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ChatGPT and the banking business: Insights from the US stock market on potential implications for banks

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ABSTRACT

Technological advances in artificial intelligence, such as ChatGPT, promise significant potential for automation in the banking sector, but might also be associated with uncertainties and potential disadvantages for banks. By empirically analyzing US stock market reactions to ChatGPT's launch, this study extracts the expectations of market participants to gauge potential future implications of ChatGPT for banks. The results indicate a significant negative stock market reaction of US bank stocks, with notable disparities between different bank types. Using cross-sectional regressions, we find that the negative market reaction is more pronounced for deposit-dependent and large banks.

1. Introduction

ChatGPT has experienced unprecedented growth since its launch on November 30th, 2022, establishing a record for the fastest user growth among consumer applications (Gordon, 2023). By January 2023, ChatGPT already had 100 million monthly active users (Hu, 2023) and was quickly regarded as a potentially major disruptive technology (Wunker, 2023). Companies, especially in the financial sector, are increasingly recognizing ChatGPT's potential (O'Neill, 2023). Banks, whose core business is fundamentally based on the processing of information (Berger, 2003) and who are leading investors in IT (Beccalli, 2007), are highly likely to benefit from the automation and process improvements that modern artificial intelligence (AI) technologies like ChatGPT can provide. Banks' inherent IT dependence for tasks like data management, transaction processing, risk assessment, and regulatory compliance emphasizes ChatGPT's potential for efficiency gains. Specifically, banks could use ChatGPT for general customer services to process inquiries more efficiently or to assist with risk management and fraud detection in loan origination and payment transactions. Further, ChatGPT's capabilities could be used to provide customers with enhanced investment recommendations in wealth management (Marr, 2023; Ray, 2023).

In this context, a new and expanding strand of academic literature has emerged, studying various applications of ChatGPT for financial service providers. In addition to a variety of other applications, recent studies examine possible use cases in investment advice. Lopez-Lira and Tang (2023) and Pelster and Val (2024) highlight ChatGPT's effectiveness in stock selection, Oehler and Horn (2024) demonstrate its superiority over robo-advisors for one-time investments, while Kim (2023) and Ko and Lee (2023) showcase its value in asset class decisions. Further, Smales (2023) shows ChatGPT's ability to classify monetary policy announcements consistently with market-observed characteristics.

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While this research highlights the promising (automation) potential of advanced AI technologies like ChatGPT in various banking tasks, its implementation can also be accompanied by serious disadvantages for banks. Whereas Peeler (2023) notes potential financial burdens and technical hurdles, Leboukh et al. (2023) and Huang et al. (2023) mention concerns regarding data security and regulatory compliance that could erode customer trust and lead to legal issues. Further, over-reliance on AI and possible errors may compromise the perceived quality of customer service, which has traditionally been based on personal interactions. Additionally, the advent of ChatGPT could usher in new competitors, putting pressure on traditional banks' business model.

Hence, ChatGPT's effect on different business models remains uncertain (Rotman, 2023) and has, so far, only been the focus of a small body of academic research. Wahyono et al. (2023), conducting an event study, observe a significantly negative market reaction for US education stocks following ChatGPT's launch. On the other hand, Saggu and Ante (2023) using a synthetic difference-in-difference approach, note a substantial increase in AI cryptocurrency returns in the month after ChatGPT's introduction. However, to date, there is no empirical research on ChatGPT's impact on the financial industry.

To address this gap and to investigate the impact of ChatGPT on banks, we conduct an empirical study focusing on ChatGPT's launch on November 30th, 2022. Employing an event study methodology, we analyze the cumulative abnormal returns (CARs) of US bank stocks to gauge market participants' expectations. While these stock market reactions cannot predict long-term effects conclusively, they provide a valuable approximation given the limited data available by capturing the expected impact perceived by market participants. Further, our analyses also examine variations in banks' stock price reactions to ChatGPT's launch. Following the reasoning of Wahyono et al. (2023), we consider conducting this study in the US to be particularly relevant, as ChatGPT was introduced by the American company OpenAI and first used by American citizens.

