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The Effects of Sovereign Risk: A High Frequency Identification Based on News Ticker Data*

Abstract

This paper uses novel news ticker data to evaluate the effect of sovereign risk on economic and financial outcomes. The use of intraday news enables me to derive policy events and respective timestamps that potentially alter investors' beliefs about a sovereign's willingness to service its debt and thereby sovereign risk. Following the high frequency identification literature, in the tradition of Kuttner (2001) and Guerkaynak et al. (2005), associated variation in sovereign risk is then obtained by capturing bond price movements within narrowly defined time windows around the event time. I conduct the outlined identification for Italy since its large bond market and its frequent coverage in the news render it a suitable candidate country. Using the identified shocks in an instrumental variable local projection setting yields a strong instrument and robust results in line with theoretical predictions. I document a dampening effect of sovereign risk on output. Also, borrowing costs for the private sector increase and inflation rises in response to higher sovereign risk.

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

JEL classification: C36, E43, E62

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1 Introduction

Before governments began fighting the economic fallout of the Covid-19 crisis, public debt had already risen to levels unseen in the past sixty years. Over the course of the pandemic debt levels increased even further and the International Monetary Fund now projects gross government debt in the rich world to reach 122% in relation to Gross Domestic Product in 2021, compared to 104% in 2019.[1] Questions about the risks and merits of such historically high debt levels loom large in policy debates. It seems plausible that higher sovereign debt levels *ceteris paribus* lead to a higher risk of sovereign default. Determining the associated costs is however complex. Empirically, the difficulty in determining the effects of sovereign risk suffers from an identification problem, as has been documented for example by Arellano et al. (2017). Observable aggregates do not reveal whether changes in sovereign risk have affected economic outcomes or whether changes in economic outcomes have triggered an increase in sovereign risk, as the two-way relationship gets washed out for low frequencies. Observing a spike in sovereign risk and associated movements in economic variables does not generally speak to the underlying causal mechanism. On one hand, the change could reflect a greater incentive of the sovereign to renege on its debt when the economy slumps and mustering interest and principal becomes more painful, a mechanism that has been highlighted for example by Eaton and Gersowitz (1981) or Ghosh et al. (2013). On the other hand, sovereign risk may put a burden on banks' balance-sheets who typically are the governments' main creditors, thereby forcing banks to restrict lending, causing sovereign stress to leak into the real economy. This mechanism has been analyzed by Bocola (2016) and Gennaioli et al. (2014). Distinguishing between the two has far-reaching policy implications. The necessity of austerity measures in Europe was for example often advocated based on the recessionary effects of sovereign risk spilling over to the broader economy (cf. Arellano et al. (2017)).

In this paper, I construct an instrument to isolate the channel running from sovereign risk to economic and financial outcomes for the case of Italy. The empirical strategy exploits the unpredictability of the political process as a source of random variation. Since a sovereign's decision to default critically depends on its political willingness (cf. Leeper et al. (2013)), everyday politics potentially induces variation in sovereign risk useable for identification. Uncertain about a country's political commitment to fiscal discipline, investors form expectations based on current and past observable information. These expectations affect the perceived default probability and consequently bond prices when investors decide on which terms they are willing to hold government debt. Political events that potentially alter expectations about a sovereign's fiscal commitment and thereby the perceived default probability can therefore be used to trace out dynamic effects of

[1] IMF, Fiscal Monitor - Policies for the Recovery, October 2021.

sovereign risk on economic aggregates. Consider for example, a government calling a vote of confidence on an austerity package, as happened in Italy in 2011. Losing the vote may plausibly be interpreted as a rebuttal of the current fiscal course, leading investors to update their beliefs about the government's fiscal priorities. Knowledge of the exact time at which the outcome of the confidence question became public allows capturing bond price movements induced by investors' revision of expectations. Importantly, the circumstances leading up to the event may be endogenous to broader economic and financial conditions. However, precise timing permits isolating price fluctuations around the event time that are (likely) attributable to that same event. The effects of other economic factors are therefore separated, addressing the reverse causality issue.

To implement the outlined identification design, I harness a novel news ticker data set which to the best of my knowledge has not been used for economic analysis. Exploiting the structure of these data allows deriving political events (and respective exact timestamps) for Italy that potentially alter sovereign risk as perceived by the market in an automated fashion. Following the high frequency identification literature of Kuttner (2001) and Guerkaynak et al. (2005), I capture bond price movements within narrowly defined time windows around the identified political events to obtain the associated variation. Aggregating the identified intraday shocks to lower frequencies allows for the interaction of the identified sovereign risk shocks with economic variables.[2] To assess the instrument, an instrumental variable local projections (IV-LP) model à la Jordà and Taylor (2016) is run. In response to an exogenous increase of sovereign risk output declines and borrowing costs increase which is consistent with impaired financial intermediation in the presence of increased sovereign risk, as documented for example by Gennaioli et al. (2014). Also, unemployment increases and inflation, in line with the Fiscal Theory of the Price Level (Leeper (1991), Cochrane (2021)), rises.

This paper focuses on Italy chiefly for three reasons. First, Italy enters the sample period starting in 2000 with a large and developed bond market due to the sharp increase in public debt levels in the late 80s and early 90s (cf. Zamagni (2018)). Second, since its rapid modernization during 1952-73, the country's politics have been relatively turbulent, potentially increasing the number of political shocks markets had to absorb. Third, the economy's size and its political heft ensure regular coverage of Italy in the news ticker used.

The paper is structured as follows. The next section describes the relevant literature. In Section 3, I lay out how the instrument is constructed and discuss some properties of

[2]Resulting fluctuations are unlikely to comprehensively capture the structural shocks to sovereign risk. They are thus interpreted as a measure with error of the underlying structural innovations, following Gertler and Karadi (2015) or Stock and Watson (2018).

the identified shock series. In Section 4 the shock series is used to investigate dynamic effects of sovereign risk. Section 5 provides a robustness analysis. Section 6 concludes this paper.

2 Related Literature

It is well established in the literature that sovereign risk has an impact on economic and financial variables. One way through which an increase in sovereign default risk may spill over into the broader economy are banks. Banks typically hold large amounts of government debt on their balance-sheets. Thus, if the quality of government debt sours, banks may reduce lending. This transmission channel has been investigated for example by Gennaioli et al. (2014). Another way sovereign risk may affect the economy is through anticipated financial repression (e.g. Cochrane (2011)). As sovereign risk increases, economic agents may suspect the sovereign to deleverage by means of financial repression. This in turn could prompt them to decrease savings and thereby investments to inefficient levels hurting medium term growth prospects. A third possible channel rests on the sovereign's desire to stay on a balanced debt path, i.e. to prevent debt from rising to unsustainable levels, leading to loss of access to capital markets (e.g. Ghosh et al. (2013)). A government may decrease public expenditures to return to a balanced debt path, thereby impacting the broader economy. While these three mechanisms are not exhaustive, they allude to the identification challenge: The affected variables also influence sovereign risk. If the economy tanks for reasons unrelated to sovereign risk, these variables will deteriorate and sovereign risk will increase as a response. In this case however, the shift in sovereign risk simply reflects the endogenous response to a flagging economy. While aggregate fluctuations in sovereign risk reveal strong co-movements with a battery of economic variables, such as unemployment, financial conditions, and asset prices, they mask the underlying causal mechanisms. It is difficult to determine if sovereign risk has changed due to shifts in economic and financial fundamentals or if sovereign risk has increased impacting fundamentals. In other words, estimating the effect of sovereign risk suffers from an identification problem of reverse causality (cf. Arellano et al. (2017)).

Attempts in the literature to disentangle the two-way relationship between sovereign risk and economic conditions can be categorized into three strands. First, the problem can be addressed using structural models. Bocola (2016) for example builds a model in which sovereign risk may impair financial intermediation through the banks' direct exposure to sovereign debt and through the perceived higher riskiness of private-sector claims that in case of default would need to be sold at a discount. Such models provide valuable theoretical guidance, but the results vary according to the assumptions of the model which are often hard to test empirically. Second, some research focuses on the reactions to sovereign distress at the micro-level directly. Altavilla et al. (2017) for

example use proprietary balance-sheet data from individual European banks to track the banks' behavior during the sovereign debt crisis in Europe. These studies can shed light on the micro dynamics under sovereign distress, but they are not suitable to derive and quantify general equilibrium effects. Third, another possible route to addressing the identification challenge is to employ structural VAR models. Born et al. (2019) for example use a smooth transition VAR to estimate the effects of austerity measures on sovereign default premiums. For identification the authors rely on a recursive ordering, assuming that government consumption does not respond contemporaneously to current changes in output and sovereign risk.

A fourth more recent approach to account for the reverse causality issue is to resort to high-frequency data. Capturing variations in sovereign risk in the immediate surrounding of exogenous events allows for high frequency identification in the tradition of for example Kuttner (2001), Guerkaynak et al. (2005) or Gertler and Karadi (2015). This approach has been employed by Bahaj (2019) which is the work closest to this paper. Bahaj uses the daily briefings of EuroIntelligence, a specialist service for news and analysis of the EU and eurozone. The author manually goes through the daily summaries over the period from July 2009 to March 2013 and selects exogenous events. The resulting events are then timed with a Bloomberg newswire. Knowledge of the precise materialization time of an event allows him to pin down associated fluctuations in sovereign risk. These movements are then causally attributed to the respective event. Exogeneity rests on the assumption that movements within a short time window around an event are not systematically driven by other factors. As Beetsma et al. (2013) have pointed out, EuroIntelligence generally publishes its newsflash concerning a particular day in the morning of the subsequent day, it therefore provides a contemporaneous assessment, an important requirement for a narrative identification (cf. Romer and Romer (2019)). This news source is available from 2006 going forward and has undergone some structural changes over time.

The contribution of this paper is to build on the idea of Bahaj (2019) and harness novel news feed data from Thomson Reuters to derive a longer time series of sovereign risk shocks for Italy in an automated fashion. The news feed is geared towards the timely reporting on any important political or general event. According to its own account, Thomson Reuters reports within 5-minutes on any major political event which renders it suitable for high frequency identification. The feed spans the years from 1996 until today and can thus shed light on potentially different policy regimes.[3] In the following section, the extraction of events from these data is outlined in more detail.

[3]This paper focuses on the time between 2000 and summer 2019.

3 A New Sovereign Risk Shock Series

In an influential paper, Gertler and Karadi (2015) use a Kuttner-type high frequency identification to investigate the dynamic impact of monetary policy on real output, prices and financial conditions using changes in federal funds future (FFF) rates around Federal Open Market Committee (FOMC) announcements. The idea is that monetary policy follows some rule (e.g. the Taylor rule), which itself is a function of the variables of interest, and some random surprise perturbation. Capturing the variation of FFF rates in a narrowly defined time window around FOMC announcements, allows isolating the surprise perturbation based on the premise that changes in other variables driving monetary policy are unlikely to fall in that exact time window. Similarly, we can think of fiscal policy as following a fiscal rule based on broader economic conditions and a country's commitment to sustainable public finances. This paper aims at capturing exogenous fluctuations in bond prices that are associated with investors updating their beliefs about a sovereign's political willingness to service its debt. Having settled on certain expectations of a sovereign's fiscal rule *ex-ante*, the changes in bond prices around political events can then be interpreted as random perturbations analogous to the monetary policy setting. However, two differences to the Gertler and Karadi (2015) set-up stand out. First, informational events on the fiscal priorities need not be pre-determined, the timing of a spontaneous market-stirring comment by a politician for example is not known *ex-ante*. This contrasts to the meticulously scheduled FOMC meetings. Second, it is unclear which events constitute informational events with respect to a sovereign's commitment to a sustainable budget. Therefore, the event type being looked for is also unknown.

The following Subsection describes how these informational events are derived and associated changes in sovereign risk calculated. Subsequently, some properties of the resulting shocks are discussed.

3.1 Construction

To derive potentially informational events on a sovereign's fiscal discipline and associated exact timestamps, I harness news ticker data from Thomson Reuters.[4] These data have not been used for economic analysis to the best of my knowledge. According to Thomson Reuters, the coverage of the ticker is particularly strong in commodity and energy, macroeconomic, political news and news about large cap equities. The feed is consumed by 300′000 users globally via different channels, such as real-time subscriptions, alerts, machine digestible information, etc. The historical data used in this paper

[4]More specifically, the Thomson Reuters Real-Time Political, General and Economic News for Europe, the Middle East, and Africa (EMEA) (Thomson Reuters (2018))

span the years from 2000 - 2019 and consist of roughly 20 million feeds.[5] The company claims that relevant political events are reported on within at most 5 minutes. This does not imply a fully-fledged report, the first feed about a specific event may only include a headline. Over time further feeds then replenish the content. The collection of feeds pertaining to one event is referred to as a *story*. The stories cover a variety of topics, both relevant and irrelevant for the analysis of this paper. For example, topics may include political interviews, stock market reports or updates on criminal investigations on non-public figures.

The news feed is a typical big data set which is not easily navigated, due to its size and the textual format. To use the data for a narrative high frequency identification two conditions must be met. As pointed out by Romer and Romer (2019), a valid narrative strategy should be based on a contemporaneous assessment of relevance for the selected events. That way, retrospective information of the researcher cannot bias the selection. The feed corpus contains summary news (referred to as "top news categories" by Thomson Reuters) with references to stories further upstream in the feed. The referenced stories have been deemed important enough at the time to be included in a top news summary feed. Using only referenced stories, allows me to base the selection on contemporaneous information, meeting the above condition. Additionally, high frequency identification requires the precise timing of a given event. Otherwise associated fluctuations cannot reliably be isolated. This requirement is addressed making use of alert tags that Thomson Reuters uses to indicate first news on a specific story, allowing for proper event timing.

