Digitalization Progress of Depositories in India : Evidences and Outcome

Lovleen Gupta [1]
Amiya Kumar Mohapatra [2]
Tripti Goel [3]

Abstract

A depository is an institution that assists and enables storing and trading of securities in dematerialized form. India is a country with a multi-depository system, constituted of two main depositories, that is, National Securities Depository Ltd. (NSDL) and Central Depository Services (India) Ltd. (CDSL). The development of technology has paved the way for the innovative development of the depository system in India. The present study focused on discussing and analyzing the dual aspects of the digitalization progress of Indian depositories since its incorporation. First of all, in terms of e-services introduced by the depositories and then in terms of growth of demat securities, demat value of traded securities, companies live on any depository, DPs live, the number of DP locations, and number of investor accounts with DPs. The results showed that the adoption of the latest technology at nascent stages helped depositories achieve phenomenal growth rates over the years. The presence of a multi-depository system and many depository participants increased the accessibility for the investors and healthy competition in the capital market. Various digital services provided by the depositories have fastened the capital market development and client satisfaction. Improvization, innovation, and effective implementation of regulations have led to the remarkable progress of digitalization of depositories in India.

Keywords : **depositories, digitalization, finance, Indian stock market**

JEL Classification : G00, G21, O16, O31

Paper Submission Date : November 15, 2020 ; Paper sent back for Revision : January 10, 2021 ; Paper Acceptance Date : February 20, 2021

That time has gone when the trading floors were filled with brokers, sub-brokers, and investors. Brokers were the ones with access to the most important information about companies and investors both. The introduction of electronic trading by NSE (National Stock Exchange) has, on the one hand, eased the delivery of financial services and on the other hand, has posed different risks and challenges regarding the transfer of securities. To tackle these challenges along with minimizing risks and reducing cost, a depository system in India was established, thereby introducing dematerialized shares (the process of conversion of physical share certificate to electronic share certificate) and scrip-less trading. Stock Holding Corporation of India Limited (SHCIL) initiated the establishment in 1992 and in 1996, through an act passed in Parliament, called as Depositories Act 1996, a legislative framework was laid to dematerialize the securities and assist in

[1] *Assistant Professor,* Department of Commerce, Hindu College, University of Delhi, Delhi - 110 007. (Email : lgupta@hinducollege.du.ac.in) ; ORCID iD : 0000-0002-3028-6471

[2] *Deputy Director,* FOSTIIMA Business School, New Delhi - 110 077. (Email : amiyaeco125@gmail.com) ; ORCID iD : 0000-0003-3963-5997

[3] *Research Scholar (Corresponding Author),* Department of Commerce, Delhi School of Economics, University of Delhi, Delhi - 110 007. (Email : tripti10sep@gmail.com) ; ORCID iD : 0000-0002-7041-3543

DOI : https://doi.org/10.17010/ijrcm/2021/v8i1-2/165085

electronic book-entry of all the transactions related to that security. This was when information technology and digitalization of Indian capital markets were introduced, and since then, there was no turning back.

Objectives of the Study and Structure of Depository System in India

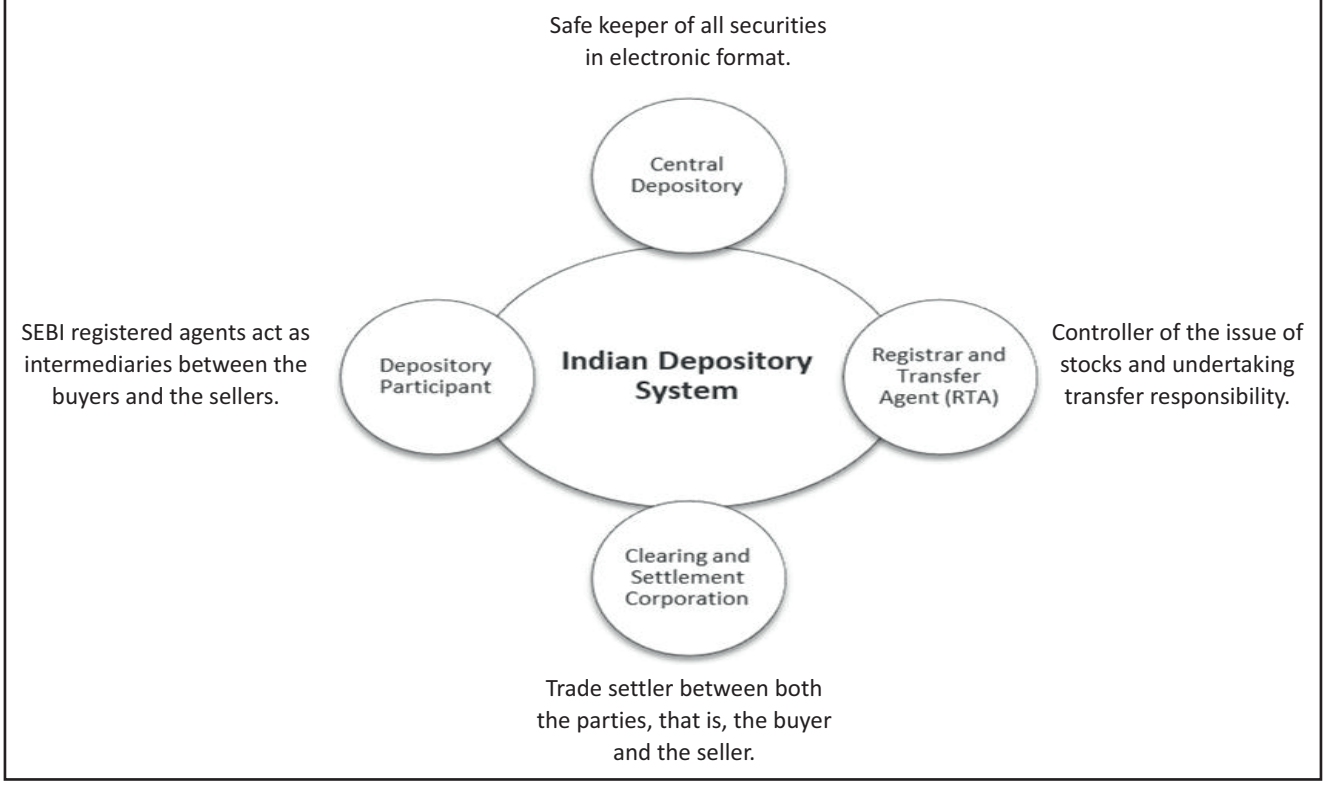
The main objective of the depositories is to eliminate the risks involved with storing, trading, and transfer of securities in the capital market. It also facilitates maintaining the investors' accounts in electronic format. Regulated by the Securities and Exchange Board of India (SEBI), depositories in India have the responsibility of preparing a statement of accounts for their investor clients and also undertake the responsibility of collecting dividends, bonus shares, etc. The broad structure of depositories is explained with the help of Figure 1.

Services Rendered by Depositories in India

Depositories provide a variety of services to their clients. Some of the services include :

- Dematerialization and rematerialization.
- Maintaining an electronic statement of accounts of securities held by their clients.
- Settlement of trade transactions.
- Settlement of off-market transactions between beneficiary owners.
- Collecting non-cash benefits such as bonus shares on behalf of account-holders.

