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Macroeconomic Effects from Sovereign Risk vs. Knightian Uncertainty

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Abstract

This paper compares macroeconomic effects of Knightian uncertainty and risk using policy shocks for the case of Italy. Drawing on the ambiguity literature, I use changes in the bid-ask spread and mid-price of government bonds as distinct measures for uncertainty and risk. The identification exploits the quasi-pessimistic behavior under ambiguity-aversion and the dealer market structure of government bond markets, where dealers must quote both sides of the market. If uncertainty increases, ambiguity-averse dealers will quasi-pessimistically quote higher ask and lower bid prices – increasing the bid-ask spread. In contrast, a pure change in risk shifts the risk-compensating discount factor which is well approximated by the change in bond mid-prices. I evaluate economic effects of the two measures within an instrumental variable local projection framework. The main findings are threefold. First, the resulting shock time series for uncertainty and risk are uncorrelated with each other at the intraday level, however, upon aggregation to monthly level the measures become correlated. Second, uncertainty is an important driver of economic aggregates. Third, macroeconomic effects of risk and uncertainty are similar, except for the response of prices. While sovereign risk raises inflation, uncertainty suppresses price growth – a result which is in line with increased price rigidity under ambiguity.

Keywords: high frequency identification, instrument, local projections, sovereign risk, text data, uncertainty

JEL classification: C36, E31, E43

1 Introduction

Under Knightian uncertainty (also referred to as ambiguity), economic agents do not exactly know the probabilities of relevant outcomes. The notion of Knightian uncertainty is here considered in contrast to the concept of risk. The latter is based on the premise that agents are able to derive meaningful subjective probabilities, which uniquely map all possible future states of the world. The importance of Knightian uncertainty in economic decision-making has led to an extensive literature on its implications for macroeconomic outcomes. Ilut and Schneider (2014) for example construct a New Keynesian business cycle model populated with ambiguity-averse agents and find that uncertainty explains a large portion of business cycle fluctuations, with uncertainty weighing on economic activity. Beissner and Riedel (2019) investigate the implications of ambiguity for equilibrium outcomes and find that, given uncertainty, the Arrow-Debreu equilibrium is only reached under certain restrictive conditions. Ilut et al. (2020) derive a theory of price rigidity based on ambiguity which produces realistic degrees of monetary non-neutrality. Under ambiguity, firms entertain multiple beliefs about the demand elasticity that they are facing. Quasi-pessimistically, the firms assume the worst-case elasticity for the price change being considered. This set-up creates a kink in firms' profit functions at current prices and generates aggregate wage rigidity. While there is ample theoretical literature on the implications of Knightian uncertainty, comparing risk and uncertainty has been challenging in empirical applications, particularly due to the difficulty of isolating exogenous variation in uncertainty (Bekaert et al.; 2013; Bachmann et al.; 2013).

This paper uses Italian political events from Staffa (2022) to construct two exogenous high-frequency measures for risk and uncertainty, respectively, to empirically investigate and compare their macroeconomic effects. The research design exploits the quasi-pessimistic behavior under ambiguity-aversion and the dealer market structure of the sovereign bond market. Dealers are market makers and obliged to quote the government bond market in *both* directions to investors. Therefore, if a political event increases ambiguity, an ambiguity-averse dealer becomes temporarily less confident of her probability assessments and revises her ask quote (selling price) and the bid quote (buying price) as if being more pessimistic with respect to *either* quote. In other words, the dealer will submit a lower bid-price quote, on the assumption that the bond price may be lower than before the event. The dealer will also quote a higher ask-price, to avoid going short and incurring a loss upon delivery of the bond – in this case pessimistically acting on the assumption of a potentially higher bond price. If the ask price increases and the bid price drops, this raises the bid-ask spread.[1] In comparison, for an event that changes risk only, the change in mid-prices is a good measure of the change in the perceived riskiness since the mid-price approximates the unconditional expected bond price (Mad-

[1] The first papers relating the bid-ask spread to ambiguity were Routledge and Zin (2009) and Easley and O'Hara (2010).

havan; 1992; Huang and Stoll; 1997; Hasbrouck; 2007). Capturing variations in bid-ask spreads and the mid-prices of Italian government bonds in narrow time windows around domestic policy events enables me to derive exogenous variations for risk and uncertainty simultaneously at the intraday level. I then aggregate the shocks to monthly frequency and assess macroeconomic implications within an instrumental variable local projections set-up. Three assumptions fundamental to the described identification are discussed in detail in sections 3 and 4. First, I assume that risk does not systematically impact the bid-ask-spread at an intraday frequency. Second, the identification is based on the premise that dealers are in fact ambiguity-averse. Third, changes in mid-prices remain a reliable measure for changes in risk even under ambiguity. While these assumptions cannot be directly tested, their plausibility is assessed against the data.

Intraday shock series are derived by the method outlined above and then used to study the effects of risk and uncertainty. My main results are threefold. First, the shock series for risk and uncertainty are uncorrelated at the intraday level, which is consistent with the pattern found for the endogenous measures of the bid-ask spread and the mid-prices for Italian bonds. However, upon aggregation to monthly frequency, the shock series become correlated. Second, I find that uncertainty is a relevant instrument and critically impacts economic aggregates. Due to the high correlation of the instrument series on a monthly level, I orthogonalize uncertainty with respect to risk – potentially weakening the uncertainty instrument. While this procedure effectively assumes that risk is the dominant shock, even the orthogonalized uncertainty instrument is strong and impulse response functions are significant. I interpret this as evidence supporting the importance of politically induced ambiguity. Third, as the theoretical literature suggests, risk and uncertainty lead to largely similar responses in economic aggregates, weighing on economic activity by depressing investment and consumption. However, prices react differently to risk vs. uncertainty. An increase in sovereign risk raises prices while uncertainty suppresses inflation. The inflation response to an increase in sovereign risk is in line with the fiscal theory of the price level (Leeper; 1991; Cochrane; 2021) which posits that in equilibrium, discounted future primary surpluses have to equal the real value of outstanding government debt. Since higher sovereign risk implies a higher discount rate and therefore a lower present value for primary surpluses, prices rise such that the relation holds again in the new equilibrium. Remarkably, uncertainty serves to suppress inflation. This finding is consistent with theoretical considerations in the ambiguity literature such as Ilut et al. (2020), according to which firms facing ambiguity regarding demand elasticity prefer to keep current prices unchanged, producing aggregate wage rigidity.

The remainder of this paper is structured as follows. Section 2 discusses related literature. Section 3 derives the uncertainty measure and discusses its specification. Dynamic effects of uncertainty and sovereign risk on macroeconomic and financial variables are investigated within the scope of a small instrumental local projections model in section

4. Section 5 assesses the sensitivity of the results and section 6 concludes the paper.

2 Literature Review

As early as 1921, the authors Keynes and Knight published on the subject of probability and uncertainty. While approaching the concepts from different perspectives – Keynes with a broader and more philosophical approach – they both argued for the importance of distinguishing between known and unknown probabilities. Knight (1921) posits that the profits of a firm are mainly driven by uncertainty. He conceived of risk as being a mere cost factor limited to the set of homogeneous events which can be reasonably well predicted based on their past frequencies. Keynes, too, argued that many phenomena defy any basis for meaningful representation in probabilistic terms. One problem with implementing such uncertainty concepts was that they are difficult to formalize, let alone to measure. Critics argued that the suggested behavioral consequences are similar to those provoked by risk (cf. Arrow (1951)). Behavior under uncertainty might be well described by optimizing behavior under risk, assuming that the optimizing agents act *as if* they are assigning specific probabilities to all possible future states of the world. This notion was promoted particularly by Ramsey (1931), De Finetti (1937) and Savage (1954).

Starting from the premise that beliefs are revealed in people's bets on certain outcomes, Ellsberg (1961) devised the famous Ellsberg paradox, which demonstrated the behavioral importance of ambiguity by showing that people prefer risky lotteries (with known odds) over uncertain lotteries (unknown odds). In the context of the current paper, this finding translates to potentially different behavior for an unknown realization of payoffs (consumption risk) as opposed to unknown probability distributions over payoffs (ambiguity). Gilboa and Schmeidler (1989) contributed the so-called multiple prior model, in which preferences were represented using sets of beliefs rather than one belief only. This rational choice approach can accommodate Ellsberg-type behavior and has been used extensively in the literature (Ilut and Schneider; 2022). Hansen and Sargent (2001, 2014) show that behavior under Knightian uncertainty is closely related to robustness-seeking behavior under model uncertainty. Another way to describe behavior under ambiguity was proposed by Bewley (2002). Similar to Gilboa and Schmeidler (1989), in Bewley's model agents also hold multiple beliefs of the world. However, Bewley introduces an inertia assumption which is loosely described as a preference for the status quo. An agent would only trade if the trade enhances expected utility for all beliefs held within her preferences.

Easley and O'Hara (2010) build on the uncertainty representation of Bewley (2002) to derive a model that explicitly characterizes the impact of uncertainty on the bid-ask spread. The authors find that under high uncertainty bid and ask quotes reflect only best and worst case prices, driving up the bid-ask spread. The model allows the authors to explain the drying-up of liquidity in the subprime market during the Great Recession. Intuitively, when traders' preferences contain multiple beliefs, they only buy or sell if the trade increases expected profits over their most optimistic and pessimistic beliefs. Consequently, the bid-ask spread increases and traders hold on to their assets – liquidity vanishes. Note that the ambiguity-driven bid-ask spread is different from the bid-ask spread in canonical microstructure models in which spreads stem from some traders holding informational advantages over the dealer (Glosten and Milgrom; 1985; Easley and O'Hara; 1987). Routledge and Zin (2009) considers a monopolistic dealer model for derivative securities. The dealer has Gilboa and Schmeidler-type preferences and find that ambiguity increases the bid-ask spread and *thereby* reduces liquidity.

While the theoretical literature on Knightian uncertainty is extensive, empirical studies on its effects are rather limited due to the difficulties in measuring uncertainty and the challenge of deriving exogenous variation. Williams (2015) uses the volatility index computed by the Chicago Board Options Exchange, VIX, to study the effects of uncertainty on the way investors perceive and react to earnings news. The author finds that investors place more weight on bad news compared to goods news when uncertainty is high. While Drechsler (2013) provides a theoretical rationale for the VIX as a Knightian uncertainty measure, it is still closely linked to standard risk measures. In particular, the VIX is derived from the Black-Scholes formula (Black and Scholes; 1973), which does not incorporate the concept of ambiguity. Dimmock et al. (2016) attest Ellsberg-type behavior in the majority of households using data from the American Panel of Life. The authors document lower stock market participation and under-diversification of portfolios for ambiguity-averse households, in line with theoretical considerations such as Epstein and Schneider (2010) and Boyle et al. (2012). Measurements of ambiguity most often draw on surveys which either include thought experiments or allow probability ranges, rather than point estimates only, as responses. The latter approach was first adopted in economics by Manski and Molinari (2010), when investigating different rounding behavior in the Health and Retirement Study. Ilut and Schneider (2022) explain the pitfalls in relating belief sets to imprecise probabilities in surveys. Bachmann et al. (2020) use questions in the ifo Business Survey about future sales growth and find a significant share of the respondents answering with probability ranges. The authors find that these "Knightian" responses are not due to sophistication and that forecast errors are similar across groups.

This paper contributes to the empirical literature by building on Routledge and Zin (2009) and Easley and O'Hara (2010) in using the bid-ask spread as a measure for ambiguity while simultaneously extracting changes of a standard risk measure. Since both mid-prices and bid-ask spreads are available for government bonds on a high frequency level, I construct shocks around political events derived in Staffa (2022) in the spirit of the high-frequency literature such as Kuttner (2001) and Gürkaynak et al. (2005). The constructed series are then used to study and compare dynamic macroeconomic effects.

