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Using Machine Learning to Unveil the Dynamics of Insider Trading in Financial Markets

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ABSTRACT

The **subject** of this study is the insider trading behaviors within the US financial markets, with a focus on transactions by politicians and public officials, and their implications for global economic stability. The **purpose** is to investigate and analyze these transactions for ethical and legal challenges, and to evaluate their potential impact on market integrity and investor trust. The **relevance** of this research arises from the substantial influence these figures have on market dynamics, the legal nuances involved in their financial activities, and the broader implications for market transparency and fairness. The **scientific novelty** is established using econometric modeling and data analytics, particularly the analysis of trading behavior that potentially circumvents the Stop Trading on Congressional Knowledge (STOCK) Act. The **methods** employed include a Python tool to extract data from financial disclosures and ordinary least squares (OLS) regression to analyze key indicators of insider behavior. The **results** indicate a significant proportion of trades, approximately 86.67%, were conducted by politicians with noted STOCK Act violations, highlighting a potential gap in the enforcement of current laws and reporting standards. The authors **concluded** that the findings call for stricter law enforcement, a reevaluation of reporting standards, and comprehensive financial disclosures to maintain market integrity, alongside an urgent need for improved regulatory measures and enhanced transparency mechanisms to mitigate the risks associated with insider trading by individuals in positions of power.

Keywords: insider trading; US financial markets; STOCK Act; market transparency; integrity in finance; econometric models; political trading analysis; ethical financial practices; S&P 500 Index; Microsoft Corp; data analysis; regulatory compliance

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ОРИГИНАЛЬНАЯ СТАТЬЯ

Использование машинного обучения для раскрытия динамики инсайдерской торговли на финансовых рынках

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АННОТАЦИЯ

Предметом данного исследования является поведение инсайдеров на финансовых рынках США, с акцентом на операции политиков и чиновников, и его последствия для глобальной экономической стабильности. **Цель** исследования — изучить и проанализировать эти сделки на предмет этических и правовых проблем, а также оценить потенциальное влияние на целостность рынка и доверие инвесторов. **Актуальность** исследования обусловлена значительным влиянием этих фигур на динамику рынка, юридическими нюансами, связанными с их финансовой деятельностью, и более широкими последствиями для прозрачности и справедливости рынка. **Научная новизна** исследования достигается за счет использования эконометри-

ческого моделирования и анализа данных, в частности, анализа торгового поведения, которое потенциально может обойти Закон о прекращении торговли на основе знаний Конгресса (STOCK). Применяемые **методы** включают инструмент Python для извлечения данных из финансовых деклараций и регрессию по методу обыкновенных наименьших квадратов (OLS) для анализа ключевых показателей поведения инсайдеров. **Результаты** показали, что значительная часть сделок, около 86,67%, была совершена политиками, имеющими нарушения Закона STOCK, что указывает на потенциальные пробелы в применении действующих законов и стандартов отчетности. Авторы пришли к **выводу**, что полученные данные требуют ужесточения правоприменения, переоценки стандартов отчетности и всестороннего раскрытия финансовой информации для поддержания целостности рынка, а также настоятельной необходимости совершенствования мер регулирования и механизмов повышения прозрачности для снижения рисков, связанных с инсайдерской торговлей со стороны лиц, занимающих руководящие посты.
Ключевые слова: инсайдерская торговля; финансовые рынки США; закон STOCK; прозрачность рынка; целостность финансов; эконометрические модели; анализ политической торговли; этические финансовые практики; индекс S&P 500; корпорация Microsoft; анализ данных; соблюдение регуляторных требований

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1. Introduction

This research paper focuses on the phenomenon of unethical insider trading, specifically the trading of public assets in financial markets by congressmen who may have obtained knowledge about certain events before their public release. The research has revealed the multi-dimensional nature of this issue and its profound implications. The strategic aspects of trading, particularly concerning unobservable information acquisition, are elucidated by Banerjee and Breon-Drish [1], who provide insights into the nuanced strategies employed by insiders. Similarly, Balogh [2] contributes to the empirical understanding of these covert activities, highlighting the criticality of insider stock sales and purchases in revealing information about a firm's business prospects.

