Economic Commentary

A new tool for measuring complexity in communication

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S V E R I G E S R I K S B A N K

Summary

How well a central bank communicates with its various target groups is central to confidence in its operations and its independence. Traditional readability measures, such as the Flesch–Kincaid Grade Level Index (FK) and LIX, are often used to assess how accessible their texts are. However, these measures focus primarily on word and sentence length and do not capture how conceptually complex a text is – that is, how much prior knowledge is required to understand the content. To measure this dimension, we have developed the Epistemic Network Conceptual Complexity Index (ENCC). The measure estimates a text's conceptual complexity by weighing how difficult its central concepts are to grasp and how densely they are interconnected in the reasoning. Examples from the Riksbank's publications show that texts can score similarly on FK and LIX while still differing substantially in how easy they are for the reader to understand.[1]

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Readability is not the same as comprehensibility

How well a central bank communicates contributes to its legitimacy and to anchoring confidence in its operations. Comprehensible communication also enables a more informed public debate on monetary policy. If communication demands more prior knowledge than the reader actually has, these conditions are weakened – regardless of how readable the text is according to traditional readability measures.

The sentence "The real interest rate exceeds the neutral interest rate" is short and contains no particularly long words – it receives a good readability score according to both LIX and the Flesch-Kincaid Grade Level Index (FK). Yet it presupposes that the reader already knows what the real interest rate and the neutral interest rate are, and how they relate to each other. This is a general problem in all specialized communication. Legal texts, patient information in healthcare, and institutional policy communication can all be "easy to read" according to traditional measures while still placing significant demands on the reader's expertise.

[1] Economic Commentaries are brief analyses of issues with relevance for the Riksbank. They may be written by individual members of the Executive Board or by employees at the Riksbank. Employees' commentaries are approved by their head of department, while Executive Board members are themselves responsible for the content of the commentaries they write. The opinions expressed in Economic Commentaries are those of the authors and are not to be seen as the Riksbank's view.

[2] Klicka här för att ange författarnas tack.

McMahon and Naylor's (2023) Conceptual Complexity Index (CCI) addresses this problem by measuring the amount of economic jargon in a text and how it is distributed across different subject areas, at the document level. Experiments they have conducted show that conceptual complexity impairs reader comprehension, even among readers with relevant background knowledge.

In this commentary, we introduce the Epistemic Network Conceptual Complexity Index (ENCC). It builds on the same basic idea but adds two dimensions that neither FK nor CCI capture: first, how difficult each individual concept is for the reader to grasp, and second, how densely the concepts are interconnected rather than used in isolation.

How ENCC works

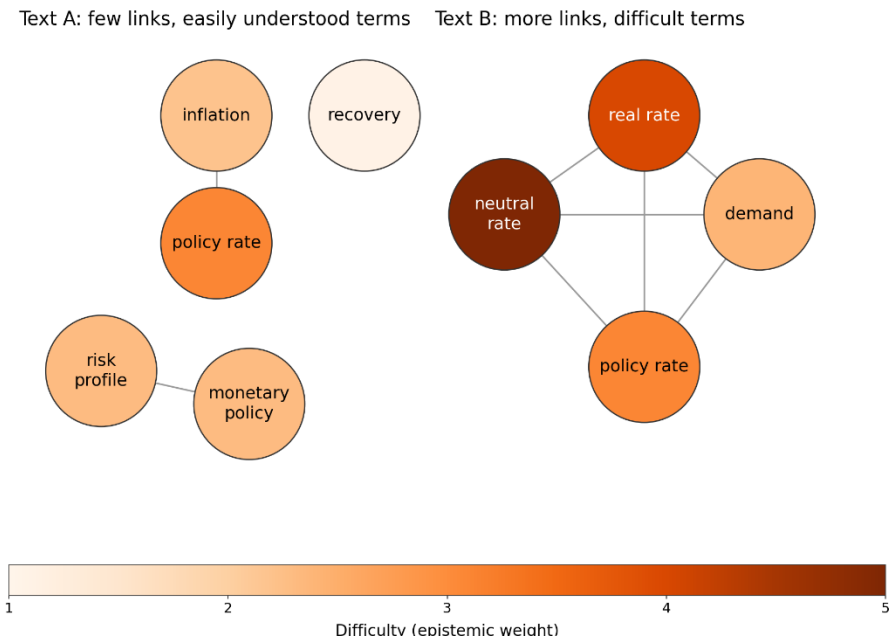
If we want to measure comprehensibility, we need a measure that takes into account not only how long words and sentences are, but also which concepts are used and how they relate to one another. A line of reasoning does not consist only of concepts, but of relationships between concepts. ENCC starts from the premise that a text can be described as a network of concepts. Each relevant technical term in the text constitutes a node in the network, and two terms are linked if they occur in the same sentence. The idea is that concepts occurring in the same sentence are likely to be argumentatively related, either because one explains the other or because together they build up a shared line of reasoning.

