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Financial markets as a public good – complexity and the sustainability of financial markets[1]

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Abstract:

Aim: In this paper, it is argued that in complex financial systems private goods, important for the creation of a market, have to be considered in a multiple of differing property rights structures necessary for the functioning of the system. This may lead to high transaction costs and adverse incentives for different players, threatening the sustainability of the system. The aim of the article is to create and explore a framework for assessing fragilities and threats to the sustainability of financial markets, using a property rights approach. This may be a useful background for development of policy to increase the sustainability of financial markets.

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Conclusions/findings: It is argued that while financial services have features of a private good for which markets exist, the infrastructure and organizational structures have features of a club good. These are characterized by problems of congestion and depreciation due to its overuse. The question is addressed to what extent the public good features are of the "weakest-link" kind, where fragilities may lead a potential collapse.

Implications of the research: The complex financial system should be prevented from getting too many features of an open access regime, while making it a self-strengthening system where failures have learning effects. This may require the increase of different types of buffers and limits to the size of the players in the financial system. Otherwise, any action that is thought to lead to an improvement, is likely to lead to have the opposite effect.

Keywords: financial markets, complexity, public goods, club goods, property rights, sustainability
JEL: D23, E42, G1, G2,

1. Introduction

1.1. Background

The financial market tends to become more complex and tightly coupled in the process of globalization (Admati, Hellwig 2013; Taleb 2012; Harford 2011; Mandelbrot, Hudson 2008; Amaral, Ottino 2004; Latora, Marchiori 2004; Johnson et al. 2003). This creates great challenges in the sustainability of financial markets as the 2007 crisis showed (Sornette 2003; Castellanos et al. 2012) and, as a consequence, in economic development on a global scale. In each system accidents and mistakes are common (Perrow 1999). In fact, they are a source of information and knowledge (Harford 2011). In this context, banking crises and financial crashes that appeared in the past can provide very useful insights, which may contribute to the sustainability and strengthening of the financial system (Taleb 2012).

However, currently, the scale of impact of such events is unevenly distributed over the whole planet (Akerlof, Shiller 2009), creating a situation where players in the market who are "too big to fail." This impedes opportunities to learn from failures. Bad practice can only provide learning effects strengthening the financial system when individual players face the consequences, while not threatening the existence of the whole system. Following evolutionary economic theories, many individual units should function in such a way to create a pool of players in the market in order to enable learning processes. A crisis or bankruptcy of one player creates knowledge for other players, which makes them stronger in the face of new challenges created by

economic and technological development. However, it is not only the increasing complexity and interconnectedness in financial markets that hamper such processes. This effect is strengthened by the fact that financial markets are a kind of meta-institution with features of a public good, which is necessary for the functioning of the global economic system.

1.2. The purpose of this paper

Using a property rights approach, the aim of the article is to create and explore a framework for assessing fragilities and threats to the sustainability of financial markets. This will be discussed in the context of complex systems. It is argued that while financial services have features of a private good for which markets exist, the infrastructure and organizational structures do have features of a club good. Among other things, these are being characterized by problems of congestion and depreciation due to its (over) use.

The effects of transactions on the financial market (e.g., lending and borrowing, instruments for risk management, the impact on the functioning of markets for goods and services) have features of positive externalities (a special case of a public good and value in the public domain (Platje 2011)). The question is to what extent this public good is of the "weakest-link" kind (Sandler 2001), where fragilities may lead a potential collapse. While this is a small probability event, the break down can cause significant economic damage due to a reduction of positive externalities created by a properly functioning financial market, at the same time spreading the negative externalities (costs) through the whole global economy, in particular to the weakest players. This idea is similar to Taleb's (2012) argument, grounded in the work of Mandelbrot (1963) and Mandelbrot and Hudson (2008), which maintains that fragilities and Black Swans may appear to create low-probability threats with disastrous consequences.

Fragilities become of particular importance in the context of opportunistic behaviour strengthened by unclear or poorly written rules of the game, where economic players in a kind of evolutionary process will find loopholes in the system (Furubotn, Richter 1997; Harford 2011). A useful framework for analyzing this issue is the notion of the public domain (Barzel 1989), which is grounded in the Coase

theorem. In the opaque property rights structure of the global financial markets with large informational problems, incentives for redistributive activities strengthen (Platje 2004). Even with the best intentions, innovations and profit-oriented activity may lead to unexpected effects in financial markets, which pose a low probability though serious threat to its sustainability. In the face of complexity of global financial market, the use of traditional economic models in risk assessment may easily lead to neglect the general rule that a financial product is based on the promise to be paid back on a certain moment in the future (Akerlof, Shiller 2009).

