economic policy should fulfil.[4] First, authorities are concerned with the *allocation* of resources and production capacity to the different actors in the economic system; second, policy can pursue the *redistribution* of wealth and income; and third, it can implement measures to ensure the *stabilization* of the economy. The latter interacts with the allocation of risk across the economy.

Within this framework, central banks are specialized in stabilization. Indeed, they are unelected and typically independent government agencies to which a specific function of stabilization is delegated by mandate. The latter usually includes the achievement of price stability and/or full employment, although in some emerging economies, directed credit is accepted as a legitimate tool and function of the central bank.

Although mostly unintendedly, the course of action of central banks also produces spillovers in allocative and redistributive terms. For instance, asset purchase programs are often condemned for their side effects on wealth inequality. Nevertheless, those side effects have generally been accepted by central banks as a price to pay to fulfill their mandates, but have been difficult to manage in their communication and operations.

However, in recent times some have advocated – in a few cases with some degree of success – that central banks go one step further in this respect, i.e., that they take on an explicit allocative function, especially by their ability to influence capital allocation both as regulators and monetary policy-makers. Within this debate, an interesting argument has emerged promoting market "neutrality" in the context of asset purchases.[5] This would require central banks to set policy with the goal of affecting the aggregate variables of the macroeconomy – nominal growth and employment – rather than being guided by microeconomic considerations about which specific sectors or regions economic activity occurs in, including whether business takes place in "green" or "brown" sectors.

However, this proposal has received criticism from two angles. On the economic side, neutrality would entail ignoring the existence of a market failure when asset prices do not incorporate the costs of global warming. From this point of view, neutrality would enable and even exacerbate market distortions. On the political side, this proposal – critics say – would induce unelected officials such as central bankers to take actions contradicting priority

[4] Musgrave (1959).
[5] See Schnabel (2021).

objectives of society at large (i.e., tackling climate change). This would be all the more unacceptable now that unconventional monetary policies have already generated irreversible non-neutral effects.

C. The question of instruments

In the context of public policy, instruments to achieve objectives can be either specialized or multipurpose. As for this distinction, central banks have historically operated under an implicit principle of specialization, adopting the instruments most adapted to each of the objectives they are mandated to pursue.

While specialization ensures efficiency and accountability, thus guaranteeing good governance, its principles are not universally accepted by the central banking profession. In fact, there is a permanent debate on whether monetary policy should also aim at financial stability, although no central bank has yet been endowed with a formal mandate to strive for financial stability. This is mostly due to the fact that objectives and tradeoffs are more difficult to define and identify for financial than for monetary policy.

There is a more general question on the "greening" of existing public policies, like monetary policy, health policy etc. Greening, in effect, should be judge based along two dimensions of measures: First, an evaluation of policy instruments how efficient it is in reducing carbon emissions; second, how much does greening of an instrument distort the original policy goal for which a particular instrument was created for. For example, monetary policy has attracted some interest because it is perceived as potentially very efficient in influencing investment choices and portfolio allocation. On the other hand, it is ethically difficult to justify “greening” of health policies, i.e., distributing healthcare services according to the carbon imprint of its recipients. This raises the question, where is the boundary?

One last aspect to consider is that greening would engender a major transformation in the approach to public policy, with the likely potential to diminish the accountability and weaken the independence of the authorities in charge of designing and implementing the relevant programs. Despite this, advocates of greening point to the very specific features of climate change as exceptional and capable of posing an existential risk, which would justify that all available public policy levers be employed. In essence, according to that view, the urgency of the problem is compelling enough to override any concerns about governance.

Section II - green finance and policy

A. Incorporating climate risk

Going forward, accounting for climate risk is an obvious obligation for policymakers. For instance, climate should play a major role in financial risk assessments. Stress tests and, in the euro area, the Internal Capital Adequacy Assessment Process (ICAAP) should incorporate a climate component. Climate scenarios should be conducted in parallel (or as complements) to macroeconomic scenarios, as climate conditions have an obvious impact on the valuation of

long-term assets and liabilities. Climate sensitivity analyses should systematically be carried out and updated for the portfolios of insurance companies, institutional investors, and asset managers.