Like CCI, ENCC requires a list, or lexicon, of relevant technical terms. This lexicon can be constructed in various ways. In this commentary, we created it partly by examining which terms are frequently used in the Monetary Policy Reports, and partly with the help of an AI (Claude) to add important economic terms that occur less frequently. Together with the AI, we then assigned weights to the concepts on a scale from 1 to 5, based on the premise (the prompt) that the intended reader is educated but has no particular prior knowledge of economics. The weights are intended to capture how much prior knowledge – or, put another way, how much epistemic knowledge – is required to understand each concept. We therefore call them epistemic weights. A low value means the concept should be familiar to most people; a high value means it requires deeper subject-matter knowledge.[3] The Appendix contains a more detailed description of how the weighted lexicon was created, along with an excerpt from it.

The idea of a network of concepts with epistemic weights is illustrated by the figure below, which represents two different text passages. In one, there are few links between the technical terms, and the terms themselves are not particularly difficult to grasp (lighter colour). In the other, the concepts are both more interconnected and more difficult (darker colour).

[3] An alternative would be large-scale testing with actual target-group readers. AI-assisted weighting, calibrated and validated as described in the Appendix, offers a cost-effective approach that is nowadays practically feasible. A full validation against actual reader comprehension nonetheless remains a valuable complement.

Figure 1. Concept network – two examples



ENCC combines three factors: (i) how many distinct technical concepts the text contains, (ii) how difficult each individual concept is, based on the depth of prior knowledge it is judged to require, and (iii) how large a share of all conceivable concept pairs among the concepts identified in the text actually co-occur within the same sentence. This share is called network density.

A text passage can thus score high on ENCC for different reasons: because it uses many technical concepts, because the concepts are genuinely difficult, or because they are tightly interwoven in the reasoning. Of these, it is above all the latter two – how difficult each individual concept is, and how closely they are interconnected – that neither FK, LIX, nor CCI capture.

An AI model could, in principle, be instructed to directly grade a text's complexity, and even justify its score with an explanation. The difference from ENCC is that the lexicon and the weights constitute a fixed, auditable intermediate layer that remains the same across all texts analysed. The AI is used here once, to build this intermediate layer – not to assess each individual text anew. An individual weight can be identified, criticized, changed, and recalculated, with a predictable outcome. An AI model's justification, by contrast, is a plausible post-hoc construction rather than a traceable calculation – it need not reflect what actually determined the assessment – and it is not possible to isolate and adjust a single component of it without redoing the entire assessment from scratch.

The mathematical formula

ENCC can be written mathematically as

$$\text{ENCC} = (1+D) \times \bar{e} \times \log(1+|N|),$$

where $|N|$ is the number of distinct technical concepts identified in the text, D is the network density (the share of all conceivable concept pairs that actually occur within the same sentence), and ē is the average difficulty per sentence, measured as the mean of the concepts' weights, calculated sentence by sentence across the entire text.

D varies between 0 and 1. If none of the text's concepts ever occur within the same sentence, $D = 0$. If, instead, every concept shares a sentence with all other concepts in the text, $D = 1$, the maximum value, since all conceivable concept pairs are then satisfied. If a very short text contains only two technical concepts and these are mentioned in the same sentence, $D = 1$ automatically, since the only conceivable concept pair is then in fact present together. *D* becomes a more informative indicator the more concepts the lexicon identifies in the text – in very short text passages with few identified concepts, the value should therefore be interpreted with caution. Adding 1 to D in the formula – rather than using *D* directly – ensures that a text passage does not receive an ENCC of 0 simply because its concepts happen to stand isolated from one another ($D = 0$). Even without interweaving, the number and difficulty of the concepts contribute to complexity.

