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Hamza Bennani
Matthias Neuenkirch

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Hamza Bennani
Nantes University

Matthias Neuenkirch†
University of Trier and CESifo

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Abstract

In this paper, we analyze whether the complexity of tax bills affects financial markets. Based on the Flesch-Kincaid grade level of the 32 tax bills identified by Romer and Romer (2010) in the period 1962–2003, we assess the relationship between tax bills' complexity and financial markets using an event study approach. Our results show a negative (positive) and significant relationship between the present value of tax bills and changes in the 10-year government bond yields (S&P 500 returns). The magnitude of this relationship increases over time, suggesting that market participants underreact at first and need a couple of days to digest the information contained in the tax bills. This delay can be explained by the textual characteristics of the bills in the case of the 10-year yields as a lower readability partly offsets the negative relationship for up to three days after the signing of a tax bill. In the case of the stock market, we find similar offsetting evidence, but only for a part of the readability measures employed in this paper.

JEL Codes: G14, H20, H30.

Keywords: Complexity, Event Study, Financial Markets, Readability, Tax Bills.

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†Corresponding author: University of Trier, Department of Economics, D-54286 Trier, Germany, Tel.: +49-651-201-2629, E-mail: neuenkirch@uni-trier.de.

1 Introduction

"We must ... transform a system that's become an endless source of confusion and resentment into one that is clear, simple, and fair for all — a tax code that no longer runs roughshod over Main Street America but ensures your families and firms incentives and rewards for hard work and risk-taking in an American future of strong economic growth."

Ronald Reagan, May 1985

"We have a tax regime that's extremely complex to such an extent that you can broaden the base and reduce rates and make the tax code simpler"

William Dudley, December 2017

With more than 75,000 pages, US federal tax bills are three times larger today than when President Jimmy Carter complained about their complexity,[1] even though the Plain Writing Act was signed into law in October 2010 to make the writing of every federal document "clear, concise and well-organized."[2] Hence, despite the regulatory efforts made to improve the readability of US government documents, multiple evidences indicate that these are low in readability (Bradbury et al., 2018). As an illustration, the audit of 100 federal government websites by the "Plain English Campaign" in 2013 showed that only 3% of all surveyed documents were actually written in plain English.

According to the literature, complexity may arise as a result of self-interested politicians that aim to extract a public rent, modify the income distribution in their favour, or to side with some groups instead of others (Aidt, 2003). However, this comes at a cost since complex financial documents, such as those related to tax bills, may limit the investors' ability or willingness to extract information and contributes towards poor financial and economic decision-making (Kahneman, 1973). This echoes Jin et

[1]In his acceptance speech for the 1976 Democratic nomination, Jimmy Carter described the income tax system as "a disgrace to the human race."

[2]The Act requires federal government agencies, including the SEC, to use plain writing in "every covered document of the agency that the agency issues or substantially revises" (Public Law 111–274, Section 4).

al. (2022) who argue that financial experts also blame the complexity of financial products for the 2008 financial crisis. Estelami (2016) traces poor decision-making to the inability of the human brain to cope with the complexity of the information in financial disclosures. Recognizing these facts, the Securities and Exchange Commission (SEC) adopted the Plain English Initiative in October 1998, which encouraged SEC registrants to use plain English in preparing all shareholder reports. However, what about federal tax bills in this context? Did their complexity evolve since Carter's statement in 1976? How do market participants react to this complexity? This paper aims at providing answers to these questions by creating a novel dataset measuring the complexity of tax bills and analyzing their impact on financial markets.

Since the legislative process in the US starts long before a bill is signed by the President and the fiscal measures are publicly debated in the meantime, future tax changes can be anticipated by forward-looking market participants, which might react to these before their actual implementation (Schmitt-Grohé and Uribe, 2012).This shows the importance of considering the legislative steps of a tax bill, from the announcement date until the implementation date, when analyzing the effect of fiscal policy. Following this line of thought, Mertens and Ravn (2012) use a timing convention to distinguish between anticipated and unanticipated changes in taxes.[3] Their finding of no strong anticipation effects is in line with several studies showing that it is the implementation date of tax changes that mainly affects macroeconomic variables (Poterba, 1988; Parker, 1999; Souleles, 1999, 2002; Mertens and Ravn, 2010). More recently, Hayo and Mierzwa (2020) find a significant reaction of financial markets on the days changes in tax legislation are actually implemented (also for the US). These findings might be explained by the prevailing uncertainty before the signing or implementation of a tax bill, which might affect firms' investment decisions (Jacob et al., 2022). For instance, will the bill actually pass the legislative process? Or, when do tax cuts or hikes become effective? As a result, the literature usually focuses on the implemen-

[3]Unfortunately, their distinction leaves too few observations for a meaningful analysis in the context of this paper.

tation date to measure the effect of tax changes (see, e.g., Romer and Romer, 2010; Cloyne, 2013).

We argue that the complexity of tax bills may affect financial market participants' behavior on the implementation date through at least two channels. First, tax bill complexity can be considered as a "barrier to entry" into markets due to private costs of acquiring information about new legislation (Kaplow, 1996). In this context, tax complexity reflects additional transaction costs that might prevent investors to access more data. This reduces their willingness to collect or process the information and, hence, ultimately affects their trading behavior (Bloomfield, 2002; Grossman and Stigliz, 1980; Lundholm, 1991). This channel is referred to as the "*incomplete revelation hypothesis*."

The second channel is based on the literature on human psychological and cognitive processes and examines the role of financial information in shaping investor decision-making processes (Sims, 2005). Specifically, given the cognitive limitations of investors, information complexity may affect their ability to fully incorporate such information into investment decisions. Put differently, complexity adds noise to messages and receivers are unable to fully internalize this information (Jin et al., 2022). As a consequence, investors may underreact to information that is more difficult to read. This results in an inertial reaction of asset prices to new information and contradicts the efficient market hypothesis (Lawrence, 2013).[4] One might argue, however, that while individual investors might be cognitively constrained by the complexity of financial documents, the experts, such as institutional investors and other market professionals, are not. Behavioral research suggests that capital market professionals also suffer from limited attention in the same way as retail investors and that they underreact to complex information (Hopkins, 1996; Hirst and Hopkins, 1998; Lee, 2012; Li, 2008).

[4] In contrast, improved processing fluency associated with more readable disclosures enhances investors' confidence so that these can rely on the information in their decision-making and react more adequately to the disclosures (Loughran and McDonald, 2014).

Against this background, we hypothesize that the complexity of tax bills affects financial market participants. To test this hypothesis, we first collect the 32 tax bills identified by Romer and Romer (2010) (henceforth RR) in the period 1962–2003 from the congressional archives.[5] We rely on this particular dataset since it is commonly used in the literature to identify fiscal policy shocks and allows to differentiate the tax bills according to their revenue effects, the nature of the changes, and their motivation. Second, to measure the complexity of tax bills, we rely on the Flesch-Kincaid (FK) grade level index to generate a readability measure based on education grade levels (Kincaid et al., 1975). The most important benefit of this measure is that it is based on objective elements of the underlying texts. Hence, despite the recent advancement in text analysis, the FK index remains very efficient and is widely used in the social science literature.[6] Finally, we assess the relationship between the tax bills' complexity and financial markets' behavior using an event study approach where we consider the changes in 10-year government bond yields and S&P 500 returns in windows from one day before the signing of a tax bill until up to four days after the signing.

