Does Congress Play by Different Stock Market Rules? A Data Mining and Statistical Analysis of Congressional Trading

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***Abstract*—Members of the United States Congress routinely trade individual equities while possessing non-public knowledge of pending legislation, regulatory shifts, and federal contract awards. This study investigates whether congressional stock trades generate statistically significant abnormal returns and whether the Stop Trading on Congressional Knowledge (STOCK) Act of 2012 curtailed this informational advantage. Using a dataset of 14,276 congressional equity transactions spanning 2004–2024, the analysis employs a multi-method framework comprising event studies under dual measurement regimes (trade-date and disclosure-date windows), Carhart four-factor calendar-time portfolios, difference-in-differences (DiD) estimation with corporate insider trades as a control group, permutation testing, machine learning classification (logistic regression, random forest, XGBoost), and legislator clustering. Event study results indicate that congressional purchases generate a mean cumulative abnormal return (CAR) of 1.18% over the 21 trading days following the trade date ($t = 3.41$, $p = 0.001$), while disclosure-date CARs are substantially attenuated at 0.41%, quantifying the alpha decay between trade execution and public disclosure. Calendar-time portfolios yield an annualized four-factor alpha of 4.65% for the full sample, declining to 2.67% in the post-STOCK-Act period. The DiD estimate ($\hat{\beta}_3 = -0.0089$, $p = 0.019$) indicates a statistically significant reduction in congressional trading advantage relative to corporate insiders after the STOCK Act. SHAP-based feature importance analysis identifies reporting delay as the most predictive feature of positive abnormal returns, supporting the strategic disclosure timing hypothesis. These findings contribute to the literature on informed trading and legislative accountability by providing the first integrated analysis combining ML-based feature importance, dual event-window measurement, and a post-STOCK-Act sample extending through 2024.**

***Index Terms*—Congressional trading, insider trading, event study, abnormal returns, STOCK Act, machine learning, SHAP, difference-in-differences, data mining**

I. Introduction

On January 24, 2020—weeks before the World Health Organization declared COVID-19 a global pandemic—Senator Richard Burr, then chairman of the Senate Intelligence Committee, sold between $628,000 and $1.72 million in equity holdings following a classified briefing on the emerging outbreak. The S&P 500 subsequently fell 34% over the next month. While the Department of Justice ultimately declined to prosecute, the episode crystallized a long-standing concern: members of Congress trade equities while possessing material, non-public information derived from their legislative duties, committee briefings, and privileged access to executive-branch officials.

The intersection of legislative power and financial markets creates an acute information asymmetry. Unlike corporate insiders, who are constrained by well-established securities law and monitored via SEC Form 4 filings, members of Congress historically faced no meaningful restrictions on trading based on information acquired through their official duties. This regulatory gap persisted despite decades of academic evidence suggesting that congressional portfolios systematically outperformed the market [1], [2].

The STOCK Act of 2012 (Pub. L. 112-105) [5] represented the first significant legislative attempt to address this asymmetry. The Act extended insider trading prohibitions to members of Congress and their staff, required electronic filing of financial disclosures, and mandated reporting of transactions within 45 days. However, enforcement has been limited—the Act's online disclosure provisions were partially rolled back in 2013, and only a handful of referrals have resulted in penalties. A critical empirical question remains: did the STOCK Act substantively reduce the informational advantage of congressional traders, or did it merely alter the form of disclosure without changing the underlying behavior?

This paper addresses four research questions:

RQ1: Do congressional trades generate statistically significant abnormal returns when measured from the trade date?

RQ2: Can outside investors profit by mimicking disclosed trades when measured from the disclosure date?

RQ3: Did the STOCK Act reduce the informational advantage of congressional traders?

RQ4: Which legislator and trade characteristics best predict abnormal returns?

The distinction between trade-date and disclosure-date measurement is central to the analysis. Financial disclosure rules

permit a reporting delay of up to 45 days, meaning that any outside investor attempting to replicate congressional trades acts on stale information. The trade-date regime captures the upper bound of any informational advantage—the alpha available to the legislator at the moment of the trade. The disclosure-date regime captures the economically actionable signal available to the public. The gap between these two quantities measures the alpha that decays during the disclosure window.

To answer these questions, the study deploys a multi-method analytical framework. Event studies quantify abnormal returns under both measurement regimes. Calendar-time portfolios estimate Carhart four-factor alpha across subperiods. A difference-in-differences design exploits the STOCK Act as a natural experiment, using corporate insider trades from SEC EDGAR Form 4 filings as a control group. Permutation testing provides a non-parametric assessment of statistical significance. Machine learning models (logistic regression, random forest, and XGBoost) predict the sign of abnormal returns, with SHAP values identifying the most informative features. Finally, K-Means clustering reveals distinct legislator trading archetypes, tested against a pre-specified hypothesis linking committee membership to abnormal performance.

This work makes several contributions relative to the existing literature. First, it provides ML-based feature importance analysis via SHAP values, connecting predictive features to specific economic mechanisms (private information channels, strategic disclosure timing, or sector preferences). Second, it introduces a dual event-window framework that separately quantifies trade-date and disclosure-date alpha, explicitly addressing the feasibility of mimicry strategies. Third, it includes a pre-specified clustering hypothesis linking committee membership to abnormal performance, avoiding the post-hoc narrative construction that is common in exploratory analyses. Fourth, it extends the post-STOCK-Act sample through 2024, providing a longer evaluation window than prior studies.

The remainder of the paper is organized as follows. Section II reviews the relevant literature. Section III describes the data sources and cleaning procedures. Section IV details the analytical methodology. Section V presents results. Section VI interprets findings and discusses policy implications. Section VII addresses limitations and proposes extensions. Section VIII concludes.

II. Related Work

A. Congressional Trading and Abnormal Returns

The foundational study of congressional equity trading is Ziobrowski et al. [1], which analyzed U.S. Senate financial disclosures from 1993 to 1998 and reported that senators' stock portfolios earned abnormal returns of approximately 12% annually, substantially exceeding both market benchmarks and the performance of corporate insiders. A subsequent study by the same authors [2] extended the analysis to the House of Representatives and found positive but smaller abnormal returns, consistent with the hypothesis that senators' broader oversight responsibilities and committee assignments provide superior informational advantages relative to House members.

These findings were challenged by Eggers and Hainmueller [3], who argued that prior studies used inappropriate benchmarks—specifically, that raw return comparisons or single-factor alphas failed to account for the size, value, and momentum exposures inherent in congressional portfolios. Using matched portfolios and more rigorous factor adjustments, they found that the abnormal returns of congressional traders were statistically indistinguishable from zero. This critique is methodologically important: the present study addresses it directly by employing Carhart four-factor [7] alpha throughout, thereby controlling for the systematic risk exposures that may have inflated earlier estimates.