3 Measuring Risk and Uncertainty

The empirical distinction between risk and uncertainty in this paper relies on two strands of the literature. First, risk is derived in line with classical microstructure models such as Glosten and Milgrom (1985), in which some traders have superior information and the dealer extracts information from trades. In such information based markets, a buy order leads the dealer to suspect a higher true value of the bond and a sell order is viewed as negative news on the true value. A bond price conditional on a preceding buy order is higher than the unconditional expected value and *vice versa*. Within such a set-up, the mid-price quote is thus a sensible (and common) choice to approximate the unconditional expected bond price and therefore the implied perceived riskiness of a bond (Madhavan; 1992; Huang and Stoll; 1997; Hasbrouck; 2007). Second, I draw on the ambiguity literature to relate the bid-ask spread with the degree of ambiguity (Routledge and Zin; 2009; Easley and O'Hara; 2010). While the two models are based on slightly different specifications of ambiguity, the general rationale is similar. Under ambiguity, agents entertain multiple beliefs (probability distributions over all future states of the world) which are not collapsed – deviating from the Savage independence axiom. The bid-ask spread increases because, depending on the quote under consideration, expected utility is either maximized over the worst-case beliefs or expected utility must be higher across all beliefs. The size of the set of beliefs is therefore often interpreted as a measure of the degree of ambiguity (Ilut and Schneider; 2022). To fix ideas within this paper, I draw on the same line of reasoning, but I motivate the distinction within a simpler framework, the Treynor-model of the dealer market. I choose this model for its intuitive graphical representation, for more rigorous treatments refer to Routledge and Zin (2009) and Easley and O'Hara (2010).

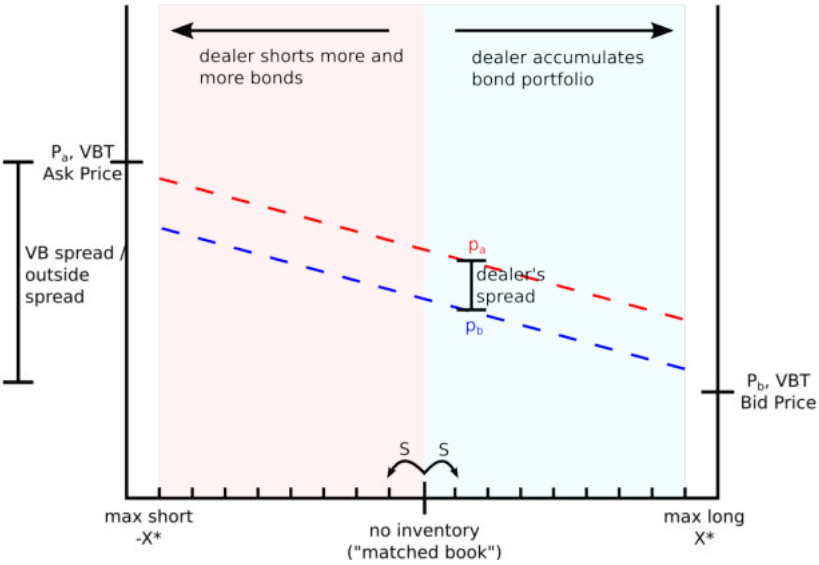
3.1 Bid-Ask-Spread and Mid-Price in a Dealer Model

The market for government bonds is not organized on regulated exchanges, instead trades are conducted "over-the-counter", just like many trades for securities in derivatives markets. Dealers play a critical role in government bond markets as intermediaries between buyers and sellers. They provide liquidity to both parties, enabling them to benefit from each other's trades, even if those trades do not occur simultaneously. For instance, an investor might sell x government bonds to a dealer in $t = 0$, who holds them in inventory until she can sell them to another hurried investor at a small profit in $t = 1$. Dealers are liquidity traders, often highly leveraged and have high risk-affinity (Stigum and Creszenzi; 2007). They tend to hold positions for only hours, days, or weeks. This contrasts to the holding periods of traders hedging or rebalancing their portfolios, or of typical value-based traders (investors).

A stylized description of the market making process by the dealer is given in the model devised by Treynor (1987), which has been popularized for example by Mehrling (2012) in the context of the Great Recession and the role money markets played therein. In this paper, the model is used to conceptualize the statistical identification of risk vs. uncertainty.

The model reflects the special characteristics of the dealer who typically borrows short-term and has limited capital, constraining the size of the trades the dealer can absorb. Dealers are motivated by the potential profit from the bid-ask spread and the volume of transactions they can execute. They also extract valuable information from their trades with clients (De Jong and Rindi; 2009). However, the building-up and drawing down of inventory exposes dealers to price risk, which can be significant.

Figure 1: Graphical Illustration Treynor Dealer Model



Notes: At zero inventory, the dealer experiences no exposure to any price swing because she does not hold a negative / positive amount. As the inventory increases the dealer will only be willing to buy more at a lower price, to compensate for the increased exposure to price changes of the inventory.

The dealer is modeled as having a symmetrical limit for her inventory position, long and short of X^* and $-X^*$ respectively. The order flow is random, meaning that buy and sell orders arrive with equal probability. The value-based trader (VBT) who is guided by fundamentals, is more risk-averse and has longer holding periods, buys at P_b and sells at P_a, effectively backstopping the dealer market. The mechanics of the model are captured graphically in figure 1. If the dealer holds no inventory of the government bond, she is not exposed to price risks. If the dealer goes short (sells to an investor), we move to the left and if the dealer goes long (buys from an investor) we move to the right. Due to the limited capital available to the dealer, she stops extending her position beyond a maximum / minimum to either side. At these points, the dealer accommodates incoming trades pushing further beyond the maximum or minimum by "laying off" to the value-based investor. Specifically, if a sequence of investors buy government bonds from the dealer, pushing her to $-X^*$, the dealer won't go short beyond $-X^*$, but instead buys the accommodation amount from the value-based investor and passes it on to the trader. Conversely, if a sequence of investors sell to the dealer and the inventory position moves to X^*, any further sell order is accommodated by passing on the position to the VBT. Therefore, the bid-ask spread of the VBT is dubbed the "outside spread" as it frames the market-making of the dealer. The bid and ask schedules of the dealer are downward sloping, moving from maximum short to maximum long, as dealers demand increasing compensation for the exposure to inventory risk. If a dealer has a large positive inventory of government bonds, she is less willing to further increase her position as this will increase her exposure to a drop in prices. For that reason, she demands a higher discount, i.e. quoting lower bid and ask prices. The Great Recession showed what happens when dealers are no longer willing to make markets. In such cases, the central bank may need to step in and backstop the dealer market (serving the role of the VBT), so that dealers again fulfill their role as intermediaries (Mehrling; 2012).

In reality, a dealer does not know at what price the VBT steps in, and therefore at what exact price she is able to lay off excess inventory. Rather, she forms expectations, $\mathbb{E}^{\mathbb{P}}P_a$ and $\mathbb{E}^{\mathbb{P}}P_b$, where $\mathbb{P}$ denotes a belief, a unique probability distribution over all possible states of the world. $\mathbb{E}$ is the expectation operator. Indeed, under ambiguity, dealers hold a set of beliefs, $\mathcal{P}$ and one may nest the risky case by assuming $\mathcal{P} = \{\mathbb{P}\}$, i.e. the set of beliefs is a singleton. I use the multiple priors preferences from Gilboa and Schmeidler (1989) to illustrate the identification of uncertainty. Under such specification, the ambiguity-averse dealer will choose the respective worst-case distribution $\mathbb{P}$ from $\mathcal{P}$ when deducing the outside spread. A relatively more pessimistic choice for both the ask and bid price quote increases the bid-ask spread. To see this, consider the ask price first. When deciding on an ask price quote, the dealer assesses the risk of going short (selling to an investor). Quasi-pessimistically, the dealer chooses the worst-case belief from $\mathcal{P}$ according to which the VBT's ask price is highest,

$$\widetilde{P}_a = \max_{\mathbb{P}\in\mathcal{P}} \mathbb{E}^{\mathbb{P}} P_a, \tag{1}$$

where the $\widetilde{\cdot}$ indicates that the price is derived under ambiguity aversion. The price $\widetilde{P}_a$ is the most pessimistic for the ask price because the difference between the outside ask price and the maximum ask price quoted by the dealer is her loss when laying off. Conversely, when setting the bid quote, an ambiguity-averse dealer will choose a belief that minimizes the outside bid price. Again, the reason being, that when the dealer is at the maximum position X^* and the incoming order is another sell order, she passes through to the VBT at a loss, therefore,

$$\widetilde{P}_b = \min_{\mathbb{P}\in P} \mathbb{E}^{\mathbb{P}} P_b. \tag{2}$$

Consider an example. Imagine that the occurrence of a policy shock increases uncertainty. Before the event occurs, $\mathcal{P}_{before}$ is a singleton containing one belief $\mathbb{P}^0$. Assume further that $\mathbb{P}^0$ gives a 50-50 chance for P_a (P_b) to be either 110 (100) or 120 (90), i.e. the implied outside spread is set by $\widetilde{P}_a = 115$ and $\widetilde{P}_b = 95$. The event reduces the dealer's confidence with respect to her probability assessment, represented by two new beliefs $\mathbb{P}^{bad}$ and $\mathbb{P}^{good}$. The new set of beliefs after the event is given by $\mathcal{P}_{after} = \{\mathbb{P}^0, \mathbb{P}^{bad}, \mathbb{P}^{good}\}$. For simplicity, assume both new probability distributions to be degenerate, $\mathbb{P}^{bad}$ assigns probability one to an ask (bid) price of 100 (90) and $\mathbb{P}^{good}$ assigns probability one to an ask (bid) price of 125 (120). Critically for ambiguous beliefs, in violation of the Savage independence axiom, these probabilities are not collapsed. Moreover, depending on the quote being assessed the belief changes endogenously, the new outside spread is spanned by

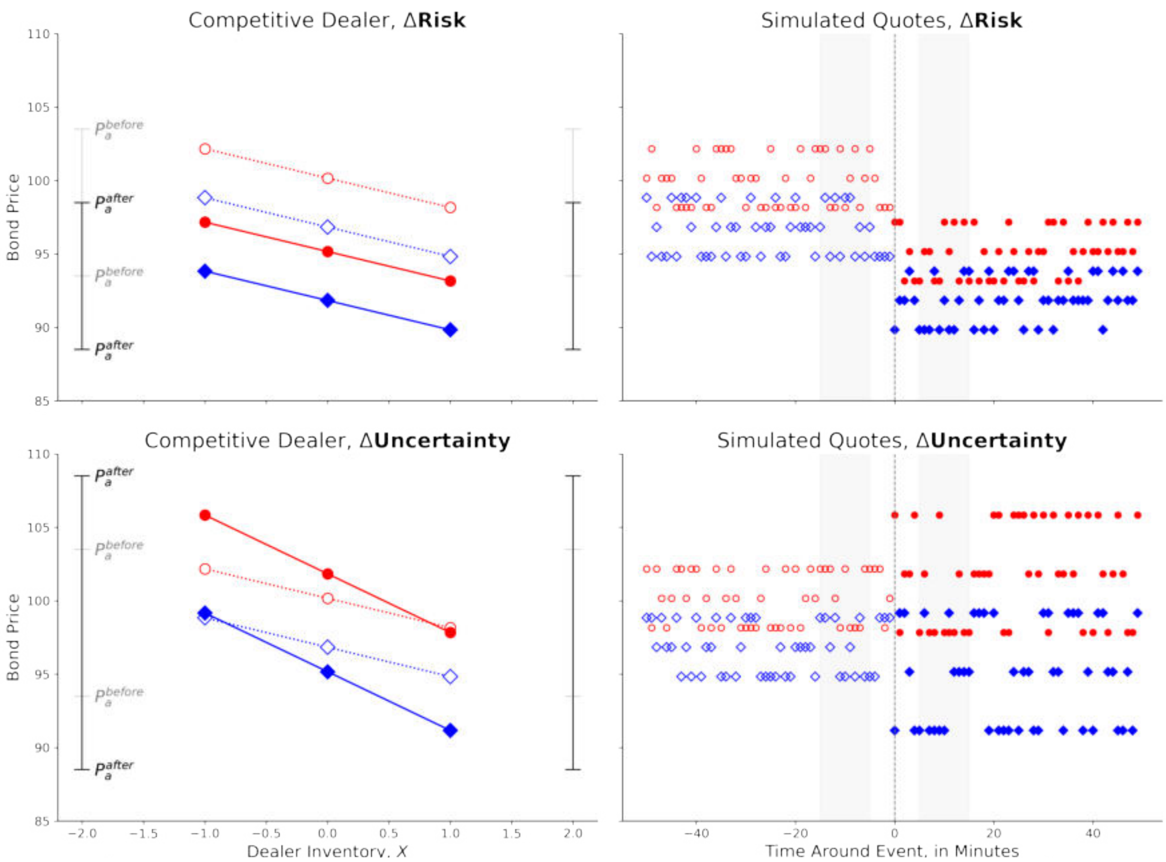
$$\widetilde{P}_a|_{after} = \max_{\mathbb{P}\in\mathcal{P}_{after}} \mathbb{E}^{\mathbb{P}} P_a = \mathbb{E}^{\mathbb{P}^{good}} P_a = 125 \tag{3}$$

