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Technology-Based Corruption: A Comparative Case Study in the Context of Enron, Lehman Brothers and Volkswagen

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Abstract: This study examines systematic forms of corruption reinforced by technology under the pressures of neoliberal competition and the pursuit of high profits. Its main argument is that corruption should not be regarded solely as a historical deviation associated with underdeveloped countries; rather, it can also emerge in technologically advanced developed economies, particularly within Western multinational corporations. To test this argument, the study conducts a comparative case analysis of Enron, Lehman Brothers, and Volkswagen, selected through purposive sampling, in order to investigate how technology-enabled forms of corruption are produced, concealed, and sustained. The theoretical framework of the study is based on Risk Society Theory, which emphasizes that technology generates not only beneficial outcomes but also new forms of systemic risk, and Principal-Agent Theory, which explains how information asymmetry and conflicts of interest may enable technology to be used as a tool for concealing corruption. The findings show that intensive technology use played a central role in the emergence of corrupt practices in the collapse of Enron as a typical case, the bankruptcy of Lehman Brothers as an outlier/extreme case, and Volkswagen's Dieselgate scandal as a critical case. Accordingly, the study argues that regulatory frameworks should be expanded, risk-based auditing should be strengthened, and technology-enabled control mechanisms should be developed to prevent technology-based corruption.

Keywords: Technology, Corruption, Techno-corruption, Risk society, Principal-agent theory, Comparative case study

Öz: Bu çalışma, neoliberal rekabet baskısı ve yüksek kâr arayışı altında ortaya çıkan, teknolojiyle pekiştirilen sistematik yolsuzluk biçimlerini incelemektedir. Çalışmanın temel argümanı, yolsuzluğun yalnızca az gelişmiş ülkelerle ilişkilendirilen tarihsel ya da kültürel bir sapma olarak görülemeyeceği; aksine teknolojik kapasitesi yüksek gelişmiş ekonomilerde ve özellikle Batılı çokuluslu şirketlerde de ortaya çıkabileceğidir. Bu argümanı değerlendirmek amacıyla, amaçlı örnekleme yoluyla seçilen Enron, Lehman Brothers ve Volkswagen vakaları karşılaştırmalı vaka analizi yöntemiyle incelenmektedir. Çalışmanın kuramsal çerçevesi, teknolojinin yalnızca yararlı sonuçlar değil, aynı zamanda yeni sistemik riskler de üretebileceğini vurgulayan Risk Toplumu Teorisi ile bilgi asimetrisi ve çıkar çatışmalarının teknolojiyi yolsuzluğu gizleyen bir araca dönüştürebileceğini açıklayan Asil-Vekil Teorisine dayanmaktadır. Bulgular, yoğun teknoloji kullanımının tipik vaka olarak Enron'un çöküşünde, aykırı/uç vaka olarak Lehman Brothers'ın iflasında ve kritik vaka olarak Volkswagen'in Dieselgate skandalında yolsuzluk pratiklerinin ortaya çıkmasında merkezi bir rol oynadığını göstermektedir. Bu doğrultuda çalışma, teknolojiye dayalı yolsuzlukların önlenebilmesi için düzenleyici çerçevenin genişletilmesi, risk temelli denetim kapasitesinin güçlendirilmesi ve teknoloji destekli kontrol mekanizmalarının geliştirilmesi gerektiğini ileri sürmektedir.

Anahtar Kelimeler: Teknoloji, Yolsuzluk, Tekno-yolsuzluk, Risk toplumu, Asil-vekil teorisi, Karşılaştırmalı vaka analizi

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Introduction

The concepts of technology and technological progress have implicitly or explicitly shaped modern thought since the Renaissance. Under the influence of the linear conception of progress, the positive dimensions of technological development have generally been emphasized through claims that technological inventions contribute to development by increasing productive efficiency, accelerate the growth of civilization by expanding material capacities, make development and progress quantitatively measurable, serve humanity in its struggle against natural constraints, remain under human control, and reach their most advanced form in Western civilization (Basalla, 1988).

The phenomenon of technology and technological change, which has traditionally been positioned as a tool under human control and in the service of humanity, has today come to the fore not only for the economic and social benefits it generates, but also for the anxieties and risks it produces. Technological transformation has been argued to disrupt income distribution and deepen social inequalities rather than generating a widespread welfare effect. Moreover, by increasing productivity, it threatens low-skilled labor, while recent developments such as artificial intelligence enhance the capacity to generate and process information, thereby opening the door to a potentially irreversible transformation (Reich, 2016).