Our results show that financial market participants react significantly to the characteristics of tax bills after their signing. Specifically, we find a negative (positive) and significant relationship between the present value of tax bills and changes in the 10-year bond yields (S&P 500 returns), suggesting that market participants actually appreciate an increase in taxes. The magnitude of this relationship increases over time, indicating that market participants underreact at first and need a couple of days to digest the information contained in the tax bills. This delay can be explained by the textual characteristics in the case of the 10-year bond yields as a lower readability (proxied by the years of education required to understand a bill) partly offsets the negative relationship for up to three days after the signing of a tax bill, but not thereafter. In the case of the stock market, we find similar offsetting evidence, but only for a part

[5] The starting date is restricted by the availability of daily data on 10-year US government bonds and the end date conincides with the last bill in the RR dataset.

[6] This is documented by Benoit et al. (2019) who find the FK index to be a crucial predictor of sophistication in political texts, whereas the introduction of various additional text features only marginally improves the predictive capacity.

of the readability measures employed in this paper. We also test if the results differ according to the nature of the tax change (endogenous or exogenous) and the phase of the business cycle during which the bill is signed. Lastly, we document the robustness of our results with respect to (i) other textual characteristics of the tax bills, such as length, textual uncertainty, and sentiment, (ii) the timing of the tax bills (using the date of the vote in the Congress instead of the Presidential signing), (iii) the electoral cycle, (iv) parameter instability, (v) bills signed shortly before or on the weekend, and (vi) outliers.

This paper relates to at least three strands of the literature. The first one analyzes the effect of tax changes using a narrative identification approach and the same dataset (e.g., Romer and Romer, 2010; Perotti, 2012; Mertens and Ravn, 2012, 2013). The second strand examines the effect of the complexity of financial disclosures on investors' behavior (e.g., Miller, 2010; You and Zhang, 2009). The third branch analyzes the connection between financial markets and tax policy (e.g., Gaertner et al., 2020; Ardagna, 2009; Wagner et al., 2018).[7]

The remainder of this paper is organized as follows. Section 2 describes our approach to measure the complexity of tax bills. Section 3 presents the empirical methodology. Section 4 shows the results. Section 5 concludes.

2 Measuring the Complexity of Tax Bills

We first collect the dataset of tax bills identified by RR from the congressional archives for the period from October 1962 until May 2003 (see Table A1 in Appendix A for a list of the bills). Hence, the Revenue Act of 1962 (signed on 16-Oct-62) marks the first event in our sample — given the availability of daily 10-year government bond yields in the FRED database — and the Jobs and Growth Tax Relief Reconciliation Act of 2003 (signed on 28-May-03) marks the final one. We obtain a set of 32 scanned PDF files that need to be converted into text files in order to be processed. We utilize the *Tesseract*

[7] There are also several papers studying the clarity of central bank communication and its impact on financial markets (e.g., Jansen, 2011; Ehrmann and Talmi, 2020; Hayo et al., 2022).

package in R that relies on a powerful optical character recognition (OCR). OCR is the process of finding and recognizing text inside a scanned paper by using language-specific training data in the recognized words. Specifically, *Tesseract* converts each single PDF file into a PNG format and then scans for texts within the created images.[8]

As a second step, we rely on Schuck (1992)'s definition to measure the complexity of the tax bills.[9] Out of the four dimensions he identifies, we focus on the density and conjecture that the complexity of a tax bill can be objectively measured with the characteristics of its text. Indeed, social scientists usually proxy text complexity by its readability, that is, the easiness for an individual to read a text and to understand the information. Following this line of thought, past research (Flesch, 1948) has identified text characteristics, such as the length of words and sentences, as good predictors of readability.

To quantify the readability of tax bills and, thus, their complexity, several measures — such as the Flesch-Kincaid (FK) grade level (Kincaid et al., 1975) — exist, which can be interpreted as the number of years of education needed to sufficiently comprehend a text.[10] The FK index has been used in a variety of fields, spanning from medicine to psychology, also including many studies in economics (e.g., Jansen, 2011a) and political science (e.g., Schoonvelde et al., 2019). The FK index is calculated as follows:

$$0.39 \cdot (\#words/\#sentences) + 11.8 \cdot (\#syllables/\#words) - 15.59 \tag{1}$$

$(\#words/\#sentences)$ reflects the number of words per sentence and $(\#syllables/\#words)$ the number of syllables per word. The rationale underlying this index is that many words per sentence or many syllables per word in a text decrease (increase) its readability (complexity) and, therefore, require more years of education to be understood.

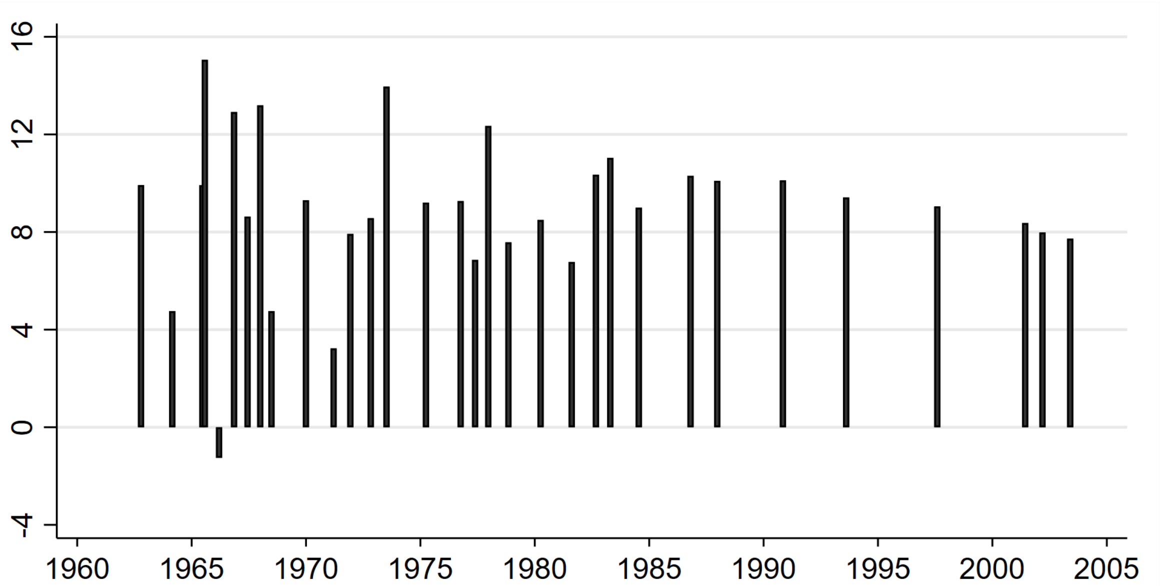
[8]Other than that, we did not do any pre-processing (e.g., removing punctuation or stemming) since we want to create a measure of complexity from a reader's perspective. More technically, the Flesch-Kincaid measure introduced below is based on the number of syllables in a word and the number of words in a sentence. Hence, manipulating the texts would distort this measure.

[9]The four characteristics to define legal complexity according to Schuck (1992) are density, technicality, differentiation, and indeterminacy.

[10]In Section 4.3, we use alternative readability measures as part of our robustness tests.