However, as these processes are introduced, a subtle distinction needs to be clarified between three categories of risk:

- The *risk* stemming directly *from climate events*: for instance, mining, farming or some industrial activities may become impossible in some areas, and existing assets ought to be depreciated accordingly;
- The risk associated to the future impact of *existing climate policies,* which must be assessed and appropriately priced;
- The risk stemming from the impact of *future climate policies* that have not yet been enacted. For instance, should a carbon tax (or some equivalent measure) be implemented, some oil reserves would become "stranded" and exposures by financial intermediaries should record some impairment. It is economically logical that institutions be stress-tested against that possibility. It is also financially sound that institutions be asked to protect against it. However, it may be operationally inconvenient for supervisors to assess the probability of policies that have been enshrined in international agreements (the Paris Agreement, for instance) but not enacted by the legislator.

Interestingly, in case these options are taken to action, a positive feedback effect might arise. Indeed, if private institutions provision for the impact of future climate policies, they will grow more resilient when measures are taken. In turn, increased preparation in the private sector may make it easier and politically more feasible for public decision-makers to adopt the necessary policies. On the contrary, in the absence of preparedness of private actors, a "climate risk dominance" phenomenon could arise. In essence, if no provisions are taken, implementing strict climate regulation becomes too risky and costly to undertake.[6]

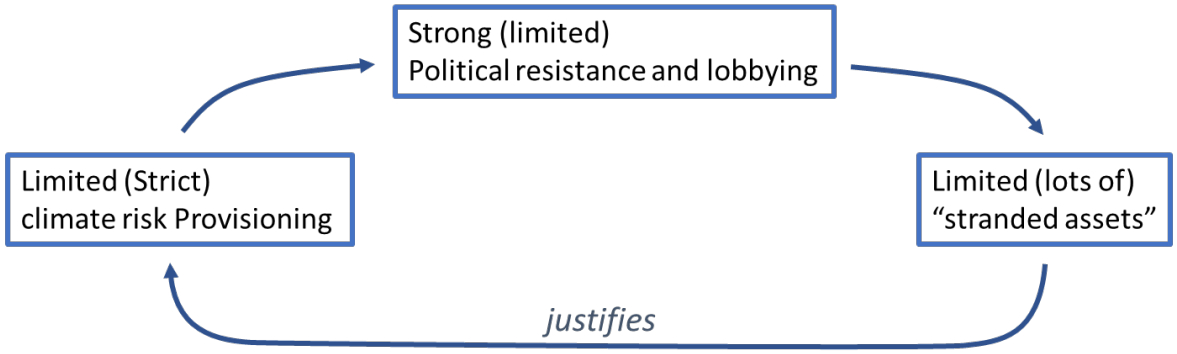

Figure1: "Climate risk dominance" analogous to "financial dominance".

[6] This is analogous to "financial dominance", which hinders central banks to tighten monetary policy when it might trigger financial crises because the financial sector has not built up extra safety buffers. See Brunnermeier (2016) "Financial Dominance".

B. Steering climate policies through finance: conceptual issues

According to some, another promising venue to stimulate the interaction of financial and climate policy is that of employing financial intermediaries to steer climate-related measures.[7] For instance, the supervision capacity that banks have towards their debtors could be leveraged to channel credit towards "green" business. This mechanism would rely upon distorting normal allocation process. In fact, while in general regulatory authorities put a price on the resource that was previously free, and then expect financial markets to reallocate capital after the policy has been incorporated into asset prices, this new procedure would entail that authorities expect financial markets to internalize polices that have not been formally implemented.

However, both theoretically and in practice, this approach raises some difficulties. First, it might *distort the wrong adjustment margin*. At the theoretical level, adding constraints to financing towards "brown" firms might turn out to be suboptimal. Indeed, one can think of capital, labor and pollution as input goods of a business' production function. Ideally, one should tax pollution directly if the latter can be measured accordingly. A less efficient alternative is to tax the output good instead, which is still better than taxing any other input good such as capital. Using intermediaries to increase financing costs (by raising risk premia) is precisely equivalent to taxing capital, so that such proposal results, in effect, in a (suboptimal) Pigouvian tax. In addition, it is likely to hit harder smaller, more financially constrained firms.

