

Monetary Policy and Green Transition*

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One of the biggest challenges in the coming decades is the achievement and maintenance of environmental sustainability, regarding which the central banks have also shown an increasingly active and supportive attitude in recent years. A new monetary policy approach is emerging, but it is unclear how central banks can participate in the green transition. In this paper, we briefly present the most relevant issues in this regard, namely how price stability, which is the most important objective of central banks, is affected by climate change and the green economic transformation; what follows from the potential conflict between the goals of green transition and price stability in terms of the green activity of central banks; and what challenges are faced as a result by central banks that also have the sustainability goal in mind.

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1. Introduction

Climate change is one of the biggest challenges of the 21st century and has attracted increasing attention and interest in recent years. Although the phenomenon is not new, as even naturally the Earth's climate is changing constantly, human activity and population growth have accelerated this process over the past 100 to 150 years. The phenomenon of climate change – the effects of which can be extremely complex (Zöldy *et al.* 2022) – is most often illustrated by global warming, melting glaciers and increasingly frequent extreme weather conditions. The rate of increase in the global average temperature started to accelerate at an unprecedented rate in the second half of the 20th century, mainly in the northern hemisphere, and is currently around 1°C above pre-industrial levels. As this rate is unsustainable in the longer term, it needs to be slowed down, which can be facilitated by climate protection measures.

* The papers in this issue contain the views of the authors which are not necessarily the same as the official views of the Magyar Nemzeti Bank.

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The 2015 Paris Agreement on Climate Change is the world's first comprehensive climate agreement. The Agreement sets the goal of keeping the global average temperature warming threshold well below 2°C above pre-industrial levels and, as a continuation of efforts following its successful implementation, below 1.5°C. It is also important to increase the ability to adapt to the adverse impacts of climate change and to foster climate resilience, along with development that involves low greenhouse gas emissions. Although the level of commitment is steadily increasing, more efforts are needed to achieve the objective of the Agreement. For example, the European Union has committed to reducing its greenhouse gas emissions by at least 55 per cent by 2030 compared to 1990 and to becoming the first climate-neutral economy and society by 2050.

Matolcsy (2022a) argues that we are heading towards an era when economic convergence, driven by new visions, must be organised around the idea of sustainability. This requires a new paradigm in economics, which should play an important role in conceiving a more sustainable future (*Virág 2019*). It is also becoming increasingly clear that the global economy must undergo a major transformation to meet the goals of the Paris Agreement. This requires a radical reduction in greenhouse gas emissions, as the UN says that global emissions must decrease by 7.6 per cent per year by 2030 in order to meet the climate target. However, in 2020, when global economic activity virtually stopped due to the pandemic (*Báger – Parragh 2020*), emissions decreased by only 5.8 per cent (*Schnabel 2022a*).

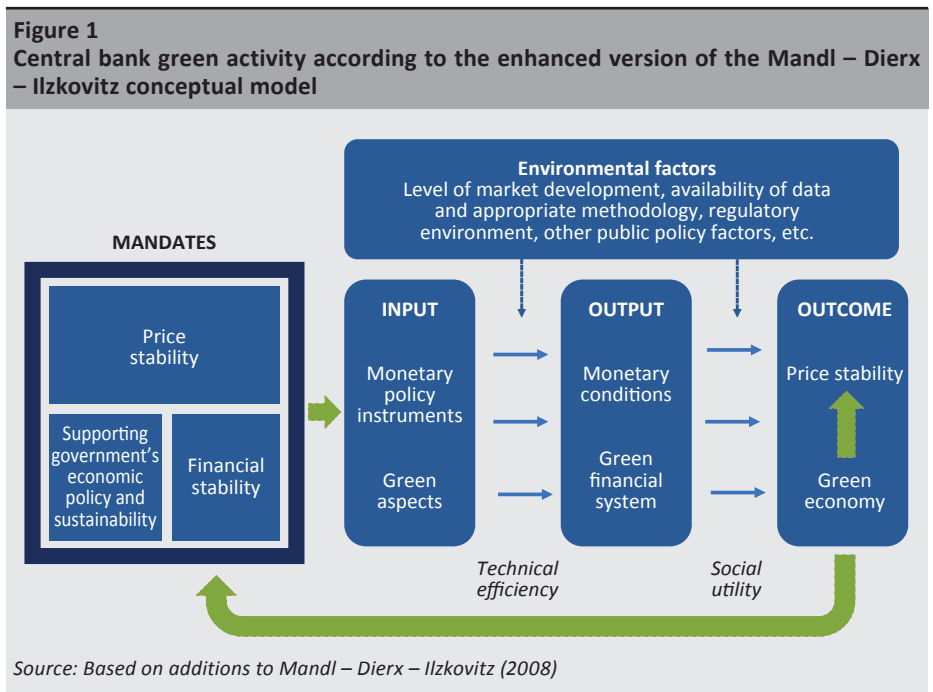
An increasing number of central banks are actively addressing the issue of environmental sustainability, in order to avoid the risks and economic damage associated with climate change. In UBS's annual survey of nearly 30 central banks, 32 per cent of respondents identified climate change as a potential risk to the world economy (*UBS 2021*). Of the 135 central banks examined by *Dikau – Volz (2021)*, 70 had direct or indirect sustainability mandates.¹

