

An Anti-Fraud Policy: A Theoretical Framework for a Prosperity Tripod of Massive Data, Blockchain, and AI

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The authors' aspiration was to learn—and focus on policy against fraud—leading to the sustainably growing societal illnesses of dishonesty, fraud, pessimism, and divisive issues. The appropriate venue, within the currently evolving laws and regulations, is proposed to be a three-tier combination of massive data, including data accumulation, transformation, organization, stratification, estimations, data analysis, and blockchain technology, predicted to revolutionize competition and efficiency, which are further suggested to be prerequisites for a more successful creation and implementation of the third element, AI. A currently evolving prosperity tripod is hinging on the three technological legs of the massive data control/management, blockchain tech, and a rapidly growing AI. While briefly incorporating some analysis of the blockchain application, we have analytically focused on the rest—the data and AI—of what we deem to be the prospective prosperity tripod for businesses, markets, and societies, in general, despite the challenges and risks involved in each. Instead of hypothesizing a predetermined economic model, we are proposing a data-based Vector Autoregression (VAR) methodology for the AI with an application to the fraud and anti-fraud structure and policymaking. Hopefully, the entire attempt would portend some tangible prospective contribution in an achievable positive societal change.

Keywords: fraud, AI, data, VAR

Introduction

Imagine that future, in which the main dominant business brain power has prevailed the market competition, and that the expected competitive forces evolve around more of human brain creating—as well as enjoying—the growth of data-based artificial brain power. In such a close to “perfect competition” environment, perfection itself would constantly be challenged through not only emerging massive data, but even more advanced and evolving techniques in usage, implementation, and application of those much-appreciated data.

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Obviously, the road map to the ever evolving “perfection” is what all business vanguards, engaged in both the applied research industry and the consequential hand-in operations, are struggling, and striving to design. This effort here is only one such draft in providing a tentative structure for what an integration of the three elemental foundations would bring businesses and societies to a more prominently constructive competition, contrasted to those, which have all ultimately been conducive to emergence of the few most successful rivals or the only one with the highest market share and more market concentration. Blockchain technology management, in its ideal progression, through appropriate learning by global researchers, legislators, business leaders, entrepreneurs, and the prospective legal environments, such as those approved for the early processes and implementation within the European Union countries (Vigliarolo, 2023), would bode well for the prospective success of market competition and gradual elimination of market concentration.

Literature Review and Analysis

Why are massive data so critical to both constructive advantages, and destructive disadvantages of creation and application of artificial intelligence (AI)? Data are altogether the evidential story of what has happened—and most possibly—will similarly happen again. While the data for a limited time frame, number of individual customers, firms, or countries may not represent the habits, sustainable behaviors, or revealed preferences of the corresponding bigger groups of their own, the massive data, on revealed preferences of the larger players within a larger time frame, would surely create relatively more predictive power for researchers, practitioners, and policymakers. In this digital age, massive data are the primary fuel for machine learning, which cannot be more technically advantageous than ever in the past.

Obviously, size wise, the massiveness of relevant data could be different, depending on various forecasting contexts. For instance, the forecasting of a certain firm’s or industry’s sales, domestically, regionally, nationally, or globally, would be all different, and the nature of data massiveness could be more limited for the smaller contexts of activities.

Data management would encompass data registration, storage, categorization, labeling, stratification, unifying transformation of certain definitions for better coordination and correspondence, transformation, and coding. Once the data organization and management are done properly, some appropriate forecasting methodology would be critical to adopt and to apply through, e.g., trend analyses, infographic representation of the revealed behaviors (see Figure 1), linear programming, regression analysis, categorical data analysis, Vector Autoregression or VAR techniques (Hamzaee & Salimi, 2023a), variance-covariance analyses, etc.

One of the advantages of historical data is in its potential capacity of making the optimal decision about, e.g., portfolio management, especially when a portfolio includes foreign assets. In Figure 1, as a simple example, one can see how the European euro’s market value, versus the U.S. dollar, has been changed since its inception as a unified currency throughout the European monetary union in 1999.

Applications of Data Analysis: Honesty, Fraud, and Anti-Fraud Policies

One of the most critical issues of our modern time has been moral imbalances and ethical mismanagement of societies, in general. Soocial (2023), in its recent research, “21 Honesty Statistics That Reveal Our True Colors 2023”, explored that “An influential study on dishonesty was found to be dishonest”.

The growth of dissatisfaction has been a big warning sign of much more prospective deterioration of global moralities. Crime and violence are being globalized faster than ever. Even oceans cannot deter any of the societal

destructive symptoms, risks of violence, and damages to human societies as much as they used to. The advantages of technological achievements and empowerment have been either leveled or even outpaced by the alarming disadvantages. Among various possible fundamental reasons for such alarming growth of failure of societies are government inefficiencies, politicization, big business excessive influences, dishonesty and fraud, sophistication of the legal system, which would either delay the equitable judicial processes or get manipulated by power and financial influences, are just some examples conducive to even a gradual decaying of democracy and real freedom.

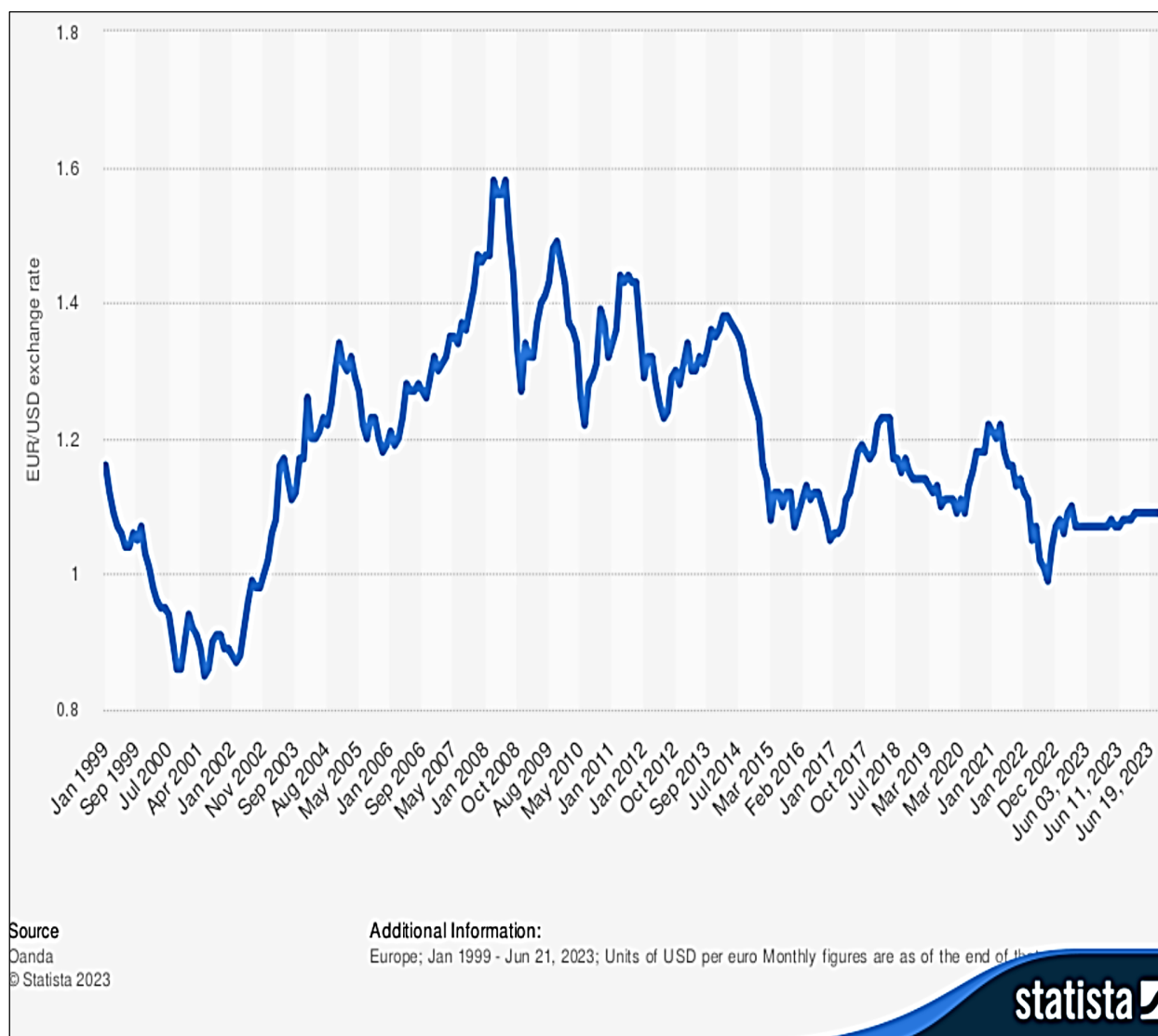


Figure 1. The records on euro to U.S. dollar exchange rates. During the Jan. 1999-June 21, 2023 (Source: Statista, 2023).

The following summarized report that we have tabulated for simplicity, was published by “Soocial”, self-defined as “a leading branding agency with a passion for creating memorable names and internationally renowned brands. Since our launch, we’ve worked on more than 1,000 projects for clients around the world”. The study embodies their 21 exactly quoted headings, and conclusive statements, as listed in Table 1.

