

LITERATURE REVIEW OF AUTHORS EXAMINING THE DIGITAL TRANSFORMATION OF BANK STRESS TESTING TO THEIR REVERSE PROFILE

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Annotation: *The scientific material reviews the most important scientific developments related to the digital transformation from standard bank stress tests to their reverse profiles. The author refers to many authors discussing the problem. Peter Grundke and Kamil Pliszka scored 6 steps on the reverse stress test. An attempt is made to define the concepts by Christian Thun, Juan M. Licari and Mark Zandi, as shown in Figure 1. The Hybrid Approach to Reverse Stress Testing includes is also briefly discussed. Three conclusions have been drawn, regarding the matter of the review.*

Key words: *digital transformation, stress testing of banks, reverse stress test*

JEL Classification Numbers: *C14, G11, G20, G21, G32*

I. Digital business transformation

The stress testing procedure has been actively used in the economy and the banking sector since the end of the last century. The financial crisis of 2008 and CoViD-19 pandemic of 2019 showed the need to modernize the existing approaches to risk assessment.

This research contains a literature review which provides insight into the fundamental comprehension of digital transformation and stress testing. In a report entitled “The Internet of Everything”, CISCO Systems estimated that 10 billion devices were connected to the internet in 2013, and predicted that this number would rise to 50 billion by 2020. Furthermore, it projected that \$14 trillion in business and economic value would be at stake between 2013 and 2020 nationwide, across industries and companies through business innovation, higher productivity, increased efficiency in processes, and enhanced customer experiences.

The roots of Digital business transformation (DBT) can be found in MIT Media Lab founder Nicholas Negroponte’s 1995 book „Being Digital”, which explores the substitutability of bits and atoms. Negroponte suggested that „any form of information that exists as atoms (like books and DVDs) can be represented by bits on a digital device”. This fundamental insight formed the basis of the early growth of e-commerce, as well as the widespread deployment in more traditional industries of information systems.”^[1,2] Digital

¹ See: Mezghani, K. and W.Aloulou. (2019) Bussines Transformation in the Era of Digitalizatioin. IGI Global. ISBN 9781522572626, pp.149-159; Ziyadin, S., S. Suienbayeva and A. Vtegenova. Digital Transformation in Business. Springer Nature Switzerland AG 2020, pp.408-415

² Donald A. Marchand and Michael R. Wade. (2020) Digital business transformation: Where is your company on the journey. Global Center for Digital Business Transformation. Available from: https://www.imd.org/research-knowledge/articles/digital-business-transformation-where--is-your-company-on-the-journey/?gclid=EAIaIQobChMIv7Lk7b_06QIVyR0YCh1gMwbTEAAYASAAEgJaDvD_BwE. [Accessed 09th June 2020]



business transformation as organizational change through the use of digital technologies to materially improve performance.

Owing to that, digital business transformation is about smarter performance. Combining digital technologies with the organizational and humanitarian changes required to build a digital information-oriented culture allows organizations to significantly improve business performance.

It is stated that, there are six specific areas of performance improvement:³

- capturing and using real-time data about customer experiences for smarter sales interactions;
- monitoring and tracking information about product, service and solutions support for continuous improvement;
- sharing knowledge and information more effectively to act across functions and organization boundaries;
- applying deeper and more targeted analytics that enable better decision-making;
- deploying more efficient and agile processes, as well as systems to react to rapid business change;
- adopting more innovative and resilient business models to create disruptive change and innovation in a particular industry.

The framework for digital business transformation, which specifies the following four quadrants:⁴

Quadrant 1: Going digital - doing the rudimentary steps;

Quadrant 2: Strong e-commerce capabilities - separated from the core business;

Quadrant 3: Exploiting digital data and business insights - building for the future;

Quadrant 4: Digital business capabilities - a global transformation journey.

Therefore, it is considered that, combining digital technologies with the organizational and humanitarian changes required to build a digital information-oriented culture allows organizations to significantly improve business performance.

Depending on this, the following conclusions can be drawn:

First and foremost, digital business transformation is happening on a scale and at a speed that managers find both threatening and promising;

Secondly, digital business transformation is about smarter performance.