After a discussion on the complexity of financial markets, the financial system is elaborated from the point of view of a property rights approach. Afterwards, the question is addressed what type of goods the different elements of the financial system are, subsequently the incentives for activities by different players in the financial system are determined as well as their impact on its sustainability. This article goes beyond the traditional "market versus state" dichotomy, as this approach neglects the importance of the multiple of differing property right structures for the functioning and sustainability of the financial system.

2. Complexity of financial markets

Currently, financial markets are elementary for the sustainability of the global economy. Just imagine what would happen when these markets collapse. As the financial crisis of 2008 shows, shockwaves can go through the global economy leading to negative economic growth, increased unemployment and growing government debts when tax money is used to bail out banks in order to prevent chain effects of bankruptcy (Admati, Hellwig 2013). Different authors have identified that financial markets have become more unstable during the last few decades (Akerlof, Shiller 2009; Admati, Hellwig 2013). Furthermore, since markets are increasingly interconnected and complex, instability is clearly reinforced.

As recognized by psychologists and behavioural economists (see Kahneman 2011), complexity is generally poorly understood by human beings. Humans rather rely on making decisions assuming a phenomenon has a directly identifiable cause.

This poses serious challenges when discussing macroeconomics and financial systems, since, many different interactions are counter intuitive (Harford 2014). In general, a complex system can be understood as a collection of many interdependent parts that interact with each other through a competitive non-linear relationship, leading to an emergent and self-organized behaviour.[2]

Although complex systems are applied in macroeconomics (Harford 2014) and business dynamics (Sterman 2000), the study of complex systems can still be regarded as a relatively new scientific discipline (Bar-Yam 1997: 1). It requires an interdisciplinary approach, where a multitude of theories and methods should be used to grasp at least a part of reality. Relying on one theory may close the way to understand the unknown parts of complex systems. Even when nothing bad happened in the past, this does not mean it cannot happen, as these unknowns may be a source of serious potential damage (Harford 2014). Rephrasing Taleb, a lack of proof of damage is something completely different than proof of lack of damage ("evidence of absence is not absence of evidence," Taleb 2012: 235). This is in particular important when considering the non-linear, irreversible changes that may appear due to the strong interdependencies in complex systems, appearing unexpectedly for most of human beings. Such systems tend to behave rather dynamic than static, and rather probabilistic than deterministic. Furthermore, the effects of actions in such systems are hardly predictable and rather uncontrollable (Helbing 2012: 10).

Financial markets can be regarded as typical complex systems. In the market, financial agents are linked by public information that they share. Many investors may watch the same price chart and simultaneously they behave implicitly coordinated. Processes can be similar to what happens with a group of commuters listening to the traffic report of the same radio station. Most of them will end up driving by the same road, supposedly uncongested, thereby, creating a traffic jam (Johnson 2007: 24).

In addition, financial markets are dynamic systems that are continuously evolving and generating a huge amount of data. It is the availability of this huge amount of data

[2] Important examples of complex systems are the ecosystem, intelligent life in general and the human brain in particular. Other examples of complexity include governments, families, societies, ecological systems, the weather, the economy, organizations, information systems and financial markets.

which enables, but also creates challenges in creating a detailed statistical description of different aspects of asset prices. Modelling dynamics of financial markets is not easy. Some studies indicate the existence of several levels of complexity in the price dynamic of such markets (Bonanno et al. 2001: 1–8). This dynamic characteristic means that time is of crucial importance, creating analytical difficulties. For example, as Mandelbrot shows (Mandelbrot, Hudson 2008), financial markets may have a kind of memory and are featured by path-dependency. A fall in prices may be followed by another, probably less deep fall in prices. Mandelbrot's multi-fractal approach may be useful in managing the explained complexity of financial systems.

Complex systems are featured by non-linear interactions among its elements, creating the possibility of rare and possibly catastrophic events (e.g., negative Black Swans, Taleb 2007). For example, in the case of stock markets it seems that expected future earnings are more important than the present economic reality in decision-making by the average investor. Unrealistic expectations may lead to speculative bubbles, followed by tremendous crashes which may be caused by self-reinforcing imitative behaviour among traders. An example is traders placing the same order (sell) at the same time; thus, bringing about a crash (Sornette 2003: XV, 15). Even in the face of a potential crash it may be rational for investors not to leave the market, as the high rate of growth in a bubble compensates for the risk of loss in a crash. A problem appears when the probability of turmoil is underestimated or even neglected, which can lead to spectacular bankruptcies and increased instability of financial markets. It is crucial to realize that the long term behaviour of complex systems is often controlled to a large extent by rare but extreme and catastrophic events (Sornette 2003: 24).

Most importantly, there exists a distinctive category of complex systems known as complex adaptive system (CAS). A CAS is capable of changing itself, to transform and adapt to a changing environment. Moreover, a CAS not only will be able to self-modify, but it might also change the environment to suit itself (Holland 2006: 6). This seems to be a good descriptor of financial systems. The ability to transform may make the financial system more resilient. The ability to influence the environment creates opportunities for imposing costs and problems on others. This is in particular visible with the consequences of the financial crisis of 2007–2008. Thus, in the financial

market many heterogeneous agents interact nonlinearly with a surprising capability of adapting their behaviour based on experience. But this depends on the institutional setting (discussed below) that limits the chain effects and externalization of costs of a crash.

