Preface

Financial Market Infrastructures (FMIs) are the backbone of financial systems in modern societies. They form an essential link between financial intermediaries and they are of critical importance for the efficiency and stability of financial systems. Being the mainstays of financial transactions in the modern world, FMIs reflect the ongoing an unprecedented change in market forces, regulations and technical developments. Regulatory changes are predominantly reactions to the ongoing financial crisis. Market forces are adjusted business strategies by market participants and impacts of further market integration. Finally, technical developments affect the emergence of transactions to be settled (e.g. induced by a rising number of embedded electronic devices), the information processing technology (e.g. see the next generation of internet), and the potential data management and analysis tools (“Big Data”).

These ongoing changes are the background for this book on Analyzing the Economics of Financial Market Infrastructures. The volume provides a comprehensive collection of works, covering the newly established areas of economic research related to FMIs, which includes, but is not limited to payment systems (PSs), central counterparties (CCPs), central securities depositories (CSDs), securities settlement systems (SSSs) and trade repositories (TRs). Given the multifaceted developments in FMIs there is a need to have a compound description of how to deal with these FMIs from the analytical perspective. This book is not intended to describe single FMIs which would be the focus of institutional economics and which would be of limited interests outside the regional reach of the FMI in question. Neither does this book intend to cover the aspects of operations research of FMIs which is a subject of informational economics. However, we aspire to deliver an overview of state-of-the-art analytical tools and applications for the economic analysis of FMIs.

This said we have already outlined the structure of the book. In part I we start from a functional analysis of the role the FMIs play in modern financial systems and economies and the risks they imply. Special regulatory aspects as well as the specific view of participants are also covered in separate chapters. Part II is devoted to the tools and applications for analyzing FMIs. We provide chapters on simulations, network analysis, agent-based modeling, monitoring indicators and transactional analysis. The approach by authors have been different: some deal explicitly with methodological questions about how to apply or improve a tool, whereas others demonstrate a fully developed application of a certain tool on a specific research question. In part III we provide a facts and evidence-based economic analysis of each type of FMI covering PSs, CCPs, CSDs including a special chapter on the newly established European platform for the settlement of securities and trade repositories, TARGET2-Securities. For each type of FMI we highlight the topics of interest for management, risk analysis and functional development.

According to the definition given by the Committee on Payment and Settlement Systems1 (CPSS) of the Bank for International Settlements and the Technical Committee of the International Organization
of Securities Commissions (IOSCO) the main purpose of FMIs is to facilitate the clearing, settlement, and recording of monetary and other financial transactions. The prime elements that nowadays form part of the FMIs are PSs, CSDs often in combination with securities settlement systems (SSSs), and CCPs, as well as TRs. In the aftermath of the financial crisis and not least due to the multifaceted regulatory efforts around the world, financial analysis has gained new prominence and progress. Much attention has been paid to the micro-level – the banks and requirements for their stability – and to the macro-level – the so-called macro-prudential approach. However, the meso-level, meaning the level of FMIs, deserves attention in its own right.

The economics of FMIs differs from both the micro- and the macro-level. FMIs are complex systems and single institutions at the same time. The common theme of FMIs is clearing, settlement and recording of transactions. Their economic rationale deals with institutional efficiency and stability of large-scale processing. Their business models build on (low) transaction fees for a large number of standardized transactions. They do not earn on market developments (e.g. changing asset prices) while at the same time they are being subject to risks stemming from market developments. In comparison to financial institutes which deal predominantly with discretionary risks FMIs mainly deal with rule-based risks. A bank may grant a loan and incur by doing so a principal risk. The settlement of the payment by the FMI, however, is independent of the discretionary risk by the underlying loan. It is like the settlement of all other payments only a rule-based risk (mainly: operational risk) of a highly standardized transaction.

