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FINANCIAL SYSTEM IN STEERING THE ECONOMY TOWARDS PLANETARY WELL-BEING

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Introduction

This chapter discusses the possible ways in which the financial system might steer economic production towards planetary well-being. Following Dasgupta (2021), we define planetary well-being as the natural capital (nature, biosphere), a self-regenerative part of the Earth that is occupied by living organisms—that is, we, the human race, are stakeholders in it. In economic terms, nature works as an asset that provides us with food, water, and shelter; regulates our climate and disease; and improves our mental well-being by offering spiritual fulfilment and recreation opportunities. Biodiversity (*i.e.*, diversity of life) allows nature to be productive, resilient, and adaptable, and any threat to biodiversity, such as external use of natural resources, poses a threat to nature and should also be regarded as jeopardizing economic prosperity. The chapter connects excessive use of natural resources to the standard asset pricing framework and discusses the roles that financial institutions (banks) as well as debt and equity funding (direct funding channels) play in the global transition towards less harmful production. Finally, the chapter emphasizes the important role that the central bank plays in resolving the incompatibility between economic development and planetary well-being through the banking system and financial markets.

The decline of natural capital challenges the traditional concept of welfare in terms of Gross Domestic Product (GDP). An increase in GDP generates higher economic welfare when measured purely in GDP/per capita for humans in a way that significantly overlooks the roles played by natural capital, biodiversity, and human well-being (see Kortetmäki *et al.*, 2021). Since the development of the Solow-Swan model, economic growth models have considered GDP per capita growth to be the product of goods and services provided using productive capital,

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human capital, and technology (see *e.g.*, Romer, 2019). Natural capital has played no role in this setup, and thus economic well-being and planetary well-being have been somewhat pitted against one another. Natural capital has no well-defined price, and the relevant resources (such as the seas and air) are considered "public", common-pool resources. Hence, no pricing mechanism exists that would steer the monetary market values of natural resources to equal their correct value (*i.e.*, the shadow price, or accounting value, as defined by Dasgupta (2021)). Consequently, revenues from exploitation of these resources significantly exceed the costs stemming from their use for nature, given that the prices do not accurately value their negative effects, particularly in the long term (*e.g.*, for oil, gas, and coal). Definition of the natural capital's correct price and value is a notoriously difficult task that requires policy actions and market interventions aimed at correcting externalities and filling the gaps in the missing market mechanism.

Nature catastrophes, such as floods and heatwaves, have alerted the world's population to the consequences ensuing from the unregulated use of natural resources. For example, increasing CO_2 emissions and the effects of global warming are hazardous and costly in terms of both environmental and human well-being as well as GDP growth and financial stability (see, *e.g.*, Alogoskoufis *et al.*, 2021; Colacito, Hoffmann and Phan, 2019; European Central Bank (ECB), 2020). Accordingly, in 2021, the European Central Bank launched action plans that incorporated considerations of climate change in the implementation of its monetary policy.

Concerns about the negative effects of economic growth on the environment are not new (see, *e.g.*, Bastien-Olvera and Moore 2021, 2022). At a time when the globally produced capital per capita has doubled and human capital per capita (*e.g.*, investments in education and other human-related investments on improvement in labour productivity) has increased by 13%, natural capital stock has decreased by approximately 40% (Dasgupta, 2021; Managi and Kumar, 2018). Nations with high GDP/capita use considerably more natural resources than poorer countries for their final consumption needs, whereas the growth rate of natural resources use is highest amongst the fastest-growing economies and in countries most recently integrated into international trade (Kacprzyk and Kuchta, 2020). Hartley, van den Bergh, and Kallis (2020) noted the differences in the development of wealth between rich, global North and poor, global South countries. For convergence, poorer Southern countries require greater economic growth than rich Northern countries, but such growth must be achieved with as little detriment to planetary well-being as possible. Natural capital relates to the debates about *green growth,* defined as "fostering economic growth and development, while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies" (Organization for Economic Co-operation and Development (OECD), 2022).