In the case of central banks, the relative importance of the risks associated with the green transition, the related opportunities and the feasibility margin are significantly influenced in the short term by the macroeconomic, financial market and geopolitical environment in which the given central bank operates. In this respect, in the early 2020s the increase in inflationary pressure, the increase in energy prices and the geopolitical rearrangement resulting from the Russian-Ukrainian war are undoubtedly of paramount importance, each posing a challenge that may take precedence over the green transition in the short run. In the longer term, however, a theoretical framework can be envisaged in which central bank

¹ The Central Bank of Hungary (Magyar Nemzeti Bank, MNB) received a green mandate from the Parliament in the spring of 2021.

room for maneuver, constraints and feedback related to the green transition can be placed. We attempt to do this in this analysis.

In our paper, the starting point was the conceptual model of *Mandl – Dierx – Ilzkovitz (2008)*, which was designed to analyse public policy measures and distinguishes between effects that occur in the shorter term and are more technical in nature (output), and effects that occur in the longer term and can also be construed at the macro level (outcome) (*Figure 1*). The conceptual scheme was originally designed to analyse fiscal measures in economic policy, but it can also be applied to monetary policy programmes (see *Kolozsi – Hoffmann 2016*). In order to assess the relationship between the green transition and monetary policy, we have created an extended scheme in which feedback is highlighted – on the one hand, in terms of the environmental sustainability of the economy and central bank mandates, and, on the other, in terms of the different mandates and the instruments deployed.



In the schematic model, central bank mandates result in central bank measures, which manifest in monetary conditions depending on the external factors,² or, where green aspects are taken into account, in the “greening” of the financial system. This

² In addition to the general level of development of the markets, this includes, for our purposes, the level of development of the green credit and green securities markets, the availability of sustainability data and the existence of methodologies suitable for processing the data.

ideally leads to price stability and the emergence of a green economy, which in turn will influence which of the central bank mandates will gain prominence based on the hierarchy of goals. Of course, these relationships are not so evident, since it is not trivial what instruments central banks can use in their green frameworks³ and what effect the transformation of the financial system has on the sustainability of the economy as a whole (see *Carney 2021*), and how the data needed for the analyses can be obtained (*Kolozsi et al. 2022; Boros et al. 2022*). Taking into account all of these constraints and acknowledging the complexity of the relationships, we focus on a few of the most important issues from a strategic point of view, which are as follows:

- (1) How does the green transformation of the economy affect price stability, the most important goal of the central bank?
- (2) What follows from the potential conflict between the goals of green transition and price stability in terms of the green activity of central banks?
- (3) As a result of the above, what challenges are faced by central banks that also have the sustainability goal in mind?

To answer these questions, in our essay we review the relevant literature and present the relevant central bank experiences and analyses.

2. Effect of the green transition on inflation

In the past, the majority of studies highlighted and estimated the impact of climate change on economic growth,⁴ whereas today's focus also includes the assessment and quantification of inflationary effects. This is explained by the fact that climate change contributes to the rise in inflation volatility and in the price level itself, which jeopardises the efficiency of monetary policy channels and the fulfilment of the central banks' price stability criterion, making it increasingly difficult to keep inflation expectations well-anchored.