Figure 1. ***Structure of the Indian Depository System***



Benefits of the Depository System in India

The depository system has the following pros :

- More efficient and accurate transactions.
- Reduce delivery risks of theft, spoilage, etc.
- Real-time trading enables liquidity in capital markets.
- Different types of securities held by an investor can be kept in a single account.
- Demat shares can be easily used as collateral security to raise further loans from financial institutions.
- Timely registration and transfer of securities.

The depositories are considered as the backbone of financial markets. The attempt to further strengthening them begins with the digitalization of the depositories, giving these a competitive advantage over the rest of the world. Technological advancement has spread to all parts and sectors of the global economy. The story of the digital transformation in Indian financial sectors is no different (Ramesh, 2017). Given the significance of depositories in the Indian financial system, digitalization at depositories paves the way for digitalization in the rest of the financial markets. Hence, it is of utmost importance to study the status and pace of the technological transformation of the depositories in India. The present study undertaken evaluates the digital evolution in the Indian depository system, both theoretically and empirically.

Many prior studies have delved upon digitalization and depositories individually. But a comprehensive study was yet to be taken. This study attempts to fill this gap and provide an exhaustive view of the same. The main objective of the study is to conduct a descriptive and exploratory data analysis to assess the growth of Indian depositories since their inception in terms of technological advancement.

Review of Literature

Various studies have been conducted to discuss and analyze different parts of either the depositories' institutions or the digital transformation in India and abroad. These observations and findings refer to different angles of depositories like their structure, financial performance over the years, objectives, and role of depositories and their impact on stock markets or capital markets.

The Indian Depository System

Bajwa (2016) concentrated on the idea that the growth of capital markets ultimately leads to the growth of the economy. Growth of capital markets in terms of primary issuances, market capitalization, and market indices is possible only with the growth of depositories, which act as the backbone of capital markets. Raju and Patil (2001) put light on the progress of depositories in India in terms of cost reduction, dematerialization progress, and compared it across different countries of the world. Settlement charges and custody charges have fallen significantly. They referred to progress in depositories in India as “quick” due to the impact of the internet, globalization, convergence of markets, consolidation of institutions, and cross - border depositories. According to them, India's depository's growth was commendable among all the selected nations and exhibited vast potential for more development.

Bhatt and Bhatt (2012) used ANOVA to calculate various accounting ratios such as financial stability ratios, expense ratio, and ROI to determine the difference in financial health of NSDL and CDSL over 5 years. It was

found that a significant difference between different aspects of both the depositories existed. On the contrary, a study by Gopal and Rao (2014) also focussed to analyze the return on assets of both the depositories and four depository participants (Dps), namely IIFL, NSBL, PCL, and KSBL (from the region of Andhra Pradesh). Their study, consisting of 300 investors and 50 branches of DP, established that return on assets of both the depositories (NSDL & CDSL) and return on assets of the four DPs were not significantly different from each other. Another work by Bhagwat and Omre (2018a) judged the soundness of both the depositories by doing a comparative trend analysis of various aspects of their balance sheets. They evaluated the average growth of current assets, loans and advances, share capital, and profit before tax to find out mixed trends. No uniform conclusions could be made regarding which was performing better. The results obtained were in contrast to an earlier study by Bhatt and Bhatt (2012).

Rajan and Manikantan (2015), in their study, examined basic services offered by depositories in India and compared the performance of both the depositories. Its results indicated that CDSL, although incorporated in 1999, three years later than NSDL, offered all the services like that of NSDL, and that CDSL performed better than NSDL in terms of average growth in DPs live, DP locations, demat custody value, demat quantity, and the number of beneficial owner accounts. Babu et al. (2016) did a similar analysis as Rajan and Manikantan (2015). But the sample size was increased to 16 years. Their results indicated a positive average annual growth rate for all the variables, implying a perpetual and exponential growth of the Indian capital markets.

Bhagwat and Omre (2018b) also studied the growth and role of depositories in the Indian financial system. They demonstrated that dematerialization has further modernized the capital markets and played a pivotal role in improving returns and liquidity and reducing the volatility of the stock market. In line with Babu et al. (2016), their results provided evidence that positive average annual growth supports the positive growth of capital markets.

Digitalization and Financial Markets

Moss and Currall (2004) discussed what, how, and why of digitalization. According to their study, the material with more demand should be converted into electronic format to make the accessibility sustainable and distribution effective. Kotishwar (2018) also highlighted that digitalization impacts employees' productivity positively in the case of the banking industry. Moreover, effective use of the latest technology like 3G/4G significantly impacts the digital transaction by the customers. Hari Krishna and Arun Kumar (2020) thoroughly reviewed the book, *FinTech, BigTech and Banks : Digitalisation and its Impact on Banking Business Models* that studied the impact of digitalization of financial services in creating a digital economy. They also discussed the regulatory norms and operational challenges faced by financial institutions in strategically introducing advanced technologies for customer satisfaction.

Rani and Srinivasan (2015) talked about the digital evolution of electronic trading, its impact, and its scope in the financial market. Digitalization enables improved liquidity and transparency ; while on the downside, it leads to an increase in high-frequency trading and the formation of dark pools. Kumar (2018) argued that the impact of digital transformation is more on the spot market than on the derivative market. He suggested some solutions to the issues related to digitalization (unavailability of digital services in remote areas, financial illiteracy, and cyber-crimes) like better product design, better treatment to clients, no overcharging of fees, and data security measures. On a similar line, Rekha et al. (2020) suggested some of the ways to promote the use of digital technology by clients. They highlighted that financial institutions should introduce user-friendly and digital portals to enable clients to adopt and utilize the benefits of digitalization and to overcome the lack of digital illiteracy.

As can be observed, research related to digitalization and depositories has been studied individually but, to the best of our knowledge, no concrete examination has been done to consolidate all the information on the

digitalization progress of depositories in India. The present study attempts to fill the research gap and discuss and quantify the pace of digitalization in the Indian scenario.

Objectives of the Study

The broader objective of this study is to analyze the digital transformation of depositories in India. A refined set of objectives includes the following :

- To discuss the digital transformation of depositories in India.
- To evaluate the growth of different variables related to the depository system.
- To assess the existence of any significant relationship between the variables identified.

Methodology

- Data were collected from the annual reports of SEBI, CDSL, and NSDL downloaded from their respective official websites. The period of study extends from the year of establishment of depositories in India, that is, from August 8, 1996 to March 31, 2020.

- The stature of digital developments at both the depositories has been studied chronologically while comparing the electronic facilities offered by them.

- For analytical research on the growth of depositories, an extensive review of literature was conducted to identify the variables associated with them. Number of depository participants in action (DPs live), the quantum of locations from which depository participants are operating (DP locations), the value of dematerialized securities (demat value), the quantum of dematerialized securities (demat quantity), number of companies whose securities are offered in demat form (companies live), and number of investor accounts/beneficiary owner account (BOA) are the variables that are considered for the study.

- The growth in these variables is studied using statistical tools like compounded annual growth rate (CAGR) and average growth rate (AGR). For the purpose of calculating growth, data belonging to initial years till 2000 were removed. Their inclusion led to biased output as the growth rate in the initial years was as high as 8700% for growth in demat securities.

- **Compound Annual Growth Rate :** CAGR may be defined as growth in the variable from beginning to end assuming compounding. It is calculated as under :

$$CAGR\ (\%) = \left[\left(\frac{Value\ at\ the\ end}{Value\ at\ the\ beginning} \right)^{\frac{1}{number\ \ of\ \ years}} \right] - 1$$

- **Average Annual Growth :** Average Annual Growth is defined as mean of all the growth values in each financial year from 1996 – 2019.

$$AAG\ (\%) = \frac{G_1 + G_2 + G_3 + \cdots + G_n}{number\ of\ years\ (n)},$$

where,

G_n = growth for that particular year.