We find a delayed reaction of US bank stocks to ChatGPT's launch, suggesting that market participants required time to process the inherent information. Overall, we observe a significant negative stock market reaction of US bank stocks, with meaningful disparities among bank types. CARs of commercial banks are significantly negative, whereas those of savings institutions are insignificant. Using cross-sectional OLS regressions, we find that this heterogeneity stems from more pronounced negative reactions for deposit-dependent and large banks. Hence, this study provides valuable insights into the potential impact of ChatGPT on the banking industry. Through analyzing diverse stock market reactions of various banks and discussing possible reasons for the observations, this study not only advances comprehension of AI's potential impact on the financial sector but also offers practical implications for banking executives, investors, and policymakers.

The remainder of this paper is structured as follows. Section 2 introduces the data and research methodology, Section 3 presents and discusses the results of our analyses, before Section 4 concludes.

2. Data and methodology

The data on US banks is gathered from Compustat and the Center for Research in Security Prices (CRSP). We define US banks as firms whose North American Industry Classification System (NAICS) code starts with 52 (i.e., finance and insurance companies) that are listed on one of the major American stock exchanges (i.e., NYSE, AMEX, Nasdaq, or Arca) and headquartered in the US. We further require those firms to have income and balance sheet data available on Compustat's quarterly bank fundamentals database. To ensure that our results are not affected by announcements related to single banks, we drop from our sample all banks for which we identified material corporate announcements between November 30th and December 14th, 2022.[1] Our final sample comprises 107 US banks, of which 88 are classified as commercial banks (NAICS code 522110) and 19 as savings institutions (NAICS codes 522120 and 522180).

To examine the impact of ChatGPT's launch on US banks, we employ an event study methodology, calculating each bank's CAR over different event windows before, after, and around ChatGPT's launch date ($t = 0$). We end our event window at $t = 9$ (i.e., on December 13th, 2022) at the latest to ensure that the press conference given by the Federal Open Market Committee on December 14th, 2022 does not impact our results. To estimate expected returns, we employ a market model (cf., Hachenberg et al., 2017) using an estimation window of 200 trading days (cf., MacKinley, 1997) ending 30 days before the start of each event window (cf. e.g., Schneider and Spalt, 2017; Aktas et al., 2021), with the CRSP value-weighted portfolio proxying for the market portfolio (cf., Dessaint et al., 2021):

$$\widehat{CAR_i}\ [t_1, t_2] = \sum_{t=t_1}^{t_2} [r_{i,t} - (r_f + \hat{\alpha}_i + \hat{\beta}_i \times (r_{m,t} - r_f))]. \quad (1)$$

Inspired by Kolari and Pynnönen (2010) and El Ghoul et al. (2023), we conduct both parametric and non-parametric tests, namely cross-sectional t-tests[2] and signed-rank tests, to examine the hypothesis that the banks' stock market reaction differs significantly from zero.[3]

All banking variables used in our analysis are calculated using quarterly income and balance sheet information from Compustat. They are lagged by one quarter to ensure that the information is publicly known at the time ChatGPT launched. Finally, the banks' *Market Value* on November 30th, 2022, is calculated as price times the number of shares outstanding using data from CRSP. We provide full information on the computation of all variables in Table A.1 in the Appendix.

[1] Our results are robust to including the dropped banks (five commercial banks and two savings institutions) in our sample.

[2] Our results are robust to employing standardized cross-sectional t-tests or Patell's Z tests (Patell, 1976) instead.

[3] Using parametric and non-parametric tests accommodates for potential outliers in CARs of the banks in our sample and handles any deviations from normality in their distribution (El Ghoul et al., 2023).

The summary statistics for our sample of 107 US banks is presented in Table 1. We observe a large negative average *CAR* (−2.73%) over the entire event window after ChatGPT's launch (from $t = 0$ to $t = 9$) with a substantial standard deviation of 4.31%. We also note large variance across the banks' *Deposit Ratio*, *Loan-to-Deposit Ratio*, *Liquidity Ratio*, and *Market Value*. Unsurprisingly, the distribution of *Market Value* is highly skewed due to a few very large banks, which causes the mean to exceed the median almost tenfold.