Second, it is wrong to *asks for ambiguity in policy measures*. One might – though mistakenly - argue that creating artificially risk and planning uncertainty imposes a Pigouvian cost on firms in the form of "risk premium tax". While such an extra "Pigouvian tax" can still steer investments, it however, in contrast to an explicit textbook Pigouvian tax, does not generate any tax revenue for the government. For this reason, it is clearly suboptimal. In other words, one should push governments and parliaments to take clear and predictable measures on climate matters. Indeed, uncertainty on future policies – more than the lack of financing – is the main factor inhibiting investment in climate change. Once those uncertainties are removed, investors will be able to take full advantage of existing low interest rates and easy financial conditions. For instance, a carbon tax with clear projections on its future path would be a tool to provide certainty on the price of carbon, and thus make investments in sustainable sources of energy less risky from today's perspective. Alternatively, policy measures could also target the quantity of emissions. This is achieved with pollution permits where the government fixes the number of permits, although uncertainty about the price path could potentially turn into a source of unnecessary risk. Some, such as French economist Jacques Delpla, have argued that a government agency could step in to additionally stabilize the price by buying or selling permits on the margin (Delpla and Gollier 2019).

Although reducing uncertainty by clarifying the trajectory of future policies is key, policymakers should also strive to keep some flexibility in deploying their policy toolbox. If tipping points become apparent, they should retain the option to double down in efforts in order to avoid those tipping points and achieve resilience. Re-optimizing the optimal climate policy over time is a key ingredient of a successful climate policy. Somewhat analogously, time inconsistency issues are also likely to arise, insofar as, as new information and knowledge is

[7] See e.g. Davies (2021).

acquired, decision-makers might find it optimal to deviate from the policy path they had committed to ex-ante. For this reason, a well-designed balance between rules and discretion will be crucial to enact efficient and effective climate policy.

In addition, policies should overcome market failures due to short-sightedness of financial markets. Green finance policies may encourage the development of long-term project, as most of the difficulties attached to financing the energy transition are common to all long-term risky projects. In fact, facilitating investment over long horizons might also remove the barriers hindering the flow of funds towards projects which are in line with environmental targets.

Finally, it needs to be stressed that any policy is typically plagued with agency and incentives problems. Interested parties will exert lobbying effects. In fact, it is often not clear whose interests the regulators would be supposed to serve. Would they aim at the interest of the general public, or rather at enhancing the competitiveness of some specific sectors or even single companies?

C. Debated implementation strategies of green finance

While the concept of green finance is widely utilized, it remains largely undefined in terms of instruments and legislation.

One possible strategy to favor green financing is to take advantage of *regulatory apparatus* in regulating banks and other financial intermediaries. In fact, most capital ratios under the Basel III regime are "risk weighted" – they vary with the estimated riskiness of loans and assets held by banks. It would be relatively straightforward to expand the concept and definition of riskiness to take climate risks into account. In this case too, there is a graduation of possible regimes depending on the kind of risks that would be considered, some relevant distinctions being existing and materialized climate risks vs. future possible climate risks; and impairments resulting from existing policies vs. future possible policies. Capital ratios could also be used in a more proactive way by applying favorable regimes to loans and investments deemed "green" by supervisors. While operationally easy to implement, such regimes would confront central banks with a triple challenge:

- Green investments may be intrinsically riskier and would, per se, require higher capital buffers;
- A natural question arises as to how the "green" characterization would be defined, by whom, and whether regulators are equipped to make such a determination;
- Using prudential ratios to influence the allocation of credit would mark a shift toward more "directed credit" policies, which were abandoned in most advanced economies several decades ago but are practiced in many emerging economies. Again, the question would arise as to whether central banks are equipped to implement such policies, and whether they would be able to resist the likely and severe lobbying pressure coming from various interest groups.