Table 1

How Honest the World Was in 2022-2023; 21 Honesty Statistics

Around three-quarters of people are consistently honest
An influential study on dishonesty was found to be dishonest
Telling fewer lies leads to better health
People often mis-predict the potential outcomes of honesty
29% of Americans admit having lied to their significant other about their sexual history
87% of Americans think that companies are not honest about the ingredients they use
Honesty is the trait most valued by Britons when seeking a new partner
Honesty is the most important character trait that UK parents want their children to possess
85% of Americans consider nurses to be extremely honest
As you move down the management chain, the level of honesty decreases
In Ireland, 48% of people don't trust their governments to tell the truth
Norway is the country most likely to trust governments to be honest
84% of people consider honesty to be an important characteristic of brands
Young people value humor and honesty most in friendships
Honesty is the most important characteristic UK voters look for in politicians
95% of people say integrity is one of the organizational values of their workplace
81% of companies have honesty-based policies in place
23% of people admit they have lied to their doctors
About 80% of people don't tell their doctors everything
75% of respondents lie to their doctor due to embarrassment
60% of people can't make it through a 10-minute conversation without one lie

Source: Soocial, 2023—Summarized and tabulated by the authors.

Reviewing the above 21 conclusions, one can understand the excessive sentiments against companies, as the study has concluded that, “87% of Americans think that companies are not honest about the ingredients they use”. Meanwhile, it is relatively encouraging that in America: “85% of Americans consider nurses to be extremely honest”.

As contrasted to America, “Honesty is the trait most valued by Britons when seeking a new partner”. Also, “Honesty is the most important character trait that UK parents want their children to possess”. More importantly, “Honesty is the most important characteristic UK voters look for in politicians”. While in America, we may not see too sharp differences, yet a reported 41.2% favorability votes (ABC News, 2023) for Donald Trump, facing the 91 indictment charges and even a high possibility of the prison time (Lin & Tillman, 2023), would bid ill for the ethical health indexation of the American nation, in general (Figure 2).

As to one of Trump's most frequently addressed anti-immigrants' claims, which has adversely influenced a noticeable fraction of the American public opinions, the Stanford's economists, Abramitzky et al. (2023), explored in their study of 1850-2020 combined Census data that as a group, although the incarceration rates for immigrants were higher than those for US-born white men before 1870, more or less, similar rates between 1880-1950, but 33% lower rates since 1960. “This decline cannot be explained by changes in immigrants' observable characteristics or immigration policy but may reflect immigrants' resilience to economic shocks” (p. 1).

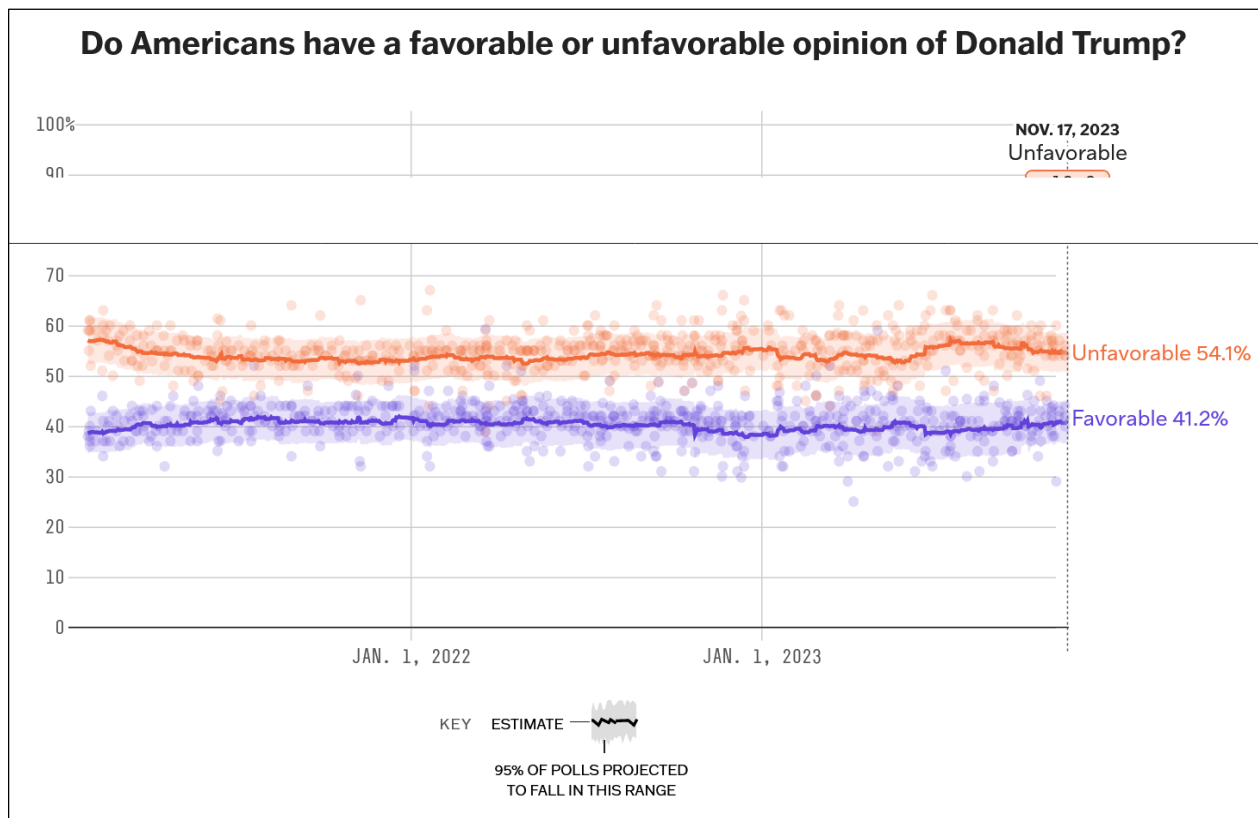


Figure 2. Donald Trump's popularity among all. Americans (Source: ABC News, updated on November 17, 2023).

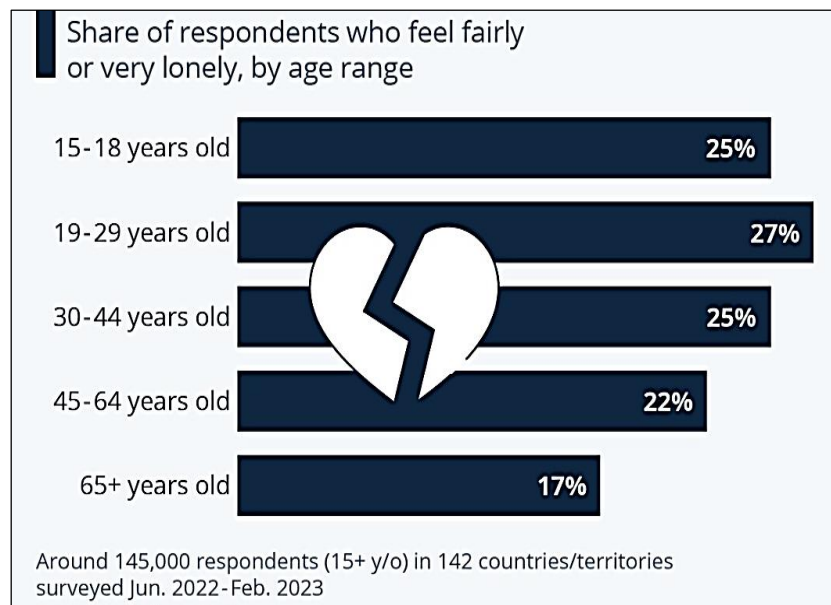


Figure 3. One in four young people in the world feels lonely (Source: Gallup, Meta, and Statista, 2023).

The loneliness index, as reported in Figure 3, at the global level is surely an indication of another societal deterioration, which deserves some strategically appropriate remedial policy eventually.

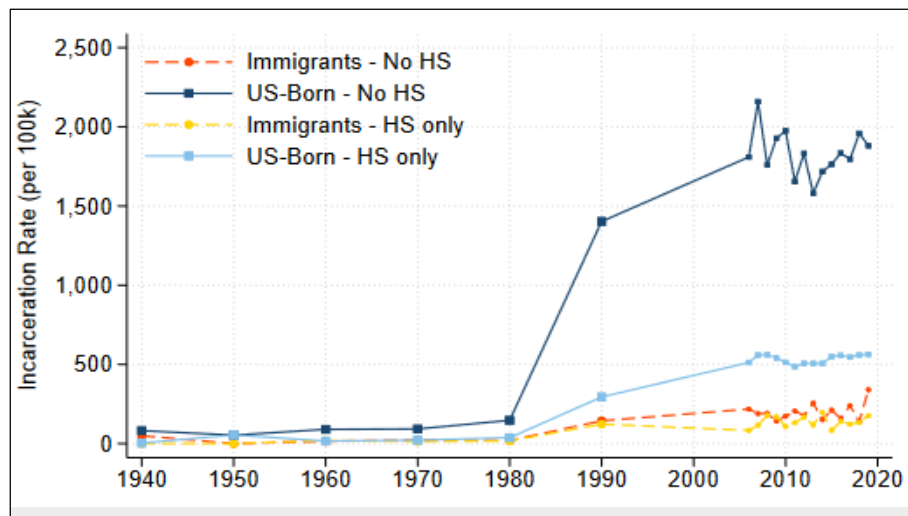


Figure 4. Incarceration rates, per 100,000 population (HS: High-School education) (Source: Abramitzky et al., 21 July 2023).