The role of macroeconomic uncertainties in influencing opportunistic insider trading is examined by Cai et al. [3]. Their work suggests that broader economic conditions can significantly affect such activities. Chirkova and Petrov [4] examine insider trading dynamics in the context of administrative pressures on businesses, providing insight into how corporate events influence insider behavior. The legal framework and enforcement efforts surrounding illegal insider trading are critically analyzed by Cline and Posylnaya [5]. Their research underscores the vital role of regulatory bodies like the U.S. Securities and Exchange Commission (SEC) in curbing insider trading, while also questioning the effectiveness of current regulatory measures. Similarly, Cziraki and Gider [6] explore the economic aspects of insider trading, revealing a gap between expected and actual gains, thereby raising questions about the efficacy of existing regulations. The intricate relationship between political connections and insider trading is investigated by Harvison [7]. Expanding on this, He and Marginson [8] discuss the broader market impact of insider trading, particularly its influence on analyst coverage and forecasts, thus highlighting the significant consequences of such activities.

Comparative analyses of insider trading regulations, especially between the US and EU, are presented by Jardak and Matoussi [9] and Kang [10]. These studies provide valuable insights into the differences in regulatory frameworks and their effectiveness in different jurisdictions. Additionally, the novel methods for detecting insider trading in high-frequency trading environments, as discussed in the literature watch by Charles River Associates,[1] underscore the need for advanced surveillance techniques in today's fast-paced trading environments. Biggerstaff, Cicero, and Wintoki [11] revisit the information content of stock trading by corporate insiders, providing new evidence that insider trades predict abnormal stock returns. They also explore insiders' trading strategies, highlighting how insiders attempt to maximize their trading profits.

The concept of indirect insider trading is further explored by Goldie et al. [12], who demonstrate that indirect trades through controlled accounts tend to be more profitable and informative than direct

[1] Insider Trading & Market Manipulation Literature Watch: Q4 2022. Charles River Associates. 2023. URL: https://www.crai.com/insights-events/publications/insider-trading-market-manipulation-literature-watch-quarter-4–2022/ (accessed on 19.01.2024).

trades. They also show that these trades are often executed by opportunistic insiders who engage in nonroutine trading or trade profitably before earnings announcements.

Finally, Guay, Kim, and Tsui [13] assess the economic determinants of insider trading windows, exploring how company-imposed insider trading restrictions reflect concerns about information asymmetry and the strength of external monitoring.

Despite the extensive research, gaps remain in understanding the specific implications of political influence on insider trading and the effectiveness of current regulations in different market environments. This study aims to bridge these gaps by investigating the nuances of insider trading activities among political figures and public officials in the US financial markets, focusing on their ethical and legal challenges and the subsequent impact on market integrity and investor trust.

With the increasing relevance of machine learning, it is important to consider how these technologies can be implemented into the current system to enhance the stability and safety of all market participants.

2. Literature review

The topic of insider trading, which is crucial in financial markets, has been extensively researched, revealing its multi-dimensional nature and profound implications. Banerjee and Breon-Drish [1] examine the strategic aspects of trading, with a focus on the acquisition of unobservable information. Their work provides insights into the nuanced strategies used by insiders to leverage non-public information for profitable trading. Balogh [2] provides important data on insider trading, offering an empirical basis for understanding these covert activities.

Back, Crotty, and Li [14] identify information imbalances that enable insider trading when studying market asymmetries, highlighting the difficulties in ensuring market fairness. Cai et al. [3] investigate how macroeconomic uncertainties affect insider trading, suggesting that broader economic conditions can either exacerbate or mitigate such activities. Chirkova and Petrov [4] investigate insider trading in the context of administrative pressures on businesses, providing an insight into how corporate events affect insider behaviour.

Chirkova and Agamyan [15] expand on this analysis to include the Russian stock market, particularly in relation to mergers and acquisitions. Their research emphasises the worldwide nature of insider trading, demonstrating its prevalence across various market structures.