Figure 1 shows the FK index of the tax bills from 1962 until 2003. While most of the federal tax bills in our sample were implemented during the period between 1960 and 1985, the few ones implemented after this period are — on average — more readable and, hence, require less years of education. Interestingly, the peaks in the FK index observed in 1965, 1968, 1973, and 1977 are all related to social security amendments, whereas the troughs in 1964 and 1968 are related to revenue tax changes (see also Table A1 in Appendix A). Hence, the complexity of a tax bill seems to be related to the type of tax changes. Moreover, additional information about the present value of the tax bills (see Figure A1 in Appendix A) does not reveal any substantial correlation between these two dimensions (see Table A3 in Appendix A). Lastly, it has to be noted that the tax bill from 15-Mar-1966 (Tax Adjustment Act of 1966) is clearly an outlier in terms of its complexity and will be excluded as part of our robustness tests in Section 4.3.

Figure 1: The Flesch-Kincaid Grading Level of Tax Bills



Notes: Figure shows the complexity of the tax bills (as measured by the FK grade level). The corresponding tax bills can be found in Table A1.

3 Empirical Methodology

Our sample consists of the 32 legislative texts identified by RR for which we have financial market data at hand. We consider the signing of each bill as an event and are interested in the movement of financial markets around the events. Figure A2 shows the average daily changes in the 10-year government bond yields as well as the average daily returns of the S&P 500 returns two days before until four days after the signing of a tax bill. We do not observe a clear pattern in the data, but this should not be surprising. Tax bills have at least two dimensions that should matter for market participants.

The first one is the *present value* of taxes (as % of nominal GDP), which has been used in various studies to analyze the effect of tax shocks (see, e.g., Romer and Romer, 2010; Perotti, 2012; Mertens and Ravn, 2012, 2013). Our sample consists of 17 bills that lead to an increase in the present value of taxes and 15 tax cuts, with the Economic Recovery Tax Act of 1981 (signed on 13-Aug-81) being the largest (with a present value of –3.96% of GDP).[11] An increase in taxes should lead to lower refinancing costs of the government and — as a contractionary fiscal policy measure — should also dampen economic growth (at least in the short-run). Both channels indicate a negative relationship between the present value of a tax bill and bond yields after the signing of the tax bill. The effect on stock returns, however, is a priori unclear. An improvement in public finances should lead to a lower discount rate, but a higher tax burden should reduce (future) cash flows. Hence, the discounted present value of firms could either increase or decrease.

The second dimension is the *complexity* of tax bills. As indicated in Section 1, market participants might need some time to digest the information in the bill in order to update their information set and to adjust their trading behavior. Hence, we expect that the full effect of a tax bill on bond yields and stock returns materializes with a time lag due to an underreaction of the investors. In particular, we conjecture that

[11] Figure A1 in Appendix A shows the present value for each tax bill and Table A2 lists descriptive statistics.

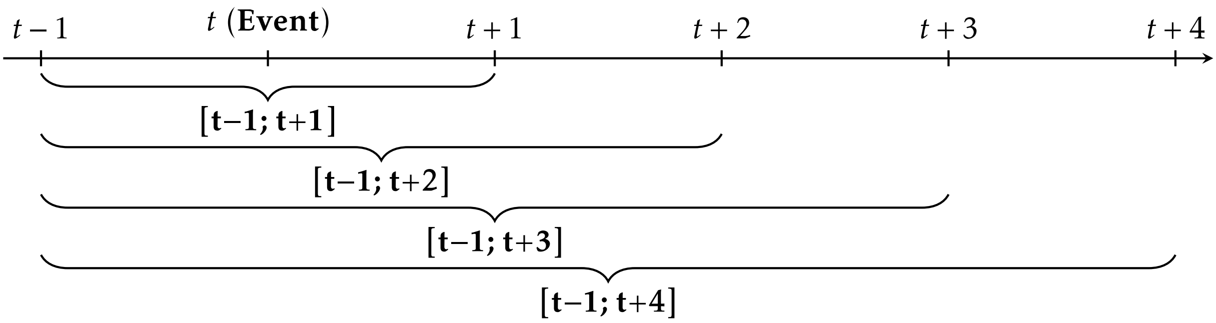
a higher level of textual complexity contributes to this delay. Accordingly, our two hypotheses are as follows:

Hypothesis 1 *Tax increases (cuts) lead to a decline (an increase) in 10-year bond yields. The effect of tax changes on stock returns is ambiguous.*

Hypothesis 2 *The full effect of a tax change can be found after a time lag.*
Higher textual complexity contributes to this transmission delay.

To test how tax bills are processed by financial market participants, we consider several windows around each event (corresponding to the signing of a bill). Such a window begins one day before the event. The end of a window can be either on the day after the signing or up to four days thereafter to capture the information processing. This yields a total of four event windows, which are summarized in Figure 2. We calculate the changes in the 10-year bond yields as well as the growth rate in the S&P 500 index over each of these windows.

Figure 2: Event Windows Around the Signing of a Tax Bill



Next, we explain these changes in bond yields and stock returns using the following specification:

$$y_{e,w} = \alpha + \beta PV_e + \gamma FK_e + \epsilon_{e,w} \tag{2}$$

$y_{e,w}$ is either (i) the change in 10-year government bond yields or (ii) the growth rate in the S&P 500 index for event e during one of the windows w introduced in Figure 2. α is a constant term, β and γ are slope parameters for the present value (PV_e) of a tax bill and its complexity (FK_e), and $\epsilon_{e,w}$ is the error term. Eq. (2) is estimated using least squares with heteroskedasticity-consistent standard errors. Both explanatory variables are demeaned, so that the constant term represents the conditional average change in the 10-year bond yields or the conditional average growth rate of the S&P 500 for an event window. It has to be noted that we also considered including an interaction term between the two slope parameters. This term, however, generates no additional insights and is excluded from the analysis.[12]

Our analysis is based on a couple of assumptions. First, we assume that there are no confounding factors. This assumption can be easily justified as the signing of tax bills is the result of a (lengthy) political process and the actual signing day should not be systematically related to, for instance, monetary policy decisions or the publication of important macroeconomic news. Second, it is typically the unexpected component of an announcement that should actually matter for financial market participants. In an ideal world, we would extract such a news component from market expectations as it is done in the literature on macroeconomic news or monetary policy decisions and their impact on financial markets. However, in the absence of a series for the expected present value (complexity), we consider the actually observed value as second-best proxy.

Finally, we also considered studying the response of the volatility of both financial series around the signing of a tax bill. For that purpose, we extract the conditional standard deviation of the change in the 10-year bond yields and the S&P 500 returns with the help of an AR(1)-GARCH(1,1) model and t-distributed errors. The results (available on request) indicate no systematic relationship of the conditional standard deviations with the present value of tax bills or their complexity in the four event windows.

[12] All omitted results are available on request.

4 Results

4.1 Baseline Results

Tables 1 and 2 show the results of Eq. (2) when using the 10-year bond yields and the S&P 500 returns as the dependent variable, respectively.