In their introduction Mariam H. Ismail, Mohamed Khater, Mohamed Zaki. (2017) indicate that, „Digital transformation (DT) is becoming a prime topic for firms across the globe (Von Leipzig et al. 2017; Kane et al. 2015; Kaufman & Horton 2015; Fitzgerald et al. 2013)⁵. It is anticipated that companies that are unable to adapt to the digital world will undoubtedly fall victims to “digital Darwinism”, where incumbents may disappear and only

³ Review, cited work: Donald A. Marchand and Michael R. Wade. (2020)

⁴ Figure 1: Digital business transformation framework. See: Marchand, D., Wade, M. and Fang Liu. Digital business transformation. Available from: <https://www.imd.org/research-knowledge/articles/digital-business-transformation/>[Accessed 24th June 2020]

⁵ See: Von Leipzig, T. et al., (2017) Initialising customer-orientated digital transformation in enterprises. *Procedia Manufacturing*, 8(2017), pp.517-524; Kane, G.C. et al., (2015) Strategy, Not Technology, Drives Digital Transformation. *MIT Sloan Management Review*, pp.1-25; Kaufman, I. & Horton, C., (2015) Digital Transformation: Leveraging Digital Technology with Core Values to Achieve Sustainable Business Goals. *The European Financial Review* (December-January), pp.63-67; Fitzgerald, M. et al., (2013). Embracing Digital Technology: A New Strategic Imperative. *MIT Sloan Management Review*, pp.1-12

the most adaptable enterprises, responsive to technological trends, will survive to remain on the competitive landscape (Schwartz 2001)⁶. Yet, the history of companies' technological advances has been plagued with failed attempts that focus solely on technologies without taking broader strategic decision areas into account (Kane et al. 2015). Currently, there are many examples of organizations unable to keep pace with the new digital era and managers still lack clarity about the strategic considerations in their digital transformation endeavors (Hess et al. 2016; Matt et al. 2014).⁷

II. Traditional stress testing of banks

The bank as a financial institution is characterized by numerous positions on its balance sheet, the three most important positions are interbank assets, liabilities and capital. According to the Bulgarian author Zhelyo Vatev, traditional stress testing focuses on the study of events with a low probability of occurrence, but containing the risk of significant potential losses.⁸

Stress testing involves putting a severe amount of pressure on an object or system, to test how resilient it is under extreme conditions. It is a tool used in a number of industries, from construction to cardiac health care. When applied to banks, stress testing involves analysing how these institutions would cope with hypothetical adverse scenarios, such as a severe recession, a financial crisis, or coronavirus CoViD-19 pandemic.

Bank stress testing is designed to test the resilience of banks to severe but plausible shocks. In practice, this typically means modelling the impact of hypothetical adverse macroeconomic and financial market scenarios on bank profitability and balance sheets.

It is necessary to consider the following two circumstances:

(i) Stress tests generally start with the specification of hypothetical stress scenarios. These scenarios tend to incorporate paths for economic and financial market variables, which together are more severe than the stress-testing authority's central expectations, and which might be expected to have an adverse impact on banks;

(ii) A variety of different modelling techniques are then used to estimate the impact of the scenario(s) on banks' profits and balance sheets.⁹

A stylized image of a bank stress test provides an answer to the question "What impact does stress testing of bank capital have?", in the following scenarios for:

- falling house prices;
- an economic recession;
- rising unemployment;
- falling share prices.

Stress forecast horizon for „capital ratio“ means: adequately capitalised and inadequately capitalised.

⁶ Schwartz, E.I., (2001) *Digital Darwinism: 7 Breakthrough Business Strategies for Surviving in the Cutthroat Web Economy*, Broadway.

