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## Innovation and Green Finance: A Joint Schumpeterian Perspective

In his “Theory of Economic Development” (published in German in 1911 and in English in 1934) Joseph Schumpeter focused on the specific idea how structural change and subsequent long-term economic dynamics are generated in a market economy. Contrary to mainstream thinking (at that time?), in Schumpeter’s view, the interaction of the financial system and the real economy plays a decisive role for structural change (= reallocation of resources) to happen, which in turn is an essential prerequisite for growth.

The two closely interrelated topics of “Innovation” and “Green Finance” – nowadays widely shared policy objectives on a global scale – can be taken as a perfect illustration of this Schumpeterian approach, as they combine two different perspectives on the same core issue: First, how can the transition to a sustainable economy be fostered by Green Finance and, second, can the financial system effectively contribute to economic dynamics by supporting innovation and structural change in general. Both perspectives presume that resources will have to be reallocated from old to new industries, to new methods of production, new markets and new products.

Obviously, addressing these two perspectives raises a number of challenging questions ranging from the structural features of the financial system to the role of financial regulation and the appropriate characteristics of financial instruments in this context. In addition, international initiatives – like the EU's Capital Markets Union – might become important drivers to advance the respective transformation of our economic systems.

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## Introduction

Since the onset of the recent financial crisis in 2008/2009 “sustainability” (or “resilience”) has become one of the central issues in many policy areas – ranging from fiscal to, predominantly, financial system issues. Originally, the term sustainability stems mainly from the environmental field, but at the same time it signals in a general way the need for a more long-term oriented perspective in several respects and many areas. The United Nations “17 Sustainable Development Goals” adopted on September 25, 2015 are ranging from “Poverty” to “Responsible Consumption and Production” and illustrate the broad range of issues covered by a sustainability perspective.

As the financial crisis has - globally but in particular in Europe - forced many economies on a significantly lower growth path, (economic) sustainability can be interpreted nowadays as a combination of the need (or hope?) for a higher (potential) growth path and a shift to a greener economy at the same time. As higher potential growth is closely related to innovation dynamics and as the transformation to a greener economy is based on the need for structural change the implementation of these processes are very much linked to Schumpeter’s view of economic development in his “Theory of Economic Development” (1911 in German). It seems surprising, how well Schumpeter’s ideas fit to these modern problems and, even more, which fundamental insights they still provide to a better understanding of current challenges.

### Schumpeter on economic dynamics and resource allocation

The popular standard understanding of the Schumpeterian vision is one of 'creative destruction', a process by which old production methods and goods are replaced. Thereby his central aim is to explain how long-term economic dynamics are created by 'entrepreneurs' who destruct the prevailing stability of the existing equilibrium with innovations with new methods of production and/or new goods. The crucial point in this process is what permits these innovating entrepreneurs to take resources out of the income stream ex-ante to invest into new projects.

Schumpeter's model is dynamic in nature. The mechanism is driven by powerful forces that shape the very long-run characteristics of an economy, like technological progress, intensity of entrepreneurial activity, and the institutional structure of an economy. However, there are two aspects that may deserve specific attention. First, the big changes which shape economic development are not taking place gradually and continuously. Second, the financial system is an integral part of the relevant institutional setting of economic development in today’s modern market economy.

The concept of innovation - which means new products, new methods of production, new markets and new sources of supply – is not part of the business cycle, but an impact of change coming from outside. Schumpeter uses the term 'gales of creative destruction'

when he speaks of innovation, because he thinks of innovation hitting the economy as an exogenous force. Innovations are the economic applications of this kind of inventions and discoveries which cause fundamental change to the entire economy.

In 'the stationary state' there is no innovation going on, and savings are used only to replace depreciated capital. 'The entrepreneurial function' is to disturb the stationary state, to create change and to seek new profit opportunities. As entrepreneurial activity increases, so does the level of income and output. But innovating occurs in periodic clusters of activity only, and these periods of 'creative destruction' mean that resources are reallocated from old to new industries and the structure of output shifts from traditional industries to new products. The increase in capital goods increases productive capacity and incomes connected with the new innovative part of the economy are rising, the whole economy is growing.

