

FUTURE POLICY AND INFORMATION DISSEMINATION: A NATURAL LANGUAGE PROCESSING APPROACH

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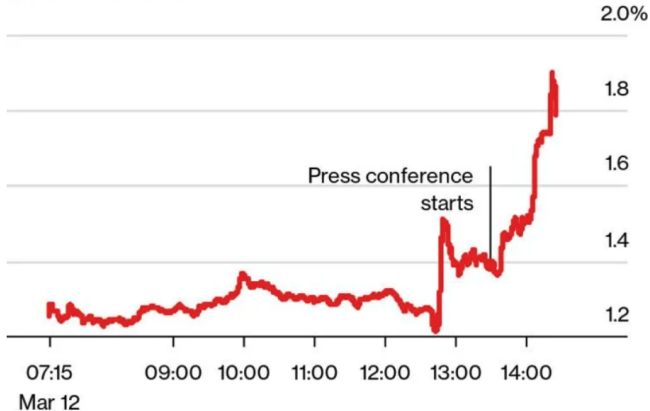
March 31, 2020

LAGARDE'S WORDS MATTER

Faux Pas

'We are not here to close spreads,' – Christine Lagarde on March 12

Italian 10-year yield



Source: Bloomberg

Bloomberg

MOTIVATION

- ▶ Which words matter the most in central banks communications?
 - ▶ A lot depends on what the market is expecting
- ▶ A list of such words - a **Dictionary** - useful for analyzing central bank communications and their effect on market
- ▶ We construct the first monetary policy (MP) dictionary
 - ▶ European context helps us controlling for market expectations on announced policy
 - ▶ Trained on new intra-day level return data
- ▶ Question: Do markets react to learning about **current economic conditions** or **future bank actions**?

LIT REVIEW

▶ **Central Bank Communication**

- ▶ Lucca-Trebbi (2011), Hansen-McMahon (2015), Hansen-McMahon-Prat (2018), Vedolin et al (2019).
- ▶ Schmeling-Wagner (2019), use tone measure on ECB press conferences during monetary policy change
 - ▶ Find that negative tone lowers financial returns.

▶ **Text Analysis**

- ▶ Loughran-McDonald (2011), Develop financial speech classification.
- ▶ Gentzkow-Shapiro (2010), Baker et al. (2016), Hassan et al (2019), Gentzkow et al (2019)

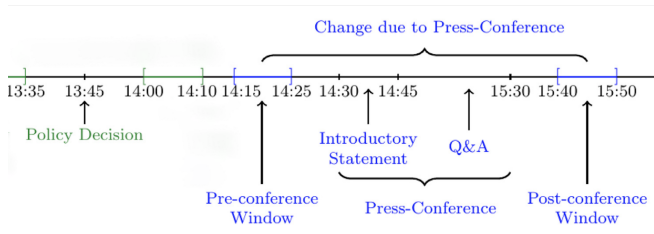
ECB MONETARY POLICY DECISION

- ▶ Governing Council takes its MP decision every six weeks
- ▶ **Press Release** with policy decision and no explanation published at 13:45 CET [Example](#)
- ▶ ECB President holds **Press Conference** at 14:30 CET
 - ▶ *Introductory Statement*: Rationale behind current decision [Example](#)
 - ▶ *Q&A Session* [Example](#)