Schnabel (2022b) divided the inflationary impact of climate change into three interrelated, yet separable shocks. The first one is 'climateflation', which results from the physical impact of climate change (floods, drought, or the increase of heat fluctuations, as the case may be). The second, 'fossilflation', relates to fossil fuels, and results from a large part of the economies being heavily exposed to coal and hydrocarbons (petroleum, natural gas), while in many countries an important element in the fight against climate change is precisely the fact that the price of

³ For possible central bank green instruments, see (*NGFS 2021*).

⁴ These included the MNB's 2019 Growth Survey. For more on the emergence of green thought in economic theory, see *Kutasi (2022)*.

fossil fuels is rising because of the environmental damage caused. The carbon dioxide quota system is undergoing significant changes, with an increasing number of countries introducing or planning to introduce a carbon tax, while quotas are becoming more and more expensive, causing production costs and consequently inflation to increase. The third shock is 'greenflation', which means an increase in the price of raw materials that are particularly affected by the green transition. In the following, we focus primarily on this third category.

The phenomenon of 'greenflation' is increasingly being addressed by analysts and economic policymakers. Globally, the transition to a green economy and the achievement of green goals entails costs. Government measures, as well as a significant demand in the private sector, may make it more expensive to implement investments involving green goals, and the decrease in the price of the relevant technologies has not yet been able to counter this on the supply side. The side-effect of this is the phenomenon of 'greenflation', i.e. an increase in the price of metals and minerals (aluminium, lithium, copper) that are essential for solar and wind energy, electric cars and other renewable technologies. The transition to renewable technologies is initially very costly, but in the longer term, efficiency gains and benefits from economies of scale can alleviate the burden of initial investment and do not jeopardise the viability of clean and sustainable energy.

Despite the growing body of literature on the economic impact of climate change, estimation results are surrounded by substantial uncertainty. One good indicator of the high degree of uncertainty is the fact that, compared to other topics, central banks tend to use more conditional language when it comes to climate change (*Arseneau et al. 2022*). The pace of global warming, the rate of adaptation to technological progress and the impact of climate change on global activity are difficult to accurately model or assess. The majority of the available studies primarily examine the effects of climate change on GDP (see *Kahn et al. 2019; Batten et al. 2020; Colacito et al. 2019*); however, the analysis of consumer prices is also becoming more and more central. As a member of the Executive Board of the European Central Bank (ECB), *Benôit Cœuré (2018)* emphasised in his speech, 'Monetary Policy and Climate Change', that central banks face regular, even persistent, supply shocks. He considers that the change in relative prices largely depends on the extent to which the economy moves away from hydrocarbon-based energy production towards renewable energy sources. He argued that it was the task of the central banks to be prepared for each scenario and to properly anchor inflation expectations.

In the process of green transition and climate change, two stages or risk categories can be distinguished according to the literature: physical risks (i.e. risks occurring while climate change is taking place) and risks related to transition (also known transition risks, i.e. those involved in the fight against climate change). Risks of the former type are due to the interaction between the increasing average temperature and more frequent extreme weather conditions, including the exposure of the socio-economic systems to these factors. Accordingly, there are two subgroups of physical risks: gradual global warming and its associated physical changes, such as rising sea levels or changes in precipitation patterns, and the impact of natural disasters (hurricanes, floods, heat waves, etc.). The former subgroup can also be referred to as chronic effects, and the latter subgroup as acute effects. Transition risks refer to the risks posed by the transition of the economy and society to lower-carbon operations (for example, when an electricity supplier changes to an operating model for the production of electricity from renewable sources only). In particular, from year to year it is becoming increasingly clear that in the long run, operations with a high level of reliance on fossil fuels cannot be maintained, which makes the climate-friendly transformation of the world economy essential. In a green economy, the ratios in the energy mix change dramatically during the transition, but supply is not always able to keep up with the sudden increase in demand during this time. The imbalance between supply and demand will be reflected in price increases in the short term. In addition, geopolitical impacts are also reflected in price developments.

Climate change exerts its impact on macroeconomic variables through supply and demand channels. Overall, inflation and inflation expectations are becoming more volatile and uncertain. *Tables 1* and *2* summarise the main channels and effects related to output and price changes, based on a comprehensive study by the *ECB (2021)*.