At this point, it would be useful to emphasize that multinational corporations, as key agents of Western-led globalization, have reached geographical borders that exceed the great empires of history, and that they command resources that in some cases exceed those of many states and international organizations through their technology-based investment, employment, production, marketing and sales strategies. In fact, it is observed that multinational corporations, which have strengthened the dependencies in the global economy, have been nurturing oligopolistic tendencies by eroding the competitive environment through their great financial power and managerial capability. This concentration of power and imperfect competitive environment, which was driven by advanced technology and the pursuit of high profits, resulted in the implicit domination of multinational corporations (Gilpin, 2016). This concentration of economic and technological power also creates new opportunities for sophisticated forms of corporate misconduct.

This study examines how technology-based corruption -techno-corruption- emerges in Western multinational corporations through a comparative case analysis of the Enron, Lehman Brothers and Volkswagen cases, treating the phe-

nomenon not only as a pathology specific to non-Western structures but also as a multidimensional behavioral problem that can emerge even in systems with seemingly strong institutional structures. More formally, we seek to answer the research question: Does corruption remain a historical and cultural pathology often associated with non-Western societies, or does it emerge as a broader organizational phenomenon that permeates corporate structures through the use of technology in Western multinational corporations operating under the pressure of neoliberal competition and high profit motivation?

The study is based on two main theoretical frameworks: The first is Ulrich Beck's "Risk Society" approach. In this perspective, modern technologies contribute to increased production and productivity, but also create new, unpredictable, and systemic risks, one of the most visible manifestations of which is large-scale corruption that emerges as a result of the inability of oversight and regulatory mechanisms to keep pace with technological complexity. Our second theoretical underpinning is the "Principal-Agent Theory". According to this theory, information asymmetry and conflicts of interest, especially in large corporate structures, lead managers to pursue short-term profit targets instead of transparency, accountability and ethical values; this situation transforms technology into a means of both producing and concealing corruption.

Accordingly, the three case studies were selected in line with the principle of "purposive sampling" based on John Gerring's case typology and each of them was structured to fulfill a different analytical function. Then, based on Mill's comparative methodology, the cases are analyzed in terms of variables common to all cases using the "Method of Agreement"; distinctive institutional factors between collapsing and non-collapsing cases using the "Method of Difference"; and the possible protective threshold function of only the differentiating elements using the "Method of Residues", thus revealing the causal effects of structural variables in the cases. This analysis aims to reveal how technology-based corruption emerges in contemporary institutional structures and under which conditions these structures become vulnerable. It is based on the argument that corruption is not a problem specific to certain periods, geographies, or institutional structures, but rather a dynamic process that can emerge in different forms across different periods, sectors, and institutional settings.

Technology-Corruption Relationship

Corruption is defined as the abuse of entrusted power for private gain (Transparency International, 2006). There are numerous studies in the literature on the causes and consequences of corruption (see Hines, 1995; Acemoglu and Verdier, 2000; Stiglitz, 2012; Aidt, 2016; Pinto and Zhu, 2016). A common conclusion in this literature is that the relationship between corruption and other variables remains complex and context-dependent (Goel and Nelson, 2010). According to recent reports by Transparency International, corruption is on the rise worldwide; it is emphasized that many major corruption cases involve multinational companies operating abroad (Transparency International, 2024). This finding points to the role of Western-based multinational corporations in the spread of information technology-enabled corrupt practices. Indeed, senior officials at the World Bank state that corruption increasingly transcends borders through technological and financial channels and remains one of the major obstacles to development (Diagana and Diagne, 2023).

The relationship between technology and corruption is multifaceted. The literature generally emphasizes the anti-corruption aspect of technology. For example, the widespread use of digital payment systems limits corrupt behavior in daily transactions by encouraging cashless payments and increasing transparency (Setor, Senyo & Addo, 2021). Likewise, the widespread use of mobile and digital technologies in public services limits opportunities for corruption in the public sector by reducing discretionary interventions and supports development by keeping accountability mechanisms alive through the recording of business processes (Castro & Lopes, 2023). Similarly, big data is increasingly used in areas such as large-scale procurement, compliance monitoring, fraud detection, and anti-money laundering. When processed and analyzed effectively, such data can significantly contribute to the detection of corruption (Zinnbauer, 2025).

On the other hand, there are studies that conclude that technological developments have facilitated corruption. The misuse of technology sometimes results from the unethical use of digital tools. Dion (2011), exploring the cultural underpinnings of cybercrime and corruption, argues that pervasive corruption networks undermine trust among employees and spread suspicion among institutional actors. In such cases, corporate culture deteriorates and technology-enabled corrupt practices may find room to develop. Brogi and Lagasio (2024), who use a bibliometric approach to analyze the relationship between technology and corruption in the FinTech sector, reveal an integrated pattern of financial misconduct rang-

ing from data breaches to fraudulent practices. The negative impact of technology on corruption sometimes stems from its erosion of the capacity to fight it. Cyber fraud is one of the most common examples of technology-enabled corruption. Especially with the increase in the volume of financial transactions and the extensive use of artificial intelligence, security vulnerabilities have turned cyber fraud into a common cross-border crime (Hasham, Joshi & Mikkelsen, 2019). Developments in digital payment systems have also facilitated international bribery, and technological capacity has become an enabling platform for the transfer of illicit funds. In the World Economic Forum's Global Risks Report 2024, cyber-related risks such as ransomware, data fraud, and data theft are identified among the most likely threats (World Economic Forum, 2024).