The formula captures three things that each contribute to complexity in their own right. A text receives a higher ENCC value the more tightly the concepts are interconnected (high *D*), the higher the difficulty of the individual concepts (high $\bar{e}$), and the more distinct technical concepts it contains (large $|N|$). The last factor, however, is weighted logarithmically: the first new concepts in a text add more to the complexity than subsequent ones, since the jump from having a few concepts to having several is larger than the effect of adding a few more once the text already contains many.

ENCC has no fixed upper bound but is in practice tightly constrained by the size of the lexicon; see the Appendix for a discussion of the index's minimum and maximum values and the possibility of normalising it.

Three passages from the Riksbank's publications

As an illustration, we calculate FK, LIX, CCI, and ENCC for three typical passages from the Riksbank's publications.[4] The three text passages illustrate three different types of monetary policy communication. The first is an overall summary, the second describes

[4] McMahon and Naylor's (2023) CCI is designed for whole documents, where the measure among other things captures how jargon is distributed across several subject areas. Our application to short text passages (148–227 words) is a different use case than the one CCI is designed for, and the CCI values should therefore be interpreted with some caution.

the current monetary policy situation, and the third addresses the more theoretical concept of the neutral interest rate.

Passage 1. Excerpt from Monetary Policy Considerations, in the Monetary Policy Report, December 2024

Over the course of the year, inflation has fallen and inflationary pressures have stabilised in line with the target. At the same time, growth has been weak. The Riksbank has cut the policy rate gradually, but at a rapid pace. Lower inflation and lower interest rates contribute to stronger purchasing power for households and support economic activity. Despite some signs that economic activity is on its way to recovery, it remains weak. A stronger economy is important in its own right, but it is also a necessary condition for inflation to stabilise close to the target. The policy rate was cut in a large step in November and the Executive Board assess that it is appropriate to cut the rate further to support the economic recovery. The interest rate has been reduced rapidly and monetary policy affects the economy with a lag. This argues for a more tentative approach when monetary policy is formulated going forward. The Riksbank will therefore carefully evaluate the need for future interest rate adjustments, in light of the effect of earlier cuts and shifts in the risk profile regarding the outlook for inflation and the economic activity.

Passage 2. Excerpt from 3.1 Monetary Policy in Sweden, in the Monetary Policy Report, December 2024

The Riksbank has cut the policy rate over the year as the inflation outlook has gradually improved. The first cut was made in May. The Riksbank has cut the policy rate at every meeting in the second half of the year, most recently by 0.5 per cent in November. In conjunction with the November decision, the Executive Board communicated that the policy rate could continue to be cut in December and the first half of 2025 if there is no change in the prospects for inflation and economic activity. Inflationary pressures are consistent with inflation of 2 per cent and CPIF inflation is close to the target. Inflation expectations are firmly anchored at 2 per cent, particularly in the longer term. CPIF inflation excluding the volatile energy prices remains close to 2 per cent, despite a certain upswing in November. Furthermore, forward-looking indicators, such as companies' price plans and producer prices, also indicate inflationary pressures that will be consistent with inflation of close to 2 per cent in the future too. Sweden remains in a mild recession. Some signs of a recovery in the economy are now becoming visible, at the same time as inflationary pressures continue to indicate inflation in line with the target. New information indicates that the economy has largely developed as expected. This implies further policy rate cuts in line with our communication from November, in order to contribute to the recovery of the Swedish economy.