This fact, that the degree of discretionary risks in FMIs is limited and that the main risk in everyday business is of operational nature may have contributed to the perception of limited economic rationale in FMIs. However, as the development of economic analysis of FMIs has shown, the economic considerations for the functional development of FMIs and for stability analysis do by no means lack any intellectual sophistication. The analytical approaches for analyzing FMIs have to cover features of two-sided markets, economies of scale and network externalities. FMIs are themselves complex systems. In order to be properly modelled sophisticated computational techniques have to be applied (e.g. as agent-based models). For solving more detailed questions still simulations are the tool of choice and substitute for modelling for the sake of manageable. In a similar way to the methodological progress in the field of financial stability, there is still no consensus for the economic analysis of FMIs. However, this opens the opportunity to approaches which are not fully recognized as mainstream economics, making the task of analyzing the economics of FMIs a challenging but an innovative one. The majority of FMIs are of systemic importance to the whole financial system and this leads us to the situation in which financial authorities and in particular central banks are incorporating their oversight and research efforts into their financial stability mandates. FMIs serve different financial institutes and in doing so they determine the efficiency, stability and overall reliability of financial systems.

Given the critical role in financial stability, the body of research focused on economics of financial market infrastructure has grown significantly over the last decade displaying various analytical approaches usually highly specialised for the institution in focus. It has grown to the point where an overview of the state-of-the-art analytical tools and applications is warranted providing benchmarks for analysts and guidelines for practitioners. Moreover, it is time to sum up the known stylised facts about FMIs and provide thereby a basis for a more systematic and interchangeable analysis.

Hitherto, there are only limited sources dedicated purely to the study of FMIs from the analytical perspective. In fact, there is only one scientific journal - the Journal of Financial Market Infrastructures (http://www.risk.net/static/about-the-journal-financial-market-infrastructures) that provides a high-quality discussion forum for the field based on quantitative analysis. Further, the proceedings of the Bank
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of Finland Payment System Simulator seminars are another source. They provide a biennial snapshot of current analytical work with a focus on payment systems. In addition, central banks increasingly devoted conferences to the research on FMIs in the recent years and created therefore additional incentives for researchers to enter this field.

The readers of this book will find a mix of institutional and tool-specific chapters. This is intended to enable a broad access for readers with different knowledge background and different interests. It was our aim that every single chapter could be read and understood independently. In compiling different approaches we allow for a multifaceted perspective on FMIs showing that there is not a single possible approach. This is also related to the fact that analyzing FMIs involves a high degree of technical knowledge specific to the type of FMI under scrutiny. This situation promotes multidisciplinary research as well given that in some cases the object of study is a sophisticated and complex machinery resisting to be treated as a typical economic topic.

As already stated Part I of the book comprises four articles all dealing with the role of Financial Market Infrastructures. Chapter 1 “Financial Market Infrastructures – The Backbone of Financial Systems” gives an overall introduction into the functions of FMIs within financial systems. The interplay of basic financial institutions, financial intermediaries, financial markets and Financial Market Infrastructures is depicted, both in a theoretical and historical perspective giving reason for the description of FMIs as backbone of financial systems. Moreover, based on the historical emergence of FMIs the functions of themselves are explained. This forms the ground for a common economic analysis of FMIs which broadly follow similar rationales. The chapter concludes with the preeminent economic questions relating to FMIs and the welfare aspects.

Chapter 2 is organized in two parts: the first part provides an overview of financial market infrastructures (FMIs) in the context of financial stability; the second part gives a general view on the Principles for Financial Market Infrastructures (PFMIs) issued jointly by the Committee on Payment and Settlement Systems (CPSS) and the International Organisation of Securities Commissions (IOSCO). More specifically, in the first part of this chapter the authors provide concrete examples of the interaction between FMIs and financial stability. Among such examples, the authors describe the following ones: i) the case of payment systems in monetary policy implementation and systemic liquidity usage, ii) the importance of securities settlement systems failures, iii) the differences of Over the Counter and centrally-cleared repo transactions, iv) the introduction of Central Counterparties (CCPs) in the derivatives markets, v) the increasing interconnectedness of CCPs, and vi) the role played by Trade Repositories (TRs) in the so called Data Gaps Initiatives of the Financial Stability Board (FSB). Meanwhile, the second part of the paper deals with a condensed description of the PFMIs; in there, the authors provide a non-exhaustive revision of the approaches followed by different jurisdictions and institutions regarding the compliance with such principles. In this part the authors call for international coordination on the implementation of the principles and also to avoid over-reliance on the PFMIs as there are still many aspects which deserve further study under the new international regulatory landscape.

