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**Implications of Germany's Draft Electronic Securities  
Regulation for RegTech and SupTech**

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# Implications of Germany's Draft Electronic Securities Regulation for RegTech and SupTech

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## Abstract

This paper documents implications of Germany's draft regulation on electronic securities for RegTech and SupTech. Regulation of electronic securities or a dematerialized system should not only serve the development of the private sector, FinTech and RegTech for regulatory compliance but also serve the public sector, namely support RegTech for regulators and SupTech for financial supervisors. Electronic securities have the potential to increase operational efficiency and accuracy both in compliance and supervision, namely, corporate governance, audit, and surveillance by deploying RegTech and SupTech systems. Digital transformation in the financial sector should include considerations in line with the digital finance requirements, such as closing the technology gap between the private and public sectors and managing asymmetric technology risks. Germany's draft regulation is a strong signal for digital transformation in Germany; however, it does not foresee a fully dematerialized system, a prerequisite for well-designed RegTech and SupTech systems.

**JEL Classification:** G23, G28, G30, G38, K22, O31, O32, O38

**Keywords:** Asymmetric Technology, BaFin, Blockchain, Crypto Securities, Cyber Risk, Dematerialization, Digitalization, Digital Transformation, DLT, Electronic Markets, Electronic Securities, FinTech, Germany, Green Blockchain, RegTech, Regulatory Risk, SupTech, Sustainable Finance.

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## **Acronyms and Abbreviations**

BaFin: German Federal Financial Supervisory Authority

BIS: Bank for International Settlements

BMF: German Federal Ministry of Finance, in German “Bundesministerium der Finanzen”

BMJV: German Federal Ministry of Justice and Consumer Protection, in German; “Bundesministeriums der Justiz und für Verbraucherschutz”

BMWi: German Federal Ministry of Economic Affairs and Energy, in German; “Bundesministerium für Wirtschaft und Energie”

CAT: Consolidated Audit Trail

CDS: Credit-default Swap

CMB: Capital Markets Board of Turkey

CSD: Central Securities Depository

DLT: Distributed Ledger Technology

DRS: Direct Registration System

DTC: Depository Trust Company

DTCC: Depository Trust & Clearing Corporation

DTS: Digital Transformation Strategy

EC: European Commission

EIB: European Investment Bank

ESG: Environmental, Social, Governance

EU: European Union

eWpG: Electronic Securities Law (Draft); in German “Gesetz über elektronische Wertpapiere”

FinTech: Financial Technology

FMI: Financial Markets Infrastructure

FREP: Financial Reporting Enforcement Panel, in German; “Deutsche Prüfstelle für Rechnungslegung”, or “DPR”

GHG: Greenhouse Gas

IOSCO: International Organization of Securities Commissions

IT: Information Technology

KWG: German Banking Act, in German; “Kreditwesengesetz”

RegTech: Regulatory Technology

SDGs: Sustainable Development Goals

SEC: U.S. Securities and Exchange Commission

SupTech: Supervisory Technology

U.S.: United States of America

## Highlights

- The draft initially opens doors for electronic bearer bonds.
- It is an implementation of the German government's digital transformation plan set out in 2018.
- As a rule, the conversion from paper certificates to electronic securities is not obligatory.
- In a special case, issuers can start conversion without the consent of bond investors.
- The draft does not foresee a full dematerialization per asset class.
- It introduces blockchain bearer bonds, which is (1) a strong signal for digital transformation in Germany, (2) a revolutionary step considering the German laws systematic.
- The draft addresses a step-by-step digital transformation, starting with only one securities class, which signals a rational perspective in managing transformation risks.
- The regulation intends to be technology-neutral, which means electronic bonds or blockchain-based bonds are not intentionally privileged to one another.
- Electronic bonds are defined as property ("Sache" in German) to entitle them directly property rights and provide a level playing field in terms of legal status.
- Digital finance reforms should consider all stages and segments of a financial system, including the regulatory and supervisory landscape (RegTech and SupTech).
- Voluntary-based or partly dematerialization neither meets the digital reform requirements nor provides a sound base for RegTech and SupTech.
- A fully dematerialized securities system is a prerequisite and one of the main pillars of SupTech systems.
- With more than 20 years of electronic security experience, the U.S. securities industry participants demand a full dematerialization system and define the current system as ineffective.
- Turkey has a fully dematerialized system, which provides a robust infrastructure for RegTech and SupTech.
- If the draft passes as it is, two critical aspects might hurt the overall German financial system: 1) The draft is not conducive to RegTech and SupTech. 2) It does not foresee a parallel development for the SupTech projects of financial supervisors; instead, it overloads the supervisory system; hence, it increases asymmetric technology risks.
- Even though it is a convention, the draft does not include an impact analysis, which raises questions about probable effects.
- In light of the EU Green Deal, it is indispensable to ensure that the new approach is green-blockchain compliant with the Paris climate targets.

## **Introduction**

Digitalization of securities, converting physical securities to electronic form, touches on many aspects of a financial system. In addition to the well-known benefits, electronic securities have the potential to increase the efficiency and accuracy in auditing, compliance, and supervision by deploying RegTech and SupTech systems.

In many countries, paper-based securities are not actively in play anymore. However, electronic securities are also not the main form. Instead, immobilization is a common industry practice. Immobilized securities are physical but treated as if they were electronic securities. Transaction and custody rules of immobilized securities are mainly tied to physical security practices. Some countries, such as India, Turkey, and the U.S., have been dematerialized securities, which means the countries converted securities to electronic form. However, dematerialization practices are not the same. A fully dematerialized system lets the audit firms, compliance structures, and financial supervisors carry out their functions and responsibilities timely and properly.

As data is considered the new oil, digital transformation policies should always include data aspects of digital transformation reforms. For example, how will the draft affect the data infrastructure of the German financial system? Going one step further, how will supervisors be positioned in terms of data arising from the new regulation, specifically blockchain-based bonds? Will the reform increase market integrity and investor protection? In this regard, Germany's draft raises more questions in the digital world. We will underscore some questions around RegTech and SupTech and try to answer them utilizing evidence from the U.S. and Turkey experiences.

This paper does not approach the draft from legal quality or legal aspects; instead, it considers the probable effects of the draft on the digital financial world, focusing on RegTech and SupTech dimensions. Since Germany's radical movement might have a ripple effect in other countries, this paper might also shed light on other countries' electronic securities reforms.

This paper has three sections. In the first section, we introduce three key concepts: Electronic securities, immobilization, and dematerialization. The first section also touches on the paperwork crisis. Section two discusses the characteristics of digital transformation. The third section compares three countries; Germany, the U.S., and Turkey, in terms of the digitalization of securities or dematerialization.

## I. From the Paperwork Crisis to Electronic Securities

In the securities industry, securities can be either in physical or electronic form. Since securities transactions occur in a high-speed world, in some markets in microseconds<sup>1</sup>, it is impossible to deliver and take securities physically in return for every transaction.

The push to eliminate physical securities originated in the “paperwork crisis” of the late 1960s when trading volumes surged, and the back offices of banks and brokerages were inundated with stock certificates and the associated paperwork in the U.S. (DTCC, 2012). In the late 1960s and early 1970s, the U.S. securities markets experienced a back-office crisis caused by increasing volumes and back-office inefficiencies in processing securities transactions (Bergmann, 2004). During the paperwork crisis, a brokerage firm used approximately 33 different documents to execute and record a single securities transaction (Bergmann, 2004). Since operational deficiencies caused fail rates and customer complaints to soar, losses in 1967-1968 caused an unprecedented number of broker-dealer firm failures; for example, roughly 160 New York Stock Exchange member firms went out of business while others either merged or liquidated (Bergmann, 2004).