↳ Another important aspect that was explored was the relationship between DP live and DP location. A model is formed to determine the number of DP locations based on the number of DPs registered. The relationship will also help to analyze whether or not DPs are dispersed or concentrated in a fewer area over the years. Consequently, this will help us know how much accessible are dematerialization services to investors in the form of near-located DPs. Accordingly, the following null and alternate hypotheses are framed to be tested at the 5% significance level using linear regression in Microsoft Excel 2010.

↳ $\mathbf{H_0}$ = No significant relationship exists between DPs live and DPs locations.

↳ $\mathbf{H_a}$ = DPs live and DPs locations are significantly related.

Analysis and Results

Digital Transformation of Depositories in India

Since their incorporation, it has been the aim of both the depositories to ensure that the Indian capital market is developed in terms of registration, transfer and trading of securities, and improving investors' accessibility and usability to capital markets. Integrating digital technology into the business strategy has facilitated the

Table 1. ***Digitalization Status at Indian Depositories***

Technology	NSDL	CDSL
Software and Hardware System	Hardware, software, and communication systems adopted are as per the industry standards. Additionally, NSDL's centralized system consists of an IBM framework with an additional backup facility. It is reviewed periodically to assess the health of the systems and avoid any threats.	Centralized database system with the outsourcing of software and multi-factor user authentication to increase data safety. Hardware server comprises of state-of-the-art server, the robust infrastructure of networks.
Disaster Recovery Site	A DRS has been set up with an identical computer framework as that of Mumbai, located outside the state. Continuous shifting of operations of the depository to DRS is done to ensure that DRS is operational.	A highly resilient system with multiple-level backup systems is maintained to avoid data loss. It includes a redundant fail-over cluster and a DRS.
Information Security	Encryption hardware lock is installed to protect data exchange between partners.	Effective Information Security Management System (ISMS) safeguards information at each stage of processing starting from file creation to its disposal.
Business Community	In event of any lag or disruption like power failure or CPU failure, NSDL operates on a dual uninterrupted power supply and a standby CPU, respectively to ensure no discontinuity in operations.	An effective Business Continuity Management System (BCMS) is ensured to restore and provide uninterrupted services in the case of any disruption. CDSL has been awarded ISO 22301 certification for Business Continuity Management Systems (2013).

Source : Data accumulated from the official website of respective depositories by the Authors.

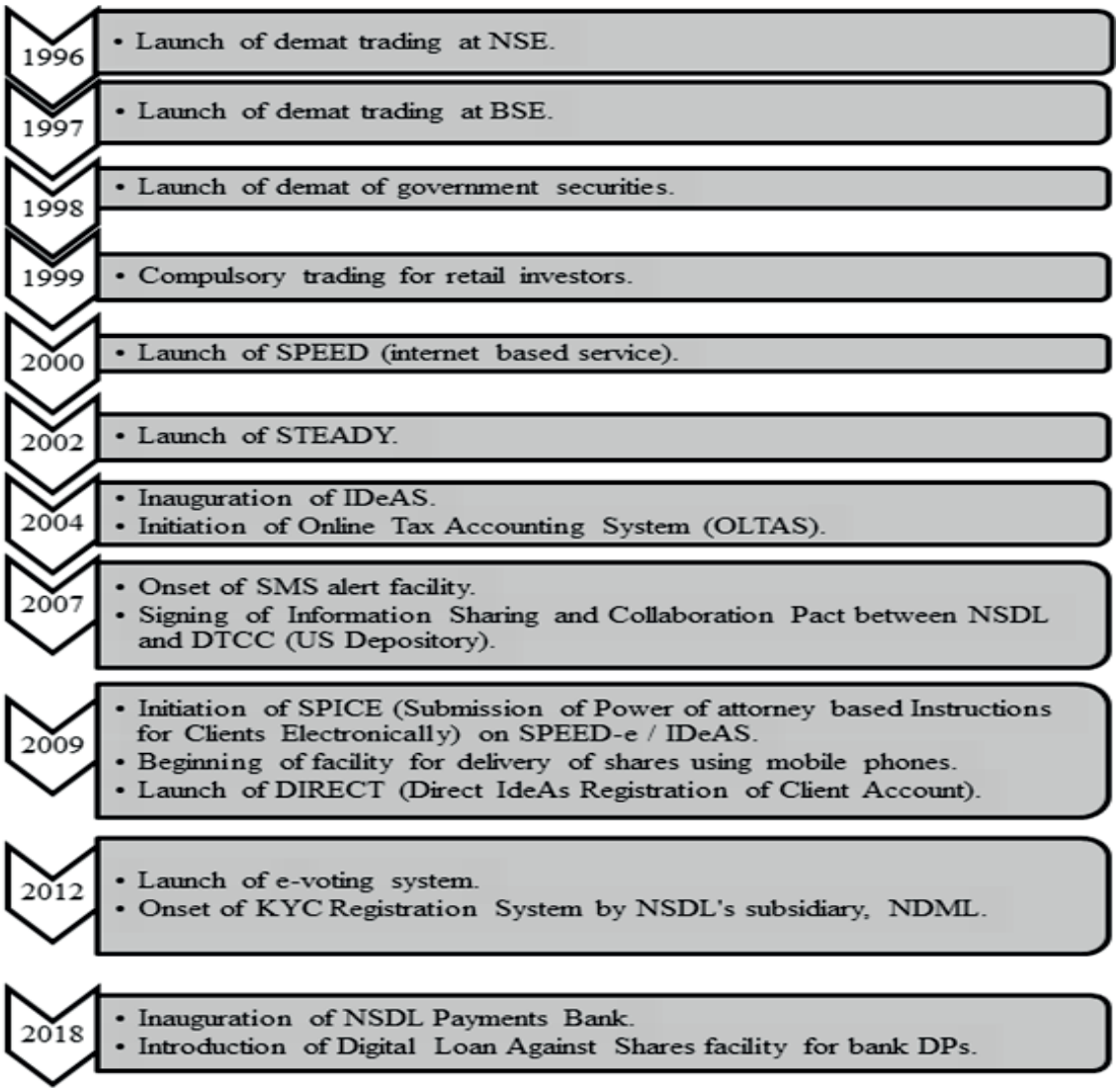
achievement of the depositories' objectives effectively and efficiently. India has a multi-depository system consisting of two depositories namely NSDL and CDSL.

Both the depositories endeavour to adopt continuously upgraded and new technologies to enhance information security and avoid risks. The core application installed in the depositories enables improved client experience, data protection, and competitiveness in the market. Table 1 discusses the status of technology at the depositories.

National Securities Depository Ltd. (NSDL)

NSDL is one of the largest depositories in the world. With its tagline "Technology, Trust and Reach," NSDL has always facilitated the use of the latest, flexible, and innovative technology to improve investors' trading experience in terms of reduction of risks and costs and increasing the effectiveness and accuracy of the transfer of

Figure 2. ***NSDL Digital Timeline***



Source : Compilation done by Authors from the official website of NSDL.

securities. To name a few, NSDL has been crowned Golden Peacock Award for Innovation Management in 2018, ISO/IEC 27001 : 2013 certification for Information Security Management System awarded for Aadhaar Authentication and e-KYC and NSDL GST functions, conferred with the SKOCH Digital Inclusion Award 2011 for Technology in Financial Inclusion for NPS Lite System and Tier IV Certification for Data Centres. The chronological series of innovations made at NSDL in relation to technology are illustrated in Figure 2.

