How Finance and Firms Can Accelerate the Green Transition*

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Access to bank credit and the quality of firms' management both play important roles in determining how much businesses invest in energy efficiency and pollution reduction. While credit constraints can hinder firms' ability to invest in capital-intensive clean technologies, such as machinery and vehicle upgrades, bad management practices often also pose a significant barrier. Firms with better green management practices – as measured by their environmental objectives, targets and monitoring systems – are more likely to invest in a wide range of green projects, from waste reduction and recycling to energy and water management. Based on a comprehensive survey of the recent literature, this article argues that policies aimed at facilitating access to green finance should be combined with initiatives to help business leaders become better green managers.

Journal of Economic Literature (JEL) codes: D22, G38, Q5

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1. Introduction

Irrefutable evidence shows that human activity, chiefly carbon emissions from industrial production, is causing the Earth to warm at a rate unmatched for at least the past 2,000 years (*IPCC 2021*). The day-to-day consequences of this warming planet are becoming ever more apparent. Extreme temperatures, droughts, floods and severe storms are already inflicting substantial human suffering, ecological damage and economic losses.

In the absence of scalable technologies to remove carbon dioxide from the biosphere, mitigating climate change will require a drastic reduction of new carbon emissions. For this reason, and in line with the Paris Climate Agreement, many countries aim to produce zero net greenhouse gas emissions by 2050 at the

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latest (*Millar et al. 2017*). This green transition (that is, the road to net zero) will require massive public, private and public-private investment to develop and then implement cleaner technologies. For example, several governments are currently investing heavily in the development of better lithium-ion batteries and electrolysers to produce hydrogen. At the same time, some private enterprises are investing to make their production methods more energy efficient and to develop new, greener technologies from scratch.

How can the financial system – banks, bonds, as well as public and private equity – facilitate this green transition?[1] A well-established body of literature now convincingly shows that deeper financial systems can foster economic growth (*Levine 1997*). One open question is whether the financial sector also influences the 'greenness' of economic growth? For example, large-scale investments to invent and then implement green technologies may only be possible if firms can access external finance. Moreover, some sources of finance may be better suited to fund green investment than others. The financial *structure* of a country – i.e. whether it is predominantly bank-based or market-based (*Levine 2002*) – may then co-determine how polluting its development path turns out to be.

This article explores the interrelationships between the financial system, carbon emissions and economic growth, focusing on the specific case of Hungary, a country characterised by a predominantly bank-based financial system. Furthermore, the article investigates the extent to which the quality of firms' management has an independent impact on corporate energy efficiency and carbon emissions, distinct from the firm's capacity to secure external financing. By examining these factors, the article aims to provide some insights into how the financial system[2] and managerial practices jointly shape the corporate climate impact in Hungary and potentially other comparable economies.

I will make three main points:

- Access to bank credit can enable firms to curtail toxic emissions and, to a certain degree, enhance the energy efficiency of their ongoing production processes.
- Organisational obstacles, notably deficient firm management, frequently pose a greater hindrance to green investment than credit constraints.
- Green innovation thrives more readily in environments where the financial sector is more equity-oriented and less reliant on bank-based financing.

[1] I focus on conventional financial instruments and abstract from specific financial contract to make firms more climate friendly, such as green bonds. For a recent empirical analysis of green bond portfolios, see *Németh-Durkó and Hegedűs* (*2021*). See also *Manasses et al.* (*2022*) for a broader discussion.
[2] For a detailed overview of financial systems in Emerging European Economies see *Mérő – Bethlendi* (*2022*).