In response to the paperwork crisis, the industry’s initial solution was to “immobilize” stock certificates in a central location, recording ownership changes with bookkeeping entries (DTCC, 2012). The second solution was the concept of substituting paper certificates with book-entry securities, a process called “dematerialization” (DTCC, 2012). Today, immobilization and dematerialization are two solutions in response to the paperwork crisis as well as other developments in the securities industry worldwide. The following figure shows three main forms of securities.

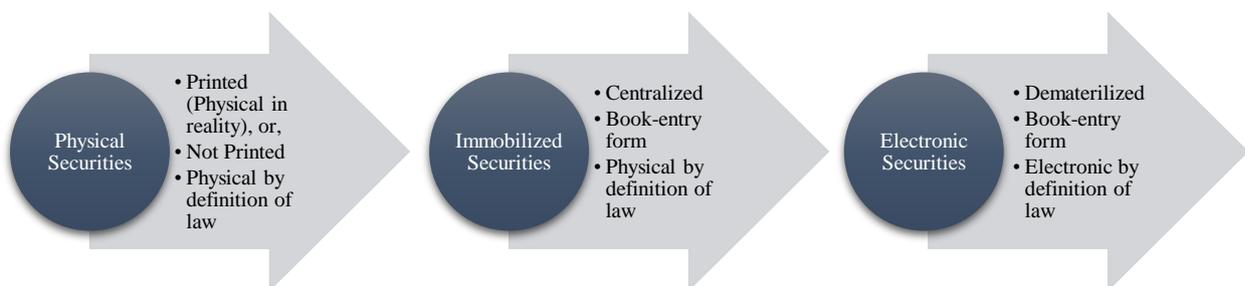


Figure 1: Three Forms of Securities.

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<sup>1</sup> One million microseconds are equal to one second ( $1 \mu\text{s} = 10^{-6} \text{s}$ ).

Electronic securities, or digital securities, are the financial instruments that exist only in electronic form and kept via a book-entry system. A central securities depository (CSD) keeps records of electronic securities and, where necessary, carries out related services. Investors do not have physical securities in this case; instead, they might have ownership statements issued by a CSD.

If securities are in electronic form or dematerialized, they do not exist in physical form. However, they have the same properties as the physical ones. In other words, in principle, the digitalization of physical securities does not change the functions of securities. As a rule, immobilization and dematerialization should not imply any loss of rights for securities holders (European Parliament, 2014). The shareholders have the same rights without regard to electronic or physical ones. However, electronic securities enable market participants practical solutions, like faster transfer, clearing and settlement, easy and continuous access to the holdings, hassle-free issuer-investor relations, practical corporate action solutions, and so forth.

Even though securities can be physical either printed or not printed, they are not subject to physical delivery rules. Industry practices force the securities industry to follow a market practice known as immobilization. Immobilization enables securities to be transferred, bought, and sold without moving physically by a book-entry system. In practice, immobilization is in between the physical securities system and the electronic securities system. A further step away from physical securities is the full dematerialization of a securities issue (BIS & IOSCO, 2012).

Immobilization means the act of concentrating the location of physical securities in a CSD in a way that enables subsequent transfers to be made by book-entry (European Parliament, 2014). The first immobilization of securities was carried out at the end of the 19th century in Germany; the institutions were called “Kassenvereine” (Chan, Fontan, Rosati, & Russo, 2007).

Treating immobilized physical securities like electronic securities but keeping them strictly subject to the physical securities regime by law is neither compatible with market integrity and consumer protection nor with the digital world requirements. Therefore, securities should be dematerialized and completely converted to electronic form.

Dematerialization, or “demat” as an industry term, is converting physical securities, and physical securities by law (not certificated yet), into electronic form. Dematerialization is the elimination of physical certificates or documents of title that represent ownership of securities so that securities exist only as accounting records (BIS & IOSCO, 2012). After

dematerialization, securities are represented only at accounts on behalf of owners at a CSD. The account used for holding dematerialized securities is named as “demat account”. In Europe, Denmark was the first to dematerialize securities in 1981 (Chan, Fontan, Rosati, & Russo, 2007).

Dematerialization eliminates risks associated with immobilization. Dematerialization might be mandatory or voluntary based. In the mandatory version, all securities are forced to be transformed into electronic form, and physical securities become obsolete, as is the case in the Turkish securities market. In some markets, investors have the option to hold physical certificates (Chan, Fontan, Rosati, & Russo, 2007). In other markets, dematerialization is mandatory, so that a CSD held the entire issue in electronic form only (Chan, Fontan, Rosati, & Russo, 2007).

Dematerialization has been mainly considered a reform only for investors, issuers, and securities depositories. However, it has more implications considering RegTech and SupTech requirements. Moreover, it has implications for economic development. The immobilization or dematerialization of securities and their transfer by book-entry within a CSD significantly reduces the total costs associated with securities settlements and custody (BIS & IOSCO, 2012). The immobilization or dematerialization of securities also reduces or eliminates certain risks, such as destruction or theft of certificates (BIS & IOSCO, 2012). The transfer of securities by book-entry is a precondition for shortening the settlement cycle for securities trades (BIS & IOSCO, 2012). The book-entry transfer also facilitates delivery versus payment, thereby eliminating principal risks (BIS & IOSCO, 2012).

The immobilization converts physical securities to paperless securities, but the securities are still legally considered physical. On the other hand, dematerialization converts physical securities to paperless securities, both practically and legally.

Under the industry developments and market drivers, immobilized securities have been treated like electronic securities for several decades. Treating immobilized physical securities like electronic securities but keeping them strictly subject to physical securities regimes by law is neither compatible with market integrity and consumer protection nor with the digital world requirements. Even though immobilized securities enable market participants to utilize practical solutions, securities in this form are still tied to physical securities risks. Thus, dematerialization is an expected reform from market integrity, consumer protection, and digital finance perspectives.

The digitalization of securities is also a key reform area for RegTech and SupTech. Paper certificates are not centralized; they can be stored anywhere by owners or intermediaries. More importantly, paper certificates are not easily trackable by issuers, auditors, and supervisors. Therefore, it is not conducive to the efficient protection of financial consumers, auditing, and financial supervision. Digitalized and centralized securities have strong implications for audit firms and supervisory authorities, which means a stronger infrastructure for RegTech and SupTech. Moreover, the dematerialization of securities is a dimension of sustainable finance in the financial sector.

The Principles for Financial Market Infrastructures suggest that securities should be immobilized or dematerialized and transferred by book entry in CSDs to the greatest extent possible (BIS & IOSCO, 2012). Where appropriate, a CSD should provide incentives to immobilize or dematerialize securities (BIS & IOSCO, 2012).

The regulation (EU) No 909/2014 on improving securities settlement in the European Union and on central securities depositories and amending Directives 98/26/EC and 2014/65/EU and Regulation (EU) No 236/2012 introduce an obligation to record in book-entry form all transferable securities admitted to trading or traded on the trading venues (European Parliament, 2014). However, this regulation does not impose one particular method for the initial book-entry recording, which can take the form of immobilization or immediate dematerialization (European Parliament, 2014).

Physical securities have many risks, such as transfer risk, counterfeit security risk, and safekeeping risk. Physical securities also have exposure to environmental risks. For example, Hurricane Sandy, which struck in the U.S. in 2012, further evidenced the benefits of moving to full dematerialization to safeguard the certificates from potential physical damage by converting them to electronic holdings (Clearstream, 2013). Moreover, Covid-19 reiterates the importance of electronic securities.