One of the most important manifestations of the deepening technology-corruption nexus can be observed in the behavior of multinational corporations. The intensification of trade relations due to globalization has strengthened the desire to maintain competitiveness - to maintain comparative advantages - for multinational companies that have to compete with many competitors in the markets. In this process, multinational companies increased their R&D expenditures and invested more heavily in innovation processes and aimed to maintain their market superiority by developing new products and technologies. Thus, the protection of trademark and patent rights became important. Posner's Technology Gap Theory argues that technological innovations create a market advantage for countries or companies with preferential access to these innovations. By contrast, Vernon's Product Cycle Theory states that this advantage can weaken later in the life cycle of products, so that other countries can imitate these products and join the competition. Within this framework, underdeveloped countries can quickly imitate the technological innovations of MNCs and gain easier access to these markets. In the face of this situation, these corporations and governments seek to protect intellectual property rights at the international level to protect their innovations. However, such an intensified competitive environment makes multinational corporations more assertive and sometimes more aggressive to protect their innovations and market shares (Xu & Yano, 2017; Lee, Wang & Ho, 2020).

Advances in accounting software technology have also highlighted the role of multinational enterprises in concealing and facilitating corrupt practices in pursuit of competitive advantage and higher profits (Otusanya, Lauwo & Ahmad-Khair, 2017). Accounting manipulation and financial reporting fraud are widely recognized to undermine a fair and well-functioning market economy. According to UNCTAD

(2025) data, the value of global capital flows exceeded USD 1.3 trillion in 2024. 65% of these global investments, which are carried out by multinational enterprises, are directed towards developing countries. In countries where institutional quality is relatively weak, officials may have stronger incentives to manipulate regulations or loosen controls for private gain. This is one of the factors that may encourage multinational enterprises to engage in corrupt practices (Zhong et al., 2019).

As is evident from the vast literature on the relationship between technology and corruption, corruption should not be treated as a fixed attribute of a particular person, organization, or country. On the contrary, corruption emerges as a pattern of behavior involving actors at different levels and unfolding through complex processes. Intense global competition and technological advances may enable multinational corporations to engage in corrupt practices through more sophisticated technological tools. This makes corruption difficult to detect and even allows for long-term concealment. While conventional approaches often associate corruption in non-Western contexts with nepotism or cronyism, the cases examined in this study suggest that corruption in technologically advanced Western corporations may also become systematic through the use of advanced technological tools. Such corruption is extremely difficult to detect as it is carried out through high-tech methods involving software and hardware. In sum, the complex nature of corruption, which has become more sophisticated with technological advances, has the potential to generate serious consequences not only for financial markets but also for corporate governance, regulatory systems, and the global economic order.

Description, Classification and Comparison of Cases

In this section, the impact of technology on corrupt behavior is examined through a comparative qualitative case study analysis of three major corruption cases centered on multinational corporations. Case selection is recognized as one of the most critical stages of qualitative research methods. In the case selection process, the case typology of John Gerring, one of the pioneers of this field, was utilized (Gerring, 2006).

According to Gerring, case selection is one of the most important factors for the researcher. Accordingly, cases should be carefully selected based on certain criteria, justified, and readers should be convinced of their relevance. Indeed, even a single carefully selected case can provide information suitable for generalization, while faulty or biased case selection can seriously damage the scientific value and reliability of the study (Süleymanoğlu-Kürüm, 2021).

The three cases analyzed in the study were selected in line with the principle of "purposive sampling" based on John Gerring's (2006) case typology and each of them was structured to fulfill a different analytical function. In the selection of cases, how technology-based corruption is shaped in organizational structures and the institutional consequences of this process were taken into account as determining criteria. Within this framework, Enron is considered as a typical case that is suitable for testing theoretical assumptions as it demonstrates how corruption can be systematically integrated into corporate functioning through technology-supported accounting manipulations. Lehman Brothers is an outlier case in that it demonstrates how complex networks of corruption through derivatives and financial algorithms can generate not only internal but also global systemic risk. By contrast, Volkswagen serves as a critical case demonstrating that unethical technological manipulations are possible in a structure that is supposed to have strong corporate governance standards.