⁷ Mariam H. Ismail, Mohamed Khater, Mohamed Zaki. (2017) *Digital Business Transformation and Strategy: What Do We Know So Far?* Digital Business Transformation and Strategy: What Do We Know So Far?, Introduction. Cambridge Service Alliance 2017, p.1

⁸ Vatev, Zh. (2012) *Diskusionni vaprosi otnosno stress-testvaneto v savremennata bankova praktika. Spisanie Dialog*, 3, p.8

⁹ Kieran Dent, Ben Westwood and Miguel Segoviano. (2016) *Stress testing of banks: an introduction. Quarterly Bulletin* 2016, Q3, p.130-131. Available from: <https://www.bankofengland.co.uk/-/media/boe/files/quarterly-bulletin/2016/stress-testing-of-banks-an-introduction.pdf> [Accessed 10th June 2020]



In this context, stress testing of banks should include:

- (a) stress tests that start with the specification of hypothetical stress scenarios;
- (b) a variety of different modelling techniques used to estimate the impact of the scenario(s) on banks' profits and balance sheets;
- (c) modelling the impact of hypothetical adverse macroeconomic and financial market scenarios on bank profitability and balance sheets;
- (d) adverse scenarios typically containing hypothetical future paths for a set of economic and financial market variables, which together might be expected to stress bank business models and to lead to losses;
- (e) scenarios are designed to be much worse than stress-testing authorities' central expectations about how economic activity and financial market developments are likely to turn out;
- (f) examples resembling severe recessions with falling GDP, sharp contractions in house prices, and rising unemployment.

In conclusion, the analysis of a scenario's impact involves modelling the way in which the scenario would be likely to affect different aspects of participating banks' businesses.

III. Reverse stress testing

The European Banking Authority (EBA) guidelines on stress testing identify reverse stress testing as a type of stress testing that meets one or more of the following characteristics:

- ✓ reverse stress testing is used as a risk management tool aimed at increasing the institution's awareness of its vulnerabilities by means of the institution explicitly identifying and assessing the scenarios (or a combination of scenarios) that result in a pre-defined outcome;
- ✓ the institution decides on the kind and timing (triggering events) of management or other actions necessary for both (a) rectifying business failures or other problems; and (b) aligning its risk appetite with the actual risks revealed by the reverse stress testing;
- ✓ specific reverse stress testing can also be applied in the context of recovery planning (e.g. reverse stress tests applied in a wider context can be used to inform a recovery plan stress test by identifying the conditions under which the recovery might need to be planned).¹⁰

Here should be noted that in a reverse stress test - certain highly unfavorable consequences are identified and then the scenarios that could lead to them are specified.

The reverse stress test is the opposite of the stress test it supplements the results of the conventional stress test by a conditional analysis of the state of the affairs, given a pre-defined scenario where some adverse outcome has already occurred.

The best way to create a reverse stress test for certain types of risks is as a part of the whole stress testing framework. As such, it is implied that the stress testing framework is a singular entity and should be treated accordingly.

¹⁰ François-Xavier Duqué and Kristian Lajkep. (2019) Reverse stress testing. Available from: <https://www.finalyse.com/blog/reverse-stress-testing>. [Accessed 08th June 2020]

The building blocks of François-Xavier Duqué and Kristian Lajkep¹¹ reverse stress testing framework would be the following ones:

(i) Bank failure target. In the case of reverse stress testing, we start with the definition of the level of bank failure needed to assess the stress test scenarios.

(ii) Tail Risk Analysis. A pragmatic way to perform this analysis is to look at the loss distribution simulated for value at risk (VaR) and to isolate the main risk factors responsible for losses in the neighbourhood of the level previously identified. In a historical VaR approach, the space of risk factor realisation may be too narrow, because only combinations of risk factors effectively observed in the past will occur.

(iii) Identifying and running the nonviable scenarios. Scenarios derived from the tail risk analysis should then be calibrated more precisely – using a sensitivity approach - to produce a sufficient level of loss.

(iv) Full reevaluation and quantification of impacts. The following step would be to add these scenarios in the stress test framework and validate the losses calculated under full-reevaluation.

(v) Documentation: The last but not necessarily least step is to provide a consistent documentation of the stress testing framework, in line with market best practices.