More specifically, the construction of the instrument requires three main processing steps. First, stories from a suitable summary news category are collected and reduced to those concerning Italy. Second, textual filters are applied to clean the events from noise or potential other structural shocks. The most problematic group of events that need to be removed are data releases. These potentially provide direct information on fundamentals thwarting the effort to isolate the channel running from sovereign risk to economic aggregates. A preliminary estimate of industrial production for example represents a data point on economic fundamentals (output, industrial production). As a consequence, inclusion of such events would capture the effect of fundamentals on sovereign risk rather than the other way around. Third, surviving events are used to capture the variation in bond prices in narrowly defined time windows around the respective event timestamps, so that a measure for the change in sovereign risk can be calculated. In the following the steps are outlined in more detail.

[5] Technically, the data are available from 1996 until today, but the research design restricts the sample to 2000 onwards and the author only has access to data until July 2019.

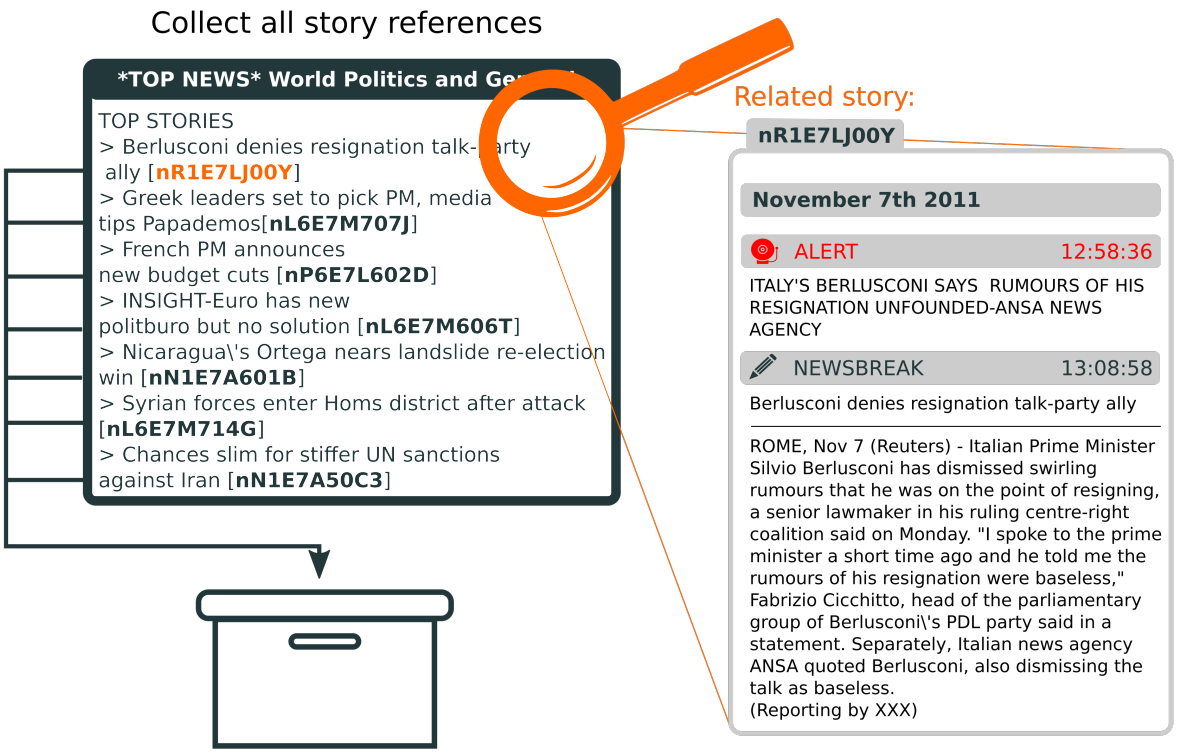
Table 1: Five Largest Top News Categories

Top News Category Tag	Top News Category	#References	Coverage
nTOPNEWS	*TOP NEWS* Front Page	479,461	2002-10 - 2019-07
nTOPG	*TOP NEWS* World Politics and General	366,038	2000-03 - 2019-07
nTOPMACRO	*TOP NEWS* Global Economy	164,752	2002-10 - 2015-07
nTOPCOM	*Reuters Commentary* / *Reuters Breakingviews*	111,084	2009-03 - 2019-07
nTOPEURO	*TOP NEWS* Euro Zone Crisis	108,276	2011-01 - 2018-05

Notes: Five largest top news categories from Thomson Reuters sorted by the number of distinct stories referenced in the respective category over the entire sample. The column "coverage" indicates the time span that a top news category was live. The summary news category used in the benchmark specification is highlighted in yellow.

#1 Derivation of Important Italian News To derive a set of Italian news that were contemporaneously rated as important, summary news are used as a starting point. There are various "top news" categories present in the feed. The most pertinent top news category provided is given by "*TOP NEWS* World Politics and General". It is the natural choice for this paper, since it covers high impact political news and since it has the largest coverage, spanning the period from 2000 until July 2019 (cf. Table 1). The "*TOP NEWS* Front Page" starts in 2002 but represents the largest category in terms of referenced stories. Unfortunately, the focus is very broad and resulting stories have a high share of non-political news. Consequently, they are too noisy for the purpose of identification. "*TOP NEWS* Global Economy" mostly reference economic developments and feature numerous data releases. The other two large categories "*Reuters Breakingviews*" (*sic*) and "Top Euro Zone Crisis" start too late and lack a specific focus on politics. The story extraction is illustrated in Figure 1 for the category: "*TOP NEWS* World Politics and General". The top news contain story identifiers that link to the corresponding collection of feeds in the news stream. The first story reference of the displayed summary news is "nR1E7LJ00Y", linking to the story (collection of feeds) on the right. The alert (the part in all caps) is sent out and subsequently fleshed out with additional information, as shown underneath the NEWSBREAK bar. To correctly time the event, I fetch the timestamp of the alert feed. Note that not all stories sport an alert because they do not contain original information (e.g. an analysis of a political conflict that is written *ex-post* would not feature an alert). To ensure that only timeable stories enter the data, referenced stories are required to feature an alert. Finally, stories are filtered for news concerning Italy, using regular expressions. More precisely, headlines

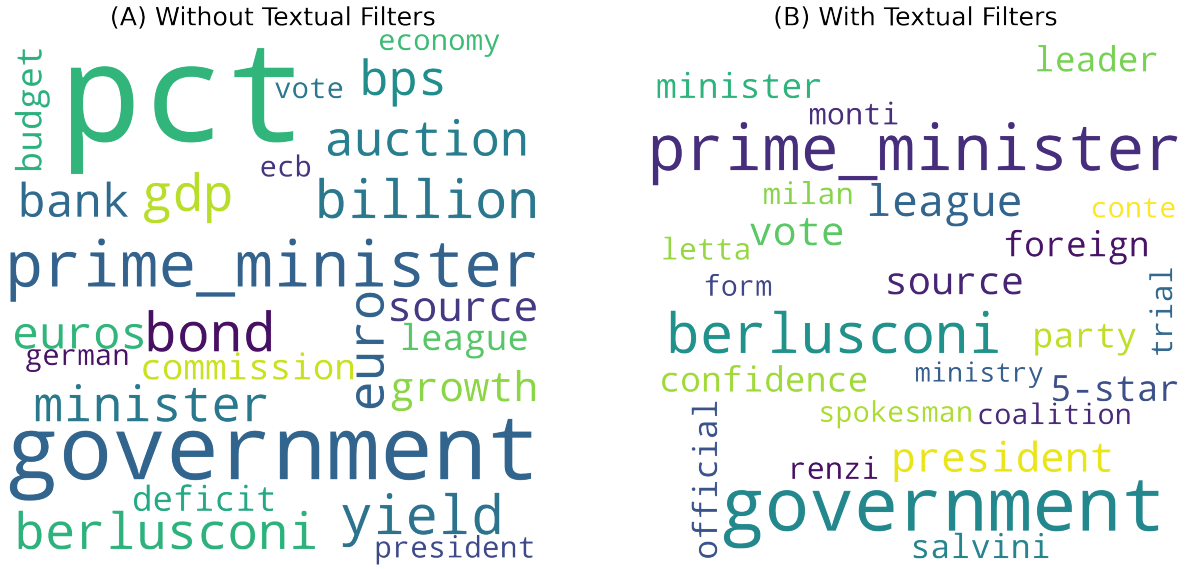
Figure 1: Determining Relevance



Notes: Illustration of how potentially relevant news are selected from the news corpus. In the given example seven references would be collected (”nR1E7LJ00Y” through ”nN1E7A50C3”). The right-hand side shows how a related story is structured for (story) reference: ”nR1E7LJ00Y”. Note that the alert only features a headline (no text body), as the story is only subsequently fleshed out with more details. Ten minutes later more text is added to the story.

are searched for different permutations of the word "Italy" and "Italian" and / or the presence of the name of a large Italian city.[6] The resulting data set consists of 822 stories. These stories concern Italy and have been deemed worthy to report in the top news category: Politics and General. To further ensure that bond price movements provide a valid signal, events with timestamps outside typical trading hours are excluded, and it is required that there is a minimum number of five quotes within the constructed time windows.[7] 540 stories satisfy these conditions and enter the next step. Panel (A) of Figure 2 displays a word cloud of the remaining stories' headlines. Visual inspection

Figure 2: Word Clouds



Notes: Word clouds formed over the stories' headlines. Beyond the usual stop words such as "and", "for", etc., the list of ignored words includes permutations of the word "Italy / Italian" because by construction they appear in most of the headlines. Panel (A) shows the word cloud constructed before textual filters are applied. Panel (B) displays the word cloud after textual filters are applied.

of the panel reveals the existence of data releases in the resulting events. Words such as "auction", "yield" and "bps" (basis points) are present in a sizeable portion of the selected stories. An example of such a data release is given by: `ITALIAN/GERMAN 10-YEAR GOVT BOND YIELD SPREAD TIGHTENS TO 296 BPS VS FRIDAY SETTLEMENT CLOSE OF 375 BPS - TRADEWEB`. Such data releases pose a serious problem for the intended identification scheme. In this case, the event constitutes the description of a market movement

[6]Other selection mechanisms such as searching the entire text corpus associated with a story for of the word "Italy" and "Italian" do not materially affect the instrument.

[7]The sovereign bond market is an over-the-counter (OTC) market and in principle it is possible to trade OTC products at any time (as long as there is a trading partner). However, outside typical trading times hedging becomes much harder and price discovery (and therefore the information content) may be distorted.

which would induce the risk of confounding cause and effect. The description of a hike in Italian yield spreads must not be counted as a market moving political event. Likewise, news pertaining to central bank decisions need to be removed, for example: `ECB POLICYMAKERS IN RELATIVE UNISON OVER ENDING QE THIS YEAR`, `DESPITE SLOWER GROWTH`, `ITALIAN WORRIES - SOURCES`. Associated bond price movements are likely to primarily capture the concomitant monetary policy shock (biasing the sovereign risk instrument). In the next step, the events are reduced to the subset potentially informative about fiscal priorities.

#2 Filtering The text based filtering described in the following serves two purposes. On the one hand, it serves to clean the instrument from potential bias as described above. On the other hand, it aids in sharpening the instrument and reducing noise in its measurement. Overall six filters were applied, leaving 221 (of 540) stories in the final set. An overview of the applied text filters is given in Table 2. Note that the selection could have been done manually. However, a manual selection process is less transparant and not easily replicated. Additionally, the chosen automatic selection scales easily and could be extended to a sample running until today.

The most important text filter targets data releases. While the selected top news category is not the central channel used by Thomson Reuters to disseminate data releases and communicate market movements, market stirring data can make their way to the top news categories as was seen in Panel (A) in Figure 2. The data do not come with a clear-cut identifier for data releases. To still identify the majority of them, I exploit the presence of relatively more numbers within data releases' text corpora. In the benchmark specification, events are excluded if their headlines and text bodies both contain more numbers than the median story (relative to the overall number of words).[8] The second text filter aims at news about supranational institutions such as the IMF, the European Commission, or the European Union. On the one hand, such events are not directly informative on Italy's fiscal discipline. On the other hand, these stories often cover data releases by the respective institutions. To remove these stories, keyword tags provided by Reuters (e.g. EUROZONE) and regular expression search are used. The third text filter removes corporate news. While such news may be less problematic than data releases, they certainly add noise to the instrument and are thus excluded. The majority of corporate news can be easily identified given the presence of firm markers in the text bodies. Additionally, Thomson Reuters tags the release of recurring reports on specific topics, such as exchange rates or stock markets as alerts, since they belong to

[8] In the robustness Section, I follow Bahaj (2019) in using an external economic calendar from Bloomberg to exclude timestamps that overlap with data releases on the country level, European level and a selection of international data releases.

their product service and alerts indicate their publishing. In essence these are summary news which do not yield timeable events and are thus excluded, as well. These can be detected with relative ease since they always sport the same headlines. Finally, central bank news are excluded as monetary policy events and rating agencies news are removed as a precautious measure. Both filters rely on regular expressions and keyword tags. One could argue that statements by rating agencies are informational events about the fiscal priorities of a country in a disciplining sense. Due to the controversy as to whether they truly lag or lead actual information, they are excluded here since this could give rise to endogeneity.[9]

Panel (B) of Figure 2 gives a first impression as to the effect of the filtering procedure.

Table 2: Text Filter Summary

	Number Excluded	
Filter	absolute n	recursive n
Data Releases	164	164
Supranational Institutions	125	89
Corporate News	42	16
Recurring News	41	22
Monetary Policy	39	24
Rating Agencies	16	4
	Number of events before:	540
	Final Number of events:	221

Notes: Applied filters to ensure exogeneity and reduce noise of the resulting instrument series. Absolute n refers to the number of stories marked by that filter. Recursive n refers to the remaining number when recursively filtering out the respective stories. The recursive numbers are smaller than the the absolute numbers since sets are non-exclusive.