3. Property rights and the financial system

A property right and transaction cost approach to the financial system is relevant. First of all, it is featured by increasing interconnectedness (opaque property rights structures). Furthermore, the system seems to be featured by adverse incentives. Extending the Coase theorem, according to property rights economics, when property rights are properly defined and transaction costs of obtaining information, negotiation processes as well as monitoring and enforcement are low, there are strong incentives for productive economic activity (North 1990; Furubotn, Richter 1997). The moment that property rights are unclearly or not defined (which is related to high costs of obtaining information, high monitoring and control costs), room for so-called opportunistic behaviour appears. An example in the 2007–2008 credit crisis is what Akerlof and Shiller (2009) call snake oil. Financial geniuses created innovative, though incredibly complex products. At this moment, economic theory predicts that due to the fact that it is difficult to find out the quality of the product, and who is responsible for what, it is more likely that someone will make use of the opportunity to enrich him/herself at the expense of someone else with less knowledge on the product.

A pivotal question is whether society should allow such processes to take place. When the system sustains and the economy grows, theoretically speaking everyone can theoretically gain. But the question is what would happen when the system completely fails and a panic appears. Even when the probability of complete collapse is very small, it may happen and have incredible consequences. This creates a great challenge in developing theories for the stability and sustainability of financial markets. It is very difficult to think outside of a different mind-set and to remain open minded for new ideas. Many students of economics have learned interesting theories

about perfect markets. A problem is that many theories are based on the assumption of the existence of a normal distribution, which is criticized by authors such as Mandelbrot (Mandelbrot, Hudson 2008), Kahneman (2011) and Taleb (2012). When a normal distribution exists, a financial downturn will on average be levelled out by a financial upturn. At such a moment, traditional risk management can be applied. However, when taking into consideration what Taleb (2007) calls negative Black Swans, which are events with a very low probability, often unexpected while having extremely high impact, then such risk management becomes useless. There have already been several crashes on the stock market that could have not appeared according to the theories based on statistics founded on the normal distribution (Mandelbrot, Hudson 2008). They wiped out the savings and investments of many people, while increasing the budget deficits in many developed countries due to the bail out of banks (Freixas et al. 2015: 23). The fact that the financial system was saved, does not mean that it cannot collapse in the future.

Banking and financial crises have always existed. As Admati and Hellwig (2013) argue, the Swedish banking crisis in the 1990s kept the international markets rather unaffected. The bankruptcy of the Lehman Brothers led to serious financial tsunami, threatening the existence of the global financial system due to its increased interconnectedness. In the case of Sweden, the banks could be saved and recover, and lessons could be learned. In case of a global financial melt-down, who has the power to save the sinking ship? At the moment that even the smallest probability of complete system collapse exists, traditional risk assessment methods tend to become useless. Just because when that event happens, everything is lost, even the highest gains. Statistically, the average gain becomes zero, or the loss of everything, in the most extreme case. Theoreticians and policy makers should be aware of this fact and take responsibility when they would intentionally ignore this issue in their theories and policies.

A problem that should not be underestimated, and which is related to the mind set of economists, who due to their training assume normal distributions, is that theories and policies seem to be soaked with normative worldviews. An example of such a worldview related to the idea that growth is good is the so-called techno-centric paradigm (Gladwin et al. 1995), the belief that economic growth and technological

development will solve all of world problems. The logic is that it is easier to solve problems such as poverty, education, infrastructure, etc. when the resources available in the economy increase, as opposition is likely to be bigger when there is a need to reallocate existing resources. To put it simply, sacrificing from something already existing hurts much more that sacrificing part of increasing national income. In this context, it is also from the policy as well as psychological point of view easier to believe that technology will solve existing and appearing problems, as society neither have to change its rules of the game, nor its production and consumption patterns.

Regarding financial systems, this worldview may turn out to be a dangerous one. As mentioned, increased interconnectedness and complexity creates stronger effects when something goes wrong. It creates more opportunities for negative Black Swans to appear, and for the whole system to collapse one day.

4. What type of good is the financial system?

The discussion on the type of goods[3] seems often to focus on private goods to be produced by the markets, and public goods where government intervention is required as the market would lead to under-provision due to the free-rider problem (Begg et al. 1994). A public good is non-excludable, and due to the fact that no direct payment can be obtained for use, so-called free-riders may not be willing to contribute as they cannot be forced to by a private producer. This is a reason for state intervention in the economy.