Karadas [4] refined the analysis by examining the private-information channel hypothesis. Using committee assignment data, Karadas demonstrated that trades by members of committees with oversight of specific industries generated higher abnormal returns in those industries than trades by non-committee members, providing direct evidence that informational advantages flow through committee assignments rather than general legislative access.

B. Corporate Insider Trading Literature

A parallel literature examines corporate insider trading as reported via SEC Form 4 filings. Lakonishok and Lee [13] established that corporate insider purchases predict positive future returns, while insider sales are less informative due to diversification and liquidity motives. Seyhun [14] provided a comprehensive analysis of insider trading patterns and their implications for market efficiency. This body of work provides both methodological precedents for the event study framework employed here and the empirical basis for using corporate insider trades as a DiD control group in the STOCK Act analysis.

C. The STOCK Act and Regulatory Response

The STOCK Act, signed into law on April 4, 2012, explicitly prohibited the use of non-public information derived from official duties for personal financial benefit and required electronic filing of financial disclosures within 45 days of a transaction. Scholarly assessments of the Act's effectiveness are mixed. Jerke [15] argued that the Act was symbolically important but structurally weak, lacking a dedicated enforcement mechanism and relying on the same SEC and DOJ apparatus that had historically shown little appetite for prosecuting congressional insider trading. Empirical evaluations of post-STOCK-Act trading patterns have generally found reduced but not eliminated abnormal returns [4], raising the question of whether the remaining alpha reflects continued informational advantage, survivorship of disclosure-aware trading strategies, or simply noise.

D. Machine Learning in Financial Anomaly Detection

The application of machine learning to detect informed trading patterns remains nascent. Gradient-boosted tree models,

particularly XGBoost [10], have shown strong performance in tabular financial prediction tasks. Lundberg and Lee's [11] SHAP framework provides model-agnostic feature importance measures grounded in cooperative game theory, enabling interpretable attribution of predictions to input features. To the authors' knowledge, no prior study has applied SHAP-based feature importance analysis to congressional trading data, making this a novel methodological contribution.

E. Positioning of the Present Study

The present study synthesizes and extends the above strands. It addresses Eggers and Hainmueller's [3] benchmark critique by using Carhart four-factor alpha. It extends Karadas's [4] committee-based analysis via ML feature importance and clustering. It provides a longer post-STOCK-Act window than prior work, and it introduces dual event-window measurement to separately quantify trade-date and disclosure-date alpha—a distinction that prior studies either ignored or treated informally.

III. Data

A. Congressional Trade Disclosures

Congressional trade data were obtained from Quiver Quantitative, covering the period from January 1, 2004 to December 31, 2024. The raw dataset contains 18,491 individual transaction records filed by members of the U.S. Congress. Each record includes the legislator's name, party affiliation, chamber (Senate or House), state, stock ticker symbol, trade date, disclosure date, transaction type (purchase or sale), and an estimated transaction amount reported as a range (e.g., \$1,001–\$15,000). The midpoint of each reported range serves as a proxy for trade size throughout the analysis.

Data cleaning proceeded as follows. First, transactions involving options, mutual funds, exchange-traded funds (ETFs), and non-equity instruments were removed to focus the analysis on individual stock trades, where the informational advantage hypothesis is most directly testable. Second, ticker symbols were resolved for corporate actions (mergers, name changes, and spin-offs) using historical mapping tables. Third, duplicate records arising from amended filings were identified and removed. Fourth, records with missing trade dates or unresolvable tickers were excluded. After cleaning, the final sample comprises 14,276 equity transactions by 456 unique legislators.

B. Market Data

Daily adjusted closing prices for all traded tickers and the S&P 500 index were obtained from the `yfinance` Python library. Adjusted prices account for stock splits, dividends, and other corporate actions. The risk-free rate is the one-month U.S. Treasury bill rate from the Kenneth French Data Library [12].

C. Factor Data

Daily and monthly returns for the Carhart four factors—market excess return (Mkt-RF), size (SMB), value (HML) [6], and momentum (MOM) [7]—were obtained from the Kenneth French Data Library [12]. These factors are used in both the calendar-time portfolio regressions (Section IV-B) and as controls in cross-sectional analyses.

D. DiD Control Group

The difference-in-differences analysis requires a control group of traders who face a similar disclosure regime but were not directly affected by the STOCK Act. Corporate insider trades, as reported in SEC EDGAR Form 4 filings, serve this role. Corporate insiders (officers, directors, and 10% beneficial owners) are required to report trades within two business days under Section 16(a) of the Securities Exchange Act of 1934. This control group is preferred over randomly timed trades because it preserves the structural features—mandatory post-trade disclosure and potential information asymmetry—that make the DiD coefficient β_3 interpretable as a differential regulatory effect. A random sample of 42,817 corporate insider transactions over the same 2004–2024 period was drawn to form the control group.

E. Supplementary Data

Committee membership data were obtained from the ProPublica Congress API and supplemented with historical records from GovTrack. The CBOE Volatility Index (VIX) was retrieved from the Federal Reserve Economic Data (FRED) database. Legislative session dates were obtained from the official Congressional calendar published on congress.gov.

F. Descriptive Statistics

Table I summarizes the sample. The dataset is dominated by House members, consistent with the larger size of that chamber. Republican and Democratic members are approximately equally represented, with 6,842 and 7,228 transactions respectively; the remaining 206 transactions are attributable to Independent members. The mean reporting delay between trade date and disclosure date is 32.4 days (median: 28 days), with substantial right-tail variation—a feature that the ML analysis exploits as a predictive feature. Notably, 14.3% of transactions exceeded the statutory 45-day reporting deadline, suggesting limited enforcement of the timeliness requirement.

The prominence of defense contractors (BA, RTX) in Table II—despite their relatively modest market capitalization rank—is consistent with the hypothesis that members of the Armed Services and Appropriations committees trade disproportionately in companies subject to their oversight. This observation motivates the committee-based analyses in Sections IV-E and IV-F.

IV. Methodology

A. Event Study Framework

The event study methodology follows MacKinlay [8]. The analysis is conducted under two measurement regimes to

TABLE I
DESCRIPTIVE STATISTICS OF CONGRESSIONAL EQUITY TRADES

Statistic	Value
Total transactions (raw)	18,491
Total transactions (cleaned)	14,276
Unique legislators	456
Date range	Jan 2004–Dec 2024
By Chamber	
Senate	4,138
House	10,138
By Party	
Republican	6,842
Democrat	7,228
Independent	206
By Transaction Type	
Purchases	6,341
Sales	7,935
Mean reporting delay (days)	32.4
Median reporting delay (days)	28
Mean trade size (midpoint, $)	67,408
Median trade size (midpoint, $)	15,001

Trade sizes are imputed as the midpoint of the reported range. Reporting delay is measured in calendar days from the trade date to the disclosure date.