$$\widetilde{P}_b|_{after} = \min_{\mathbb{P}\in\mathcal{P}_{after}} \mathbb{E}^{\mathbb{P}} P_b = \mathbb{E}^{\mathbb{P}^{bad}} P_b = 90 \tag{4}$$

and the bid-ask spread therefore increases from $\widetilde{P}_a|_{before} - \widetilde{P}_b|_{before} = 20$ to $\widetilde{P}_a|_{after} - \widetilde{P}_b|_{after} = 35$. The widening of the outside spread leads to a rotation of the bid and ask quote schedule of the dealer increasing observed bid-ask spreads. Importantly, I assume that uncertainty does not alter the mid-price, rather that it increases the spread symmetrically around the mid-price. Conversely, I assume that risk does not alter the bid-ask spread. So, if the event were to increase risk, a possible new probability distribution would assign a 50-50 chance for P_a (P_b) to be either 105 (95) or 115 (85), preserving the prior spread of 20. Therefore, within the Treynor model set-up, risk shifts both bid and ask schedules upwards or downwards depending on the new price (interest rate) that compensates for the change in risk. Clearly, most events are likely to shift both risk and uncertainty and thus be a mixture of the described effects. However, risk is assumed to systematically drive the mid-price (or the dealers' bid and ask schedules), uncertainty on the other hand is assumed to systematically widen and narrow the bid-ask spread. The outlined rationale is illustrated in figure 2. The first column visualizes the mechanics for a change in both risk and uncertainty (upper and lower panel respectively). The increase in risk shown in the upper panel of the left column shifts both ask and bid schedules down (as bond prices move inversely to interest rates). For comparison, the lower panel illustrates an increase in uncertainty in response to an event. Here we see the schedules *rotating* rather than shifting, which increases the wedge between bid and ask prices. The second column shows simulated quotes from the respective models before and after the event. Since dealers' quotes are observable, they can be used to compute changes in both risk and uncertainty.

Assumptions While this model serves as a motivating device, it points to the three assumptions underlying the identification in this paper. First, when risk and uncertainty are affected by an event, I assume that the change in mid-prices remains a reliable measure for the change in risk. This approach implicitly requires ambiguity to increase

Figure 2: Adjusted Treynor Model For ΔRisk / ΔUncertainty



Notes: The upper panel illustrates the change in risk for the competitive representative dealer. The dealer knows the new probabilities and therefore knows how the outside spread has shifted, moving her schedules along. The upper right panel illustrates corresponding simulated quotes. Likewise, the lower panel illustrates changes in ambiguity. A change in ambiguity induces the dealer to assume more pessimistic prices for both ask and bid quotes. Her bid and ask schedules therefore rotate to the right, leading to a higher bid-ask spread as illustrated in the lower right panel. They gray shaded areas point to the narrow time windows which are later constructed to record the respective changes for an event.

symmetrically around the unconditional expected price – at least on average. In contrast, Easley and O'Hara (2010) construct a model in which ambiguity increases bid-ask spreads, but compromises the mid-point as a reliable signal of the unconditional expected price. However, the authors consider extreme market events and more opaque securities, whereas I am here focusing on Italian sovereign debt and day-to-day political events. This assumption cannot be tested directly, but if the mid-price were severely compromised as a risk measure by uncertainty, the extracted risk shock series would be unlikely to produce meaningful results. As can be seen in section 4, the sovereign risk series is a relevant instrument and produces significant impulse response functions in line with the theoretical literature. Second, *ex-ante* I cannot rule out that risk also systematically alters the bid-ask-spread around events. In fact, in cross-section comparisons, riskier securities typically feature higher bid-ask spreads. However, this is different from the time dimension regarding *one* class of securities. The correlation between endogenous mid-prices and bid-ask spreads for Italian bonds over time for example is insignificant. If risk affected bid-ask spreads systematically, mid-price changes – reflecting risk – should correlate with changes in bid-ask-spreads. This hypothesis can easily be tested empirically after deriving the shock series. The correlation is insignificant, as will be seen below. Third, dealers need to be ambiguity-averse. While this assumption cannot be tested directly, section 4 will show that results are in line with theoretical considerations on ambiguity. This is taken as evidence supporting a sufficiently large degree of ambiguity aversion among dealers.

3.2 Uncertainty Shock Construction

The policy events that are used to identify the uncertainty shocks and the risk shocks are taken from Staffa (2022). The shock series is derived from the intraday news feed data set from Thomson Reuters and uses political summary news to trace out relevant political events for the case of Italy. Since the data include intraday timestamps, the stories can be timed and used within a high-frequency identification set-up in the tradition of the policy surprise literature following Kuttner (2001) or Gürkaynak et al. (2005). For more details on the construction of the event series, please refer to Staffa (2022). As explained earlier, the bond mid-price is used to capture risk. In the empirical application, possible changes in the safe rate are taken into account by including the change in mid-prices relative to German mid-prices. Specifically, changes in risk are calculated as

$$\begin{aligned}\Delta\sigma_\tau &= (\overline{P}^{mid,IT}_{\tau,after} - \overline{P}^{mid,DE}_{\tau,after}) - (\overline{P}^{mid,IT}_{\tau,before} - \overline{P}^{mid,DE}_{\tau,before}) \\ &= \Delta\overline{P}^{mid,IT}_{\tau} - \Delta\overline{P}^{mid,DE}_{\tau}, \end{aligned} \tag{5}$$

where $\overline{P}^{mid,c}_{\tau,before} = \sum_{t\in\mathcal{B}_\tau} P^{mid,c}_t / |\{P^{mid,c}_t | t \in \mathcal{B}_\tau\}|$ and $\overline{P}^{mid,c}_{\tau,after} = \sum_{t\in\mathcal{A}_\tau} B^{mid,c}_t / |\{P^{mid,c}_t | t \in \mathcal{A}_\tau\}|$ denote the mean mid-bond price quote in the ten-minute window before and after the adjustment period of ten minutes. $\mathcal{A}_\tau$ and $\mathcal{B}_\tau$ indicate the sets containing timestamps that fall into the window before and after the adjustment period, respectively.[2] The superscript $c \in \{IT, DE\}$ indicates Italian and German bonds. For the quotes to be sufficiently informative, I require a minimum liquidity of five quotes in the window before and after the adjustment period for means to be informative. Events that fall outside normal trading hours are excluded.

Uncertainty, on the other hand, is measured as the change in the bid-ask spread around a policy event. Other specifications are the same as those used for the calculation of risk. The average bid-ask spread in the ten minutes before the adjustment period is subtracted from the average bid-ask spread in the 10 minutes after the adjustment period. More formally, the change in uncertainty around an event is computed as

$$\begin{aligned}\Delta\varrho_\tau &= \left(\overline{P}^{ask}_{\tau,after} - \overline{P}^{bid}_{\tau,after}\right) - \left(\overline{P}^{ask}_{\tau,before} - \overline{P}^{bid}_{\tau,before}\right) \\ &= \Delta\overline{P}^{ask}_{\tau} - \Delta\overline{P}^{bid}_{\tau}, \end{aligned} \tag{6}$$

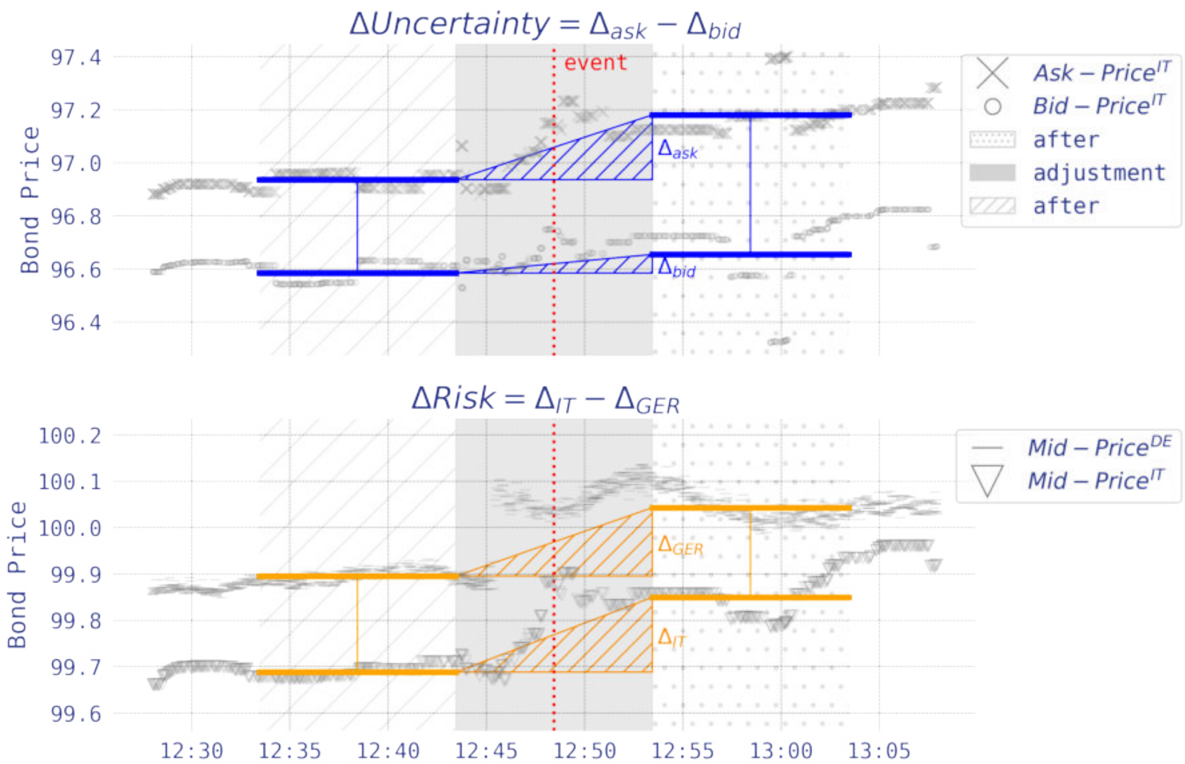
$\overline{P}^{j}_{\tau,before} = \sum_{t\in\mathcal{B}_\tau} P^j_t / |\{P^j_t | t \in \mathcal{B}_\tau\}|$ and $\overline{P}^{j}_{\tau,after} = \sum_{t\in\mathcal{A}_\tau} P^j_t / |\{P^j_t | t \in \mathcal{A}_\tau\}|$ equals the average bid and ask prices in the ten-minute window before and after the adjustment period. The superscript $j \in \{bid, ask\}$ denotes either bid or ask prices. Note the possibly confusing scaling of the two measures. While uncertainty is based on the positively defined bid-ask spread, meaning an increase in ϱ corresponds to an increase in uncertainty, risk is derived from changes in mid-prices and an increase in σ corresponds to higher relative Italian bond prices and consequently to a reduction in risk.

The calculation for both measures is illustrated for a sample event in figure 3 with the story ID "nR1E7LJ00K". This event captures an announcement by Silvio Berlusconi, then the prime minister of Italy, at a G20 meeting that he plans to call a confidence vote in order to pass certain legislation that he and his cabinet had agreed on. The upper panel visualizes how this information changed ambiguity, as calculated by a change in the bid-ask spread for Italian bonds with constant maturity of three years. The lower panel shows the change in risk as computed by the change in Italian mid-bond prices relative to the safe asset, German bonds of the same maturity. While interpreting these movements is speculative, the prospect of a confidence vote appears to have increased the bid-ask spread. Possibly, liquidity trading dealers guarded against traders with more insights trading against them and therefore increased their quoted spread. In is interesting to note that risk hardly budged in the wake of the event.