Description of the Cases

In the following three subsections, three major corruption cases involving Western multinational enterprises -Enron, Lehman Brothers and Volkswagen- are analyzed comparatively and the relationship between technology and corruption is discussed. Specifically, the aim is to show how the use of technology has enabled widespread corruption, how regulators have been misled, and how these processes challenge conventional non-Western-centered perceptions of corruption.

The Enron Scandal

The Enron scandal, one of the most striking examples of financial scandals, occurred in 2001. Enron was founded in 1985 in Houston with the merger of two energy companies, Houston Natural Gas and InterNorth. By the early 2000s, it had become the seventh largest company in the US, with investments in many different fields, particularly in the energy sector (Altinbay & Unal, 2022; Ayboga, 2021). Enron, which directed its investments to the energy sector, which was innovative, high value-added/profitable and the favorite field of activity at the time, later on made investments in very different sectors such as communication, pulp and paper, and insurance, which it had no experience in. Enron's rapid growth while the US economy was gaining strength won the admiration of many, but it was revealed through internal whistleblowing that Enron's success was supported by problematic (corrupt) practices (Koban & Karakaya, 2022; Moncarz et al., 2006).

A whistleblowing letter sent to Chairman Ken Lay by then Enron Vice President Sherron Watkins revealed in October 2001 that billions of dollars in losses from years of failed deals and projects had been concealed through complex off-balance sheet and special purpose vehicles and various false accounting practices. Enron subsequently revised its previously announced profits downward and announced a reduction in its after-tax net income and shareholders' equity (Benston and Hartgraves, 2002). The adjustment for the previous years (1997-2000) amounted to approximately 2.1 billion dollars (Kandemir & Kandemir, 2012; Ayboga, 2021).

This clearly showed that there was a major problem with the reliability of the financial information that the company presented to the public and that there were serious errors or deliberately misleading information in financial reporting. By manipulating its financial reports and painting a misleading picture, Enron damaged investor and public confidence, which led to a major bankruptcy and legal problems. Enron's bankruptcy affected not only itself but also many investors and employees (Akyuz, 2002). In addition to Enron's collapse, the accounting/consulting firm Arthur Andersen, which had approved the company's controversial accounting practices (and was one of the five largest accounting firms in the US at the time), effectively went bankrupt (Moncarz et al., 2006).

The Enron corruption was rooted in fraudulent behavior and conflicts of interest as well as creative accounting methods adopted in the company's accounting practices. The combination of creative accounting methods with technology increases the risks of corruption and financial fraud. In the case of Enron, these high-tech corruption methods were systematically used to conceal the company's debts and overstate its profits. Technology-driven accounting manipulations seriously undermined the reliability of financial statements and made it difficult for investors to understand the company's true financial position (Altinbay & Unal, 2022).

The Enron corruption, one of the biggest failures in the history of American capitalism, was not only the collapse of a company, but also called into question financial reporting and auditing systems. In addition to the Enron crisis, there were other major corporate bankruptcies in the US in 2001 and 2002. A year after the Enron crisis, in 2002, the WorldCom company declared a massive bankruptcy of $103.9 billion due to a similar financial scandal. In the same year, Conseco, an insurance and finance company, filed for bankruptcy for $61.4 billion due to mismanaged assets and a high debt burden. An important bankruptcy in the telecommunications sector was Global Crossing, which succumbed to the financial crisis and filed for bankruptcy worth $30 billion. Given the $63.4 billion Enron

bankruptcy at the end of 2001 and the even larger WorldCom bankruptcy in 2002, the US Congress could not remain indifferent to the issue and passed the corporate governance law known as Sarbanes-Oxley (SOX) in response to such scandals. These changes are considered as steps to compensate for the loss of trust caused by the Enron corruption and to restore the credibility of the financial system.

Lehman Brothers' Bankruptcy

With a 158-year history, the bankruptcy of Lehman Brothers, one of the five largest investment banks in the United States, is, like Enron, one of the most important scandals of the 21st century. Founded in 1844 by German brothers Henry, Emanuel and Mayer Lehman, Lehman Brothers began its investment banking operations in 1899. Although the company faced many difficulties from its foundation to the date it declared bankruptcy – such as the depression of 1929 and two world wars – it continued to develop steadily as the US economy became an international powerhouse. However, when it filed for bankruptcy on September 15, 2008, it caused a major liquidity crisis in the markets. Following the bankruptcy, many financial institutions struggled to find liquidity due to the loss of mutual trust. Although governments tried to rescue some financial institutions under the "too big to fail" policy, these efforts failed to restore confidence in the markets. This led to a global credit crunch and a financial crisis. In fact the bankruptcy of Lehman Brothers was even blamed for the 2008 Global Financial Crisis (Pepinsky, 2014; Wiggins et al., 2019; Amegashie, 2018).