Crucial elements in the distinction between different types of goods are rivalry and excludability (see Table 1). Rivalry means that the use by one person reduces the possibility of use by others (capacity problem) while depreciation appears, leading to the need for maintenance (e.g. in case of using buildings or physical infrastructure) or the goods are used up (in case of consumption goods, natural resources and capital goods). Also rules of the game (e.g., laws, regulations, rules

[3] The term "good" is used in its broadest sense, not only embracing services and physical commodities, but also different types of rights embedded in legal systems, rules guiding financial markets, positive and negative externalities appearing in financial markets, etc.

guiding financial markets based on Basel type voluntary regulatory frameworks) can depreciate or erode in the face of technological development, and increase number of transactions in the market, etc. (compare Pejovich 1995: 88–90). Excludability concerns the question whether potential users can be denied access at low transaction costs (monitoring, enforcement). In order to determine the type of good, and eventually answer the question who may most effectively and efficiently produce the good, the following questions need to be addressed:

1. *Exclusion.* Is it possible to exclude someone from use or access at low transaction costs?
2. *Rivalry*. Is there a capacity or congestion problem when using the good, can the good be regenerated or is it used up, what is the rate of depreciation, and how much and what type of resources are needed for maintenance.

Table 1. Different types of goods

<table>
<tr><td></td><td colspan="4">Production and use characteristics of goods</td></tr>
<tr><td rowspan="5">Rivalry considers the issue of capacity (rivalry in use at one point in time), depletion and depreciation which in case of lack of maintenance leads to reduced resilience</td><td>Perfect rivalry</td><td>Open access (Tragedy of the Commons)</td><td>Private good featuring high control costs</td><td>Private good</td></tr>
<tr><td>Partial rivalry</td><td>Impure public good with some rivalry, but no exclusion</td><td>Congestion good</td><td>Club good</td></tr>
<tr><td>No rivalry</td><td>Pure public good</td><td>Impure public good with some exclusion</td><td>Excludable public good</td></tr>
<tr><td rowspan="2"></td><td>Non excludability</td><td>Partial excludability</td><td>Excludability</td></tr>
<tr><td colspan="3">Excludability depends on the control costs (monitoring, enforcement) of preventing access</td></tr>
</table>

Source: based on Platje (2012). Adapted from Bieger (2008, 244, based on Oakland 1972) and Cornes and Sandler (1996).

Rivalry and exclusion are no yes/no or 0–1 cases. In economic theory, when discussing the issue of state intervention in the market, the market is assumed to function in case of pure private goods (perfect exclusion and perfect rivalry in use) while the state has a role in producing public goods (non-excludable and non-rival). The main analytical problem is that in reality excludability and rivalry do not possess

such extreme characteristics. They should be assessed on a continuous scale. For simplicity, the category partial rivalry and partial excludability are used. According to the Coase theorem (see Coase 1960), transaction costs are always positive, property rights cannot be perfectly delineated while there is no perfect contractual freedom. There are always different types of limits on use (e.g., using money for sanitary purposes), alienation (burning banknotes), etc. (see Furubotn, Richter 1997). Basically, due to the existence of transaction costs, complete exclusion is not possible, making characteristics of a property right available to others, who opportunistically can improve their wealth by way of redistribution instead of productive activities (Platje 2004). In other words, there is value in the public domain (Barzel 1989). An open access regime is a case where all value is in the public domain.

In order to assess what type of good the financial system is, a broad interpretation of this notion will be used. It is not the aspiration of the authors to provide an exclusive answer, as this is rather impossible due to the mentioned fact that there is strong interconnectivity and complexity in financial systems. The aim is rather to create a framework for further discussion and research, and to draw attention to the fact that in complex systems private goods, important for the creation of a market, have to be considered in a multiple of differing property rights structures necessary for the proper functioning of the system. However, from the mentioned fact of interconnectivity and complexity, it can be inferred that property rights are not completely delineated, while transaction costs (information on products, the situation of players on the financial markets, negotiation about changing the rules for the functioning of the international financial system, monitoring and enforcement costs of complying ongoing rules, etc.) are high. Due to the high value in the public domain, following theories applied to natural resource management, there are strong incentives for overuse and abuse of the system, leading to depreciation of, e.g., the rules governing the system as well as the products offered in the market. This is especially the case when a proper governance structure lacks (an essential point in Hardin's *Tragedy of the Commons* [1968]).

A financial system organizes the transfer of money between savers (and investors) and borrowers (Sullivan, Sheffrin 2003). A financial system can operate on a global, regional or firm specific level. Gurusamy (2008) described it as comprising "a set of

complex and closely interconnected financial institutions, markets, instruments, services, practices, and transactions." According to Franklin Allen and Douglas Gale (2001) "Financial systems are crucial to the allocation of resources in a modern economy. They channel household savings to the corporate sector and allocate investment funds among firms; they allow intertemporal smoothing of consumption by households and expenditures by firms; and they enable households and firms to share risks. These functions are common to the financial systems of most developed economies. Yet the form of these financial systems varies widely."