Having computed the changes in uncertainty, events can be sorted according to the changes they have induced in the bid-ask spread (uncertainty). Table 1 displays the 10 largest absolute shocks to uncertainty, as measured by the change in bid-ask spreads. A first thing to note is that, there are more adverse than favorable shocks among the top ten. In other words, uncertainty widens more often than it is reduced in the face of the

[2] $\mathcal{B}_\tau = \{t | t \in [\tau - 15\text{min}, \tau - 5\text{min}]\}$, $\mathcal{A}_\tau = \{t | t \in [\tau + 5\text{min}, \tau + 15\text{min}]\}$.

Figure 3: Visualization Risk vs. Uncertainty Measurement



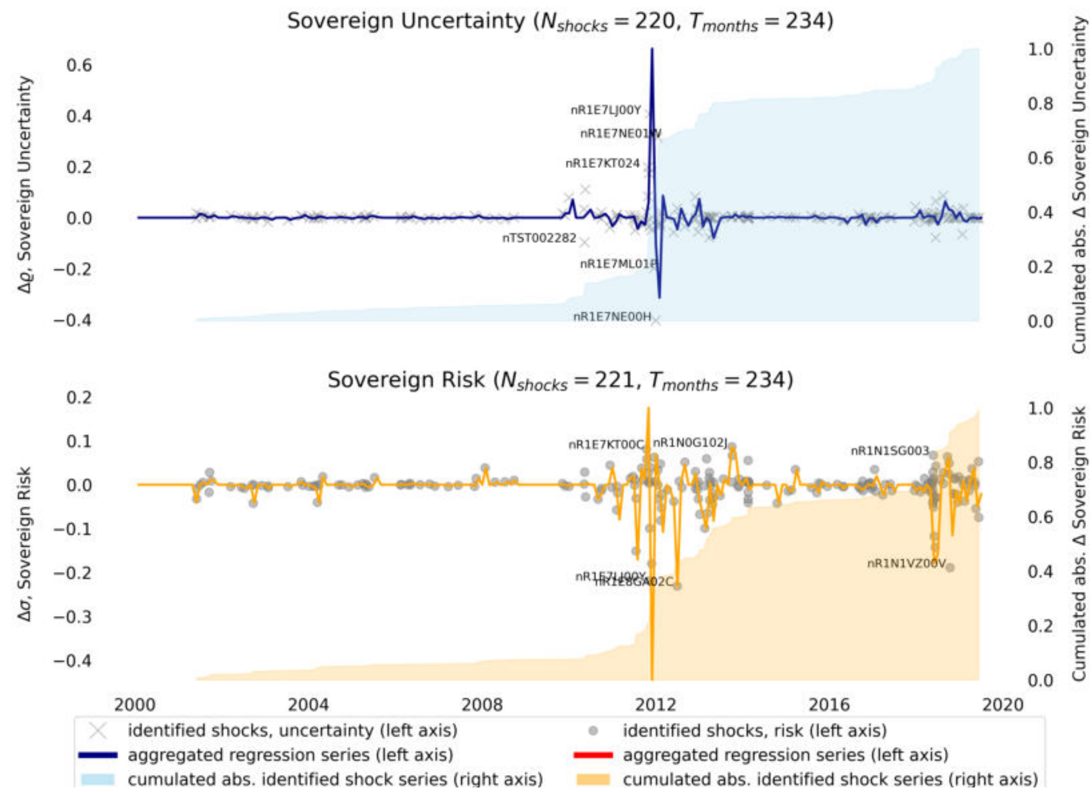
Notes: Respective measures computed as the change in bid-ask spread and the change in the difference of Italian and German bond price for the event "nR1E7LJ00K". We can see that risk as measured by the relative change of mid-bond prices around the event relative to Germany, whereas the bid-ask spread widens in light of the new information.

Table 1: 11 Largest Absolute Uncertainty Shocks

Timestamp (CET)	Story-ID	First Headline	$\Delta\varrho$	$\Delta\sigma$
2011-11-17 16:34	nF9E7JH01K	IIF'S DALLARA - ALL PARTIES INVOLVED NEED TO CONTRIBUTE TO GREEK DEBT SOLUTION	1.19	0.01
2011-11-07 12:58	nR1E7LJ00Y	ITALY'S BERLUSCONI SAYS RUMOURS OF HIS RESIGNATION UNFOUNDED-ANSA NEWS AGENCY	0.41	-0.22
2011-12-29 13:16	nR1E7NE00H	ITALY'S MONTI SAYS WILL MEET WITH UK'S CAMERON, GERMANY'S MERKEL IN JANUARY	-0.40	0.01
2012-01-16 17:37	nR1E7NE01W	ITALY ENVIRONMENT MINISTER SAYS TO DECLARE STATE OF EMERGENCY OVER CRUISE LINER DISASTER, MOVE WILL RELEASE SPECIAL FUNDS	0.31	-0.00
2011-12-16 13:07	nR1E7ML01P	ITALY GOVERNMENT WINS CONFIDENCE VOTE IN LOWER HOUSE ON AUSTERITY MEASURES, PACKAGE MOVES TO SENATE	-0.20	0.06
2011-10-25 12:10	nR1E7KT024	ITALIAN PRESIDENT NAPOLITANO SAYS MUST DO EVERYTHING TO REDUCE RISK TO GOVERNMENT BONDS, NEED CREDIBLE COMMITMENTS TO CUT DEBT, BOOST GROWTH	0.20	0.03
2011-11-03 13:48	nR1E7LJ00K	ITALY'S BERLUSCONI TOLD EUROPEAN G20 PARTNERS HE WILL HOLD CONFIDENCE VOTES ON BUDGET MEASURES DECIDED BY CABINET WEDNESDAY -SOURCE	0.17	0.00
2010-05-17 17:36	nWEA2613_split0	ROME-ARGENTINE ECONOMY MIN SAYS ECONOMY WILL GROW MORE THAN FIVE PERCENT IN 2010	0.11	-0.03
2010-05-10 13:22	nTST002282	ITALY LIKELY TO APPROVE 2011-12 BUDGET CORRECTION MEASURES BY JUNE TO REASSURE MKTS-SOURCE	-0.10	0.03
2018-08-14 17:23	nL5N1V570H	RPT-AUTOSTRADE DIRECTOR FOR GENOA AREA SAYS COLLAPSED BRIDGE WAS CONSTANTLY MONITORED BEYOND LEGAL REQUIREMENTS	0.09	0.03
2011-10-25 12:17	nR1E7KT025	ITALIAN NORTHERN LEAGUE LEADER BOSSI SAYS GOVT AT RISK OVER REFORMS, ALTERNATIVE IS NEW ELECTION	0.08	0.01

Notes: Computation of $\Delta\varrho$ is based on Italian bond prices with remaining maturity of three years. To see the absolute largest 20 shocks in the uncertainty measure go to table A1. Note that the shock pertaining to the event with ID "nF9E7JH01K" is removed as an outlier.

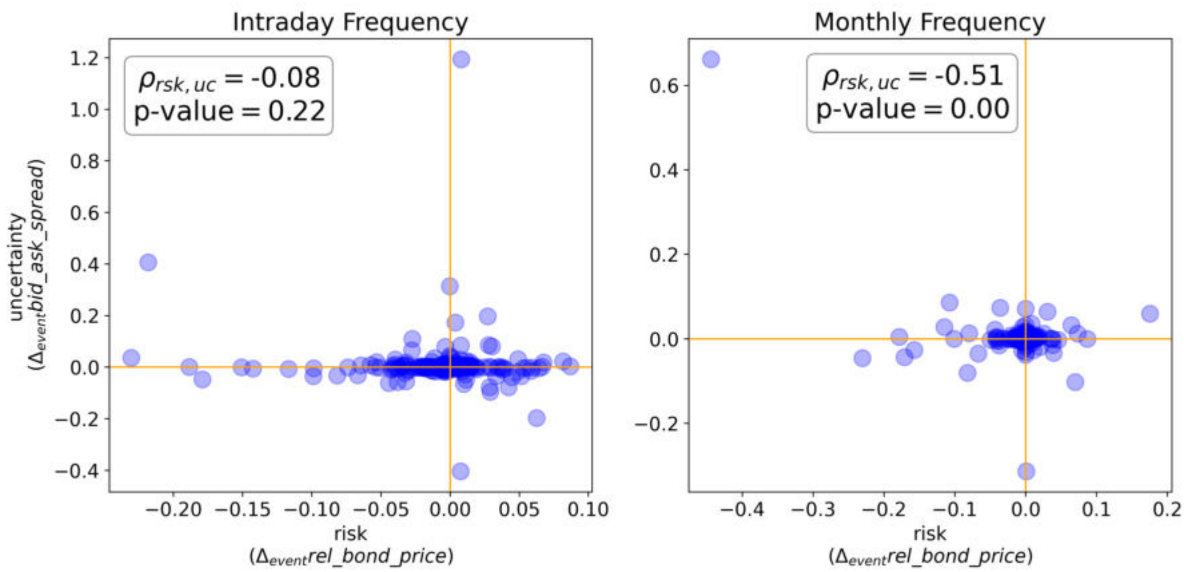
Figure 4: Shock Time Series



Notes: Time series plots for both the risk series from Staffa (2022) and the uncertainty series.

derived news events. This mirrors the findings for the sovereign risk series constructed in Staffa (2022). In contrast to the sovereign risk shock series, the uncertainty shock series contains a salient outlier, which is removed from the shock series.[3] Generally, the data can be seen to be noisy. The news item with ID "nWEA2613_split0" in table 1 does not represent Italian political news. Consequently, the series is not interpreted as a pure shock series but rather as an instrument in the regression analysis, as advised by Stock and Watson (2018). Lastly, the dates of the largest shocks as shown in table 1 indicate another characteristic of the obtained series: that most of the variation occurred during the Euro Crisis. This finding is confirmed by inspection of the entire time series for both instruments in figure 4. While there is some variation in uncertainty after 2017, these fluctuations are relatively minor. To a lesser degree, the constructed risk measure displays the same concentration of variations. In fact, the two measures appear to fluctuate in proximity to each other. This observation is important, since the degree of correlation between the two measures determines how well their respective effects can be distinguished in the regression analysis. To drill down on this question, figure 5 plots the

FIGURE 5: CROSS PLOT OF HIGH FREQUENCY RISK AND UNCERTAINTY SHOCKS



Notes: Recording the change in the Italian bid-ask spread for the events derived in Staffa (2022) and plotting them against the sovereign risk shocks, as measured by the change in mid-prices around the events for both intraday (left panel) and monthly (right panel) frequency.

two series against each other for intraday and monthly frequencies. Two observations

[3]This large change in the bid-ask spread was caused by comments of Charles Dallara, then the managing director of the Institute of International Finance (IIF), which had an important role in devising policy responses to the euro area crisis (for example the private sector involvement). This shock is a supranational shock that potentially correlates with monetary policy. It is excluded from the uncertainty series.

stand out. First, there is no significant correlation between the two measures at a high-frequency level, which supports the proposed identification strategy as outlined in the previous subsection. Second, upon monthly aggregation, the correlation becomes significant. Note that the risk measure is derived from bond prices and positive values indicate a decrease in risk. Therefore, the negative correlation coefficient indicates a positive relation between risk and uncertainty. This correlation at lower frequencies needs to be accounted for when distinguishing effects from risk vs. uncertainty in the regression analysis described in the next section.