E - Services Offered by NSDL

- **NSDL Mobile App :** Free application to all the investors to view their account balances.

- **Speed :** E-Service enables investors to deliver trading instructions directly through internet.

- IDeAS (Internet-based Demat Account Statement) is the online service rendered to view balances and transactions in the demat-holder account updated continuously with a delay of a maximum of half an hour.

- **STeADY (Securities Trading Information easy Access and Delivery) :** Provides the brokers with an option to deliver contract notes to custodians by transmitting encrypted and electronically signed trade information.

- **Depository Account Validation (DAN) :** Facilitates subscribers to validate client ID, DP ID, and PAN of investors through upload of a single file.

- **SPICE (Submission of Power of attorney-based Instructions for Clients Electronically) :** Clearing members can submit auto pay-in instructions to participants.

- **SIMPLE (Submission of Instruction through Mobile Phone Login Easily) :** Facilitate users of SPEED-e facility to submit Client to Clearing Member Pool Account transfer instructions on SPEED-e website through a password and their GPS enabled mobile phones.

- NSDL service of e-voting on crucial matters by shareholders.

- SMS Alert Facility which sends real-time text messages to clients regarding every important trade taking place through their accounts.

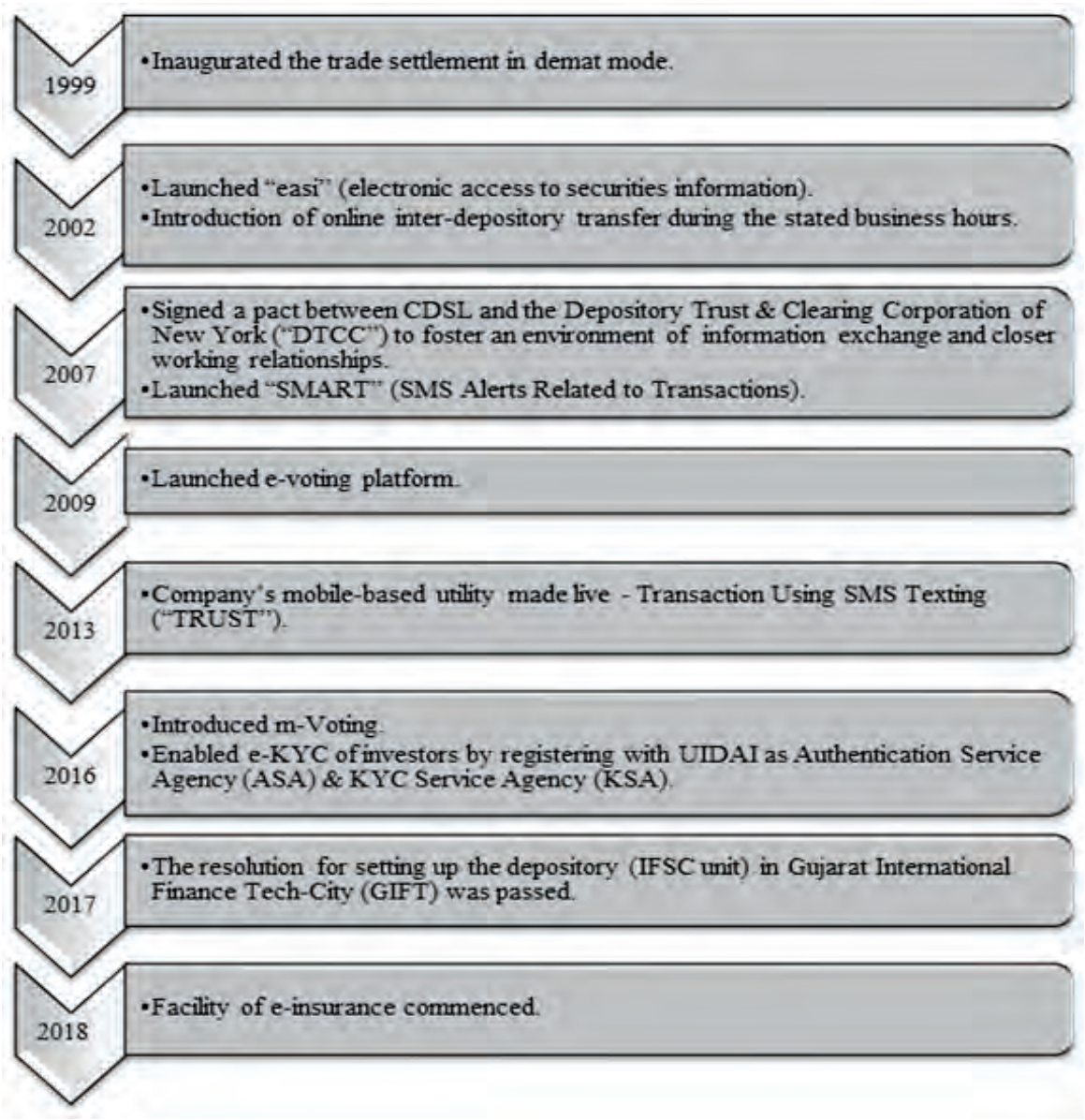
Central Depository Services (India) Ltd. (CDSL)

CDSL has always been a forerunner in promoting digitalization in the capital markets. Over the years, it has built an amazing technological infrastructure to deliver its services. CDSL has been awarded various awards and recognitions to acknowledge its best efforts to promote fairness and investor protection in the capital markets with the help of information technology. Some of the recent awards are IDG CSO100 Award for IT security in 2019 ; NetApp Innovation Award for visionary data in 2018 ; BIG 50 BFSI Innovators Award for technological innovation in 2018 ; FinTech India Award for data security in 2017 ; EMC Transformers Award for smart, best, and judicious use of IT to digitally transform business in 2014, and the list goes on. The evolution of technology at CDSL is depicted in Figure 3.

E-Services Offered by CDSL

- Easiest (electronic access to securities information and execution of secured transactions) enables clients to electronically transfer deposit instructions from their demat account.

Figure 3. ***CDSL Digital Timeline***



Source : Compilation done by Authors from the official website of CDSL and Ramkumar (2016).

↳ E-Notices in which the clients are emailed important notices regarding the securities held or any other significant information.

↳ **Online Inter - Depository Transfer :** Enables the transfer of securities between depositories electronically during pre-stated business hours.

↳ EASI (Electronic access to securities information) enables account holders to view balances of their demat account online.

↳ E-Voting facilitates online voting by shareholders on company matters and resolutions to improve corporate governance standards.

↳ SMART (SMS Alerts Related to Transactions) sends a text message to investors regarding every significant transaction from their demat account.

↳ **e-Locker :** Provides locker to the companies.

↳ National Academy Depository facilitates the issue and storage of academic mark sheets, degrees, and convocation certificates in electronic form.

↳ **M-Voting :** An e-voting mobile app for shareholders to cast their vote at their convenience.

↳ **E-Insurance :** Services offered by CDSL to hold all the insurance policies in a digital format. Under this facility, clients are provided with group insurance coverage, given the Depository Participants (DPs) opt to participate and pay in the scheme ₹130 plus GST as premium for a life cover of ₹1 lakh for their clients.

In the next section, an attempt has been made to evaluate the growth of the digitalization progress in the depository system and establish the relationship (if any).