However, no empirical evidence on resource use exists to support green growth theory (Hickel and Kallis, 2020; Ward *et al.*, 2016). For example, Hickel and Kallis (2020) argue that it is not possible to introduce the necessary absolute decoupling, whereby the environmentally harmful variable is stable or decreasing

while the economic driving force (*e.g.*, GDP) is growing on a global scale against a background of continued economic growth. Hence, policy makers should put more effort in strategies other than the existing green growth-based policy strategies in the immediate future.

As alternatives for green growth, Mastini, Kallis, and Hickell (2021) analyzed two prominent climate change mitigation narratives: The Green New Deal and degrowth (zero-level or even negative real economic growth). In the former, the role that energy systems and markets play is essential because the idea is to advocate a plan to co-ordinate and finance a large-scale overhaul of the energy system. Some regard the positive real economic growth rate over time as the core element in financing this transition and claim that the Green New Deal will further stimulate growth (Pollin, 2018). As a completely contradictory alternative, proponents of degrowth (see, *e.g.*, Buch-Hansen and Koch, 2019) maintain that growth makes it more difficult to accomplish transition to ecologically sustainable economies. However, these two approaches agree on the *importance of public investments for financing* the transition of industrial policies towards the economy's decarbonization, socializing the energy sector to allow longer investment horizons, and expanding the welfare state to increase social protection (Mastini, Kallis and Hickell, 2021).

Which are the economic forces that can help to minimize production costs to natural capital? We focus on a mechanism wherein the financial allocations to nature-friendly capital guide production in such a way that the negative side effects experienced by the environment are minimized, natural resources can be regenerated, and decoupling may take place. The financial system must channel financial resources from lender-savers who have a surplus of funds to borrower-spenders who have funding shortages. Given that capital is always required in the production of goods or services, financial institutions, and markets function as arteries of the modern economies' production by evaluating the expected returns of investment and financing viable projects. The central banks are tasked with guaranteeing the stable functioning of the entire financial system, implying that the central banks are powerful institutions in the process whereby capital is steered towards environment-enhancing production. Moreover, strong evidence indicates that private investors wish investment opportunity providers to consider sustainability in their instrument supply (the United Nations Environment Programme Finance Initiative (UNEP FI) and Principles for Responsible Investment (PRI), 2019).

This chapter discusses the ways in which the price of financial investments in productive capital that steers real economic production has the potential to preserve and even enhance natural capital. These financial resources' prices operate via production and Dasgupta's (2021) Impact Equation which relates the use of natural resources to biosphere regeneration. The capital market should increase the investment costs (*i.e.*, cost of capital) of activities that dilute planetary well-being to such an extent that they are substituted with a capital allocation towards production that are more conducive to planetary well-being. Capital markets are physical or non-physical spaces in which investors trade on assets (*e.g.*, stocks, bonds, currencies)

with longer-term holding periods. Market prices are determined according to asset supply and demand and should reflect expectations of both the asset's future values and their uncertainty. For an individual company, expectations regarding the company's and the relevant industry's performance form the basis of the price; for the market in general, however, prices are driven by expectations regarding overall economic development. Although anyone can participate in asset markets as an owner, large institutional investors, and funds—together with governments and central banks in particular—exert the greatest impact on stronger market movements. The role played by standard instruments (*e.g.*, taxonomy, taxation, fees, *etc*.) is inarguably essential here, but we suggest that central banks in particular will play a vital role in this process in the near future.

The nature-friendly capital market allocates capital into production, which uses fewer natural resources and enables nature to regenerate the biosphere. In terms of standard macro-finance thinking, the need for these changes in investment behaviour clearly entails renewed thinking about the expected or required rates of returns on investment. Future financial market-based activities should take into account, for example, the need to reduce inequality of wealth between the global economy's poor Southern and rich Northern parts (see, *e.g.*, Hartley, van den Bergh and Kallis, 2020) and simultaneously achieve the ultimate target of GDP's absolute decoupling from resource use and carbon emissions, although this would necessitate the acceptance of lower levels of returns together with higher levels of risk in the financial investments. The sections that follow thoroughly describe the current status of the ideas, instruments, and mechanisms that are most relevant to achieving these changes.