Table 1
Summary statistics.

	N	Mean	SD	Min	*p*25	Median	*p*75	Max
CAR [0, +9] (%)	107	−2.73	4.31	−16.66	−5.43	−2.51	0.53	10.95
Deposit Ratio (%)	107	91.36	6.87	63.97	90.30	93.23	95.84	99.45
Size	107	8.66	1.46	5.80	7.55	8.50	9.67	15.14
ROE (%)	107	3.50	1.62	−2.22	2.55	3.43	4.28	11.56
NPL Ratio (%)	107	0.45	0.38	0.00	0.18	0.39	0.56	1.82
Loan-to-Deposit Ratio (%)	107	84.65	19.20	22.89	75.14	84.11	96.22	160.63
Liquidity Ratio (%)	107	4.28	4.51	0.51	1.68	2.69	5.18	29.45
Loan Loss Provision (%)	107	2.71	2.75	−3.02	0.19	2.48	4.70	12.23
Market Value (USD mio.)	107	5,725	39,214	57	187	596	2,393	405,310

This table reports descriptive statistics for all banks in our sample. The descriptive statistics include the number of observations, sample mean, standard deviation, minimum, 25%-quantile, median, 75%-quantile, and maximum. All variables are described in Table A.1 in the Appendix.

3. Results and discussion

3.1. Results

An overview of the results of our event study analysis regarding the market reaction of US bank stocks to ChatGPT's launch is provided in Table 2. The results indicate that there is no significant market reaction prior to the launch date, as all test statistics are far from any conventional level of significance. Those event windows can be seen as a placebo test, showing that market participants did not anticipate ChatGPT's launch.

Table 2
Event study.

	CAR (%)		Significance	
Event window	Mean	Median	*t*-stat	*z*-stat
Before the event date				
[−1, 0]	0.0505	0.1225	0.35	1.06
[−3, 0]	−0.2672	−0.1624	−1.25	−0.48
[−9, 0]	−0.1385	−0.3287	−0.37	−0.87
After the event date				
[0, +1]	−0.4781	−0.5555	−3.01***	−2.80***
[0, +3]	−1.8249	−1.6440	−6.55***	−4.93***
[0, +9]	−2.7284	−2.5073	−6.36***	−4.74***
From before to after the event date				
Symmetric event window				
[−1, +1]	−0.1660	−0.2962	−0.96	−2.03**
[−3, +3]	−1.8057	−2.1259	−6.04***	−4.55***
[−9, +9]	−2.4952	−3.3551	−4.39***	−4.55***
Asymmetric event window				
[−1, +3]	−1.5104	−1.7965	−5.31***	−4.16***
[−1, +9]	−2.3980	−2.2083	−5.58***	−4.35***

This table presents the mean and median cumulative abnormal returns of all bank stocks in our sample for different event windows before, after, and around the launch of ChatGPT ($t = 0$). *t*-stat indicates the cross-sectional *t*-statistic for the cumulative abnormal returns at the end of the respective event window. *z*-stat indicates the generalized sign test statistic for the cumulative abnormal returns at the end of the respective event window. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

However, we observe economically large negative mean and median CARs after and around the launch of ChatGPT, with highly significant test statistics across almost all event windows considered.[4] This reveals that the stock market reacts unfavorably to ChatGPT's introduction in the US banking sector. In addition, we see that market participants need some time to process the information contained in ChatGPT's launch. They might need to use ChatGPT first, before comprehending its potential impact on banks. This is evident from the fact that the banks' mean and median CARs decrease substantially from the event window [0, +1] over [0, +3] until [0, +9], reaching −2.73% and −2.51%, respectively.[5] Given the banks' average *Market Value* of 5,725 million USD, the average market reaction over nine trading days equals an average loss of roughly 156 million USD in banks' *Market Value*.