Table 1: Change in 10-Year Bond Yields

Event Window	**[t−1; t+1]**	**[t−1; t+2]**	**[t−1; t+3]**	**[t−1; t+4]**
Present Value	−0.031*	−0.037**	−0.068***	−0.093**
	(0.015)	(0.016)	(0.015)	(0.040)
	[0.055]	[0.030]	[0.000]	[0.028]
FK Grading Level	0.007**	0.012***	0.011***	0.004
	(0.004)	(0.004)	(0.004)	(0.009)
	[0.050]	[0.004]	[0.005]	[0.615]
Constant	−0.023	−0.019	−0.037*	−0.042
	(0.019)	(0.019)	(0.021)	(0.029)
	[0.239]	[0.315]	[0.094]	[0.152]
R^2	0.089	0.154	0.253	0.253

Notes: Table shows results for a least squares estimation of Eq. (2) and different event windows with heteroskedasticity-consistent standard errors in parentheses and p-values in brackets. All explanatory variables are demeaned. ***/**/* indicate significance at the 1%/5%/10% level. Number of observations: 32.

Table 2: S&P 500 Returns

Event Window	**[t−1; t+1]**	**[t−1; t+2]**	**[t−1; t+3]**	**[t−1; t+4]**
Present Value	0.234	0.635**	0.792***	0.849***
	(0.185)	(0.232)	(0.250)	(0.236)
	[0.218]	[0.010]	[0.004]	[0.001]
FK Grading Level	0.030	−0.101	−0.086	−0.067
	(0.088)	(0.067)	(0.069)	(0.068)
	[0.739]	[0.142]	[0.223]	[0.334]
Constant	−0.207	−0.120	0.302	0.320
	(0.233)	(0.280)	(0.341)	(0.353)
	[0.383]	[0.673]	[0.383]	[0.372]
R^2	0.047	0.145	0.147	0.157

Notes: Table shows results for a least squares estimation of Eq. (2) and different event windows with heteroskedasticity-consistent standard errors in parentheses and p-values in brackets. All explanatory variables are demeaned. ***/**/* indicate significance at the 1%/5%/10% level. Number of observations: 32.

We find a negative and significant relationship between the present value of tax bills and the change in the 10-year bond yields (in line with H1). In line with H2, this relationship increases over time, suggesting that financial market participants underreact at first and need a couple of days to digest the information contained in the tax bills. In terms of economic magnitude, we find that a one percentage point (pp) increase in the present value of tax bills lowers the 10-year bond yield by 3.1 basis points (bps) on the day after the bill is signed (as compared to **t−1**), while the response increases to −6.8 bps three and −9.3 bps four days after the signing. Stock market returns, on the other hand, increase significantly by 63.5 bps two days after a bill is signed, and the response amounts to 84.9 bps for the event window **[t−1; t+4]**. Hence, we find evidence that tax consolidation is actually appreciated by financial markets.

The complexity of tax bills, measured by the FK grading level, provides additional insights about market participants' behavior when confronted with difficult-to-read texts. We observe that a lower readability (i.e., higher complexity) is positively associated with the changes in the 10-year bond yields. Whereas the effect of complexity on bond yields slightly increases over time (up to 1.2 bps after two days), it is no longer significant four days after the signing. Hence, in line with H2, higher textual complexity contributes to the delay in the processing of information by market participants. This result, however, is not replicated for the stock market as the coefficients for complexity are insignificant at the 10% level.

4.2 Subsample Analysis

One of the most important contributions of the narrative approach by RR is to demonstrate that exogenous fiscal policy shocks have a larger and more significant effect on output as compared to broader measures of tax changes. Additional studies, such as Auerbach and Gorodnichenko (2012) and Fazzari et al. (2015), find that the effect of exogenous tax changes on output varies over the business cycle and that it is larger during economic slack. Against this background, we test whether the effect of the present value and the complexity of the tax bills on financial markets' behavior is conditional on the nature of tax bills or the business cycle phase during which they are signed. Specifically, we distinguish between (i) endogenous and (ii) exogenous tax bills relying on the classification of RR and between tax bills implemented during (iii) an expansion and (iv) a recession relying on the NBER business cycle chronology.[13] We focus on [**t−1**; **t+2**] in this subsample analysis as the baseline results show the largest effects for complexity in this event window. Tables 3 and 4 show the results.

When considering the changes in the 10-year bond yields, the results for the present value and the complexity are qualitatively similar for exogenous (albeit insignificant at the 10% level for the present value) and endogenous tax changes as well as for bills signed during an expansion. The only difference can be found for bills signed during a recession. However, the latter results have to be taken with a grain of salt due to the low number of observations in this subsample. For the S&P 500 returns, we find that the complexity of exogenous tax changes and those signed during an expansion significantly matter in a way consistent with H2 as there is an underreaction to more complex bills. Other than that, we find qualitatively similar results for the present value of exogenous tax changes, those signed during an expansion, and for endogenous tax changes (albeit not significant at the 10% level).

Table 3: Change in 10-Year Bond Yields: Subsample Analysis

	Full	**Exogenous**	**Endogenous**	**Expansion**	**Recession**
Present Value	−0.037**	−0.028	−0.069**	−0.054***	−0.191**
	(0.016)	(0.021)	(0.026)	(0.014)	(0.044)
	[0.030]	[0.195]	[0.025]	[0.001]	[0.023]
FK Grading Level	0.012***	0.012**	0.012*	0.011***	0.271**
	(0.004)	(0.006)	(0.005)	(0.003)	(0.072)
	[0.004]	[0.039]	[0.057]	[0.003]	[0.033]
Constant	−0.019	−0.013	−0.013	−0.006	−0.163**
	(0.019)	(0.028)	(0.027)	(0.012)	(0.050)
	[0.315]	[0.655]	[0.632]	[0.637]	[0.047]
Observations	32	23	12	26	6
R^2	0.154	0.088	0.430	0.366	0.836

Notes: Table shows results for a least squares estimation of Eq. (2) and the event window [**t−1**; **t+2**] for different subsamples with heteroskedasticity-consistent standard errors in parentheses and p-values in brackets. All explanatory variables are demeaned. ***/**/* indicate significance at the 1%/5%/10% level. Endogenous/Exogenous: Classification of tax changes according to Romer and Romer (2010); Expansion/Recession: According to NBER definition.

[13] It has to be noted that some of the tax bills contain a part exogenous to the business cycle and an endogenous part.

Table 4: S&P 500 Returns: Subsample Analysis

	Full	**Exogenous**	**Endogenous**	**Expansion**	**Recession**
Present Value	0.635**	0.453**	1.226	1.008*	0.210
	(0.232)	(0.190)	(0.682)	(0.500)	(0.599)
	[0.010]	[0.027]	[0.106]	[0.055]	[0.750]
FK Grading Level	−0.101	−0.191**	−0.005	−0.125*	0.277
	(0.067)	(0.079)	(0.095)	(0.065)	(0.852)
	[0.142]	[0.025]	[0.962]	[0.069]	[0.766]
Constant	−0.120	−0.350	−0.137	−0.241	−0.079
	(0.280)	(0.367)	(0.495)	(0.362)	(0.721)
	[0.673]	[0.351]	[0.789]	[0.512]	[0.920]
Observations	32	23	12	26	6
R^2	0.145	0.112	0.379	0.169	0.336

Notes: Table shows results for a least squares estimation of Eq. (2) and the event window [**t−1**; **t+2**] for different subsamples with heteroskedasticity-consistent standard errors in parentheses and p-values in brackets. All explanatory variables are demeaned. ***/**/* indicate significance at the 1%/5%/10% level. Endogenous/Exogenous: Classification of tax changes according to Romer and Romer (2010); Expansion/Recession: According to NBER definition.