Evaluation of Growth of Variables Recognized

Six variables, namely companies live, number of investor accounts, DPs live and locations, number and value of demat securities were taken as a barometer for measuring digitalization at the depositories. The data, along with growth in the variables, is discussed in the following sections with the help of Table 2.

↳ **Companies Live :** The majority of the companies registered their shares in demat form with NSDL only. The growth rate calculated was 18.94% compounded annually, while the average growth rate was 26.59%. Figure 4 illustrates the number of companies live at both NSDL and CDSL with the help of a bar graph, while growth is depicted using the line chart on the secondary axis. The growth rate remained consistent at around 5 – 10%, except at the end of the year 2001 as very high growth can be observed, which is attributed to the kick start to depositories' operations in their beginning years.

Figure 4. ***Data and Growth Pertaining to Companies Live***

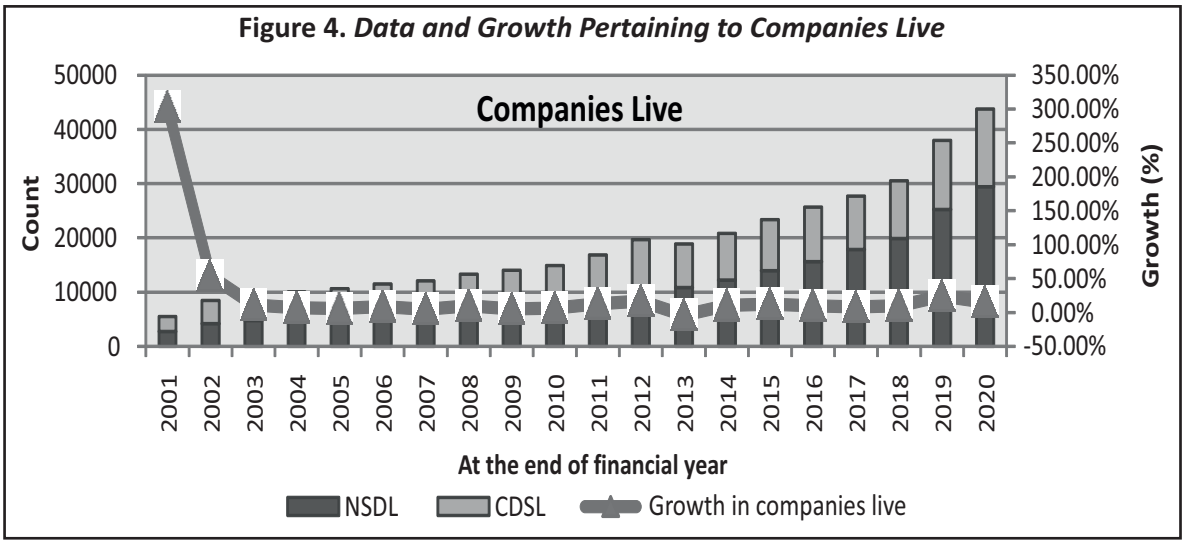


Figure 5. ***Data and Growth Pertaining to DPs Live***

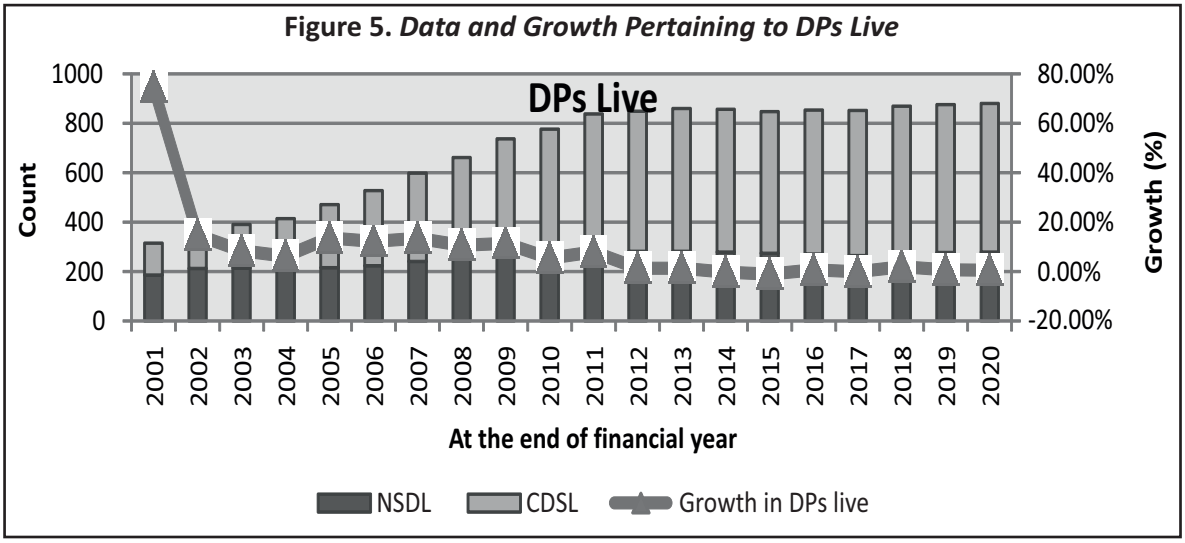
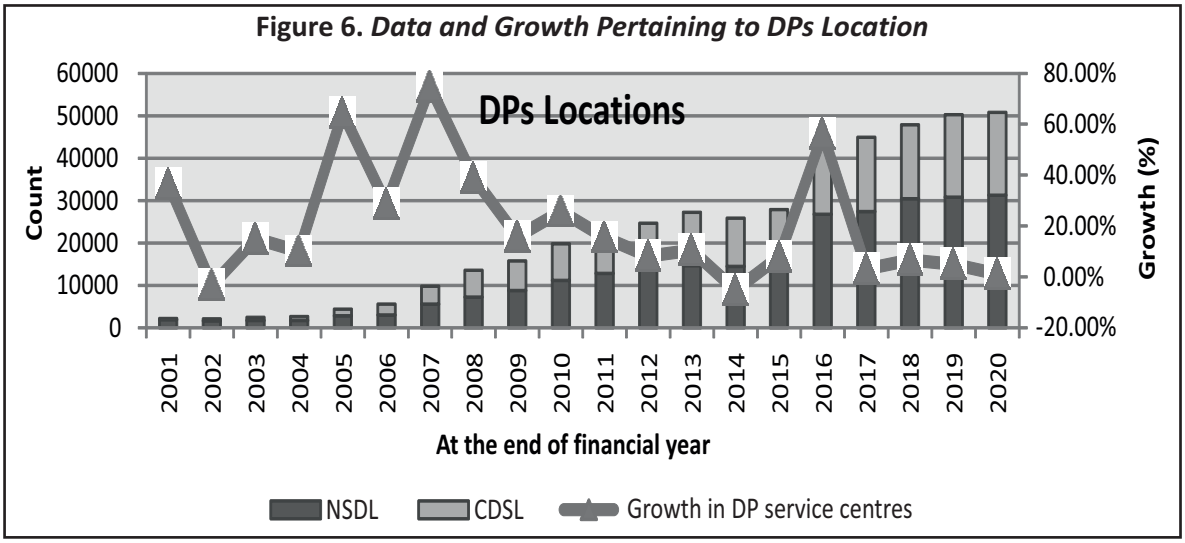


Figure 6. ***Data and Growth Pertaining to DPs Location***



↳ **DPs Live :** Figure 5 visualizes the number of DPs which are registered with both the depositories. CDSL leads the domain. DPs live seems to be consistent over the past few years, with only a very few changes in the total. The growth of DPs live remained negative from the financial year 2011 to 2016. And even in the last 2 years, growth is close to 1% only. The annual growth rate (both compounded and average) is higher for CDSL, while the average for the whole sample is 8.25% CAGR.