We list the advantages of dematerialization and address the risks of physical securities based on investors, issuers, financial supervisors, and the overall economy.

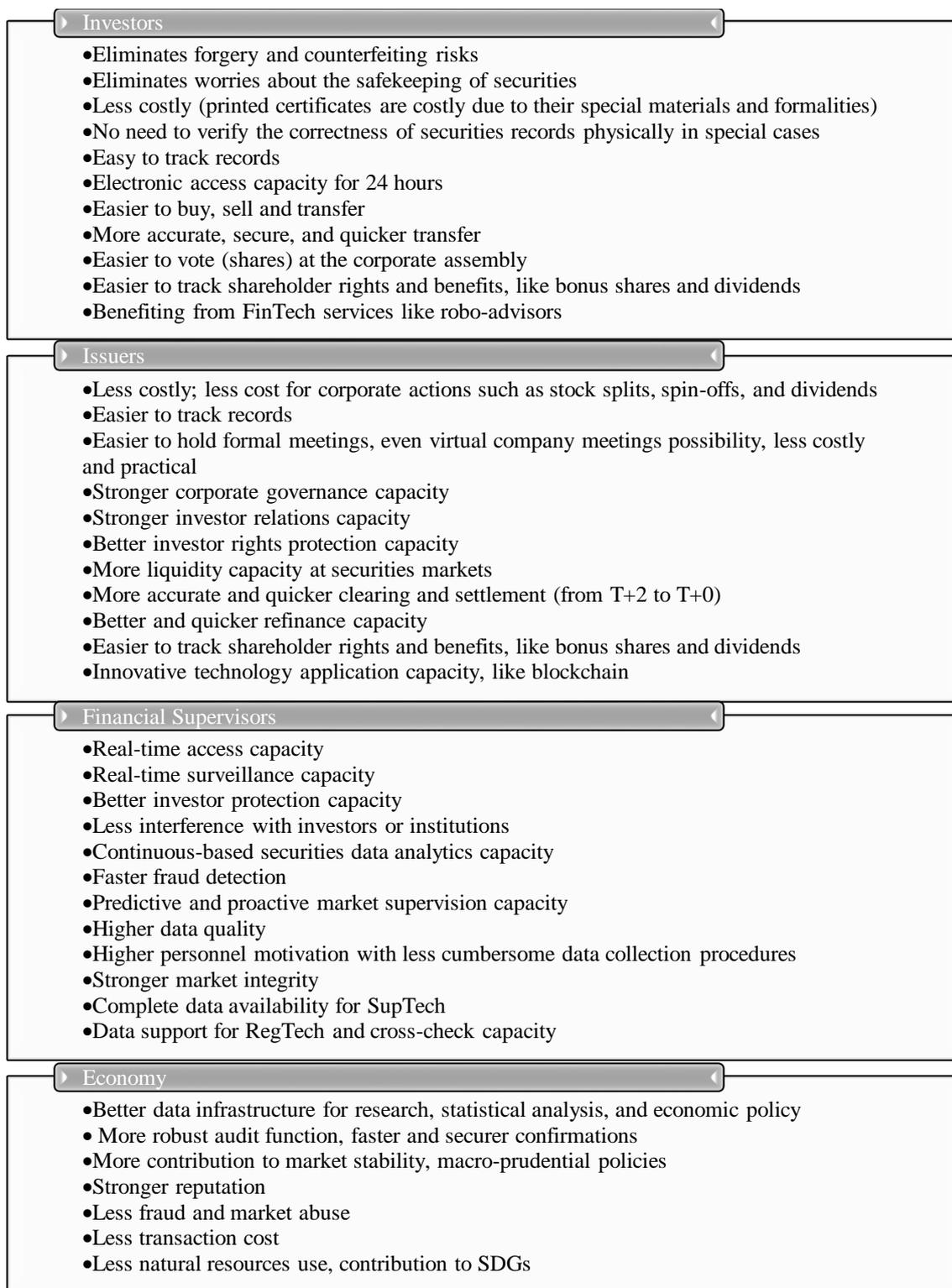


Figure 2: Potential Benefits of Securities Dematerialization

Fully achieving the elimination of paper from clearing and settlement requires changes in business processes, law, and culture (Group of Thirty, 2006). Even though most of the benefits

can be achieved through immobilization, full dematerialization of certificates remains the ultimate goal (Group of Thirty, 2006).

The physical securities realm is a barrier in the way of market developments in the digital world. Notably, in the international markets, circulation and custody of physical securities are not compatible with market developments.

On the other hand, dematerialization paves the way for a more functional financial sector. As an example, the European Investment Bank’s bond issuance in dematerialized form has the following features: In July 2013, the European Investment Bank (EIB) launched the largest EUR Climate Awareness Bond (CAB), which was the first dematerialized issue under the adopted Luxembourg law on dematerialized securities (European Investment Bank, 2013). Its investor allocation was as follows:

<b>Geographical Region</b>	<b>Investor Type</b>
Benelux: 32%	Asset Managers: 38%
Germany 30%	Banks: 35%
France 22%	Insurance & Pension funds: 14%
Other Europe 8%	Central Banks/Off Inst's: 13%
Asia 8%	NA

Table 1: Investor Allocation of the European Investment Bank’s Climate Awareness Bond

Source: European Investment Bank (2013)

As stated within the same issuance announcement, the dematerialization has the following benefits for the issuer and investors:

- increasing operational efficiency,
- shorter settlement cycle,
- reduced risk,
- lower transaction costs on cross-border trades.

The case addresses that the lack of a dematerialized system is doomed to less operational efficiency, longer settlement cycle, higher risk, higher transaction costs on cross-border transactions. Moreover, the lack of a dematerialized system means a partly disconnection from the modernized financial world.

## **II. Characteristics of Digital Transformation**

### **2.1. Content of Digital Transformation**

Digitalization is the design and application of IT-based solutions by individuals, organizations and society to increase user experience, efficiency and effectiveness (Alt, 2018). The strength of digitalization lies in the possibility of supporting both efficiency and effectiveness and combining them with higher user experience (Alt, 2018). For the financial sector, users are financial consumers, issuers such as publicly held companies and bond issuers, intermediary institutions, clearing and settlement companies, audit firms, rating agencies, financial supervisors, and national and multinational financial organizations.

Data in this context is both a product and raw material of digital transformation. For example, converting physical securities to electronic form is the digitalization of securities and digital transformation of the securities market. Data related to electronic securities is, in this case, the new product of digital transformation. More specifically, electronic securities enable related parties to reach new and more comprehensive data.

On the other hand, this product is the raw material of RegTech and SupTech, or data analytics tools. Therefore, the question about the quality of the product and raw material is relevant in terms of digital transformation success.

Digital transformation goes beyond digitization and digitalization by including the whole organization (Mergel, Edelman, & Haug, 2019). In this respect, the draft has an approach to digitalize securities; however, it does not include the RegTech and SupTech dimensions.

The empirically grounded definition of digital transformation focuses on a holistic process to change products and culture (Mergel, Edelman, & Haug, 2019). The draft aims at changing the technological infrastructure of financial products. However, it does not foresee parallel changes considering the digital finance ecosystem, particularly RegTech and SupTech.

Digital transformation is a continuous process that needs frequent adjustments of its processes, services, and products to external needs (Mergel, Edelman, & Haug, 2019). Crafting a digital transformation strategy is a highly dynamic process (Chanias, Myers, & Hess, 2018).