The economic and market conditions that led to the collapse of Lehman Brothers are complex, but the root causes include excessive leverage and the depreciation of mortgage-backed securities (MBS). The global savings surplus and cheap credit that emerged in the late 1990s and early 2000s led to a bubble in the US housing market. In these conditions, banks were known to have an appetite for lending at low interest rates and often on loose terms, even to those who could not afford to pay. Banks created complex derivative financial products by securitizing the mortgages they secured against the housing loans they extended in the expanding market environment. As rating agencies rated these complex derivative products as low-risk, many investors purchased these products. However, with the repayment problems that emerged in the following period and the disruptions in the housing market, these securities were assessed to be high-risk. Expectations of rapid depreciation intensified, leading to sharp declines in the value of securitized products linked to subprime mortgages and a virtual freeze in credit markets. Lehman Brothers, which was heavily dependent on short-term borrowing to finance

its operations due to its highly leveraged business model, was unable to refinance itself in this environment and went bankrupt (Wiggins et al., 2019; Polat, 2018).

Throughout 2006, Lehman Brothers had been aggressively buying real estate assets and by mid-2007 had significant positions in commercial real estate. The collapse of Lehman Brothers in 2008 was, of course, caused not only by the economic conjuncture but also by a series of critical management mistakes. As mentioned earlier, the first mistake was the adoption of a highly leveraged and risky business model. Despite the preferred high-risk business model, liquidity management was not designed to be compatible with it. In addition, the balance sheet was misleadingly managed through the so-called "Repo 105" transactions, which allowed assets to be moved off the balance sheet and made the net leverage ratio appear more favorable. In this case, the Repo 105 transactions were most likely concealed through the use of data and accounting software in the process of creating the financial statements. Of course, the ineffectiveness of the risk management department in preventing excessive risk and insufficient oversight of the company's risk management processes (internal and external audit; primary regulator SEC-Securities and Exchange Commission) are other important factors leading to the bankruptcy (Wiggins et al., 2019; Jeffers, 2011).

The collapse of Lehman Brothers, which was not only the collapse of an investment bank but also an event that exposed the fragility of the global financial system and regulatory shortcomings, led to significant changes in financial regulations. For example, the Dodd-Frank Wall Street Reform and Consumer Protection Act introduced comprehensive regulations to reduce risks in the financial system and protect consumers in the wake of the crisis, requiring financial institutions to demonstrate greater transparency and conduct less risky operations (Pepinsky, 2014; Amegashie, 2018).

Volkswagen Emissions Scandal

Another major corruption scandal that has had a global impact is the Volkswagen Emissions crisis, commonly referred to as "Dieselgate". After the Enron and Lehman crises, this scandal, which emerged on September 18, 2015, when the US Environmental Protection Agency (EPA) found that Volkswagen had installed defeat-device software in approximately eleven million diesel vehicles, also had an international impact (Jinga, 2022; Keskin, 2024). In 1960, Volkswagen went public on a large scale by selling 60% of its shares and became globally recognized for producing high-quality vehicles (Volkswagen Group, n.d.). By 2023, the company

earned a profit of $19.1 billion on total revenues of $322.3 billion and reached a market capitalization of $58 billion. Currently, Volkswagen is the world's largest automobile manufacturer by revenue (Volkswagen Group, 2024).

Volkswagen has a strong reputation for quality, but in 2015, the United States Environmental Protection Agency (EPA) found that Volkswagen (VW) had installed "defeat devices" in its diesel engines to pass emissions tests. The EPA's discovery revealed a major scandal in which the devices enabled the vehicles to pass tests under laboratory conditions by reducing the vehicle's nitrogen oxide (NOx) emissions, but in normal use, the software was disabled and vehicle emissions were 40 times higher than the permitted pollution level in the US. The scandal caused major reputational damage for the company, as well as the recall of millions of vehicles worldwide and a quarterly loss for the company after 15 years. The incident is estimated to have cost the company around $18 billion in fines and settlements (Dumay & Guthrie, 2017; Jung & Sharon, 2019).

The Volkswagen emissions scandal is an important example of how the use of technology can facilitate corruption, and how technology, when misused, can make corruption possible and to what extent. On the other hand, this incident can also be considered as a turning point for understanding and/or analyzing the financial, environmental and social dimensions of fraudulent practices enabled by technology. Moreover, in this case, technology was systematically used not only to circumvent legal regulations but also to conceal a manipulation that would last for years. The Volkswagen scandal also revealed that sophisticated technological corruption can remain hidden for a long time even in highly regulated countries such as the United States (Jung & Sharon, 2019).