↳ **DP Locations :** The number of locations, at which registered DPs are located, is depicted in Figure 6. NSDL's depository participants are more dispersed as compared to depository participants of CDSL. The growth rates seemed to dwindle over some time. Calculated growth rates are as high as 75% and as low as – 5%. The average growth rate stood at 19% CAGR and 21% AAG rate.

↳ **The Number of Investor Accounts :** Since trading in securities by the opening of a demat account is compulsory ; hence, lakhs of investors open their accounts with any of the depository, who in turn also provide auxiliary services to the owners like dividend collection, etc.

Figure 7. ***Data and Growth Pertaining to Investor Accounts***

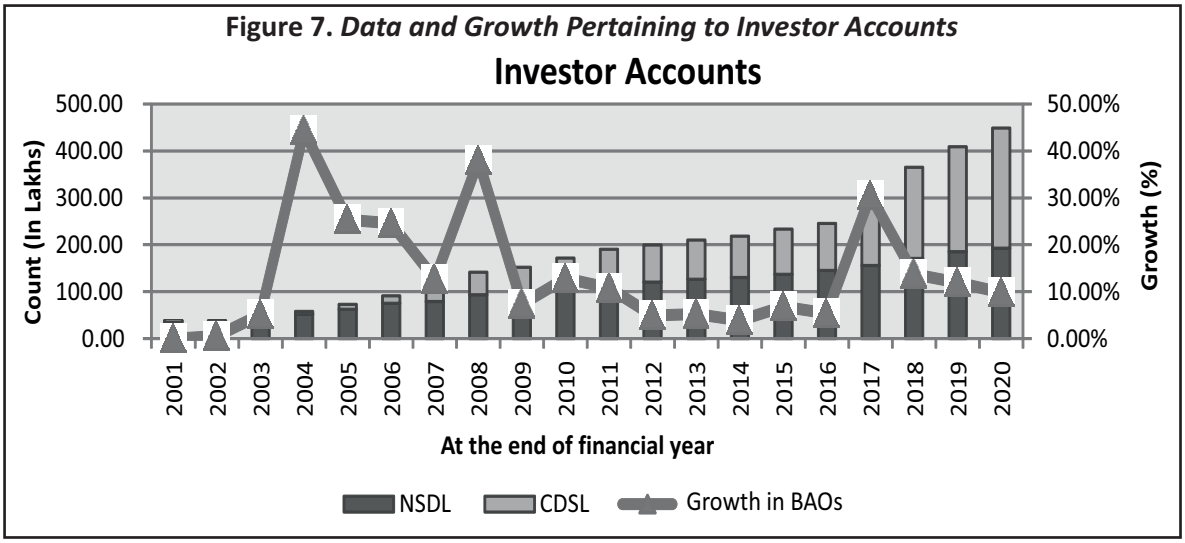
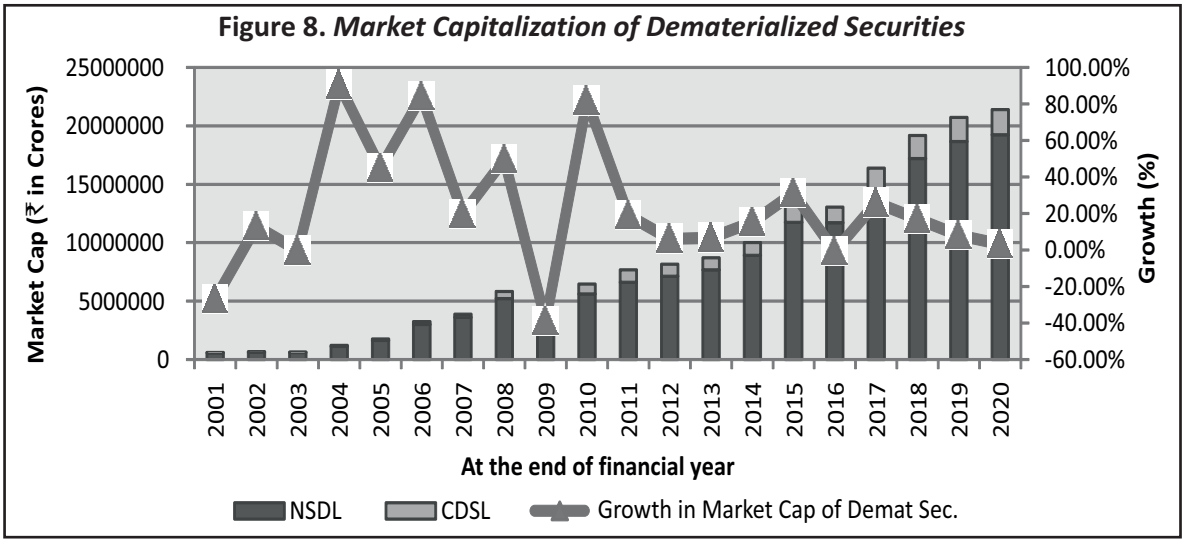


Figure 8. ***Market Capitalization of Dematerialized Securities***



↳ CDSL recorded very high growth rates and the number of beneficiary owner accounts as compared to NSDL (Figure 7). NSDL's growth rate stood around 9% for the whole sample period, while approx. 14% growth rate was calculated for the whole sample.

↳ **Value of Demat Securities :** There is no doubt that NSDL had the highest market value for their demat securities. But growth is higher in the case of the value of CDSL demat securities ; 18.05% CAGR and 22.46% AAG rate were observed for the whole sample. It is evident from Figure 8 that growth fell during FY 2008 – 09, the reason of which can be attributed to the financial crisis of 2008.

↳ **The Number of Demat Securities :** Approximately 90% of the securities are dematerialized with NSDL as can be observed in Figure 9. The average annual growth rate of demat securities with either of the depositories stood at 31.38%, while CAGR was calculated near 29%.