4.3 Robustness Tests

Different Readability Measures. To test if our results are robust to the readability measure used in the specification, we use different approaches gauging text clarity: (i) the Flesch reading ease (FRE) index, (ii) the Gunning Fog (GF) index, the (iii) Simple Measure of Gobbledygook (SMOG) grade, and (iv) the new Dale-Chall (DC) readability formula. The FRE, the GF, and the SMOG indexes are similar to the FK grading level as these indicate the easiness to read a text and the years of formal education a person needs to understand the text on the first reading. While the Flesch reading-ease (FRE) is computed with the same formula as the FK grading level but with different values, the GF index, and the SMOG grade are calculated using complex words (polysyllables), that is, words consisting of two or more syllables.[14] The new DC index uses a count of "hard" words and sentence length to calculate the US grade level of a text.[15]

[14]The alternative measures are calculated as follows:
FRE: $206.835 - 1.015 \cdot (\#words/\#sentences) - 84.6 \cdot (\#syllables/\#words)$;
GF: $0.4 \cdot [(\#words/\#sentences) + 100 \cdot (\#complex\ words/\#words)]$;
SMOG: $1.043 \cdot \sqrt{\#polysyllables \cdot (30/\#sentences)} + 3.1291$.

[15]These "hard" words do not appear in a specially designed list of common words familiar to most 4th grade students. The new DC index is computed as follows:
$[0.1579 \cdot (\#hard\ words/\#words) + 0.0496 \cdot (\#words/\#sentences)] + 3.6365$.

We replace the FK grading level with the different readability measures and re-estimate Eq. (2) in the event window **[t−1; t+2]**. It has to be noted that the FRE measure is defined as actual reading *ease* measure (and not a complexity measure). Hence, we expect the opposite sign for the coefficient on this variable as compared to the other readability measures. Tables 5 and 6 show the results.

Table 5: Change in 10-Year Bond Yields: Different Readability Measures

	FK	**FRE**	**GF**	**SMOG**	**DC**
Present Value	−0.037**	−0.034**	−0.038**	−0.037**	−0.026*
	(0.016)	(0.015)	(0.017)	(0.016)	(0.015)
	[0.030]	[0.034]	[0.030]	[0.028]	[0.096]
Readability	0.012***	−0.003***	0.011***	0.019***	0.028**
	(0.004)	(0.001)	(0.004)	(0.006)	(0.013)
	[0.004]	[0.007]	[0.004]	[0.005]	[0.039]
Constant	−0.019	−0.019	−0.019	−0.019	−0.019
	(0.019)	(0.019)	(0.019)	(0.019)	(0.020)
	[0.315]	[0.314]	[0.317]	[0.316]	[0.329]
R^2	0.154	0.159	0.148	0.151	0.104

Notes: Table shows results for a least squares estimation of Eq. (2) and the event window [**t−1**; **t+2**] for different readability measures with heteroskedasticity-consistent standard errors in parentheses and p-values in brackets. All explanatory variables are demeaned. ***/**/* indicate significance at the 1%/5%/10% level. FK: Flesch-Kincaid Grading Level; FRE: Flesch Reading Ease; GF: Gunning Fog Index; SMOG: SMOG Index; DC: Dale-Chall Readability. Number of observations: 32.

Table 6: S&P 500 Returns: Different Readability Measures

	FK	**FRE**	**GF**	**SMOG**	**DC**
Present Value	0.635**	0.622***	0.639**	0.645***	0.543**
	(0.232)	(0.220)	(0.235)	(0.230)	(0.207)
	[0.010]	[0.008]	[0.011]	[0.009]	[0.014]
Readability	−0.101	0.033*	−0.095	−0.180*	−0.486**
	(0.067)	(0.018)	(0.066)	(0.105)	(0.217)
	[0.142]	[0.081]	[0.164]	[0.099]	[0.033]
Constant	−0.120	−0.120	−0.120	−0.120	−0.120
	(0.280)	(0.277)	(0.281)	(0.279)	(0.275)
	[0.673]	[0.669]	[0.673]	[0.671]	[0.667]
R^2	0.145	0.162	0.141	0.152	0.177

Notes: Table shows results for a least squares estimation of Eq. (2) and the event window [**t−1**; **t+2**] for different readability measures with heteroskedasticity-consistent standard errors in parentheses and p-values in brackets. All explanatory variables are demeaned. ***/**/* indicate significance at the 1%/5%/10% level. FK: Flesch-Kincaid Grading Level; FRE: Flesch Reading Ease; GF: Gunning Fog Index; SMOG: SMOG Index; DC: Dale-Chall Readability. Number of observations: 32.

The results for the 10-year bond yields are robust, irrespective of the readability measure used in the estimation. Higher complexity — as measured by an increase in FK, GF, SMOG, and DC or a decrease in FRE — leads to an underreaction of bond returns. In the case of stock returns, we now find some support for a significant effect of the complexity of tax bills. A decrease in the FRE index as well as an increase in the SMOG and DC measures partly offset the positive effects of the present value on stock returns. Hence, when replacing the FK index, we also find results that are consistent with H2 as there is an initial underreaction of the stock market, which can be (partly) explained by the complexity of the tax bills.

Length, Uncertainty and Sentiment. In a second step, we test if our results are not confounded by other textual characteristics, such as the length of the text, textual uncertainty, and the sentiment conveyed in a tax bill. Hence, we extend our baseline specification and control for the number of words in tax bills (in logs), the textual uncertainty of tax bills, and the sentiment of tax bills. The measures for textual uncertainty (the share of words with an uncertain connotation) and sentiment (the share of positively connotated words minus the share of negatively connotated words) are obtained using the dictionary of Loughran and McDonald (2011). Tables 7 and 8 show the results.

The results for the 10-year bond yields are robust, irrespective of any additionally included covariate. If at all, the coefficient for the present value loses significance once sentiment is included into Eq. (2). In the case of the S&P 500 returns, we find some variation in the size of the coefficient for the present value (between 50.6 bps and 74.1 bps). The smallest coefficient can be explained by the inclusion of the sentiment variable, which positively affects stock returns as a 1pp higher sentiment leads to an increase of 124.3 bps in the S&P 500 returns. Lastly, textual complexity remains insignificant on the stock market.

Table 7: Change in 10-Year Bond Yields: Length and Sentiment

	Baseline	**Length**	**Text. Unc.**	**Sentiment**
Present Value	−0.037**	−0.036**	−0.038**	−0.033*
	(0.016)	(0.017)	(0.018)	(0.018)
FK Grading Level	0.012***	0.011**	0.011***	0.011***
	(0.004)	(0.004)	(0.004)	(0.004)
Log(Words)		0.005		
		(0.011)		
Textual Uncertainty			0.025	
			(0.163)	
Sentiment				−0.039
				(0.042)
Constant	−0.019	−0.019	−0.019	−0.019
	(0.019)	(0.019)	(0.019)	(0.019)
R^2	0.154	0.158	0.154	0.173

Notes: Table shows results for a least squares estimation of Eq. (2) and the event window [**t−1**; **t+2**], controlling for the length of tax bills (number of words, in logs), the textual uncertainty of tax bills, and the sentiment of tax bills with heteroskedasticity-consistent standard errors in parentheses. The measures for textual uncertainty (the share of words with an uncertain connotation) and sentiment (the share of positively connotated words minus the share of negatively connotated words) are obtained using the dictionary of Loughran and McDonald (2011). All explanatory variables are demeaned. ***/**/* indicate significance at the 1%/5%/10% level. Number of observations: 32.