The financial system consists of three main components: "the financial infrastructure (in particular legal, payment settlement, and accountancy system), financial institutions (in particular banks, securities firms, institutional investors, and specialty financial companies) and financial markets (in particular stock, bond and derivative markets)" (Houben et al. 2004: 6–7). The analysis below will take a slightly different approach, focussing, besides infrastructure, on services provided and traded by financial players in financial markets, the positive and negative impact of activities on the whole economy (functions and effects of the system), as well as dynamic interactions in the system threatening its stability and sustainability. Also, regarding infrastructure a difference is made between physical infrastructure and different types of rules related to the legal infrastructure, as both of them have a different meaning for the functioning of the financial system and markets. While physical infrastructure is important for the number, speed and safety of transactions that can be concluded, the legal framework is important for the management of the system, influencing its stability and sustainability.

The following points will be discussed: a) the products services provided, b) the infrastructure (physical buildings, computer networks, etc.) required for the functioning of the system, c) the rules required for the functioning and sustainability of the whole system, d) the functions and effects of the system and e) positive feedback loops that may lead the system to get out of control.

Financial institutions provide products and services in financial markets. They also have a strong interest in developing physical infrastructure, as this facilitates different types of financial transactions. Public intervention (regulation, the creation of rules / a legal framework (c)) may be required in both cases, when, for example,

financial products and services become very complex, making risks less visible to customers (a market failure). Development of physical infrastructure requires cooperation between financial institutions at the national and international level, which may be facilitated by governments, while the creation of new rules may be necessary. Point c, d and e are strongly related to theories of public goods (or bads) such as stability (Houben et al. 2004), the importance of the financial system for the functioning of non-financial markets and the economy as a whole, etc. As a consequence, there is a role for governments in assuring its stability and sustainability. However, instruments such as bail outs like in the case of the 2007–2008 financial crisis, may put a huge burden on governments and have serious consequences for the whole economy (see Akerlof, Shiller 2009). A deeper analysis of what type of goods the five elements (a–e) present is relevant for the question whether and when public intervention is needed, and what type of policy may be required.

Products and services provided in the financial system (a) are a kind of private good, and there exist strong incentives for private players to provide them. This may be a bank account, a savings account, an investment fund, a loan, etc. The players have incentives to influence the rules governing the financial system. In case of liberalization, incentives are strengthened to create new financial products and constructions. However, as the 2007–2008 financial crisis shows, the products may become very complex, creating high transaction costs (information, control) not only for customers and intermediaries, but also for investment funds and banks regarding products created by other players. The more complex a product is, the higher the transaction costs, e.g., of information on its exact characteristics, quality and risks. The stronger the incentives for opportunistic behaviour, the higher the need for controlling mechanisms (like rating agencies, having features of a public good).

However, through saving, borrowing and lending services, banks, as players in the financial system, can create money. This may support economic growth, and make borrowers and lenders to use their resources now or in the future for consumption or investment purposes. This is a kind of non-exclusive and non-rival effect. In other words, a public good in the form of a positive external effect. From the point of view of an individual bank at one moment in time, a loan is a private good where rivalry exists. However, in case of money creation, when the money returns to

the banking system in different ways after being spent, it may be argued that there is partial rivalry. As in both cases customers can be excluded from obtaining loans, loans are in fact a club good.

The physical banking infrastructure (b) has features of a club or congestion good. An example is a bank office which has a maximum capacity to serve clients, and is thus featured by partial rivalry. In order to increase the capacity to deal with the increasing amount of financial transactions due to the increasing amount of economic transactions, Internet banking seems to be a solution. However, although the capacity is larger than in the case of traditional banking, it is still a club good. Exclusion is possible, while there is a maximum capacity regarding the number of transactions. Even though the capacity may be large, there always remains the issue whether the capacity can increase at least at the same pace as the number of transactions and amount of data transferred. Fees are a mean to exclude users and obtain funds for maintenance and development. When current clients, in case of a flat rate for banking services, would increase the amount of transactions and data used significantly, similar to a physical bank congestion may appear in the form of virtual queues and long waiting times. Thus, capacity management remains crucial (TeamQuest 2015) due to the increased data used by customers. When capacity cannot increase at low cost, exclusion mechanisms need to be introduced, unlikely improving customer satisfaction. The increase in capacity by way of increasing reliance on electronic banking creates a new potential Black Swan – what to do in the unlikely event of a longer dropout of energy when no one would use cash transactions anymore?

Different types of public goods are produced for the members of the "club of bank account holders" (a bank account is a requirement to join). The bank account number, SWIFT, BIC code, etc. provide non-excludable and non-rival information on the account holder facilitating bank transfers on a global scale. The integration of systems has facilitated international banking transfers, and simplified the identification of banks and account holders.