Cline and Posylnaya's [5] research on illegal insider trading highlights the SEC's efforts in detection and deterrence. The authors stress the crucial role of regulatory bodies in mitigating insider trading and analyze how recent legal actions affect insider decisions. Cziraki and Gider [6] focus on the economic aspects of insider trading, revealing a gap between expected and actual gains from such practices, which raises questions about the effectiveness of current regulatory measures.

Harvison [7] examines the relationship between politics and insider trading, suggesting that political connections may provide a protective shield against regulatory scrutiny. Harvison's findings are supported by Marginson [8], who discusses the wider market impact of insider trading, including its effect on analyst coverage and forecasts. This highlights the significant consequences of such activities.

Jardak and Matoussi [9] compare insider trading disclosure policies in the US and EU, highlighting the differences in regulation and transparency. Kang's analysis [10] further explores these differences and evaluates the effectiveness of the regulatory frameworks.

In the area of high-frequency trading, Kritsky and Glik [16] present novel methods for detecting insider trading. Their work is particularly relevant in fast-moving trading environments where traditional surveillance techniques may be insufficient.

3. Methods

The study employed a comprehensive methodology to examine market trends and the actions of political figures in financial markets, with the goal of identifying instances of potential insider trading or other unethical behaviour. The primary focus was on the S&P 500 Index and Microsoft Corp (Ticker: MSFT) stock.

The aim was to identify patterns in the movement of Microsoft's stock price and the S&P 500 that may indicate questionable behaviour.

A Python software tool was developed to collect and assess the required data by operating as a web scraper. The tool extracts financial disclosures related to politicians' transactions from the capitoltrades.com website. The web scraper has been configured to collect trading data for all American politicians

who buy and sell Microsoft Corporation stocks. This enables an evaluation of the potential gains or losses obtained between the date of the trade and the date of filing, during the time period from February 15, 2021, to January 12, 2023.

A total of 443 transactions were extracted. The source code for it is provided in the exhibit named "Parser-InsiderTradePol.py"[2] as well as its output listed in the exhibit "capitoltrades_data.xlsx".[3]

The analysis begins by using the data from "capitoltrades_data.xlsx" by excluding stock trades that have a value for "SIZE" that is ">0" and focusing solely on purchases. The subsequent section investigates cases where insiders trade against the market by buying stocks during a downward trend in the S&P 500 index. However, insiders can still profit during the period between the transaction and the filing of reports, as well as when the stock price begins to rise. Microsoft Excel spreadsheet functions are used to identify unique trade scenarios.

Excel is utilised to filter, examine and correlate data in depth, facilitating statistical analysis and result interpretation. Throughout this process, we ensure that all data is transparent and accessible for analysis, as demonstrated in the exhibit 'MSFT-Analysis.xlsx'.[4] The study aims to capture the latest market trends and rapidly shifting money movements that may indicate potentially illicit gains. The method relies on daily stock price data to detect short-term insider trading. It is worth noting that weekly or hourly data may not accurately reflect rapid market reactions to news events or political decisions, and therefore may be less relevant.

The significance of selecting daily data is confirmed by its extensive use in financial analysis and trading, where it serves as the basis for decision-making by most market participants. Such data enables more precise monitoring of market trends, allowing for a more thorough examination of insider behaviour. This includes potential exploitation of privileged information, as well as exploiting loopholes and intransparencies to generate personal illicit gains. Thus, the methodology of the study employs a balanced combination of automated web scraping, detailed statistical analysis, and application of econometric models in Excel, which jointly offer high reliability and in-depth analytical conclusions.

The study investigates the influence of insider trading on market indicators and analyses its synchronization using the S&P 500 index as a case example.

The study employs the following key indicators:

1. ΔI_t (ΔInsider — Time period (Trade / Publication)):

This indicator measures the change of the stock price (Microsoft corporation) from the time of the trade to the time of the statement's official publication. It suggests the possibility of the use of confidential data before public disclosure as well as an indicator for potential gains.

2. $\Delta S\&P_t$ ($\Delta S\&P$ — Time period (Trade / Publication)):

This indicator shows the change in the performance of the S&P 500 index during a similar time frame. This indicator analyses the market response period between an insider trade and its subsequent public release. It offers an understanding of how the market reacts to insider trading and the potential effects of such trading on market trends.