The digitalization of financing underpins a broader reconfiguration of economies (Zadek & Bruett, 2019). Economic sectors are being disaggregated and recombined in new forms as technology firms, particularly e-commerce and social platforms with massive amounts of data, compete with financial service firms by offering payment, credit, savings, and even wealth

advisory products and services directly on their platforms (Zadek & Bruett, 2019). The dynamic nature of digital transformation and reconfiguration requirements address reorganization reforms in the financial sector. Thus, digitalization reforms should be introduced with a holistic approach and include ESG factors; for example, the GHG impact of establishing and maintaining a new system.

The formulation and implementation of a digital transformation strategy (DTS) have become key concerns for many pre-digital organizations across traditional industries, but how such strategies can be developed remains an open question (Chanias, Myers, & Hess, 2018). Studying how a European financial services provider has formulated and implemented a digital transformation strategy, Chanias, Myers, & Hess (2018) show that the crafting of a DTS is a highly dynamic process involving iterating between learning and doing. Hence, financial industry experience plays a vital role when dealing with digital transformation in the financial sector. Therefore, countries with long and diverse electronic securities experience, such as the U.S. and Turkey, should be analyzed and considered to minimize transformation and transition risks.

## **2.2. Risk Implications of Digital Transformation**

Digital transformation risks are tied to the type of technology, such as cloud computing and blockchain, including the typical risk sources associated with the organization and business activities. Multiple organizations use the same service providers, which are limited in the sector. A technological collapse at a service provider might cause cascading service interruption in the financial sector.

Each digital transformation has its unique risks. Digital transformation might also trigger unique risks with this regard. For example, changing securities markets from analog to digital has unique risks that we might not experience at another segment of the financial sector. As another example, transforming a supervisory structure has unique risks to the supervisory landscape that we cannot see anywhere else.

On the other hand, digitalization can enable fraud by those that use the anonymity of digital technologies to mislead investors (Zadek & Bruett, 2019). Cyber-risks are the main risk types associated with all digital environments. As it is expected, digital securities markets and institutions, particularly CSDs, are under continuous Cyber-risks.

Moreover, technological imbalance or asymmetric technology between financial markets or institutions and their supervisors is more dangerous than cyberattack risks since cyberattacks are well-known risk types; hence there is considerable vigilance to develop shields against them (Zeranski & Sancak, July 2020). However, the lack of a well-functioning SupTech leaves many doors wide-open for detrimental technological transactions and their ensuing effects on an economy's financial stability. In other words, asymmetric technology between financial markets and the relevant supervisors is one of the most significant risks today. Therefore, having a digital financial supervisory system with a well-functioning SupTech is one of the best risk management strategies (Zeranski & Sancak, July 2020).

The world recently experienced the Wirecard case with a story of FinTech, which was used to cover a longstanding financial fraud. After the Wirecard scandal, the market perception about supervisory authorities assumingly weakened. With the draft regulation on electronic securities, a highly challenging role has been given to German financial authorities in a negative sentiment environment. Thus, the perception of asymmetric technology might be worse off.

The draft is in the area of financial regulation and a candidate to change the German financial sector's infrastructure. The financial regulation drafts are expected to have an impact analysis on the financial sector. For example, as the responsible financial authority, does the BaFin have blockchain experts to supervise transactions in the blockchain-based bond market? If not, the regulation, on the one hand, opens doors for innovation in the financial sector; on the other hand, it increases asymmetric technology risks, which is a worse off situation. White-collar fraudsters always expect perfect timing and atmosphere to strike, particularly in such a foggy environment. It is historically known that fraudsters abuse innovations. It is uncertain how financial consumers will be protected if potential fraudsters abuse blockchain-based securities. Blockchain-based securities might be introduced as new miracle instruments, which might fuel the irrational exuberance of financially illiterate financial consumers. On top of that, white-collar fraudsters are always ready for such technological transition periods with attractive stories to strike. The world experienced similar cases with credit-default swaps (CDS), a type of financial derivatives, as a financial engineering miracle before the Global Financial Crisis of 2007-2008.

The draft touches on a cross-sectional landscape, both economywide and organization-based areas. For example, bonds might be issued nationwide, even multinational, and might impact

the economy. Issuers, depositories, intermediaries, rating agencies, audit firms, and financial supervisory agencies are all in the domain of digital securities. Therefore, any regulation related to electronic securities should have parallel considerations in the areas above. More specifically, the draft should also consider and support well-functioning RegTech and SupTech systems.

Under the free market rules, countries cannot change their financial structure from one to another. For example, Germany cannot change the financial structure to market-based, which means capital market-oriented, in the short term. However, Germany can transform its financial system digitally. We argue that a SupTech dominated financial system shapes the FinTech sector, positively affects digital transformation and manages the risks arising from FinTech. Therefore, early actions on SupTech has a “timing” effect on FinTech risk management policies.

### **2.3.Digital Transformation on the Governmental Side**

To operate technological tools effectively and appropriately, the quality and efficiency of financial regulators or supervisors matter depend on many aspects, including the organizational design, regulatory model, and institutional culture (Yang & Tsang, 2018). Therefore, financial authorities may need to adjust their supervisory architecture and practices to FinTech activities (Ehrentraud, Ocampo, Garzoni, & Piccolo, 2020).

A survey of 60 financial authorities worldwide about new industry trends and their likely impact on regulatory and supervisory processes indicates that financial supervisors oversee a rapidly transforming industry, and they expect a profound effect on the way they operate (Frisell et al., 2018).

Another survey out of 31 jurisdictions on financial authorities’ policy responses to FinTech developments indicates that while most authorities supervise FinTech activities as part of the ongoing supervisory processes within their existing organizational structure, a few introduced visible changes to their organigram (Ehrentraud, Ocampo, Garzoni, & Piccolo, 2020).

As financial markets and institutions evolve, so too must the regulatory systems supervise them (Group of Thirty, 2008). Strong leadership and qualified administrators can offset to some degree the impediments and deficiencies that may stem from suboptimal regulatory structures, but at some point, regulatory regimes need to be updated and modernized to accommodate financial evolution, market realities, and global integration (Group of Thirty, 2008).

Evidence shows that technology is developing faster than other dimensions of the investment environment. For example, a work based on an *infoDev* model<sup>2</sup> about the applicability and readiness of crowdfunding in Turkey indicates that the technology dimension is more developed than the other three dimensions; regulations, investment culture, and capital (Sancak, 2016). Therefore, digital transformation has a priority and need a faster reform reaction.

The free market economy lets the market participants follow a direction based on business aims in the digital world. The current trend moves towards a decentralized and disaggregated ecosystem. This will address challenging approaches and organizational transformation for financial supervisors. The question about which model best works with SupTech might be a research area, but there are some signals for the FinTech-oriented organizational models. He et al. (2017) argue that regulators or supervisors may need to complement their focus on entities with increasing attention to activities, as financial services are increasingly provided by a diverse group of firms and market platforms. Frisell et al. (2018) also point out the same view by stating that since the financial industry is modularizing, and its boundaries are becoming blurred, as non-bank firms enter the market, competing at selected points along the value chain, supervisors will need to respond by shifting their focus from entities towards activities – for example, supervising payments rather than payment institutions.