The main force of economic change - what can be called 'progress' - consists substantially of a change in method of production also. Examples of this are 'revolutions' like the introduction of electricity, of the motor car or the personal computer, what we would call nowadays new 'general purpose technologies'. All these events entail quite a risk of carrying out processes that have not been tried by experience before. That is the reason why most of these attempts fail but those few which succeed create a 'rush' and change the structure of our economies fundamentally. Schumpeter-type progress comes in rushes, structural and sustainable upswings are dominated by some new industry or product. They create lasting prosperity but they are also, later on after prosperity, the source of depression. But to understand the entire Schumpeterian mechanism in detail one has to go one step further and to take into account the central role he attributes to the financial system in this context.

### **The fundamental role of financing**

An integral and important part of the Schumpeterian story is that the financial system is essential for making technological innovation and economic development possible. In his own words: 'The banker . . . authorizes people, in the name of society as it were, to . . . (innovate)' (Schumpeter, 1934). This specific importance of the role of the financial system for economic development is closely related to his views on the dynamics of the process of development, in particular on how innovation and new investment opportunities can be realized – very much connected to his famous concepts of 'creative destruction' and the 'entrepreneur'.

The financing of innovation or a new industry always means expansion of financing. An innovative entrepreneur investing in new things – a start-up as we would say nowadays - has at the time of investment at his command expectations only and not yet the receipts from (expected) future sales. He will generally have to rely on new credit, from

whatever source.<sup>1</sup> Banks, for example, meet this demand by credit creation, they expand credit by granting new loans; but in modern developed financial markets many more institutions and instruments are available to offer financing, and perhaps in a more efficient way as banks can. In short, entrepreneurs need finance to gain command over inputs engaged in 'old-style' productions in order to recombine resources for their innovative investments.

It has to be kept in mind that the connection between finance and economic growth was of almost no importance in the thinking of classical economists. Schumpeter was among the first (and few) to put the role of financial institutions and financial markets at the center of economic development. Of course, he did not use the modern jargon of financial markets at his time but he concentrated on the role of the banker as an example: The banker stands between those who wish to form new combinations of resources and the old possessors of productive means: 'the relation between credit creation by banks and innovation is fundamental to the understanding of the capitalist engine' (Schumpeter, 1934). Financing becomes a necessary prerequisite for innovation, which in turn is the fundamental source of economic dynamics, relying on new entrepreneurs, new enterprises, new products or new production processes.

Schumpeter used the relationship between banker and industrialist to illustrate the importance of the financial system in choosing and adopting new technologies. He contends that a well-functioning financial system spurs technological innovation by identifying and funding those entrepreneurs with the best chances of successfully implementing innovative products and production processes.

### **Keynes on the “Finance Motive”**

In the English speaking world of economics the publication of Keynes' “A Treatise on Money” in 1930 summarized the status of the discussion on monetary and financial issues since the beginning of the century. Early knowledge of its content may have caused Schumpeter's decision not to publish his own volume on money. But overall the impact of the “Treatise” on the discipline was soon overshadowed by the publication of the General Theory in 1936 because of its “revolutionary” content.