Table 8: S&P 500 Returns: Length and Sentiment

	Baseline	**Length**	**Text. Unc.**	**Sentiment**
Present Value	0.635**	0.581**	0.741***	0.506**
	(0.232)	(0.244)	(0.263)	(0.217)
FK Grading Level	−0.101	−0.057	−0.035	−0.085
	(0.067)	(0.071)	(0.080)	(0.075)
Log(Words)		−0.240		
		(0.166)		
Textual Uncertainty			−4.301	
			(3.057)	
Sentiment				1.243*
				(0.677)
Constant	−0.120	−0.120	−0.120	−0.120
	(0.280)	(0.278)	(0.274)	(0.270)
R^2	0.145	0.187	0.212	0.234

Notes: Table shows results for a least squares estimation of Eq. (2) and the event window [**t−1**; **t+2**], controlling for the length of tax bills (number of words, in logs), the textual uncertainty of tax bills, and the sentiment of tax bills with heteroskedasticity-consistent standard errors in parentheses. The measures for textual uncertainty (the share of words with an uncertain connotation) and sentiment (the share of positively connotated words minus the share of negatively connotated words) are obtained using the dictionary of Loughran and McDonald (2011). All explanatory variables are demeaned. ***/**/* indicate significance at the 1%/5%/10% level. Number of observations: 32.

Congressional Vote vs. Presidential Signing. Every bill in the US has to pass both chambers of the Congress before the President has to sign or veto the enrolled bill. Hence, there is some uncertainty in the electoral process even after the final vote of the Senate. Still, market participants might already react to the present value and the complexity of a bill after it has passed the Congress. Accordingly, we collect the dates of the final vote in the Senate and test if market participants react at that time. Table 9 sets out the results with column 'President' replicating the baseline results using the restricted sample.[16] A couple of things are worth highlighting. First, the R^2 is higher in the three-day windows around the singing of the bill by the President. In addition, we observe larger (absolute) coefficients with a higher level of significance in the columns 'President' as compared to the columns 'Congress.' Hence, this reaffirms our choice of using the signing day by the President as endpoint for the electoral process as the weaker results for the Congress vote might indeed reflect the reamaining uncertainty in the process.

Table 9: Congressional Vote vs. Presidential Signing

	Change in 10-Year Yields		**S&P 500 Returns**	
	Congress	**President**	**Congress**	**President**
Present Value	−0.026*	−0.035**	0.539**	0.682***
	(0.015)	(0.016)	(0.241)	(0.240)
	[0.089]	[0.036]	[0.033]	[0.008]
FK Grading Level	0.004	0.012***	0.045	−0.098
	(0.004)	(0.004)	(0.079)	(0.064)
	[0.303]	[0.005]	[0.573]	[0.138]
Constant	−0.012	−0.022	0.190	−0.042
	(0.016)	(0.020)	(0.330)	(0.273)
	[0.470]	[0.278]	[0.571]	[0.879]
R^2	0.089	0.140	0.113	0.179

Notes: Table shows results for a least squares estimation of Eq. (2) and the event window [**t**−**1**; **t**+**2**] around the final vote in the Congress and the signing of the bill by the President with heteroskedasticity-consistent standard errors in parentheses and p-values in brackets. All explanatory variables are demeaned. ***/**/* indicate significance at the 1%/5%/10% level. Number of observations: 30.

[16]For one bill (Tax Reform Act of 1969), the date of the final vote in the Senate is not available on the Cogress website. The Revenue Act of 1962 passed the senate in 1961; however, daily data for the 10-year bond yields is only available since 1962. Hence, the number of observations shrinks to 30 as compared to 32 in the previous estimations.

Electoral Cycle. Three of the bills in our sample (8-Nov-1966, 6-Nov-1978, and 5-Nov-1990) were signed on an election day or on the day before. Hence, the results could be confounded by the financial markets' reaction to these three midterm elections. Alternatively, market participants could react differently to bills signed close before an election. As a consequence, we exclude the three bills and re-estimate Eq. (2) without these in a first step. Furthermore, four additional bills (16-Oct-1962, 30-Oct-1972, 4-Oct-1976, and 22-Oct-1986) were signed in the month before an Presidential or midterm election. Accordingly, we exclude all seven bills to account for the potentially confounding electoral cycle in a second step. The results[17] remain robust for the bond market with a minor shrinkage in the significance of the coefficient for the present value. On the stock market, the coefficient for the present values becomes smaller, but remains quantitatively robust. Hence, we are confident that our results are not confounded by the electoral cycle.

Parameter Stability. Next, we test for the stability of the estimated parameters over time. With the emergence of the Internet, information might be spread quicker and computer technology might also be helpful in digesting the complexity of the tax bills. To test for potential breaks in the parameters, we re-estimate Eq. (2) recursively using an expanding window with a minimum size of ten tax bills. The results can be found in Figure B1 in Appendix B. The coefficients for the present value and complexity are significant on the bond market for all windows considered in the recursive estimations. If at all, the estimate for the present value decreases over time (in absolute terms), whereas the estimate for complexity increases. In the case of the stock market, the estimate for the present value does not show a distinct tendency over time with respect to its size; however, it becomes statistically significant only if a certain number of observations is included in the analysis. In general, we do not find evidence of a distinct structural break in the data.

Bills Signed on Fridays or Saturdays. Four of the bills in our sample are signed on Fridays and two more on Saturdays. However, the analysis thus far is based on

[17]To conserve space, we do not report these results in detail. All omitted results are available on request.

(relative) changes over the previous *trading* days. It might be argued that investors have more time to digest the content of the bills over the course of the weekend. Accordingly, we test if our results change when bills signed on Fridays or Saturdays are omitted from the dataset. The coefficient for the complexity of the tax bills does not change at all on the bond market and remains insignificant on the stock market when excluding Fridays or Saturdays. The coefficients for the present value are virtually unchanged in this robustness test.

Outlier Analysis. As mentioned in Section 2, the Tax Adjustment Act of 1966 (Text №5 in Table A1) is an outlier. It contains a lot of numbers and short half-sentences and, therefore, the FK measure fails to grade this text in an "appropriate" way. Accordingly, we test whether our results are robust when excluding this text. In the case of the 10-year bond yields, the coefficients are slightly larger when omitting the "questionable" text; for the stock returns, the results are qualitatively unchanged despite some slightly smaller coefficients without the outlier.

Our results also remain robust if we exclude the Economic Recovery Tax Act of 1981 (signed on 13-Aug-81, Text №21 in Table A1) from the analysis. This tax cut (the largest one in our sample as mentioned in Section 3) was at the center of Ronald Reagan's Presidential campaign and, therefore, largely anticipated by market participants. In this case, the coefficient for the present value is slightly larger for bond yields and stocks returns without the outlier, whereas the coefficients for complexity remain virtually unchanged.

5 Conclusions

In this paper, we analyze whether the complexity of tax bills affects financial market participants' behavior. We first collect the 32 tax bills identified by Romer and Romer (2010) in the period 1962–2003 from the congressional archives. Second, to measure the complexity of tax bills, we mainly rely on the Flesch-Kincaid grade level index to generate a readability measure based on education grade levels. Lastly, we assess the relationship between tax bills' complexity and financial markets' behavior using an event study approach where we consider the changes in 10-year government bond yields and S&P 500 returns in windows from one day before the signing of a tax bill until up to four days after the signing.