The current studies on financial regulators mainly focus on the cost and benefit of a fragmented regulatory system, the relative relationship between the central bank and other financial regulatory bodies, the independence of financial regulators, but relatively few studies discuss the organizational models of financial regulators from a public-private perspective (Yang & Tsang, 2018). Yang and Tsang (2018) argue that a regulator or supervisor requires the character of a public-private partnership, which should contain some public elements to ensure the unbiasedness of financial supervision and some private elements to adapt to rapid technological changes. However, the recent Wirecard scandal raised questions about public-private partnerships regarding the woefully inadequate performance of the FREP. Therefore, a better model might be a public-university partnership, particularly for managing digital transformation. The Wirecard case might be a catalyst for the country and a strong motivation

<sup>2</sup> “infoDev” is a global partnership program within the World Bank Group and has developed a model for testing a country’s crowdfunding readiness.

for German politicians to overhaul the financial supervisory system regarding digital finance requirements.

With a broad perspective, on the governmental side, a full-fledged supervisory system should have, at least, the following pillars (Zeranski & Sancak, 2020).



Figure 3: Digital Pillars of Financial Supervisory Systems

An important drawback of digital transformation is finding actors who can comfortably assume leadership roles to coordinate transformation and manage transition risks, particularly in the governmental landscape. At governmental agencies, the personnel mobility has limited policy-making capacity in the short term, especially in critical times (Zeranski & Sancak, August 2020). In some countries, hiring personnel directly from the private sector is almost impossible. Moreover, in some countries, financial data can be seen as a national security matter. Thus, hiring new IT personnel requires lengthy and complicated procedures. Some government organizations hire IT-staff only from other governmental organizations in their country. To put it shortly, the unique nature of in-house organizational parameters increases the gap between two parties, financial supervisors, and their sectors.

Budget constraints and budget procedures are also another risk source of supervisory agencies. Even though financial supervisors are independent in their responsible areas, their budgets are tied to political decisions (Zeranski & Sancak, July 2020). We observe that the significant financial reforms have been initiated and shaped mostly by crises or scandals. Unless politicians do not get pressure from lobbying channels, they are less inclined to increase financial supervisors' budget.

Moreover, evidence suggests that public sector innovation today mostly happens through uncoordinated initiatives rather than as a result of deliberate, strategic efforts (European Commission, 2013). However, the development of a DTS requires a mix of top-down and bottom-up strategizing (Chanias, Myers, & Hess, 2018). In the digitalization context, all financial sector stakeholders should be involved with and positioned for the electronic securities. For example, financial supervisors should be ready to deal with the regulatory and supervisory issues arising from electronic securities, particularly blockchain-based ones.

Since digital transformation in the financial sector addresses collaboration among different professions and divisions, the dominance of one group of professions might increase risks. Although an IT department is obviously an essential stakeholder, it cannot necessarily take a leading role in the formulation and implementation of a digital transformation strategy (Chanias, Myers, & Hess, 2018). The same rule holds for professionals in the area of law when drafting a law on electronic securities. Regarding the current draft, supervisory aspects of electronic securities are not embedded in the provisions, particularly in the RegTech and SupTech contexts, which signals risks ahead.

### III. Dimensions of Germany's Electronic Securities Reform and Comparisons with Implementations of Turkey and the U.S.

#### 3.1. Different Approaches in Digitalization of Securities

Digital transformation efforts require extensive experience, and use cases play critical roles in drafting robust strategies and managing transition risks. The following table highlights the main features of the draft and enables comparisons with the U.S. and Turkey from the digital finance and SupTech perspectives.

Feature/Country	Germany	Turkey	the U.S.
<b>Scope of Application</b>	(Initially) Bearer bonds	Securities	Securities
<b>Year of Start</b>	Expected in the end of 2020	2005	<ul style="list-style-type: none"> <li>• 1996 (DTC initiative)</li> <li>• 2008 (SEC approval)</li> </ul>
<b>Transition Period</b>	Not required	7 Years	17 months (after SEC's approval)
<b>Conversion to Digital</b>	Upon request	Mandatory	Direct Registration System (DRS)-Upon request
<b>Outstanding Securities</b>	In the scope	In the scope	In the scope
<b>New Securities</b>	In the scope	In the scope	In the scope
<b>Function of Securities</b>	No difference	No difference	No difference
<b>Operational Agency/Central Registrar</b>	An authorized central securities depository	Central Securities Depository of Turkey	Depository Trust Company (DTC)
<b>Electronic Access</b>	Holders and relevant authorities	Holders and relevant authorities	Holders and relevant authorities
<b>SupTech Support</b>	Electronic access by competent supervisory, regulatory and enforcement authorities	SupTech, RegTech, and corporate governance-oriented	SEC's enforcement practices
<b>Legal Background</b>	Electronic Securities Act (Draft)	Capital Markets Law	SEC's approval of the rule change SR-NASDAQ- 2006-008 pursuant to Section 19(b)(1) of the Securities Exchange Act of 1934
<b>Supervision</b>	BaFin	CMB	SEC

Table 2: Dematerialization Features; Germany, Turkey, and the U.S.

Sources: BMJV (2020), CSD of Turkey (2020), DTCC (2012), SEC (2006)

Germany has a plan to let the financial industry convert their securities to electronic form. As the first step, Germany plans to open doors for bearer bonds till the end of 2020 in this regard.

Dematerialization is a process of converting physical securities or other financial instruments held in physical forms into electronic or digital forms. Even though dematerialization has many other benefits and different purposes, it is a requirement for a successful SupTech system. Dematerialization enables supervisors to track the records of transactions electronically and utilize more analytics tools.

As the EU's leading country, Germany, moves forward with a revolutionary regulation draft considering the country's conservative legal system. However, some emerging countries passed laws many years ago to pave the way for digital transformation. For example, India did so almost twenty years ago (Gade, 2015). Turkey started the dematerialization of securities in 2005 (CSD of Turkey, 2020). In fact, developed and developing countries have different priorities and problems. For example, even though Turkey had significant progress in the way of the digital transformation of its financial sector, the country's economy suffers from severe personalized and anti-democratic policies and implementations, even massive human rights violations, which led to a case that all reforms in the financial sector became almost ineffective for economic developments.

On the other hand, developing or emerging countries have the flexibility advantage and relatively low cost of digital transformation. For example, Turkey's capital market authority developed a real-time data based multi-market and multi-asset supervisory system in several years with less than EUR 10 million. The SEC estimates that one of the primary digital transformation projects, the Consolidated Audit Trail (CAT), will initially cost 2.4 billion USD and then 1.7 billion USD a year to run (Bullock & Stafford, 2019). Announced in 2010, the CAT project is still ongoing, and the project has not been in play yet (FINRA, 2020).

The dynamic nature of digital transformation endangers developed economies, such as the U.S. and Germany, where transformation is relatively difficult, costly, and time-consuming. The cost of reforming a system and transformation risks discourage governments. Reforming a financial system comes with multiple risks since it cannot be tested at a lab before the implementation. Reforms address the future, and the future comes with surprises. Therefore, reforming the financial system in developed countries means taking additional risks with enormous costs. However, doing nothing is not a choice anymore considering the risks of

<sup>3</sup> Turkey's place in the Rule of Law Index is 107<sup>th</sup> out of 128 countries (World Justice Project, 2020). In its region, Eastern Europe & Central Asia, out of 14 countries, Turkey has the worst score.

asymmetric technology. It should be separately analyzed; however, our initial observations address a situation where the technological spread, or asymmetric technology, between the public and private sectors is bigger in developed countries than in developing or emerging economies.

### **3.2. Digitalization of Securities in Germany**

The German government has been pursuing technology-oriented policies as set out in the coalition agreement of 12 March 2018 to tap the potential of blockchain technology, prevent possible abuse and strengthen Germany's role as one of the world's leading digital technology and FinTech locations (BMF & BMJV, 2019).