2. Financial and managerial constraints to green corporate investment

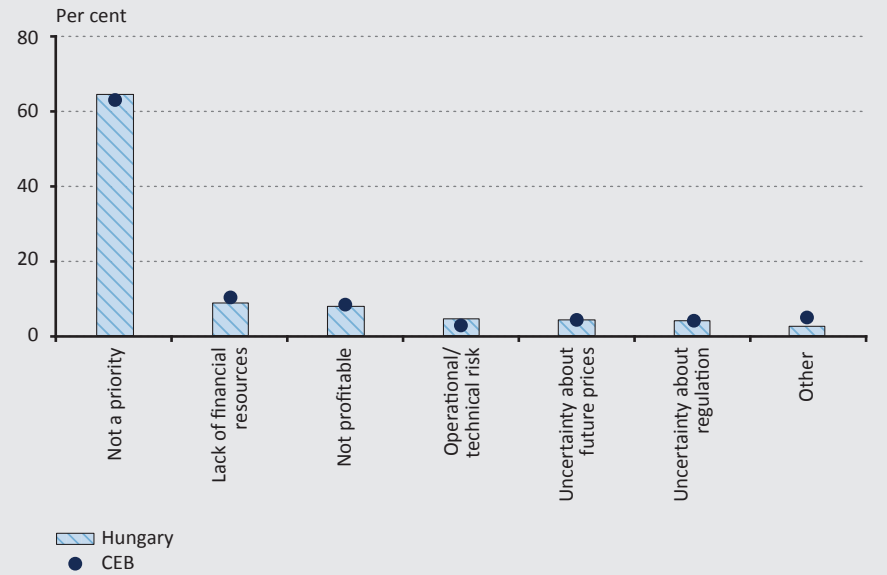
In the early phases of the green transition, substantial emissions reductions can be achieved by enhancing energy efficiency in corporate production and buildings. According to the *International Energy Agency* (*IEA*) (*2018*), energy efficiency measures could account for over 40 per cent of the carbon abatement required by 2040 to align with the Paris Agreement. This highlights the need for large-scale industrial investment in cleaner technologies to reduce firms' carbon footprints. However, many firms, especially smaller ones, face challenges in financing energy efficiency initiatives. Not only do they lack internal funding, but they often struggle to access bank credit for such investments. When credit constraints are present, climate-related investments may suffer setbacks.

An emerging body of literature shows that when firms get better access to bank loans, the amount of toxic pollution they emit locally often declines.[3] This is presumably because bank credit allows them to invest in, and hence clean up, their production processes. For example *Levine et al.* (*2018*) show how positive credit supply shocks in US counties help to reduce local air pollution. Likewise, *Götz* (*2019*) finds that financially constrained firms reduced toxic emissions once their capital cost decreased as a result of the US Maturity Extension Programme. *Xu and Kim* (*2022*) also find that financial constraints increase firms' toxic releases. Their evidence suggests that firms trade off pollution abatement costs against potential legal liabilities: the impact of financial constraints on toxic releases is stronger when regulatory enforcement is weaker.

To what extent does access to bank credit not only allow firms to reduce their emission of locally-polluting toxins but also of globally-harmful carbon? Carbon emissions are less visibly harmful at the local level and hence tend to expose firms to less legal risk. Firms may therefore deprioritise investments to reduce such emissions. Recent evidence confirms that while access to bank loans can help firms to limit carbon emissions, credit constraints appear not to be the most binding organisational constraint. For example, a cross-country survey of firm managers shows that, despite the potential environmental and efficiency benefits of green investments, many firms refrain from implementing such measures (*EBRD 2019*). As can be seen in *Figure 1*, 64 per cent of all interviewed firms in Central and Eastern Europe and the Baltics see investments in energy efficiency as low priority relative to other investments. This percentage is the same in Hungary. A lack of financial resources is the second-most cited reason not to do so, but this answer is only given by about 11 per cent of all interviewed managers (9 per cent in Hungary).

[3] For a comprehensive overview of the literature on the role of banks during the green transition, see *De Haas* (*2023*).

Figure 1
Reasons why firms do not invest in measures to improve energy efficiency