Following the emergence of this scandal, Volkswagen took several steps to restore its reputation, ensure legal and ethical compliance, and secure its future, which is an important example of how companies' failure to adhere to corporate social responsibility strategies and unethical behavior can have serious consequences (Macaityte and Virbasiūte, 2018). Public and media attention to the scandal was usually short-lived, consumers perceived little harm from the incident, and the company tried to overcome the situation with competitive guarantees and radical changes in its organizational structure to restore consumer confidence (Jung & Sharon, 2019; Cavico & Mujtaba, 2016). The ripple effect of Dieselgate not only affected Volkswagen, but also fueled suspicion toward the entire automotive industry, leading to increased scrutiny and regulatory changes to prevent similar incidents in the future.

Comparative Analysis of Cases

Case analysis is a qualitative research method used to examine a case in depth in a specific context. The main purpose of qualitative case analysis is to provide detailed information about why and how a particular event or process occurred and to reveal the internal structure and dynamics of complex phenomena. In descriptive case analysis studies, researchers aim to understand the case subject to analysis in depth by observing all variables and their relationships in interaction with each other, often without associating it with a theoretical perspective (Süleymanoğlu-Kürüm, 2021). According to Creswell (2013), the case analysis method involves the process of collecting comprehensive data from various sources of information by investigating one or more cases in depth over time. In this method, a comprehensive definition of the case under investigation is made and the main themes are reported (Ezikoglu, 2022).

This study aims to analyze how technology-based corruption emerges in contemporary organizational structures and under what conditions these structures become vulnerable. As mentioned earlier, the qualitative comparative case study method is adopted and the analysis process is structured on the basis of Mill's comparative methods. The selection of cases is based on Gerring's case study typology, which has already been mentioned in detail. By analyzing three different cases (Enron, Lehman Brothers, Volkswagen), which share structural similarities but differ in their outcomes, the study aims to uncover the causal logic of technology-enabled corruption patterns.

Table 1

Summary Information on the Cases Subject to the Study

Case	**Enron**	**Lehman Brothers**	**Volkswagen**
Corruption Method	Distortion of financial data through manipulation of internal accounting systems and software	Complex financial algorithms and abuse of derivatives	Development of specialized software to cheat emission tests
Technology Used	Automation-based accounting software and reporting systems	Financial derivatives and algorithms	Emission test software

Detection Difficulties and Causes	Complexity of software and reporting system	Limited capacity of the financial technologies of the period and underdeveloped audit systems	Software programs used
Similarities	All three cases involved sophisticated corrupt practices using advanced technologies; the corruption went undetected for a long time and was widespread before it became public knowledge.		
Differences	Internal accounting systems	"Repo 105" Manipulations	Emission-test manipulation software

The study is based on the qualitative comparative analysis method theorized by J. S. Mill in 1843 (Celikdin, 2017). The comparative method has been used for a long time, especially in the study of events brought together by certain socio-economic and historical factors (Ragin, 1987; Befani, 2013). In the 19th century, the founders of sociology such as Marx, Weber and Durkheim used the comparative method in their studies. In the 1970s and 1980s, prominent social scientists in the US such as Wallerstein, Moore, Skocpol and Tilly developed this method methodologically and thematically. In the 2000s, it is seen that interest in the comparative method has increased with globalization (Aydin & Hanagasi, 2017).

Mill's comparative method, which is used in this study, consists of five basic procedures: the Method of Agreement, the Method of Difference, the Method of Concomitant Variation, the Method of Residues, and the Joint Method of Agreement and Difference. These procedures make it possible to examine the conditions under which certain outcomes emerge across cases with similar or different structural characteristics. In this study, the Method of Agreement, the Method of Difference, and the Method of Residues are used together to identify the common conditions among the cases, the factors that distinguish collapsing and non-collapsing cases, and the residual factors that may function as protective thresholds against systemic collapse (Aydin & Hanagasi, 2017; Befani, 2013).

In this framework, the Method of Agreement examines the variables that are common to all cases; the Method of Difference examines the institutional factors that distinguish between collapsing and non-collapsing cases; and the Method of Residues examines the potential protective threshold function of only the differentiating factors. In order to analyze technology-based corruption, the study de-

velops a scoring system based on five structural variables: technology use, audit process, public response, regulatory gap, and governance weakness. The scoring system was structured according to the analytical needs of the study, drawing on key studies in the literature (Klitgaard, 1988; Rose-Ackerman & Palifka, 2016; Johnston, 2005; North, 1990) and based on official reports, media documents and institutional records. In this context, each variable was scored from 1 (low) to 4 (very high) on a case-by-case basis, and the evaluation process was based on both the content-based findings and the institutional impacts of the case outcomes.