Passage 3. Excerpt from Anna Seim's speech "The Neutral Interest Rate – Importance, Limitations and Assessment", 26 November 2024

It should first be noted that the definition of the neutral interest rate varies across studies and depends on the exact question asked, the type of model used and the choice of time horizon. There is also some ambiguity surrounding the two related terms "neutral" and "natural" interest rates. The two terms are often used

synonymously, but sometimes they are assumed to mean different things. A term that is also sometimes used, but is almost always used synonymously with the neutral interest rate, is r or r-star. The most common definition of the neutral interest rate is the interest rate that is neither expansionary nor contractionary. This means that the real economy is in balance and inflation is stable. The real economy is usually represented by labour market outcomes or total output. If the central bank sets a policy rate that is lower than the neutral rate, this has an expansionary effect on the economy, as households want to consume and businesses want to invest, which increases aggregate demand in the economy. High demand makes it easier for companies to raise prices and inflation rises. If the policy rate is higher than the neutral rate, the effect is instead tightening, that is, demand will be low, as will inflation. Somewhere between these two states is a policy rate that has neither an expansionary nor a contractionary effect on the economy, that is, the effect on demand and inflation is neutral.*

Table 1. FK, LIX, CCI and ENCC for the three passages

Passage	Source	Words	Sentences	LIX	FK	CCI	ENCC
P1	Monetary Policy Considerations, Monetary Policy Report, December 2024	148 (192)	10	46.56	11.93	0.231	7.77
P2	3.1 Monetary Policy in Sweden, Monetary Policy Report, December 2024	183 (240)	12	53.50	12.52	0.140	7.15
P3	Anna Seim, speech, "The Neutral Interest Rate – Importance, Limitations and Assessment," 26 November 2024	227 (241)	11	51.47	12.19	0.154	9.62

Note: Word counts refer to the Swedish original text, with the corresponding English word count (from the Riksbank's official English translation) given in parentheses. Sentence counts refer to the Swedish original text. LIX and ENCC are calculated on the Swedish original text; LIX is used as the Swedish readability measure corresponding to Flesch–Kincaid (FK). FK and CCI are calculated on the Riksbank's official English translation of the same passages, since McMahon and Naylor's (2023) CCI tool (mcmahonecon.com/CCI/) is built on an English-language lexicon and cannot be applied directly to Swedish text.

Already LIX, FK, and CCI paint a divided picture. P1 has the lowest LIX (46.56) – the most readable passage in the traditional sense – but at the same time the highest CCI (0.231), that is, the most economic jargon. CCI is calculated on the English translation, which gives different word counts than in Table 1. One explanation for the difference in CCI is that P1 packs in as many jargon terms (11) as P3 but in fewer words (192 versus 241 English words), giving it the highest jargon share (5.7 per cent) of the three.[5] By contrast, there is no difference in the number of subject areas in the text – all

[5] The jargon-term count here follows McMahon and Naylor's (2023) CCI lexicon. It differs from the ENCC lexicon used to calculate $|N|$ in Table 2, which is why the two measures give different concept counts for the same passage.

three passages cover exactly four subject areas according to McMahon and Naylor's word list and subject classification.

P2 and P3 show almost the opposite pattern, that is, higher LIX but lower CCI. FK, which, like CCI, is calculated on the English translation, is in practice unchanged across the three passages (11.93 / 12.52 / 12.19). All correspond to roughly the same readability level according to this measure, even though CCI shows clear differences in jargon density in the same text.

The ENCC values in Table 1 point to a pattern that neither LIX, FK, nor CCI capture on their own. P3 receives the highest ENCC value of the three passages (9.62), despite not having more distinct technical concepts than P1, having fewer than P2, and not having the highest CCI. The explanation is that P3's concepts – among others "neutral interest rate", "policy rate", "demand", and "real" – are both individually more difficult and more densely interconnected in the reasoning than the concepts in P1 and P2. P1, which has the highest CCI (0.231), scores lower on ENCC (7.77) because its concepts tend to occur more in isolation rather than within a cohesive line of reasoning. P2 has the lowest ENCC (7.15) of the three, consistent with it having the most distinct concepts but both the lowest network density and the lowest average difficulty. This is precisely the type of difference ENCC is intended to capture. Table 2 shows ENCC's component parts.