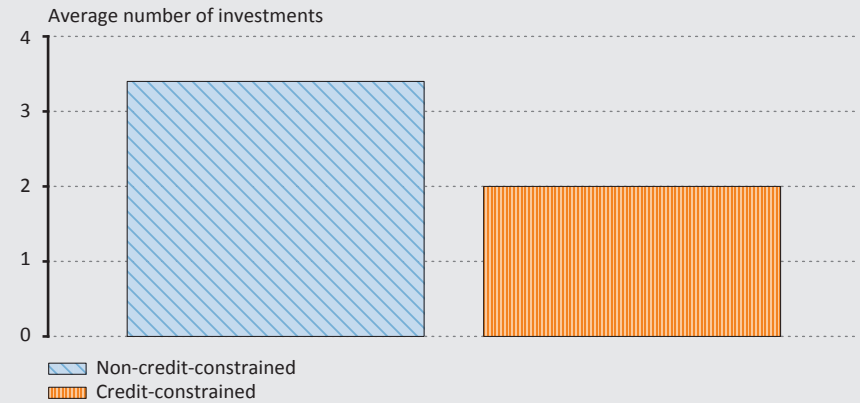


Source: EBRD-EIB-World Bank Enterprise Surveys and author's calculations. Sample of firms which had not taken any measures to enhance energy efficiency over the last three years prior to the survey.

De Haas et al. (*forthcoming*) investigate these data in more detail and focus on the relative importance of credit constraints versus managerial constraints. They measure each firm's green management practices using standardised data on firms' strategic objectives concerning the environment and climate change. This includes whether there is a manager with an explicit mandate to deal with environmental issues, and how the firm sets and monitors targets (if any) related to energy and water usage, carbon emissions and other pollutants. In addition, they track which green investments firms have made in the recent past. Green investments include machinery and vehicle upgrades; heating, cooling and lighting improvements; on-site generation of green energy; waste minimisation, recycling and waste management; improvements in energy and water management; and measures to control air or other pollution.

Their analysis shows how both credit constraints and green management influence the likelihood of green investments. Credit constraints hinder capital-intensive green investments in particular, such as machinery and vehicle upgrades and improved heating, cooling or lighting. They do not significantly reduce the likelihood of investing in air and other pollution control, potentially due to the 'low-hanging-fruit' nature of such investments. *Figure 2* shows how, also in the case of Hungary, credit-constrained firms implement fewer green investments as compared with firms that are not credit constrained.

Figure 2
Green investments by credit-constrained and non-credit-constrained Hungarian firms



Note: Credit-constrained firms are firms that indicate in the Enterprise Surveys that they need additional credit, but were either rejected by a bank when they applied for credit or were discouraged from applying in the first place. Non-credit-constrained firms are firms that indicate that they do not need additional credit or that they needed additional credit and received such credit when they applied for it. The number of green investments is defined as the number of investments to i) purchase fixed assets that have a greener technology embedded in them; or ii) explicitly target an increase in the firm's energy efficiency and/or a reduction in pollution or other negative environmental impacts.

Source: EBRD-EIB-World Bank Enterprise Surveys and author's calculations

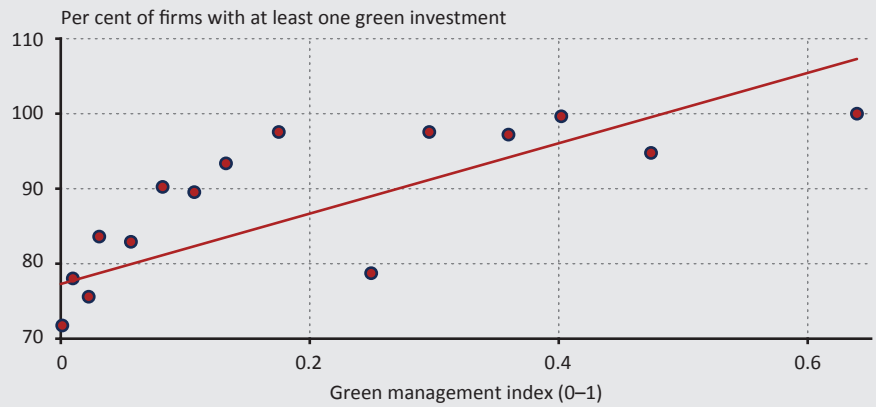
Firms with good green management practices, on the other hand, are more likely to invest in *all* types of green investment, with the effect larger for those kinds of investments that are more typically thought of as green: waste and recycling; energy or water management; air and other pollution controls. This positive relationship between the quality of a firm's green management and the likelihood that it makes green investments is also observed in Hungary, as can be seen in the binscatter plot below (*Figure 3*).[4]

If credit constraints and weak green management reduce firms' green investments, then this may eventually also hamper decarbonisation efforts. To investigate this, the authors use the European Pollutant Release and Transfer Register (E-PRTR) and focus on a sample of Eastern European countries. The E-PRTR contains data on pollutant emissions of a large number of industrial facilities. Their estimates indicate that, although there was a secular emissions reduction in 2007-2017, this decline was smaller in localities where banks had to deleverage more after the global financial crisis and where, as a result, more firms were credit-constrained.