Table 1
Inflation channels and expected effects of climate change risks – supply and demand shocks

		Physical risks		Transition risks
		Gradual warming	Extreme events	
Supply shock	Food, energy and other raw material supply	Decline in agricultural productivity and yields	Disruption to supply and production chains	–
Demand shock	Energy demand	Increased demand for electricity in summer exceeds decreased demand in winter	–	Higher carbon tax leading to lower demand for fossil fuels Transition to renewable energy reduces demand for fossil fuels
	Trade	Disruption to trade routes due to geophysical changes (such as rising sea levels)	Changes in food prices and disruptions to trade flows	Taxes, regulations and restrictions may cause disruption to trade routes; Risks of bias from asymmetric or unilateral climate policies

Source: Based on ECB (2021)

On the supply side, global warming and extreme weather can have inflationary effects on the prices of food, energy and other raw materials, although the direct impact on consumer prices may be dampened by the fact that raw materials (according to some analyses) only account for a very small part of the price of the final products (see *WEF 2021* analysis with Boston Consulting Group). On the demand side, the seasonality of energy demand may change due to increased energy demand in relation to warmer summer weather. Disruption to trade may occur as a result of weather effects. In addition, the introduction of carbon taxes and other taxes not only contributes to higher prices, but also shifts demand away from traditional fossil fuels towards renewable energy sources.

Through supply and demand channels, the risks of climate change ultimately appear in economic output, inflation and the evolution of inflation expectations. In the case of economic output, climate change may not only cause physical damage, but may also adversely affect, for example, labour productivity or investment developments. In the case of inflation, we can expect changes in relative prices and increasing volatility in the case of already volatile food and energy prices compared to the other items in the consumer basket. In addition to inflation, the volatility of

inflation expectations may also intensify, which may justify more frequent revisions in the evolution of expectations, thereby jeopardising the appropriate anchoring of inflation expectations.

Table 2				
Inflation channels and expected effects of climate change risks – aggregated effects				
		Physical risks		Transition risks
		Gradual warming	Extreme events	
Aggregated effects	Output	Lower labour productivity, investments being used to mitigate impacts and prevent arable land loss	Physical damage (crop failures, destruction of facilities and infrastructure, disruption in supply chains)	Frictions resulting from transition policies and/or the uncertainty surrounding them Use of revenues from transition policies may influence the level of impact on emissions
	Inflation	Relative prices change as a result of changes in consumer demand, preferences and comparative cost benefits	Increased inflation volatility, in particular in food, housing and energy prices	Prices affected by climate-related transition policies, policy uncertainty, technological changes and shifts in consumer preferences
	Inflation expectations	Climate shocks, such as their impact on food and energy prices, may affect inflation expectations	Inducing more homogenous, sudden and frequent revisions of expectations	Formation of inflation expectations affected by policies

Source: editing based on ECB (2021)

3. What can central banks do?

Climate change therefore affects the macroeconomic environment, the financial and banking system⁵ and prices through several channels. The question, however, is whether this implies that central banks have a role to play regarding this process. As we will see, there is no complete agreement, but there are more and more signs that a new consensus is emerging in the world of central banks.

⁵ On that subject, see Boros (2020) and Ritter (2022).

The thought of green monetary policy, i.e. the role of central banks in the fight against climate change, has become more widespread in recent years. Previously, the dominant position was that central banks should not deal with climate change and that monetary policy should not play a relevant role in the fight against climate change (Boneva et al. 2021). Many economists, including Cochrane (2019) argue that the active fight against climate change can endanger central bank independence due to its political nature. In addition, representatives of the earlier consensus believe that setting a further target for central banks in addition to their existing mandates could make it more difficult to achieve these (Buiter 2021). Similarly, Charles Goodhart (Jeffery 2021) claimed that the green commitment of central banks is only justified if they see a sudden and unpredictable event occurring that seriously threatens financial stability; he notes, however, that this is not the case at the time. However, as Weitzman (2011) points out, economists should consider the high probability of and uncertainties about extreme outcomes in relation to climate change, rather than using traditional cost-benefit analyses.

Conversely, Schnabel (2021) sets out the position that a new consensus is emerging that central banks should not remain on the sidelines in the fight against climate change, as it affects the viability of their mandates. Economists representing central banks' green engagement argue that central banks cannot ignore climate change primarily because it has a direct impact on inflationary developments and financial stability. Danae Kyriakopoulou, former chief economist of OMFIF and researcher at the London School of Economics, said that climate change amounts to a 'macro-critical' event (Kolozsi 2022), placing central banks under an obligation to actively support the green transition (Kyriakopoulou 2021). Based on a summary by Boneva et al. (2021), 5 channels can be identified through which climate change has an impact on monetary policy.