Table 2. ENCC's component parts for the three passages

Passage	$\|N\|$	D	$\bar{e}$	ENCC
P1	10	0.267	2.558	7.77
P2	12	0.227	2.271	7.15
P3	10	0.311	3.061	9.62

Note: $|N|$ is the number of distinct technical concepts identified in the passage, D is the network density (the share of all conceivable concept pairs that actually occur within the same sentence), and $\bar{e}$ is the average difficulty per sentence, calculated as the mean of the concepts' weights, sentence by sentence across the entire text. $ENCC = (1+D) \times \bar{e} \times \log(1+|N|)$.

How have other central banks used complexity measures, and what have they found?

McMahon and Naylor (2023) find that FK for the Bank of England's publications has decreased noticeably since the early 2000s, indicating successful efforts to simplify the language purely syntactically. Their CCI, however, shows no corresponding downward trend. For several publications, including the Monetary Policy Report and the Monetary Policy Summary, it has on the contrary increased and is now clearly higher than ten years ago. This means that the Bank of England's communication has

become easier to read in purely linguistic terms, while at the same time becoming more conceptually complex.

The ECB also analyses its communication in a similar way. In its report on monetary policy strategy and communication (ECB, 2025), it reports the share of “uncommon words” over time for several types of publications. Among other things, it finds that the “Monetary Policy Statement” has become more accessible, both in terms of the share of uncommon words and FK. However, an analysis of the same document using CCI finds the opposite picture: the “Monetary Policy Statement” has become more conceptually complex, as a result of rising inflation and increasingly detailed debate and discussion (Byrne et al., 2025). The ECB itself describes this as contradicting evidence – a reminder that the choice of complexity measure is not a technicality, but can lead to directly opposite conclusions about the same text.

What could the Riksbank use ENCC for?

One example of what ENCC could be used for is to analyse how the complexity of the Riksbank’s publications has evolved over time. This question is relevant given that communication with the broader public – rather than solely with financial market participants – has become an increasingly important part of monetary policy. So far, however, we have lacked a measure that captures conceptual complexity. As a first step, we plan to conduct a study using ENCC for the Riksbank’s Monetary Policy Reports from 1997–2025 and compare the results with conventional readability measures such as LIX.

ENCC can be used for more than a historical retrospective. The measure could, for example, serve as an editorial complement to standard readability checks prior to publication. By also measuring conceptual complexity, for instance using ENCC, central banks can design communication that is more accessible to the broader public.

ENCC could also be used more broadly, to map the full range of the Riksbank’s communication channels – from speeches and press releases aimed at the general public to more technical reports aimed at market participants and analysts. Such a cross-section could show whether the level of complexity in practice varies with the intended target audience, or whether it is instead uniform regardless of who the communication is directed at.

Concluding remarks

What has been presented here is really a specific way of realizing a broader idea. ENCC is fundamentally a way of thinking about text complexity in terms of three components – how many technical concepts a text contains, how difficult they are to grasp, and how densely they are interwoven – rather than a single, specific calculation. The lexicon, the sentence as the window, and the multiplicative formula are the choices we have made in this particular application, but they are not the only conceivable ones.

The lexicon is the most obvious thing to vary. An application to legal text would be built with legal terms instead of monetary policy terms, an application in healthcare with medical concepts. Which "window" counts as a unit is another choice. Here the window is a sentence, but one could also imagine argumentative connections spanning two or three sentences. How the components are combined is a third choice. Here it is done multiplicatively, but an additive combination would give the components a different relative weight and make the measure less sensitive to a single component being zero.

The design of ENCC described in this commentary is thus one of several possible ways of realizing the same basic idea. Nor is the framework limited to measuring complexity. By choosing other types of concepts, weights, or ways of describing the relationships between them, it could in principle be used to construct other measures of text content.

This commentary focuses solely on conceptual complexity. But the basic point is general: easy to read is not the same as easy to understand – and that difference only becomes visible if you measure with more than one measure.

References

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APPENDIX – Construction of the weighted lexicon and properties of the ENCC formula

Construction of the weighted lexicon

Candidate terms were extracted automatically from the report corpus (words and phrases that recur across many reports). The AI (Claude) went through the candidates and determined which were genuine concepts, and supplemented these with central but less frequent concepts that a frequency-based extraction misses.