Figure 9. ***Quantity of Dematerialized Securities***

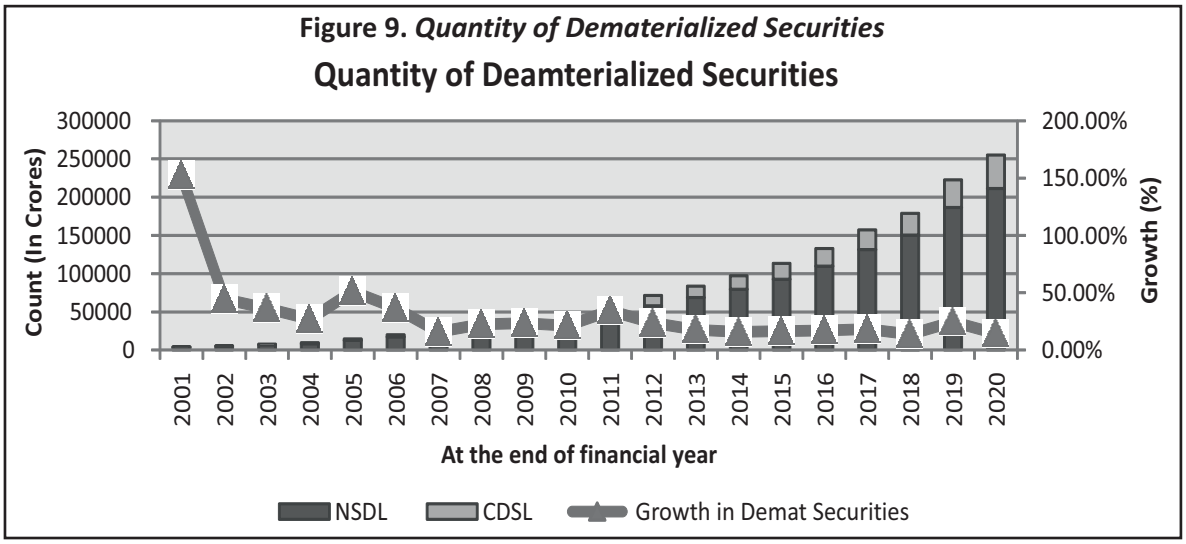


Table 2. ***Growth of Depositories***

Variable Studied	CAGR (%)			Average Annual Growth (%)		
Depository	**NSDL**	**CDSL**	**Total**	**NSDL**	**CDSL**	**Total**
Companies Live	19.59	17.80	18.94	24.86	29.49	26.59
DPs Live	4.14	12.59	8.25	4.63	14.77	9.14
DPs Location	16.69	27.28	18.94	19.00	30.00	20.76
Beneficiary Owner Accounts (BOAs)	9.01	35.83	13.84	9.34	40.82	14.42
Demat Value	17.49	32.13	18.05	21.83	40.44	22.46
Demat Quantity	27.86	33.07	29.07	29.88	36.21	31.38

Source : Authors' calculations based on data collected from annual reports of SEBI, NSDL, and CDSL.

Note. For purpose of calculating growth rates, data pertaining to 2000 – 2020 has been considered to minimize the impact of the exponential increase in the values in the initial years which acted as outliers.

The summary analysis for growth of both the depositories is detailed in Table 2 for better comprehension.

Table 2 suggests a positive average and compounded annual growth of depositories in India. Despite CDSL commencing its operations after one year of the inauguration of NSDL, it has gained momentum over the years and stands at par with NSDL. The growth figures suggest that CDSL has made a remarkable jump in all the variables. In conclusion, it can be said that high growth figures of variables suggest paced and efficient digitalization operations at the depositories.

Regression Results for Hypotheses Testing

Regression was run considering total DPs location as the dependent variable and total DPs live as the independent variable. The results in Table 3 were obtained at the 5% significance level.

The results suggest that DPs locations are positively and significantly related to DPs live. The null hypothesis (H_0) is rejected at the 5% significance level. As the variable DPs live increases by 1%, an increase of 44% is observed in the number of DPs locations. Also, a positive relationship indicates that for every subsequent DP, the locations at which these DPs are located are dispersed, hence making them more accessible to investors.

Table 3 (a). ***Regression Statistics***

Multiple *R*	0.843981836
R Square	0.71230534
Adjusted *R* Square	0.697920607
Standard Error	8553.163182
Observations	22

Table 3 (b). ***Regression Coefficients Obtained***

	Coefficients	*p* - value
Intercept	–9278.604131	0.030682639*
DPs Live	44.2725456	0.000000796741*

Note. * indicates that the relationship is significant at the 5% level.

Table 3 (c). ***ANOVA***

	df	SS	MS	*F*	Significance *F*
Regression	1	3622579382	3620000000	49.51814822	0.000000796741
Residual	20	1463132008	73156600		
Total	21	5085711391			

The model is found to be fit as the ANOVA *F*-statistic is 49.52 and is significant at the 5% level. Adjusted *R*-squared of about 70% means that 70% variation in DPs location is explained by DPs live.

Issues and Challenges Amidst Technological Transformation

Every technological reform brings additional challenges to the economy. Curbing cybercrime is one of the major hurdles that all digitalized companies have to face. Companies attempt to eliminate risks by adopting suitable risk mitigation measures such as continuous monitoring, close vigilance, multi-layer back-up system, upgradation of technology, etc. Yet, cyber-attacks take place causing a huge loss in terms of consumer data, compromised internal information, monetary losses, and loss of investor confidence in the operations of the institutions. One such incident took place in NSDL on October 10, 2016, where the NSDL's website (hosted by a third-party data provider and data centre Ctrl-S) was hacked. Though the website was restored within a few minutes without any damage, yet this incident is conclusive proof of the main challenge faced by the depositories (Dalal, 2017).

Initiatives by SEBI to Promote Digital Transformation

SEBI, as a market regulator, periodically issues circulars ordering different market participants to follow some guidelines. Some of the guidelines are :

- SEBI has made the transfer of listed securities in the dematerialized form held by the depository compulsory with effect from April 1, 2019.

- Use of Unified Payment Interface (UPI) system to block funds while submitting subscription applications to the intermediaries, thus giving an additional easier option to investors and improving liquidity. This facility applies to firms issuing shares after January 1, 2019.

- SEBI, vide amendment dated January 31, 2019, has ordered intermediaries to compulsory reporting of Artificial Intelligence/Machine Learning Reporting Form quarterly. The objective of such an amendment is to create a database and gain an in-depth knowledge of prospective opportunities and challenges arising from the use of technology in Indian capital markets.

- A project, work in progress, with a technology-based inspection agenda, will collect data from various intermediaries into the SEBI database and develop algorithms and models to foresee incidences of breaches of regulatory guidelines in advance along with alerts on possible non-compliance.

- SEBI is very particular regarding reporting of cyber security and cyber resilience framework by the depository participants, which is to be made on a quarterly basis.

Summary and Conclusion

India has made remarkable progress when it comes to the digitalization of depositories in a short period. Extensive use of technology with the latest software and hardware systems, a disaster recovery site, encrypted information security systems, and multiple backup plans ensure that depositories attain their objectives. Both NSDL and CDSL have digitally transformed themselves over the years to utmost client satisfaction and capital market development. They have been acknowledged and awarded for the various e-services and facilities provided by them.

CAGR of 18.94%, 8.25%, 18.94%, 13.84%, 18%, and 29.07% have been computed for the number of companies live, number of DPs in operation, DPs locations, number of beneficiary owner accounts, demat value, and number of shares in demat form, respectively. The growth rate of the variables provides evidence of the phenomenal growth of the digitalization of depositories in India.

A significant relationship has been established between DPs live and DPs location, that is, as the number of DP increases by 1%, the number of locations at which the DPs are operational increases by 44%. This implies that DPs are not concentrated in one place, rather they are distributed across the country and the services of DPs are accessible to investors.

Further, despite the challenges faced, depositories, along with SEBI, have always ensured that these challenges do not come in the way of the development process. They have always opted for improvization, innovation, and strict implementation of regulations for the effective technological transformation.

Managerial and Theoretical Implications

Digital technology was once considered as one of the major disruptive forces in Indian capital markets. But the scenarios have completely changed now. It is one of the most important factors for capital market development as is evident from the study. It has become all the more important due to COVID-19 fears. The lockdowns and restraints in almost all parts of the world have mandated digital evolution and innovation in capital markets. The future of digital technology in capital markets lays in the continuous effective use of artificial intelligence, big data tools, blockchain technology, and data footprint security for better and effective analysis for portfolio monitoring, investment decision making, and investor protection. Investment in information and technology will not only help in improving investor experience, decision making (Tolo, 2016), and transparency, but also help in facing the challenges created by technology like cyber-crimes. If done so, in the future, the Indian capital markets

will surely be connoted as intelligent and automated, data-led and client-centric, open and accessible, simple and homogenous (Jelf, 2018).