1. *Impact on key economic variables.* Climate change may increase inflation volatility due to extreme weather conditions, and the transition may permanently distort the rate of inflation upwards.
2. *Monetary policy conduct.* The transition to a carbon-neutral economy may make monetary policy decision-making more complex, as significant uncertainty may make it more difficult to accurately determine and forecast the level of equilibrium interest rates or business cycles, while also weakening the transmission mechanism. Depending on the instrument used, green central bank financing may affect the central bank balance sheet and thus the result of the central banks.

3. *Impact on central bank analytical framework.* In the analysis frameworks and models traditionally used by central banks, there is little involvement of natural resources or externalities related to their use, and the models are often only intended to provide medium-term forecasts (consistent with the fulfilment of traditional monetary policy objectives).
4. *Climate change and asset allocation.* According to the current professional consensus, capital markets may not fully reflect the risks associated with climate change and the transition to a carbon-neutral economy, but if these risks materialise they may have consequences in terms of financial stability and the real economy.
5. *Carbon bias in financial market and central bank portfolios.* Central banks have recently significantly expanded their balance sheets through their asset purchases. In general, central banks made their purchases in line with market weights, but this meant that they could have bought proportionally more of the securities of high-emission companies, which tend to be more capital-intensive.

In addition to the above, another important change is that by the second decade of the 21st century, the role and responsibility of the central banks has changed radically (*Matolcsy 2022b*). Central bank thinking and the role of central banks in the financial markets and the range of instruments they use have also undergone a significant change – and this makes central banks more suitable for contributing to the fight against climate change, as both targeted and long-term instruments have become standard, and these approaches may be relevant from a green perspective. As a consequence of the great financial crisis of 2007–2008, central banks around the world applied non-conventional, novel instruments. While central banks had previously mainly achieved their objectives by changing short-term interest rates, following the onset of the crisis, their set of monetary policy instruments was expanded to include the use of negative interest rates, forward-looking guidelines, asset purchases and long-term loans. Although the significant expansion in the range of monetary policy instruments used in practice did not go hand in hand with a broad focus on green central bank thinking, it may have contributed to the subsequent grounding of green monetary policy considerations by calling into question conventional thinking and breaking down taboos. Non-conventional instruments often have a targeted nature, which runs counter to traditional monetary policy, which takes a more general approach. As a result of asset purchases, central bank balance sheets have expanded significantly in general; consequently, central banks have a more meaningful impact on financial markets, allowing them to participate more proactively in the fight against climate change (*Brunnermeier – Landau 2020*). It is also appropriate to underline that central bank

policies now tend to be committed for a longer period than previously, and climate change is indeed a challenge that requires a long-term commitment from decision-makers (MNB 2021).

4. Challenges

The breakthrough is yet to come, but the outlines of the ‘*new normal*’ are already visible. This holds that central banks cannot afford to remain neutral on the issue of environmental sustainability. Nevertheless, of course, central banks also cannot ignore their operational frameworks arising from their original – and primary – purpose. This ‘multipurpose’ character is the main reason for the challenges posed by the practice of green central banking. We examine four of these challenges: market neutrality, varying horizons, direct funding and central bank independence.

4.1. What will happen to market neutrality?

One important principle of the functioning of central banks is market neutrality, which means that central banks seek to minimise the impact of monetary policy on the relative prices of financial products.⁶ This principle also applies to targeted programmes in the monetary policy instruments. However, the question arises as to whether or not it represents a violation of this principle, if the central bank deviates from it on the basis of a specific green aspect within the targeted instruments, as such programmes may contradict the objectives of monetary policy and the principle of market neutrality, and therefore the central bank may be forced to compromise.