Peter Grundke and Kamil Pliszka scored 6 steps on the reverse stress test, namely:

steps 1: Calculation of the principal components of the term structure of risk-free interest rates;

steps 2: Estimation of the sensitivities of the asset returns with respect to risk factors;

steps 3: Estimation of the multivariate distribution of the systematic risk factors;

steps 4: Calibration of the asset return thresholds with respect to the empirical migration and default probabilities;

steps 5: Evaluation of all scenarios in the risk factor space;

steps 6: Determining the most probable scenario exhausting the capital buffer.¹²

In particular, the definition, idea and purpose of the reverse stress test are defined as follows:

The standard definition specifies: Process of identifying the point at which a financial institution's business model becomes unviable and then identifying scenarios and circumstances that might cause this to occur;

The constructed idea: Reverse engineering of the risk management process. Think beyond capital/losses/liquidity: reputation, concentration, loss of confidence;

Two Purpose:

- Overcome disaster myopia an improves contingency planning;

- To be added as a key Risk Management tool.¹³

¹¹ Cited according to: François-Xavier Duqué and Kristian Lajkep. (2019)

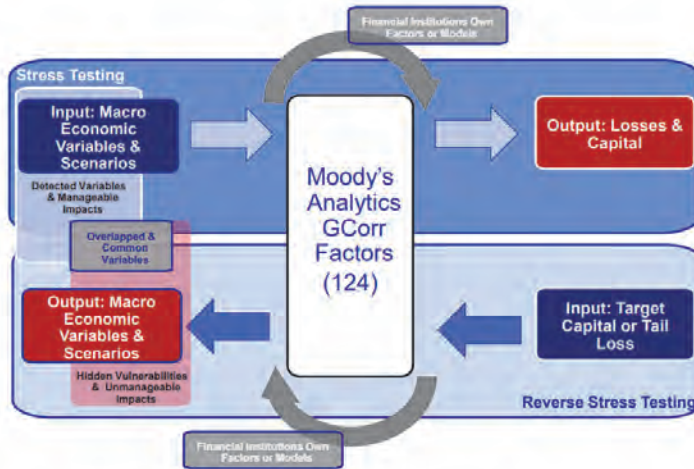
¹² Peter Grundke and Kamil Pliszka. (2015) Discussion Paper. Deutsche Bundesbank, No 30/2015, pp.2-3

A Macroeconomic Reverse Stress Test. Bundesbank Discussion Paper No. 30/2015, ISBN 978-3-95729-185-1, p.2-5

¹³ Christian Thun, Juan M. Licari and Mark Zandi. (2010) Reverse Stress Testing: Challenges & Benefits. November 23rd, 2010. Moody's analytics. Available from: <https://www.moodyanalytics.com/-/media/presentation/before-2011/10-23-11-Reverse-Stress-Testing.pdf> [Accessed 08th June 2020], p.12

The direction of movement of Reverse Stress Testing vs. Stress Testing based on 124 factors is as follows. (See fig.1)

Figure 1
Reverse Stress Testing vs. Stress Testing - “The Big Picture”



Source: Christian Thun, Juan M. Licari and Mark Zandi. (2010) Reverse Stress Testing: Challenges & Benefits. November 23rd, 2010. Moody's analytics. Available from: <https://www.moodyanalytics.com/-/media/presentation/before-2011/10-23-11-Reverse-Stress-Testing.pdf> [Accessed 08th June 2020], p.12

(i) *Stress Testing*

- ◆ Input: Macro Economic Variables & Scenarios; Detected Variables & Manageable Impacts; Overlapped & Common Variables; [Moody's Analytics GCorr Factors (124)]
- ◆ Output: Losses & Capital.

(ii) *Reverse Stress Testing*

- ◆ Input: Target Capital or Tail Loss; [Moody's Analytics GCorr Factors (124)]
- ◆ Output: Macro Economic Variables & Scenarios; Hidden Vulnerabilities & Unmanageable Impacts.

Hybrid Approach to Reverse Stress Testing includes:

- Stress on Business Model;
- Qualitative Analysis: Key Risks;
- Potential Scenarios;
- Time Series of Macro & Financial Series;
- Implement scenarios into Risk Management Tools;
- Calculate Losses, Capital and Liquidity.¹⁴

¹⁴ As quoted from Christian Thun, Juan M. Licari and Mark Zandi. (2010)

Summarizing the existing research, it can be concluded that:

First: The digital transformation of business is an irreversible process that involves all economic actors.

Second: In the specific research area, stress testing and the use of reverse stress tests will improve the risk management of the banking institution.

Third: The Authors' Review shows that the issues are discussed in order to put the banking institution in a real situation with a corresponding scenario.

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