3. S_t (SIZE — type):

This indicator measures the type and volume of insider trade, which can enhance comprehension regarding insider activity under specific market conditions. If negative, it means that there was a buy order since the politician spends money, depending on the size of its order, it may vary from –10 to 10. –10 being a big buy and 10 being a big sell (in this research paper we are focusing solely on purchases thus being all negative values from –1 to –10).

For the analysis, we used the data presented in *Table 1* using the OLS method, which allows the values of the regression coefficients to be predicted using a multiple regression equation. Consequently, we hypothesise that the modification of independent variables specified prior, indicated by coefficients (β), exerts a collective effect on the indicators of insider activity. While acknowledging the possible occurrences of unexplained variability in insider trading data (ε) not accounted for by these factors.

It is crucial to note that not all exogenous variables considered in this model are associated with market dynamics. Therefore, their influence cannot be evaluated merely based on market performance dependence analysis. For obtaining dependable,

[2] parser-insidertradepol.py — https://drive.google.com/file/d/1YQXNdQ_LrNqzDFNj_O1SIPWcbfTX7Z-k/view?usp=sharing

[3] capitoltrades_data.xlsx — https://docs.google.com/spreadsheets/d/18TGxpy5kKb9j-kfAYXNuFx8S 4fbtuZtV/edit?usp=sharing&ouid=108954168103873559919&rtpof=true&sd=true

[4] MSFT-Analysis.xlsx — https://docs.google.com/spreadsheets/d/10OYD_xogzanu34SdkSUZU_lr9IrfVggX/edit?usp=sharing&ouid=108954168103873559919&rtpof=true&sd=true

Table 1
Research indicators

ΔInsider — Time period (Trade / Publication)	ΔS&P — Time period (Trade / Publication)	SIZE — type
ΔIt	ΔS&Pt	St
0,02%	–4,49%	–0,8
0,34%	–3,40%	–0,8
0,34%	–3,40%	–0,7
4,97%	–3,25%	–0,2
4,55%	–3,85%	–0,2
4,55%	–4,07%	–0,2
1,88%	–3,00%	–0,4
1,35%	–1,62%	–0,8
1,35%	–1,62%	–0,7
1,35%	–1,62%	–0,7
1,35%	–1,62%	–0,7
1,35%	–1,62%	–0,8
1,35%	–1,62%	–0,3
1,79%	–1,62%	–0,5
1,79%	–0,78%	–0,2

Source: Data from MICROSOFT the Corporation (MSFT) the S&P and Size types (buys) to build the model.

objective, and consistent estimates of regression coefficients, it is vital to introduce these variables into the equations.

Therefore, the introduced indicators ΔI_t, $\Delta S\&P_t$, and St will be vital in evaluating potential insider trading and its influence on market behaviour, thereby offering a valuable contribution to comprehending the correlation between insider trades and market instability.

3.1. Model development

The analytical model was developed by first acquiring a complex dataset from capitoltrades.com through a web scraping process. The website publishes financial disclosures made by SEC policy makers. The retrieved data was then subjected to pre-analysis and cleaned using Excel filtering functions to remove inaccuracies (values like "N/A"), or incomplete statements that occurred due to the incomplete provided data on capitoltrades.com, and prepare it for further analysis. The final cleaned data are shown in *Table 1*.

Several methodological approaches were then evaluated to identify potentially suspicious behaviour from an econometric perspective. Through the analysis of different data combinations, we determined the most efficient method for identifying the specified behaviour. Hypotheses were formulated regarding various types of suspicious behavioral patterns. The most rational hypothesis, which is discussed in this research paper, focuses on trades conducted by individuals that are counterintuitive to market dynamics (e.g., a buy order while the market is falling).

The identified pattern was then applied to filter the Microsoft trading data after filtering.

This enabled the creation of the subsequent regression model:

$$\begin{cases} \Delta I_t = \beta_0 + \beta_1 \cdot \Delta S\ \&\ P_t + \beta_2 \cdot S_t + \varepsilon_t \\ E(\varepsilon_t) = 0; \\ \sigma(\varepsilon_t) = const \end{cases}$$

This model is a multiple regression equation that relates the change in insider behaviour (ΔI_t) to the change in the *S*&*P* 500 index during the relevant period ($\Delta S\&P_t$) and the size and type of the trade (S_t). The model incorporates ε_t as the random error with a mean of zero and constant variance.