On 18 September 2019, Germany's Ministry of Finance and Ministry of Economic Affairs announced that *"The German government has adopted a new blockchain strategy. This makes Germany one of the first countries to unveil a blueprint for taking advantage of the opportunities that blockchain technology offers and for harnessing its potential to advance digital transformation."* (BMF, 2019; BMWi & BMF, 2019). Germany wants to be at the forefront of innovation and reinforce the position as a leading technology hub (BMF, 2019).

Germany introduced a draft regulation in August 2020 to dematerialize physical securities. The draft foresees a smooth transition to electronic securities, starting with only bearer bonds. Other securities in bearer form might be included in the future (BMJV & BMF, 2020).

The draft includes two new forms of issuing bearer bonds electronically (Dey, Reul, Schlee, & Storck, 2020): (1) by way of an electronic register which is to be maintained by a central securities depository (CSD), and (2) via a decentralized crypto securities register (Kryptowertpapierregister). Even though the name of the draft law is Electronic Securities Law (Gesetz über elektronische Wertpapiere, eWpG), the draft does not initially include other securities, like shares.

The strategy addresses a sound policy since transformation and transition risks are high. The draft's central concept is to open German laws to electronic securities, which means the certificate-based securities system will change. Germany follows a gradual and conservative approach in this way, in contrast to Turkey's approach, which was the full dematerialization of securities. Germany's strategy behind the draft is to take advantage of electronic securities' benefits with as little transformation risk as possible and fit into existing civil and supervisory laws as smoothly as possible (BMJV & BMF, 2020).

The draft designs two different forms of electronic bonds: Standard electronic bonds and crypto-based via blockchain bonds. The draft serves to modernize German securities law and the associated supervisory law (BMJV, 2020).

The rules on electronic securities will be technology-neutral, which means the use of blockchain technology will not be privileged in any way, especially in view of the high current energy needs of public blockchain technologies and their negative effects on the climate (BMF & BMJV, 2019). Even though the draft law aims to be technology-neutral, it is expected that once implemented, DLT and blockchain technology will receive a boost and become more established in capital markets (Dey, Reul, Schlee, & Storck, 2020).

On the other hand, the new regime would also allow new business models to be introduced (e.g., a crypto securities register) and should enhance the digitalization and speed-to-market for products in relevant financial markets (Dey, Reul, Schlee, & Storck, 2020). The draft introduces blockchain-based electronic bearer bonds with an approach to hedge an important risk that today's financial markets are under its exposure: The entities operating crypto securities register will be under the supervision of the BaFin, and the crypto securities registration will be considered as a financial service (BMJV & BMF, 2020). In other words, the registrar maintaining such a crypto securities register will require a new financial services license under the German Banking Act (KWG) (Dey, Reul, Schlee, & Storck, 2020).

Pursuant to the draft, electronic security is a security that the certificate is replaced by an entry in an electronic securities register (BMJV & BMF, 2020). The draft, as a rule, entitles electronic securities the same legal effect as physical securities.

Issuing bearer bonds in electronic forms is not compulsory; instead, optional. The draft does not plan to set up a fully dematerialized securities realm, only plans to enable new options for bearer bond issuance. In other words, bearer bond issuers will have a choice to use the existing paper form or switch to one of two electronic forms (Dey, Reul, Schlee, & Storck, 2020).

Blockchain-based securities and business models will increase the burden of financial supervisors and force the supervisors to change their supervisory models as well as personnel policies. Therefore, if the draft passes as it is, two critical aspects might hurt the overall German financial system: 1) The draft is not conducive to RegTech and SupTech. 2) It does not increase the SupTech capacity of financial supervisors; instead, it overloads the supervisory system; hence, increase asymmetric technology risks.

On the other hand, even though the draft signals a firm digital finance reform intention, it does not cover all risks of the electronic securities; instead, it leaves many questions unanswered concerning RegTech and SupTech. For example, one question is about the impact analysis. The draft does not include potential impacts on the financial industry. An impact analysis might also have supervisory responses in case of abuse of electronic securities, specifically, blockchain-based securities.

The financial supervisory authority of Germany, the BaFin, formulates its digital transformation strategy by setting out three questions (BaFin, 2018):

1. “Supervision and regulation” area: What is the most appropriate supervisory and regulatory approach for addressing the market changes triggered by digitalization?
2. “IT supervision and security” area: How can the BaFin ensure that the innovative technologies, IT systems, and data used by the supervised entities are secure?
3. “Transformation of BaFin” area: How will the BaFin have to evolve further in light of progressive digitalization – internally and at the interfaces to the market?

Concerning the given questions, the German authority has multiple ongoing projects aiming to improve support in supervisory activities (BaFin, 2018). Moreover, the agency aims to be one of the leading supervisory authorities worldwide in terms of managing progressive digitalization by the year 2025 (BaFin, 2018). However, the draft does not address a useful infrastructure for RegTech and SupTech projects of the authority and is not in line with the BaFin’s digital transformation strategy.

### **3.3. Dematerialization in Turkey**

As an emerging country, Turkey utilized the benefits of relatively small capital markets and reform flexibility features in the way of modernizing capital markets. As is the case in many countries, securities clearing and settlement agencies, custodians, or central securities depositories, named Financial Markets Infrastructures<sup>4</sup> or FMIs, are the main sources of granular data that feed analyses and investigations of supervisory agencies. Therefore, FMIs are the strategic organizations for RegTech and SupTech systems. In Turkey, FMIs have a

<sup>4</sup> In market parlance, the term FMI refers to an entity that is set up to carry out centralized, multilateral payment, clearing, settlement, or recording activities (BIS & IOSCO, 2012)

semi-governmental feature, which helps financial supervisors shape data infrastructures considering RegTech and SupTech requirements.

Unlike Germany's approach, Turkey followed a full dematerialization method and introduced a mandatory digitalization, which paved the way for robust RegTech and SupTech systems.

The dematerialization process was started with mutual funds in April 2005, and as of November 2005, publicly traded shares on the Istanbul Stock Exchange (later named as Borsa Istanbul) were fully dematerialized in Turkey (CSD of Turkey, 2020). Currently, the following financial instruments are held in the dematerialized form (CSD of Turkey, 2020):

- Equities (Listed at the Borsa Istanbul)
- Mutual funds
- Exchange-traded funds (ETF)
- Corporate bonds
- Commercial papers
- Bank bills
- Corporate warrants
- Covered bonds
- Asset-backed securities
- Government debt securities (investor holdings)
- Government lease certificates
- Private sector lease certificates
- Electronic warehouse receipt
- Real estate certificates
- Gold-backed lease certificates
- Gold-backed bonds
- Convertible bonds
- Foreign exchange government certificates
- Foreign exchange government bonds.

Since 2005, all new capital market instruments have been issued in a fully dematerialized form (CSD of Turkey, 2020). In the dematerialized system, the total capital of issuers, including all non-floating shares, are held in the dematerialized form (CSD of Turkey, 2020).

Turkey's central depository agency, the Central Securities Depository of Turkey (CSD of Turkey), provides its members with registration, settlement and custody services (CSD of Turkey, 2020). Besides acting as the CSD in the country, the CSD of Turkey carries out the registry function as the registrar (CSD of Turkey, 2020).

The CMB has direct access to the CSD of Turkey's digital system under protocols to retrieve real-time and historical data about ownerships of securities to carry out supervisory responsibilities. To go beyond that, the CMB assigned and authorized the CSD of Turkey as the "Financial Accounts Center" of Turkey in 2011 (CSD of Turkey, 2020). Under this designation, all financial consumer accounts must be reported to the CSD of Turkey. Thus, if a financial consumer or a legal entity has multiple accounts at multiple financial institutions, the person or legal entity can be followed under a unique investor code. The account center helps control all financial accounts only at one data center, namely at the CSD of Turkey. Dematerialization of securities and some other financial instruments, setting up a financial account center, and using investor code were key steps toward a better SupTech system in Turkey. Utilizing these technological reforms, the CMB developed a completely new SupTech system between 2010 and 2012<sup>5</sup>.