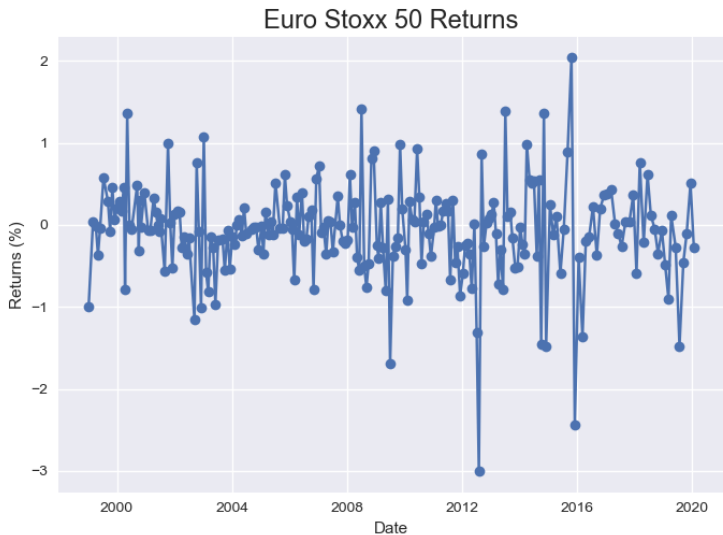


DATA

- ▶ All **ECB Press Conference (PC) Statements** from 1999 to 2019 (total of 226)
- ▶ Intra-day data on **Euro Stoxx 50** Altavilla et al(2019):
 - ▶ Change in median quote 10 minutes interval before the PC to the median quote in the 10 minutes interval after
 - ▶ High-frequency variation around statement window



EUROSTOXX RETURNS



BUILDING THE DICTIONARY

- ▶ Idea: Pick relevant phrases - **grams** - based on the reaction of Eurostoxx
 - ▶ Use ECB PC statements to train dictionary on high-frequency stock data **Eurostoxx Restrictions**
- ▶ Prepare ECB PC transcripts for textual analysis:
 - ▶ Remove numbers
 - ▶ Remove punctuations
 - ▶ Remove stop words (e.g., very, and, of, for, etc.)
 - ▶ Strip whitespace
 - ▶ Stem words
- ▶ Get unigrams/bigrams/trigrams, exclude Q&A section
- ▶ Regress Eurostoxx on gram frequencies to establish link

OLS FRAMEWORK

- ▶ Run G regressions, where G total number of grams

$$Stoxx_t = a_g + b_g f_{g,t} + \epsilon_{g,t} \quad \forall g = 1, \dots, G$$

- ▶ $f_{g,t}$: # of times gram g appears at time t relative to total grams at t
- ▶ $Stoxx_t$: Eurostoxx return at time t
- ▶ Words in our dictionary will be ordered by the R^2 .

THE DICTIONARY: BIGRAMS

Unigrams

Positive	b/100	t	R ²	Negative	b/100	t	R ²
continued_decline	0.63	3.28	0.04	corporations_households	-1.32	-4.12	0.07
credit_private	0.53	2.75	0.03	loan_growth	-0.98	-3.76	0.06
stability_euro	0.26	2.25	0.02	heightened_uncertainties	-0.92	-3.18	0.04
broadly_similar	0.81	2.13	0.02	facilitated_appropriateness	-1.10	-2.96	0.03
financial_private	0.78	2.08	0.01	attended_commission	-0.83	-2.77	0.03
markets_economy	0.49	2.05	0.01	area_banking	-0.89	-2.72	0.03
improving_economic	0.39	2.03	0.01	households_adjust	-0.74	-2.70	0.03
june_eurosystem	0.39	1.99	0.01	higher_expected	-0.77	-2.66	0.03
broadly_line	0.48	1.98	0.01	survey_information	-0.69	-2.63	0.03
remains_lows	0.47	1.95	0.01	related_particular	-0.61	-2.54	0.02
put_place	0.62	1.93	0.01	commission_vice	-0.74	-2.50	0.02
markets_developments	0.37	1.92	0.01	first_quarter	-0.30	-2.47	0.02
economic_fundamentally	0.44	1.89	0.01	consolidation_efforts	-0.71	-2.45	0.02
meeting_also	0.52	1.88	0.01	underlying_growth	-0.73	-2.40	0.02

COMMENTS ON BIGRAMS

- ▶ Positive returns: Improved Economy/Private Credit/Market Development/Stability of the Euro/Remain Low
- ▶ Negative returns: Growth of Loans/Heightened Uncertainties/Survey Information
- ▶ Stronger results by historical periods
 - ▶ Before Great Recession **Before FG**
 - ▶ Forward Guidance **FG**