[4] Our results are robust to using a different estimation period of 120 trading days ending 20 days before the start of each event window to calculate expected returns (cf., Wahyono et al., 2023). Further, the magnitude of our results even slightly increases if we use market-adjusted abnormal returns to calculate CARs. Lastly, using alternative event windows (i.e., [0, +5], [0, +15], [−5, +5], [−15, +15], [−1, +5], [−1, +15]) does not alter our results qualitatively. The respective results are shown in Panel A, B, and C of Table A.2 in the Appendix. Overall, these results are consistent with our main analysis and support our conclusions.

[5] When considering event windows around ChatGPT's launch date, our results are comparable, as shown in Table 2.

The time required by market participants to process the information on the potential impact of ChatGPT on banks is also evident when comparing the Google Trends Index for the keyword "ChatGPT" in the US and the average CARs of our sampled banks during our event window, as shown in Fig. 1. Only after a few trading days did the public shift its attention progressively toward ChatGPT, reaching its peak in search volume eight trading days after its launch within our event window (Google Trends). This helps explain the somewhat delayed market reaction of US bank stocks, which becomes increasingly more negative the higher the Google Trends Index is.

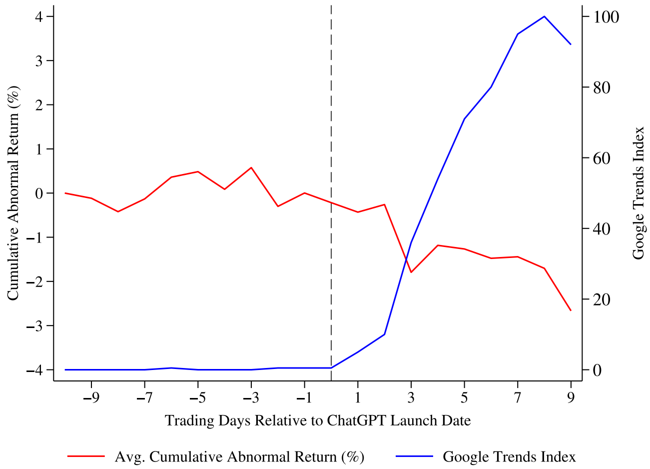

Fig. 1. Stock market reaction and Google search volume.
This figure shows the average cumulative abnormal returns of US banks and the Google Trends Index for "ChatGPT" in the US over a symmetric time period of 19 trading days around ChatGPT's launch. The end of day $t = -10$ is the starting date. The red and blue lines depict the cumulative abnormal returns for bank stocks and the Google Trends Index, respectively.

As we have two bank types in our sample, namely commercial banks and savings institutions, we want to know whether any heterogeneity exists in their investors' reactions. Therefore, we split our sample according to the banks' NAICS code classification and conduct the same event study as in Table 2.[6] We observe no significant stock market reaction before ChatGPT's launch for both bank types, but after and around the launch of ChatGPT commercial banks show statistically and economically significant negative CARs. This is not the case for savings institutions. The respective results are displayed in Table 3. This heterogeneity in the market reaction is also evident from Fig. A.1 in the Appendix.

Table 3
Event study — NAICS code split.