Depending on the legal mandates and operating framework of the central banks, active support of green aspects can be achieved either by the pricing of the central bank facilities or by changing the eligibility conditions. Given the current increased size of central bank balance sheets, even a partial greening of central bank portfolios can have a significant impact. This also serves as a signal to market participants of the central bank’s commitment, which may increase the efficiency of the programmes. For a significant number of central banks, asset purchases became an integral part of the unconventional set of monetary policy instruments once the effective lower bound on interest rates was reached. In order to maintain the principle of market neutrality, central banks typically made purchases in proportion

⁶ The principle of market neutrality has not yet been fully implemented, since central banks cannot always be present on all markets with the same intensity, and the markets in which they are present are favoured over the markets in which they are not present. In other words, market bias was already a natural feature of implementation, and indeed, some already considered market neutrality as a “myth”, see: *The Green Central Banking Scorecard: How Green Are G20 Central Banks and Financial Supervisors?* <http://positivemoney.org/wp-content/uploads/2021/03/Positive-Money-Green-Central-Banking-Scorecard-Report-31-Mar-2021-Single-Pages.pdf>

to market shares. However, this practice results in ‘carbon bias’ in the portfolios of central banks, as carbon-intensive companies are also generally capital-intensive and therefore have a greater weight on corporate bond markets than their less carbon-intensive counterparts. Thus, traditional benchmarks for asset purchases based on market neutrality are not necessarily conducive to the transition to a low-carbon economy, so that the implementation of a green programme compared to previous instruments can lead to a positive distinction between green instruments or to an incentive for other activities.⁷

The greening of the Bank of England’s (BoE) corporate bond purchase programme is a good example of the implementation of proactive monetary policy. In May 2021, the BoE published a comprehensive study that included the planned transformation of the programme, then presented the draft for wide discussion, and finally a decision was made in November to adjust the programme parameters from a green perspective (*BoE 2021a*). Accordingly, the BoE aims to reduce the weighted average carbon intensity of the corporate bond portfolio by 25 per cent by 2025 and to reduce the exposure to zero by 2050. Bond purchases are made according to the extent to which an issuer takes climate protection aspects into account within the given sector. To this end, the central bank uses four measures: the intensity of the pollutant emissions of the activity, the result achieved so far in reducing emissions, whether climate change information has been published and whether it has an emission reduction target (*BoE 2021b*). The central bank also stated that in the future it may impose sanctions (such as reducing purchases, withdrawing from the scope of the scheme or selling previously purchased assets) on issuers who do not comply with the gradually tightening requirements of the scheme.

Green monetary policy can distort financial markets due to the current scarcity of green instruments. The transmission of monetary policy may be hampered, for example, by the exclusion of certain institutions from access to central bank assets. In addition, in the absence of a clear taxonomy and accepted market standards for green and polluting investment and viable guidelines, central banks lack an objective definition and possibly a legal basis for establishing their green policy. In view of these constraints and trade-offs, central banks should carefully consider the costs and benefits of activities to proactively mitigate climate change (*Boneva et al. 2022*).

⁷ For the effects of central bank programmes on the development of green bond markets in Hungary, see *Bécsi et al. (2022)*.

4.2. How to address the tragedy of the horizon?

The nature of the supply shock resulting from the volatility of energy prices is somewhat similar to that of the transition to zero emissions. The similarity is that in both cases monetary policy is confronted with an effect that can be interpreted as a negative supply shock. This means that the origin of the shock to the economy is the increase in the price of energy sources for some reason, for example due to production costs or due to taxes on energy sources. However, it varies in terms of the temporality of the shock and its impact on the macro-economy and therefore requires a different monetary policy response.

Short-term surges in energy prices are a general phenomenon. These shocks fall well within the monetary policy time horizon and do not necessarily need to be addressed by monetary policy action. If monetary policy were to react, it would amplify the negative impact of rising energy prices on aggregate demand and output. Moreover, as monetary policy measures generally take effect in 5 to 8 quarters, they would exert downward pressure on inflation at a time when the shock is likely to have passed. Thus, temporary supply shocks tend to justify a deviation from the target in the short term, provided that price stability is restored in the medium term and inflation expectations remain anchored.

By contrast, rising energy prices in the green transition process may be *sustained* due to divergent economic policies (e.g. tax increases) and may have an impact on the definition of the monetary policy stance. The green transition involves risks, including inflation, as the gradual transition to greener energies can entail higher and more volatile prices, at least during the transition period. During the green transition, a sustained rise in inflation may occur if the expansion in the supply of alternative energy sources is too slow, and the cost of the transition can also raise prices, i.e. the shifting of demand accompanying the transition may lead to changes in prices in certain sectors (*De Galhau 2022*). The combination of insufficient production capacity of renewable energy in the short term, subdued investments in fossil fuels and rising carbon prices means that a potentially protracted transition period is expected, where energy prices are constantly rising (*Schnabel 2022a*). Several factors should be taken into account when formulating the monetary policy response to this process.