The data release vocabulary has disappeared from the word cloud, indicating that the removal largely succeeded. It is also noteworthy that the size difference between the largest and smallest words is reduced when compared to Panel (A). This suggests a more balanced word corpus that one might expect from non-standard reports on politics (as opposed to data releases with a rather repetitive jargon, which are dominant in Panel (A)).

#3 ΔSovereign Risk Lastly, the timestamps of the 221 derived events are used to capture associated movements in bond prices in proximity to the respective timestamp. To illustrate this, I return to the example story from Figure 1. The alert timestamp reads 12:58:36 (CET). To calculate associated movements in bond prices a symmetric time window of 10 minutes (à five on each side) is constructed around it. This time

[9]For a critical review of the role of rating agencies see for example De Haan and Amtenbrink (2011).

period is assumed to be adjustment time, i.e. the period during which bond prices incorporate the associated information. A shift in sovereign risk is then calculated as the change between the mean bond price in the 10 minutes before and after the adjustment period relative to the change in the corresponding German bond which serves as the safe asset. Figure 3 illustrates the approach for the outlined example for Italian bonds with remaining maturity of three years.[10] The benchmark analysis uses bonds with a three-year maturity because ten year maturity bonds are less reactive, which is in line with the findings of Bahaj (2019) who uses two-year maturities. It can be seen that Italian bond prices dropped in the face of Berlusconi's indication that he does not plan to resign. That is, the yield on Italian bonds increased. Since German bonds moved in the opposite direction, this results in an increase in sovereign risk. More specifically, the change in sovereign risk is computed as follows,

$$\begin{aligned}\Delta\sigma_{\tau}^{IT} &= (\overline{B}_{\tau,after}^{IT} - \overline{B}_{\tau,after}^{DE}) - (\overline{B}_{\tau,before}^{IT} - \overline{B}_{\tau,before}^{DE}) \\ &= \Delta\overline{B}_{\tau}^{IT} - \Delta\overline{B}_{\tau}^{DE}, \end{aligned} \tag{1}$$

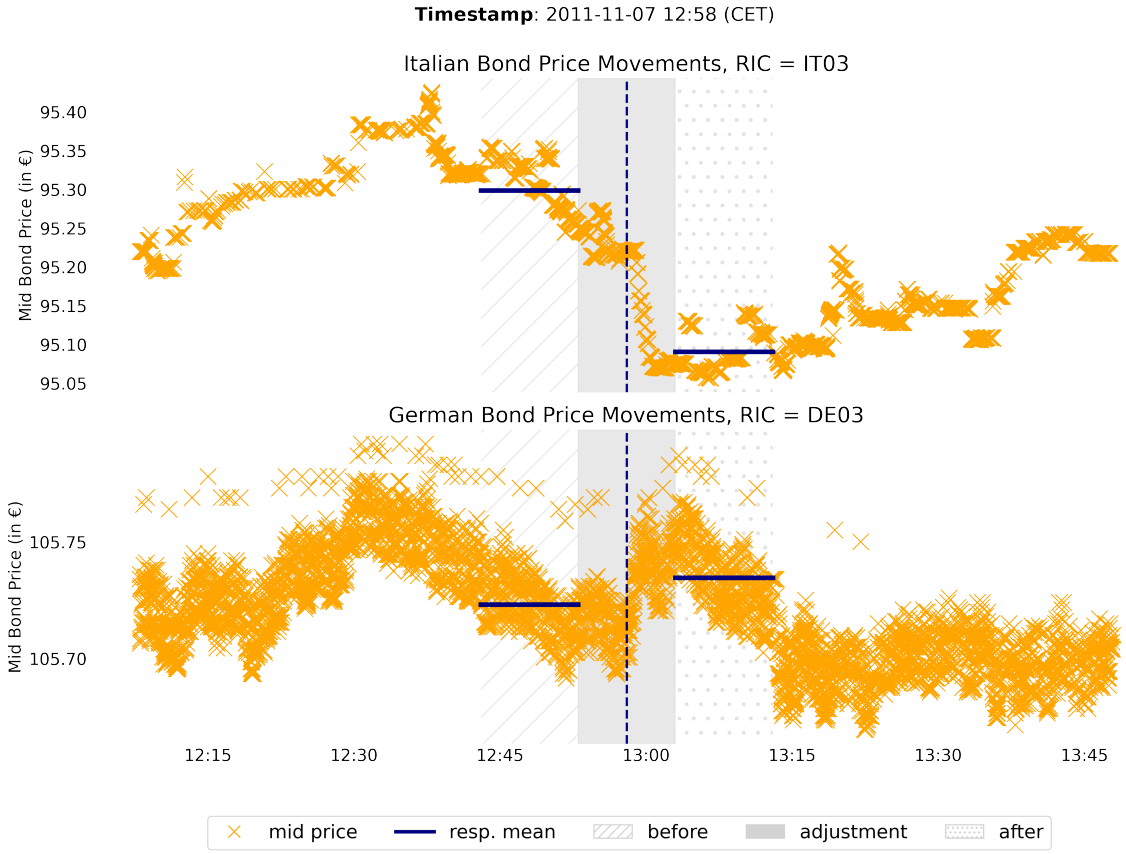
$\overline{B}_{\tau,before}^{c} = \sum_{t\in\mathcal{B}_\tau} B_t^c/|\{B_t^c|t\in\mathcal{B}_\tau\}|$ and $\overline{B}_{\tau,after}^{c} = \sum_{t\in\mathcal{A}_\tau} B_t^c/|\{B_t^c|t\in\mathcal{A}_\tau\}|$ equals the average mid-bond price quote in the ten-minute window before and after the adjustment period of ten minutes with $\mathcal{A}_\tau$ and $\mathcal{B}_\tau$ denoting the corresponding sets[11] and c taking on the values IT of Italian bonds and DE to mark German bonds. A common concern with government bond data is limited liquidity, especially in periods prior to the Great Recession. To ensure that prices are informative, there must be a minimum of five bond price quotes in the window before and after the adjustment period respectively (for German bond prices and bond prices of the concerned country). Additionally, all timestamps that lie outside the normal trading hours (7:15-17:45) are ignored.

For $\Delta\sigma_{\tau}^{IT}$ to be a valid external instrument, two main identifying assumptions have to hold. First, $\Delta\sigma_{\tau}^{IT}$ must be orthogonal to other structural shocks hitting the economy at the same time. Going back to the example in Figure 1, this could be a sudden seizing up of financial conditions that falls within the considered 30-minute frame. Given the narrow definition of the time window, the probability for such disturbances to systematically affect results are small. Second, an event might reveal private information on fundamentals such that the resulting change is really due to new information about fundamentals. Sticking with the above example, this could e.g. mean that Berlusconi's denial disclosed private information about the true state of the Italian economy. In this example a leakage of private information seems less probable. But generally, this is an important concern that cannot be fully eliminated within this framework. However,

[10] Strictly speaking, the change in sovereign risk is computed as a time weighted average, i.e. mid-price quotes are averaged for each minute and filled forward if there are no observations in the next minute interval.

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

Figure 3: Computation of Sovereign Risk



Notes: Illustration of the computation for a change in sovereign risk around the alert of story "nR1E7LJ00Y" (depicted on the right side of Figure 1). First a symmetric window of ten minutes is constructed around the timestamp to mark the adjustment time. Then means are computed for the ten minutes before and after adjustment time. Germany serves as the safe asset benchmark.

while the informational effect of monetary policy statements and in particular the central bank's economic assessment may indeed add to public information (cf. Bernanke (2004), Nakamura and Steinsson (2018)), this problem may be less significant in the political process which is at the center of the present analysis.

3.2 Properties

Computing the changes in sovereign risk according to Equation 1, the shocks can be sorted in descending absolute magnitude. The ten largest shocks are displayed in Table 3. It leaps to attention that the events are largely political events, as intended. Another noteworthy but unfortunate characteristic of the resulting series is the absence of large shocks before the Euro Crisis. This impression is confirmed for the entire time series as displayed in Figure 4. The uneven distribution of variation over time is a feature of the data and has been documented in similar research (cf. Bahaj (2019)).

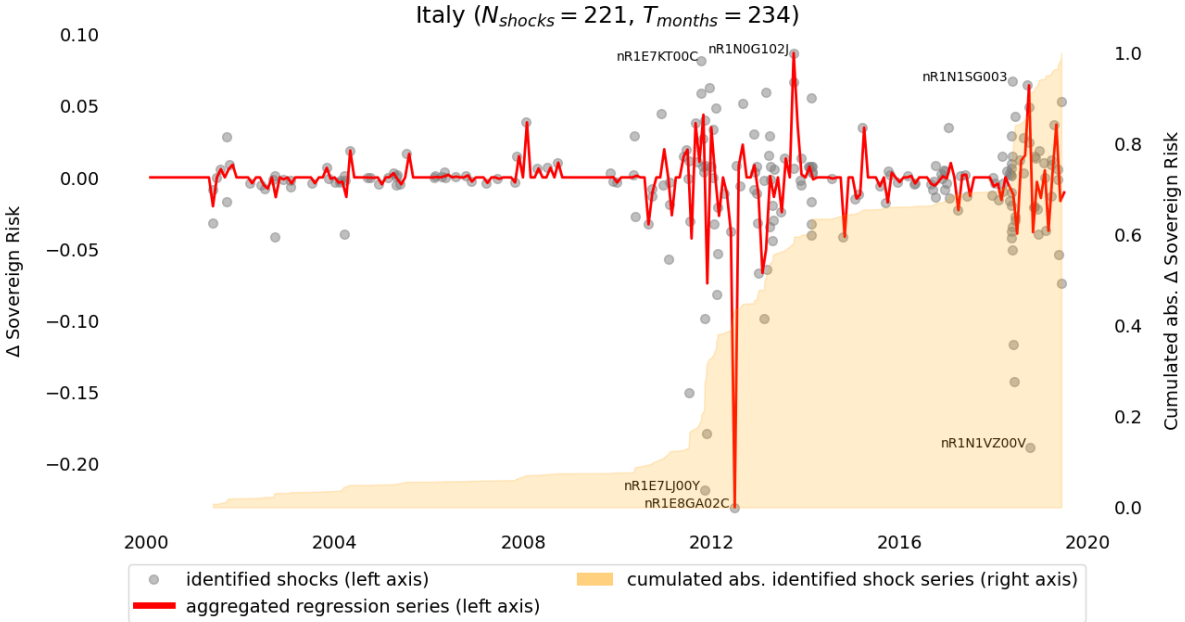
Table 3: 10 Largest Absolute Shocks (after filtering)

Timestamp (CET)	Story-ID	First Headline	$\Delta\sigma_\tau^{IT}$
2012-06-26 16:27	nR1E8GA02C	ITALY PM MONTI SAYS JOINT EUROPEAN SOLUTIONS NEEDED TO PREVENT SOME COUNTRIES FALLING INTO RECESSION SPIRAL	-0.231
2011-11-07 12:58	nR1E7LJ00Y	ITALY'S BERLUSCONI SAYS RUMOURS OF HIS RESIGNATION UNFOUNDED-ANSA NEWS AGENCY	-0.218
2018-10-08 10:49	nR1N1VZ00V	ITALY DEPUTY PRIME MINISTER SALVINI SAYS MOSCOVICI AND JUNCKER ARE REAL ENEMIES OF EUROPE	-0.188
2011-11-25 10:59	nL5E7MP0XX	ITALY TRYING TO PERSUADE ITS FIRMS TO DIVERSIFY FROM USING IRANIAN OIL -FOREIGN MINISTRY	-0.179
2011-07-14 11:38	nR1E7HU012	ITALIAN GOVT CALLS CONFIDENCE VOTE IN SENATE OVER AUSTERITY PACKAGE	-0.151
2018-06-06 15:53	nL5N1T843R	ITALY'S NEW ENVIRONMENT MINISTER SAYS ITALIAN STAGE OF TAP PIPELINE PROJECT LOOKS 'POINTLESS', WILL BE REVIEWED	-0.142
2018-05-28 10:53	nR1N1SG016	ITALY'S ANTI-ESTABLISHMENT 5-STAR "EVALUATING" POSSIBLE COALITION WITH LEAGUE IN NEXT ELECTIONS - 5-STAR SOURCE	-0.117
2011-11-08 16:11	nR1E7LJ016	ITALIAN LOWER HOUSE SPEAKER OPENS VOTE KEY TO BERLUSCONI'S FUTURE	-0.099
2013-02-14 10:10	nI6E8G700Y	ITALY POLICE ARREST MONTE PASCHI FORMER FINANCIAL DIRECTOR BALDASSARRI - INVESTIGATIVE SOURCES	-0.099
2013-09-30 14:37	nR1N0G102J	AS MANY AS 20 SENATORS FROM FORMER ITALIAN PM BERLUSCONI'S PDL PARTY READY TO FORM BREAKAWAY PARTY - PDL SOURCE	0.087

Notes: Computation of $\Delta\sigma_\tau^{IT}$ is based on Italian and German bond prices with a remaining maturity of three years. To see the 30 largest shocks please go to Table A1.