On the other hand, investors can access online to their holdings at the CSD of Turkey and can control and protect their financial assets via protective tools. Moreover, the CSD of Turkey's system is more convenient to RegTech from multiple perspectives.

### **3.4. New Concerns about Physical and Electronic Securities in the U.S.**

The U.S. financial services industry has been grappling with physical certificates since the late 1960s when it was overwhelmed by rising volumes on the exchanges that required paper certificates (DTCC, 2012). The industry's initial solution was to immobilize stock certificates in a central location, and the second solution was the dematerialization (DTCC, 2012). However, since then, the U.S. capital market industry has not been fully dematerialized. Instead, the industry faces a new crisis, which is a dual system letting the circulation of physical securities and electronic securities together.

<sup>5</sup> Turkey was one of the pioneers in SupTech in the years of 2010-2012. Turkey's SupTech model was presented at one of the IOSCO's international programs, the Developing Surveillance Capacity of Securities Regulators Workshop, in Santiago, Chile, in 2012. Prof. Sancak was the program's keynote speaker as the founding director of the CMB's Market Oversight and Enforcement Division.

In 1996, to develop an alternative to physical certificates, DTCC's depository (with SEC's support) launched its Direct Registration System (DRS), which allowed individual investors to have their share ownership reflected on the books of an issuer or an issuer's transfer agent (DTCC, 2012).

The Direct Registration System (DRS) in the U.S. enables investors to keep their securities, either in electronic form or certificate form. Therefore, the DRS is not a mandatory system for keeping securities in electronic form or book-entry form. Under the DRS, investors can elect to have their securities registered directly on the issuer's records in book-entry form. With the DRS, investors do not receive a physical certificate, instead receives periodic account statements (at least yearly) from the transfer agent or issuer, evidencing holdings.

In July 2004, the Securities Industry Association (SIA) issued the Securities Industry Immobilization & Dematerialization Implementation Guide, which reinforced the industry's commitment to full dematerialization and underscored the importance of the DRS in attaining that goal (DTCC, 2012). Two years later, the SEC rendered the DRS eligibility a listing requirement for all new issues starting in 2007, and in 2008, it made the DRS a listing requirement for all existing exchange-listed issues (DTCC, 2012).

Most U.S. securities, including municipal and corporate bonds, government and mortgage-backed securities, commercial papers, and mutual funds, are offered in paperless form; however, still, certain asset classes are lagging, of which equities are the most significant (DTCC, 2012).

In 2012, the Depository Trust & Clearing Corporation (DTCC) proposed steps to advance the full dematerialization of physical securities. The proposal comes in a white paper – *Strengthening the U.S. Financial Markets: A Proposal to Fully Dematerialize Physical Securities, Eliminating the Costs and Risks They Incur* – issued by the Depository Trust Company (DTC), a DTCC subsidiary (DTCC, July 2012). The paper states that “*complete dematerialization will contribute to a more cost-effective, efficient, secure and competitive U.S. marketplace*”.

From the DTCC's perspective, the dual system turns the fixed cost of physical securities a serious concern in terms of cost reduction, which means, while the number of physical issuances and transactions declines, the unit cost of processing them rises. Yet until the U.S. markets are fully dematerialized, the industry will be obliged to support this fixed-cost structure

for physical processing regardless of the volume of certificates processed (DTCC, 2012). The DTCC also addresses risk management concerns. Given the heightened focus on risk management in financial markets globally, the need to eliminate the risks associated with the movement and manual processing of paper certificates is now greater than ever (DTCC, 2012).

Moreover, the U.S. capital market participants assert that complete dematerialization will contribute to a more cost-effective, efficient, secure, and competitive U.S. marketplace and support the industry's move to a shorter settlement cycle, as handling physical securities, already a burden in today's markets, could be a source of risk in a shorter cycle (DTCC, 2012).

On the other hand, the DTCC and U.S. capital market participants' concerns do not include a RegTech or SupTech; instead, they are mainly about operational and cost-cutting issues.

As an international central securities depository (ICSD) based in Luxembourg, Clearstream, a company in the Deutsche Börse Group, provides post-trade infrastructure and securities services for the international market as well as for the German securities industry offering access to a growing number of international markets (Clearstream, 2020). Clearstream announced that they support DTCC's dematerialization initiative (Clearstream, 2013).

## **Conclusion**

Germany has introduced a revolutionary reform by drafting a regulation on electronic securities in August 2020. Digitalization of securities, converting physical securities to electronic form, affects many dimensions of a financial system.

Electronic securities or a dematerialized system should not only serve the development of the private sector, FinTech and RegTech for regulatory compliance but also serve the public sector, namely support RegTech for regulators and SupTech for financial supervisors and fulfill ESG requirements.

Electronic securities have the potential to increase operational efficiency and accuracy both in compliance and supervision, namely, corporate governance, audit, and surveillance by deploying RegTech and SupTech systems. Digital transformation in the financial sector should include new considerations in line with digital finance requirements, such as closing the technology gap between the private and public sectors and managing asymmetric technology risks.

Germany's draft regulation with the provisions of blockchain-based bonds is a strong signal for digital transformation in Germany; however, it does not foresee a fully dematerialized system, which is a prerequisite for well-designed RegTech and SupTech systems.

The draft does not envisage fully dematerialized securities; instead, it allows voluntary basis conversion of bearer bonds to electronic form. We believe that this is not a complete action in terms of the digitalization of securities. In other words, the draft, when it passes, cannot meet the requirements of RegTech and SupTech. To be able to provide a strong infrastructure with the financial system, with an acceptable transition period, all securities should be dematerialized.

Finally, the draft is mainly about digitalization, not about the digital transformation of the securities market or the financial sector. Digital transformation goes beyond digitalization by including organizational designations and holistic reform approaches. Moreover, the draft increases the technological imbalance, namely asymmetric technology, between the private and public sectors, by not delivering parallel provisions for financial supervisors. Hence, the draft overburdens financial supervisors, right after an unresolved financial scandal environment. To sum up, the draft raises many questions if it passes as it is.