What is much less known is that Keynes in his 'Monetary theory of production' (1933) as well as in 'The general theory of employment' (1937) very much stressed the importance of (ex-ante) finance (the “Finance Motive”) for the dynamics of a monetary economy – very similar to Schumpeter's thoughts dating back to 1911. Also in Keynes' view banks

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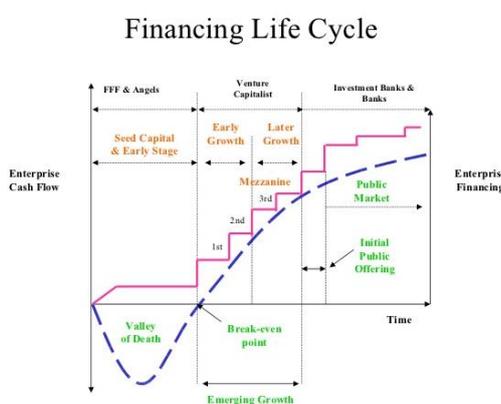
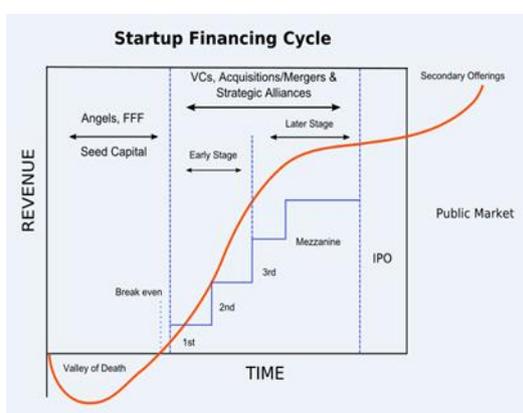
<sup>1</sup> It is perhaps worth mentioning, that this argumentation can be easily extended to „old firms“, which have to shift retained earnings from their traditional business to new areas of investment if they want to innovate. However, fundamental innovation in the Schumpeterian sense is less likely to happen this way compared to the innovations realized by new firms. Old firms tend to do incremental innovations and to concentrate on small scale process improvements.

hold the key position in the transition from a lower to a higher scale of activity and only a rise in investment financed by credit expansion increases overall income (Arestis et al., 2002). In the controversial discussion triggered by the General Theory Keynes forcefully made explicit two important interrelated issues on the need for funding. On the one hand, he qualified the existence of mechanisms to finance, in particular to fund investment, as the central condition for sustained growth of investment. On the other hand, he strongly underlined the importance of the respective institutional setting (the financial system of an economy) for macroeconomic performance.

Very similar to Schumpeter, Keynes clearly had in mind the procedures to be followed by a firm in order to secure the necessary financing of its investment plans. First there is the need to secure short-term liquidity covering the cost of production, and second it is necessary to refinance the short-term obligations by long-term funding. This two-step provision of finance envisaged by Keynes is exactly the required device faced by entrepreneurs in deciding on new investment. The initial provision of credit makes the production of new capital goods possible and at the same time increases the money stock. When investment has been carried out with the consequent increase in income and saving, long-term finance is accommodated by the outcome of a successful wave of new investment based on innovation.

### The special case of financing (fundamental) innovation

The difficulties of how to finance innovation on existing financial markets under conditions of prevailing long-term uncertainty and widespread risk adverse behavior of economic agents are extensively dealt with in the literature (for example Hall - Lerner, 2009). The essence of these problems is well summarized in the start-up financing cycle of young firms on the one hand and in the life cycle financing needs of a (successfully growing) firm on the other hand.



Innovation typically entails R&D leading to an invention as well as subsequent patenting of new products and technologies and more. In addition, it often involves the adopting of existing products and processes and adapting them to catch up with the technological frontier. Funding constraints may limit the adoption of technology, as external inventions (which are typically context-specific and involve tacit know-how) are costly to integrate into a firm's production structure. Firms therefore need sufficient financial resources to properly adapt external technologies, products and processes to their local circumstances. If insufficient funding is available, businesses – in particular small- and medium-sized ones - may be unable to fully exploit the easy option of R&D that has been carried out elsewhere. Such firms remain stuck in low-productivity activities, and this may, at country level, contribute to the persistence of divergent growth patterns around the world. Exactly how – and how much – external finance helps firms to innovate, be it through own innovation activities or the adoption of existing products and processes, remains a matter of debate.