	Commercial banks (N = 88)				Savings institutions (N = 19)			
	CAR (%)		Significance		*CAR* (%)		Significance	
Event window	Mean	Median	t-stat	z-stat	Mean	Median	t-stat	z-stat
Before the event date								
[−1, 0]	−0.0311	0.0599	−0.22	0.43	0.4283	0.3375	0.86	1.61*
[−3, 0]	−0.3954	−0.1627	−1.70*	−0.64	0.3266	0.2266	0.62	0.14
[−9, 0]	−0.3051	−0.3640	−0.83	−1.28	0.6328	0.4305	0.52	0.69
After the event date								
[0, +1]	−0.5233	−0.5573	−2.97***	−2.98***	−0.2684	−0.2689	−0.72	−0.23
[0, +3]	−1.9946	−2.0972	−6.24***	−4.69***	−1.0387	−0.4544	−2.09*	−1.61*
[0, +9]	−3.1896	−3.0886	−6.46***	−5.33***	−0.5923	0.0727	−1.00	0.23
From before to after the event date								
Symmetric event window								
[−1, +1]	−0.2635	−0.3762	−1.42	−2.77***	0.2858	0.1871	0.62	1.15
[−3, +3]	−2.0718	−2.4604	−6.13***	−4.90***	−0.5734	−1.0505	−1.03	−0.32
[−9, +9]	−3.0775	−3.7788	−5.01***	−5.12***	0.2018	0.7556	0.15	0.23
Asymmetric event window								
[−1, +3]	−1.7318	−2.1498	−5.33***	−4.05***	−0.4848	−0.1273	−0.98	−1.15
[−1, +9]	−2.9099	−2.7143	−5.94***	−5.12***	−0.0273	0.2695	−0.04	0.69

This table presents the mean and median cumulative abnormal returns of commercial bank and savings institution stocks separately for different event windows before, after, and around the launch of ChatGPT (t = 0). t-stat indicates the cross-sectional t-statistic for the cumulative abnormal returns at the end of the respective event window. z-stat indicates the generalized sign test statistic for the cumulative abnormal returns at the end of the respective event window. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

[6] The summary statistics for commercial banks and savings institutions are reported separately in Table A.3 in the Appendix.

To analyze the determinants of the observed market reaction and to investigate whether the results presented in Table 3 are driven by the banks' differing NAICS classification, we run cross-section OLS regressions using the estimated CARs over the event window [0, +9] for each bank in our sample as the dependent variable and a dummy variable (*Commercial Bank*) equaling one for commercial banks and zero otherwise as one of the explanatory variables (cf., Hachenberg et al., 2017):

$$\widehat{CAR_i}\ [0,\ +9] = \alpha + \beta \times Commercial\ Bank_i + \gamma \times Deposit\ Ratio_i + \delta \times Size_i + \eta' \times X_i + \varepsilon_i, \quad (2)$$

where X_i includes all banking controls (*ROE*, *NPL Ratio*, *Loan-to-Deposit Ratio*, *Liquidity Ratio*, and *Loan Loss Provision*). To account for heteroskedasticity, we use the method of White (1980) to calculate robust standard errors. The results are presented in Table 4.

Table 4
Drivers of the stock market reaction.

	Dependent variable: *CAR* [0, +9] (%)				
	(1)	(2)	(3)	(4)	(5)
Commercial Bank	−2.4822***	−2.0500***	−1.3111	0.0331	0.0435
	(−3.30)	(−2.71)	(−1.41)	(0.03)	(0.04)
Deposit Ratio		−0.0819*		−0.1932***	−0.1658**
		(−1.83)		(−3.54)	(−2.31)
Size			−1.1499***	−1.4682***	−1.5165***
			(−2.86)	(−4.25)	(−4.29)
ROE					−0.1352
					(−0.58)
NPL Ratio					−0.5711
					(−0.36)
Loan-to-Deposit Ratio					0.0178
					(0.66)
Liquidity Ratio					0.1536
					(1.22)
Loan Loss Provision					0.2374*
					(1.67)
Adjusted R^2 (%)	3.99	4.66	17.50	24.51	25.03
N	107	107	107	107	107

This table shows results for cross-sectional OLS regressions with a bank's cumulative abnormal return over the event window [0, +9] as the dependent variable. The main explanatory variables are *Commercial Bank*, *Deposit Ratio*, and *Size*, as evident from Eq. (2). Further explanatory variables are defined in Table A.1 in the Appendix. A constant term is included but not reported. The *t*-statistics in parentheses and small font size are calculated using the method of White (1980) to account for heteroskedasticity. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