- On the one hand, given that price increases can be sustained, monetary policy cannot overlook the impact of this and must respond. As a result of the transition, persistently high energy prices could affect inflation expectations. If expectations remain above the central bank's target at the end of the monetary policy horizon, inflation could rise further. Taking the experience of the 1970s as a reference point, when the increase in energy prices triggered a damaging price-wage

spiral, strong evidence is found that the deterioration of inflation expectations significantly increases the cost of returning inflation to the target.

- On the other hand, the shock caused by the green transition differs from the traditional temporary energy price shock in another aspect. In this case, the rising prices of conventional energy sources are essentially due to the taxes levied on them. Tax revenue remains in the economy, which does not adversely affect the performance of the economy through an appropriate redistribution mechanism. This also justifies a different monetary policy response: while monetary policy measures are not justified in the case of traditional short-term shocks, the central bank cannot disregard the price increase during the green transition.

Climate change, and thus the green transition, also shapes economic and financial developments beyond the traditional monetary policy horizon (*'tragedy of the horizon'*) (ECB 2021). Given the timeframe of the transition, it is questionable whether the current medium-term horizon of monetary policy is appropriate. There are views that, in the event of supply shocks, the long-term horizon can also mitigate output and employment losses and volatility, as well as fluctuations in exchange rates and yields. This is also valid for the supply shock under consideration (Boneva et al. 2021). At the same time, the creditworthiness of the central bank may be jeopardised if the time horizon extends too far into the future and the deviation of inflation from its target becomes the norm rather than the exceptional event. In order to preserve credibility, the central bank's monetary policy framework must be clear and transparent. It should contain clear guidance on the extent to which it will tolerate the deviation of inflation from its target during the transition.

4.3. Who should finance the green transition?

There is no question that significant new investments are needed to transform the economic system, i.e. to achieve low emissions in a given country. According to former Bank of England Governor *Mark Carney*, the role of the financial sector in financing the necessary investments is unavoidable. According to *Bloomberg (2021)*, Carney estimated the necessary investments at USD 130,000 billion. The emergence of significantly restructured central bank instruments, in particular lending programmes and asset purchases, raises the question of the role that central banks can play in providing the necessary resources for the transition. As *Brunnermeier – Landau (2020)* put it, the increased role of central banks in the financial markets can also provide an opportunity to play a more proactive role in the fight against climate change.

Central banks can primarily contribute to green investments by reducing their funding costs. By directing financial sector actors towards sustainable lending and securities, central banks can indirectly stimulate green investments. One possible way to do this is to provide supervision measures, such as capital requirement discounts for banks in the case of green loans (*Prestedge 2021*). In addition to their incentive role, such measures can also strengthen financial stability, as they lead to the build-up of greener balance sheets, while the financial sector is currently unable to adequately price climate risks due to uncertainty about climate change and the lack of data or measurement methodologies.

In the context of bond purchases and certain central bank stimulus programmes, it has been suggested that these programmes have in many cases indirectly favoured carbon-intensive companies (*Matikainen et al. 2017*), due to the prevalence on the bond market of incumbent industries with high emissions. Therefore, central banks may also seek to correct the distortions inherent in their asset purchase programmes used so far, but may also focus on environmental sustainability. One possible way to do this is to purchase assets with a specific focus on sustainability, or to launch direct, targeted credit programmes that can help accelerate the necessary green transition. Asset purchases for green securities can also be even more effective in stimulating the economy than programmes that reflect general market ratios (*Monasterolo – Raberto 2017*). The low-emission sectors can respond more strongly to the expansion of resources in terms of employment and investment.

However, despite the above, prudent behaviour by central banks is justified, as they may face significant trade-offs in relation to their sustainability policy (*Radu – Paun 2021*). While support for incentive measures, such as green lending or the holding of green securities, by supervisory means, may be neutral from a monetary policy perspective, in the case of direct financing of investments, the central bank must also bear in mind its primary objective, which is to preserve price stability. The level of investment required for a successful transition is so significant that – although in the long run support for the transition will make an explicit contribution to achieving the objective of price stability – in the short run, more direct central bank involvement can be made possible through targeted, smaller-scale programmes.