Banks themselves may be able to create efficient *rules of the game* (c), guiding the development of such public goods. They also develop rules determining access and exclusion mechanisms. However, the rules governing the whole banking

system (as well as the financial system) have features of a public good. This brings about the traditional question, who is interested in creating a banking system that is accessible for a wide group of people, while supporting sustainable economic activity as well as the sustainability of banking and the financial system supporting a wide range of positive externalities. Not only the formal rules of the game (formal institutions), but also informal institutions related to culture, trust and the discussed worldviews should be considered. While trust is essential for the functioning of money and banking, another issue is a so-called institutional equilibrium (see Furubotn, Richter 1997: 23) – to what extent do different stakeholders trust accept and support the existing rules of the game as well as the enforcement mechanisms governing the banking system? For example, the opportunistic behaviour leading to the financial crisis of 2007–2008, the bailouts and stories of managers of bailed out banks still receiving large bonuses has done much damage.

The general public may be unable to influence the formal system directly. However, while financial issues are only an element of general elections, it may be a determinant in making the political system unstable, while creating support for populist policies which due to their lack of consideration of functioning of complex systems are likely to have different unintended and/or unexpected side effects. This is unlikely to support sustainable change in the banking system.

The functions and effects of the banking system (d) are public goods (positive externalities) or public bads (negative externalities). The positive externalities are related to the reduction of transaction costs in trade due to the use of money and an efficient banking system, support for saving and investment, risk management of assets, creation of intergenerational equity (e.g., a pension system), etc. However, it should never be forgotten that money is not a physical means of production, like natural resources, physical capital and human capital. Money is a mean of exchange, useful for calculating value (crucial for, e.g., market transparency – information on prices), and a mean of value storage.

In a sense, money is a factor of production as it reduces the transaction costs of market exchange, it facilitates the identification of value and measures of wealth, providing people with information useful for current and future consumption decisions, which is related to the storage function, allowing for saving and investment.

Access to financial resources makes it possible to invest in new production possibilities now, which leads to an increase in output in the future. The point is that money in itself is not a good which can be consumed to produce something directly. What people seem to forget is that even when they have millions of euros on their saving accounts when being pensioned, the money itself cannot clean the house. Somebody else must be paid to get it done. This may strengthen over-optimism (Kahneman 2011).

All the mentioned functions of money are crucial for the functioning of any economic system, including the market discussed here. Without money, there would be barter trade, seriously hampering exchange. While goods possess to a certain extent all the functions of money, albeit accompanied by high transaction costs, they cannot really be considered an efficient form of money as the general acceptance of many goods is limited. Without money, like without transport (see Rydzkowski, Wojewódzka-Król 2000; Smith 1998 [1776]), no trade is possible. As such, it can be argued that money (and in the current processes of globalization the global financial system) is a kind of meta-institution without which the development of any type of exchange, and this the development of markets, would be impossible.

While a stable financial system is essential for the functioning and development of markets, this process may be threatened by positive feedback loops triggered off by different types of *externalities* (e). Negative externalities of a financial crisis may lead to a huge burden on government budgets in case of bail outs, recession, unemployment, loss of pensions, etc. Focus here will be on the potential destabilizing effects of positive externalities.

An assumption essential for understanding why positive externalities exist is the idea that growth is good. When adhering to the techno centric paradigm, where it is assumed that growth and technological development will solve problems (Gladwin et al. 1995), the effects can be considered positive externalities. However, when considering the type of growth, and the problem that the pressure on natural resources can increase while also inequalities may increase, the story is different. At such a moment, these externalities may lead to different negative effects for current and future generations. Thus, depending on the type of growth and the institutional structure determining its effects, a well-functioning financial system can create

positive externalities (a public good) or negative externalities (a public bad) or both at the same time (creating, for example, growth for the poor and excluded, while putting more pressure on the environment, in turn reducing the developmental opportunities for future generations).

From the system point of view, the financial system as well as financial markets may be a kind of public good of the weakest-link type (compare Sandler 2001). This weakest link feature has become more important in the process of integration and globalisation – the issue is, can one large player destroy the system, or at least weaken it so that its resilience disappears? The financial system is featured by goal conflicts. The providers of financial services, for example, may aim at individual profits. It is too well-known that this may trade-off with the collective aim of stability of the system.

The individual aim of profit may lead to an increasing the number and size of transactions, supporting the goal of economic growth. However, following Pejovich (1995), an expanding market and the increasing number of transactions lead to increasing transaction costs. More transactions implies the need for more information, in particular when transactions take place in the context of increasing complexity in international trade and the related development of logistic chains.