The results in Column (1) suggest that commercial banks indeed suffer significantly more from ChatGPT's launch than savings institutions. However, as soon as we control for a bank's *Deposit Ratio* (Column (2)) or its *Size* (Column (3)), the coefficient for *Commercial Bank* and its *t*-value become less negative. When controlling for a bank's *Deposit Ratio* and *Size* simultaneously in Column (4), the coefficient for *Commercial Bank* and its *t*-value approach zero. Adding further banking controls in Column (5) does not alter this result. As the coefficients for *Deposit Ratio* and *Size* are statistically and economically significantly negative across Columns (2) to (5), we infer that the difference in the stock market reaction to ChatGPT's launch between both bank types is driven by their significant differences in those variables, as evident from Table A.3 in the Appendix. Further, Table 4 shows that a bank's *CAR* is lower the higher its *Deposit Ratio* and the larger its *Size*. According to Column (5) one standard deviation increase in a bank's *Deposit Ratio* (6.87%) or *Size* (1.46) reduces its *CAR* by 1.14 or 2.21 percentage points, equaling an average *Market Value* loss of 65 or 127 million USD, respectively.

To sum up, we observe that US bank stocks react, on average, negatively to the launch of ChatGPT. However, market participants need time to process the information contained in ChatGPT's launch. In addition, we find that the reaction differs substantially between different bank types primarily due to differences in deposit dependency and size, with banks relying more strongly on deposits and larger banks experiencing more negative CARs.

3.2. Discussion

One cannot solely rely on stock price reactions to determine how market participants expect the introduction of ChatGPT to impact banks' business model due to the complexity of the financial market, which is influenced by many factors. Thus, it is difficult to scientifically pinpoint the exact reasons for these reactions. Still, we can conjecture on potential explanations. Therefore, the following discussion aims to propose possible rationales for the observations, rather than offering definitive conclusions.

Overall, the introduction of ChatGPT appears to have caused apprehension among market participants in the banking sector. They may interpret ChatGPT's introduction as a harbinger of significant changes for banks, perhaps worrying about integrating such advanced technologies and their, as of now, unforeseeable long-term impact on traditional banking practices. Additionally, there might be concerns about new competitors entering the banking market due to the technological progress.

The heterogeneous reaction of market participants to different banks suggests a differentiated understanding about banks' abilities to adapt to technological advancements. Traditional banks with deposit-oriented businesses might be perceived as facing greater challenges in adopting AI technologies like ChatGPT compared to banks already embracing technology-driven approaches. Market expectations seem influenced by the extent to which banks rely on traditional activities, such as the deposit business, with greater deposit dependence potentially signaling vulnerability to AI disruption. Moreover, market participants may assume that larger banks with more complex corporate structures may encounter more challenges when introducing AI technologies, while smaller banks could be perceived as more agile and adaptable.

Overall, our study provides valuable insights into the immediate stock market reaction to ChatGPT's launch in the banking sector along with initial explanations. However, our study cannot conclusively forecast ChatGPT's long-term impact on banks. The results are, therefore, to be understood as an initial indication, which should encourage discussions on ChatGPT's potential applications in banking and its possible effects. Further in-depth research is required to thoroughly comprehend the future impact of AI technologies like ChatGPT on the banking sector.

4. Conclusion

Our study provides initial empirical evidence of a significantly negative market reaction of bank stocks to ChatGPT's launch, with notable differences among bank types. Through cross-sectional regressions, we find that stock price reactions are more negative for deposit-dependent and large banks. Furthermore, we propose initial explanatory approaches that could help in interpreting these observed market reactions.

Although the observed stock market reactions cannot definitively determine the long-term impact of ChatGPT and other AI technology on banks, they provide a valuable approximation of the impact expected by market participants in the absence of further data. Thus, our study not only contributes to a better academic understanding of the relatively underexplored impact of AI on financial services providers but also gives practical implications for bank executives, investors, and policymakers.

Future research should aim at better understanding the long-term effects of AI technologies like ChatGPT on the banking sector. Specifically, investigating the channels through which these technologies influence different facets of banking operations would be valuable.

CRediT authorship contribution statement

Lars Beckmann: Writing – review & editing, Writing – original draft, Validation, Supervision, Resources, Project administration, Methodology, Conceptualization. **Paul F. Hark:** Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Resources, Methodology, Investigation, Formal analysis, Data curation.