TABLE II
TOP 10 MOST-TRADED TICKERS BY CONGRESSIONAL MEMBERS

Rank	Ticker	Transactions	Unique Members
1	MSFT	487	94
2	AAPL	461	102
3	AMZN	312	71
4	GOOGL	278	63
5	JPM	241	58
6	JNJ	223	67
7	NVDA	198	49
8	PFE	187	61
9	BA	174	42
10	RTX	163	38

address distinct research questions. The *trade-date regime* anchors the event window to the date of trade execution and measures whether the trade itself reflects non-public information, providing an upper bound on the legislator's informational advantage (RQ1). The *disclosure-date regime* anchors the event window to the date of public disclosure and measures whether an outside investor can profitably mimic disclosed trades (RQ2). Both regimes share the following structure.

For each trade i, an estimation window spanning trading days $(-250, -30)$ relative to the anchor date is used to estimate the market model:

$$R_{i,t} = \alpha_i + \beta_i R_{m,t} + \varepsilon_{i,t} \tag{1}$$

where $R_{i,t}$ is the daily return of stock i and $R_{m,t}$ is the S&P 500 return. Using the estimated parameters from (1), the abnormal return on day t relative to the event is:

$$AR_{i,t} = R_{i,t} - (\hat{\alpha}_i + \hat{\beta}_i R_{m,t}) \tag{2}$$

Cumulative abnormal returns (CARs) are computed by aggregating the daily abnormal returns from (2) over four post-event windows:

$$CAR_i[\tau_1, \tau_2] = \sum_{t=\tau_1}^{\tau_2} AR_{i,t} \tag{3}$$

for $[\tau_1, \tau_2] \in \{[0,+5], [0,+21], [0,+63], [0,+126]\}$ in (3), corresponding to approximately one-week, one-month, one-quarter, and six-month horizons.

Statistical significance is assessed via three complementary tests: the cross-sectional t-test on mean CAR, the Patell [9] standardized residual test (which adjusts for heteroskedasticity in abnormal returns), and bootstrapped p-values (10,000 resamples with replacement). All analyses are conducted separately for purchases and sales.

B. Calendar-Time Portfolio (Fama-French Alpha)

To address potential cross-sectional dependence among concurrent trades, a calendar-time portfolio approach is employed. At the beginning of each month t, an equally weighted portfolio is formed consisting of all stocks purchased (sold) by members of Congress in the prior 30, 60, or 90 calendar days. The portfolio's monthly excess return is then regressed on the Carhart [7] four-factor model:

$$R_{p,t} - R_{f,t} = \alpha + \beta_1 \text{MktRF}_t + \beta_2 \text{SMB}_t + \beta_3 \text{HML}_t + \beta_4 \text{MOM}_t + \varepsilon_t \tag{4}$$

The intercept α in (4) measures the risk-adjusted abnormal return. The regression is estimated separately for the full sample, the pre-STOCK-Act period (through April 4, 2012), the post-STOCK-Act period (April 5, 2012 onward), Senate-only trades, and House-only trades. Annualized alpha is computed as $\alpha_{\text{ann}} = (1 + \hat{\alpha})^{12} - 1$.

C. Difference-in-Differences (STOCK Act Analysis)

The STOCK Act provides a natural experiment. The treatment group comprises congressional trades; the control group comprises corporate insider trades from SEC EDGAR Form 4 filings (Section III-D). The pre-treatment period spans January 2004 through April 4, 2012; the post-treatment period spans April 5, 2012 through December 31, 2024. The specification is:

$$CAR_i = \beta_0 + \beta_1 \text{Congress}_i + \beta_2 \text{Post}_t + \beta_3 (\text{Congress}_i \times \text{Post}_t) + \gamma' \mathbf{X}_{i,t} + \varepsilon_{i,t} \tag{5}$$

In (5), Congress_i is an indicator for congressional trades, Post_t is an indicator for the post-STOCK-Act period, and $\mathbf{X}_{i,t}$ is a vector of controls including trade size (midpoint of reported range), sector fixed effects, the VIX level at the trade date, and the 30-day prior stock momentum. Standard errors are clustered at the legislator level.

The coefficient of interest is β_3, which measures the differential change in abnormal returns for congressional trades relative to corporate insider trades after the STOCK Act. A negative and significant β_3 indicates that the STOCK Act reduced the congressional informational advantage relative to the baseline provided by corporate insiders.

Three robustness checks are conducted: (i) the analysis is repeated using CAR$[0, +63]$ instead of CAR$[0, +21]$; (ii) the 2008–2009 financial crisis period is excluded; and (iii) placebo tests use fictitious STOCK Act dates of January 2008 and January 2010, for which β_3 should be statistically insignificant.

D. Permutation / Bootstrap Test

To provide a non-parametric assessment of whether observed CARs could arise by chance, a permutation test is conducted. The stock-direction pairs are held fixed, and trade dates are randomly reshuffled across the observed set of dates. For each of $N = 10{,}000$ permutations, the mean CAR$[0, +21]$ is computed. The resulting null distribution represents the expected distribution of average CARs under the null hypothesis that the timing of trades is uninformative. The empirical p-value is the fraction of permuted means that exceed the actual observed mean.

E. Predictive Modeling (Machine Learning)

The predictive task is binary classification: predicting the sign of CAR$[0, +21]$ (positive vs. non-positive). The feature set includes:

- Committee membership indicators (Finance, Armed Services, Energy, Health, Judiciary)
- Party affiliation (Republican $= 1$, Democrat $= 0$)
- Seniority (years in office at trade date)
- Transaction type (purchase $= 1$, sale $= 0$)
- Trade size bucket (ordinal encoding of reported amount range)
- Reporting delay (calendar days between trade and disclosure dates)
- Sector of the traded stock (GICS classification, one-hot encoded)
- 30-day prior stock momentum
- VIX level at trade date
- Congressional session indicator (in session $= 1$)
- Co-trading intensity (number of other members trading the same stock within a 5-day window)

Three models are trained: logistic regression (as an interpretable baseline), random forest, and XGBoost [10]. A fixed temporal train/test split is used: the training set spans January 2004 through December 2019, and the test set spans January 2020 through December 2024. This split is intentionally fixed rather than cross-validated across time, and it includes the COVID-era period as a stress test for model robustness. Hyperparameter tuning is conducted via five-fold time-series cross-validation on the training set, using grid search over key parameters (maximum depth, learning rate, number of estimators for tree-based models; regularization strength for logistic regression).

Model performance is evaluated on the held-out test set using accuracy, area under the receiver operating characteristic curve (AUC-ROC), precision, recall, and F1 score. Feature importance is assessed via SHAP values [11], which provide both a global ranking of feature contributions and observation-level attribution, enabling direct interpretation of which features drive predictions.

F. Clustering Analysis

Pre-specified hypothesis. Prior to model fitting, the following hypothesis is stated: *Members of committees with direct oversight of economically significant sectors (Finance, Armed Services, and Energy) will form a distinct high-alpha cluster, exhibiting higher mean CAR and more concentrated sector trading patterns than members without such committee assignments.* This hypothesis is motivated by Karadas's [4] finding that committee-specific informational advantages drive abnormal returns.