The world honesty indicators are mixed: “Around three-quarters of people are consistently honest”. It is good that “95% of people say integrity is one of the organizational values of their workplace”. Also, “84% of people consider honesty to be an important characteristic of brands”. Yet, “23% of people admit they have lied to their doctors. “About 80% of people don’t tell their doctors everything”. “75% of respondents lie to their doctor due to embarrassment”. Also, “60% of people can’t make it through a ten-minute conversation without one lie”.

Moreover, the list of religious leaders convicted for violent and non-violent crime is rather long (https://en.wikipedia.org/wiki/List_of_religious_leaders_convicted_of_crimes).

The above report has also partially hinged on Zenger and Folkman (2012) in their “Risk Management: The Data’s in: Honesty Really Does Start at the Top”. The following figure summarizes ratings of honesty at the top, middle, and lower management levels, which are within all the three rankings of “Average”, “Highest”, and “Lowest”, consistently showing the same linkage: The higher the management levels, the higher the three levels of honesty.

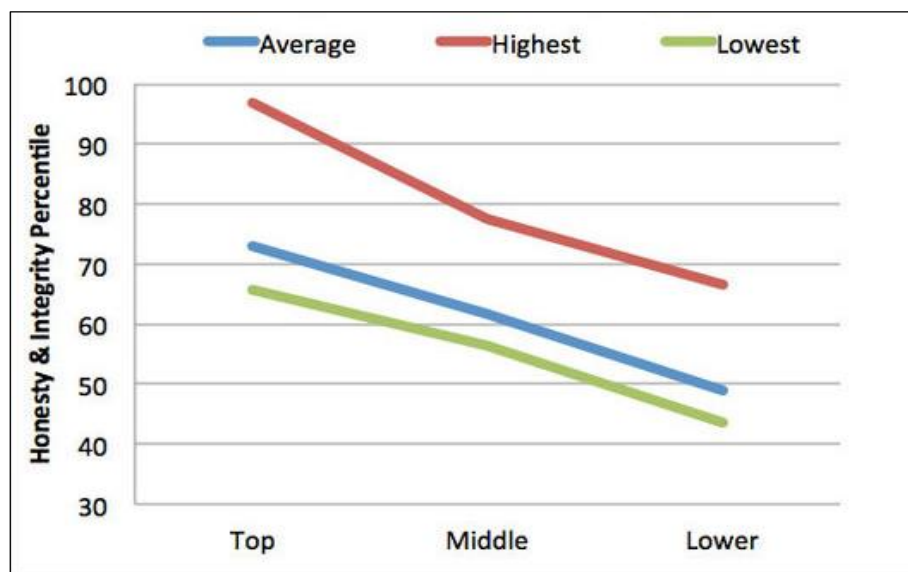


Figure 5. Three levels of ratings on honesty & integrity (Source: Zenger & Folkman, 2012).

Dishonesty and fraud, revealed in corporate tax evasion (Table 2), was heavily costly to societies (Statista, 2023). The collective cost of the 11 major countries' corporate tax cheaters in 2023 was estimated to be one trillion, 231 billion, 900 million dollars. Global budgetary mismanagement has continually damaged the welfare of the rest of taxpayers, and indirectly, the lives of the severely deprived people around the world.

Table 2

Major Corporate Tax Evasion Costs in the World

Ranking	Countries	U.S. \$ billion
1	EU countries	881
2	U.S.A.	188.8
3	China	66.8
4	Japan	46.9
5	India	41.2
6	France	19.8
7	Germany	15.00
8	Australia	6.1
9	Spain	5.5
10	South Korea	1.1
11	United Kingdom	1.1
	Total	1,231.9*

Notes. With EU countries included, France, Germany, Spain, and U.K. were dropped to avoid double accounting (Source: Statista, 2023).

On the positive side, although the existence of any levels and rates of crime is acceptable, but for the U.S., it has been relatively lowered in the last decade, moving below 0.04%, as contrasted with those of the previous two decades, as depicted in Figure 6. The last three years have been even better.

Several research reports, e.g., Reich (2014), Hamzaee (2016), Hamzaee, Guy, and Ryan (2017), and Sanders (2014), recommended more effective and fairly implemented regulations. Dyck, Morse, and Zingales (2013) estimated that there was a chance of 14.5% in any given year that a company would engage in a fraud, and that corporate fraud resulted in the investors' 22-percent loss of the fraud-committing company's value. It was an average rate of 3% of enterprise value across all firms.

Also, as Hamzaee et al. reported (2017), in the four graphical trend analyses, Figures 7-A, 7-B, 7-C, and 7-D, a discouragingly weakening trend of the legal punitive consequences of various stages of fraud was revealed, which has been in line with many well-communicated concerns about an obvious lack of effective government rules and regulations, supposedly governing greed and corporate crime. This has been usually less serious during the liberal than conservative dominance of the governance.

On some strategically healthier and more equitable income distribution and higher sustainability of the socio-economic foundation, there has been a continual debate on what fair rates would be in taxing various income and asset levels. Among many nations of the world in 2018, the corporate income tax rates for the U.S. were set about 38.9%, as depicted in Figure 8, before Donald Trump was elected to be at the helm of the U.S. government. That could have led to more collective prosperity, should those rates remain more sustainable, given the too many other national and international urgencies always emerge unexpectedly.

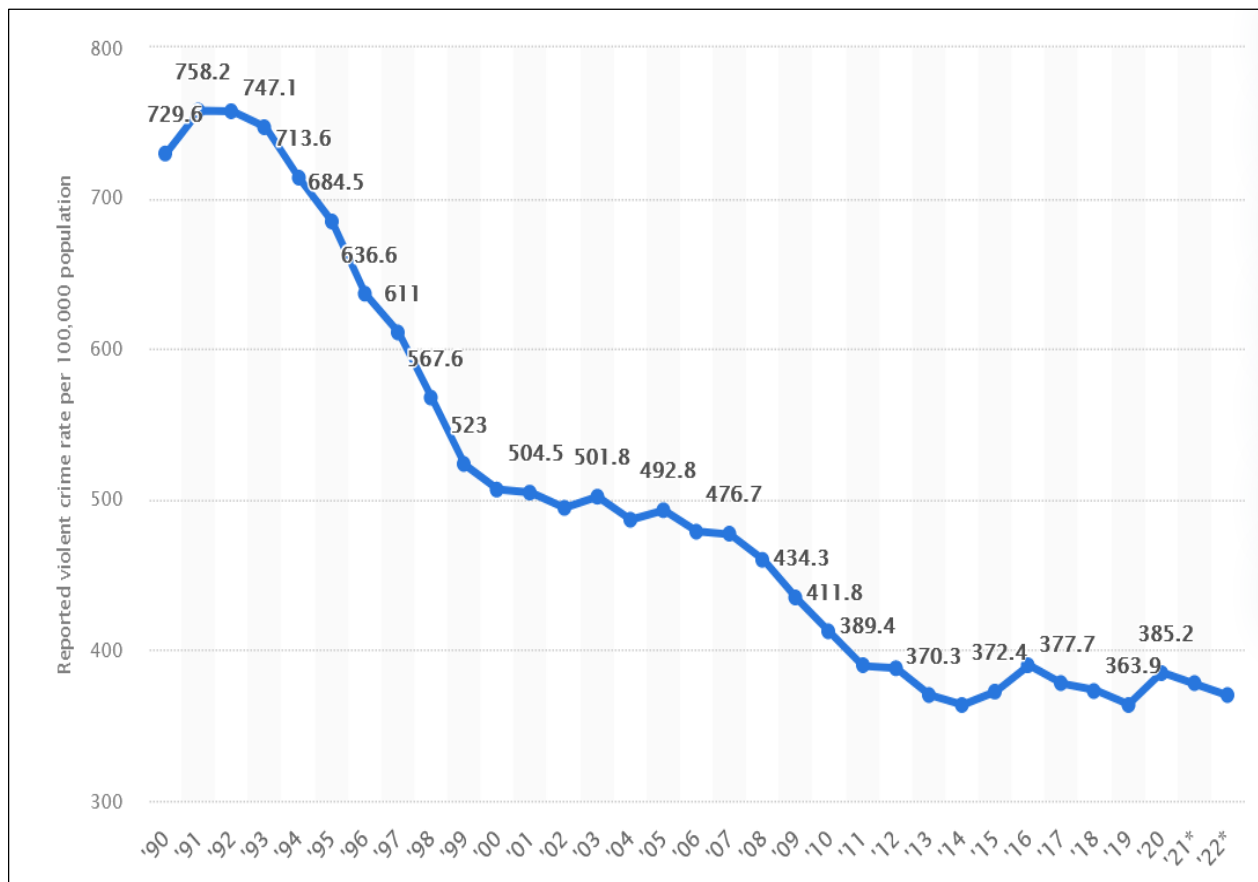


Figure 6. Reported violent crime rates in the U.S. (per 100,000 of population) for 1990-2022 (Source: Statista, 2023).