The quantification of sovereign risk also allows examination of the textual filters from another angle. If the unfiltered set of 822 events would be used as a basis for deriving

Figure 4: Shock Time Series



Notes: Time series plot for the identified shock series (constructed based on Italian and German bonds with remaining maturity of 3 years). The red line represents the monthly sums entering the regression in Section 4. The largest positive and negative identified shocks are annotated with the story references for comparison in Table A1.

the instrument, the ten largest shocks would have been quite different as can be seen in Table 4. Therefore, data releases have not only been important in terms of relative word counts (as shown in Figure 2) but also quantitatively, further validating the use of the textual filters. The same is true for monetary shocks. While there were only 39 monetary policy stories filtered out, the largest one in Table 4 is larger than any of the political shocks shown in Table 3. Figure 5 compares the number of quotes over the hours of the day for the benchmark set of events, the events that have been sorted out as data releases and the typical number of quotes observed during trading hours for the respective bond overall. For the data release events, a spike can be seen between `11:00` and `12:00` (CET). That is due to releases of the European Commission and the OECD, such as `EU COMMISSION FORECASTS 2010 EURO ZONE GDP GROWTH AT 1.7 PCT VS 0.9 PCT PREVIOUSLY`. The benchmark does not feature such conspicuous spikes and is relatively evenly distributed.

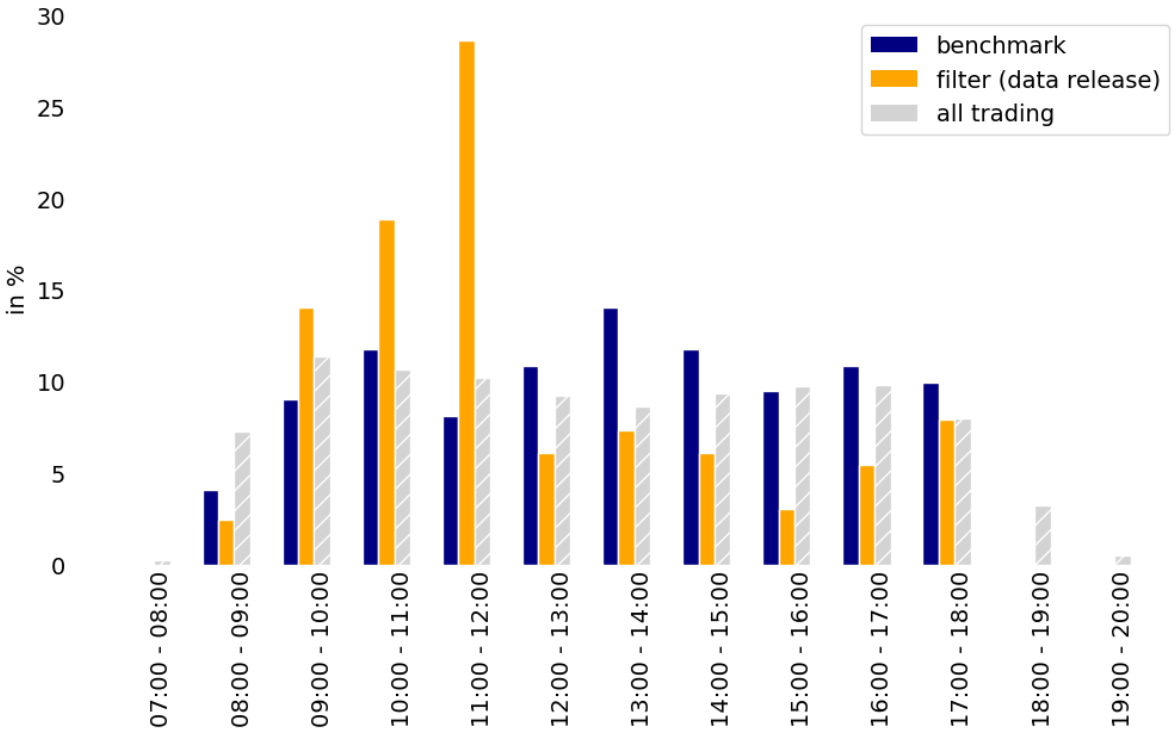
However, inspection of the longer version of Table 4 (Table A1 in the Appendix) indicates that there is still noise in the data and some data releases such as story "nLDE7110MR" (`SPANISH 5-YEAR CREDIT DEFAULT SWAPS FALL TO 209 BPS, DOWN 20 BPS ON DAY`) have not been purged from the events. This points to a broader challenge with the outlined research strategy, namely the relatively noisy data it is based on. An instrument

Table 4: 10 Largest Absolute Shocks (before filtering)

Timestamp (CET)	Story-ID	First Headline	$\Delta\sigma_\tau^{IT}$
2011-08-08 09:07	nL6E7J809F	ITALIAN/GERMAN 10-YEAR GOVT BOND YIELD SPREAD TIGHTENS TO 296 BPS VS FRIDAY SETTLEMENT CLOSE OF 375 BPS - TRADEWEB	0.547
2018-10-02 09:12	nL8N1WI1BG	EU'S DOMBROVSKIS SAYS EU REMAINS OPEN TO DIALOGUE WITH ITALIAN AUTHORITIES ON BUDGET	-0.47
2018-12-12 13:42	nS8N1XX00I	ITALY/GERMANY 10-YR BOND YIELD SPREAD DROPS BELOW 280 BPS HITS LOWEST SINCE OCT. 4	0.396
2011-11-02 09:43	nL9E7I4027	ITALY OCT MANUFACTURING PMI FALLS TO 43.3 (SEPT 48.3, FORECAST 47.1), LOWEST SINCE JUNE 2009	-0.393
2012-07-13 11:28	nI6E8E702H	ITALY SELLS 5.25 BLN EUROS AT BOND AUCTION VS TARGET RANGE OF 3.50-5.25 BLN EUROS	-0.317
2018-05-30 08:27	nL5N1T10YX	ITALY 10-YEAR GOVT BOND YIELDS COME OFF FOUR-YEAR HIGHS, NOW DOWN 7 BPS ON DAY AT 3.04 PERCENT <IT10YT=RR>	0.307
2018-05-25 14:53	nL5N1SW40N	ECB POLICYMAKERS IN RELATIVE UNISON OVER ENDING QE THIS YEAR, DESPITE SLOWER GROWTH, ITALIAN WORRIES - SOURCES	-0.307
2010-12-01 09:22	nLDE6B00EP	ITALIAN/GERMAN 10-YEAR GOVERNMENT BOND YIELD SPREAD TIGHTENS TO 192 BPS, 17 BPS TIGHTER ON DAY	0.251
2011-11-04 15:07	nP6E7K902Z	G20 FINAL COMMUNIQUE AFFIRMS COMMITMENT TO MOVE "MORE RAPIDLY" TOWARDS MORE MARKET-DETERMINED EXCHANGE RATES	-0.249
2018-10-19 15:39	nR1N1W5006	EU'S MOSCOVICI SAYS WAS CLEAR FROM EVERYONE HE SPOKE TO DURING ITALY VISIT THAT ITALY WANTS TO REMAIN IN THE HEART OF EUROPE	0.238

Notes: Computation of $\Delta\sigma_\tau^{IT}$ is based on Italian and German bond prices with a remaining maturity of three years.

Figure 5: Distribution Time of Day



Notes: Distribution of shocks over the hours of the day (CET) compared to the distribution of usual trading in the respective three years to maturity bonds.

constructed from such data is likely to suffer to some degree from measurement error. However, as pointed out by Stock and Watson (2018), instrumental variable models offer good ways to mitigate such problems and the results in Section 4 look encouraging. Furthermore, the approach offers three important advantages. First, the structure of the data allows retrieving news that have been deemed important *at the time* rather than retrospectively. This mitigates the risk of inadvertently incorporating posterior information. Second, the data allow me establishing relevancy consistently from a single underlying source in an automated fashion. This avoids a tedious manual selection process, as conducted e.g. by Bahaj (2019), which is less transparent and possibly more error-prone. Third, the proposed approach is scalable and could be adopted to investigate other research questions with Thomson Reuters ticker data. In the next Section, the resulting shock series is used in a regression set-up.

4 Dynamic Effects of Sovereign Risk

In this Section, the identified exogenous series is used within a local projection model set-up following Jordà and Taylor (2016) to trace out dynamic effects of sovereign risk on economic and financial outcomes. As indicated, the instrument is probably suffering from measurement error. I therefore treat the constructed shock as an instrument for the true shock and estimate dynamic causal effects by instrumental variable local projections (IV-LP), as recommended by Stock and Watson (2018). More specifically, Italian yields to maturity are instrumented with the shock series. For the instrument to be valid, it must correlate with the true shock—the counterpart to the standard relevance condition. The instrument also needs to be contemporaneously exogenous, i.e. it must not be correlated with other structural shocks in the system. This condition is equivalent to the exogeneity condition in conventional IV regression set-ups. To render the instrument valid, a third condition is needed to account for the dynamic nature of the estimation. Since the variables of interest generally depend on the entire history of the structural shocks, the instrument must be uncorrelated with *all* leads and lags of *all* structural shocks. This so-called "lead-lag" exogeneity is an extension necessary to account for the dynamic nature of the estimation. If this condition were violated, the effect of the instrument at time t on the variables of interest could be confounded with other structural shocks.

In the given setting, contemporaneous exogeneity is ensured by capturing variation in a narrow time window around the exact event time. As recommended by Andrews et al. (2019), relevance is assessed based on the effective F-statistic developed by Olea and Pflueger (2013) for the external instrument in the first stage.[12] Unlike the conventional

[12]Note that the effective F-statistic coincides with the robust F-statistic in the case of one endogenous regressor and one instrument.

F-statistic for homoskedastic errors, the effective F-statistic accounts for heteroskedastic and autocorrelated (HAC) errors. If there were more than one instrument, the critical values would have to be taken from Olea and Pflueger (2013) or computed in a Monte Carlo simulation. Generally, the F-statistic will be high if the instrument explains a meaningful portion of the fluctuations in yields to maturity. If the F-statistic is however low, then the instrument does not explain enough variation of the endogenous variable. Another possibility would be that sovereign risk as reflected by yields to maturity is exclusively driven by fundamentals and there is no causality running the other way around. To mitigate concerns about the lead-lag exogeneity condition, lags of the instrument and the endogenous variables are added as controls as suggested in Stock and Watson (2018). A rule of thumb for assessing an instrument's relevance requires the effective F-statistic to be larger than 23.1.[13]

To align the frequency of the external instrument, $\Delta\sigma_{\tau}^{IT}$, for the estimation, it is aggregated on a monthly basis (see red line in Figure 4 for comparison). The monthly sums of the instrument are referred to as z_t. In the first stage yields to maturity are regressed on z_t and the control variables of the second stage. The first stage is thus given by

$$YTM_t^{IT,3Y} = \delta_0 + z_t\theta + \boldsymbol{\gamma}\boldsymbol{x}_t + \epsilon_t, \tag{2}$$

where ϵ_t is a random error, $\boldsymbol{x}_t$ is a vector of the control variables. In the second stage, impulse response functions (IRF) are directly estimated with local projections,

$$y_{t+h} = \alpha_h + \beta_h \widehat{YTM}_t^{IT,3Y} + \boldsymbol{\phi}\boldsymbol{x}_t + u_{t+h},\ h = 0, 1, ..., H-1, \tag{3}$$

where α_h is a constant, β_h traces out the IRF, u_{t+h} is an error term and h denotes the respective propagation horizon. $\boldsymbol{x}_t$ contains the lags of all system variables: Italian yields to maturity, year-on-year log growth in industrial production, unemployment rate, inflation as measured by the year-on-year log growth of the Harmonised Index of Consumer Prices (HICP), financial conditions as measured by bank interest rates for corporations, and yields to maturity for Germany. The latter variables are included in percentage points. The controls also encompass lags of z_t. This serves to ensure that the effect of the instrumented shock in $t = 0$ on variables at horizon $t + h$ are not confounded with the effect of shocks at $t > 0$ due to potential serial correlation. For a detailed exposition of the regression variables and the underlying data sources, please refer to Table A2 in the Appendix. Note that credit default swaps (CDS) might be preferable over yields to maturity as a proxy for sovereign risk. However, I opt for yields to maturity due to their availability over the sample period from 2000 to 2019 (CDS start being available for Italy from 2007 going forward). The choice of included variables is based on the regression