Data availability

The authors do not have permission to share data.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix

Table A.1
Variable definitions.

Variable	Variable definition
CAR	A bank's cumulative abnormal return during the indicated event window, where $t = 0$ is equal to ChatGPT's launch date on November 30th, 2022. The abnormal returns are calculated using a market model estimated over 200 trading days ending 30 days prior to the event window – unless indicated otherwise. The distribution is expressed in percentage points.
Commercial Bank	Dummy equal to 1 if the bank's NAICS code is equal to 522110 and 0 otherwise.
Deposit Ratio	A bank's quarterly deposit ratio defined as total customer deposits (DPTCQ) over total liabilities (LTQ). The distribution is expressed in percentage points.
Liquidity Ratio	A bank's quarterly liquidity ratio defined as all interest and non-interest bearing cash and due from banks, restated up to six years (CDBTQ) over total assets (ATQ). The distribution is expressed in percentage points.
Loan Loss Provision	A bank's quarterly loan loss provision defined as provision for loan and asset losses (PLLQ) over total interest income (IDITQ). The distribution is expressed in percentage points.
Loan-to-Deposit Ratio	A bank's quarterly loan-to-deposit ratio defined as the amount of gross loans net of unearned income loans (LGQ) over total customer deposits (DPTCQ). The distribution is expressed in percentage points.
Market Value	A bank's stock market value at the launch date of ChatGPT on November 30th, 2022 ($t = 0$) calculated as price (PRC) times the number of shares outstanding (SHROUT). The distribution is expressed in million USD.
NPL Ratio	A bank's quarterly non-performing loan ratio defined as total non-performing assets (NPATQ) over the amount of gross loans net of unearned income loans (LGQ). The distribution is expressed in percentage points.
ROE	A bank's quarterly return on equity defined as net income (or loss) (NIQ) over total common/ordinary equity (CEQQ). The distribution is expressed in percentage points.
Size	A bank's quarterly size defined as the natural logarithm of total assets in million USD (ATQ).

In this table, we define all variables used in the paper. In brackets, we report the item codes from CRSP and Compustat, where applicable.

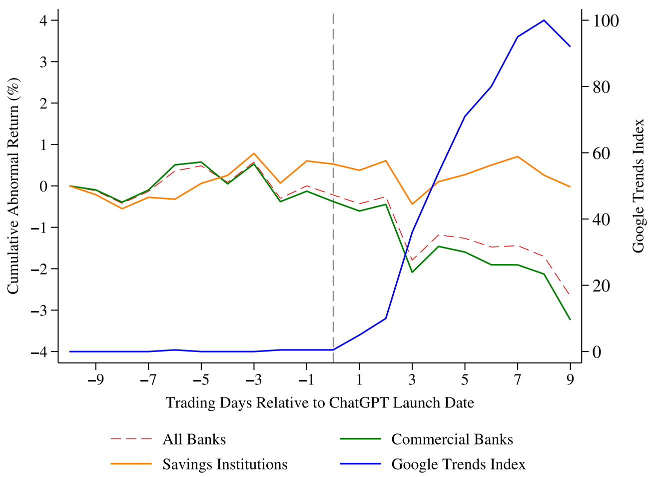

Fig. A.1. Stock market reaction and Google search volume — NAICS code split.
This figure shows the average cumulative abnormal returns of US banks and the Google Trends Index for "ChatGPT" in the US over a symmetric time period of 19 trading days around ChatGPT's launch date. The end of day $t = -10$ is the starting date. The red dashed line depicts the cumulative abnormal returns for all US bank stocks, while the green and orange solid lines illustrate the cumulative abnormal returns of commercial bank and savings institution stocks, respectively. The blue line displays the Google Trends Index.

Table A.2
Event study — Robustness.