Limitations of the Study and Scope for Future Research

Every piece of work is bound to have certain limitations. This study is no different. The qualitative aspect of digitalization at depositories, that is, the pros and cons in terms of reduction of human efforts could not be explored in depth. The study has also a lot of potential for future research. A thorough analysis and comparison could be undertaken for international depositories with the Indian depository system. The digitalization progress of other financial institutions can also be studied. Last but not the least, digitalization of depositories in pre-and post-COVID-19 regimes can be studied in-depth to ascertain the impact of the pandemic on the digitalization progress of financial markets.

Authors' Contribution

Dr. Lovleen Gupta and Dr. Amiya Kumar Mohapatra conceived and articulated the presented idea. Dr. Gupta extracted high quality research articles from reputed journals to develop a theory and streamline the objectives. Tripti Goel collected data and performed the computations and prepared the sample article in consultation with both the authors. Dr. Amiya Kumar Mohapatra verified the analytical methods and supervised the findings of the work. Ms. Goel took lead in writing the manuscript. All authors discussed the results, provided critical feedback, and contributed to the final manuscript.

Conflict of Interest

The authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest, or non-financial interest in the subject matter, or materials discussed in this manuscript.

Funding Acknowledgement

The authors received no financial support for the research, authorship, and/or for the publication of this article.

References

Babu, B. H., Rao, B. K., & Rao, B. S. (2016). Role of depositories in Indian capital market – A comparative study between NSDL and CDSL. *International Journal of Scientific and Research Publications, 6*(12), 135–141.

Bajwa, R. (2016). Strengthening the capital market in India : A key to growth. *Indian Journal of Finance, 10*(2), 24 – 39. https://doi.org/10.17010/ijf/2016/v10i2/87233

Bhagwat, S., & Omre, R. (2018a.). An analysis on financial performance of Indian depositories. *International Journal of Research and Analytical Reviews, 5*(3), 1149 – 1170.

Bhagwat, S., & Omre, R. (2018b.). A study on Indian depository system : Growth & role in Indian financial market. *Journal of Emerging Technologies and Innovative Research, 5*(7), 266 – 280.

Bhatt, K. A., & Bhatt, K. (2012). Financial performance evaluation of depositories in India (A comparative study of NSDL and CSDL). *International Journal of Scientific and Research Publications, 2*(2), 1 – 7.

Dalal, S. (2017, February 14). *Cyber attacks : SEBI questions NSDL's speed of reporting 10th October attack.* MoneyLife. https://www.moneylife.in/article/cyber-attacks-sebi-questions-nsdls-speed-of-reporting-10th-october-attack/49716.html

Gopal, B. V., & Rao, R. P. (2014). A comparative study on depository and depository participants with reference ROI and ROA. *MIJBR - MITS International Journal of Business Research, 1*(2), 7 – 15.

Hari Krishna, B., & Arun Kumar, A. (2020). Book Review - FinTech, BigTech and Banks : Digitalisation and its Impact on Banking Business Models. *Indian Journal of Finance, 14*(5–7), 76–79. https://doi.org/10.17010/ijf/2020/v14i5-7/153326

Jelf, O. (2018, January 29). *Capital markets technology 2022 : Designing your competitive advantage.* Accenture Capital Market Blog. https://capitalmarketsblog.accenture.com/capital-markets-technology-2022-designing-competitive-advantage

Kotishwar, A. (2018). Impact of digitalization on select banks. *Indian Journal of Finance, 12*(12), 32–51. https://doi.org/10.17010/ijf/2018/v12i12/139890

Kumar, A. (2018). A technical analysis of Indian spot and derivative market through digitization. *ZENITH International Journal of Business Economics & Management Research, 8*(7), 1–12.

Moss, M., & Currall, J. (2004). Digitisation: Taking stock. *Journal of the Society of Archivists, 25*(2), 123–137. https://doi.org/10.1080/0037981042000271457

Rajan, J., & Manikantan, G. (2015). Performance evaluation of depositories in India : A comparative study of NSDL and CDSL. *Review of Social Sciences, 16*(2), 38 – 50.

Raju, M. T., & Patil, P. R. (2001). *Dematerialisation - A silent revolution in the Indian capital markets* (Working Paper Series No 4). Securities and Exchange Board of India.

Ramesh, N.G. (2017). *Indian capital market 2020.* https://www.primedatabase.com/article/2017/10.Article-Ramesh%20NGS.pdf

Ramkumar, K. (2016). *Implementation of digitalization & STP processes in the capital market - The CDSL way.* https://www.primedatabase.com/article/2016/53.Article-Ramkumar%20K.pdf

Rani, P., & Srinivasan, A. (2015). Digitization of financial markets : Impact and future. *International Journal of Research in Finance and Marketing, 5*(7), 29 – 33.

Rekha, I. S., Basri, S., & Kavitha, T. C. (2020). Acceptance of internet banking : Comparing six theoretical models. *Indian Journal of Finance, 14*(3), 7–21. https://doi.org/10.17010/ijf/2020/v14i3/151073

Tolo, E. (2016, June 7). Will digitalisation transform the financial sector too ? *Bank of Finland Bulletin.* https://www.bofbulletin.fi/en/2016/2/will-digitalisation-transform-the-financial-sector-too/

About the Authors

Dr. Lovleen Gupta is an Assistant Professor in the Department of Commerce, Hindu College, Delhi University. She completed her PhD from Department of Commerce, Delhi School of Economics, University of Delhi and is an Associate Member of the Institute of Chartered Accountants of India (ICAI). She has been honored with a number of prestigious awards and medals from various academic institutions and ICAI for her academic performance and literary contribution. She has various articles and research papers to her credit published in the journals of national and international repute.

Dr. Amiya Kumar Mohapatra is Deputy Director at FOSTIIMA Business School, New Delhi. Dr. Mohapatra has been engaged in teaching as well as research in the areas of economics, finance, public policy, and quality assurance. He has co-authored five reference books and published 21 edited books and more than 75 research articles. He is also Guest Editor and Editorial Board Member of many reputed national and international journals.

Tripti Goel is a Research Scholar at Department of Commerce, Delhi School of Economics, University of Delhi. She is a rank holder in her post graduation from Sri Ram College of Commerce. Her research areas include stock market, especially primary markets. She has attended various faculty development programmes and national and international conferences.

INDIAN JOURNAL OF RESEARCH IN CAPITAL MARKETS

Statement about ownership and other particulars about the newspaper "INDIAN JOURNAL OF RESEARCH IN CAPITAL MARKETS" to be published in the 1st issue every year after the last day of February.

FORM 1V
(see Rule 18)

1.	Place of Publication	:	NEW DELHI
2.	Periodicity of Publication	:	QUARTERLY
3.	4,5 Printer, Publisher and Editor's Name	:	S. GILANI
4.	Nationality	:	INDIAN
5.	Address	:	Y-21,HAUZ KHAS, NEW DELHI - 16
6.	Newspaper and Address of individual	:	ASSOCIATED MANAGEMENT
	Who owns the newspaper and partner of	:	CONSULTANTS PRIVATE LIMITED
	Shareholder holding more than one percent.	:	Y-21, HAUZ KHAS, NEW DELHI-16

I, S.Gilani, hereby declare that the particulars given above are true to the best of my knowledge and belief.

DATED : March 1, 2021

Sd/-
S. Gilani
Signature of Publisher