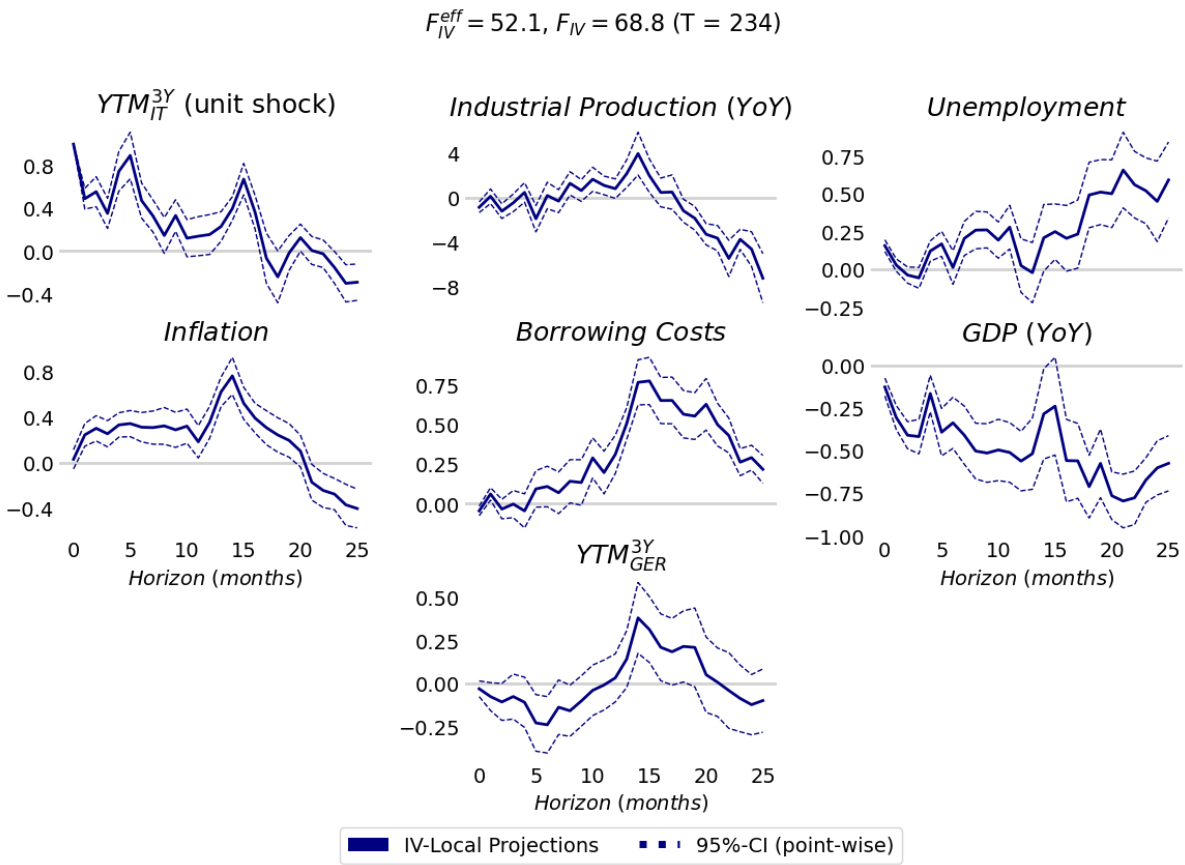
[13] Andrews et al. (2019) propose another rule of thumb for the effective F-statistic of 10 for one instrument and one endogenous variable, resembling the threshold for the case of homoskedastic errors. This value is however not theoretically motivated but an empirical observation.

setting used in Bahaj (2019), except for the fiscal balance. Monthly GDP is interpolated following Chow and Lin (1971), see Appendix for details on the construction. For comparison, I also estimate a local projection model for which the instrument (shock series) is directly plugged into the Equation without a first stage,

$$y_{t+h} = \nu_h + \overline{\beta}_h z_t + \boldsymbol{\psi} x_t + \zeta_{t+h}^h, \quad h = 0, 1, \ldots, H-1. \tag{4}$$

This Equation is run to shed light on the noise of the respective shock series. Since there is no first stage to reduce noise in Equation 4, a comparison with the impulse response functions of the LP-IV regression can serve as an indication of the noise contained in the respective instrument.

Figure 6: Impulse Response Functions



Notes: Impulse response functions LP-IV regression as specified in Equations 2 and 3. The lag order of $p = 4$ is chosen by AIC criterion. F_{IV} corresponds to the ordinary homoskedastic F-statistic. F_{IV}^{eff} corresponds to the effective F-statistic from Olea and Pflueger (2013). Underlying data spans the period from January 2000 to June 2019.

The impulse response functions from the IV-LP estimation are displayed in Figures 6. Figure A2 in the Appendix additionally displays the local projections without a second stage along the lines of Equation 4. Inspection of the graphs reveals that the effective

F-statistic comfortably exceeds the threshold of 23.1 and therefore its relevance cannot be rejected based on the data for any conventional significance level. Figure A2 shows that one-stage estimation leads to noisier IRF's, the general picture however remains unchanged.[14] The similarity of LP and the LP-IV regression results speaks in favor of the instrument's quality.

The overall economic picture emerging from the regression analysis is a dampening effect of sovereign risk on the broader economy. In response to an increase in sovereign risk output declines, borrowing costs increase and unemployment rises. Additionally, inflation goes up and industrial production declines, despite a brief pick-up after one year. The German yields to maturity initially decrease slightly, consistent with a so-called "flight to safety" dynamic, i.e. investors flock to the safer German bonds in response to an increase in sovereign risk in the peripheral country Italy (cf. Lane (2013)). After a year, German yields to maturity record a short increase and remain flat afterwards. Given the economic importance of Italy within the eurozone, the increase in German yields could reflect the interconnected risk of the two countries.

These results are in line with the theoretical literature. The increase in inflation in response to higher sovereign risk aligns with the Fiscal Theory of the Price Level (Leeper (1991); Cochrane (2021)), which has recently drawn renewed interest with inflation rates running high around the globe. According to this theory, the real value of nominal government debt must in euqilibrium equal the present value of real primary surpluses. The theory posits that the price level will move such that this relation holds. Importantly, the theory states that investors' assessment regarding a sovereign's fiscal discipline matters for inflation. If markets start doubting a country's willingness to repay its debt, the present value of government surpluses diminishes. For a fixed nominal stock of government bonds, prices then have to rise accordingly. The theory therefore implies an inflationary effect of sovereign risk.

Another well studied transmission channel by which sovereign risk might leak into the broader economy is through financial intermediaries. Corsetti et al. (2013) for example argue that as a consequence of higher sovereign risk, domestic firms have a harder time to raise capital. As the sovereign is likely to resort to some counter measures to maintain sovereign sustainability, firms run a higher risk of being faced with higher taxes or capital controls. Banks may also reduce lending or demand higher interest from businesses when government debt sours on their balance sheets. The latter channel has been investigated for example by Gennaioli et al. (2014). To the extent that markets interpret an increase in sovereign risk as an indication of immanent higher funding needs of a country, interest

[14] Note that the one-stage IRF's have been multiplied by minus one so that they more easily compare to the IRF's from the IV regression, which uses yields instead of bond prices.

rates may increase in anticipation of the ensuing crowding-out effect. Since sovereigns compete with private companies for loanable funds, this can increase borrowing costs for the entire private sector. The crowding-out effect has been studied for example by Laubach (2009) and Lian et al. (2020). The results in Figure 6 line up with these theoretical predictions. It seems however that borrowing costs do not immediately shoot up but increase roughly a year after the shock. Maybe this reflects the time it takes for banks to pass on the increased cost. The increase in borrowing costs is robust to alternative definitions of borrowing costs as is shown in Section 5.

The decline in output is in line with the previous statements about increasing borrowing costs. However, there are other immediate channels running from sovereign risk to output. The increased sovereign risk may lead economic agents to believe higher consumption taxes are immanent or that the sovereign will be tempted to resort to financial repression to deleverage (cf. Cochrane (2011)). This in turn, could result in households cutting back on consumption today thereby lowering domestic consumption. Another channel potentially depressing output is through a reduced fiscal multiplier, a mechanism explored by Corsetti et al. (2013). Assuming that the central bank does not react strongly enough to an increase in sovereign risk by lowering interest rates, the fiscal multiplier can be reduced drastically. The critique wielded against the restraint of the European Central Bank (cf. Mody (2018)) support the potential importance of this mechanism.

In line with subdued economic activity, the unemployment panel in Figure 6 points to increases of about half a percentage point in the longer run.

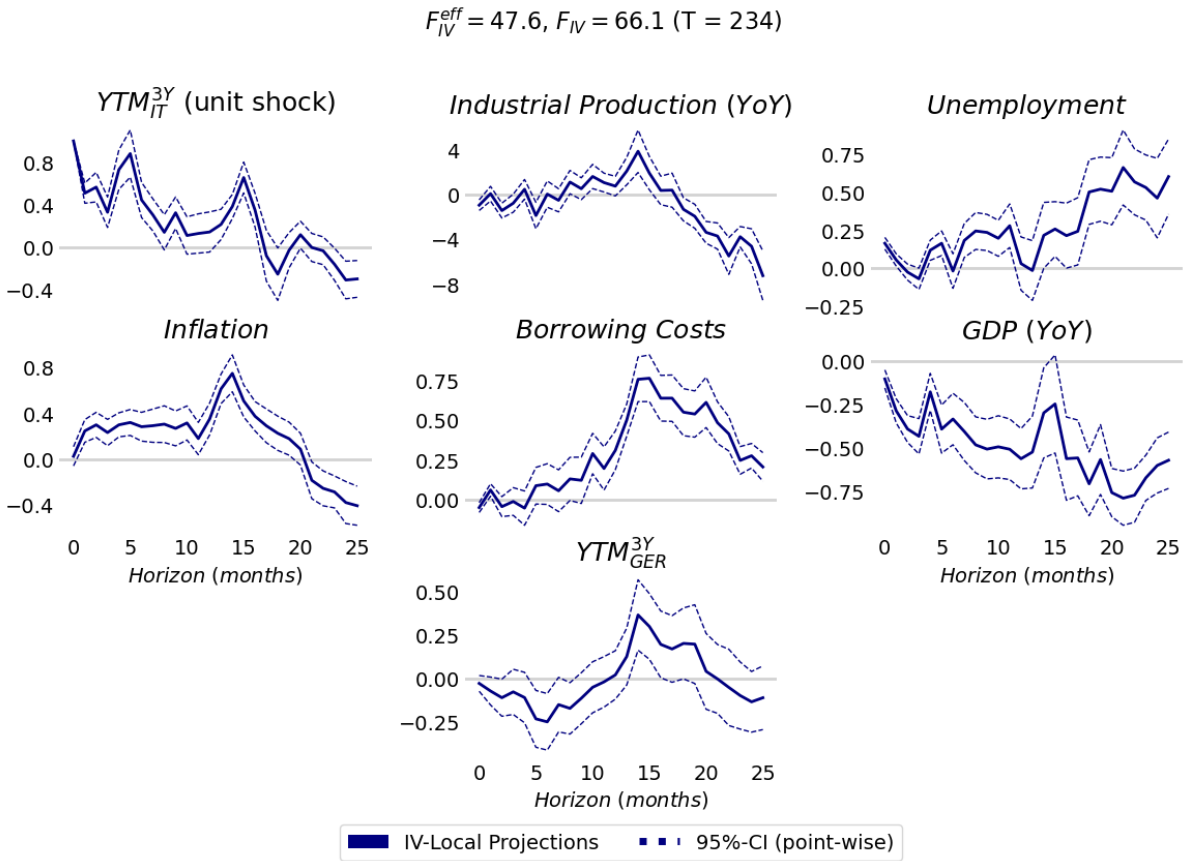
After remaining relatively flat for roughly ten months, industrial production increases after a year accompanied by higher inflation. Thereafter industrial production registers negative growth rates. Possibly, higher inflation allow firms to post higher prices or makes their products more competitive in international markets. This would be in line with the general observation that Italian firms have turned to exporting their products in the face of sagging domestic demand (cf. Zamagni (2018)). Eventually, the impact is however unambiguously negative in line with the outlined theoretical considerations.

5 Robustness

The previous discussion has shown that the instrument series constructed for this study is subject to some degree of measurement error. Data releases arguably represent the most important exclusion group. In fact, running the IV-LP regression with only the textual filter on data releases already yields results qualitatively very similar to the benchmark,

but with lower F-statistics (cf. Figure A3). The lower F-statistics follow from the lower signal-to-noise ratio in the presence of more confounding events such as corporate events, monetary policy etc. To gain additional confidence regarding the validity of the filtering procedure, I follow Bahaj (2019) and use an external calendar from Bloomberg to exclude timestamps that overlap with data releases on the country level, European level and a selection of international data releases. Results are displayed in Figure 7. While

Figure 7: Impulse Response Functions (External Calendar)

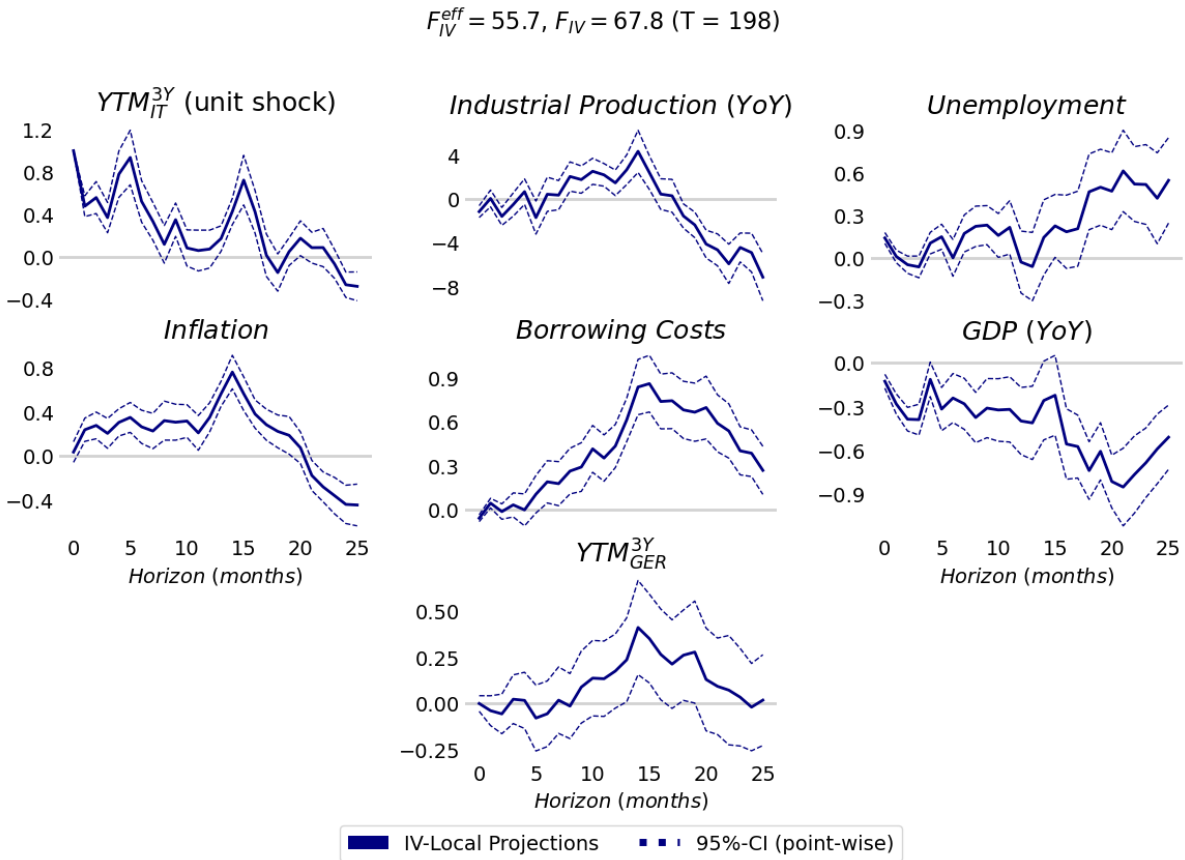


Notes: Impulse response functions from LP-IV regression as specified in Equations 2 and 3. Configurations are equivalent to the benchmark, except from additional use of an external calendar. F_{IV} corresponds to the ordinary homoskedastic F-statistic. F_{IV}^{eff} corresponds to the effective F-statistic from Olea and Pflueger (2013). Underlying data spans the period from January 2000 to June 2019.

the effective F-statistic drops slightly, the impulse response functions hardly change.