[4] While the data shown in *Figure 3* are purely correlational, evidence on the causal relationship between the quality of a firm's green management and its propensity to make green investments is given in *De Haas et al.* (*2024*). Information on the size of green investments is unfortunately lacking.

In sum, a growing body of evidence indicates that when firms have better access to bank credit, they may invest more in cleaner production technologies. This may not only reduce (local) toxic emissions but also (global) carbon emissions. At the same time, for many important energy-efficiency measures that firms can take, access to credit is less of a constraint than the quality of firms' (green) management. Better-managed firms tend to produce more cleanly, and this is often unrelated to their ability to access bank credit.

Figure 3
Quality of Hungarian firms' green management and their green investments



Note: Higher values of the green management index indicate better green management practices, as measured by the extent to which firms incorporate environmental considerations into their strategic objectives, the clarity and attainability of their environmental targets and the regularity and thoroughness with which they monitor and manage their energy consumption, water usage, carbon emissions and other pollutants to minimise their environmental footprint. All Hungarian firms that participated in the EBRD-EIB-World Bank Enterprise Surveys are ranked by the quality of their green management and then divided into 15 buckets of increasing average green management quality. For each bucket, the percentage of firms that undertook at least one green investment is shown on the vertical axis.

Source: EBRD-EIB-World Bank Enterprise Surveys and author's calculations

3. Funding green innovation and reducing carbon emissions

The previous section shows that banks can help, to some extent, with funding investment in tried-and-tested technologies that enhance firms' energy efficiency. Nevertheless, the steep emissions decline needed to achieve net zero by 2050 also requires developing entirely new production technologies. There are at least three reasons to believe that banks may be less willing (or able) to finance R&D for such innovative, greener technologies.

First, many banks tend to be inherently technologically conservative. They fear that funding new (and possibly cleaner) technologies will erode the value of collateral that underpins their existing loans – and which firms used to finance

older technologies (*Minetti 2011*; *Degryse et al. 2022*). Second, green innovation (as any innovation) often involves assets that are intangible and highly firm-specific. Many banks would instead be more comfortable with funding tangible and easily collateralisable assets. Third, banks often have a shorter time horizon (the loan maturity) than equity investors and are hence less interested in whether assets will become less valuable (or even stranded) in the more distant future. For example, banks have only very recently started to price some of the climate risk related to firms with large fossil fuel reserves (*Delis et al. 2024*). Even then, many (large) banks continue to provide syndicated loans to fossil fuel firms at spreads that underprice the risk of stranded assets – as compared to bonds issued by those firms. As a result, carbon producers are gradually switching from bond to bank funding (*Beyene et al. 2021*).

Stock markets may be better suited to financing innovative and environmentally friendly technologies. Equity contracts, by their nature, are more appropriate for funding projects with high risks and high potential returns. If stock prices rationally discount the future cash flows of polluting industries, equity investors may be more attuned to the long-term costs and risks associated with pollution, even if these consequences may not materialise until the future.

One key question is therefore to what extent equity investors take carbon emissions into account when assessing longer-term corporate risk. A growing body of evidence suggests that especially institutional investors are increasingly doing so. Survey evidence by *Krueger et al.* (*2020*) shows that a large proportion of investment managers believe that climate risk is already affecting their portfolio companies. Almost 40 per cent of the surveyed investors are therefore aiming to reduce the carbon footprint of their portfolios, including through active engagement with management.[5] Such investors may also benefit from pushing companies to reduce carbon emissions because this helps to attract environmentally responsible investment clients (*Ceccarelli et al. 2024*). Because institutional investors are taking carbon emissions into account when assessing corporate risk, *Bolton and Kacperczyk* (*2021*) find that stocks of US firms with higher carbon emissions earn higher returns. Moreover, investors appear to shun carbon-intensive companies, although this effect is limited to direct emissions from production and to the most carbon-intense industries. Recent evidence shows that also *private* equity providers can help to clean up production processes. *Bellon* (*2021*) find that private equity investors have helped to reduce pollution (both CO_2 and toxic chemicals) in the oil and gas industry.