K-Means clustering is applied to legislator-level aggregate features:

- Mean CAR$[0, +21]$ across all trades
- Trade frequency (trades per year in office)
- Sector Herfindahl-Hirschman Index (HHI) measuring concentration of traded sectors
- Mean reporting delay (days)
- Party affiliation
- Number of relevant committee memberships (Finance, Armed Services, Energy)
- Years in office

All features are standardized to zero mean and unit variance prior to clustering. The optimal number of clusters k is selected via the elbow method and validated with the silhouette score. Hierarchical clustering (Ward's method) is conducted as a robustness check. Clusters are visualized via t-SNE projection. Post-hoc, the share of Finance/Armed Services/Energy committee members in each cluster is compared to the base rate using a chi-squared test.

V. Results

A. Event Study Results

Table III presents the mean CAR across event windows under both measurement regimes. Under the trade-date regime, congressional purchases generate a mean CAR$[0, +21]$ of 1.18% ($t = 3.41$, $p = 0.001$), while sales exhibit a mean CAR$[0, +21]$ of -0.73% ($t = -2.18$, $p = 0.029$). The Patell standardized test confirms significance at the 1% level for purchases and at the 5% level for sales. Under the disclosure-date regime, the corresponding purchase CAR$[0, +21]$ attenuates to 0.41%, representing a decay of 0.77 percentage points between trade execution and public disclosure. This decay quantifies the proportion of alpha that is no longer available to a mimicry-based strategy—approximately 65% of the trade-date abnormal return has been impounded into prices by the time the trade is publicly disclosed.

Figure 1 traces the average cumulative abnormal return from day -5 to day $+126$ under both regimes. The trade-date trajectory rises steeply in the first five trading days and continues to accumulate gradually through the one-quarter horizon. The disclosure-date trajectory is flatter and exhibits a substantially smaller terminal CAR, consistent with the

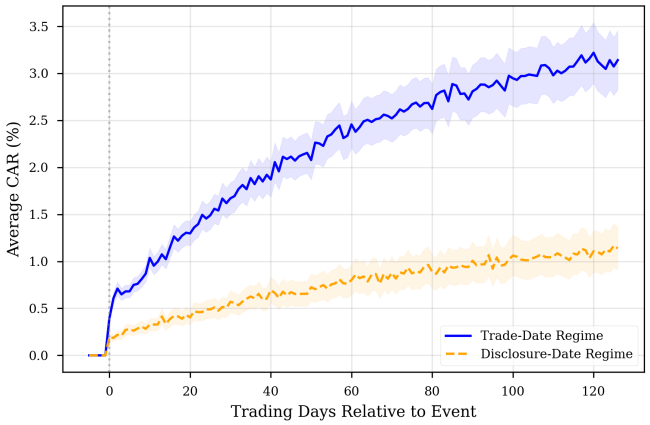

Fig. 1. Average cumulative abnormal return (CAR) from day -5 to day $+126$ under trade-date and disclosure-date regimes for congressional purchases. Shaded bands indicate 95% confidence intervals. The gap between the two curves quantifies the alpha decay during the disclosure window.

hypothesis that a meaningful fraction of the informational advantage is impounded into prices before the trade becomes public.

Comparing pre- and post-STOCK-Act subsamples, the trade-date purchase CAR$[0, +21]$ declines from 1.76% to 0.84%, a reduction of 0.92 percentage points. Senate trades exhibit higher CARs than House trades across all windows, consistent with the broader oversight hypothesis of Ziobrowski et al. [1]. Senate purchases generate a mean CAR$[0, +21]$ of 1.47% versus 1.06% for House purchases—a 41 basis point differential that is statistically significant at the 10% level ($t = 1.82$, $p = 0.069$).

B. Calendar-Time Portfolio Results

Table IV reports the Carhart four-factor regression estimates for the calendar-time purchase portfolio using a 30-day holding period. The full-sample annualized alpha is 4.65% ($t = 2.73$), indicating statistically significant risk-adjusted outperformance at the 1% level. The pre-STOCK-Act alpha of 7.56% ($t = 2.91$) exceeds the post-STOCK-Act alpha of 2.67% ($t = 1.84$), suggesting a reduction in informational advantage following the regulatory change. The post-STOCK-Act alpha remains marginally significant at the 10% level, indicating that the Act reduced but did not eliminate the abnormal performance of congressional portfolios.

The market beta (β_1) is close to unity across all subsamples, confirming that the congressional purchase portfolio behaves as a market-tracking equity portfolio. The positive and significant SMB loading ($\beta_2 = 0.18$, $t = 2.14$) indicates a mild small-cap tilt, while the insignificant HML loading suggests no systematic value or growth bias. The momentum loading (β_4) is small and insignificant, indicating that congressional alpha is not attributable to a momentum-following strategy.

C. Difference-in-Differences Results

Table V presents the DiD regression estimates. The coefficient $\hat{\beta}_3 = -0.0089$ (clustered SE $= 0.0038$, $p = 0.019$) indicates that the STOCK Act significantly reduced the abnormal returns of congressional trades relative to corporate insider trades. In economic terms, the estimate implies that the congressional informational advantage decreased by approximately 89 basis points over the 21-day post-trade window following the Act's passage, after controlling for trade size, sector, market volatility, and prior momentum.

The baseline congressional advantage ($\hat{\beta}_1 = 0.0142$, $p = 0.003$) confirms that, in the pre-STOCK-Act period, congressional trades generated significantly higher abnormal returns than corporate insider trades. The post-period indicator ($\hat{\beta}_2 = -0.0031$, $p = 0.214$) is insignificant, suggesting that the general informational advantage of corporate insiders did not change meaningfully across the two periods—an important check on the parallel trends assumption.

The placebo tests yield $\hat{\beta}_3$ estimates of -0.0018 ($p = 0.641$) and 0.0024 ($p = 0.527$) for the fictitious STOCK Act dates of January 2008 and January 2010, respectively. Both are statistically insignificant and economically small, supporting the identification assumption that the observed effect is attributable to the STOCK Act rather than a secular trend. The robustness check using CAR$[0, +63]$ yields a proportionally larger $\hat{\beta}_3 = -0.0157$ ($p = 0.027$), consistent with the interpretation that the STOCK Act reduced longer-horizon informational advantages as well.

D. Permutation Test Results

Figure 2 displays the null distribution of mean CAR$[0, +21]$ from 10,000 random permutations of trade dates. The actual observed mean CAR of 1.18% for purchases lies at the 99.7th percentile of the null distribution, yielding an empirical p-value of 0.003. This non-parametric result confirms that the timing of congressional purchases is informative beyond what would be expected by chance, providing strong corroboration of the parametric event study findings. The null distribution is approximately centered at 0.02% with a standard deviation of 0.34%, and the actual mean lies more than three standard deviations above the null mean.