4 Dynamic Effects of Uncertainty vs. Risk

To trace out the dynamic effects of uncertainty and contrast it with sovereign risk, I use local projections (LP) following Jordà and Taylor (2016). Since the uncertainty and risk series have been shown to suffer from measurement error, being derived from a big data source, the series are treated as instruments for the true shock and causal effects are estimated using instrumental variable local projections (LP-IV). This procedure aids in cleaning the instrument and reduces the confounding effects of the noise contained in the series, as advised by Stock and Watson (2018). I instrument uncertainty as measured by the median monthly bid-ask spread for an Italian bond with three year maturity with the derived uncertainty shock series. Risk is measured as the corresponding yield on Italian bonds of the same maturity and instrumented with the sovereign risk series. In a dynamic setting, the instruments need to fulfill three criteria. First, they must correlate with the true shocks, i.e. they must be relevant. Second, they must not correlate with other structural shocks in the system, the counterpart to the exogeneity assumption in cross-sectional IV regressions. Third, due to the dynamic nature of the LP regression, instruments need to be uncorrelated with all leads and lags of all structural shocks in the system. If the latter requirement were violated, then estimation of impulse response functions could be compromised as the coefficients potentially pick up effects of other structural shocks.

The first requirement of instrument relevance is evaluated using the Olea and Pflueger (2013) effective F-statistic. The effective F-statistic accounts for the nature of the LP-IV residuals which are autocorrelated and likely heteroskedastic. In general, high values of the effective F-statistic correspond to a stronger instrument. The rule of thumb value proposed by Olea and Pflueger is to reject the null hypothesis of a weak instrument, when the F-statistic exceeds a value of 23.1. Less strict but not grounded in theory, Andrews et al. (2019) use simulated data and find that an effective F-statistic of above 10 seems indicative of a strong instrument. The second requirement of exogeneity is ensured by a timing restriction. Due to the narrowly chosen time windows used to calculate changes in risk and uncertainty associated with the events, it is unlikely that other structural shocks fall within those time windows. Upon aggregation to monthly frequency, figure 5 shows that the shocks to sovereign risk and uncertainty become correlated. To address this, I purge the uncertainty instrument of influence from risk before using it within the regression as explained below. There could also be correlation with other structural shocks at the monthly level. While shocks to slower moving macro variables are less of a concern, monetary policy could react to changes in sovereign risk and uncertainty at an intraday level and therefore correlate at monthly frequency. To avoid confounding effects of monetary policy with sovereign risk and uncertainty, I use monetary policy shocks in the euro area from the database developed in Altavilla et al. (2019) and check for correlation with the instrument series. Lastly, following advice by Stock and Watson (2018), I add lags of the instruments to reduce the risk of violating the lead-lag exogeneity. The LP-IV is estimated using monthly data and instruments are therefore aggregated to monthly sums. The aggregated series of sovereign risk is denoted as z_t^{rsk}. The raw uncertainty series (unadjusted for the impact of risk) is denoted with z_t^{uc}. To purge the impact of risk from z_t^{uc}, I run the auxiliary regression

$$z_t^{uc} = \alpha + \gamma z_t^{rsk} + \omega_t \tag{St0}$$

and set the cleaned uncertainty series, $z_t^{\widetilde{uc}}$, equal to the estimated residuals $z_t^{\widetilde{uc}} = \widehat{\omega}_t$. The cleaning implicitly assumes that sovereign risk is the dominant shock and potentially weakens the uncertainty instrument. This approach was chosen to produce a conservative estimate of the effects of uncertainty despite the high correlation at monthly frequency with the risk series. Note that running regression equation (St0) on the full sample makes slightly more efficient use of the data compared to merely including the risk instrument into the set of control variables in the dynamic estimation. As a precautionary measure, I check for correlation with the Altavilla et al.-monetary policy shock series. Table A2 contains the correlation coefficients of the respective instrument series with the monetary policy shocks. All correlations are small and insignificant, supporting the exogeneity assumption underpinning the LP-IV approach.

The standard steps of a two-stage-least squares LP-IV estimation follow. In the first stage, controls and the respective instrument are projected onto the endogenous variables

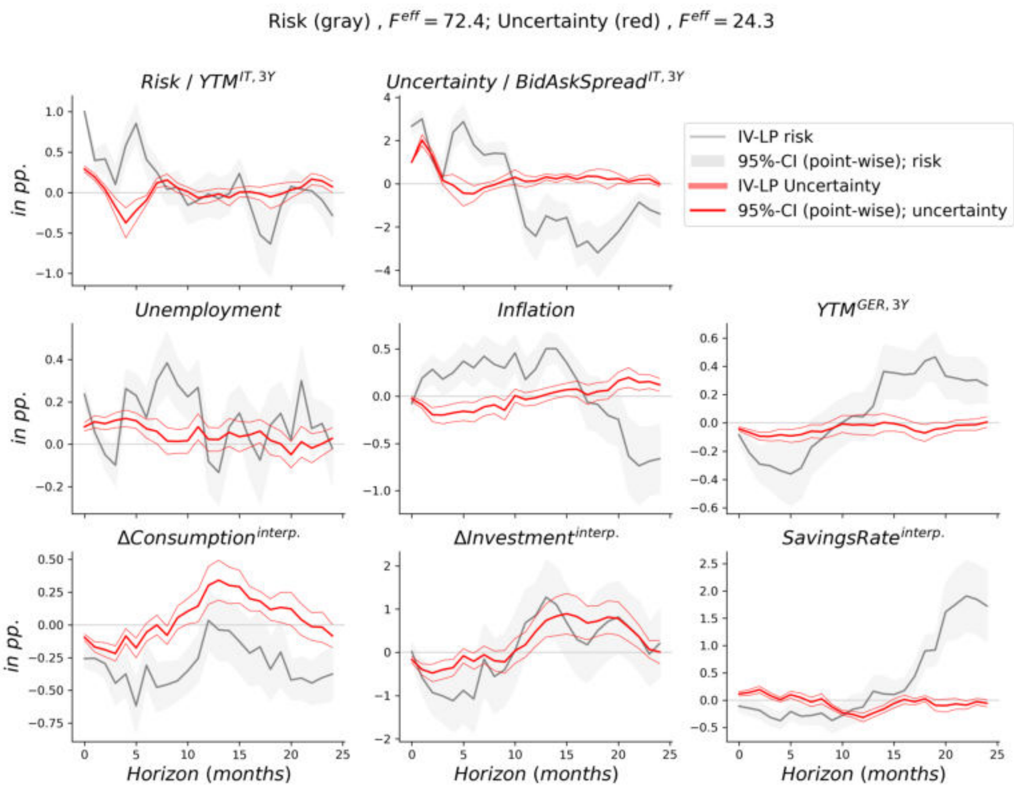
$$endog_t^j = \delta_0 + z_t^j \theta^j + \boldsymbol{\gamma}^j \boldsymbol{x}_t + \epsilon_t^j, \tag{St1}$$

where $j \in \{rsk, \widetilde{uc}\}$ denotes risk, uncertainty and cleaned uncertainty. The variable $endog_t^{rsk}$ is the Italian three-year bond yield and $endog_t^{\widetilde{uc}}$ corresponds to the median monthly bid-ask spread. Moreover, ϵ_t^j is a random error and $\boldsymbol{x}_t$ is a vector of control variables. Impulse response functions are estimated in the second stage according to

$$y_{t+h}^j = \alpha_h^j + \beta_h^j \widehat{endog_t^j} + \boldsymbol{\phi}^j \boldsymbol{x}_t + u_{t+h}^j, \quad h = 0, ..., H-1 \tag{St2}$$

where α_h^j denotes the respective constant, β_h^j the dynamic coefficients, u_{t+h}^j is an error term and h marks the propagation horizons. The lags of all system variables are included in $\boldsymbol{x}_t$, namely Italian three-year bond yields, monthly median bid-ask spreads for Italian bonds with constant three year maturity[4], unemployment rate, inflation measured as year-on-year log growth in the Harmonized Index of Consumer Prices (HICP), German yields of constant three-year maturity, year-on-year log growth in consumption expenditures and investment as measured by gross capital formation and the savings rate. The vector of controls $\boldsymbol{x}_t$ also contains lags of the respective instruments to mitigate risks of a violated lead-lag exogeneity assumption. Unfortunately, consumption, investment and the private savings rate are not available on a monthly frequency for Italy, they are therefore interpolated using the Chow and Lin-method for temporal disaggregation. For more information on the regression variables used, please refer to table A3 in the appendix.

Figure 6: Impulse Response Functions (Benchmark)



Notes: Impulse response functions from the LP-IV regression as specified in equations (St0), (St1) and (St2). The lag order $p = 3$ is chosen by AICc criterion. The reported F-statistics denote the Olea and Pflueger (2013) effective F-statistics. The underlying data covers the period from 2001 to June 2019.

The impulse response functions from the LP-IV regression are depicted in figure 6. A

[4] The bid-ask spread is scaled such that it corresponds to an increase of roughly one percentage point in an approximated bid-ask yield spread for better comparison to the risk shock. Scaling is achieved by approximating the bid-ask spread to yield-to-maturity percentage points, estimating the LP-IV regression and matching the resulting impact effect of uncertainty on the endogenous risk measure.

first glance at the impulse response functions reveals the interdependency between risk and uncertainty. Upon an exogenous increase in either risk or uncertainty the impact effects on the respective other endogenous measure is strong and positive. So, an increase in risk drives up uncertainty and *vice versa*. This finding is in line with the literature (e.g. Stock and Watson (2012)). Interestingly, it appears that risk impacts uncertainty more strongly than uncertainty impacts risk. When risk increases, uncertainty shoots up by more than proportionately. An increase in uncertainty, however, elicits only a partial response in risk. This could point to dealers hedging strongly against increases in risk by raising bid-ask spreads, but conversely, they may widen the spread because of a loss in confidence without moving the mid-price. The sample feed "nR1E7LJ00K" discussed in the previous section could be taken as anecdotal evidence here. The Italian prime minister's announcement of his intention to call a confidence vote did not provide further information on the planned reforms and possible concessions, but perhaps increased the imponderables – widening the set of beliefs.

In accordance with existing literature, the effects of risk and uncertainty as documented by the IRF's in figure 6 are similar in many respects. Increases in either measure weigh on economic activity by reducing consumption and investment. Also, the shapes of the responses suggest similar dynamics. Both investment and consumption decline for some months, bouncing back once the endogenous measures have levelled out. However, the recovery is more pronounced for the uncertainty shock. This result seems plausible. Both risk and uncertainty guide intertemporal decision-making (cf. Ilut and Schneider (2014)). When overall risk increases, fewer projects are worth executing and investment declines. When ambiguity increases, economic agents take a more pessimistic view on the success of projects, resulting in fewer projects being accepted and executed. Generally, uncertainty dissipates somewhat faster than risk, which may drive the more pronounced bounce backs in consumption and investment.

Likewise, both risk and uncertainty cause negative employment effects. This goes hand in hand with subdued economic activity. Theoretically, risk and uncertainty have different implications on labor market dynamics. Nishimura and Ozaki (2004) for example incorporate ambiguity into a labor search model and find that, unlike risk, uncertainty results in agents reducing search time and lowering their reservation wage. This is because uncertainty reduces workers' confidence regarding the wage distribution, while risk – modelled as an increase in the mean-preserving spread of the wage distribution – increases the reservation wage (Nishimura and Ozaki; 2004; Rothschild and Stiglitz; 1971; Rothschild et al.; 1970). The concept of risk used is not the same, and sovereign risk induced changes in the wage distribution are probably not mean-preserving, however, aggregate labor market dynamics might still be different. To investigate this question, I include the nominal year-on-year log growth into wage rates in the regression. The corresponding IRF's are shown in figure A1 in the appendix. While the regression set-up cannot discriminate between different search behavior, it might still provide cues as to differences in dynamics. At first sight, one could argue that the stagnant and negative wage growth rates in response to an increase in uncertainty point to relatively more wage restraint when compared to the responses induced by an increase in sovereign risk. However, given the increase in inflation in response to sovereign risk, real wages are much lower for the risk case. Indeed, nominal wage rates rather track labor market development as depicted for the response in unemployment. This result echoes findings in the literature, such as Adamopoulou and Villanueva (2020), which document Italian wages to mirror labor market conditions. The authors also find that collective bargaining agreements have a limited effect on wage development in Italy. This underscores the hypothesis that the observed pattern in wages largely reflect labor market dynamics as captured by the unemployment rate.