	CAR (%)		Significance	
Event window	Mean	Median	*t*-stat	*z*-stat
Panel A: Alternative estimation window				
After the event date				
[0, +1]	−0.6143	−0.4181	−3.95***	−2.21**
[0, +3]	−1.9356	−1.4773	−6.86***	−3.76***
[0, +9]	−2.9676	−2.0398	−6.67***	−3.95***
From before to after the event date				
Symmetric event window				
[−1, +1]	−0.3328	−0.0803	−1.94*	−0.28
[−3, +3]	−1.8982	−1.4765	−6.09***	−3.95***
[−9, +9]	−2.5612	−2.4979	−4.22***	−2.40***
Asymmetric event window				
[−1, +3]	−1.6651	−1.5300	−5.73***	−2.60***
[−1, +9]	−2.7172	−1.5871	−6.05***	−3.18***
Panel B: Alternative estimation model				
After the event date				
[0, +1]	−2.0841	−2.1687	−12.41***	−8.85***
[0, +3]	−2.2521	−2.2863	−8.93***	−6.72***
[0, +9]	−3.1510	−3.0970	−8.21***	−7.11***
From before to after the event date				
Symmetric event window				
[−1, +1]	−1.6584	−1.7456	−9.24***	−7.89***
[−3, +3]	−1.3056	−1.5690	−4.52***	−4.01***
[−9, +9]	−2.1928	−2.2253	−4.18***	−3.41***
Asymmetric event window				
[−1, +3]	−1.8265	−2.2824	−7.14***	−6.53***
[−1, +9]	−2.7253	−2.5431	−7.17***	−6.92***
Panel C: Alternative event windows				
After the event date				
[0, +5]	−1.2863	−1.3063	−4.14***	−3.58***
[0, +15]	−2.4504	−2.8765	−5.55***	−4.93***
From before to after the event date				
Symmetric event window				
[−5, +5]	−1.5351	−2.1841	−3.67***	−4.16***
[−15, +15]	−3.1623	−4.2456	−4.40***	−3.96***
Asymmetric event window				
[−1, +5]	−0.9689	−0.8756	−3.03***	−3.00***
[−1, +15]	−2.1092	−2.3859	−4.74***	−4.35***

This table presents the mean and median cumulative abnormal returns of all bank stocks in our sample for different event windows after and around the launch of ChatGPT ($t = 0$). t-stat indicates the cross-sectional t-statistic for the cumulative abnormal returns at the end of the respective event window. z-stat indicates the generalized sign test statistic for the cumulative abnormal returns at the end of the respective event window. In Panel A expected returns are calculated using a market model over 120 trading days ending 20 trading days before the start of each event window. In Panel B we use returns in excess of the CRSP value-weighted market return to compute abnormal returns. In Panel C we use our standard setup to compute abnormal returns but report results for alternative event windows. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Table A.3
Summary statistics — NAICS code split.

	Commercial banks		Savings institutions		Difference in means	
	Mean	Median	Mean	Median	Difference	*t*-value
CAR [0, +9] (%)	−3.11	−3.09	−0.63	0.07	−2.48**	(−2.33)
Deposit Ratio (%)	92.30	93.53	87.02	89.72	5.28***	(3.16)
Size	8.84	8.63	7.82	7.86	1.02***	(2.84)
ROE (%)	3.72	3.54	2.48	2.45	1.24***	(3.16)
NPL Ratio (%)	0.43	0.37	0.51	0.40	−0.07	(−0.76)
Loan-to-Deposit Ratio (%)	81.42	82.68	99.59	97.37	−18.17***	(−4.00)
Liquidity Ratio (%)	4.49	2.71	3.35	2.41	1.13	(0.99)
Loan Loss Provision (%)	2.83	2.55	2.12	1.27	0.71	(1.02)
Market Value (USD mio.)	6,789	645	797	356	5,992	(0.60)

This table reports the mean and the median of the main variables used in our analyses for commercial banks ($N = 88$) and savings institutions ($N = 19$) separately. The last two columns display the difference in means between commercial banks and savings institutions and the corresponding t-value. All variables are described in Table A.1 in the Appendix. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

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