Another policy strategy that has been recently adopted that of *sustainable finance labels*. The latter are generally awarded by financial centers, professional responsible investment associations, and specialized environmental labelling organizations to certify funds' quality level on sustainable asset management (Novethic 2021).

The EU has also introduced a taxonomy to guide investors looking for "green" opportunities. The EU taxonomy defines a list of objectives that an economic activity must contribute to in order to qualify as environmentally sustainable. Among such objectives, one can find climate change adaptation and mitigation, the transition to a circular economy, and pollution prevention and control. Besides setting clear standards on sustainable enterprises, the EU taxonomy has the discouragement of "greenwashing" – the use of misleading marketing campaigns based on conveying an environment-friendly image of the company – as an explicit objective.

The need to classify investments based on their environmental impact has also engendered the fast multiplication of *rating* entities with a focus on environmental, social, and governance (ESG) sustainability. Unfortunately, there is evidence that such ratings are very noisy (they show much lower correlation than, for instance, credit ratings, with each other, see Rigobon et al. (2020)) and even non-informative about the actual emissions growth path of companies (Elmalt et al. 2021).

Moreover, as in the previous discussion about the role of financial intermediaries, it is not clear that entrusting the asset management industry with the promotion of climate policy would not lead to issues in terms of perverse incentives and of democratic legitimacy. Be it as it may, in recent years there has been a proliferation of so-called "green funds" and "green bonds", providing investors with the opportunity to invest in projects described as environmentally conscious. These developments have sparked an intense debate about the fitness of this types of tools to have an impact on long-term climate outcomes, with critics arguing that ESG investing does not have enough depth to be effective in tackling global warming (see, for instance, Armstrong (2021)) and the debate on the Financial Times).

Section III - Monetary policy and climate change

A. Impact of climate transition on the macroeconomy

As Jean Pisani-Ferry (2021) noted, the climate transition is likely to have significant short- and medium-term consequences on key macroeconomic indicators. One of the main trends the conversion will trigger is the accelerated obsolescence of some classes of capital, e.g., production sites and equipment in environmentally non-sustainable activities. Obsolete jobs will also be lost, and workers will need to be reallocated in other sectors of the changing economy. These facts will in turn generate a greater demand for new funding towards "greener" outlets, so that the consumption-investment balance is likely to shift towards the latter component. Although future generations will likely benefit from better climate and the

returns on current "green" investment, non-negligible transition costs are likely to materialized in the short-term.

Climate change adjustments are also bound to weigh on public coffers for several different reasons. Public investment in research, new infrastructure and the reconversion of physical capital will be necessary. Transfers will be needed to buffer the impact of the transition on those who are more exposed – most-likely the poorest households. These expenses would almost certainly need to be paid by issuing new public debt, a tendency which would be in line with political economy considerations as well.

B. Climate change and r*

Climate change and climate change policy can impact the neutral interest rate r*. The theoretical construct of r* gives a useful practical guide whether a monetary policy rate is expansionary or contractionary. It is determined by structural characteristics of the economy and is not affected by monetary policy. The distance between the r* and the effective lower bound (reversal interest rate) also gives an indication how much policy space monetary policy has.

It is straightforward to deduce that the policies allowing for the climate transition will likely put upwards pressure on r*. In fact, the massive need of infrastructural and industrial investments will increase the demand for new capital and savings, which in equilibrium will yield higher returns. A shift in the composition of capital is also to be expected, since some of it will become obsolete and will need to be replaced by new one. One should also note, however, that as long as climate risk persist, we might witness pressures on r* in the opposite direction as well. Indeed, climate-related uncertainty could lead to the accumulation of precautionary savings, which in turn would drive down the neutral rate r*.