CURRENT ECONOMY - FUTURE POLICY

- ▶ In PCs the ECB provides rationale of policy decision and provides assessment of economy
 - ▶ Market participants also extract information on future course of policy
- ▶ Do market reacts to information on current economic activity or on future policy?
- ▶ Disentangle the two effects by looking at parts of speech:
 - ▶ Verb: Future Action. “We are not here *to close* spreads”
 - ▶ Adjective: Current state. “[. . .] market volatility remain *prominent*” **Example**.

BIGRAMS, ADJECTIVES

Positive	b/100	t	R^2	Negative	b/100	t	R^2
lows_hicp	0.63	2.81	0.03	weakness_quarter	-0.88	-4.07	0.06
annual_september	0.51	2.68	0.03	particular_tensions	-0.87	-4.03	0.06
continued_growth	0.44	2.59	0.02	currently_account	-1.07	-3.88	0.06
financial_commodity	0.73	2.59	0.02	key_basis	-0.72	-3.79	0.06
high_economy	0.54	2.50	0.02	potential_tensions	-0.91	-3.54	0.05
strong_area	0.24	2.49	0.02	modest_area	-0.90	-3.50	0.05
financial_supply	0.76	2.48	0.02	modest_growth	-0.69	-3.26	0.04
fiscal_line	0.57	2.45	0.02	ongoing_markets	-0.64	-3.11	0.04
annual_credit	0.58	2.41	0.02	euro_debt	-0.61	-3.07	0.04
domestically_risks	0.48	2.36	0.02	geopolitical_growth	-0.70	-3.01	0.03
annual_mfi	0.61	2.35	0.02	euro_tensions	-0.36	-3.00	0.03
real_demand	0.51	2.28	0.02	economic_sentiment	-0.76	-2.98	0.03
economic_forecast	0.43	2.27	0.02	euro_process	-0.54	-2.96	0.03
second_council	0.35	2.18	0.02	high_adjust	-0.72	-2.91	0.03

BIGRAMS, VERBS

Positive	b/100	t	R^2	Negative	b/100	t	R^2
emerging_economy	0.46	3.08	0.04	weighing_growth	-0.85	-5.16	0.10
increase_stability	0.46	3.02	0.03	dampening_factors	-1.04	-4.54	0.08
put_policies	0.66	2.69	0.03	dampening_number	-1.14	-4.23	0.07
increase_prices	0.25	2.57	0.02	dampening_growth	-0.56	-4.19	0.07
intensify_efforts	0.63	2.53	0.02	weighing_area	-0.85	-4.19	0.07
put_credit	0.82	2.52	0.02	dampening_area	-0.46	-3.57	0.05
reflecting_increase	0.27	2.51	0.02	looking_factors	-0.66	-3.01	0.03
keep_governing	0.35	2.49	0.02	expected_momentum	-0.51	-2.97	0.03
based_council	0.44	2.37	0.02	adjust_growth	-0.41	-2.90	0.03
increase_risks	0.30	2.35	0.02	remains_environment	-0.42	-2.89	0.03
compared_inflation	0.53	2.31	0.02	affecting_growth	-0.52	-2.88	0.03
make_stability	0.40	2.30	0.02	related_markets	-0.37	-2.82	0.03
based_effect	0.35	2.20	0.02	confirmed_crosscheck	-0.46	-2.76	0.03
conducting_prices	0.25	2.19	0.02	report_commission	-0.60	-2.71	0.03

COMMENTS ON ADJECTIVES VS VERBS

- ▶ Bigrams containing adjectives seem to describe state of the economy
 - ▶ Strong Area/Domestic risks/Weak Quarter/Euro Tensions
- ▶ Bigrams with verbs don't really point at future actions