Impact Equation and price of capital

Planetary well-being and Impact Equation

The aggregate-level exploitation of natural resources comprises a combination of the exploitation of individual natural assets with different characteristics. Dasgupta (2014) presents the total natural capital resources $S(t)$ at time t as a sum over individual natural assets, including all types. Production can occur with any non-zero values of natural resources (S), capital (K) and labour (L) inputs. Dasgupta (2021) additionally introduced the biosphere's regeneration rate (G), which is a real accounting value given as a function of the stock of biosphere S (*i.e.*, $G = G(S)$)—that is, G is the rate at which the biosphere regenerates natural resources on a sustainable basis. The *Impact Equation* (IE) demonstrates the relationship between the regeneration rate of the biosphere's stock, G, and the aggregate demand of natural resources—the global ecological footprint, Ny / α. Here, N is the world population and y is the output, so y/N reflects the economic activity per capita. α is the efficiency parameter $(\alpha_z + \alpha_x) / (\alpha_z \alpha_z)$, which takes into account how biosphere's goods and services are converted into the GDP (α_x) and the extent to which the biosphere is transformed by global waste products (α_z) (Dasgupta, 2021, p. 116).

Impact Equality follows when these are equal, *i.e.*, $Ny/\alpha = G(S)$. If the resource supply $G(S)$ exceeds the demand, the supply of natural capital increases. When the aggregate demand for natural resources exceeds the supply, a decrease in natural capital and *Impact Inequality* ensues, where

$$Ny/\alpha > G(S)$$

Financial system has the means to affect the IE's demand and supply sides by directing funds towards various economic activities and impacting consumer preferences by reducing financial flows to activities that exert adverse impacts on the biosphere while supporting the opposite (affecting y). Moreover, it enables investment in the research and development of technologies that can enhance the efficiency with which natural assets are exploited (α). On the supply side, channelling financial flows in a way that increases natural assets directly (*e.g.*, via restoration and conservation of natural capital) improves the natural capital regeneration rate (*i.e.*, S and G; *ibid.*).

For example, to mitigate the impact inequality, investment in physical capital and technologies that use fewer natural resources (*e.g.*, less energy-intensive machinery) or cause less pollution must be increased. Furthermore, not only is the technological progress an essential factor in economic growth but technological improvements increase efficiency (*i.e.*, the value of α). The greater the α, the smaller the demand exerted on the biosphere at a given level of production. Increased α could further compensate for the impact associated with population growth, N. New technology would also replace older technologies, resulting in lower production costs per unit.

Planetary well-being and the price of capital

In theory, for any investment project—whether physical (*e.g.*, factory) or financial (stocks or bonds)—and for any investor—whether public, private, or non-profit—the decision to invest should be based on the discounted present value (DPV) of the investment, which is the discounted sum of all its future values (FV):

$$DPV_t = \frac{FV_{t+1}}{1+r} + \frac{FV_{t+2}}{(1+r)^2} + \frac{FV_{t+3}}{(1+r)^3} + \ldots = \sum \frac{FV_{t+i}}{(1+r)^i},$$

where the expected rate of return (r) used to discount the accruing future values (FV, *e.g.*, dividends for stocks or coupon payments for coupon-paying bonds) consists of both the compensation that investors require to delay their consumption (*i.e.*, the time value of money) and the risk premium (*e.g.*, for higher credit default probability). In equilibrium, the discounted present value (DPV) should equal the price

of the asset. That is, the higher the future values, other things equal, the more profitable the investment project today is and the higher its price is. The higher the risks associated with the investment, the more compensation investors demand for it and the lower the present value. When the price is higher than the DPV, the investment does not take place. This mechanism should also drive the capital allocations of natural capital-related investments.