Chapter 3 studies the implications of the arising systemically important FMIs and examines the different regulations, both domestic and international which apply to such entities. The author argues that despite of the progress being made more international coordination is needed in order to guarantee the stability and efficiency of such global entities. In particular, this chapter focusses on the implications of the commitments of the G-20 in promoting the use of TRs and CCPs. The author also argues that the implementation of such reforms faces important challenges given that some FMIs operate on a
cross-border environment. In addition, the author points to the impact of the regulatory structure on the operational efficiency of cross-border FMIs.

Chapter 4 has been written by authors from a market participant. Looking differently at the role of FMIs they explain how FMIs contribute to the changing needs of financial intermediaries both in using FMIs as well as in managing own business. The authors lay out the benefits of FMIs for financial intermediaries and the possible drawbacks as well as means to counter them. In addition, they point to the inherent dynamics of financial markets caused by the changing role of FMIs in combination with new regulatory efforts. The dynamic is most pronounced in liquidity needs (especially intraday liquidity management), collateral management and risk management. The authors outline the implications for the business case in transaction banking as well as possible strategies for financial intermediaries to cope with it.

Part II is going one step further to focus on tools and applications for analyzing FMIs. The chapters 5 through 10 cover simulations, network analysis, agent-based modeling, monitoring indicators and transactional analysis. In chapter 5 the authors ask themselves whether it is possible to implement parallelization during simulations, and if so, to what extent the speed of simulations can be increased. After going into the concepts of parallelization in general, they focus on the ways it can be implemented in the Bank of Finland Payment and Settlement Simulator. Simulation runs require time for a number of tasks and their performance depends highly on the number of transactions and accounts, the scenario to be simulated, the topology of the payment network, the scarcity of liquidity leading to queue management and the complexity of the netting algorithms. The authors conclude form their experiments that parallelization is possible and increases simulation speed; the highest gain in speed is found at full liquidity level and database operations ignored. The experiment is also interesting for a possible future implementation of parallelization over a network of computational environments (distributed computers), as opposed to the current implementation of parallel computers within one multicore PC.

Chapter 6, also focusing on simulations elaborates on the possibility to skip some of the transaction data in simulations for the sake of faster simulation runs. It is called “Using FMI Transaction Data in Simulations - Less is More”. As multi day simulations take more and more time and computer power is limited, researchers often have to limit the time span in simulations. The authors, therefore, test if it is possible to speed up simulations by aggregating the lower value transactions, and still maintaining the same reliable simulation outcome. In order to test this the authors set up a set of benchmark simulations and compared this to simulations in which the lower value transactions between two participants within the day were aggregated. The set of benchmark and aggregation simulations was then repeated for ten different levels of liquidity, as often simulations are focusing on situations in which the liquidity decreases. The outcome was compared at four different statistics; percentage of value settled, lower bound of liquidity, balance drop within the day and the average queue value. The comparison of the benchmark simulations to the outcome leads the authors to the conclusion that aggregation of low value transactions is indeed possible without disturbing the reliability of simulations. The authors have observed features about the duration of simulations: the decrease in the number of transactions leads to a linear decrease in duration; the decrease in liquidity leads to an exponential increase in duration.