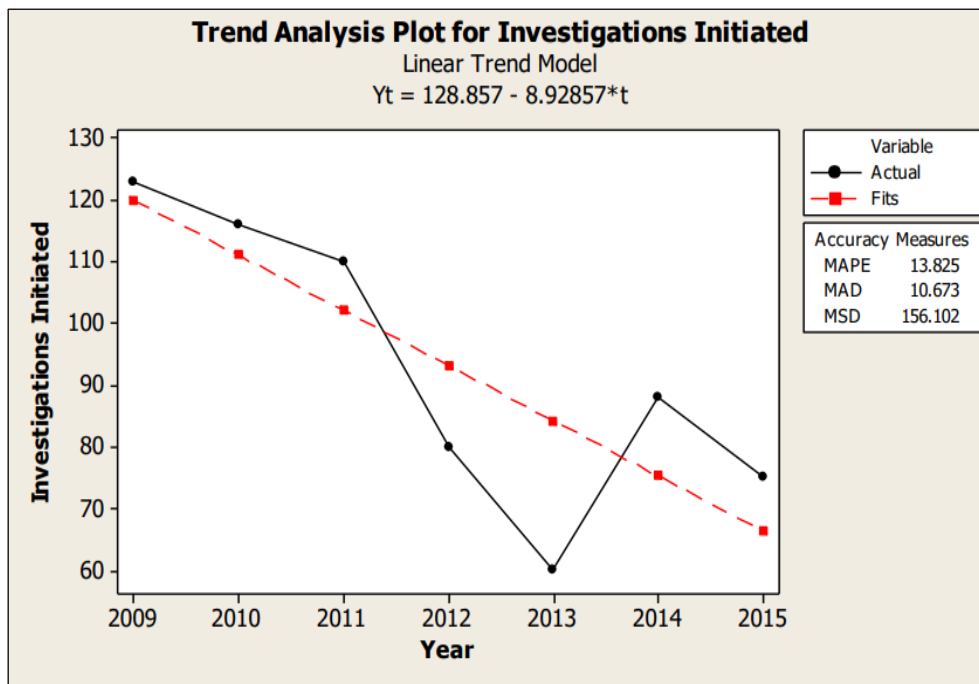


Figure 7-A. In pursuit of corporate fraud within the period of 2009-2015, at the early stage of investigations initiated, were diminishing (Source: Hamzaee et al., 2017).

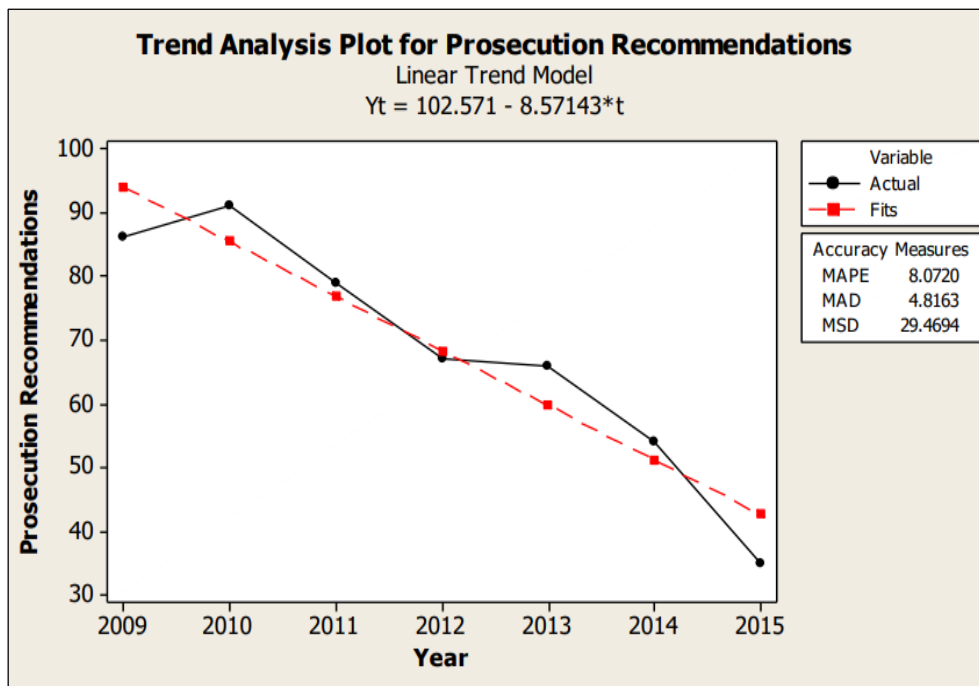


Figure 7-B. In pursuit of corporate fraud within the period of 2009-2015, at the stage of prosecution recommendations were also diminishing (Source: Hamzaee et al., 2017).

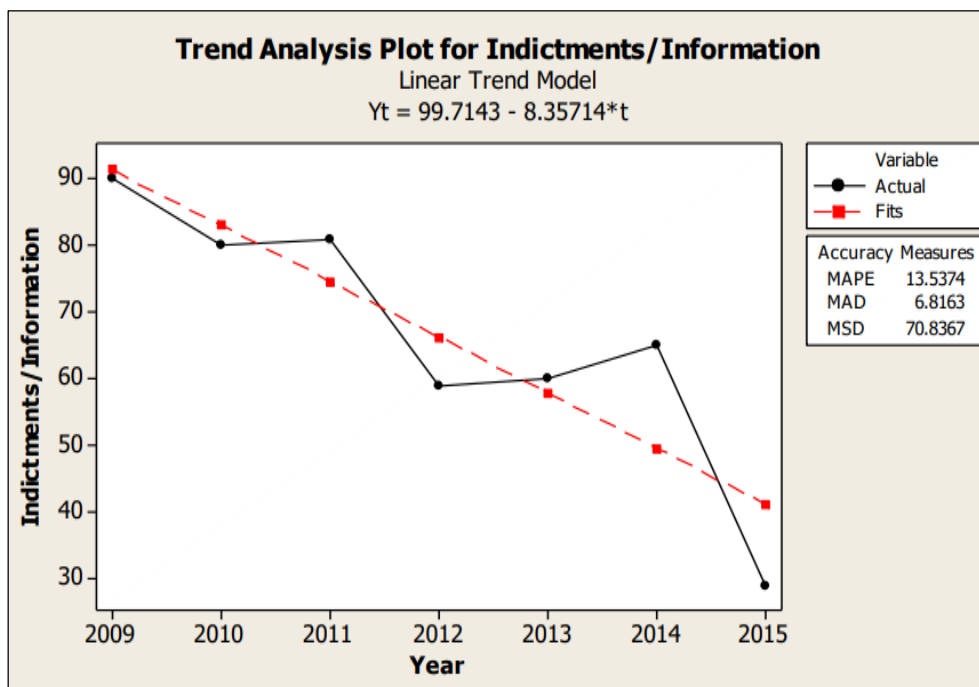


Figure 7-C. In pursuit of corporate fraud within the period of 2009-2015, at the stage of indictments were diminishing (Source: Hamzaee et al., 2017).

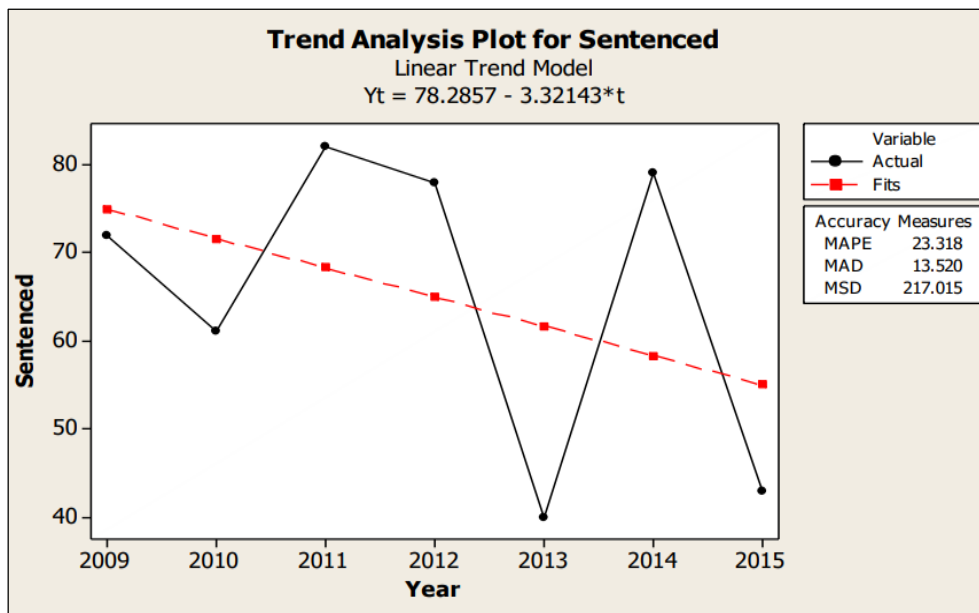


Figure 7-D. In pursuit of corporate fraud within the period of 2009-2015, at the stage of sentences were diminishing (Source: Hamzaee et al., 2017).