Another issue to be explored in this section concerns the measure for borrowing costs. The benchmark uses the interest rate that is charged by credit and other institutions for new business in the non-financial sector. Another (possibly more) suitable choice would be the corporate cost of borrowing series provided by the Bank of Italy. The calculation is specifically geared towards capturing borrowing costs. Unfortunately, using this series

Figure 8: Impulse Response Functions (Alternative Borrowing Cost)



Notes: Impulse response functions from LP-IV regression as specified in Equations 2 and 3. Configurations are equivalent to the benchmark, except from the borrowing cost measure. F_{IV} corresponds to the ordinary homoskedastic F-statistic. F_{IV}^{eff} corresponds to the effective F-statistic from Olea and Pflueger (2013). Underlying data spans the period from January 2003 to June 2019.

results in clipping the data set, because it is only available from 2003 going forward. The impulse response functions based on this alternative measure of borrowing costs are shown in Figure 8. Generally, the results look very similar to the benchmark. Conspicuously however, under this alternative specification borrowing costs pick up slightly earlier. The lagged pass-through documented in the benchmark specification may thus be partly driven by the variable choice.

A rather *ad hoc* choice meriting further investigation is the selected length of time windows to record changes in bond prices. The benchmark specification opted for a relatively short time window of ten minutes before and after the adjustment period (cf. Figure 3). Other specifications are conceivable. Figure 9 demonstrates that extending the window before and after the adjustment period to 20 minutes does not materially affect the results. It does however lower the effective F-statistic, which possibly indicates that larger windows pick up more noise. Given that the shocks are derived from a news feed and therefore inherently come with a small lag when compared to a monetary policy announcement for example, the narrower time windows seem warranted for the benchmark specification.

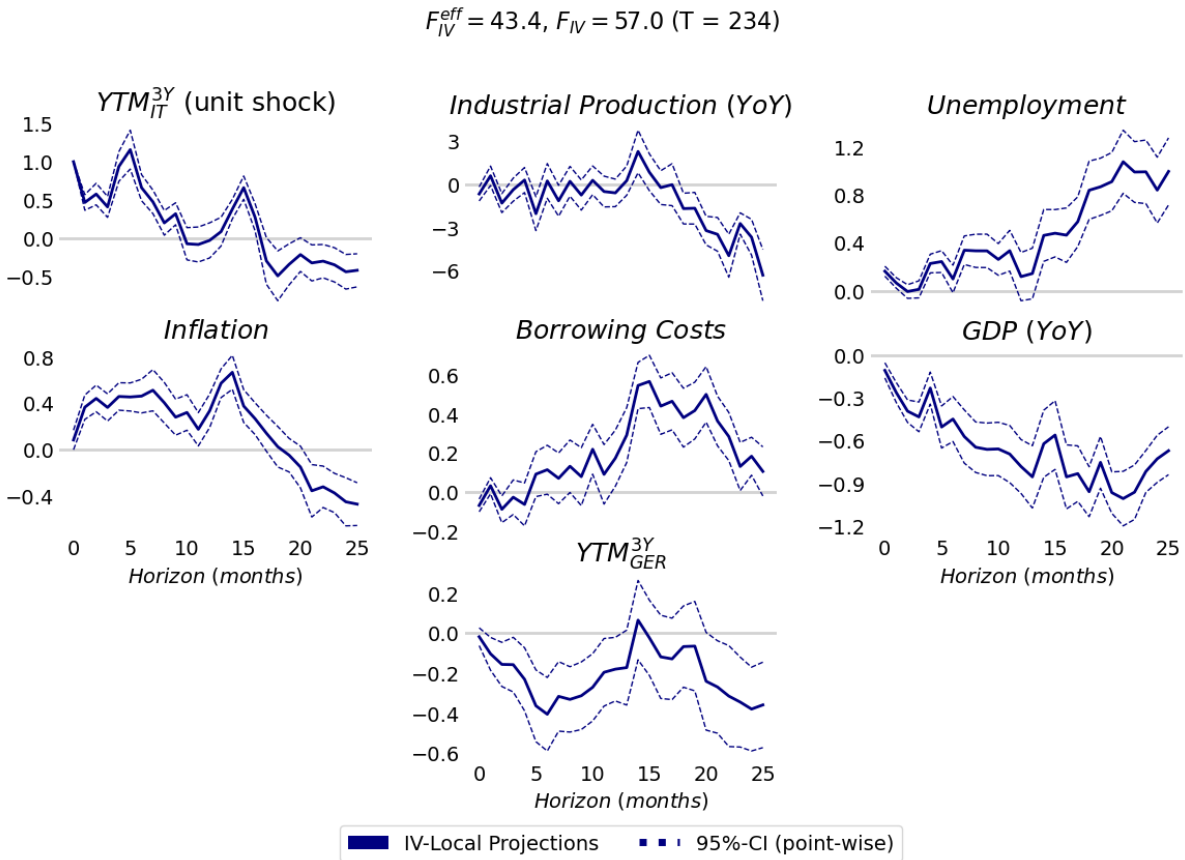
A further robustness analysis provided in the Appendix varies the set of monthly indicators used to construct the monthly GDP series.

6 Conclusion

The proposed identification produces a strong instrument for Italy and yields results in line with theoretical predictions, robust to multiple configurations. Specifically, the results lend empirical support to the sovereign risk bank nexus and the Fiscal Theory of the Price Level. Higher sovereign risk is passed on by banks through an increase in interest rates to the private sector. This observation is in line with the discussed balance sheet channel and the perceived higher riskiness of private sector firms. Unfortunately, the set-up does not allow distinguishing between these mechanisms. According to the Fiscal Theory of the Price Level, investors' expectations about the fiscal commitment to service debt are linked to the price level because the present value of primary surpluses equates with real outstanding bonds. The price level will adjust such that this relation holds in equilibrium. The identified events impact sovereign risk and consequently the factor at which primary surpluses are discounted. The observed inflationary response to an increase in sovereign risk is in line with the predicted price adjustment. More generally, the documented dampening effect on economic activity cautions against the consequences of an overly lenient stance on public debt.

In future work, it would be interesting to use this instrument to analyze the implications

Figure 9: Impulse Response Functions (Alternative Time Window)



Notes: Impulse response functions from LP-IV regression as specified in Equations 2 and 3. Configurations are equivalent to the benchmark, except from the chosen time window. F_{IV} corresponds to the ordinary homoskedastic F-statistic. F_{IV}^{eff} corresponds to the effective F-statistic from Olea and Pflueger (2013). Underlying data spans the period from January 2000 to June 2019.

of sovereign risk in a richer economic model set-up to allow for more general conclusions. A natural extension of the presented idea would be to include multiple countries. While results are expected to be qualitatively similar (at least for Southern) countries, a comparison could lead to a better understanding of national dynamics. Also, the textual information associated with each event could be used to identify different shock categories. This could aid in painting a more nuanced picture with respect to the kind of political events driving sovereign risk.

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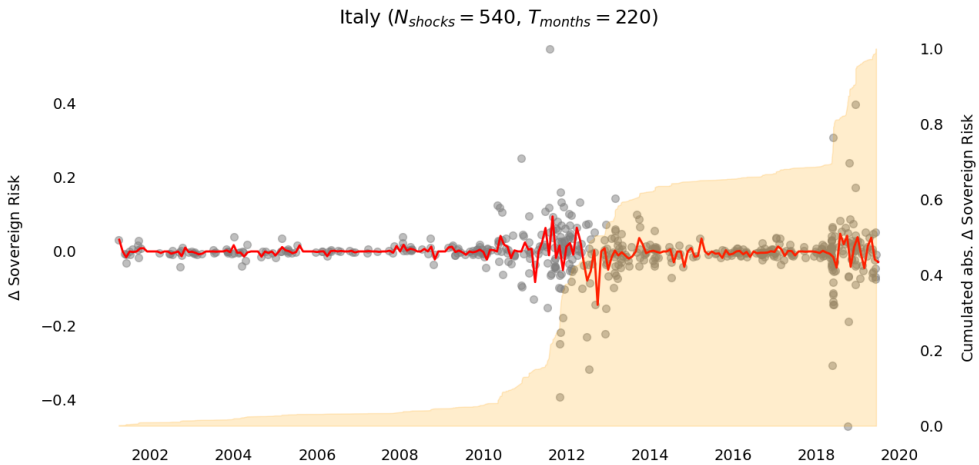
Appendix

Figure A1: Shock Time Series (no text filter)



Notes: Time series plot for the identified shock series without any textual filtering (for bonds with 3 year maturity). The red line represents the monthly sums.