The problem extravagates when more transactions take place in the impersonal market between players who do not know each other – the incentives for opportunistic behaviour strengthen. Furthermore, the enforcement mechanisms used in the system may become under pressure, as the enforcement mechanisms that are not self-enforcing (like in the case where a parties in exchange may lose reputation), for example relying on judiciary or special contractual arrangements, have a certain capacity. The moment a court exceeds a certain capacity, the enforcement costs increase. This, in turn, strengthens the incentives for opportunistic behaviour requiring different types of contractual safeguards, adding to the increasing transaction costs.

Finally, when the output increases, also the struggle over the distribution of the benefits may strengthen. It is not in the aim of this article to assess how serious these problems are. The point is that the accumulation of such problems is a continuous process, requiring change in the rules of the game through time in order to keep the

system effective and efficient. The moment the transaction costs are too high due to the increasing complexity of the system, fragilities may increase. The problem with these fragilities is that they often are difficult to detect. As the financial system may rely on its weakest link, this increases the threat of a crisis. When intervening in the system, due to its complexity different types of unintended side effects may appear, unexpectedly weakening the system.

When too much focusing on increasing gains by providing more opportunities for private entities to deliver different financial services, the question is whether these private entities have a strong interest in looking at the long-term stability and sustainability of financial system. The idea of perfect markets has been widely criticized. However, an issue is how many strong stakeholders in the financial system, influencing the rules governing its development, adhere to the paradigm that markets are perfect, and Black Swans do not exist as they have never been observed. Black Swans are small probability, high impact events, that can trigger off a collapse scenario in a complex system with serious fragilities and weakest links. They are, paraphrasing Bertrand Russel, related to what Taleb (2007), following Popper, calls the turkey problem. The idea is that historical data, showing an event has never happened or observed, do not guarantee the event will not happen in the future. Exclusion of such a possibility increases the likeliness stakeholders in the financial system taking riskier positions.

One of the aims of changing the rules of the game in the financial system is economic growth. The relation between the financial system and economic growth may go into both directions. While economic growth requires an efficient and developing financial system in order to deal with the increasing amount of transactions, the financial system requires economic growth as otherwise resources will be drawn away from productive activities. As long as positive interest rates or rate of return on capital is required, a higher amount of money representing a higher purchasing power has to be returned in the future. In order to achieve this, either the value of production needs to increase, or income and savings are redistributed.

While this is a simplification (e.g., the impact of redistribution of income and savings depend on the availability of investment opportunities or the marginal propensity to consume), it draws the attention to an important question: does a large

financial system reflect financial development and resilience or does it also reflect a system risk? When observing the impact of the recent crisis in Europe, it seems that countries with a relatively small financial system (Greece, Portugal, Italy) were hit more severe than several countries with large financial systems (Netherlands, Switzerland). An issue requiring deeper elaboration is whether such large financial systems are more resilient at the expense of smaller systems, due to a kind of beggar-thy-neighbour policies, and different ways of externalizing the costs of a crisis.

More important for the argument here is to what extent the mentioned both-way relation of the financial system and economic growth can trigger off a permanent demand for growth, and even a demand for increased growth, creating positive feedback loops and threats to the financial system. An example is when the demand for growth creates speculation bubbles, or when the financial system becomes too large and interconnected, that a huge global crisis would be the effect of a crisis faced by one country of a player on the financial market.

There are many reasons for the need of economic growth, strengthening the incentives to expand the financial system. This in turn, as mentioned, increased its complexity and interdependencies within the system, creating new fragilities. Without economic growth, the current financial system may stagnate or even collapse, leading to the possibility of unpredictable social, economic and political changes. The following sources of economic growth, among others, need to be considered when rethinking the relation between economic growth and the sustainability of the financial system.

A first source is population growth and an ageing society. In the first case, output needs to increase in order to keep GDP per capita at the same level. In the second case, an increase in productivity is required (growth of output per worker) as the number of workers per retired person declines. The phenomenon of an ageing society requires, for example, immigration (with different political and economic effects for the country of origin and recipient country) and/or innovation. Innovation often replaces labour by capital, creating labour redundancy. Stiglitz (2010) argues that a 2–3% annual growth may be needed in order to create enough jobs in order to keep the unemployment rate stable. However, with the increasing robotization, so much manual labour may become redundant, that too few new jobs are created, leading to

large structural unemployment. According to Bill Gates (2014) this requires a different approach to the distribution of income. Furthermore, with technological development and innovation, e.g., in medicine, also demand for the new products and services is created. When income elasticity is larger than 1, without growth, resources would have to be reallocated from other sectors to the expanding sector.

Another issue is that people may get "addicted" to growth. They get used to a certain level of wealth, and as a consequence the level of autonomous consumption increases. For example, sanitary comfort, medical services, size of living space, etc. seem often to be taken for granted, and what now seems to be a minimum level of existence may have been unimaginable wealth some decades ago. This phenomenon may be strengthened by the following. A hypothesis that needs to be researched more deeply is that a higher income may lead to larger dissatisfaction from a reduction in income (or even a reduction in the expected increase in income). As Kahneman (2011) argues, satisfaction rather depends on the change in than the level of income. A decline of income by, say, 100 euro is supposed to provide 2–2.5 times more dissatisfaction that the satisfaction obtained by an increase in income by 100 euro. For a rich person, a decline in income by 5% caused by an economic crisis may be felt as a deep loss. For people living in deep poverty a crisis may be something like "business as usual."