Our results show that financial market participants react significantly to the characteristics of tax bills after their signing. Specifically, we find a negative (positive) and significant relationship between the present value of tax bills and changes in the 10-year bond yields (S&P 500 returns), suggesting that market participants actually appreciate an increase in taxes. The magnitude of this relationship increases over time, indicating that market participants underreact at first and need a couple of days to digest the information contained in the tax bills. This delay can be explained by the textual characteristics in the case of the 10-year bond yields as a lower readability (proxied by the years of education required to understand a bill) partly offsets the negative relationship for up to three days after the signing of a tax bill, but not thereafter. In the case of the stock market, we find similar offsetting evidence, but only for a part of the readability measures employed in this paper. We also test if our results differ according to the nature of the tax change (endogenous or exogenous) and the phase of the business cycle. Lastly, we document the robustness of our results with respect to (i) other textual characteristics of the tax bills, such as length, textual uncertainty, and sentiment, (ii) the timing of the tax bills (using the date of the vote in the Congress instead of the Presidential signing), (iii) the electoral cycle, (iv) parameter instability, (v) bills signed shortly before or on the weekend, and (vi) outliers.

Our findings highlight the need for policymakers to use simple, concise, and clear English when writing the bills to limit any undesirable market behavior following their signing, even if it just observable for three days. In addition, we provide empirical evidence showing that market participants respond to the form of the bills (i.e., their complexity) and not only their content (i.e., their present value).

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Appendix A: Background on Dataset

Table A1: Legislative Texts

№	Date	Legislative Text
1	16-Oct-62	Revenue Act of 1962
2	26-Feb-64	Revenue Act of 1964
3	21-Jun-65	Excise Tax Reduction Act of 1965
4	30-Jul-65	Social Security Amendments of 1965
5	15-Mar-66	Tax Adjustment Act of 1966
6	08-Nov-66	Public Law 89-800 (Suspension of Investment Tax Credit)
7	13-Jun-67	Public Law 90-26 (Restoration of the Investment Tax Credit)
8	02-Jan-68	Social Security Amendments of 1967
9	28-Jun-68	Revenue and Expenditure Control Act of 1968
10	30-Dec-69	Tax Reform Act of 1969
11	17-Mar-71	1971 Changes to Social Security
12	10-Dec-71	Revenue Act of 1971
13	30-Oct-72	Social Security Amendments of 1972
14	09-Jul-73	1973 Changes to Social Security
15	29-Mar-75	Tax Reduction Act of 1975
16	04-Oct-76	Tax Reform Act of 1976
17	23-May-77	Tax Reduction and Simplification Act of 1977
18	20-Dec-77	Social Security Amendments of 1977
19	06-Nov-78	Revenue Act of 1978
20	02-Apr-80	Crude Oil Windfall Profit Tax Act of 1980
21	13-Aug-81	Economic Recovery Tax Act of 1981
22	03-Sep-82	Tax Equity and Fiscal Responsibility Act of 1982
23	20-Apr-83	Social Security Amendments of 1983
24	18-Jul-84	Deficit Reduction Act of 1984
25	22-Oct-86	Tax Reform Act of 1986
26	22-Dec-87	Omnibus Budget Reconciliation Act of 1987
27	05-Nov-90	Omnibus Budget Reconciliation Act of 1990
28	10-Aug-93	Omnibus Budget Reconciliation Act of 1993
29	05-Aug-97	Balanced Budget Act of 1997 / Taxpayer Relief Act of 1997
30	07-Jun-01	Economic Growth and Tax Relief Reconciliation Act of 2001
31	09-Mar-02	Job Creation and Worker Assistance Act of 2002
32	28-May-03	Jobs and Growth Tax Relief Reconciliation Act of 2003

Notes: Table shows all legislative texts covered in the analysis. Source: Romer and Romer (2009).

Table A2: Descriptive Statistics

	Mean	Std. Dev.	Min	Max
Present Value (% of Nominal GDP)	−0.09	1.03	−3.96	1.15
Flesch-Kincaid Grading Level	8.90	3.15	−1.26	15.06
Flesch Reading Ease	65.45	11.44	49.44	107.84
Gunning Fog Index	12.16	3.19	2.24	18.67
SMOG Index	11.42	1.95	4.68	14.67
Dale-Chall Readability	10.30	0.88	6.55	11.06

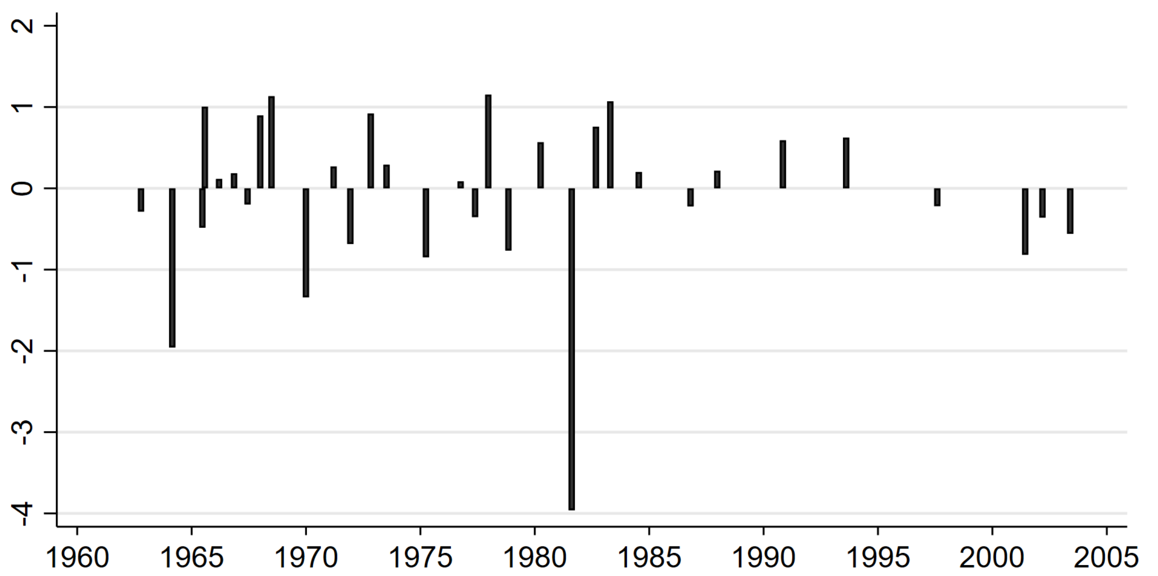
Notes: Table shows descriptive statistics for the present value of the tax bills and their complexity.