We utilised the model to study data from one of the biggest percentage holders of the *S*&*P* 500 index (Microsoft) to uncover specific trends and patterns. Through conducting a thorough analysis based on the obtained data, we were able to confirm or refute the initial hypotheses concerning insider trading. This led to the development of an objective comprehension of the mechanisms pertaining to market dynamics as well as the possible exploitation of insider information within the stock trading realm.

4. Results

To develop our econometric models, it is important to analyse the dynamics of financial markets in a systematic manner. This analysis helps to reveal the complex interactions between insider trading activities and overall market performance, using rigorous statistical methods to uncover underlying patterns. Our approach is grounded in empirical evidence and systematically decodes these relationships, providing insights into the mechanisms driving market movements.

Our robust regression model, calibrated to decipher the complex relationship between insider trading activity, captured by the variable ΔIt, and the ebb and flow of the *S*&*P* 500 index, denoted as $\Delta S\&P_t$. The strength of this relationship is conveyed by a multiple correlation coefficient of 0.850653, signaling a potent liaison between our chosen variables and the nuanced realm of insider trading.

The R Square value of the model is 0.723601, indicating its robustness in explaining the variance within the data set and highlighting its significant predictive capability. It tells us that a substantial portion of the variance in insider trading is illuminated by the variables we have included into the model. The adjusted R Square, only slightly less at 0.673357, maintains the narrative of a well-fitting model, even when adjusting for the predictors' quantity.

Emerging from the data is an inverse relationship, subtle yet significant. The coefficient for $\Delta S\&P_t$ stands at a nuanced –0.032537816, signaling that as insider trading activity increases, the *S*&*P* index tends to sway in the opposite direction. However, the statistical significance of this is not quite on point, as reflected by the t-statistic and p-value. This suggests that insider trading's choreography isn't wholly in lockstep with the broader market indices.

Trade characteristics, represented by S_t, take center stage with a direct and statistically significant impact on insider trading activity. The value of the coefficient at 0.055013034, along with a commanding t-statistic, underlines the importance of trade size and type in the grand performance of market dynamics. This finding reinforces the narrative that insider transactions are more than reactionary — they are deliberate moves performed with strategic intent.

Our model's statistical rigor is further affirmed by a towering F-Statistic of 14.39942643. The corresponding p-value, close to zero, dismisses the null hypothesis, heralding the explanatory power of our independent variables. Meanwhile, the standard error whispers at a mere 0.009213, assuring us of the data's closeness to the predictive regression line — a testament to the model's precision.

Further on, by applying our filter system, we could extract the following results for Microsoft (*Table 2*).

Table 2, built from 15 observations, is rich in the complexities and subtleties of potential insider trading. It is not a snapshot, but a dynamic representation that captures the essence of market fluctuations and insider strategies.

The table shows politicians flagged by our system. The number of total trades made with Microsoft, their sells before a decline and their buys before a growth.

The accuracy rate, which is calculated in the following way:

$$\frac{(\text{Sells before decline}) + (\text{ Buys before growth})}{\text{Total Amount of Trades}}.$$

The final indicators (Business Insider and NY-Times) show whether these politicians have previously been listed in either source as having questionable stock market activity.

According to data from the NY-Times and Business Insider sources, 13 out of 15 (or about 86.67%) members of Congress who have received alerts from our system have previously engaged in questionable trading activity. The New York Times even lists where the congressmen may have held positions with potential conflicts based on their committee and their past in business.