## References

- Alt, R. (2018). Electronic Markets on Digitalization. *Electronic Markets* , 397–402.
- BaFin. (2018). *BaFin's Digitalisation Strategy*. Bonn: BaFin.
- Bergmann, L. E. (2004, February 10). *International Securities Settlement Conference — "The U.S. view of the role of regulation in market efficiency"*. Retrieved from SEC: <https://www.sec.gov/news/speech/spch021004leb.htm>
- BIS & IOSCO. (2012). *Principles for Financial Market Infrastructures*. Basel & Madrid: BIS&IOSCO.
- BMF & BMJV. (2019, March 7). *Key-issues paper on the regulatory treatment of electronic securities and crypto tokens-Allowing for digital innovation, ensuring investor protection*. Retrieved from Bundesfinanzministerium: [https://www.bundesfinanzministerium.de/Content/EN/Standardartikel/Topics/Financial\\_markets/Articles/2019-03-25-electronic-securities-and-crypto-tokens\\_download.pdf?\\_\\_blob=publicationFile&v=2](https://www.bundesfinanzministerium.de/Content/EN/Standardartikel/Topics/Financial_markets/Articles/2019-03-25-electronic-securities-and-crypto-tokens_download.pdf?__blob=publicationFile&v=2)
- BMF. (2019, September 18). *Financial Markets-German government adopts blockchain strategy*. Retrieved from Federal Ministry of Finance: [https://www.bundesfinanzministerium.de/Content/EN/Standardartikel/Topics/Financial\\_markets/Articles/2019-09-18-Blockchain.html](https://www.bundesfinanzministerium.de/Content/EN/Standardartikel/Topics/Financial_markets/Articles/2019-09-18-Blockchain.html)
- BMJV & BMF. (2020). *Entwurf eines Gesetzes zur Einführung von elektronischen Wertpapieren*. Retrieved from Federal Ministry of Justice and Consumer Protection: [https://www.bmjv.de/SharedDocs/Gesetzgebungsverfahren/Dokumente/RefE\\_Einfuehrung\\_elektr\\_Wertpapiere.pdf?\\_\\_blob=publicationFile&v=1](https://www.bmjv.de/SharedDocs/Gesetzgebungsverfahren/Dokumente/RefE_Einfuehrung_elektr_Wertpapiere.pdf?__blob=publicationFile&v=1)
- BMJV. (2020, August 11). *Gesetz zur Einführung von elektronischen Wertpapieren*. Retrieved from BMJV: [https://www.bmjv.de/SharedDocs/Gesetzgebungsverfahren/DE/Einfuehrung\\_elektr\\_Wertpapiere.html](https://www.bmjv.de/SharedDocs/Gesetzgebungsverfahren/DE/Einfuehrung_elektr_Wertpapiere.html)
- BMWi & BMF. (2019, September 9). *Bundesregierung verabschiedet Blockchain-Strategie*. Retrieved from Bmwi.de: <https://www.bmwi.de/Redaktion/DE/Pressemitteilungen/2019/20190918-bundesregierung-verabschiedet-blockchain-strategie.html#:~:text=Die%20Blockchain%2DTechnologie%20ist%20eine,erschlossen%20und%20Missbrauchsm%C3%B6glichkeiten%20verhindert%20werden.>
- Bullock, N., & Stafford, P. (2019, December 10). *SEC Approves Vast Surveillance System for Stock Market*. Retrieved from Financial Times: <https://www.ft.com/content/2a428156-ab1e-11e6-9cb3-bb8207902122>
- Chan, D., Fontan, F., Rosati, S., & Russo, D. (2007). *The Securities Custody Industry*. Frankfurt am Main: European Central Bank.
- Chanias, S., Myers, M. D., & Hess, T. (2018). Digital transformation strategy making in pre-digital organizations: The case of a financial services provider. *Journal of Strategic Information Systems*, 17-33.
- Clearstream. (2013, April 4). *U.S.A.: Prospective changes : Dematerialisation of physical securities : Update*. Retrieved from Clearstream:

- <https://www.clearstream.com/clearstream-en/products-and-services/market-coverage/u-s-a-prospective-changes-dematerialisation-of-physical-securities-update-1305754>
- Clearstream. (2020, August 25). *About Clearstream*. Retrieved from Clearstream: <https://www.clearstream.com/clearstream-en/about-clearstream>
- CSD of Turkey. (2020, September 2). *About MKK*. Retrieved from Merkezi Kayit Istanbul: <https://www.mkk.com.tr/en-us/About-Us/Pages/MKK-Kimdir.aspx>
- Dey, S., Reul, F., Schlee, A., & Storck, C. (2020, August 17). *Draft Electronic Securities Act paves the way for DLT based securities in Germany*. Retrieved from Linklaters: <https://www.linklaters.com/en/insights/publications/2020/august/draft-electronic-securities-act-paves-the-way-for-dlt-based-securities-in-germany>
- DTCC. (2012). *Strengthening the U.S. Financial Markets: A Proposal to Fully Dematerialize Physical Securities, Eliminating the Costs and Risks They Incur*. New York: DTCC.
- DTCC. (August 2020). *Direct Registration System*. Retrieved from DTCC: <https://www.dtcc.com/settlement-and-asset-services/securities-processing/direct-registration-system>
- DTCC. (July 2012). *DTCC Calls on Industry To "Fully Dematerialize" U.S. Financial Services Market*. Retrieved from DTCC: <https://www.dtcc.com/news/2012/july/09/dtcc-calls-on-industry-to-fully-dematerialize>
- Ehrentraud, J., Ocampo, D. G., Garzoni, L., & Piccolo, M. (2020). *Policy Responses to Fintech: A Cross-country Overview*. Basel: Financial Stability Institute, Bank for International Settlements.
- European Commission. (2013). *Powering European Public Sector Innovation: Towards A New Architecture*. Brussels: European Commission.
- European Investment Bank. (2013). *EIB launches largest EUR Climate Awareness Bond (CAB) ever*. Luxembourg: European Commission.
- European Parliament. (2014, August 28). *Regulation (EU) No 909/2014 of the European Parliament and of the Council*. Retrieved from EUR-Lex: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32014R0909>
- FINRA. (2020, April 02). *catnmsplan*. Retrieved from FINRA CAT: <https://www.catnmsplan.com/>
- Frisell, L., Fernandes, M. J., Quest, L., Rennick, E., Roy, S., & Treeck, D. (2018). *Supervising Tomorrow*. New York: Oliver Wyman.
- Gade, S. (2015). Dematerialization of Shares and Retail Investors in India - A Study. *International Journal of Engineering and Management Research*, 393-400.
- Group of Thirty. (2006). *Global Clearing and Settlement; Final Monitoring Report*. Washington, DC: Group of Thirty.
- Group of Thirty. (2008). *The Structure of Financial Supervision: Approaches and Challenges in a Global Marketplace*. Washington, D.C. : Group of Thirty.
- Mergel, I., Edelman, N., & Haug, N. (2019). Defining Digital Transformation: Results from Expert Interviews. *Government Information Quarterly*, 1-16.

- Sancak, I. E. (2016, January). Applicability and Readiness of Crowdfunding in Turkey. *International Journal of Business and Social Science*, pp. 99-110.
- SEC. (2006, August 8). *Self-Regulatory Organizations; The NASDAQ Stock Market LLC; Order Granting Approval of a Proposed Rule Change Requiring Securities be Eligible to Participate in a Direct Registration System*. Retrieved from SEC: <https://www.sec.gov/rules/sro/nasdaq/2006/34-54288.pdf>
- World Justice Project. (2020). *The World Justice Project Rule of Law Index® 2020*. Washington, DC: World Justice Project.
- Yang, Y.-P., & Tsang, C.-Y. (2018, December 31). RegTech and the New Era of Financial Regulators: Envisaging More Public-Private-Partnership Models of Financial Regulators. *University of Pennsylvania Journal of Business Law*, pp. 354-404.
- Zadek, S., & Bruett, T. (2019). *Harnessing Digitalization in Financing of the Sustainable Development Goals*. New York: UN Task Force on Digital Financing of the Sustainable Development Goals.
- Zeranski, S., & Sancak, I. E. (2020). Digitalisation of Financial Supervision with Supervisory Technology (SupTech). *Journal of International Banking Law and Regulation*, 309-329.
- Zeranski, S., & Sancak, I. E. (August 2020). *Does Wirecard Case Address FinTech Crises?* Wolfenbüttel: ZWIRN-Research Center.
- Zeranski, S., & Sancak, I. E. (July 2020). *Prudential Supervisory Disclosure (PSD) with Supervisory Technology (SupTech): Lessons from a FinTech Crisis*. Wolfenbüttel: ZWIRN Research Center.