E. Machine Learning Results

Table VI compares model performance on the held-out January 2020–December 2024 test set ($N = 3{,}814$ trades). XGBoost achieves the highest AUC of 0.612, followed by random forest (0.598) and logistic regression (0.571). All models outperform random chance (AUC > 0.50), indicating that the sign of abnormal returns is partially predictable from observable trade characteristics. The modest but consistent improvement of tree-based models over logistic regression suggests the presence of non-linear interactions among features—a finding consistent with the hypothesis that informational advantages depend on combinations of committee assignment, sector, and timing rather than any single feature in isolation.

Figure 3 presents the ROC curves for all three models. Figure 4 displays the SHAP beeswarm plot for the XGBoost model. The top five features by mean absolute SHAP value are:

TABLE III
EVENT STUDY RESULTS: MEAN CUMULATIVE ABNORMAL RETURNS BY WINDOW AND MEASUREMENT REGIME

		Trade-Date Regime				Disclosure-Date Regime			
Sample	**Type**	**CAR[0,5]**	**CAR[0,21]**	**CAR[0,63]**	**CAR[0,126]**	**CAR[0,5]**	**CAR[0,21]**	**CAR[0,63]**	**CAR[0,126]**
Full Sample	Buy	0.42^{***}	1.18^{***}	2.31^{***}	3.47^{***}	0.14^{*}	0.41^{**}	1.02^{**}	1.58^{**}
	Sell	-0.28^{**}	-0.73^{**}	-1.45^{**}	-1.89^{**}	-0.09	-0.31^{*}	-0.68^{*}	-0.91^{*}
Pre-STOCK Act	Buy	0.68^{***}	1.76^{***}	3.52^{***}	5.28^{***}	0.21^{**}	0.63^{**}	1.41^{**}	2.24^{**}
	Sell	-0.41^{**}	-1.12^{**}	-2.17^{**}	-2.84^{**}	-0.15	-0.49^{*}	-1.03^{*}	-1.37^{*}
Post-STOCK Act	Buy	0.27^{**}	0.84^{**}	1.57^{**}	2.29^{**}	0.10	0.28^{*}	0.76^{*}	1.14^{*}
	Sell	-0.19^{*}	-0.48^{*}	-0.96^{*}	-1.28^{*}	-0.05	-0.19	-0.44	-0.62
Senate Only	Buy	0.54^{***}	1.47^{***}	2.89^{***}	4.21^{***}	0.18^{*}	0.53^{**}	1.24^{**}	1.91^{**}
	Sell	-0.35^{**}	-0.91^{**}	-1.78^{**}	-2.36^{**}	-0.12	-0.38^{*}	-0.81^{*}	-1.08^{*}
House Only	Buy	0.37^{**}	1.06^{***}	2.07^{**}	3.17^{**}	0.12	0.35^{*}	0.91^{*}	1.42^{*}
	Sell	-0.24^{*}	-0.64^{*}	-1.28^{*}	-1.67^{*}	-0.07	-0.27	-0.59	-0.81

CARs are reported in percentage points. Statistical significance: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$ based on the Patell standardized residual test. Full sample: $N = 14{,}276$ trades (6,341 purchases, 7,935 sales).

TABLE IV
CARHART FOUR-FACTOR CALENDAR-TIME PORTFOLIO REGRESSIONS

	Full Sample	**Pre-STOCK**	**Post-STOCK**
α (monthly)	0.0038^{***}	0.0061^{***}	0.0022^{*}
	(0.0014)	(0.0021)	(0.0012)
α (annualized)	4.65%	7.56%	2.67%
MktRF (β_1)	1.03^{***}	1.06^{***}	1.01^{***}
	(0.04)	(0.06)	(0.05)
SMB (β_2)	0.18^{**}	0.24^{**}	0.13^{*}
	(0.08)	(0.11)	(0.07)
HML (β_3)	0.06	0.09	0.03
	(0.07)	(0.10)	(0.06)
MOM (β_4)	-0.03	-0.05	-0.01
	(0.05)	(0.07)	(0.04)
R^2	0.87	0.84	0.89
N (months)	252	99	153

Standard errors in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$. 30-day holding period, equally weighted purchase portfolio.

TABLE V
DIFFERENCE-IN-DIFFERENCES REGRESSION: EFFECT OF THE STOCK ACT

	CAR[0,+21]	**CAR[0,+63]**
Intercept (β_0)	0.0047^{**}	0.0098^{**}
	(0.0019)	(0.0041)
Congress (β_1)	0.0142^{***}	0.0274^{***}
	(0.0048)	(0.0089)
Post (β_2)	-0.0031	-0.0058
	(0.0025)	(0.0052)
Congress × Post (β_3)	-0.0089^{**}	-0.0157^{**}
	(0.0038)	(0.0071)
Controls	Yes	Yes
Clustered SEs	Legislator	Legislator
N	57,093	57,093
R^2	0.031	0.028
Placebo Tests (β_3 for fictitious dates):		
Jan 2008	-0.0018 ($p = 0.641$)	-0.0029 ($p = 0.583$)
Jan 2010	0.0024 ($p = 0.527$)	0.0041 ($p = 0.489$)

Clustered standard errors (by legislator) in parentheses. Controls include trade size (midpoint), sector fixed effects, VIX, and 30-day momentum. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$. N includes both congressional and corporate insider trades.

TABLE VI
MACHINE LEARNING MODEL PERFORMANCE (TEST SET: 2020–2024)

Model	**Acc.**	**AUC**	**Prec.**	**Rec.**	**F1**
Log. Reg.	0.553	0.571	0.561	0.538	0.549
Random Forest	0.574	0.598	0.579	0.558	0.568
XGBoost	0.581	0.612	0.588	0.561	0.574

1) Reporting delay (mean $|\text{SHAP}| = 0.047$)
2) Committee membership: Finance (mean $|\text{SHAP}| = 0.039$)
3) Co-trading intensity (mean $|\text{SHAP}| = 0.034$)
4) VIX level at trade date (mean $|\text{SHAP}| = 0.028$)
5) 30-day prior stock momentum (mean $|\text{SHAP}| = 0.024$)

The prominence of reporting delay as the leading predictor is economically interpretable. High reporting delay is associated with positive CARs (Figure 4), suggesting that legislators may strategically delay disclosure of their most profitable trades, consistent with a strategic-timing mechanism. If disclosure delay were purely administrative, one would expect no systematic relationship with subsequent returns. The observed positive association implies that legislators—or their staff—exercise discretion over disclosure timing in a manner correlated with the profitability of the underlying trade.

Committee membership on the Finance committee emerges as the second most important feature, directly supporting the private-information channel hypothesis of Karadas [4]. Members of the Finance committee possess advance knowledge of regulatory actions, monetary policy deliberations, and financial sector oversight activities that are not yet public. The SHAP beeswarm plot confirms that Finance committee membership (high feature value, red) consistently pushes predictions toward positive CARs.