In chapter 7 – “A Multi-layer Network of the Colombian Sovereign Securities Market” the Colombian sovereign securities settlement network is analyzed. The transactions in the Central Bank owned system for clearing and settlement of local sovereign securities have been broken down into three trading platform networks; SEN, MEC and MEC-R. Using granular transaction datasets, these three networks have been analyzed individually as well as their aggregated total and compared using modern network
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analysis statistics. Statistics used are density, degree, power-law exponent, mean geodesic distance and clustering coefficient. After this comparison the importance of individual participants across the networks is analyzed using a correlation matrix containing the degree, strength, hub centrality and authority centrality. The authors conclude that the total network is similar to the underlying three monoplex networks, according to both the global statistics as well as the measures at individual participant level. The participants that are too connected to fail appear to have that characteristic in all three underlying networks. Using a multi-layer approach by studying the individual networks as well as their aggregated total can give important added information. Analyzing one monoplex network does not provide a full view of the market, nor does analyzing the aggregated total network as diversions from one layer to the other are not visible.

In chapter 8, an agent-based model is presented that examines how overconfidence impact the usage of credit card. The authors use the concept of overconfidence to explain why people who never intend to borrow on their credit card(s), do so anyway. Agents’ decisions are model based on their propensity to buy. Further, these decisions are effected by two factors - their friends’ consumption behavior and their expectations about future income, which may be distorted due to overconfidence. In addition, credit card issuers can compete for customers by changing the conditions in the market. Under this rich framework the authors have created a model, which contains consumption, two means of payment (credit card and cash), and a distortion to agents’ income expectations via overconfidence. The model allows the analysis of how consumer overconfidence can influence consumer behavior and the dynamics of the credit card market. Despite several strong simplifications by the model, it can be seen as a method to analyze behavior of credit card users with and without overconfidence. The authors found that overconfidence leads to more “accidental” borrowing and higher interest rates.

Chapter 9 provides a detailed conceptual view of how timing indicators in payment systems can be constructed. Being a prima facie simple measure the authors provide empirical and theoretical explanation why the basic construction of an indicator matters for results. The chapter provides empirical examples of the relevant measures based on data from TARGET2. However, the chapter goes well beyond the TARGET2 specific aspects and derives in great detail the implications of specific features of timing indicators. The chapter is written with utmost care for traceability in order to facilitate reproduction of the indicators proposed.

For more than a decade liquidity issues have been one of the strongest lines of research in payment systems. This reveals the significant role of liquidity for the sound functioning not only of the payment system, but for financial market infrastructures overall. Under this line of research follows the aim of chapter 10, which presents a methodology to study the flow of funds in large-value payment systems (LVPSs). With data from the Mexican Real Time Payment System SPEI, the authors study how intraday liquidity is distributed through different FMIs in Mexico. The presented algorithm splits payment transactions into two categories: 1) external funds, which are funds transferred from other financial market infrastructures (FMIs) or are provided by the central bank, and 2) the use of incoming payments to cover payment obligations within the same FMI. The algorithm uses individual transaction data, in order to evaluate to what extent incoming payments are recycled. The method also studies the interdependency among FMIs towards the flow of intraday liquidity. More specifically, this analysis involved another three FMIs, which are – the security settlement system DALÍ, the Continuous Link Settlement (CLS) system and SIAC, the system in charge to provide intraday liquidity provision within Mexican FMIs. The aim is to evaluate the level of efficiency of intraday liquidity distribution, and understand how liquidity is transmitted to participants within FMIs in Mexico.
Finally, the Part III of the book provides chapters which do not focus on a particular tool, but rather on a particular type of FMI. Since many different questions in economic analysis of FMIs are of interest the most important types of FMIs are covered by more than one chapter.

The Part III starts in chapter 11 with a first look at payment systems analysis. Central banks play the most prominent role in the analysis of PS, since they have unique responsibilities, which consequently creates a unique opportunities. Chapter 11 systematizes the different aspects of payment system analysis and presents their importance from a central bank perspective. This is performed by theoretical and practical points of view by giving examples of actual work in the field. The structure of the chapter is determined to three different types of payment system analysis, which the author defined as: analysis of PS in the broad sense of the term; specific PS analysis and finally the use of payment system data. The first definition relates to the entire set of instruments, banking procedures and interbank funds transfer systems employed to facilitate the circulation of money in an economy; in the context of the second type of analysis, interbank funds transfer systems is synonymous to “payment systems” and the research is focused on a more technical aspects. In the third case, payment transactional data is used for purposes beyond the functioning of the PS.