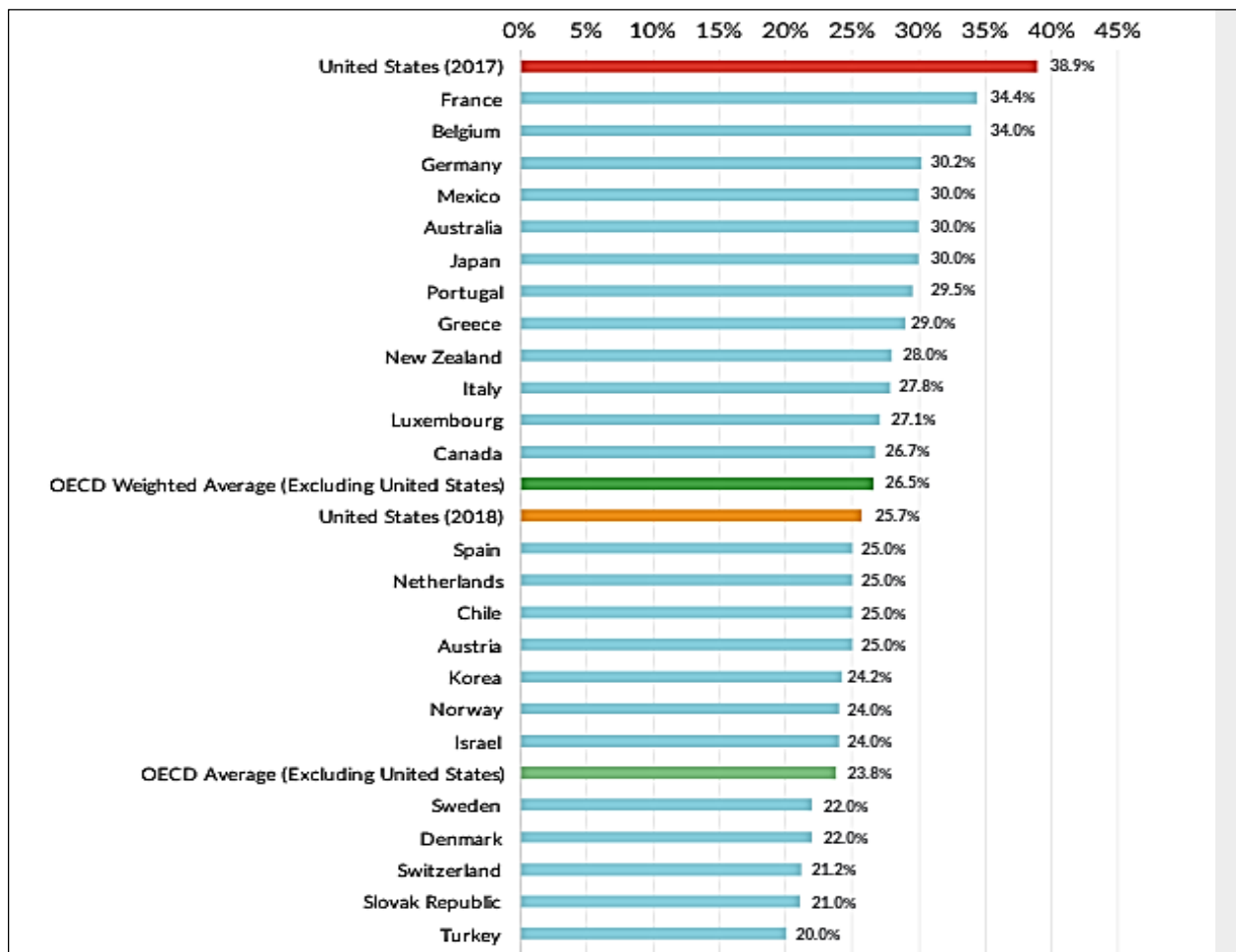


Figure 8. Statutory corporate income tax rates, OECD countries (Source: Pomerleau, 2018).

The noticeable revelation of higher percentages of tax evasions, as depicted in Figure 9, and the resulting loss of government income have unexceptionally deprived other taxpayers adversely, leading to growing dissatisfaction with their finances and their generally more pessimistic views of their lives, and the establishments.

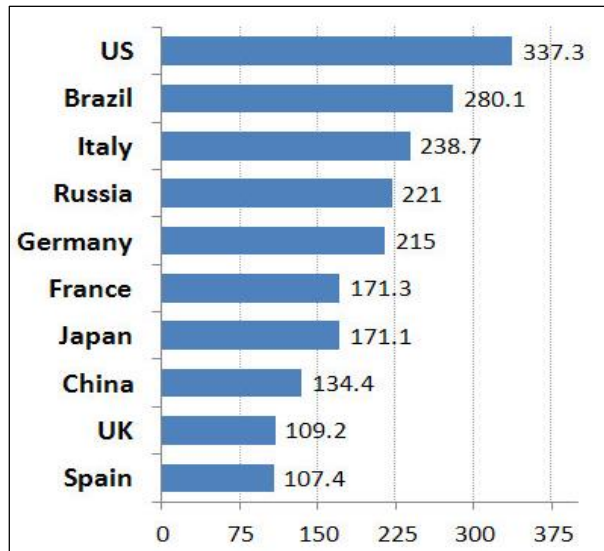


Figure 9. Countries with largest tax evasion amounts; tax loss in billions of dollars (Source: Johnson, 2011).

Among many influential factors, the pessimism among nations could be fostered by some negative political, socio-economic, and psychological factors. While nations have fortunately revealed growing awareness and priority to the environmental health than even economic growth (Figure 10), it is unexpectedly discouraging to learn that a one-week annual holiday away from home has not been easily available to a sizable percentage of Europeans within the 16 and higher ages, surveyed for the period of 2017-2022, as depicted in Figure 11.

The main impact of blockchain technology. Blockchain technology has not been free of controversies, mainly due to its complexity, lack of more understanding and knowledge, and especially, unprepared legislators, and hence, a clear lack of enough regulations, as needed inevitably for a more upcoming stabilization policy.

Blockchain technology should be considered a talented business design beyond just a cryptocurrency concept. It would, in its integrative potential role, save the world's confusion on the conflicting economic efficiency of the less than perfect competition and the perceived experiences with the loss of social welfare, as a historical challenge. According to Hamzaee and Salimi (2022, pp. 87-88),

the biproduct of that competitive efficiency, has been for long, the outgrowth of bigger and more successful businesses into heavily concentrated market power in the hands of very few oligopolists or even a single monopolist in various industries at the cost of smaller business organizations, and a consequential continual loss of economic status of the middle class.

This was more emphatically analyzed and clarified earlier by some MIT leading researchers, specialized in blockchain technology management (Catalini, 2017).

The major impacts of artificial intelligence. AI has been defined by several researchers and practitioners in various, yet cohesive ways. Nils J. Nilsson, the Stanford University's Kumagai, Professor Emeritus of Computer Science Engineering (Mind Data, 2018) offered: "Artificial intelligence is that activity devoted to making machines intelligent, and intelligence is that quality that enables an entity to function appropriately and with foresight in its environment".

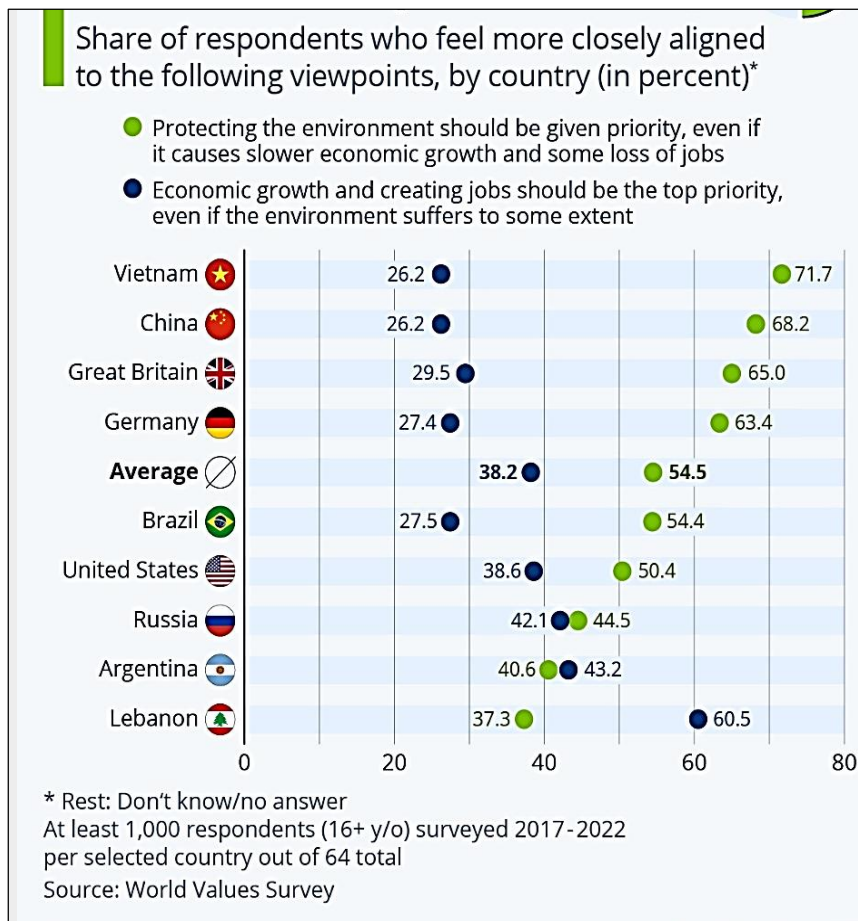


Figure 10. Earth or economy: A glob snapshot (Source: World Values Survey, 2022, extracted from Statista).