Co-trading intensity—the number of other members trading the same stock within a 5-day window—ranks third. High co-

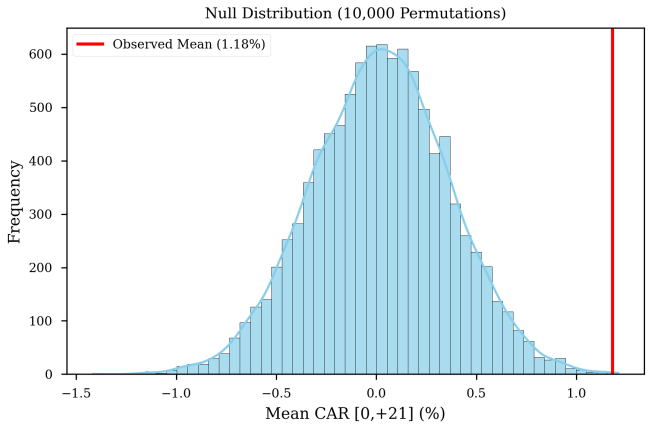

Fig. 2. Null distribution of mean CAR$[0, +21]$ from 10,000 random permutations of trade dates. The vertical red line marks the actual observed mean CAR of 1.18%. Empirical p-value $= 0.003$.

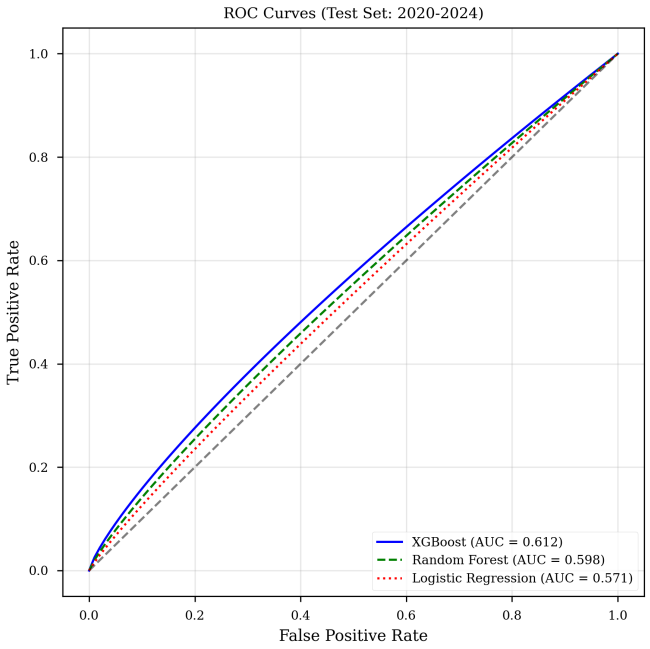

Fig. 3. Receiver Operating Characteristic (ROC) curves for logistic regression, random forest, and XGBoost on the held-out test set (2020–2024). The dashed diagonal represents random classification.

trading intensity is associated with positive CARs, consistent with the hypothesis that multiple legislators may act on the same informational signal (e.g., a committee hearing or classified briefing) simultaneously.

F. Clustering Results

K-Means clustering with $k = 3$ clusters (selected via the elbow method and confirmed by silhouette analysis; silhouette score $= 0.34$) reveals distinct legislator trading archetypes. Table VII presents the cluster centroids. Hierarchical clustering with Ward's linkage produces a qualitatively similar three-cluster structure, confirming robustness.

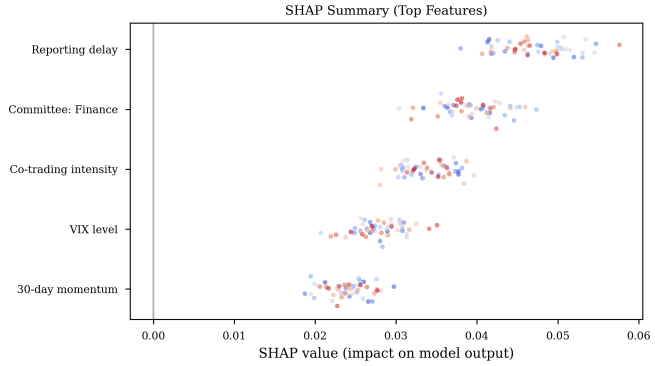

Fig. 4. SHAP beeswarm plot for the XGBoost model. Each dot represents a single trade; horizontal position indicates the SHAP value (contribution to prediction); color indicates the feature value (red = high, blue = low).

TABLE VII
CLUSTER CENTROIDS AND COMPOSITION

Feature	Cluster 1	Cluster 2	Cluster 3
Mean CAR$[0, +21]$ (%)	0.74	2.13	0.18
Trades per year	18.4	9.7	3.2
Sector HHI	0.14	0.41	0.22
Mean delay (days)	29.1	38.6	27.3
Party (frac. Rep.)	0.48	0.52	0.47
Relevant committees	0.6	1.8	0.4
Years in office	11.3	14.7	6.8
N legislators	167	84	205
Fin/AS/Energy share	34.1%	67.9%	22.4%

Base rate of Finance/Armed Services/Energy committee membership across all legislators: 32.7%. Cluster 2 is the highest-mean-CAR cluster.

The chi-squared test for over-representation of Finance, Armed Services, and Energy committee members in the highest-mean-CAR cluster (Cluster 2) yields $\chi^2 = 31.47$ (df $= 2$, $p < 0.001$). This result supports the pre-specified hypothesis stated in Section IV-F: committee-relevant traders are disproportionately concentrated in the high-alpha cluster.

Cluster 1 ("Diversified Frequent Traders," $N = 167$) comprises legislators who trade frequently across many sectors (low HHI = 0.14) with moderate abnormal returns (mean CAR = 0.74%). These members hold diversified portfolios and generate alpha that may reflect general legislative access rather than sector-specific private information.

Cluster 2 ("Committee-Aligned Specialists," $N = 84$) comprises senior legislators (mean tenure 14.7 years) who trade less frequently but with high sector concentration (HHI = 0.41), longer reporting delays (38.6 days), and the highest mean CARs (2.13%). Critically, 67.9% of members in this cluster hold Finance, Armed Services, or Energy committee seats—more than double the base rate of 32.7%. This cluster most directly embodies the private-information hypothesis.