All policy actions affecting the future values and/or discount rate exert an impact on the investment's profitability and can either direct capital to or from nature-enhancing investments and support or hamper less environmentally harmful production. For example, owing to the failure to correctly evaluate nature, markets are unable to price the exploitation of natural capital correctly. The standard suggestion is that policy makers should intervene to compensate for this. In financial system, this could take the form of, for example, limited collateral value of nature-detrimental investment, nature-related taxonomy, green bond rating or any other policy that generates extra costs on nature-detrimental investment capital. Mathematically, this leads to the definition $r_{S,PW} = r_S + r_{S,\text{intervention}}$, where r_S is the cost of using S, $r_{S,\text{intervention}}$ is the intervention-related extra cost and $r_{S,PW}$ captures the total negative impacts on natural capital. This decreases the DPV of those investments, implying declines in investments to both the environmentally harmful production and to the exploitation of natural resources. Similarly, actions contributing to increased FV and reduced r will lead to higher financial flows to the project. That is, the intervention can also be regarded as a negative tax rate or subsidy to the cost of capital for environmentally friendly, green industry investments, in which the use of natural resources does not threaten the environment, leading to the enhancement of nature-friendly production.

Financial system and natural capital

Risks and natural capital

The role that financial system plays, as reflected in the natural capital literature, remains in its early phases. Existing studies have focused primarily on the valuation of Environmentally, Socially, and Governance (ESG) actions and policies, calculation of the social cost of carbon and climate risks. However, owing to the multifaceted interplay between nature and production, no universally accepted framework for incorporating nature-related risks into economic models has yet been developed.

Koumbarakis *et al.* (2020) propose that in financing the climate change-related real investment projects, financial institutions are most exposed in light of their credit risk and connection to financed firms' physical, transition, and litigation risks due to the environmental change. More specifically, the financial institutions must confront *credit risk* because they include in the asset side of their balance sheets

the exposures to projects (*i.e.*, loans given to their customers) that may cause them to default on their obligations. *Physical risks* refer to the severe disruptions or collapses of ecosystems leading to supply chain interruptions caused by property damage, business disruption, loss of production, and/or via stranded assets. These reduce both the debt-servicing capacity and the collateral values of the financial institution. If the damages to the collateral are not insured, the financial burden may be transferred onto other market participants, further increasing the credit exposures. The realization of sudden extreme physical risks may even result in bank defaults (Dasgupta, 2021; Schüwer, Lambert and North, 2019). Moreover, *transition risks* stem from the adoption of environmentally friendly operations and business models. Government policies and direct subsidies can contribute to technological advances that promote biodiversity, while changing consumer preferences impose a pressure to move away from environmentally detrimental operations. Finally, *litigation risks* relate to the liability issues taken against the firms responsible for the realization of physical and transition risks (*e.g.*, biodiversity loss) due to the firm's production decisions (Abdelli *et al.*, 2021). To understand the overall risk dimension imposed by the changes in natural capital, the firm's entire value chain must be investigated. In any case, the risks are ultimately related to the price of capital. The higher the risks, the higher the r (return) required from the firm/investment.

Financing natural capital

Governments play an important role in the development of less environmentally harmful production that can also support the positive development of natural capital. They do not merely provide regulation; they also aim to correct for market failures surrounding natural capital pricing. As they are maximizing long-term social well-being, they can also participate in long-term projects with low and risky expected financial returns. With their main toolbox, which consists of budgets as well as tax policies and legislation, governments can channel financial flows, impact the incentive structures, and undertake financial de-risking to increase private financial flows to assets supporting natural capital (United Nations Development Program (UNDP), 2020). Taxes, fees, and charges can help to reflect the social value of natural assets in market prices, whereas subsidies can be used to enhance and support actions that benefit the environment while limitations to harmful subsidies impact the industries that pollute and cause significant environmental damage. Other public instruments for natural capital include payments for ecosystem services (*e.g.*, payments for carbon storage, biodiversity conservation, and watershed services); climate and biodiversity offsets that direct funds towards projects that aim to compensate nature's losses; and direct fundraising for natural asset investments.