Table A3: Bivariate Correlations

	PV	FK	FRE	GF	SMOG	DC
Present Value	1					
FK Grading Level	0.31	1				
Flesch Reading Ease	−0.23	−0.97	1			
Gunning Fog Index	0.34	1.00	−0.95	1		
SMOG Index	0.31	0.99	−0.98	0.99	1	
Dale-Chall Readability	0.01	0.80	−0.90	0.77	0.83	1

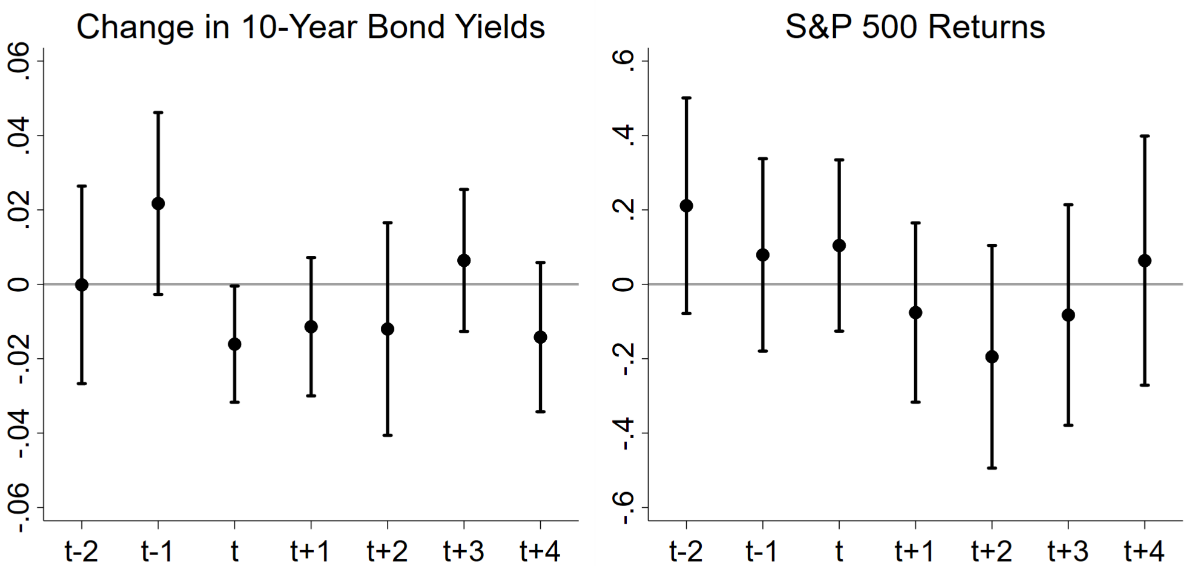
Notes: Table shows bivariate correlations for the present value of the tax bills and their complexity. PV: present value (% of nominal GDP); FK: Flesch-Kincaid Grading Level; FRE: Flesch Reading Ease; GF: Gunning Fog Index; SMOG: SMOG Index; DC: Dale-Chall Readability.

Figure A1: Present Value of Tax Bills



Notes: Figure shows the present value of the tax bills (as % of nominal GDP). The corresponding tax bills can be found in Table A1.

Figure A2: Financial Market Data Around the Signing of Tax Bills

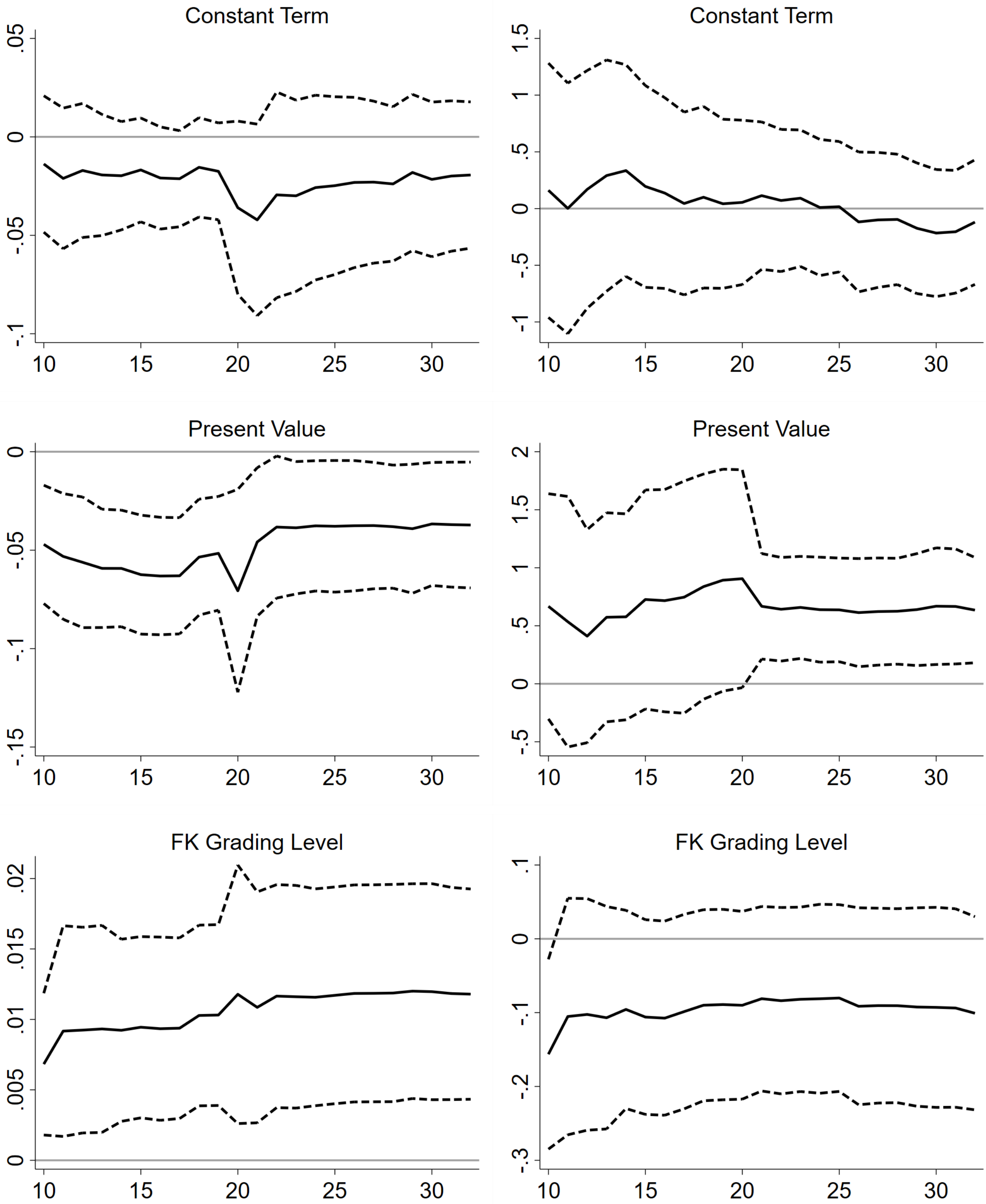


Notes: Figure shows the average daily change in the 10-year government bond yields as well as the average daily returns of the S&P 500 returns two days before until four days after the signing of a tax bill. 95% confidence intervals are indicated by whiskers. The average changes (returns) are obtained by a least sqaures regression (with robust standard errors) of the respective time series on a constant term and dummies for $t-2$, $t-1$, ..., and $t+4$.

Appendix B: Results of Recursive Estimations

Figure B1: Results of Recursive Estimations

Panel A: Change in 10-Year Bond Yields	Panel B: S&P 500 Returns



Notes: Solid lines show the coefficients of a recursive estimation of Eq. (2) and the event window [**t−1**; **t+2**]. Dashed lines are the 95% confidence intervals based heteroskedasticity-consistent standard errors. y-axis: Size of the coefficients and the confidence intervals. x-axis: Last bill considered in the recursive estimation (see also Table A1).