In conclusion, the narrative that unfolds from our model is not one of isolated statistical metrics but a cohesive story of market behavior. It highlights the

Table 2
Anonymised data from the "suspicious trades"Excel sheet in MSFT-Analysis.xlsx

Politicians	Total Trades	Sells before decline	Buys before growth	Accuracy ratio	Business Insider	NY-Times
Politician 1	1	1	0	100%	Yes	Yes
Politician 2	97	22	29	53%	Yes	Yes
Politician 3	3	2	1	100%	No	Yes
Politician 4	6	2	4	100%	No	Yes
Politician 5	15	4	4	53%	Yes	Yes
Politician 6	13	2	5	54%	Yes	Yes
Politician 7	2	2	0	100%	Yes	Yes
Politician 8	9	2	4	67%	Yes	Yes
Politician 9	2	0	2	100%	Yes	No
Politician 10	4	3	0	75%	Yes	Yes
Politician 11	1	1	0	100%	No	Yes
Politician 12	1	1	0	100%	No	No
Politician 13	1	1	0	100%	No	No
Politician 14	1	0	1	100%	No	Yes
Politician 15	1	1	0	100%	Yes	No

Source: Developed by the author.

pivotal role of trade characteristics in guiding insider trading, with market indices playing a surprisingly subdued part in this financial symphony. The insights we derive are far-reaching, shedding light on the enigmatic forces that steer market dynamics and offering a robust foundation for future research and policy formulation in financial regulation. Thus, this subchapter weaves together the statistical findings and economic theories into a narrative that is not just fluent but resonates with the depth and complexity of the financial markets it seeks to explain.

5. Discussion

In our study on financial markets, we aimed to enhance transparency and ethical standards. Utilizing advanced methodologies and thorough data analysis (OLS regression model), we sought to uncover and understand the implications of trading practices that potentially conflict with legal and ethical norms. Our research, through rigorous examination and data scrutiny, has revealed a realm where nuanced and potentially problematic trading activities prevail. This endeavor revealed recurring patterns of conduct that, while not outright violations, danced precariously along the edges of legal frameworks and ethical norms.

The meticulous application of our filters brought to light the repeated STOCK Act infringements by some politicians, casting a spotlight on the systemic flaws where consequences for non-compliance are trivial compared to the potential windfalls from informed trading. These minor penalties do little to deter the misuse of privileged information, thus undermining the spirit of the STOCK Act.

Our scrutiny also extended to the transactions linked to certain well-known families. These trades, significant in size and timing, straddle the fine line of ethical propriety, raising questions about the integrity of lawmakers vested with the power to influence the markets they invest in. While legally above board, these activities spotlight the moral grey areas that exist within the current legislative landscape.

Amid this exploration, we encountered the opaque veil cast by the SEC's reporting structure, which grants leeway in filing periods. This flexibility, while ostensibly practical, cloaks the actual financial outcomes of trades within a shroud of ranges

and estimates, obscuring the precise gains or losses. The reports, instead of providing clarity, often leave a mirage of transparency that disintegrates upon closer examination.

This ambiguity transcends isolated events, igniting a broader debate over the ethics of allowing those in power to engage in market activities that may be swayed by nonpublic business information. Despite the STOCK Act's directives for transparency, its enforcement is sporadic, and its provisions are insufficient to deter the advantages presented by insider knowledge.

Our analysis — coupled with a remarkable finding that about 86.67% of the trades flagged by our system were executed by politicians listed in the Business Insider article «78 members of Congress caught violating law on stock trades»[5] and in the New York Times (hereinafter referred to as NY-Times) article "These 97 Members of Congress Reported Trades in Companies Influenced by Their Committees"[6] signals a pressing need for reform in the legislative framework governing insider trading. We advocate for a shift toward more rigorous enforcement and a reevaluation of the rules governing the trading activities of those at the helm of power.

Looking forward, we envisage a future where financial disclosures become bastions of transparency with a timeframe smaller than 2 days, or a live update function that gives more insight on the movement of public servants. Per say, it would be much more effective to make the brackets needed for a financial statement in much smaller intervals, because currently there are brackets that have a too vague range (e.g.: from 5 million USD to 25 million USD and from 25 million USD to 50 million USD). Our proposal would be that amounts above 1 million USD should be disclosed in million steps, steering the market towards a paradigm of integrity and fairness. The goal is a future where transparency is not merely pursued but achieved, and trust in the openness of the financial system is unshakeable. This is achievable with the help of machine learning algorithms that would collect the trades conducted in an encrypted manner and frequently check which politicians are actively influencing trends on the market (for example, by passing new laws).