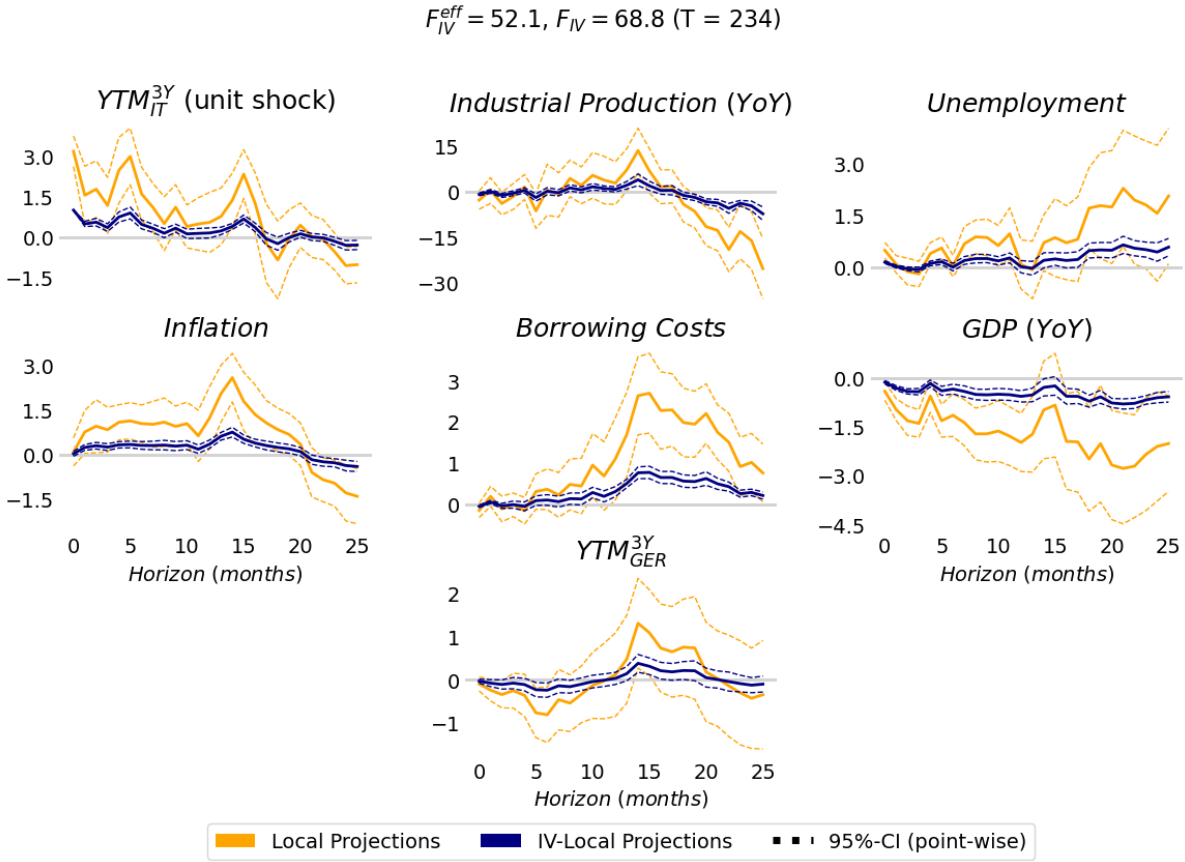
Table A1: 30 Largest Absolute Shocks

Timestamp (CET)	Story-ID	First Headline	$\Delta\sigma_\tau^{IT}$
2012-06-26 16:27	nR1E8GA02C	ITALY PM MONTI SAYS JOINT EUROPEAN SOLUTIONS NEEDED TO PREVENT SOME COUNTRIES FALLING INTO RECESSION SPIRAL	-0.231
2011-11-07 12:58	nR1E7LJ00Y	ITALY'S BERLUSCONI SAYS RUMOURS OF HIS RESIGNATION UNFOUNDED-ANSA NEWS AGENCY	-0.218
2018-10-08 10:49	nR1N1VZ00V	ITALY DEPUTY PRIME MINISTER SALVINI SAYS MOSCOVICI AND JUNCKER ARE REAL ENEMIES OF EUROPE	-0.188
2011-11-25 10:59	nL5E7MP0XX	ITALY TRYING TO PERSUADE ITS FIRMS TO DIVERSIFY FROM USING IRANIAN OIL -FOREIGN MINISTRY	-0.179
2011-07-14 11:38	nR1E7HU012	ITALIAN GOVT CALLS CONFIDENCE VOTE IN SENATE OVER AUSTERITY PACKAGE	-0.151
2018-06-06 15:53	nL5N1T843R	ITALY'S NEW ENVIRONMENT MINISTER SAYS ITALIAN STAGE OF TAP PIPELINE PROJECT LOOKS 'POINTLESS', WILL BE REVIEWED	-0.142
2018-05-28 10:53	nR1N1SG016	ITALY'S ANTI-ESTABLISHMENT 5-STAR "EVALUATING" POSSIBLE COALITION WITH LEAGUE IN NEXT ELECTIONS - 5-STAR SOURCE	-0.117
2011-11-08 16:11	nR1E7LJ016	ITALIAN LOWER HOUSE SPEAKER OPENS VOTE KEY TO BERLUSCONI'S FUTURE	-0.099
2013-02-14 10:10	nI6E8G700Y	ITALY POLICE ARREST MONTE PASCHI FORMER FINANCIAL DIRECTOR BALDASSARRI - INVESTIGATIVE SOURCES	-0.099
2013-09-30 14:37	nR1N0G102J	AS MANY AS 20 SENATORS FROM FORMER ITALIAN PM BERLUSCONI'S PDL PARTY READY TO FORM BREAKAWAY PARTY - PDL SOURCE	0.087
2011-10-12 10:24	nR1E7KT00C	ITALY'S PRESIDENT SAYS WORRIED ABOUT ACUTE TENSIONS AND UNCERTAINTY IN GOVT AFTER LOSS OF KEY VOTE	0.082
2012-02-08 10:00	nL5E8D82NW	TUNISIA TO TEMPORARILY CEDE ITS SHARE OF ALGERIAN GAS SUPPLIES TO ITALY DUE TO COLD WEATHER, SAYS AN OFFICIAL IN TUNISIAN INDUSTRY MINISTRY	-0.082
2019-06-07 16:22	nR1N20Z014	ITALY'S LEAGUE CABINET UNDERSECRETARY GIORGETTI SAYS "MINI-BOT" SCHEME IS A POSSIBILITY - ITALIAN NEWS AGENCY AGI	-0.074
2018-05-21 09:51	nR1N1SG003	ITALY'S 5-STAR, LEAGUE LEADERS TO SEE PRESIDENT IN THE AFTERNOON, EXPECTED TO PROPOSE PRIME MINISTER OF COALITION GOVT - STATEMENT	0.067
2013-01-03 09:18	nR1N09M00H	ITALY PM MONTI SAYS BOND SPREAD HAS FALLEN DUE TO A RETURN OF FOREIGN, ITALIAN INVESTOR FAITH IN ITALY, SAYS HOPES TREND CONTINUES	-0.067
2013-10-02 09:43	nR1N0HR006	ITALY PM LETTA SAYS FUTURE OF GOVERNMENT MUST BE KEPT SEPARATE FROM BERLUSCONI LEGAL PROBLEMS	0.067
2013-03-07 12:03	nI6N0BJ012	ITALY COURT SENTENCES BERLUSCONI TO 1 YEAR IN JAIL IN WIRETAP TRIAL - JUDGE SAYS IN COURT	-0.064
2018-09-17 11:01	nEMN2TQZOM	NHC SAYS TROPICAL DEPRESSION FLORENCE CONTINUES TO PRODUCE WIDESPREAD HEAVY RAINS OVER PARTS OF NORTH CAROLINA AND NORTHEASTERN SOUTH CAROLINA INTO WESTERN VIRGINIA. FLASH FLOODING WILL CONTINUE OVER PORTIONS OF THE WESTERN MID-ATLANTIC REGION	0.064
2011-12-16 13:07	nR1E7ML01P	ITALY GOVERNMENT WINS CONFIDENCE VOTE IN LOWER HOUSE ON AUSTERITY MEASURES, PACKAGE MOVES TO SENATE	0.063
2013-03-01 11:21	nR4E8JL02D	RUSSIAN FOREIGN MINISTRY SAYS DECISIONS MADE AT "FRIENDS OF SYRIA" MEETING IN ROME ENCOURAGE EXTREMISTS TO SEEK THE GOVERNMENT'S OVERTHROW	0.059
2011-10-14 14:22	nR1E7KT011	ITALIAN PM BERLUSCONI WINS GOVT CONFIDENCE VOTE	0.059
2011-02-02 10:11	nLDE7110MR	SPANISH 5-YEAR CREDIT DEFAULT SWAPS FALL TO 209 BPS, DOWN 20 BPS ON DAY - MARKIT	-0.057
2014-02-13 15:58	nI6N0LB010	ITALY'S BLUE-CHIP INDEX AND ITALY'S 10-YR BTP CUT LOSSES, TRADERS CITE RENZI'S WORDS ON NEED FOR POLITICAL CHANGE	0.056
2019-05-14 13:47	nS8N22507X	ITALY'S DEPUTY PM SALVINI SAYS GOVT READY TO EXCEED 3% BUDGET DEFICIT LIMIT OR ALLOW DEBT TO SURPASS 130-140% IF NECESSARY TO SPUR JOBS	-0.054
2012-02-17 09:38	nB4E8CG01O	GERMANY'S MERKEL POSTPONES PLANNED FRIDAY TRIP TO ROME AND MEETING WITH ITALY'S MONTI -GOVT SOURCE	-0.053
2019-06-05 08:58	nR1N20Z00S	ITALY'S LEAGUE WANTS END TO STRUCTURAL DEFICIT CALCULATIONS, ONLY DEFICIT RULE SHOULD BE 3% HEADLINE DEFICIT CAP - BORGHI	0.053
2012-08-29 14:33	nB4E7HM020	GERMANY'S MERKEL SAYS CONVINCED THAT ITALIAN REFORMS WILL BEAR FRUIT	0.051
2018-05-23 10:50	nR1N1SG00B	ITALY 5-STAR LEADER DI MAIO SAYS GIUSEPPE CONTE "ABSOLUTELY" REMAINS PM CANDIDATE FOR LEAGUE AND 5-STAR	-0.051
2018-10-02 09:58	nR1N1RB01P	ITALY'S LEAGUE LAWMAKER BORGHI SAYS LEAVING THE EURO IS NOT IN THE GOVERNMENT'S PROGRAMME AND IT HAS NO PLANS TO DO SO	0.049
2012-02-06 10:28	nL5E8D618U	ITALY INDUSTRY MINISTER SAYS ITALIAN GAS SITUATION "CERTAINLY CRITICAL"	0.048

Table A2: Regression Variables

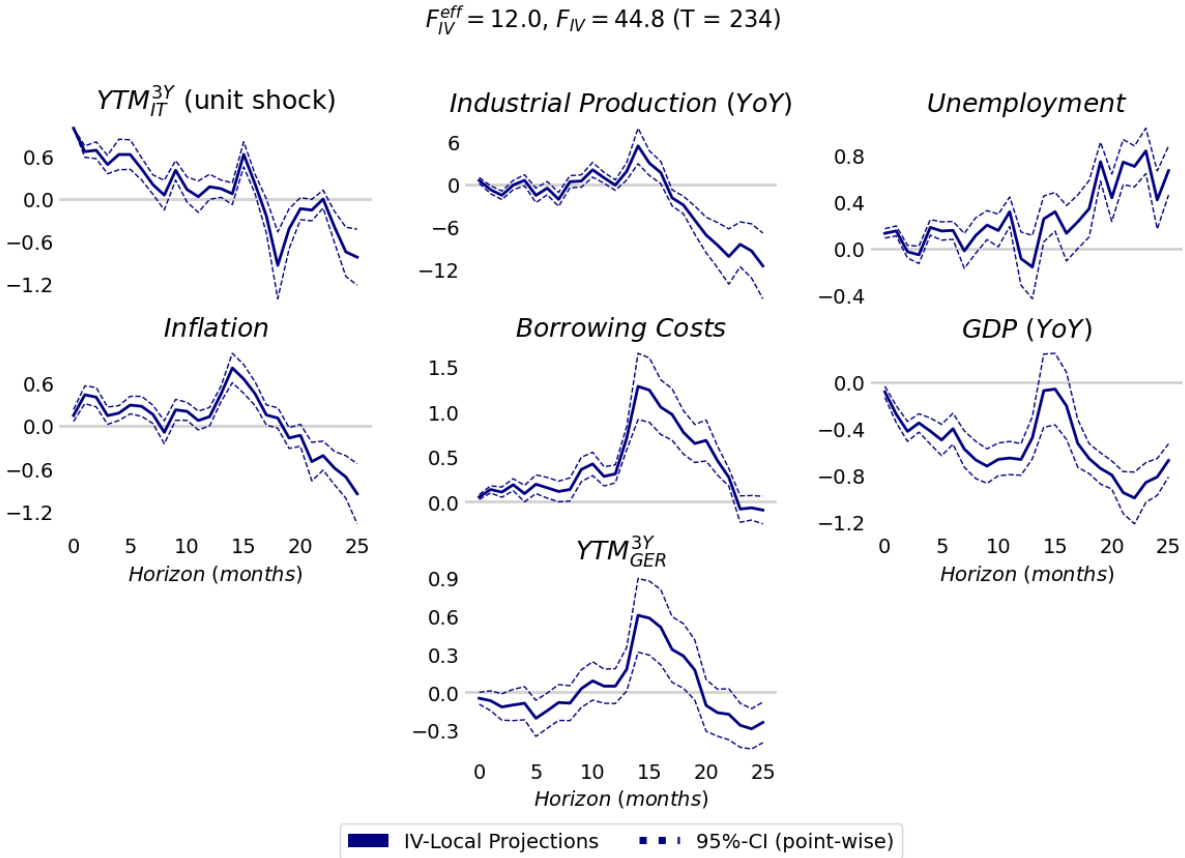
Variable	Description	Source	Table / Mnemonic	Unit	Availability
industrial production	industrial production according nace_2 (B-D)	ISTAT (drawn from eurostat; Table sts_inpr_m)	Table: sts_inpr_m	YoY-log-change (calendar adjusted)	2000-2019
unemployment	unemployment rate total	ISTAT (drawn from eurostat; Table une_rt_m)	Table: une_rt_m	in % (seasonally adjusted)	2000-2019
inflation	harmonized index of consumer prices (I15)	Eurostat	prc_hicp_midx; CP00 (I15)	YoY-log-change	2000-2019
borrowing costs	bank interest rates - loans to corporations (new business) - Italy	Bank of Italy (drawn from ECB)	MIR.M.IT. B.A2A.A.R.A.2240.EUR.N	interest in %	2000-2019
borrowing costs (alt.)	cost of borrowing for corporations - Italy	ECB	MIR.M.IT. B.A2I.AM.R.A.2240.EUR.N	interest in %	2003-2019
gdp	monthly interpolation of GDP	see below			2000-2019
ytm germany	Refinitiv Italy Government Benchmark Bid Yield 3 Years	Refinitiv	TRBD3YT	yield to redemption in %	2000-2019
ytm italy	Refinitiv Germany Government Benchmark Bid Yield 3 Years	Refinitiv	TRIT3YT	yield to redemption in %	2000-2019

Figure A2: Shock Time Series (with LP)



Notes: Impulse response functions for the benchmark specification, displaying also the (one-stage) estimation described in Equation 4. Underlying data spans the period from January 2000 to June 2019.

Figure A3: Shock Time Series (Only Data Release Filter)



Notes: Impulse response functions (LP-IV) as specified in Equations 2 and 3. Benchmark specifications are maintained, but events fetched by the textual filters are included. Underlying data spans the period from January 2000 to June 2019.