However, governments cannot do all the heavy lifting as, from the finance perspective, in industrialized, market-based economies, private funding is

significantly greater than public finance (Bank for International Settlements (BIS), 2020). Private investments are an extremely powerful machine for development that should henceforth be harnessed for nature. Private financial investments in natural capital are typically regarded as a sub-set of financial investments in broader investment categories, such as "sustainable" and "green" finance. "Sustainable" investment defines a large category for approaches to investment behaviour wherein non-financial factors also guide the selection and management of investments (Suttor-Sorel and Hercelin, 2020). The "green finance" label encompasses green bonds, sustainability-linked loans, private equity funds in supporting biodiversity, environmental impact bonds, and other sources, such as insurance products as the forms of mechanisms and instruments (Deutz *et al.*, 2020; OECD, 2020). Carbon markets (or emissions trading schemes) are another potential mechanism for supporting conservation and restoration projects (von Unger and Emmer, 2018) and, thus, natural assets (see, *e.g.*, Dasgupta 2021, Figure 20.2).

However, financial investments in natural capital remain scarce due to three key factors. First, these investments have not proven particularly profitable. Second, even globally, projects that enhance natural capital are often too small to attract financial investment (Huwlyer, Käppeli and Tobin, 2016), which affects their riskiness and the time required to set up each project (Cooper and Trémolet, 2019; World Bank, 2020). Third, standardized data and transparency on financial investments are lacking. For potential investors, it is difficult to make investment decisions in the absence of information about expected returns and impact. Nature-related risks will be realized over lengthy time horizons, and these risks may be ignored and overshadowed by the much shorter time horizon of risks to financial players. Lack of information and information asymmetry regarding the outcome of the investments have also been identified as barriers to private finance's provision of sufficient investment in natural capital (G20 Sustainable Finance Study Group, 2018). However, some mechanisms have already been developed with the aim of overcoming these problems. *Blended Finance* uses public finance to mobilize sources of private funding as governments provide both grants and guarantees to cover or reduce the risks related to loans and equities. Typically, it covers potential first losses, provides grants for initial finance and venture funding, and undertakes result-payments or provides technical assistance. Blended finance mechanisms can signal to investors the financial returns of a project, de-risk it and develop proof-of-concept (Dasgupta, 2021). Another alternative, *spatial finance,* utilizes information derived from the independent assessment of the location of the company's or country's assets and infrastructure using ground data, remote sensing observations and modelled insights (World Bank and World Wide Fund for Nature (WWF), 2020). This lends greater substance to the use of, for example, ESG information in the investment decisions by utilizing, for example, satellite data to measure all the sustainability-related characteristics of the relevant entity's assets.

The EU Taxonomy for sustainable activities represents a recent European action (European Commission, 2022). It has been designed as a tool for investors,

companies, issuers, and project promoters to use in advancing the transition to a low-carbon, resilient, and resource-efficient economy. It is a classification system that establishes a list of environmentally sustainable economic activities. Sustainable activities should not exert significant environmental harm and must make a substantive contribution to one or more of the following six environmental objectives: (1) Climate-change mitigation; (2) climate-change adaptation; (3) sustainable protection of water and marine resources; (4) transition to a circular economy; (5) pollution prevention and control; and (6) protection and restoration of biodiversity and ecosystems.