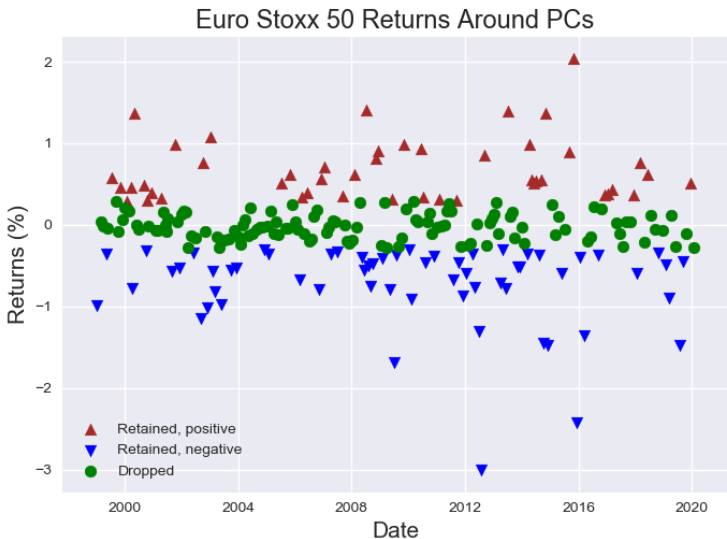
CONCLUSION

- ▶ Constructed a monetary policy dictionary
- ▶ Attempted to distinguish whether markets react to current economic conditions VS future policy

Future Direction

- ▶ Improve the dictionary
 - ▶ Analysis using **ECB speeches** (but no intraday data!)
 - ▶ Lasso type analysis instead of OLS
- ▶ Need better identification to distinguish market reaction to future policy VS current economic conditions
- ▶ Compare dictionary with Loughran-McDonald(2011)
- ▶ Using dictionary for out-of-sample-predictions

EUROSTOXX RESTRICTIONS

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PRESS RELEASE

Monetary policy decisions



25 October 2018

At today's meeting the Governing Council of the European Central Bank (ECB) decided that the interest rate on the main refinancing operations and the interest rates on the marginal lending facility and the deposit facility will remain unchanged at 0.00%, 0.25% and -0.40% respectively. The Governing Council expects the key ECB interest rates to remain at their present levels at least through the summer of 2019, and in any case for as long as necessary to ensure the continued sustained convergence of inflation to levels that are below, but close to, 2% over the medium term.

Regarding non-standard monetary policy measures, the Governing Council will continue to make net purchases under the asset purchase programme (APP) at the new monthly pace of €15 billion until the end of December 2018. The Governing Council anticipates that, subject to incoming data confirming the medium-term inflation outlook, net purchases will then end. The Governing Council intends to reinvest the principal payments from maturing securities purchased under the APP for an extended period of time after the end of the net asset purchases, and in any case for as long as necessary to maintain favourable liquidity conditions and an ample degree of monetary accommodation.

The President of the ECB will comment on the considerations underlying these decisions at a press conference starting at 14:30 CET today.

INTRO STATEMENT EXAMPLE

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Mario Draghi, President of the ECB,
Luis de Guindos, Vice-President of the ECB,
Frankfurt am Main, 25 October 2018

INTRODUCTORY STATEMENT

[▶ Jump to the transcript of the questions and answers](#)

Ladies and gentlemen, the Vice-President and I are very pleased to welcome you to our press conference. We will now report on the outcome of today's meeting of the Governing Council, which was also attended by the Commission Vice-President, Mr Dombrovskis.

Based on our regular economic and monetary analyses, we decided to keep the **key ECB interest rates** unchanged. We continue to expect them to remain at their present levels at least through the summer of 2019, and in any case for as long as necessary to ensure the continued sustained convergence of inflation to levels that are below, but close to, 2% over the medium term.