Mazzucato (2013) and Criscuolo - Menon (2015), for example, discuss in detail the different need of different firms for different instruments ranging from venture capital to public funding and show the difficulties to match financing needs with appropriate willingness to finance. In any case, the complicated relationship between access to finance and firm-level innovation, given that many – in particular young and small to medium-sized - firms are bank credit constrained is a persistent challenge in the innovation process.

### **And what about “Green Finance”?**

“Green finance” is an even more difficult combination of innovation finance and the attempt to reallocate resources. It can be understood as financing of investments that provide environmental benefits in the broader context of an environmentally sustainable development. The realization of these environmental benefits involves efforts to internalize environmental externalities and to adjust risk perceptions in order to boost environmental friendly investments. In principle, it covers a wide range of financial institutions and asset classes – many of them of a systemic nature - and it includes a wide range of both public and private finance, at least in theory. As Carney (2015) as well as Bank of England (2016) have shown, it involves the effective management of environmental risks across and by the financial system as a main challenge. Many of these risks are largely unique to green projects, such as difficulties in internalizing environmental externalities, information asymmetry (e.g. between investors and recipients), inadequate analytical capacity and lack of clarity in size and definitions. Others are more generic to most long-term projects in some markets, such as maturity mismatch, but similarly hard to overcome.

Options to address these challenges are emerging. Many countries have adopted policy measures to make significant contributions to enhancing green investment, but overall the mobilization of private capital remains insufficient, in fact very low. Concrete actions to support the development of Green Finance include, among others, voluntary principles for sustainable lending and investment, enhanced environmental disclosure and a spectrum of financial products such as green loans, green bonds or green infrastructure investment trusts.

Although sustainable financing has been a topic since a long time, the UN Principles for Responsible Investments (2006) mark the first step of creating a sustainable financial

Capital intensity	High	<b>Project Finance/Existing firms</b> <ul style="list-style-type: none"> <li>• Wind farms</li> <li>• Utility-scale solar</li> <li>• First-generation biofuel refineries</li> <li>• Manufacturing of solar cells using established technologies</li> </ul>	<b>Hard to Fund ("Valley of Death")</b> <ul style="list-style-type: none"> <li>• First commercial plants for unproven technologies</li> <li>• Advanced biofuel refineries</li> <li>• Offshore wind farms</li> <li>• Carbon sequestration</li> </ul>
	Low	<b>Bank Debt/ Existing firms</b> <ul style="list-style-type: none"> <li>• Wind and solar component of proven technologies</li> <li>• Internal combustion engines</li> <li>• Insulation/building materials</li> <li>• Energy efficiency services</li> </ul>	<b>Venture Capital</b> <ul style="list-style-type: none"> <li>• Energy efficiency software</li> <li>• Lightning</li> <li>• Electric drive trains</li> <li>• Fuel cells / Power storage</li> <li>• Wind and solar components of unproven technologies</li> </ul>
		Low	High
		<i>Technology risk</i>	

Fig. 2. Many Green sector ventures are "hard to fund"  
Source: Ghosh and Nanda (2015).

system. But the overall goal to reduce our carbon footprint and finance low carbon and climate resilient infrastructure was set only by the start of a Divestment Strategy (2010), the creation of the Montreal Carbon Pledge (2014) and the implementation of the Paris Climate Agreement recently.

To reach the ambitious goals of The Paris Climate

Agreement an appropriate supply of targeted finance is a necessary condition, besides a new technology framework and an enhanced capacity building framework (Rodrik, 2014). But the "financing gap" for green projects is structurally even more important and harder to overcome than in innovation financing in general, as illustrated by a classification developed by Gosh - Nanda (2015).

As today only a very small fraction of bank lending can be explicitly attributed to environmental innovation (based on available not standardized definitions), green bonds represent one of the most effective tools to invest in the environment. They are defined to have a direct impact on green innovation, as their proceeds are expected to be exclusively applied to finance or re-finance - in part or in full new and/or existing - eligible green projects. But currently it is estimated that less than 1% of global bonds are labeled green and less than 1% of the holdings by global institutional investors are green assets only. The potential for the necessary and intended scaling up of Green Finance is substantial.