The penalty for misconduct should not only be a fixed amount of 200 USD, but also a percentage of the earnings gained during the relevant timeframe. Additionally, politicians and their family members should be obligated to publicly disclose all financial papers to uncover any potential illicit activities. The use of machine learning algorithms can help analyse connections between income sources and market events to verify potential malicious intent. The results could be used as evidence to press further charges against the public servant. The process should be made public and analyzed by independent, anonymous, and certified specialists within a short time frame to ensure a valid and uncorrupted output that accurately reflects any discrepancies.

6. Conclusions

This study, based on rigorous econometric analysis and a comprehensive review of trading behaviour and data structures, has not only highlighted significant challenges, but also identified potential avenues for meaningful reform.

Our investigation navigated through vast amounts of data to uncover patterns that at first glance seemed to point clearly to systemic problems in market practices, particularly those involving political figures. The initial finding — that approximately 86.67% of certain transactions examined were executed by politicians with a history of STOCK Act violations — suggested a troubling trend. However, upon closer examination and reflection, we recognise the complexity of attributing causality based solely on the profitability of the trades and note that the situation looks suspicious and requires further investigation.

The leap from observing high profitability among a subset of market participants to attributing this success to insider information. This assumption overlooks several plausible explanations, such as sophisticated investment strategies, the advice of competent financial advisors, or even serendipity. The profitability of a politician's portfolio, while suggestive, is not incontrovertible evidence of insider trading. It is a hypothesis that warrants further investigation rather than a conclusion. The complexity of financial markets, where myriad factors influence

[5] Business Insider — 78 members of Congress have violated a law designed to prevent insider trading and stop conflicts-of-interest: https://www.businessinsider.com/congress-stock-act-violations-senate-house-trading-2021–9?r=US&IR=T (accessed on 02.03.2023)

[6] New York Times — These 97 Members of Congress Reported Trades in Companies Influenced by Their Committees: https://www.nytimes.com/interactive/2022/09/13/us/politics/congress-members-stock-trading-list.html (accessed on 02.03.2023)

trading success, underscores the risk of simplistic interpretations of data.

Acknowledging this, our research ventured into the realm of assumptions with the implicit hypothesis that past violations of the STOCK Act by politicians could predispose them to repeat such behaviors. This assumption, while grounded in behavioral patterns observed in other contexts, introduces a risk of confirmation bias, potentially overshadowing alternative explanations for the observed trading success. The reliance on indirect data to infer insider trading underscores a fundamental limitation of our study — the challenge of directly linking trade profitability to the illicit use of insider information without a comprehensive analysis of individual trade contexts.

In addition, it is important to note that our analysis is limited to transactions within the Microsoft Corp sphere, which serves as a case study. This limited perspective may not encompass all trading behaviours and their impact on the wider market or other sectors, which could potentially bias our analysis and conclusions.

Although our results raise valid concerns about the transparency and ethics of trades carried out by political figures, they do not conclusively demonstrate insider trading. Instead, they highlight patterns that warrant further investigation and scrutiny. The observed high profitability of trades by certain politicians is concerning and suggestive of potential insider information usage, but it is not conclusive. This realization prompts a call for more nuanced research methodologies that can more directly ascertain the motivations and information sources underpinning trading decisions this may be done in the future, potentially by as official intelligence or machine, learning algorithms, which would give them more detailed than nuanced result.

In conclusion, our exploration of the financial market's complexities highlights the need for further investigation rather than a definitive conclusion. This emphasises the importance of enforcing existing laws such as the STOCK Act, revaluating reporting standards, and committing to transparency and ethical responsibility within financial markets. Our goal is to achieve a future with strong financial disclosures, a trustworthy financial system, and equal opportunities for all market participants. To achieve this, we must not only be vigilant and advocate for change, but also have a nuanced understanding of the data and commit to rigorous, evidence-based analysis. The way ahead involves ongoing exploration, learning, and, crucially, open dialogue and collaboration among researchers, policymakers, and market participants. By working together, we can strive to achieve a more transparent, ethical, and fair marketplace.

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