Regarding **non-standard monetary policy measures**, we will continue to make net purchases under the asset purchase programme (APP) at the new monthly pace of €15 billion until the end of December 2018. We anticipate that, subject to incoming data confirming our medium-term inflation outlook, we will then end net purchases. We intend to reinvest the principal payments from maturing securities purchased under the APP for an extended period of time after the end of our net asset purchases, and in any case for as long as necessary to maintain favourable liquidity conditions and an ample degree of monetary accommodation.

Incoming information, while somewhat weaker than expected, remains overall consistent with an ongoing broad-based expansion of the euro area economy and gradually rising inflation pressures. The underlying strength of the economy continues to support our confidence that the sustained convergence of inflation to our aim will proceed and will be maintained even after a gradual winding-down of our net asset purchases. At the same time, uncertainties relating to protectionism, vulnerabilities in emerging markets and financial market volatility remain prominent. Significant monetary policy stimulus is still needed to support the further build-up of domestic price pressures and headline inflation developments over the medium term. This support will continue to be provided by the net asset purchases until the end of the year, by the sizeable stock of acquired assets and the associated reinvestments, and by our enhanced forward guidance on the key ECB interest rates. In any event, the Governing Council stands ready to adjust all of its instruments as appropriate to ensure that inflation continues to move towards the Governing Council's inflation aim in a sustained manner.

Let me now explain our assessment in greater detail, starting with the **economic analysis**. Euro area real GDP increased by 0.4%, quarter on quarter, in both the first and the second quarter of 2018. Incoming information, while somewhat weaker than expected, remains overall consistent with our baseline scenario of an ongoing broad-based economic expansion, supported by domestic demand and continued improvements in the labour market. Some recent sector-specific developments are having an impact on the near-term growth profile. Our monetary policy measures continue to underpin domestic demand. Private consumption is fostered by ongoing employment growth and rising wages. At the same time, business investment is supported by solid domestic demand, favourable financing conditions and corporate profitability. Housing investment remains robust. In addition, the expansion in global activity is expected to continue supporting euro area exports, though at a slower pace.

Q&A EXAMPLE

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We are now at your disposal for questions.

* * *

Did you discuss downgrading your risk assessment to tilted to the downside? What were the main arguments for and against in the discussion?

Second question is about Italy, as you can imagine. In the past you said, “Look at the facts and not the words”, but the facts have been coming in and then haven’t been that good. There’s a budget in breach of EU rules; it’s been rejected by the Commission. Now with facts on the table, what is your assessment now?

Let me answer the first question; it will require a little time. By and large, the Governing Council discussions you've seen from the introductory statement confirmed the balance of risks and of course didn't take any decision on monetary policy. There was acknowledgement of a somewhat weaker momentum, but in the midst of most eurozone countries – which still have positive output gaps, and slightly expansionary and sometimes in some cases pro-cyclical fiscal policies in some countries. We're talking about a weaker momentum, not a downturn. This is clearly certified by most survey indicators that have come out since the last time we met. But these indicators remain above – and in some cases well above – historical averages and certainly is certified by slower growth. Then the issue is: what are the reasons behind this weaker momentum and these weaker survey indicators? Here we go into a variety of explanations, one of which certainly is country-specific factors; so-called idiosyncratic phenomena. Think about the car sector in Germany. This is having quite a powerful effect for this quarter but not next quarter.

The second is the export performance. Last time we discussed the export performance saying that last year, 2017, had an extraordinary export performance. Now we're coming back to normal and so we had a decline in exports that seems now is reflected in the current weaker momentum, but seems now to have come to a halt. Then of course we have trade uncertainties. We have the stalemate between US and China, with Brexit, with Italy, with financial market volatility, so a bunch of uncertainties. Then we have perhaps the one important part of the explanation; it's simply that we're having growth returning to potential after 2017, where it was clearly above potential.