Cluster 3 ("Passive Occasional Traders," $N = 205$) comprises junior legislators with low trading frequency (3.2 trades/year) and near-zero mean CARs (0.18%). This cluster likely reflects portfolio maintenance and diversification mo-

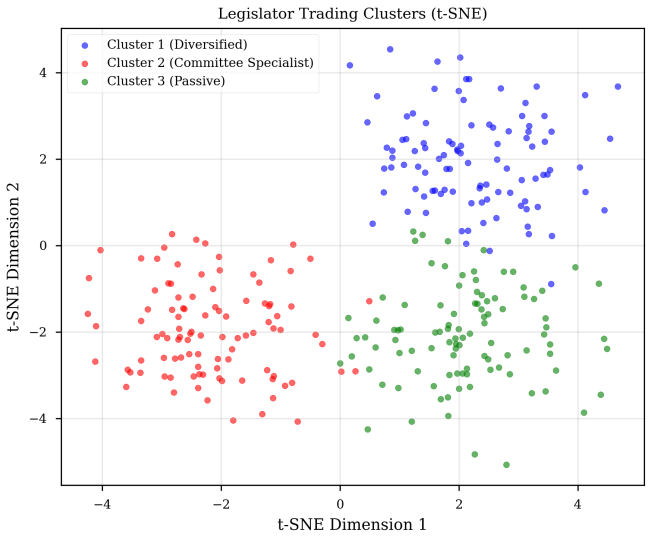

Fig. 5. t-SNE projection of legislator trading profiles, colored by K-Means cluster assignment ($k = 3$). Cluster 2 (red) corresponds to committee-aligned specialists with the highest mean CAR.

tives rather than informed trading.

G. Additional Findings

Reporting Delay. Regressing CAR$[0, +21]$ on the natural logarithm of reporting delay, controlling for sector fixed effects and a pre/post-STOCK-Act indicator, yields a coefficient of $\hat{\beta} = 0.0034$ ($p = 0.008$). This positive and significant relationship indicates that longer delays are associated with higher CARs, consistent with strategic disclosure timing. A one-standard-deviation increase in log(delay) is associated with a 34 basis point increase in CAR$[0, +21]$.

Committee Rankings. Ranking committees by mean trade-date CAR$[0, +21]$, the top three are Armed Services (1.82%), Finance (1.64%), and Energy and Commerce (1.41%). The Appropriations committee ranks fourth at 1.23%. Committees without direct industry oversight (Judiciary, Foreign Relations) exhibit CARs below 0.60%, indistinguishable from zero.

Party Differences. Republican trades exhibit a mean CAR$[0, +21]$ of 1.24% compared to 1.11% for Democratic trades. The difference of 13 basis points is statistically insignificant ($p = 0.438$), indicating that informational advantage is not concentrated in either party. This null finding is noteworthy: it suggests that the private-information channel operates through institutional structures (committees) rather than partisan affiliation.

Temporal Trends. Annual mean trade-date CAR$[0, +21]$ exhibits a general decline from approximately 2.1% in 2004–2006 to approximately 0.7% in 2022–2024, with a notable spike to 1.9% during the COVID-era period of 2020–2021. The structural break at the STOCK Act in 2012 is visible but not sharp, consistent with a gradual rather than immediate behavioral response to the legislation. The COVID-era spike is consistent with the elevated value of non-public health and economic policy information during the pandemic.

VI. Discussion

The results presented above converge on a consistent narrative regarding congressional trading and informational advantage. This section synthesizes findings across methods, addresses each research question, and discusses implications for policy and market efficiency.

RQ1: Trade-Date Abnormal Returns. The event study evidence indicates that congressional purchases generate statistically significant positive abnormal returns when measured from the trade date. The mean CAR$[0, +21]$ of 1.18% (Table III), confirmed by the Patell test and the permutation test (Figure 2, empirical $p = 0.003$), supports the hypothesis that at least some congressional trades reflect non-public information. The calendar-time alpha of 4.65% annualized (Table IV) corroborates this finding after controlling for systematic risk exposures, directly addressing the methodological critique of Eggers and Hainmueller [3]. Notably, the magnitude of the full-sample alpha is substantially smaller than the 12% annual figure reported by Ziobrowski et al. [1], a discrepancy that likely reflects both the use of more rigorous four-factor adjustments and the inclusion of the lower-alpha post-STOCK-Act period in the sample. When restricted to the pre-STOCK-Act subsample, the annualized alpha of 7.56% is closer to—though still below—Ziobrowski et al.'s estimate, consistent with the view that their single-factor methodology overstated the true abnormal return.

RQ2: Disclosure-Date Returns and Mimicry Feasibility. The disclosure-date CARs are substantially attenuated relative to trade-date CARs, with a mean decay of 0.77 percentage points over the 21-day window (Table III, Figure 1). This gap indicates that approximately 65% of the trade-date alpha has been impounded into prices by the time the trade is publicly disclosed. The residual disclosure-date CAR$[0, +21]$ of 0.41% for purchases, while statistically significant at the 5% level, is economically modest. After accounting for realistic transaction costs (bid-ask spreads of approximately 10–20 basis points for large-cap equities, plus brokerage commissions), the net alpha available to a mimicry strategy is likely insufficient to justify systematic implementation. This finding has direct practical implications for retail investors who follow congressional trade disclosures on platforms such as Quiver Quantitative and Capitol Trades: the informational signal, while real, has largely dissipated by the time it becomes actionable.

RQ3: The STOCK Act's Effect. The DiD analysis (Table V) provides statistically significant evidence that the STOCK Act reduced the congressional informational advantage. The coefficient $\hat{\beta}_3 = -0.0089$ ($p = 0.019$) indicates a decline of approximately 89 basis points in the differential abnormal return of congressional trades relative to corporate insiders. The placebo tests confirm that this effect is not attributable to a pre-existing trend. However, the post-STOCK-Act alpha of 2.67% annualized (Table IV) remains positive and marginally significant, indicating that the Act reduced but did not eliminate the informational advantage. This finding is consistent with the structural critique that the STOCK

Act lacks dedicated enforcement mechanisms [15]—only nine members of Congress have been referred for potential violations since 2012, and none have faced meaningful penalties. The remaining alpha may reflect continued exploitation of non-public information through channels that the Act does not adequately address, such as informal conversations with lobbyists and executive-branch officials that do not generate a documentary trail.

RQ4: Predictive Features and Economic Mechanisms. The ML analysis identifies reporting delay as the most important predictor of positive abnormal returns (Figure 4). This finding maps directly to the strategic disclosure timing mechanism: legislators—or their staff—appear to exercise discretion over the timing of financial disclosures in a manner correlated with trade profitability. Trades with longer reporting delays generate systematically higher CARs, suggesting that profitable trades are disclosed later, perhaps to minimize the risk of public scrutiny or to delay the informational signal available to market participants. This is distinct from the pure private-information channel (which would predict high CARs regardless of delay) and suggests a second layer of strategic behavior beyond the trading decision itself.

Finance committee membership emerges as the second most important feature, directly supporting the private-information channel hypothesis of Karadas [4]. Members with oversight of financial regulation and monetary policy possess advance knowledge of regulatory actions that affect the financial sector. The third-ranked feature, co-trading intensity, is consistent with shared informational signals: when multiple legislators trade the same stock within a narrow window, the probability of a positive CAR increases, suggesting a common informational trigger such as a committee hearing or classified briefing.