While these arguments are disputable, they provide a theoretical basis for the hypothesis that high developed countries with a large, well-developed financial system, may be not as resilient as they seem to be. While there are many other determinants, and serious arguments and opportunities for de-growth exist (e.g., Jackson 2009), the point to be emphasized is that the positive externalities caused by banking money, as well the financial system as a whole, in the form of increased wealth, security, etc., may contribute to positive feedback loops threatening to get the system out of control. The pressure on finding new sources of growth, like with new sources of profit, may lead to opportunistic behaviour of players in the financial system. This opportunistic behaviour is stimulated by the high transaction costs and rather opaque property rights structure in the increasingly complex financial system.

5. Concluding remarks

The financial system is a complex system where private goods, important for the creation of a market, have to be considered in a multiple of differing property rights structures necessary for the proper functioning of the system. The public good function is partly created by private entities. However, a well-known problem is that the global financial system is governed in a situation where no real global governance exists. At such a situation, stabilizing the global financial system relies on negotiations between different central banks, governments, financial institutions, etc. In the context of large information asymmetries and goal conflicts, this will be a real challenge, as incentives exist supporting opportunistic behaviour and unsustainable expansion of the system. The development of bitcoins is likely to strengthen these challenges.

The liberalisation policies of the last decades have, for example, widely increased the opportunities for private players. It also has increased the costs of controlling the operations of these entities, snowballing the room for opportunistic behaviour, which in turn may lead to depreciation in the financial system as a whole. Without going into details how this should look like, the discussed issues provide arguments for decoupling in the global financial system, reducing interconnections between different players and increasing financial buffers (e.g., equity, reserve requirement ratio). However, these buffers should be created with care, as a part of the problem, as identified by, e.g., Akerlof and Shiller (2009) and Stiglitz (2010), is that financial players from higher developed countries have experienced a long history of bail outs, reducing the incentives for careful lending policy.

Basel III (Bank for International Settlements 2010) boosted quality and quantity of capital buffers for banks, and requires systemic banks to hold extra buffers. It also aims at reducing adverse incentives and excessive risk taking by way of developing requirements to ensure the investors the costs of a bank failure instead of the government and taxpayers in case of a bailout. Also measures are being developed to reduce adverse incentives created by the bonus system of CEO's and managers.

However, even when these measures would be applied everywhere, if the financial system remains too complex and interconnected, just due this fact decisions taken by private players may make the whole system more vulnerable or fragile. In

order to create a kind of competitive balance, the financial system should be strengthened as much as possible in any part of the world. This would not only support its stability, but also, when accompanied by different institutional reforms (see De Soto 2000), be a stimulant for a fairer development at a global level. However, this may be unattainable, as the developed countries are unlikely to reduce their power in the financial system. The reason is that this may have direct impact on their economic performance, while probably not being interested in empowering weaker stakeholders in the financial system who in that way may become serious competitors.

In fact, the complex financial system should be prevented from getting too many features of an open access regime, and make it a self-strengthening system where failures have learning effects and no real threats of total collapse related to externalization of costs to, for example, the tax payers. An open access regime can theoretically be a self-strengthening system in case of continuous crises where the opportunistic strong (or rather dangerous) stakeholders, the robust players in the financial system, remain solid at the expense of a large amount of players in the system.

In order to dampen positive feedback loops in a dynamic system, besides buffers, limits on the size of financial players as well as their interconnectedness are needed, as any player is basically fragile and collapses from time to time. Thus, a system of rules needs to be created to limit the expansion of global financial markets. The authors do not think this is an easy task. However, seen the current interconnectedness and increasing complexity, as well as the fundamental importance of the financial system for economic performance, the question is similar to the one Taleb (2012) poses. Is it worth to create opportunities for growth by liberalization and expansion, while increasing the risk of a complete system failure?

In the context of globalization of the financial system, as well as markets (see Ahrens et al. 2005), it may be that there is a limit to its optimal size. While expansion may lead at a certain moment to decreasing marginal benefits (e.g., the level of competitiveness does not increase after a certain size), conflict of interests and differing institutional environments may lead to increasing problems with governance aimed at maintaining and developing the public good aspects of the financial system.

Concluding, policy making needs to go beyond the thought that growth and technology can solve all problems. In other words, that win-win solutions can be found while assuring the sustainability of the financial system. Because of increasing complexity of human interactions, when thinking of a win-win situation, it is likely there will be one or another surprise challenging its sustainability. The cost will appear someday, some time, for someone.

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