Chapter 12 - Liquidity-saving Mechanisms in Payment Systems and Settlement Liquidity: From the Experience of Japan’s Next-Generation RTGS Project – deals with stability and safety vs efficiency. Not a trivial dilemma, given that from economic perspective both sides contribute to a harmonious and integrated social development. In this regard, chapter 12 makes an important contribution and focuses on the evolutionary process of PS, starting by explaining the DNS scheme and following with the development on RTGS system. Further, much more sophisticated designs of PS have been put in place, which include “Hybrid System,” and “RTGS system with Liquidity Saving Mechanism (LSM).” To finalize, the chapter include a discussion on the experience from the “Next-Generation Real-Time Gross Settlement” (RTGS-XG) project of BOJ-NET. BOJ-NET is the large-value payment system operated by Bank of Japan (BOJ). BOJ-NET added an LSM in 2008. The impact of the LSM’s introduction is analyzed, which includes the liquidity-saving effect, the average waiting time in the queue, the turnover ratio, and the volume of idle liquidity.

Chapter 13 is one of three chapters dealing with CCP. Here CCPs are viewed from the perspective of practical oversight. The paper starts with a short summary of the historical development of CCPs, followed by an outline of the concept and core functions CCPs. Then an illustration of the main risk management safeguards of CCPs is provided. This includes an excursus regarding the hierarchical structure of clearing and regarding procyclical considerations with respect to CCPs. The outline of CCP counterparty risk management is complemented by a brief overview of other risks, including liquidity risk, legal risk, and operational risk. The consideration of the risk profile of CCPs is concluded with some insight into the main factors determining the oversight of CCPs’ governance. The full picture of CCPs from an oversight perspective is given by placing the CCPs in the clearing process and the outlining the resulting challenges for regulatory oversight. The chapter concludes with a description of the manifold layers of today’s oversight of CCPs.

In the context of the financial crisis starting in 2008, studying how effectively CCPs deal with the risks associated with trading in financial markets is the aim of chapter 14. This chapter presents a framework to analyze the role of regulation and the factors influencing the risk controls CCPs have in place. Without a clear assessment method, authorities would face difficulties to figure out the motivation behind the management choices of different CCPs. The framework developed in this chapter illustrates the importance of sound regulation of CCPs and helps to explain why different risk management choices
could make sense. The authors incorporate key factors into their approach, which include ownership, governance and the participants’ profile and preferences. Furthermore, as Principles for Financial Market Infrastructures (PFMIs) incorporate international standards for the design and operation of CCPs, the chapter also considers these standards. Modelling key elements of the standards, the authors demonstrate the importance of a flexible regulatory framework that allows for the mix of risk controls applied by each CCP to vary according to its particular incentives and operating environment and it is able to achieve the desired level of stability. The chapter goes on to discuss the emerging trends towards competition and interoperability between CCPs. The authors argue that, the market structure of clearing and the robustness of CCP risk management will determine the extent to which increased central clearing contributes to greater financial stability.

Chapter 15 discusses an all important issue in the new international financial landscape: the problem of undercollateralization in the global OTC derivatives market as well as in the specific case of Canada. The chapter starts providing estimates of the collateral gap by using data from several sources. The author estimates the collateral gap under two definitions: the first one is the amount of additional assets needed to collateralize current exposures in the OTCD market; the second one is the amount of assets needed to collateralize potential future exposures. The author also highlights that after the 2007-2008 global crisis, the amount of collateral has increased relative to gross credit exposures. However, such an increase is partially due to the reuse of collateral (known as re-hypothecation). After controlling for the double counting due to re-hypothecation the author arrives at the important conclusion that the level of undercollateralization currently stands (in terms of current exposures) at $3.1 trillion globally and $23 billion in Canada, meaning that 80% of global and 30% of Canadian current exposures are undercollateralized. Moreover, the author also estimates that $4 trillion and $104 billion of collateral would be needed to centrally clear the global and Canadian OTCD markets, respectively. Finally, the author arrives at the conclusion that given the recent trends and the current levels of collateralization, Canadian banks would face fewer difficulties in closing the collateral gap than banks elsewhere.