The Green Bond Market saw initial issues in 2007 and 2008 by the EIB and World Bank. Strong growth started in 2013 and this led to the establishment of the Green Bond Principles (GBP) in 2014. The GBP are voluntary process guidelines that recommend

transparency and disclosure and promote integrity in the development of the GB market. GBPs are built on 4 pillars:

1. Use of Proceeds
2. Proceeds for Project Evaluation & Selection
3. Management of Proceeds
4. Reporting

HSBC (2016) estimates the climate aligned bond universe to \$694 bn of outstanding volume. About \$118 bn are explicitly labelled as green bonds, the much larger part consists of issues that are judged that they might or are likely to fulfill the respective criteria. Main issuers are Development Banks, public sector entities and corporates also. Issuance of green bonds amounted for approximately \$42 bn. in 2015, significantly higher than a few years ago. In 2016 the volume increased further up to an expected volume of \$100 bn. The sectors or uses covered by the GB market are rather encompassing, ranging from renewable energy to low carbon transport and climate adoption.

What becomes very obvious when analyzing these figures is, that to meet the goal of reducing the carbon emission and to encourage the market to invest in green bonds, the key task for governments is to provide a convincing overall architecture by providing legislation to reduce emissions, carbon taxes and perhaps tax relief on income from GB. In a respective efficient framework of regulations and incentives the new driving factors - green technologies and innovation - will enforce corporates to scale up climate friendly products in order to improve their market position. At the same time investors will value green investments as increasingly attractive, thereby raising demand considerably. Under these conditions implementing sustainability will no longer be seen as a burden on profitability of firms, but will become increasingly important as a factor contributing to the competitiveness of enterprises on the market.

### **Three examples of recent policy initiatives**

Understood in the Schumpeterian sense Green Finance can be seen as an instrument or mechanism to direct resources to the financing of green innovations and to the realization of politically agreed environmental goals. As these objectives are connected to externalities and are of a predominantly political nature, it is important to initiate public programs to support this transformation or transition process on all administrative levels, from global to very local, as well as bottom-up private initiatives. What all these programs usually have in common is that they (i) try to support the implementation of politically agreed goals in various ways, (ii) try to correct for market imperfections and barriers, and (iii) try to match people's preferences with market conditions.

Obviously, addressing these perspectives in the context of Green Finance raises a number of challenging questions ranging from the structural features of the financial system to the

role of financial regulation and the appropriate characteristics of financial instruments. Because of its political nature and supranational relevance, international initiatives have become important drivers to advance the respective transformation of our economic systems.

**G20:** Under China’s Presidency of the G20 a study group was established to “identify institutional and market barriers to green finance, and based on country experiences, develop options on how to enhance the ability of the financial system to mobilize private capital for green investment.” As a result of this work a number of key options to enhance the ability of the financial system to mobilize private capital for green investment were developed (G20 Green Finance Study Group, 2016):

1. Provide strategic policy signals and frameworks
2. Promote voluntary principles for green finance
3. Expand learning networks for capacity building
4. Support the development of local green bond markets
5. Promote international collaboration to facilitate cross-border investment in green bonds
6. Encourage and facilitate knowledge sharing on environmental and financial risk
7. Improve the measurement of green finance activities and their impacts

**EU:** To date, the majority of assets managed according to environmental, social and governance principles are based in Europe. Ambitious steps are needed to support the transition towards a low-carbon economy in the next decades, for which the Paris agreement marks a turning point. The financial sector can support the transition to a sustainable economy in many ways, from mobilizing savings to an adequate pricing and tradability of carbon risk. The financial sector is also important to manage climate risk, by providing insurance and financial instruments to hedge such risks.