Both risk and uncertainty lower German yields-to-maturity. Analogously to consumption and investment, the dynamic responses of German yields to a sovereign risk shock are relatively more pronounced when compared to the counterparts for uncertainty. This pattern could be driven by portfolio adjustments in response to higher Italian sovereign risk and uncertainty. Due to the large size of the Italian sovereign debt market, a one-percentage point increase in sovereign risk raises demand for the safe asset. Uncertainty on the other hand does not evoke such strong reactions, in line with the notion that risk creates trades while uncertainty reduces trading (Easley and O'Hara; 2010).

Interestingly, responses for inflation differ. While risk increases inflation, in accordance with the fiscal theory of the price level, an increase in uncertainty lowers inflation. Higher sovereign risk results in heavier discounting of future primary surpluses, necessitating an increase in the price level to equate the outstanding real value of government debt with the present value of primary surpluses. However, inflation is suppressed in response to an exogenous rise in uncertainty. This could reflect a loss in confidence by firms in their ability to correctly estimate the price elasticity of demand facing them (cf. Ilut et al. (2020)). Naturally, there is less uncertainty surrounding past and current prices, which then become reference points for firms. If a sufficiently large fraction of firms behaves accordingly in response to an increase in uncertainty, this would be expected to result in a lower inflation rate.

The response functions for the savings rate fit the inflation picture, showing slightly different trajectories for a risk vs. an uncertainty shock. The savings rate declines immediately when risk increases and slightly increases in response to an increase in uncertainty. Given the similar dynamics in real consumption and employment, the sharper decline in savings for the sovereign risk case could reflect higher prices denting households' budgets, thereby reducing savings. Conversely, without increases in prices, the strengthened precautionary motive induced by uncertainty causes the savings rate to rise. The sharp increase in the savings rate in the second year after a sovereign risk shock coincides with reversal in inflation. This underscores the role of prices for equilibrium savings rates.

5 Sensitivity Analysis

Within this section, I explore the robustness of the results obtained. First, I investigate whether shocks could be explained by past economic and financial conditions. If the derived political events were in fact driven by broader economic conditions, then exogeneity may not hold despite the reliance on very narrow time windows in deriving the shock series. In fact, Bachmann et al. (2013) argue that uncertainty is just a concomitant of unfavorable economic conditions, rather than a driver in its own right. Second, I investigate the results' sensitivity to inclusion of monetary policy using the shadow rate from Krippner (2013). Third, I explore dependence of the results on the choice of the length of the time window. Fourth, I use the derived uncertainty instrument and estimate the model without a first stage – inserting the derived instrument directly into the regression equation. This exercise gives an idea of the noise in the data. Lastly, I estimate the regression model without the auxiliary regression (St0) and compare results.

Table 2: Granger Causality Test

	Risk	Uncertainty	Uncertainty (benchmark)
F^{rob}-statistic	1.16	0.52	0.31
p-value	0.28	0.98	1.00

Notes: Granger causality test running regression (7) for the variables included in the benchmark specification from figure 6.

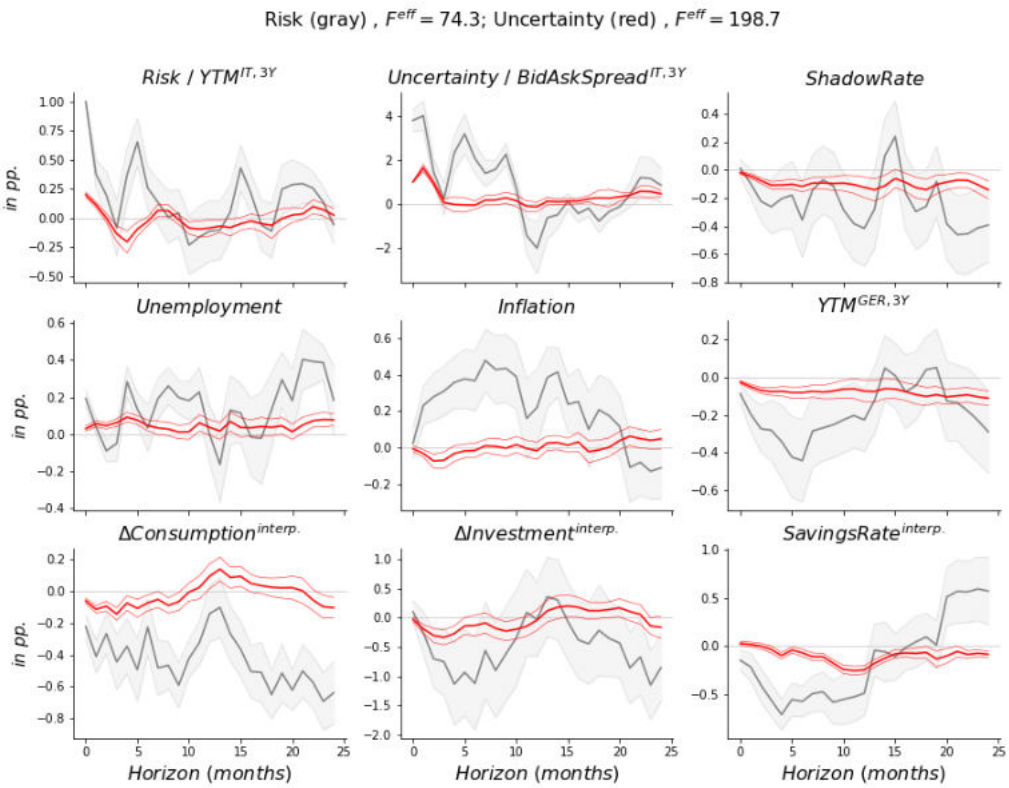
(1) Exogeneity w.r.t. Economic Conditions A critical question with respect to the identification of effects from both risk and uncertainty concerns the dependence of the political process on broader economic conditions and / or the dependence of markets' sensitivity to the political process conditional on broader economic conditions. What if economic and financial circumstances were making politicians more prone to missteps, or what if markets were more sensitive to political turmoil depending on broader economic conditions? If the shocks used in this paper were the result of increased political pressure due to deteriorating economic conditions or if markets' sensitivity to politics were endogenous to economic conditions, then even very narrow time windows to isolate variations in bond prices possibly fall foul of exogeneity as they still vary systematically with the system variables. If this concern were valid for the derived shock series, economic conditions should possess some explanatory power with respect to the instrument series. While this proposition cannot be tested contemporaneously, it can be tested for past economic conditions up to $t-1$. More specifically, I can test whether the vector of controls $\boldsymbol{x}_t$ (Granger)-causes the shock series $z_t^j | j \in \{rsk, uc, \widetilde{uc}\}$. If broader conditions drove the size of the shocks, then one should expect the vector of controls $\boldsymbol{x}_t$ to contain information on the shocks, as well. To test this, I run the regression equation

$$z_t^j = constant^j + \boldsymbol{\varphi}^j \boldsymbol{x}_t + \zeta_t^j \tag{7}$$

where $j \in \{rsk, uc, \widetilde{uc}\}$, $\boldsymbol{\varphi}^j$ denotes the vector of coefficients on controls (including the instruments' own lags analogous to the regression set-up). Results of the regression are shown in table 2. For all instruments, the hypothesis of $\boldsymbol{x}_t$ Granger-causing $z_t^j | j \in \{rsk, uc, \widetilde{uc}\}$ must be rejected based on the data. This does not imply that political pressure does not mount when economic conditions deteriorate or that the markets' sensitivity is independent of crises and business cycle dynamics. However, the concern regarding the exogeneity of the events derived in this paper is not supported by the data.

(2) Monetary Policy Another interesting question with respect to the results concerns the role of monetary policy. How does monetary policy react to both a change in sovereign risk and uncertainty? This question seems particularly relevant because the inflation responses to sovereign risk and uncertainty are different. To address this

Figure 7: Impulse Response Functions



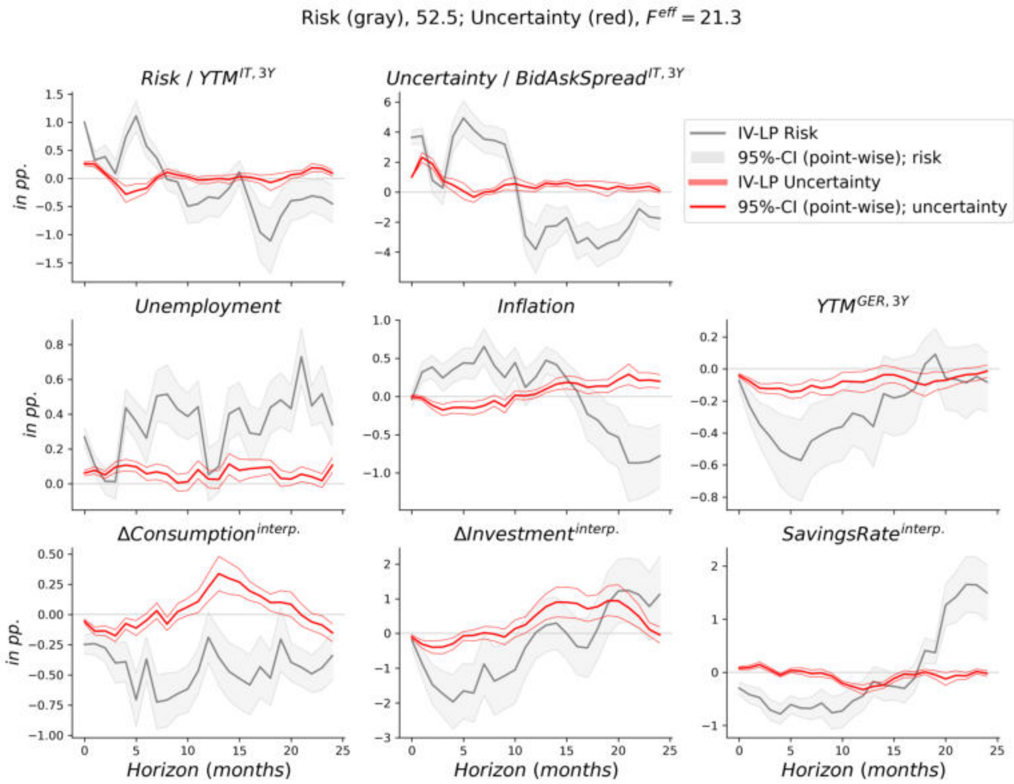
Notes: Impulse response functions from the LP-IV regression as specified in equations (St1) and (St2). The lag order $p = 2$ is chosen by AICc criterion. The reported F-statistics denote the Olea and Pflueger (2013) effective F-statistics. The underlying data covers the period from 2001 to June 2019.

question, the Krippner-rates are included in the benchmark regression. Corresponding

IRF's are shown in figure 7. Including the shadow rate into the regression does not alter results. On the contrary, while results remain stable, monetary policy appears to pin down unexplained variation in the model and effective F-statistics for both risk and uncertainty increase markedly. In response to a sovereign risk shock, the shadow rate decreases slightly but remains largely flat. This finding seems at odds with the concomitant increases in inflation, which should rather lead to an increase in the shadow rate. However, the finding is in accordance with earlier work von Schweinitz and Staffa (2023) and reflects Italy's membership in the euro currency union, which entails that the monetary authority, the European Central Bank, has to safeguard price stability in the entire euro area, leaving less room to react to national inflation tendencies (see also Mody (2018)). Interestingly, the effect of uncertainty on the shadow rate is consistent and significantly negative across all horizons. Taking into account that both shocks are scaled such that they represent (approximately) a one percentage point increase in yields and the yield bid-ask-spread respectively, it is surprising that the shadow rate reacts relatively strongly to uncertainty. For the other system variables, responses to uncertainty tend be dampened versions of responses to risk (except for the case of inflation case). The current set-up only allows me to speculate about the reasons, but a reasonable candidate explanation ties back to the dealers. Dealers typically operate internationally and trade in more than one country's government bonds. If their confidence for pricing Italian bonds—which represents one of the largest government bond markets in Europe—deteriorates, this may have ramifications beyond Italian borders. This international dimension might then cause a relatively more pronounced reaction from the ECB when compared to sovereign risk.