Natural capital and central banks

The development of regulation and institutional arrangements governing the supply of financial resources to nature-enhancing projects is evidently eminent. Both public and private funding sources are required to ensure a sustainable shift from Impact Inequality to Equality, but the role that financial system plays is ultimately bounded by broader government and regulatory policies to correct for institutional failures. Since governments have been unable to fully internalize the externalities stemming from previous institutional failures, such as the failure to meet the Paris Agreement 2015 emission reduction targets globally and the accompanying target of retaining global warming below 1.5°C, financial system cannot incorporate these costs into pricing and therefore into credit allocation and lending decisions. To mitigate this situation, central banks should be given a more robust role in the near future.

The central banks have recognized the effects of global warming, natural disasters, biodiversity, and natural capital loss in light of the potential threats that they pose to economic, financial, and price stability. Boneva, Ferrucci, and Mongelli (2021) have emphasized the need for central banks to tackle the climate change, both to safeguard their ability to conduct monetary policy smoothly, deliver on their mandates, and to ensure that they remain resilient to emerging climate-related financial risks. As banks' banks, central banks may assume a more substantial role in the fight against the biodiversity loss that poses environmental risks on a systemic level, with non-linear consequences and tipping points (Abdelli *et al.*, 2021).

Masciandaro and Russo (2022) focus on the trade-offs that central banks would face were they to begin tackling especially climate change more aggressively and note that the selection of instruments available to central banks to mitigate climate-related risks overlaps considerably with those already used in relation to their monetary and macroprudential mandates. They argue that central banks' effectiveness here depends on their degree of independence from governments' climate preferences and on their ability to calibrate their "green" easing, either monetary and/or regulatory, on the realized abatement level and emissions.

From a supervisory perspective, central banks have already begun to monitor the banks in terms of their effects on Climate and Environmental (C&E) risks.

The ECB's (2021) report of 112 significant euro-area banks revealed that none of the institutions are even close to fully aligning their practices with the supervisory C&E risk management expectations. Although some have already taken steps towards adapting their practices to reflect C&E risks, most remain in the early stages of development. As the challenges related to the integration of C&E risks into banks' operations are constantly evolving, the ECB is committed to continuing its dialogue with these institutions and aims to play a substantial role in the enhancement of C&E risk management practices in the near future.

Finally, central banks' role in enhancing the efficiency of funding channels regarding especially the greening of financial system has increased recently. Eliet-Doillet and Maino (2022) report that the announcement of the July 2021 ECB's Monetary Policy Strategy Review had a significant effect on the pricing and issuance of green bonds in the Eurozone: ECB-eligible green bonds' prices increased together with the amount of issued green bonds. Hence, ECB's action seemed to have a positive effect on increasing funding of green projects in the euro area.

Debt, equity, and natural capital

All dimensions of sustainability have received greater attention from investors in recent decades. Investors demand ethical portfolio allocations and prioritize social responsibility in their decisions. Krueger, Sautner, and Starks (2020) reveal that active institutional investors believe climate change has significant financial implications. JP Morgan has stated that the value of socially responsible investment is up 200% from the previous decade and was worth almost $22.8 trillion in 2018. The numbers of both ESG-themed funds and assets under their management have tripled in the last seven years (JP Morgan, 2018). Most importantly, investors prioritize the protection of their own reputations, followed by their moral/ethical obligations and legal/fiduciary duties. However, suitable investment opportunities, risk management, and asset owners' preferences follow closely.

Green bonds can work as an indirect medium to also attract the equity capital required for environment-supporting production. Aside from bank loans, firms can finance their operations by issuing bonds and/or stocks. Investors buying corporate bonds lend money for the company which, in return, promises to pay back interest on the principal and the principal itself when the bonds mature. On the other hand, equity capital provides funds for firms in exchange for stocks. Shareholders own parts of the firms and are entitled to a portion of their earnings in form of dividends and have a voting right in shareholders' meetings. The higher the price of a stock, the lower the cost of capital for the firm when it issues new stocks. The connection between green bonds and firms' equity valuations has been identified in recent findings implying that an issuance of the green bonds attracts positive media attention and functions as a signalling device. Given that only firms with the most efficient green projects commit to the process, the issuance of green bonds signals the

environmental project's positive values, leading to higher stock prices and lower equity capital costs for the firm (Daubanes, Mitali and Rocher, 2022).