A number of promising initiatives have been launched in recent years, but the EU sees a lot of scope for necessary further improvement (EU 2013). Initiatives are fragmented and would benefit from more standardization and stronger incentives across the entire economy. More standardization and aligning price incentives with the underlying climate risks would help to boost sustainable investments and facilitate the transition to a low-carbon economy. Standardization and larger volumes would generate economies of scale. Several EU member states have already taken steps to enhance firms’ disclosure on sustainability, while at the EU level the Non-Financial Reporting Directive will require large companies to report on environmental issues. The Union is willing to play a leading role and to support similar initiatives at the global level. For investment decisions in particular, a strong, prudent and stable regulatory environment would reduce

uncertainty for economic agents, which is important given the long-term nature of investments.

In addition, it remains important to monitor potential systemic risks for the financial sector. Financial firms are potentially exposed to stranded assets and sectors that need to adjust. The financial sector is also confronted with risks related to climate change itself (e.g. operationally or in the insurance industry). Supervisors will have to monitor these risks closely and take action when these are insufficiently managed.

**CMU:** The Capital Market Union initiative of the EU provides an opportunity to further strengthen the development of financial instruments, such as green bonds (Capital Markets Union – Accelerating Reform, 2016). Such reforms are essential to meet climate and environment objectives and international commitments. The Commission supports alignment of private investments with climate, resource-efficiency and other environmental objectives, both through policy measures and public investment. In this regard, work is ongoing to increase the availability of green funds through the European Fund for Strategic Investment, by earmarking at least 20% of the EU 2014-2020 budget available for climate action, and by setting up a platform for financing the circular economy. The need to support EU green bond standards was highlighted in the CMU Action Plan. An expert group will be established to develop a comprehensive European strategy on green finance. Regarding environmental, social and governance issues, the EU has adopted mandatory disclosure requirements for certain large companies and will also adopt non-binding guidelines on the methodology for reporting such information to investors and consumers. It is also assessing the follow-up on long-term and sustainable investment which should underline its importance for the longer-term performance of companies and investors.

### Concluding remarks

Without doubt, financial market developments, in particular financial market growth and a marked differentiation of financial products, have shaped the economic situation of the twentieth century markedly. Although the framework conditions for this development may have been very specific, it seems very unlikely that there is no interrelationship between financial market developments and the real economy, or only a negligible one, in reality.

Surprisingly enough, and rather contrary to Schumpeter, mainstream economic theory as well as financial economics have considerable problems in sufficiently integrating financial markets into macroeconomic analysis – which has become even more problematic after the experience of the crisis of 2008/2009. Economic policy-makers had and have to regard financial market developments as a growing and permanent economic policy challenge. One specific aspect of the debate is that nowadays the overall degree of

development of a financial system is seen to be the important factor. Well-developed financial markets can be expected to have a positive influence on economic performance, if properly regulated and supervised.

In the end, the functional efficiency of a financial system, centring on the efficient transfer of funds with a view to financing investment and innovation, directly relates financial markets to the real economy and long-term economic development in a Schumpeterian sense. Factors determining the transfer of financial funds to 'entrepreneurs' and 'innovators' are essential for the potential level of investment and the dynamics of the growth path of the economy to be realized.

The two closely interrelated topics of “Innovation” and “Green Finance” – nowadays widely shared policy objectives – are a good example of this Schumpeterian approach, as they combine two different perspectives on the same core issue: First, how can the transition to a sustainable economy be fostered by Green Finance and, second, can the financial system effectively contribute to economic dynamics by supporting innovation and structural change in general. Both perspectives presume that resources will have to be reallocated from old to new industries, to new methods of production, new markets and new products. Obviously, addressing these two perspectives raises a number of challenging questions ranging from the structural features of the financial system to the role of financial regulation and the appropriate characteristics of financial instruments in this context. But international initiatives – in particular by the G20 and the EU – have already become important drivers to advance the respective transformation of our economic systems. Without doubt, the potential for the necessary and intended scaling up of Green Finance is substantial.

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