(3) Size of Time Windows To construct the shock series, Italian political events are derived and associated bond market movements are captured by constructing narrow time windows around the materialization time of the respective event. The preceding section has outlined the procedure and the benchmark specification uses time windows of ten minutes before and after the adjustment time (cf. equation 5 and (6)). The choice of a ten-minute time window to construct the means is to a degree arbitrary. For comparison, the underlying shocks used to construct the IRF's shown in figure 8 are instead derived on 20-minute windows before and after the adjustment time of 10 minutes. It can be seen that results are robust when extending the window size to 20 minutes. However, as expected the instruments lose some of their edge and become noisier. This is documented by the reduction in effective F-statistics. As a consequence, the effective F-statistic for the uncertainty instrument no longer exceeds the rule-of-thumb-value of 23.1 from Olea and Pflueger (2013). It is however still close and comfortably above the simulation-based threshold of 10, proposed in Andrews et al. (2019). When the window size is increased even further to 30 minutes – corresponding IRF's can be found in figure A3 in the appendix – the value for the effective F-statistic for uncertainty drops below 10.

Figure 8: Impulse Response Functions (Window Size 20Min)



Notes: Impulse response functions from the LP-IV regression as specified in equations (St1) and (St2). The lag order $p = 3$ is chosen by AICc criterion. The reported F-statistics denote the Olea and Pflueger (2013) effective F-statistics. The underlying data covers the period from 2001 to June 2019.

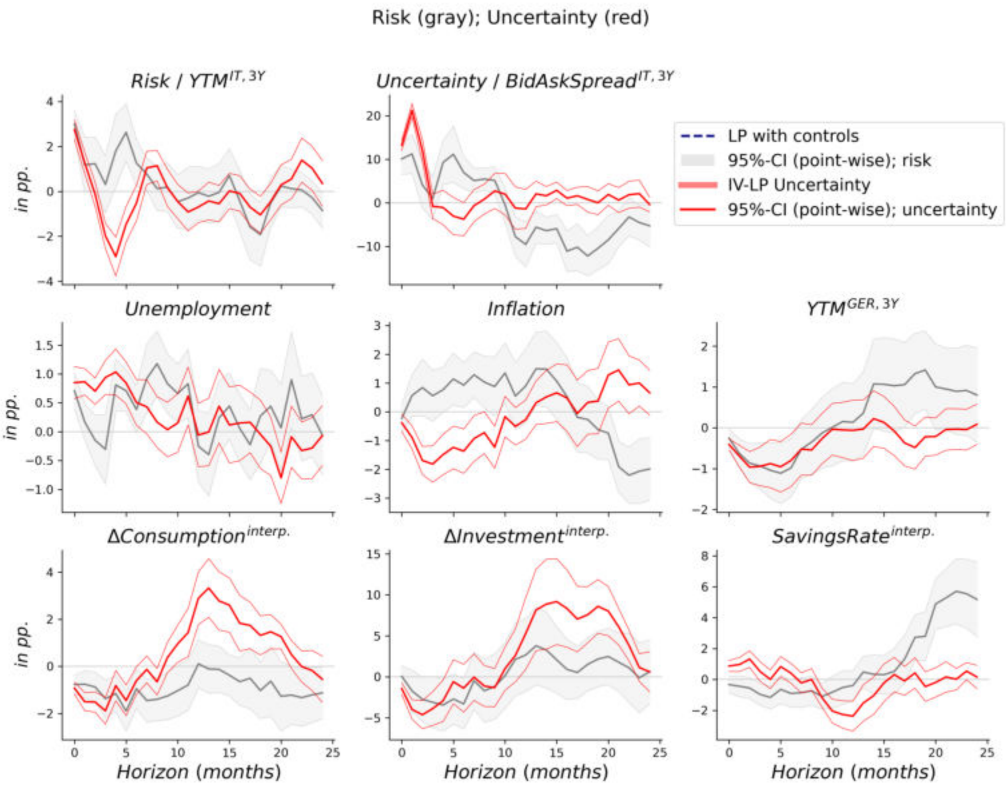
At the same time, and confirming the findings of Staffa (2022), the sovereign risk shocks remain relevant for the case of 30 minute windows.

(4) Shock-only Regressions Running a first stage regression as specified in equation (St1) also serves to reduce the noise in the instrument (cf. Stock and Watson (2018)). Conversely, I can obtain an impression of the scale of the measurement error contained in each instrument by projecting the system variables directly onto the instruments and controls. The corresponding regression equation reads

$$y_{t+h} = \nu_h^j + \overline{\beta}_h^j z_t^j + \boldsymbol{\psi}^j \boldsymbol{x}_t + \zeta_{t+h}^{j,h}, \quad h = 0, 1, \ldots, H-1. \tag{8}$$

where $j \in \{rsk, \widetilde{uc}\}$ and $\overline{\beta}$ denotes the dynamic coefficients from the LP estimated without two stage estimation. The variable ν_h^j denotes the constant and $\zeta_{t+h}^{j,h}$ a serially correlated error term. Corresponding IRF's are displayed in figure 9. Note that the

FIGURE 9: IMPULSE RESPONSE FUNCTIONS (LP ONLY)



Notes: Impulse response functions from the LP-IV regression as specified in equations (St1) and (St2). The lag order $p = 3$ is chosen by AICc criterion. The reported F-statistics denote the Olea and Pflueger (2013) effective F-statistics. The underlying data covers the period from 2001 to June 2019. Note that the sovereign risk instrument is multiplied by negative one. Otherwise, the functions would be flipped due to the logic of bond prices moving opposite to yields.

sovereign risk instrument is multiplied by negative one such that an increase in the instrument refers to an increase in sovereign risk. The original instrument series derived from bond prices follows the opposite logic. While confidence bands widen as expected and scales change, IRF's remain qualitatively robust to using regression equation 8. Note that the scale of the two shocks is no longer comparable in size due to the construction based on Italian and German bond prices and the bid-ask spread based on Italian bond prices only.

(5) No cleaning of uncertainty When estimating the model without cleaning the uncertainty instrument, results remain qualitatively similar – IRF's are shown in figure A2. Note however, that partialling out the impact of risk drastically reduces the F-statistic for the uncertainty regression. This finding is intuitively plausible considering the strong linear correlation between the two monthly series and therefore the implied reduction in variation in the uncertainty instrument when running equation (St0).

6 Conclusion

Against the backdrop of the ambiguity literature, this paper motivates changes in the bid-ask spread in the government bond dealer market as a measure of political uncertainty. The measure enables direct comparison to a standard risk metric, and it is shown that on an intraday frequency, these risk and uncertainty measures are uncorrelated. This finding underscores the concept that uncertainty as represented by the bid-ask spread measures something different from risk, namely agents' confidence in their assessments. Indeed, the endogenous measures for bid-ask-spreads and bond mid-prices are also uncorrelated. The paper thus provides evidence supporting the notion that confidence can move independently of risk and that uncertainty is not merely a concomitant of bad economic times, as suggested for example by Bachmann et al. (2013). Since aggregation to a monthly level yields significantly correlated instrument series, a conservative approach is employed to evaluate the effects of uncertainty. The regression results confirm that even upon eliminating the influence of the risk series, political uncertainty wields a significant impact on economic and financial variables. However, the effects observed for uncertainty and risk are broadly similar. This is in line with the literature, but echoes early critics of the concept of uncertainty, such as Arrow (1951), who argued that the distinction was not worthwhile making, since the effects mirror those of risk. In contrast to this critique, I find diverging responses for inflation. Whereas an increase in risk drives inflation in line with the fiscal theory of the price level (cf. Leeper (1991) and Cochrane (2021)), an increase in political uncertainty dampens inflation. This finding is in accordance with theoretical literature such as Ilut et al. (2020), positing that uncertainty creates kinks in the pricing schedules of firms at current prices. These kinks result from uncertainty with respect to the demand elasticity in either direction. Assessing either a price increase or a price decrease under ambiguity, firms assume relatively pessimistic demand elasticities to either side, resulting in aggregate price rigidity. This seems an interesting direction for future research. In particular, it seems promising to integrate micro evidence, such as firm surveys containing information on price setting and ambiguity.

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Appendix

Table A1: 20 Largest Absolute Uncertainty Shocks

Timestamp (CET)	Story-ID	First Headline	ChangeUC	$\Delta\sigma$
2011-11-17 16:34	nF9E7JH01K	*IIF'S DALLARA - ALL PARTIES INVOLVED NEED TO CONTRIBUTE TO GREEK DEBT SOLUTION*	*1.19*	0.01
2011-11-07 12:58	nR1E7LJ00Y	ITALY'S BERLUSCONI SAYS RUMOURS OF HIS RESIGNATION UNFOUNDED-ANSA NEWS AGENCY	0.41	-0.22
2011-12-29 13:16	nR1E7NE00H	ITALY'S MONTI SAYS WILL MEET WITH UK'S CAMERON, GERMANY'S MERKEL IN JANUARY	-0.40	0.01
2012-01-16 17:37	nR1E7NE01W	ITALY ENVIRONMENT MINISTER SAYS TO DECLARE STATE OF EMERGENCY OVER CRUISE LINER DISASTER, MOVE WILL RELEASE SPECIAL FUNDS	0.31	-0.00
2011-12-16 13:07	nR1E7ML01P	ITALY GOVERNMENT WINS CONFIDENCE VOTE IN LOWER HOUSE ON AUSTERITY MEASURES, PACKAGE MOVES TO SENATE	-0.20	0.06
2011-10-25 12:10	nR1E7KT024	ITALIAN PRESIDENT NAPOLITANO SAYS MUST DO EVERYTHING TO REDUCE RISK TO GOVERNMENT BONDS, NEED CREDIBLE COMMITMENTS TO CUT DEBT, BOOST GROWTH	0.20	0.03
2011-11-03 13:48	nR1E7LJ00K	ITALY'S BERLUSCONI TOLD EUROPEAN G20 PARTNERS HE WILL HOLD CONFIDENCE VOTES ON BUDGET MEASURES DECIDED BY CABINET WEDNESDAY -SOURCE	0.17	0.00
2010-05-17 17:36	nWEA2613_split0	ROME-ARGENTINE ECONOMY MIN SAYS ECONOMY WILL GROW MORE THAN FIVE PERCENT IN 2010	0.11	-0.03
2010-05-10 13:22	nTST002282	ITALY LIKELY TO APPROVE 2011-12 BUDGET CORRECTION MEASURES BY JUNE TO REASSURE MKTS-SOURCE	-0.10	0.03
2018-08-14 17:23	nL5N1V570H	RPT-AUTOSTRADE DIRECTOR FOR GENOA AREA SAYS COLLAPSED BRIDGE WAS CONSTANTLY MONITORED BEYOND LEGAL REQUIREMENTS	0.09	0.03
2011-10-25 12:17	nR1E7KT025	ITALIAN NORTHERN LEAGUE LEADER BOSSI SAYS GOVT AT RISK OVER REFORMS, ALTERNATIVE IS NEW ELECTION	0.08	0.01
2012-11-26 17:43	nL5E8MQC3B	ITALIAN JUDGES ORDER FINISHED AND SEMI-FINISHED PRODUCT OF ILVA STEEL PLANT IN TARANTO TO BE SEIZED - OFFICIALS	0.08	0.03
2009-12-29 17:02	nSGE5BS0DK	AFGHAN SOLDIER KILLS U.S. SERVICEMAN, WOUNDS TWO ITALIANS IN SHOOTING ON BASE-AFGHAN ARMY OFFICIAL	0.08	0.00
2018-06-11 12:19	nL8N1TD2DE	U.N. REFUGEE AGENCY UNHCR CALLS FOR GOVERNMENTS TO ALLOW 629 MIGRANTS ON HUMANITARIAN SHIP AQUARIUS STRANDED OFF MALTA AND ITALY TO DISEMBARK	-0.08	0.04
2013-03-25 8:44	nR1N0C000Q	ITALY'S BERLUSCONI SAYS CENTRE-LEFT MUST OPEN TO COALITION WITH CENTRE-RIGHT OR ITALY MUST RETURN TO VOTE	-0.08	0.03
2019-01-23 8:15	nL8N1ZN17C	ITALY'S DEPUTY PM SALVINI SAYS HE DOES NOT FEAR THAT CLASH WITH FRANCE WILL EFFECT EFFORT TO SAVE ALITALIA	-0.07	0.01
2018-06-12 17:15	nR1N1SZ006	ITALY'S PM CONTE SAYS WILL NOT ACCEPT "HYPOCRITICAL LESSONS" FROM FRANCE OVER IMMIGRATION - STATEMENT	0.06	-0.03
2013-04-19 8:56	nL5N0D60PA	ITALY CENTRE-LEFT LEADER BERSANI PROPOSES FORMER PM ROMANO PRODI TO PARTY ELECTORS AS CANDIDATE FOR PRESIDENT-PARTY SOURCE	-0.06	-0.04
2012-05-29 9:03	nL5E8GT2F0	TREMOR FELT IN ITALY'S FINANCIAL CAPITAL MILAN FOLLOWING EARTHQUAKE IN PAST WEEK	-0.06	-0.04
2012-12-21 14:05	nL5E8NL6C3	ITALY PM MONTI EXPECTED TO RESIGN LATER ON FRIDAY - POLITICAL SOURCES	-0.05	-0.03
2011-07-08 13:10	nR1E7HD02J	ITALY PM BERLUSCONI SAYS ASKED TREMONTI TO MEET HIM TO DISCUSS AGENDA FOR COMING DAYS	-0.05	0.01