Table 2

Comparative Scoring Table of Structural Variables by Case

Case	Use of Technology	Audit Processes	Public Reaction	Regulatory Deficiencies	Corporate Governance Deficiencies	Conclusions
	(Score / Explanation)					
Enron *(Typical)*	4 – Manipulation of internal financial data via proprietary software systems.	4 – Audit processes were systematically misled and failed to detect irregularities.	3 – Public backlash occurred; significant reputational damage followed.	4 – Regulatory frameworks in the energy sector were insufficient and had accounting gaps.	4 – Severe governance failure with internal control issues and ethical violations.	The company went bankrupt; executives faced trial.

Lehman Brothers *(Extreme)*	4 – Risk concealment through complex financial algorithms and derivative instruments.	4 – Regulatory bodies failed to intervene despite early signals; oversight collapsed.	4 – Public trust in global finance severely damaged; widespread panic ensued.	4 – Weak capital adequacy rules and fragmented financial supervision structures.	4 – Governance focused on short-term profits; board accountability was ineffective.	Company collapse triggered a global financial crisis.
Volkswagen *(Critical)*	4 – Emission test manipulation through customized defeat device software.	3 – Software bypassed audits, though oversight mechanisms remained partially functional.	4 – Strong public outcry led to environmental activism and institutional response.	2 – Environmental regulation was fragmented and insufficient in scope.	2 – Ethical lapses and limited whistleblower protection, yet reform capacity remained.	Product recalls, executive dismissals, and reform initiatives.

Based on the scoring structure created within this framework, a 'truth table' was prepared in a way specific to Mill's comparative method. Table 3 is organized on the basis of binary coding (1: present / 0: absent) in order to simplify the causal presence of each structural variable in the case. The binary coding system is structured to categorically classify the effect of each structural variable on the outcome on a case-by-case basis. In this framework, variables with a score of 3 and above were coded as '1' (effective condition/present), while scores below 3 were coded as '0' (ineffective condition/absent). Thus, the 1-4 scoring system, which serves to measure the level of structural influence, and the 1-0 binary coding system, which allows for comparative analysis, were clearly separated from each other; each assumed an analytical function within its own methodological context. This approach paves the way for comparative analysis based on Mill's Method of Agreement, Method of Difference, and Method of Residues and systematically makes visible the areas in which the critical structural threshold is concentrated in cases that result in collapse.

Based on Mill's comparative methodology, Table 3 systematizes the causal impact of structural variables in the cases. Technology use, weaknesses in oversight, and public pressure were common to all cases, and this was evaluated in the context of the Method of Agreement, showing that technology-based corruption is not only technical, but also institutional and social. However, the occurrence of collapse cannot be explained by these similarities alone. The absence of a collapse in the Volkswagen case is attributed to stronger regulatory and governance capacity compared to other cases. This distinction is made clear by the Method of Difference, whereas it is only through the Method of Residues that these two variables can be understood as creating a threshold that prevents collapse. As a result, the table clearly shows not only which variables are effective but also which structural thresholds cause collapse. Based on these findings, the main conclusion that can be drawn from the table is that technology-enabled corruption can only lead to systemic collapse if institutional weaknesses such as oversight, governance and regulation are simultaneously in place.

Table 3

Mill's Truth Table: The Relationship between Structural Conditions and Collapse (Binary Coding)

Case	Use of Technology (C1)	Audit Processes (C2)	Public Reaction (C3)	Regulatory Deficiencies (C4)	Corporate Governance Deficiencies (C5)	Collapse (Conclusions)
Enron *(Typical)*	1	1	1	1	1	1
Lehman Brothers *(Extreme)*	1	1	1	1	1	1
Volkswagen *(Critical)*	1	1	1	0	0	0

Systematic analysis based on case comparisons has made visible both structural common factors and institutionally divergent threshold-setting variables. This analysis reveals the multidimensional and complex nature of technology-enabled corruption, and clearly demonstrates how the phenomenon varies across sectors, institutional structures and governance styles. As shown in Table 2, in all three cases, technology played a critical role as a tool that enabled and at the same time

concealed corruption. Similarly, weaknesses in oversight mechanisms and the strong reaction of public opinion were also common to all three cases, suggesting that these three variables (technology, oversight, public opinion) are the structural conditions that make corruption possible. This pattern is consistent with Mill's Method of Agreement.

However, Table 3 shows that the presence of these variables in each case does not lead to systemic collapse. Unlike the cases of Enron and Lehman Brothers, Volkswagen did not experience a complete collapse. This difference can be attributed to a relatively stronger performance in the regulation and governance dimensions. In line with Mill's Method of Difference and Method of Residues, these two variables function as protective thresholds that prevent collapse even when other risk factors are present. In this regard, regulatory capacity and the quality of governance can be seen as protective thresholds that prevent systemic collapse due to structural vulnerabilities.