THE DICTIONARY: UNIGRAMS

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Positive	b/100	t	R ²	Negative	b/100	t	R ²
clear	1.88	3.04	0.04	premia	-3.05	-3.49	0.05
change	0.92	3.01	0.03	modest	-1.60	-2.90	0.03
international	0.94	2.94	0.03	heightened	-1.31	-2.82	0.03
closer	2.04	2.74	0.03	dampening	-0.96	-2.79	0.03
statistics	0.79	2.63	0.03	sovereign	-2.34	-2.77	0.03
increase	0.24	2.37	0.02	broader	-2.63	-2.72	0.03
rose	1.13	2.32	0.02	environment	-0.58	-2.61	0.03
information	0.39	2.27	0.02	normalisation	-2.24	-2.60	0.03
rapid	1.90	2.25	0.02	operation	-0.40	-2.59	0.02
based	0.38	2.16	0.02	lower	-0.63	-2.53	0.02
commissioner	1.36	2.04	0.01	commission	-1.05	-2.53	0.02
supply	1.09	2.03	0.01	clearly	-1.17	-2.52	0.02
judged	1.93	2.03	0.01	reinforced	-1.54	-2.51	0.02
upwards	0.39	2.00	0.01	cost	-0.78	-2.32	0.02

COMMENTS ON UNIGRAMS

- ▶ Increase/Upwards/Rose/Information associated to days with positive returns
- ▶ Premia/Low/Dampening/Cost associated to days with negative returns
- ▶ Incoming/Information/MRO only show up in the Forward Guidance (FG) period Before FG FG

UNIGRAMS, BEFORE FG [back](#)

Positive	b/100	t	R ²	Negative	b/100	t	R ²
international	1.10	3.75	0.08	sales	-2.39	-4.59	0.11
statistics	0.80	2.96	0.05	securitisation	-2.05	-4.07	0.09
clear	1.64	2.77	0.04	premia	-3.10	-4.00	0.09
rose	1.33	2.72	0.04	loan	-0.56	-3.85	0.08
rapid	2.00	2.60	0.03	enterprises	-3.25	-3.76	0.08
commissioner	1.69	2.56	0.03	heightened	-1.72	-3.66	0.07
revised	0.80	2.46	0.03	decreased	-2.06	-3.59	0.07
increase	0.24	2.36	0.03	modest	-1.84	-3.48	0.06
change	0.80	2.35	0.03	sovereign	-2.55	-3.25	0.06
indexed	1.44	2.35	0.03	subdued	-0.75	-3.01	0.05
payments	0.98	2.34	0.03	standards	-1.02	-2.91	0.04
industries	0.74	2.33	0.03	survey	-1.11	-2.90	0.04
strong	0.34	2.20	0.02	weakness	-0.70	-2.85	0.04
stability	0.23	2.19	0.02	cost	-0.95	-2.82	0.04

UNIGRAMS, FORWARD GUIDANCE

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Positive	b/100	t	R ²	Negative	b/100	t	R ²
analysis	3.10	2.93	0.11	reinforced	-3.43	-3.74	0.17
signals	2.78	2.42	0.07	main	-1.93	-2.39	0.07
warrants	2.99	2.36	0.07	fourth	-1.96	-2.37	0.07
demand	0.85	2.19	0.06	least	-2.42	-2.33	0.07
previous	1.18	2.02	0.05	dombrovskis	-2.69	-2.27	0.06
council	0.62	1.98	0.04	stimulus	-2.35	-2.17	0.06
decreased	1.72	1.90	0.04	operation	-0.69	-2.04	0.05
change	1.20	1.89	0.04	second	-1.09	-2.01	0.05
facilitated	2.13	1.88	0.04	new	-1.04	-2.01	0.05
imbalance	1.37	1.83	0.04	refinancing	-1.04	-1.93	0.04
households	0.84	1.82	0.04	lower	-0.93	-1.93	0.04
notably	1.65	1.78	0.03	muted	-1.80	-1.85	0.04
information	0.95	1.76	0.03	downwards	-1.15	-1.84	0.04
put	1.87	1.74	0.03	facility	-1.49	-1.77	0.03