Table A2: Instrument Correlation with Monetary Policy Shocks

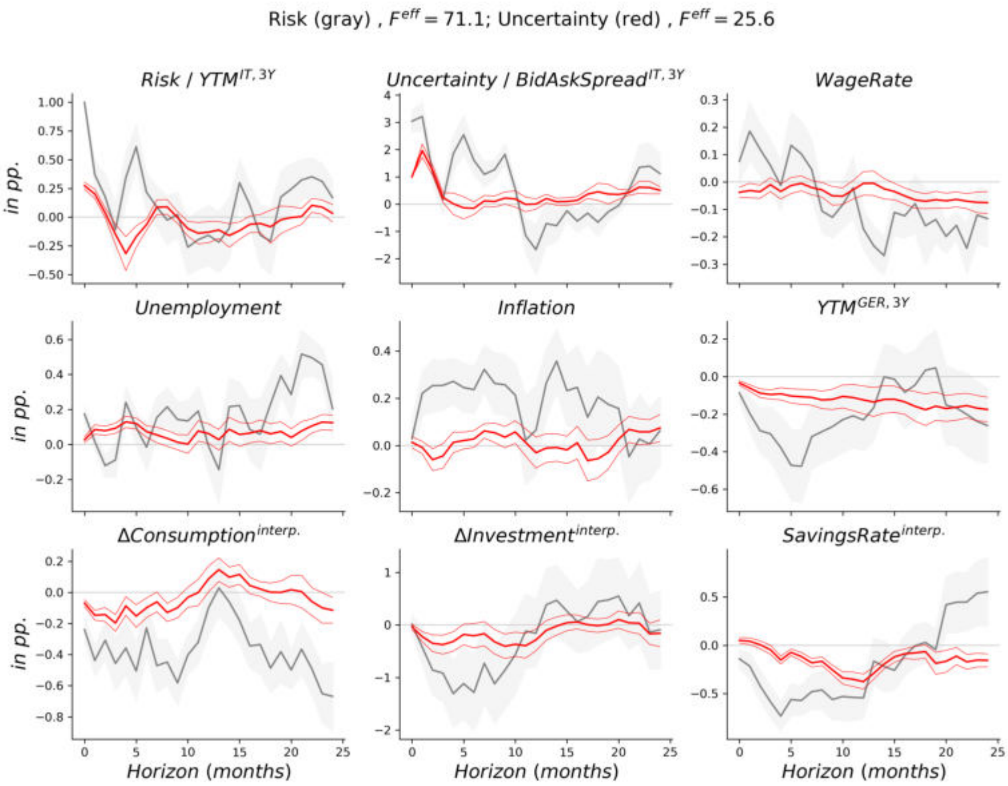
	Risk (z_t^{rsk})	Uncertainty (z_t^{uc})	Uncertainty, cleaned ($z_t^{\widetilde{uc}}$)
ρ	0.06	-0.05	-0.01
p-value	0.38	0.48	0.83

Notes: Evaluation of the correlation of the sovereign risk and uncertainty series with the euro area monetary policy shock series constructed in Altavilla et al. (2019).

Table A3: Regression Variables Overview

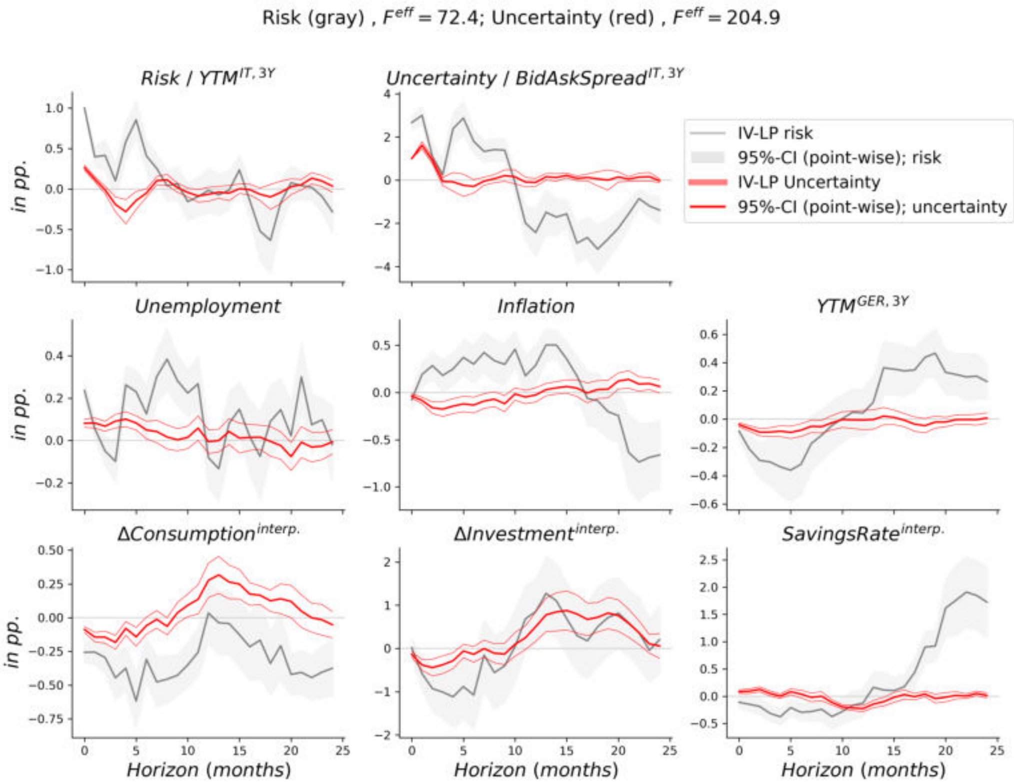
Variable	Description	Source	Table/Mnemonic	Unit
Risk / YTM	Refinitiv Italy Government Benchmark Bid Yield 3 Years	Refinitiv	TRIT3YT	yield to redemption in %
Uncertainty / BidAskSpread	Difference between ask and bid bond price quote	Product Refinitiv: ETI CASH & OTC PERPETUAL FRONT OFC	RIC,IT3YT=RR	% of par value
Unemployment	unemployment rate total	ISTAT (drawn from eurostat; Table une rt m)	Table: une rt m	in % (seasonally adjusted)
Inflation	harmonized index of consumer prices (I15)	Eurostat	prc hicp midx; CP00 (I15)	YoY-log-change
YTM	Refinitiv Germany Government Benchmark Bid Yield 3 Years	Refinitiv	TRBD3YT	yield to redemption in %
Consumption	Chowlin Interpolation of quarterly Price Personal Consumption Expenditures	Refinitiv		YoY-log-change
Investment	Chowlin Interpolation of quarterly real gross capital formation	Refinitiv	ITGFCF..D	YoY-log-change
SavingsRate	Chowlin Interpolation of the quarterly gross savings rate Italian HH	Refinitiv	ITCHGSAVQ	in % (seasonallyadjusted)
ShadowRate	Shadow Rate taken from Krippner	Krippner	Euro-area SSR	in %
WageRate	Nominal wage rate	Refinitiv	ITWAGES.F	YoY-log-change

Figure A1: Impulse Response Functions (Wages)



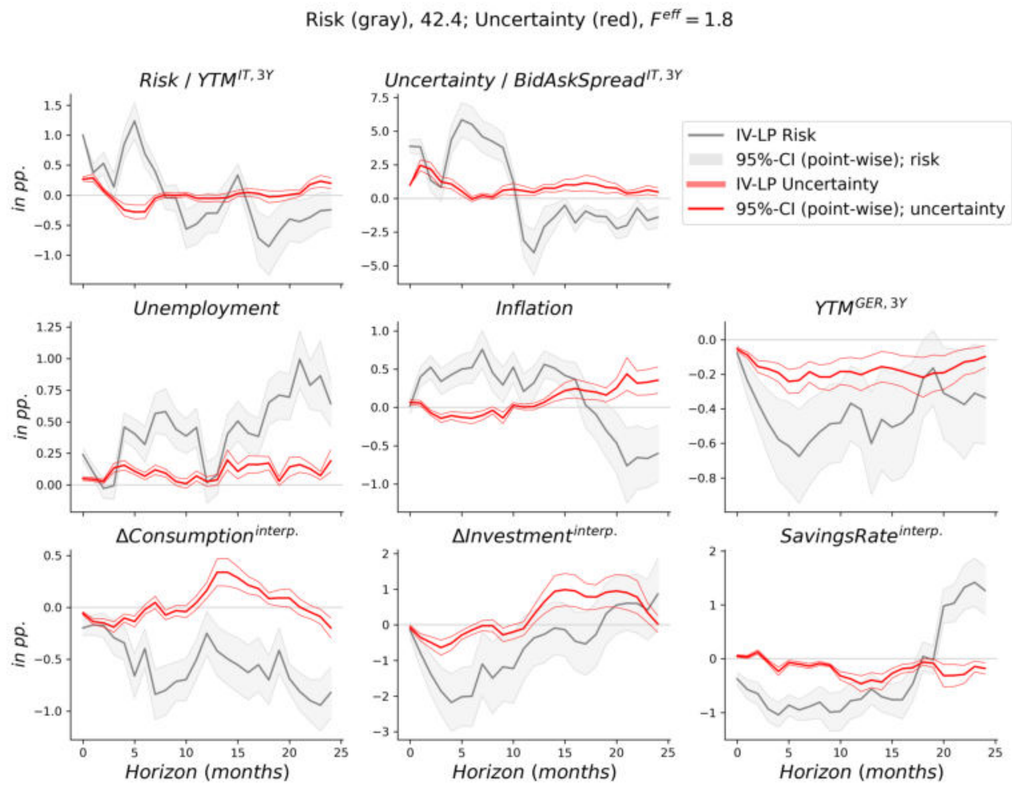
Notes: Impulse response functions from the LP-IV regression as specified in equations (St1) and (St2). The lag order $p = 2$ is chosen by AICc criterion. The reported F-statistics denote the Olea and Pflueger (2013) effective F-statistics. The underlying data covers the period from 2001 to June 2019.

Figure A2: Impulse Response Functions (not orthogonalized)



Notes: Impulse response functions from the LP-IV regression as specified in equations (St1) and (St2). The lag order $p = 3$ is chosen by AICc criterion. The reported F-statistics denote the Olea and Pflueger (2013) effective F-statistics. The underlying data covers the period from 2001 to June 2019.

Figure A3: Impulse Response Functions (Window Size 30Min)



Notes: Impulse response functions from the LP-IV regression as specified in equations (St1) and (St2). The lag order $p = 3$ is chosen by AICc criterion. The reported F-statistics denote the Olea and Pflueger (2013) effective F-statistics. The underlying data covers the period from 2001 to June 2019.

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