[5] This not only holds for investors in developed markets but increasingly also for those investing in emerging market securities (*EBRD 2021*).

The above discussion raises the question whether, on aggregate, countries with deeper stock markets relative to their banking sectors may in fact follow steeper decarbonisation trajectories. To help answer this question, *De Haas and Popov* (*2022*) compare the role of banks and equity markets as potential financiers of green growth. Using a 48-country, 16-industry, 26-year panel data set, they assess the impact of both the size and the structure of the financial system on industries with different levels of carbon intensity. In particular, they distinguish industries on the basis of their inherent, technological propensity to pollute, measured as the carbon dioxide emissions per unit of value added. The authors then investigate two channels through which financial development and financial structure (the relative size of equity markets relative to banking sectors) can affect pollution: between-industry reallocation and within-industry innovation.

Using this empirical framework, the authors derive three findings. First, industries that pollute more for technological reasons start to emit relatively less carbon dioxide where and when stock markets expand. Second, there are two distinct channels that underpin this result. Most importantly, stock markets facilitate the development of cleaner technologies within polluting industries. Using data on green patents, the authors show that deeper stock markets are associated with more green patenting in carbon-intensive industries. This patenting effect is strongest for inventions to increase the energy efficiency of industrial production. In line with this positive role of stock markets for green innovation, carbon emissions per unit of value-added decline relatively more in carbon-intensive sectors when stock markets account for an increasing share of all corporate funding. There is also more tentative evidence for another channel: holding cross-industry differences in technology constant, stock markets appear to gradually reallocate investment towards more carbon-efficient sectors. This is in line with the aforementioned tendency of (some) institutional investors to avoid the most carbon-intensive sectors. Polluting firms in these sectors will then find it more difficult to access external finance, putting them at a competitive disadvantage compared with cleaner companies.

Third, the domestic green benefits of more developed stock markets ‘at home’ may be offset by more pollution abroad, for instance because equity-funded firms offshore the most carbon-intensive parts of their production to foreign pollution havens. Analysis shows that the reduction in emissions by carbon-intensive sectors due to domestic stock market development is indeed accompanied by an increase in carbon embedded in imports of the same sector. However, the domestic greening effect dominates the pollution outsourcing effect by a factor of ten. This means that stock markets may have a genuine cleansing effect on polluting industries and do not simply help such industries to shift carbon-intensive activities to foreign pollution havens.

4. Conclusions and policy recommendations

This article has discussed some emerging evidence on the nexus between the financial system, carbon emissions and economic growth. The evidence shows that while bank lending can help firms to improve the energy efficiency of their current production processes, other organisational constraints, in particular weak firm management, often hold back green investments more than credit constraints. While policy measures that ease access to bank credit may be useful (for example, credit lines that are contingent on the adoption of state-of-the-art energy efficiency technologies) this might just be one element of a broader policy mix to stimulate green investments to boost firms' energy efficiency.

Governments and development banks may also consider measures to directly help strengthen firms' green management practices. Advisory services, training programmes and other consultancy-related, firm-level interventions can help managers to become better 'green managers'. Such interventions effectively teach managers how to not leave money at the table by postponing much-needed investments in energy efficiency.

Efforts to increase green investments by reducing credit constraints and by enhancing firms' managerial skills, will only pay off when the broader institutional framework is supportive. This means in particular that highly distortionary fossil fuel subsidies need to be eradicated. Recent evidence reveals that better-managed firms tend to reduce the fossil-fuel intensity of their production *unless* they can exploit high fuel subsidies (*Schweiger and Stepanov 2022*). The introduction of carbon pricing, either through a carbon tax or a cap-and-trade system, can incentivise firms to invest in measures that make their production more energy-efficient, rather than procrastinating. The financial sector plays a complementary role by mobilising funding for energy-efficiency improvements and new technologies as firms respond to price signals, such as carbon taxes. However, it is the responsibility of politicians and policymakers to create a policy framework that sets the right incentives for firms to transition to net-zero emissions. The financial system's role is to then facilitate this transition efficiently by supporting firms with the necessary financing.