4.4. How can a green central bank remain independent?

According to the standard approach, the ability of central banks to operate as an independent body allows them to carry out their work in a way, which affects redistribution between economic actors the least, i.e. in the most ‘market-neutral’ manner. Green activity naturally creates a new situation in this regard, since the aim of this is to make central banks committed to a process that affects economic participants differently.

As climate change is one of the biggest challenges for all aspects of policymaking today, the involvement of central banks in mitigating the economic impacts of environmental factors is increasingly being supported. Economic participants are unlikely to be able to voluntarily switch to the green economy, which may be termed as a ‘market failure’. The basic assumption is that the state is responsible for correcting the market failure, while central banks, as parts or ‘branches’ of the state, are obliged to assist in this endeavour on the basis of the authority granted to them in their mandates. In this approach, central banks cannot avoid being involved, as climate change may lead to the accumulation of financial risks affecting financial stability at the macro level.

The proactive participation of central banks in the green transition is generally accepted by the public, but its disadvantages and possible costs should also be taken into account. Institutional independence is the basis of traditional central banking activity in the Western world. The central bank has a limited mandate, which sets clear, unchanged objectives to ensure its legitimacy. As a result, it is accountable to elected officials and resistant to political and public pressure. However, the greening of central banks may have an impact on this role. The extension of the mandate of the central bank, which includes new objectives that may be pursued by other political actors, may have disadvantages and, as we indicated at the beginning of this paper, the different mandates of the central bank may conflict with each other. Regardless of how central banks receive these new tasks (via legislative changes or a reinterpretation of the existing mandate), the assumption of ‘unattainable’ targets may reduce the central bank’s credibility. The broader scope of rights entails greater publicity and criticism, as well as new organisational responses and possibly higher costs. Together with the new tasks, the central bank must coordinate its activities with other bodies performing related tasks, in particular the government.

Fiscal and monetary policy are, to some extent, substitutes for each other: the ‘easy money policy’, i.e. a loose monetary policy, is temporarily compatible with low inflation if the state has a large budget surplus. Similarly, policymakers may be tempted to use temporary fiscal and monetary measures as temporary substitutes for more painful structural adjustments. Faced with the high costs of greening the economy, elected officials may tend to transfer responsibility to an ‘independent’ technocratic body, i.e. the central bank (*Radu – Paun 2021*), which may lead to higher coordination costs and a deterioration of central bank independence.

5. Summary

The importance of the incentives provided by the public sector to market participants has already been highlighted by the process of managing the crises that emerged as a result of the 2008 financial crisis and the coronavirus outbreak in 2020, as well as the process of recovery from the crises. Joint action by the different policy areas is also needed during the green transition, as the integration of environmental sustainability aspects into the economic environment and the greening of the economy poses challenges for both fiscal and monetary decision-makers.

It is now increasingly clear that without active state involvement there can be no successful green transition. The energy transition should be promoted while protecting the most vulnerable in society from possible negative consequences, and the measures to achieve the latter should be designed in a way that does not reduce incentives to reduce carbon emissions.

Due to the non-linear nature of the processes, time becomes an important constraint and we need to decide as soon as possible which path to take: whether to allow climate change to take place or whether to intervene and fight it. If we opt for the latter, then it is absolutely necessary to make a directed technological change. Accordingly, state intervention through various climate protection measures will play an increasingly important role. If these measures are not taken, we can “save” the cost-side effects, but the price of this will be that the likelihood of a climate catastrophe will increase, which may have serious social impacts, in addition to economic ones.

Thus, the green transition is not an option in reality, but a necessity. It is not clear, however, who is responsible for accomplishing it. In the case of central banks, this issue is particularly acute, as central banks have considerable potential due to their power to create money, but their mandate is limited and they should in particular help to achieve price stability. The challenge is when the objectives of central banks “clash”, although under central bank law the objective of price stability must take precedence. Obviously, however, this will not promote the green transition. Therefore, the best approach is that the responsible central bank always seeks to achieve and maintain price stability, while at the same time constantly looking for ways to promote the green transformation of the economy. This consensus is beginning to emerge in the world of central banks as well, but the challenges remain, in terms of market neutrality, varying time horizons, funding and independence.

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