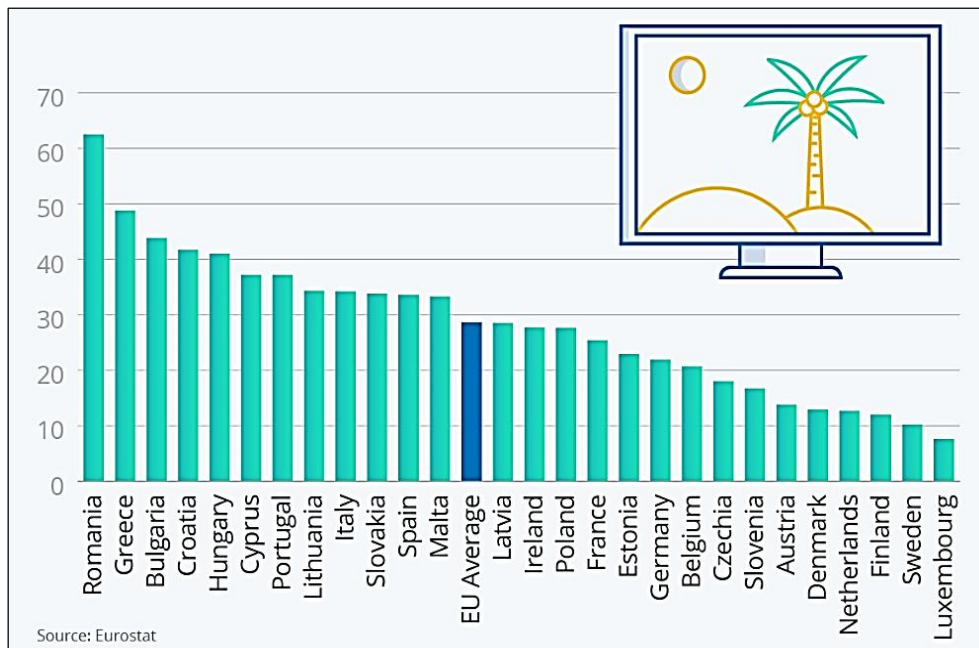


Figure 11. Percentage of European population within the ages of 16 and over, unable to afford a one-week annual holiday away from home in 2022 (Source: Eurostat, 2022, extracted from Statista).

As in prediction of the impacts of AI on 2023 evolutions, Express Computer (2022) highlighted several points, two of which are “Intelligent automation, and its impacts on the business processes and information technology adopted, will benefit all industries”. Also, “The emergence of cyber assistants is critical in confronting the growing cyber-security risks and threats”.

According to Keith Peterson (2022), AI in public relations would help in recognizing the individuals’ identities, the business names, the types of outputs, services, etc., that would all exist in images. The visual communications related to one’s business are also possible to identify and register.

Daley (2019) adds to the discussion on advantages of AI in marketing. Ramakrishnan (2023) has proposed how to resort to reliable AI solutions when the needed massive or even enough data are not available to a specific business organization.

Massive Data Analysis, and a Background to the Proposed Theoretical Model

In Table 3 and Table 4 the categorical data on the most common occupational fraud and anti-fraud controls, respectively, identified within the U.S. and Canada, expressed in percentages of all cases studied, are reported. All the variables are well defined by Dorris (2022, p. 94). As one example, corruption is defined as: “A scheme in which an employee misuses their influence in a business transaction in a way that violates their duty to the employer in order to gain a direct or indirect benefit (e.g., schemes involving bribery or conflicts of interest”.

Table 3

The Most Common Occupational Fraud Schemes in the United States & Canada

Item	Variables defined	Fraud categories	Percent of cases
1	CORR	Corruption	37%
2	BILL	Billing	24%
3	NCAS	Noncash	18%
4	EXRE	Expense reimbursements	17%
5	PRLI	Payroll	16%
6	CPTM	Check and payment tampering	15%
7	SKMG	Skimming	13%
8	CSHD	Cash on hand	11%
9	CSHL	Cash larceny	10%
10	FSFD	Financial statement fraud	8%
11	RGDS	Register disbursements	4%

Source: The authors’ arrangement, data coding, and tabulation, borrowing from data analysis from Dorris, 2022.

Table 4

The Most Common Anti-Fraud Controls in the United States & Canada Variable Designation

Item	Variable	Anti-fraud control focus	% of cases
1	COC	Code of conduct	74
2	EAFS	External audit of financial statements	72
3	ESP	Employee support programs	66
4	IAD	Internal audit department	66
5	MCFS	Management certification of financial statements	65
6	EAIC	External audit of internal controls over financial reporting	63

Table 4 to be continued

7	HL	Hotline	63
8	MREV	Management review	63
9	IAC	Independent audit committee	56
10	FTE	Fraud training for employees	55
11	FTME	Fraud training for managers/executives	55
12	AFP	Anti-fraud policy	51
13	PDMA	Proactive data monitoring/analysis	43
14	FFRA	Formal fraud risk assessments	42
15	DFD	Dedicated fraud department, function, or team	41
16	SA	Surprise audits	35
17	JRMV	Job rotation/mandatory vacation	20
18	RFW	Rewards for whistleblowers	14

Source: The authors' arrangement & tabulation, using data from Dorris, 2022.

We have used the above categorical data for the U.S. and Canada, and produced Figure 12:

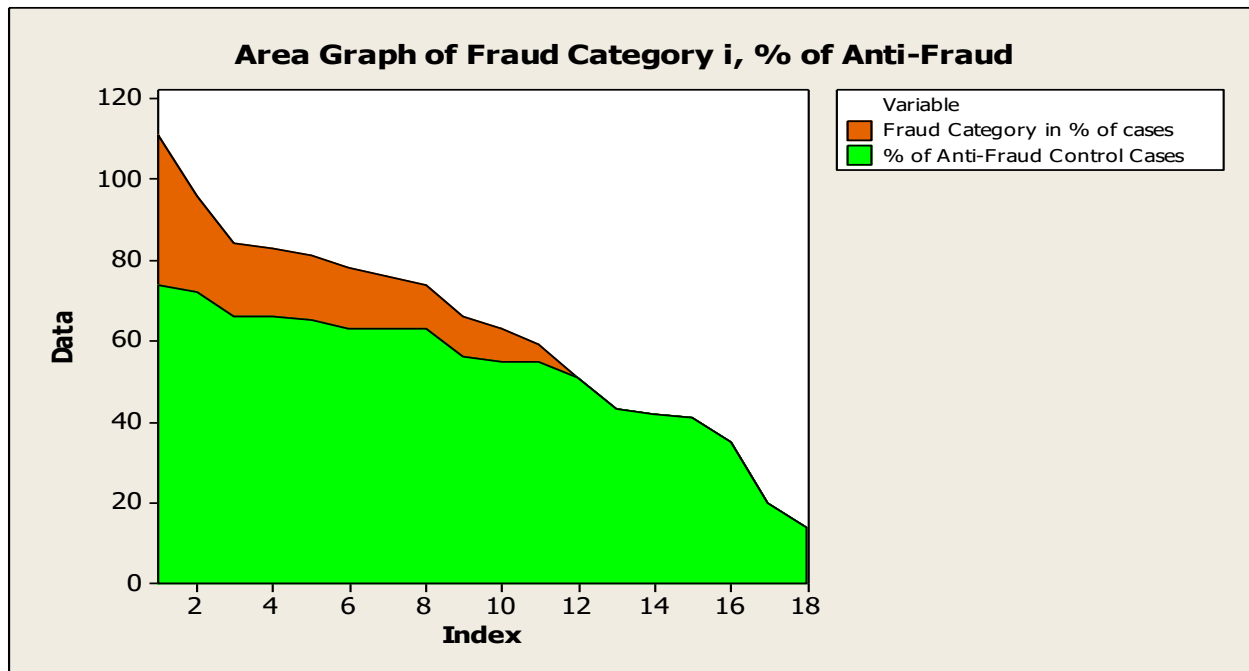


Figure 12. The major fraud and anti-fraud reported for the U.S. & Canada in 2022 (Source: The authors' statistical analysis of Dorris, 2022).

Green area represents percentages of all integrative cases of 18 items of anti-fraud control, and the red area shows the percentages of all cases of fraud, broken into 11 items of identified fraud in the U.S. and Canada region.

The same types of information and data for the Western Europe, like those of the U.S. and Canada, were also compiled and reported by Dorris (2022), coded and symbolized by the authors, and reported through the following Table 5, Table 6, and Figure 13. As is clear, both fraud and anti-fraud variables are different in percentages across the two major districts of the world. External audit variables, e.g., are large in percentages of all cases in both districts: 72% for the U.S.-Canda, and 90% for the Western Europe case.

Table 5

The Most Common Occupational Fraud Schemes in the Western Europe

Variable	Fraud categories	% of cases
CORR	Corruption	44%
NCAS	Noncash	24%
BILL	Billing	19%
CSHD	Cash on hand	13%
FSFD	Financial statement fraud	10%
EXRE	Expense reimbursements	10%
CPT	Check and payment tampering	9%
CSHL	Cash larceny	9%
PRLL	Payroll	8%
SKMG	Skimming	7%
RGDS	Register disbursements	3%

Source: The authors' arrangement & tabulation, using data from Dorris, 2022.