C. Extreme events and supply shocks

Even abstracting from the complications entailed by the evaluation of climate risks in the long-run, climate change might have a significant disruptive impact on the economy in the short-run. This is especially true if global warming were to lead to an *increased frequency* of extreme weather events. Such occurrences can be identified as negative supply shocks, in that they mostly disrupt the production side of the macroeconomy, and tend to decrease output while increasing prices. These effects have the potential to complicate the conduct of monetary policy, a task which might become particularly challenging in some small- and medium-sized emerging economies that may be especially exposed and thus need to readily adjust their policy frameworks accordingly. Another channel through which climate-induced supply shocks could hinder monetary policy is related to expectations. Frequent shocks might make it difficult for central banks to anchor or manage the expectations of agents in the economy, thus removing one of the key instruments available to monetary authorities from their (already shrinking) toolbox. Losing the inflation anchor makes monetary policy less effective as a powerful tool to promote resilience.

D. Monetary policy instruments

Over the last decade, central banks have significantly expanded their balance sheets, often by a factor of five or ten. In many countries, those balance sheets are now commensurate to the size of the national economy. With such an imprint on the economy and financial markets, central banks could take a more proactive approach to financing the climate transition.

In this respect, three possibilities come to mind, both involving no significant changes to the current operational framework of most central banks:

- Reorient their asset purchases towards "green" securities, so as to boost those market participants which contribute the most to climate sustainability;
- Modulate haircuts applied to different kinds of collateral used in refinancing operations, thus creating an incentive to detain some – the climate-friendly ones – and offload others;
- Using instruments steering the allocation of the Eurosystem's assets and collateral towards low-carbon sectors, which would reduce the cost of capital for these sectors relative to high-carbon ones.

E. Central Banks' mandates and independence

In countries in which central banks are subordinate to the government and do not enjoy any independence, a clear assignment of the various policy functions is not relevant. This is especially true if the government-directed credit is part of the economic model as, for instance, in the case of China.

In democratic societies, decisions on allocating resources and redistributing incomes are taken by elected bodies. Obviously, policies relating to climate change belong to that category. Independent central banks, in contrast, are non-elected 'agents' of the society, although they have a well-specified *mandate to stabilize the economy*. In this framework, it can be argued that central banks would be going beyond their mandate if they were to tweak their instruments of monetary policy to allocate resources and direct credit to specific sectors, as it would most likely happen in case they took up climate goals. This argument seems to have been embraced by the Federal Reserve, as Chairman Powell stated recently that "[c]limate change is an important issue but not principally for the Fed".

In contrast, the situation may be more complex for the European Central Bank (ECB). Compared to the US Federal Reserve, the ECB's mandate is both more hierarchical – with price stability as a priority objective – and more complex. Indeed, the Treaty states that "… without prejudice to the objective of price stability", the Euro system shall also "support the general economic policies in the Union with a view to contributing to the achievement of the objectives of the Union". These include "full employment" and "balanced economic growth".

Thus, to the extent that price stability is not compromised, and as long as fighting climate change is considered as a major (recently reaffirmed and emphasized) priority of the European

Union, the question arises as to whether the ECB can use some of its available instruments to also pursue a climate change objective. While this is certainly a point made by many climate activists, Ilzetzki and Jia (2021) report that a majority of the members of the CfM-CEPR European panel of experts "supports active measures to use the ECB's bond-purchasing programme to either exclude industries with negative environmental impact or bias its portfolio towards green investments", but at the same time "also believes it would be inappropriate to change the ECB's mandate to reflect green objectives."

However, this type of policy proposal immediately raises further questions. Democratic governments all around the world pursue numerous kinds of policies, but base their legitimacy on the democratic process which confers them the needed powers. In view of this, is it legitimate for central banks to pick and freely select its preferred secondary objective? Or should they rather defer to elected bodies if the policy aims at allocating public resources, as seems customary in a representative democracy.

The trade-off is real and difficult to resolve. If central banks were to assess the situation itself and contemplate actions, their legitimacy would be challenged (Tucker 2018). In addition, they would expose themselves to various political pressures, which could possibly engender perverse incentive problems. On the other hand, if they requested some formal guidance by elected bodies (e.g. parliaments), they would risk fueling a perception of lost independence. There might be subtle ways and procedures to navigate between those risks, but the dangers are substantial and would justify great caution. Anyway, there is no doubt that, under all circumstances, central banks should keep the ultimate discretion to interrupt any action or program if their first-priority objective – in most cases, price stability – were to be compromised.

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