Thus, the findings suggest that while technology-based manipulation, regulatory weakness and public backlash explain the emergence of corruption, systemic collapse occurs only when technology-based manipulation is coupled with weak regulation and inadequate governance. This highlights the imperative of establishing sector-specific, adaptive regulatory frameworks and strengthening ethical and accountable governance structures to limit the risks of technology-based corruption.

Conclusion

Corruption is defined as the abuse of entrusted power for private gain. Extensive literature on this concept shows that corruption is one of the main obstacles to development, as evidenced by the large number of empirical findings. The emphasis on transparent, inclusive, and accountable institutions shows that corruption is often analyzed in relation to institutional quality, governance capacity, and accountability. This is also reflected in the indicators used to measure corruption. While developed Western economies are generally associated with lower perceived levels of corruption, corruption is often perceived as more closely associated with political and administrative relations in non-Western contexts.

The main starting point of this study is the assumption that corruption is not merely a historical or cultural pathology, but also a systematic form of behavior that can emerge in contemporary institutional structures. Indeed, in the modern

global economy, corruption has evolved from a problem often associated with underdeveloped countries into a systemic pattern of behavior embedded in the operations of multinational corporations. This study investigates how this new phenomenon, shaped by neoliberal competitive pressures and profit motives and defined as "techno-corruption," has deepened through technological capabilities.

In this context, the cases of Enron, Lehman Brothers, and Volkswagen, selected through purposive sampling, were examined using J. S. Mill's Method of Agreement, Method of Difference, and Method of Residues. The findings showed that the high technological capacity possessed by companies created information asymmetries that exceeded the oversight capacity of regulatory authorities. The analysis concluded that while technology is the fundamental tool enabling corruption, whether a company ultimately experiences systemic collapse is determined by its "governance quality" and "regulatory architecture."

Within the scope of the comparative case analysis method used in the study, the main variables of the cases were identified as the use of technology, audit processes, public reaction, regulatory deficiencies, corporate governance deficiencies and consequences, and the different results of similar cases were determined through the truth table prepared. Accordingly:

1- In the Enron case, it was understood that the financial data of the company was distorted through internal accounting systems and software manipulations, and that automation-based technologies used in accounting and reporting systems were misused by exploiting the complexity of software-based accounting and reporting systems.

2- In the case of Lehman Brothers, derivative products produced through complex financial algorithms were misused, and the risk assessments of these products were distorted due to the limited information-technology audit capacity of the period. The case also involved excessive leverage and improper financing practices.

3- In Volkswagen's Dieselgate scandal, it was understood that special software was developed to manipulate emission tests, that this corruption was facilitated by Volkswagen's strong public reputation for corporate quality, and that the technology was systematically designed and applied not only to circumvent legal regulations but also to conceal long-term market manipulations.

When the specific dynamics of each case involving techno-corruption are analyzed, it is revealed that the intensive use of technological tools in both the "typical case" of Enron, the "outlier case" of Lehman Brothers bankruptcy, and the "critical

case" of Volkswagen's Dieselgate scandal played a significant role in the emergence and implementation of corrupt practices. Moreover, weak audit structures and inadequate instruments for detecting techno-corruption contributed to the spread and continuity of corrupt behavior.

In all three cases, it was observed that the level of technology used by MNCs exceeded the technical capability of the authorities conducting legal audit processes. Moreover, institutional deficiencies such as conflicts of interest, weak whistleblowing mechanisms, ethical violations, and other institutional deficiencies, which resulted in a lack of capacity of the internal control system to combat corruption risks, had a significant impact on the occurrence of corrupt behavior. The fact that two companies went bankrupt and one had to undergo extensive restructuring following the discovery of corruption, and incurred huge losses, confirms the critical role of regulatory and institutional gaps in the corruption cases examined.

In this context, Beck's Risk Society approach and Principal-Agent Theory provide important theoretical explanations for understanding the complex nature of techno-corruption as a multi-layered behavioral problem. Indeed, as Beck (1992) emphasizes, contemporary technologies bring not only new production processes but also new areas of unforeseen risk, which, when combined with deficiencies in supervisory capacity, can pave the way for the emergence of complex pathologies such as corruption. On the other hand, from the perspective of the Principal-Agent Theory, information asymmetry allows decision-makers to use their informational advantage for private or organizational gain and thus to systematize corrupt behavior by neutralizing oversight processes (Jensen & Meckling, 1976; Eisenhardt, 1989).

Overall, the findings highlight three key dimensions: (1) the role of technology as an enabler of corruption processes, (2) the decisive function of regulatory and governance structures in preventing collapse, and (3) the need to structure oversight mechanisms in a sector-specific and technology-enabled manner. Finally, the study offers a clear conclusion for policymakers: traditional oversight methods are no longer sufficient. Regulatory agencies must acquire the technological capability to oversee not only financial outcomes but also the algorithmic processes that generate these outcomes.

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