Computation Monthly GDP

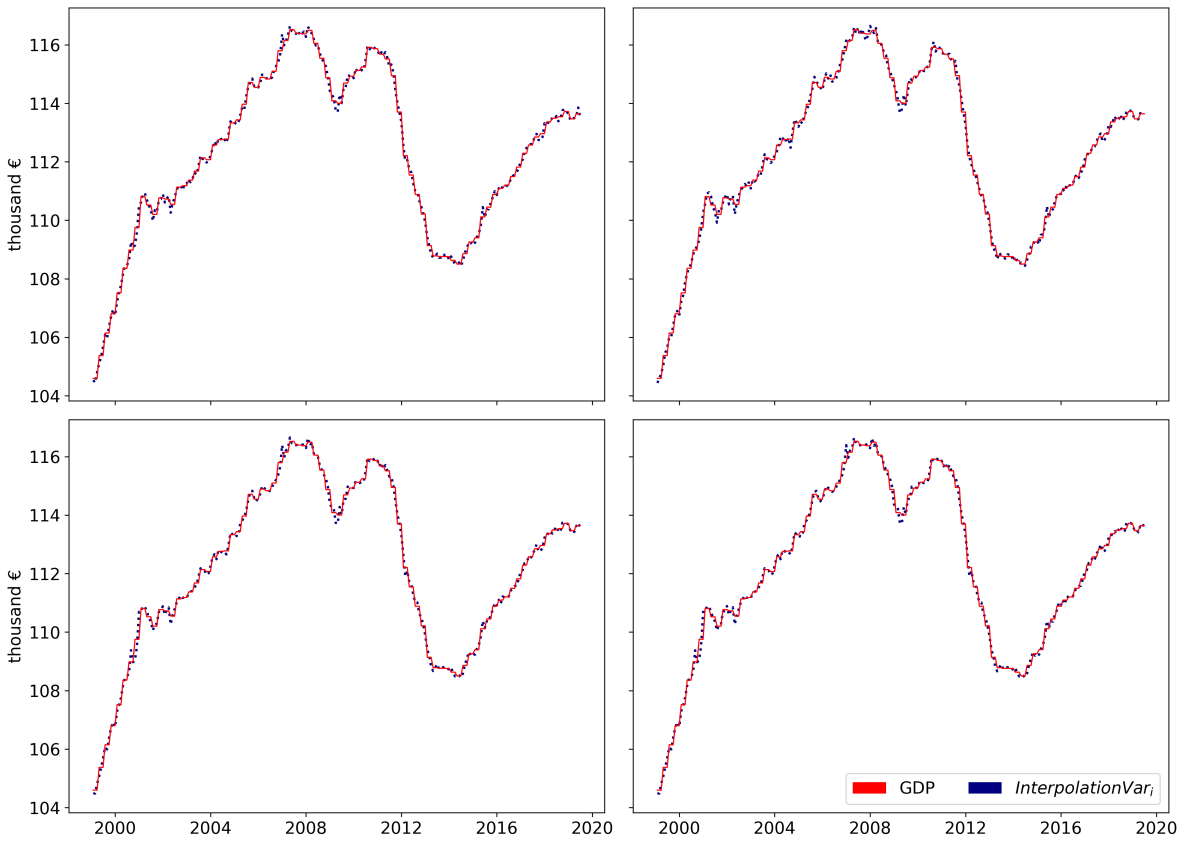
Monthly GDP is computed using the Chow and Lin (1971) distribution method. The implementation follows the matlab package 'Temporal disaggregation' (by Enrique M. Quilis). The monthly indicator variables used in the estimation are shown in Table A3. Aside from standard economic indicators such as industrial production (and its components) and consumer confidence, variables were selected to account for the structure of the Italian economy. Foreign tourists contribute largely to Italian output and native Italians also spend their vacations in Italy in large proportions (cf. Zamagni (2018)). Overall tourism is estimated to add roughly 10% to domestic output. While net exports contribute little to Italian output, it may still affect business cycle fluctuations since a considerable portion of Italian firms produce for the foreign market. Following these considerations, the benchmark interpolation (variant 1) includes numbers of national and foreign tourists plus the effective real exchange rate. Italy's economy is reliant on foreign gas and oil. These variables are added in the third variant. Figures A5 through A7 show that the selection of indicators does not materially affect results. Figure A4 shows the time series plots for all four variants (variant 1 is used in the benchmark specification).

Table A3: Indicators for Monthly Interpolation real GDP

Variable	**Source**	**Var1**	**Var2**	**Var3**	**Var4**
Industrial Production	eurostat (sts_inpr_m;B-D_F)	✗	✗	✗	✓
Mining / Quarrying	eurostat (sts_inpr_m;B)	✓	✓	✓	✗
Manufacturing	eurostat (sts_inpr_m;C)	✓	✓	✗	✗
Electricity, gas, steam ...	eurostat (sts_inpr_m;D)	✓	✓	✗	✗
MIG: capital goods	eurostat (sts_inpr_m;MIG_CAG)	✓	✓	✓	✗
MIG: consumer goods	eurostat (sts_inpr_m;MIG_COG_X_FOOD)	✓	✓	✓	✗
Consumer confidence	datastream (ITCNFCONQ)	✓	✓	✓	✓
National tourism (nace_2: I551-I553)	eurostat (sts_inpr_m;NAT_I551-I553)	✓	✓	✓	✓
Foreign tourism (nace_2: I551-I553)	eurostat (sts_inpr_m;FOR_I551-I553)	✓	✗	✗	✓
Real Effective Exchange Rate (EU)	eurostat (sts_inpr_m;REER_EU28_CPI)	✓	✓	✓	✓
Oil Price	Oil Price (Brent - Europe; Fred: DCOILBRENTEU)	✗	✗	✓	✗
Gas Price	Gas Price (Henry Hub; Fred: MHHNGSP)	✗	✗	✓	✗

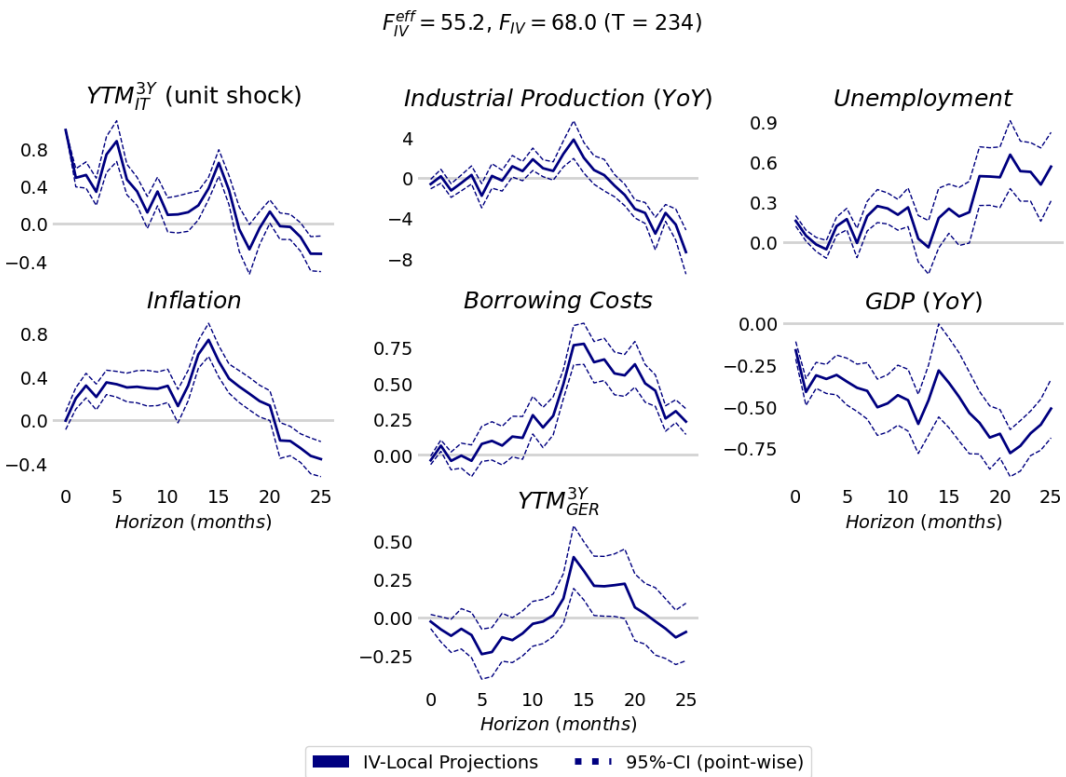
Notes: The GDP series (`CLV15_MNAC`) was taken from eurostat table `namq_10_gdp`; Series from table `tour_occ_nim` are seasonally adjusted by the author using the package of the U.S. Bureau of the Census X-13ARIMA-SEATS Seasonal Adjustment Program (from 'statsmodel' package python).

Figure A4: Monthly GDP Interpolation



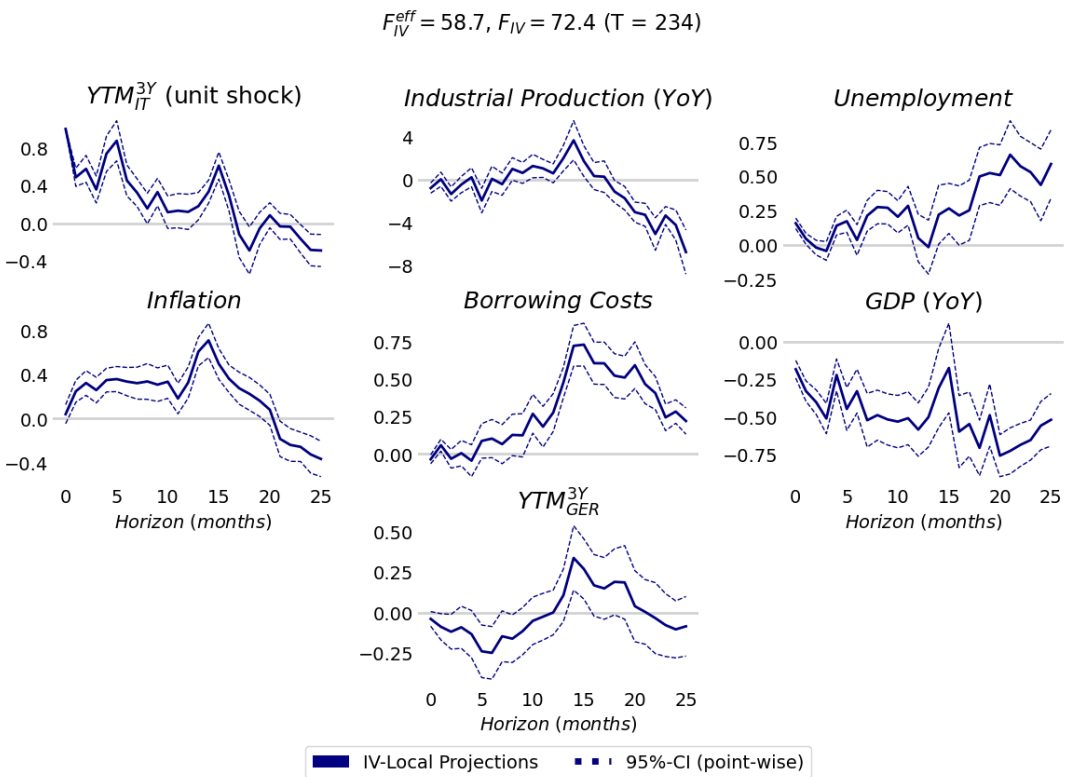
Notes: Monthly time series plots for the different variants estimated with the Chow and Lin (1971) method, following the matlab implementation in the 'Temporal disaggregation' package (by Enrique M. Quilis). Quarterly GDP is divided by three to better compare to the monthly interpolations.

Figure A5: Impulse Response Functions (Alt. Monthly GDP Variant 2)



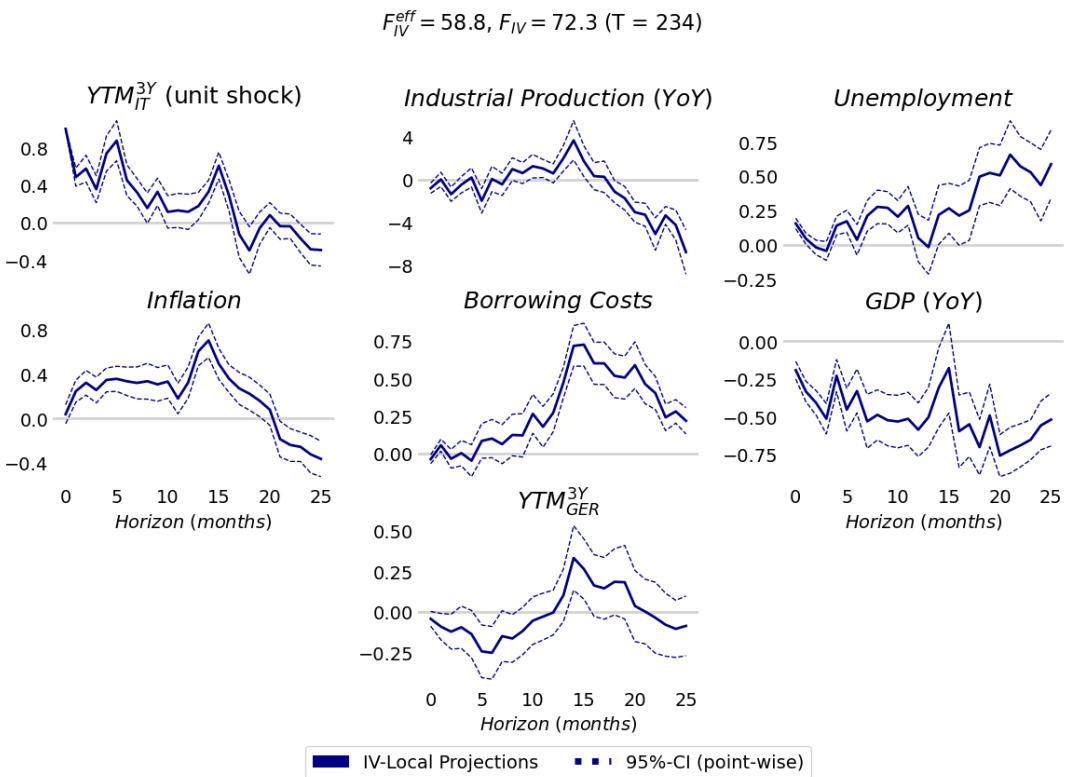
Notes: Impulse response functions (LP-IV) as specified in Equations 2 and 3. Benchmark specifications are maintained while the monthly GDP series is based on indicators in the respective column of Table A3. Underlying data spans the period from January 2000 to June 2019.

Figure A6: Impulse Response Functions (Alt. Monthly GDP Variant 3



Notes: Impulse response functions (LP-IV) as specified in Equations 2 and 3. Benchmark specifications are maintained while the monthly GDP series is based on indicators in the respective column of Table A3. Underlying data spans the period from January 2000 to June 2019.

Figure A7: Impulse Response Functions (Alt. Monthly GDP Variant 4)



Notes: Impulse response functions (LP-IV) as specified in Equations 2 and 3. Benchmark specifications are maintained while the monthly GDP series is based on indicators in the respective column of Table A3. Underlying data spans the period from January 2000 to June 2019.

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