A second lesson from recent research is that green innovation tends to flourish more where and when finance is more equity-based and less bank-based. Countries with a bank-based financial system that are on the transition path towards net-zero carbon emissions, may therefore also consider measures to stimulate the development of conventional equity markets. This holds especially for middle-income countries where carbon dioxide emissions may have increased more or less linearly during the development process. There, stock markets could play an important role in making future growth greener, in particular by stimulating innovation that leads to cleaner production processes within industries.

One way of doing so, especially in smaller economies, is through the regional integration of smaller equity markets. Such integration could target cross-border market infrastructure (such as links between stock exchanges and securities depositories), the harmonisation of regulations, as well as capital market accelerator funds with regional mandates. One example is the successful consolidation of national stock markets in the Baltic region. Nasdaq Baltic operates the stock exchanges in Estonia, Latvia and Lithuania, as well as a common Central Securities Depository. It provides capital market infrastructure across the whole value chain, including listing, trading and market data, as well as post-trade services including clearing, settlement and safe-keeping of securities. This makes it easier for investors to transact cross-border and, ultimately, for firms to raise equity. Similar efforts are ongoing to integrate several stock exchanges in the Balkans.

Another way to help develop equity markets that can provide firms with the equity needed for green innovation is by levelling the playing field between the cost of equity and the cost of debt. Countries that want to limit the negative environmental externalities stemming from a financial system that is overly reliant on bank lending (and debt more generally) can reduce tax-code favouritism towards debt (such as the deductibility of interest payments and double taxation of dividends). An example is the notional interest deduction that Belgium introduced in 2006. Similarly, as part of the European Commission's work on the Capital Markets Union, a common corporate tax base has been proposed to address the current debt bias in corporate taxation. A so-called Allowance for Growth and Investment will give firms equivalent tax benefits for equity and debt.

In parallel, countries can take measures to counterbalance the tendency of banking sectors to (continue to) finance relatively 'dirty' industries. Examples include the green credit guidelines and resolutions that China and Brazil introduced in 2012 and 2014, respectively, to encourage banks to improve their environmental and social performance and to lend more to firms that are part of the low-carbon economy. From an industry perspective, adherence to the so-called Carbon Principles, Climate Principles, Equator Principles, UN Principles for Responsible Banking, as well as the Collective Commitment to Climate Action should also contribute to a greening of bank lending. Strict adherence to these principles can potentially make governmental climate change policies more effective by accelerating capital reallocation and investment towards low-carbon technologies.

To incentivise and enable banks to adhere to these Principles in a meaningful way, supervisory climate stress tests, such as currently being undertaken by the European Central Bank, can be useful. Moreover, a growing number of banking supervisors – as part of developing a Pillar 3 framework on ESG risks and in line with the Financial

Stability Board's Task Force on Climate-related Financial Disclosures – is moving towards mandatory disclosure of climate-related financial risks.[6] The meaningful disclosure of climate risks will allow depositors, investors and other stakeholders to make more informed decisions and hence to enhance market discipline. Such corporate disclosure of climate risks is also a precondition for banks and other providers of capital to understand and manage climate-related risks. This work is likely to be facilitated by that of the recently established International Sustainability Standards Board (ISSB), a new board created by the IFRS Foundation to develop a global baseline of sustainability disclosure standards.

Lastly, the so-called Net-Zero Banking Alliance (NZBA), a United Nations initiative, brings together banks that are committed to align their portfolios with net-zero emissions by 2050. A useful aspect of this alliance is that it helps banks to set (and publicly commit to) an intermediate target for 2030 or sooner, thereby accelerating their decarbonisation strategies and making them more credible. Even then, voluntary commitments may not suffice, as evidenced by the fact that many global banks that signed up to the NZBA and similar initiatives continue to finance fossil-fuel extraction at scale. Banks looking for more credible decarbonisation strategies may choose to have their strategies validated by the Science Based Targets initiative (SBTi), an independent body that assesses whether banks strategies are aligned with the Paris goal of limiting global warming to 2° C.

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[6] See *Ritter* (*2022*) for a recent analysis of transition risks in the Hungarian banking system, using two complementary risk assessment methodologies.

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