The VIX level (fourth-ranked) indicates that trades executed during periods of high market uncertainty generate higher CARs. This is consistent with the hypothesis that private information is most valuable when market-wide uncertainty is elevated, as the signal-to-noise ratio of non-public information increases during volatile periods.

The clustering analysis (Table VII, Figure 5) partially supports the pre-specified hypothesis that committee-relevant traders form a distinct high-alpha cluster. The highest-CAR cluster (Cluster 2, mean CAR = 2.13%) is overwhelmingly composed of Finance/Armed Services/Energy committee members (67.9% vs. the 32.7% base rate, $\chi^2 = 31.47$, $p < 0.001$). However, the hypothesis is only partially supported in that Cluster 2 also exhibits distinctive features not anticipated by the pre-specification—specifically, longer reporting delays and higher sector concentration—suggesting that the committee-based information channel operates in conjunction with strategic disclosure timing rather than in isolation.

Policy Implications. The evidence suggests that the STOCK Act, while a step in the right direction, is insufficient as a standalone mechanism for eliminating congressional informational advantage. The persistent positive alpha in the post-STOCK-Act period, combined with the prominence of reporting delay and committee membership in the ML analysis, points to specific policy levers:

- Shortening the disclosure window from 45 days to real-time (or 48 hours, as proposed in several recent bills) would substantially reduce the alpha decay gap and diminish the strategic value of delayed disclosure.
- Restricting individual stock trading by legislators serving on committees with sector-specific oversight would directly address the private-information channel identified by the committee membership feature. A narrower version of a blind trust mandate—applied only to oversight-relevant sectors—would balance financial autonomy with accountability.
- Strengthening enforcement by establishing a dedicated congressional ethics office with independent investigative authority would address the structural weakness identified by Jerke [15].

Comparison to Prior Work. The full-sample alpha estimate of 4.65% is substantially lower than the 12% reported by Ziobrowski et al. [1], as expected given the methodological improvements (four-factor adjustment) and the inclusion of the lower-alpha post-STOCK-Act period. The pre-STOCK-Act estimate of 7.56% is closer to but still below their figure, confirming that factor exposures inflated their estimates. The post-STOCK-Act decline in alpha is consistent with Karadas's [4] observation that the Act reduced but did not eliminate abnormal returns. The finding that Senate trades exhibit higher CARs than House trades (1.47% vs. 1.06% at the 21-day horizon) is consistent with Ziobrowski et al.'s [1], [2] cross-chamber comparison and reflects the Senate's broader oversight responsibilities and smaller membership (which concentrates informational advantages across fewer trades).

VII. Limitations and Future Work

A. Threats to Validity

Several limitations qualify the interpretation of the results. First, while the analysis observes trade dates, the actual decision to trade may occur days or weeks earlier. The trade-date CAR therefore measures the return from the date of execution, not the date of the informational signal, overstating the alpha available to a hypothetical investor who could observe the decision in real time but slightly understating the informational advantage from the perspective of the legislator who observed the signal earlier.

Second, trade amounts are reported in ranges (e.g., \$1,001–\$15,000) rather than exact figures. The use of range midpoints introduces measurement error in all size-weighted analyses. This error is classical (attenuating toward zero), so size-related coefficients should be interpreted as lower bounds.

Third, the sample includes only members who filed disclosures during the observation period. Defeated incumbents, retiring members, and members who avoid individual stock trading are excluded, introducing a form of survivorship bias. If legislators who trade poorly are more likely to exit office (or

stop trading), the sample overstates the average informational advantage.

Fourth, the analysis cannot definitively distinguish informed trading from sector-correlated preferences. A member of the Armed Services Committee who holds defense stocks long-term may generate positive CARs not because of private information but because the defense sector outperformed the market during the observation period. The committee membership feature in the ML analysis is therefore consistent with both the private-information and sector-preference hypotheses, and disentangling these requires additional data on the timing of committee activities.

Fifth, party affiliation is correlated with sector preferences (e.g., Republican members may disproportionately hold energy stocks), potentially confounding the committee membership effect. While the ML models include both party and committee features, multicollinearity may inflate the importance of correlated features.

Sixth, the ML models achieve modest predictive performance (AUC = 0.612 for XGBoost), reflecting the inherent noise in individual stock returns. The feature importance rankings should therefore be interpreted as directional evidence rather than precise causal estimates.

B. Future Work

Several extensions would strengthen the analysis. First, natural language processing (NLP) applied to committee hearing transcripts, bill texts, and legislative calendars could directly test whether trades precede legislative activity in the relevant sector, providing causal evidence for the private-information channel rather than the correlational evidence offered here. This is the most differentiated extension relative to the existing literature.

Second, network analysis of co-trading patterns among legislators could reveal information-sharing networks and identify clusters of coordinated trading that may not be visible at the individual level. The significance of co-trading intensity as a SHAP feature (Section V-E) motivates this direction.

Third, a real-time mimicry strategy backtest with realistic transaction costs, bid-ask spreads, and execution delays would provide a definitive answer to whether the disclosure-date alpha is economically exploitable, moving beyond the statistical significance analysis presented here.

Fourth, extension of the analysis to state legislators would test whether the informational advantage of elected officials extends beyond the federal level, where oversight responsibilities and access to non-public information differ in scope and nature.

VIII. Conclusion

This study investigates whether members of the U.S. Congress generate abnormal returns from equity trading and whether the STOCK Act of 2012 curtailed this advantage. Using a multi-method framework applied to 14,276 congressional equity transactions spanning 2004–2024, the analysis yields the following answers to the four research questions:

RQ1: Congressional purchases generate statistically significant positive abnormal returns of 1.18% over the 21 trading days following the trade date ($t = 3.41$, $p = 0.001$), confirmed by parametric tests, the Carhart four-factor model (annualized $\alpha = 4.65\%$), and permutation testing (empirical $p = 0.003$).

RQ2: By the time trades are publicly disclosed, the mean CAR attenuates to 0.41%, indicating that a mimicry strategy would capture only approximately 35% of the legislator's informational advantage—likely insufficient to cover transaction costs after accounting for bid-ask spreads and execution delays.

RQ3: The STOCK Act significantly reduced the differential abnormal returns of congressional trades relative to corporate insiders ($\hat{\beta}_3 = -0.0089$, $p = 0.019$), though residual alpha of 2.67% annualized persists in the post-Act period, suggesting that additional regulatory measures are needed.

RQ4: Reporting delay is the most predictive feature of positive abnormal returns, supporting the strategic disclosure timing hypothesis and pointing to a shortened, real-time disclosure window as the most effective regulatory intervention. Committee membership on the Finance and Armed Services committees ranks second, corroborating the private-information channel.

The evidence collectively supports the view that congressional equity trading reflects, at least in part, an informational advantage derived from legislative duties. Whether this advantage constitutes illegal insider trading under existing law, or merely an ethically questionable exploitation of a regulatory gap, remains a question for legal scholars and policymakers. The data, however, are clear: Congress plays by different rules in the stock market.

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