Table 6

The Most Common Anti-Fraud Controls in the Western Europe

Item	Variable	Anti-fraud control focus	% of cases
1	EAFS	External audit of financial statements	90%
2	COC	Code of conduct	84%
3	MCFS	Management certification of financial statements	78%
4	EAIC	External audit of internal controls over financial reporting	77%
5	IAD	Internal audit department	74%
6	MREV	Management review	72%
7	HL	Hotline	68%
8	IAC	Independent audit committee	65%
9	FTE	Fraud training for employees	59%
10	FTME	Fraud training for managers/executives	58%
11	AFP	Anti-fraud policy	56%
12	FFRA	Formal fraud risk assessments	52%
13	ESP	Employee support programs	51%
14	PDMA	Proactive data monitoring/analysis	48%
15	DFD	Dedicated fraud department, function, or team	47%
16	SA	Surprise audits	40%
17	JRMV	Job rotation/mandatory vacation	25%
18	RFW	Rewards for whistleblowers	7%

Source: The authors' arrangement & tabulation, using data from Dorris, 2022.

We have also used the above categorical data listed in Tables 5 and 6, for the Western Europe, to get the following infographic presented in Figure 13.

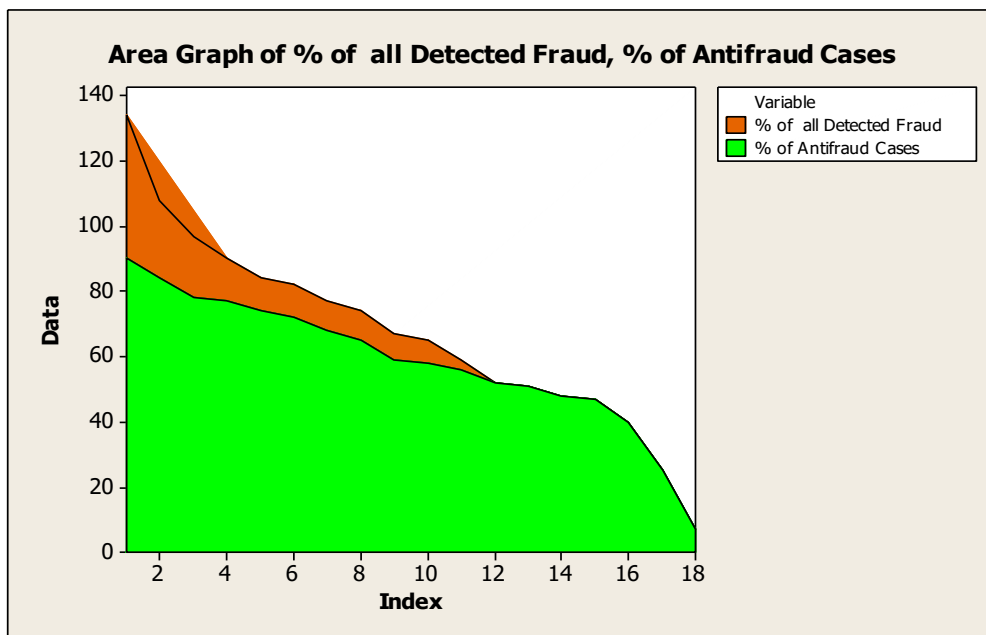


Figure 13. The major fraud and anti-fraud reported in the Western Europe in 2022 (Source: The authors' statistical analysis of Dorris, 2022).

Dorris (2022) concluded that the trend of the data on a blend of categories education, CEOs & managers, living beyond means, financial difficulties, showed no red flags of perpetration. Yet, as reported in Figure 14, despite the findings indicating a decline in the female perpetration rates contrasted with an increase from 65% (by employees) to 75% (managers) and 82% (owner/executives), the median losses—attributable to the detected fraud—in both categories of male and female cases, increased with the authority levels, a disappointing exploration.



Figure 14. Gender distribution and median loss variations based on the perpetrators' levels of authorities (Source: Dorris, 2022).

In Figure 15, an unfortunate experience is revealed: Occupational fraud and the corresponding losses were at the highest level amongst those employees with university degrees (47% and \$150 thousand respectively), while both figures declined in the case of those with postgraduate degree, but ironically registered too high at the 18% and \$135 thousand, respectively.

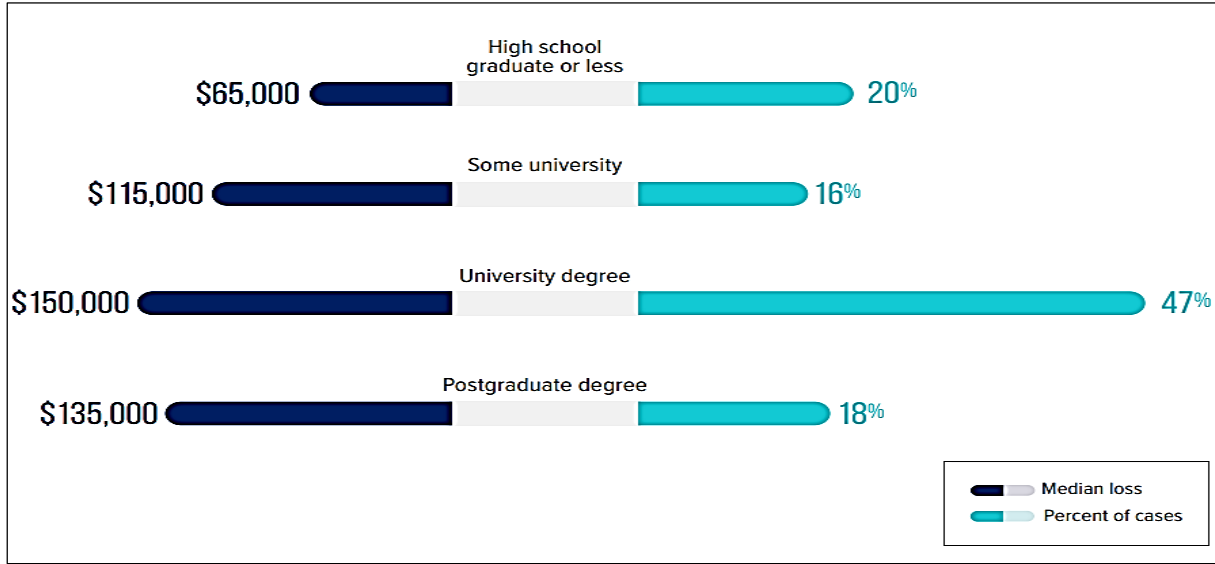


Figure 15. Education distribution and median loss variations, based on the perpetrators' levels of retained education (Source: Dorris, 2022).

The Theoretical Model: Fraud and Anti-Fraud Policy

If the time series data on corruption and its various subcomponents, as discussed above, are all collected and recorded, one can generate a VAR model for the inclusion and implementation of artificial intelligence, as summarized below. All the variables are defined in Tables 3 and 4.

Fraud Index and Fraud Control Index

Define the two indexes of fraud and anti-fraud variables for designing our artificial intelligence model of fraud control, as listed in the following 12 equations:

$$\sum_{k=1}^{k=11} \alpha_{kt} \cdot F_{kt} = FI_{kt} \quad (1) \quad \text{where, } t = \text{time period, } k=1 \text{ to } 11 \text{ types of fraud categories (variables), and}$$

$$\sum_{i=1}^{i=18} \beta_{it} \cdot FC_{it} = FCI_{it} \quad (2) \quad \text{where, } i=1-18 \text{ types of fraud-control categories (variables), } \alpha \text{ and } \beta \text{ are weights,}$$

in percentages, and FI_{kt} = Fraud Index in Period t for k fraud categories (variables), and

FCI_{it} = Fraud-Control Index in period t , for i categories (variables) of fraud control.

Instead of 11, to make our own model's Fraud Index, we are adopting the three (as opposed to all the 11) top fraud categories (variables) of CORR, BILL, and NCAS due to their reported top percentages of 37%, 24%, and 18%, respectively, in Table 3. Also, for our anti-fraud control index, we have adopted the top 4 variables of COC (74%), EAFS (72%), ESP (66%), and IAD (66%), listed in Table 4. So, more specifically, Equation (1) would be summarized to Equation (3) as follows:

$$fI_t = 0.37 \text{ CORR}_t + 0.24 \text{ BILL}_t + 0.18 \text{ NCAS}_t \quad (3)$$

and Equation (2) will melt down to:

$$\text{FCI}_t = 0.74 \text{ COC}_t + 0.72 \text{ EAFS}_t + 0.66 \text{ ESP}_t + 0.66 \text{ IAD}_t \quad (4)$$

In the application of Vector Autoregression (VAR), the number of lags adopted is critically significant in the reliability of the estimation results. The significance of the number of lags to adopt can be detected within the VAR specifications. Let's define Fraud Index (FI) and Fraud-Control Index (FCI) here, and assume using the relevant data, optimal number of lags would end up being three. Then the procedure we follow to propose our VAR model is summarized in the following subsection.