BIGRAMS, BEFORE FG [back](#)

Positive	b/100	t	R ²	Negative	b/100	t	R ²
credit_private	0.62	3.14	0.05	adjust_loan	-1.06	-4.75	0.12
prices_stability	0.10	2.73	0.04	loan_sales	-1.06	-4.75	0.12
stability_euro	0.30	2.59	0.03	sales_securitisation	-1.06	-4.75	0.12
june_eurosystem	0.68	2.41	0.03	policies_measures	-0.80	-4.22	0.10
levels_uncertainties	0.67	2.29	0.03	facilitated_appropriateness	-1.41	-3.65	0.07
improving_economic	0.44	2.22	0.02	loan_growth	-1.19	-3.45	0.06
economic_fundamentally	0.49	2.09	0.02	first_quarter	-0.43	-3.38	0.06
eurosystem_staff	0.31	2.05	0.02	remains_subdued	-0.50	-3.27	0.06
international_organisation	0.55	2.03	0.02	second_quarter	-0.59	-3.25	0.06
high_levels	0.29	2.03	0.02	higher_expected	-0.92	-3.08	0.05
forecast_international	0.51	2.01	0.02	key_factors	-0.87	-3.06	0.05
related_mainly	0.66	1.96	0.02	non_standards	-0.62	-2.97	0.05
meeting_also	0.58	1.94	0.02	financial_non	-1.02	-2.80	0.04
risks_prices	0.11	1.92	0.02	provision_credit	-1.03	-2.79	0.04

BIGRAMS, FORWARD GUIDANCE [back](#)

Positive	b/100	t	R ²	Negative	b/100	t	R ²
rate_remains	1.08	2.10	0.05	dombrovskis_based	-1.30	-2.34	0.07
monetary_analysis	1.40	1.92	0.04	mrs_dombrovskis	-1.28	-2.32	0.07
put_place	0.98	1.92	0.04	long_necessary	-0.68	-2.21	0.06
measures_put	0.98	1.92	0.04	securities_purchase	-1.13	-2.08	0.05
governing_council	0.23	1.75	0.03	developments_medium	-0.68	-2.03	0.05
loan_households	0.84	1.63	0.03	assessment_greater	-2.00	-1.96	0.04
domestically_demand	0.42	1.61	0.02	council_also	-0.92	-1.86	0.04
welcomes_press	2.21	1.57	0.02	december_eurosystem	-0.58	-1.70	0.03
previous_months	0.56	1.54	0.02	refinancing_operation	-0.34	-1.65	0.03
loan_private	0.72	1.53	0.02	accommodation_stance	-0.77	-1.64	0.03
rate_change	0.44	1.47	0.02	return_inflation	-0.55	-1.55	0.02
keep_key	1.00	1.43	0.02	inflation_levels	-0.54	-1.53	0.02
rate_unchanged	1.00	1.43	0.02	interest_rate	-0.35	-1.50	0.02
decided_keep	1.00	1.43	0.02	remains_unchanged	-0.59	-1.44	0.02

REDUCING THE DIMENSIONALITY

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- ▶ Compute statistic that summarizes asymmetric group belonging of grams g :

$$\chi_g^2 = \frac{(f_{gp}f_{\sim gn} - f_{gn}f_{\sim gp})^2}{(f_{gp} + f_{gn})(f_{gn} + f_{\sim gn})(f_{gp} + f_{\sim gp})(f_{\sim gp} + f_{\sim gn})}$$

- ▶ f_{gp} : # of times g belongs to positive Eurostoxx variation
- ▶ f_{gn} : # of times g belongs to negative Eurostoxx variation
- ▶ $f_{\sim gp}$: total occurrences grams that are not gram g belong to positive Eurostoxx variation
- ▶ $f_{\sim gn}$: total occurrences grams that are not gram g belong to negative Eurostoxx variation
- ▶ Retain grams with highest χ^2