Chapter 16 – The changing Role of CSDs in the Post-Trade Industry in Europe – focusses on the current introduction of TARGET2-Securities. This moment is used by the author to describe past, present and future of the European post-trade market in which the position of CSDs and cross-border securities settlement is changing. Cross border securities settlement in the EU is still complex and complicated. In the past years, more efficiency was achieved by market participants, resulting in lower costs and prices of domestic and cross-border transactions. CSD-R and T2S will however enforce the speedup of efficiency, safety, transparency and market integration. T2S, which has gone live in June 2015, will deliver securities settlements for the entire euro area, to the 24 committed CSDs which will outsource their securities settlement business. This way settlement volumes will be consolidated on one single platform, bringing efficiency and economies of scale, with the aim to lower the settlement fees in Europe, to economize on liquidity and collateral. The concentration of activities does however also introduce a concentration of risk in the financial system.

Chapter 17 describes from an historic perspective well into modern times the evolution of securities settlement systems and central securities depositories (CSDs) in various jurisdictions. The author also examines liquidity and clearing and settlement risks in the context of CSDs. The author starts by describing how the important concept of ownership has evolved from paper based systems and how nowadays ownership is recorded and transferred in modern global financial markets by means of securities accounts; then he explains the main risks and costs involved in securities clearing and settlement: i) principal risk, ii) replacement and operational risk, iii) the provision of liquidity for securities market transactions, and
iv) settlement failures. An important element of the paper is that disentangles some of the concepts in the FMIs parlance like multi-tiered ownership, fungibility, custodian bank, etc. This chapter includes a section in which the interesting topic of failed trades is examined, including opposite views on the systemic implications of these failures. Then, the author discusses systemic implications for securities settlement systems and CSDs; in his discussion the authors points to the increasing complexity faced by securities settlement systems in a cross border context and he also shares his concerns about how contagion like cascade effects after a trade fails which may be exacerbated by the widespread use of re-hypothecation.

Finally, in chapter 18 – Undressing the Global Derivatives Market: Trade Repositories: Past, Present and Future – the author first gives a description of the history of trade repositories. Starting 2009, due to the initiative of the G20 meeting in Pittsburg all standardized OTC derivatives were required to be cleared through Central Counterparties and reported to Trade Repositories, in order to enhance market transparency. TRs in Europe are overseen by the European Securities and Market Authority (ESMA) under the European Market Infrastructure Regulation (EMIR), starting with DTCC (UK), KDPW (Poland), Regis-TR (Luxembourg) and Una-Vista (UK) in November 2013 and soon followed by ICE Trade Vault (UK) and CME Trade Repository (UK). Nowadays the interoperability and proper data reporting of the individual TRs remains a big challenge. In the United States the reporting mandate is single sided, meaning that only one side of the transaction is obliged to report, leading to higher data integrity. The landscape in Asia Pacific differs hugely from the others, caused by the high number of different jurisdictions. Looking ahead, regulators should be able to supervise at macro and micro level.

The editors are grateful having edited this book. We would like to acknowledge all authors who contributed and incorporated their respective contributions to the overall structure of the book. All of them experts in the field share with generosity their insights, accumulated over a good deal of years. We thank all reviewers, and the members of the editorial advisory board. In addition we are grateful to our central banks granting us some freedom to work on this project. Freedom was also granted by our spouses and families who equally deserve a warm thank you. The book is jointly edited by four researchers from three central banks. We are proud having brought together some outstanding experts and researchers from around the world to write or review high quality chapters in our book. All chapters have undergone a double-blind review process by two anonymous reviewers and have been substantially revised afterwards. The overwhelming majority of reviews has been very considerate and well worked-out, some of them even being worth to be published independently, because of the expertise of their authors and the profundness of their considerations. Finally, we thank IGI Global for publishing our book and for supporting us over the last year and beyond.

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