Fraud control policy and Vector Autoregression model. Hence, hypothesizing that fraud-control policy (variables) would correspondingly control fraud, incorporating the recent report published by Dorris (2022), there are several procedural regression models to choose from. One way is to just take no prior causality stories or hypotheses. Insert the available data on whatever possible variables that may reveal any relationship between the two groups of fraud variables and the anti-fraud variables. Then, statistically, let the most significant VAR estimation results help in exploring the best causality relationship, through the corresponding variance decomposition, impulse response functions, etc. Among several other choices, we have defined and chosen our Fraud Index in period t (fI_t) to be explained by three lags of itself and the four most heavily adopted (percentage wise) anti-fraud variables, as listed in Table 4.

$$fI_t = f(\text{COC}_t, \text{EAFS}_t, \text{ESP}_t, \text{IAD}_t) \quad (5)$$

Let's see how many different possible orderings of the above five variables we may have in exploring the one with the highest significance:

$$\text{Ordering 1: } fI \text{ COC EAFS ESP IAD} \quad (6)$$

$$\text{Ordering 2: } \text{COC } fI \text{ EAFS ESP IAD} \quad (7)$$

...

...

and 118 extra orderings of those five variables. Simply because it would be:

$$A_5^5 = \frac{5!}{(5-5)!} = 120 \quad (8)$$

Let us think of AI and blockchain technology, which would broaden the potential capacity of estimation into much more substantiated statistical significance, warranted by so much of observations and massive data registered permanently on the blockchain ledgers. The data already compiled, marked, coded, entitled, transformed, categorized, and would be used through the high-speed software for the best predictions, marketing, resource allocations, election campaigns, targeted communications, political and socio-economic policy decisions, etc. Potentially, as an example, only if a substantiated five-variable response functions are adopted, there would be 120 possible autoregressive functions (five variables' permutations, five by five variables) for the maximal number of groups of option to consider.

$$fI_t = f(fI_{t-1}, fI_{t-2}, fI_{t-3}, FCI_{t-1}, FCI_{t-2}, FCI_{t-3}) \quad (9)$$

which is the VAR reduced form of our two fraud and anti-fraud equations (indexes)

Assuming that: $fI_t = f(FCI_{t-1}, FCI_{t-2}, FCI_{t-3})$, in our VAR format,

$$fI_t = f(fI_{t-1}, fI_{t-2}, fI_{t-3}, COC_{t-1}, COC_{t-2}, COC_{t-3}, EAFS_{t-1}, EAFS_{t-2}, EAFS_{t-3}, ESP_{t-1}, ESP_{t-2}, ESP_{t-3}, IAD_{t-1}, IAD_{t-2}, IAD_{t-3}) \quad (10)$$

More specifically, Equation (11) can be re-expressed as:

$$\begin{aligned} fI_t = & a_0 + a_1 fI_{t-1} + a_2 fI_{t-2} + a_3 fI_{t-3} + a_4 COC_{t-1} + a_5 COC_{t-2} + a_6 COC_{t-3} + a_7 EAFS_{t-1} \\ & + a_8 EAFS_{t-2} + a_9 EAFS_{t-3} + a_{10} ESP_{t-1} + a_{11} ESP_{t-2} + a_{12} ESP_{t-3} + a_{13} IAD_{t-1} + a_{14} IAD_{t-2} \\ & + a_{15} IAD_{t-3} + e_{fI_t} \end{aligned} \quad (11)$$

Through VAR estimation, and the corresponding variance decomposition analysis, we can estimate the impact of any one standard deviation change (shock) in each of the right-hand side variables on the targeted (left hand-side) variable, our Fraud Index, fI_t , at any period, t .

To verify how stable our estimation results would be, Impulse Response Functions (Figure 16) would be so useful: All possible fraud components and variables that may influence any targeted policy variable, such as fI_t , or each of the separate components of fraud, such as CORR, are inserted into many regression equations of each given variable, regressed on several lagged values of itself as well as those of the other hypothetically-possible relevant variables. There are many possible autoregressive impulse response functions that can be printed and adopted. Figure 16 exhibits only three for U.S.-Canada impulse response functions for fI_t , our own defined Fraud Index, reflecting the responses of fI_t to a shock (a one standard-deviation change) in COC, code of conduct established, EAFS, external audit of financial statements, and MCFS, management certification of financial statements, all detected in the adopted world sample organizations by Dorris (2023), as three selected measures of adopted anti-fraud policy.

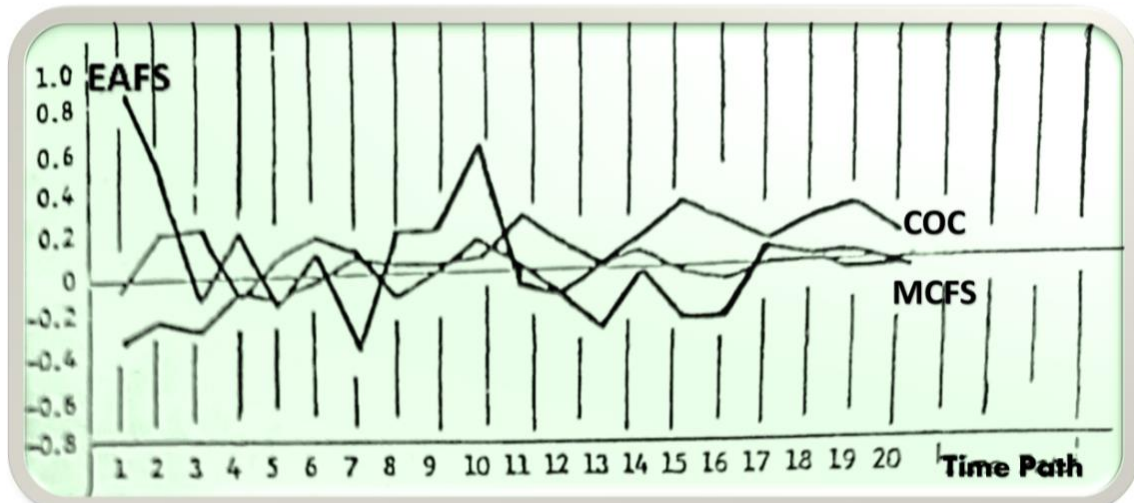


Figure 16. A hypothetical-theoretical example of impulse responses of the integrated USA & Canada's Fraud Index to a one-standard deviation shock in anti-fraud control variables, EAFS, COC, and MCFS (Source: Hamzaee & Salimi, 2023b).

The reason we should discuss that potential number of impulse response functions is that the ordering of the variables is sensitive in rendering various statistical significance. There is a general understanding in the literature that earlier appearance of each variable, as contrasted with the ones listed in the later orders, would appear to reveal relatively stronger explanatory power for that variable (Hamzaee 1987, p. 87; Litterman & Weiss, 1984). Moreover, the stability, and hence, reliability of those relationships, as hopefully observed through oscillations that would be either minimal, or diminishing into some tighter and flatter ones, or even most ideally, eventually fading away through time path, would be promising, as is here, to the researchers' hope.

Conclusion and Summary

More than anything, this research work is to bring the three major technological legs of efficiency and potential prosperity, namely massive data management through blessings of blockchain technology, and machine learning that would create more accountable estimations and guidelines through some data-based AI models into an integrative and dynamic processing model. Using VAR techniques in a hypothetical setting, we have shown how best the needed time-series data could help in making dynamic models that could be adjusted through time and further observations and variations.

We have focused our attention and sensitivities on the application of that tripod of efficiency and prosperity in alleviating the growing dissatisfaction and pessimistic sentiments in the U.S. and around the world. Business ethical scandals, tax evasion, various types of fraud, dishonesty, and broadly experienced failures from governments to businesses, religious leaders, many celebrities, political leaders, and then obviously, "normal individuals", would be better controlled through more extensively accumulated data, involving blockchain, and AI, and dynamically functioning models for machine learning.

Physicians, policymakers, and economists do similarly need more information and data to have further and easier access to some much better remedial diagnoses of the sophisticated illnesses, unnecessarily experienced by the massive populations in desperate need of better lives.

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Appendix: The Survey Methodology

For any further description of our coded variables, refer to the main source, Dorris (2022), as is entirely expressed in the exact quote:

“Occupational Fraud 2022: A Report to the Nations is based on the results of the ACFE 2021 Global Fraud Survey, an online survey opened to 53,118 Certified Fraud Examiners (CFEs) conducted from July 2021 to September 2021. As part of the survey, respondents were asked to provide a narrative description of the single largest occupational fraud case they had investigated since January 2020. Respondents were then presented with questions regarding the details of the fraud case, including information about the perpetrator, the victim organization, and the methods of fraud employed, as well as fraud trends in general. (Respondents were not asked to identify the perpetrator or the victim.) We received 7,890 total responses to the survey, 2,110 of which were usable for the purposes of the report. The data contained herein is based solely on the information provided in these 2,110 survey responses. Cases submitted were required to meet the following four criteria: 1. The case must have involved occupational fraud (i.e., fraud committed by a person against the organization for which they work). 2. The investigation must have occurred between January 2020 and the time of survey participation. 3. The investigation must have been completed at the time of survey participation. 4. The respondent must have been reasonably sure the perpetrator(s) was (were) identified.

Analysis Methodology Percentages: In calculating the percentages discussed throughout this report, we used the total number of complete and relevant responses for the question(s) being analyzed. Specifically, we excluded any blank responses or instances where the participant indicated that they did not know the answer to a question. Consequently, the total number of cases included in each analysis varies. In addition, several survey questions allowed participants to select more than one answer. Therefore, the sum of percentages in many figures throughout the report exceeds 100%. The sum of percentages in other figures might not be exactly 100% (i.e., it might be 99% or 101%) due to rounding of individual category data”.