The banking sector and bond markets have already begun to reduce the capital costs for sustainable loans. Kempa, Moslener, and Schenker (2021) suggest that renewable energy firms might initially face higher debt costs but that these have decreased in recent years in comparison to others. Similar changes have occurred among economies with more developed banking sector and stringent environmental policies. According to JP Morgan, 65% of all socially responsible investments are focusing on bond markets. Firms issuing green bonds pledge finance for environmentally friendly projects, such as clean and renewable energy or energy storage investments (Giglio, Kelly and Stroebel, 2021).

The green bonds trade at a premium and offer lower yields than otherwise similar, non-green bonds (Baker *et al.*, 2018; Zerbib, 2019). This signals the inclusion of non-financial utility related to investing in green bonds, stemming from environmental concerns. Bonds issued by governments and supranational institutions and very large issues of corporate bonds together with third-party certificates signal credibility, leading to reduced debt costs (Kapraun *et al.*, 2021). These premia are modest but non-negligible. Stock (2021) advocates a shift in the emphasis in sustainability discussion to sectoral level policies with the idea of permanently reducing the cost of debt for funding the nature-enhancing projects of real investments.

Sustainable equity financing is currently considered less profitable than investments in traditional assets, but Bauer, Ruof, and Smeets (2021) argue that investors are also willing to sacrifice part of the returns for the social good. Pástor, Stambaugh, and Taylor (2021, p. 550) state that "green assets have low expected returns because investors enjoy holding them and because green assets hedge climate risk". Hence, the lower expected returns verify non-pecuniary compensations or that the nature-supporting assets are regarded as safer investments with respect to environmental and regulatory risks. To attract more market-based funding, environment-supporting production should offer higher returns with similar or lower risks than the alternatives and should be able to signal this to the investors.

Conclusions

This chapter has discussed financial system's ability to steer investments towards production that will ensure the Earth's natural capital (nature, biosphere), a self-regenerative part of the planet. We propose that planetary well-being-oriented sustainable economic production of this nature occurs via the financial exclusion of non-environmentally friendly investments that tilt investment and resources towards more sustainable production. In addition to the obvious substantial role played by governments, the financial intermediation system—through both the indirect (banking) and direct (market-based) channels—and the central banks, in setting the rules and as active market participants, are vital in steering the economy towards planetary well-being-preserving production.

The sustainability-related criteria in finance, together with the emergence of green bonds, and the newly introduced European taxonomy in investments are directing the future of real economic production towards more planetary well-being-friendly production. However, the long-term nature of planetary well-being and valuation uncertainties also call for changes in traditional thinking. In planetary well-being-oriented projects, investors must be willing to accept higher long-term risks that are not necessarily compensated with higher returns. To ensure funding in these circumstances, the standard thinking is that supporting public policies are also required in terms of direct subsidies and tax allowances. However, experiences from the central banks' role in the recent crises (the GFC 2007–2009 and the COVID-19 pandemic) lend support to central banks' abilities to also enhance the funding available for planetary well-being projects. Among other standards, the internationally agreed financial standards, such as the Basel III and IV capital adequacy rules for banks and the Insurance Capital Standard, could also be applied to biodiversity-related financial risks. The central banks and financial supervisors should fundamentally integrate the environmental risks into macro- and micro-prudential supervision. They should also address carefully the environmental risks on their own balance sheets and request enhanced disclosure from the financial sector (as is envisaged by the work of the Taskforce on Nature-related Financial Disclosures). Furthermore, they should speed up the adaptation of international financial standards to properly take into account the new cross-cutting dimensions into traditional financial risk management, ensuring the necessary coordination and convergence of practices among the relevant institutions.

It is our hope that, in the very near future, finance will facilitate the perennial integrity of Earth and ecosystem processes without serious conflicts with economic well-being.

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