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Review of
Handbook of Green Finance (1200 words)
For Submission in *Ecological Economics* (word version)

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Book Review of *Handbook of Green Finance*, edited by Jeffrey D. Sachs, Wing Thyee Woo, Naoyuki Yoshino and Farhad Taghizadeh-Hesary, the MRW Series on Sustainable Development, Springer Singapore, 2019, 718 pages

Achieving the objectives of the Paris Agreement requires developing financial tools, and completely re-examining the way finance works, so as to reallocate capital to low-carbon projects that promote energy transition without delay. New green finance tools and concepts, such as green bonds, green banks, carbon markets, green central banking or community-based green fund, have been widely developed in these last few years to promote economic growth and improve the environment. Banks, asset management companies, pension funds, insurers and households are gradually including environmental criteria in their financial portfolio choices. However, investments in green assets are far from growing sufficiently to meet a two-degree global warming limit, and a key contradiction remains for the time being unbridgeable: How to attract financial investors to greener projects, often characterized by a higher risk profile and lower profitability than

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polluting projects with no environmental constraints? How can governments, public agencies and economic agents reduce the risk and increase the return of green assets to encourage investments in green activities? The purpose of this *Handbook of Green Finance* is to discuss these issues by detailing the barriers to financing green assets and the energy transition, providing solutions through the discussion of new financial instruments, the appropriate role of financial institutions, fintechs and investors, and debating effective public policies and regulatory strategies to be implemented, with some focus on Asian countries. The book is divided into 12 parts with 29 chapters, and is written by a reputable mix of researchers, policy-makers and professionals.

The first, introductory, part points out the decline of investments in renewable energy in 2017, and notes that many countries continue to invest massively in fossil fuels, without any significant foreseeable change in trend. At a microeconomic level, financial institutions and private investors still favor profitability of investments and low risk, which makes them deviate from green projects. Therefore, the editors call for the promotion of innovative financial instruments and new public policies to support green finance, taking advantage of all the available financial avenues that could shift capital to ecological transition.

The second part describes the barriers in Asian countries that inhibit the expansion of green projects: underdeveloped financial markets and venture capital, limited governmental funds to support green transition, the reluctance of risk averse private banks constrained by stringent capital regulations to finance projects with lower returns and higher risks, the limited availability of advanced technologies and finally the high cost of switching from fossil to clean energies. Many of these obstacles are similar to those found in Europe and America.

Since public funds are not sufficient to lead the ecological transition, part 3, the most interesting section of the book in my opinion as a finance researcher, discusses opportunities to develop private investments in green assets. An exciting point is that authors reconsider the classical valuation models of financial assets by adding an environmental dimension to the traditional components of risk and return. That is, individual utility functions integrate a "green value". This paradigm shift is a major step to evaluate financial assets and provides the opportunity for green products to compensate for their low level of profitability, by valuing the positive externality that they produce. To compel investors to embrace this shift, another chapter proposes central banks to be the major players. In addition to fighting inflation or financial instability, developing sustainability could be part of their responsibilities by promoting low-cost green financing of commercial banks, and by restricting the funding of polluting assets. Central banks could develop micro-prudential regulations, integrating ecological dimensions into bank credit risk management, requiring banks' disclosure and transparency on their own climate risk, and decreasing reserve requirements of banks that would finance green assets. From a macro-prudential point of view, the introduction of climate-related stress tests, the requirements of differentiated bank capital based on environmental criteria, or lower interest rates to bank loans for green projects, could drastically change capital allocation towards ecological projects.

Part 4 notes the difficulty of financing green projects, due to an overestimation of credit risk, the complexity in understanding the projects and estimating the technological risks, the lack of information on and track record of these new businesses, and the regulatory constraints that restrict private bank lending. The authors note that new policies can lower this funding cost through credit enhancement, for instance in the use of

guarantees or insurance. Part 5 outlines the way green bonds, which have grown significantly in recent years and show promise, are used to finance green projects on the financial markets. The authors econometrically illustrate that, despite a widespread belief, the cost of financing green bonds is often not higher than conventional bonds, which should stimulate the growth for green instruments.

Part 6 promotes carbon capture and storage and carbon pricing to support the transition to "zero emission energy" and details the financial barriers that need to be addressed to facilitate its deployment. Part 7, which is of special interest for environmental economists who are concerned about progress in green finance, makes a practical link with part 3 and surveys the changes in practice of many institutional investors. These stakeholders provide a significant portion of the capital invested in financial markets and are beginning to play a major role in financing the ecological transition. They now begin to include environmental criteria in their asset allocation strategy, through positive and negative screening of companies, sustainability ratings of assets or active ownerships, and they invest in new green asset classes. New policy initiatives are also discussed, such as the "standardization of environmental impact metrics" for companies, the differentiated capital requirement for bank loans depending on how green the enterprise is, public private partnerships or Green Investments Banks.

Parts 8 and 9 address how fintechs, blockchain technology or big data can contribute to the green transition, as well as public programs and financing schemes implemented by some countries to support green projects and technologies. Part 10 discusses Community-Based Green Finance as a new tool to finance small scale green energy projects.

Finally, Parts 11 and 12 analyze the impacts of public policies, such as feed-in tariffs and loans, which seem to be fairly effective in some situations, or taxes, grants and subsidies, on the increase of investments in green energy. Public policies pursued in Asian countries are discussed in depth, considering their efficiency, weaknesses, obstacles, and achievements. Potential solutions are also presented. These last two parts illustrate that there is still a huge amount of work to comply with the Paris Agreement.

This book suggests that the increase in green private investments will be supported by reducing the cost of capital and the risk of these projects. For this to be achieved, central banks, governments, and international institutions need to work in a coordinated framework and use new monetary tools to be combined with public policies. Overall, this book is an exciting contribution on how to achieve the challenging targets of the Paris Agreement. It can be read as a whole or only for some specific chapters, depending on the reader's preferences. Environmental economists, financiers, and more broadly all academics, students or practitioners, who wish to learn about recent developments in green finance, will be able to explore what will certainly be the future of finance.