In the next step, the AI proposed a number of anchor concepts that together span the entire scale, from generally well-known to highly technical. The authors and the AI then weighted these independently, after which the weights were discussed until a shared scale was established – for example, “government” (1), “interest rate” (2), “GDP” (3), and “neutral interest rate” (5). The authors and the AI then weighted a random sample of concepts independently, without seeing each other's assessments, to test whether the scale was interpreted consistently. Agreement was good, particularly regarding which concepts are more demanding than others (Krippendorff’s α = 0.74; average rank correlation 0.80). The AI weighted the remaining concepts against the same scale, after which the authors jointly reviewed the weights and made changes where warranted. A weight of 1 was used during anchor calibration as the lower reference point of the scale (e.g., “government”), in order to establish where on the scale the more demanding concepts should be placed. Such terms, however, do not require any specialist knowledge in a meaningful sense – they are part of everyday language rather than economic terminology – and therefore do not contribute to a text's conceptual complexity. We therefore chose to exclude all weight-1 terms from the final lexicon. This means that the scale in the lexicon in practice runs from 2 (familiar, but still a technical term) to 5 (requires deep subject-matter knowledge), while weight 1 remains as a conceptual floor point for the calibration.

In total, the lexicon contains 256 concepts. The prompts and an excerpt from the weighted lexicon are given below.

Prompt 1: Anchor Calibration

PURPOSE: Establish a shared scale of 1–5 by having each of you independently weight the anchor concepts on the “Anchors” sheet. Once the anchor is agreed upon, the scale is shared.

REFERENCE READER (fixed): an educated non-economist – the plain-language citizen – reading for functional understanding. NOT the Monetary Policy Reports' actual sophisticated readership.

ONE CRITERION – Knowledge load: how much prior knowledge the reader must have to understand the term AS IT IS USED. Scale 1–5, higher = more demanding. This number IS the term's weight.

THE COUNTERFACTUAL TEST: “can a reader who does not already have the concept understand the term as it is used?” Assess the knowledge REQUIRED – not how everyday the word SOUNDS. (Otherwise, e.g., unemployment/disruption would incorrectly get a low weight.)

TASK: for each term, enter ONE weight (1–5) and a brief justification on the “Anchors” sheet.

INDEPENDENT: complete separately. Do not consult each other, do not look at each other's sheets. Claude's values are deliberately withheld. Feel free to use your own copy of the file.

AFTERWARD: send back both completed sheets. Claude will then reveal its values and justifications; we compare and agree. That establishes the scale.

Prompt 2: Bulk Weighting

PURPOSE: Weight all remaining concepts, category by category, against the scale established in the anchor calibration.

REFERENCE READER (fixed, unchanged): an educated non-economist – the plain-language citizen – reading for functional understanding.

ONE CRITERION – Knowledge load (unchanged): how much prior knowledge the reader must have to understand the term as it is used. Scale 1–5, higher = more demanding.

THE 4-VERSUS-5 CONVENTION: weight 5 is reserved for the maximally opaque (e.g., “und1x”, “equilibrium interest rate”, “effective lower bound”). A highly technical but still decodable concept is placed at 4.

TASK: for each concept in the category, assign ONE weight (1–5). A justification is written out only for borderline cases and high weights (4–5); clear-cut cases receive only the number.

FORMAT: one category at a time. The authors review each category before the next one begins. Weights that are changed during review are set based on the assessment of the individual concept’s knowledge requirement – not based on how they affect the aggregated ENCC result.

EXCLUSION FLAG: concepts judged to belong at weight 1 are flagged as possible exclusion candidates, but are not automatically removed; the final exclusion review is conducted as a separate step after all categories have been weighted.

FREEZING: the weights in this round constitute a first draft. Nothing is locked until the authors explicitly freeze the final version of the lexicon.

Excerpt from the Lexicon

Concept	Weight	Category
interest rate	2	Monetary policy
policy rate	3	Monetary policy
neutral interest rate/r*	5	Monetary policy
inflation	2	Inflation and prices
CPI	3	Inflation and prices
HICP	5	Inflation and prices
growth	2	Real economy and business cycle
economic activity	3	Real economy and business cycle
output gap	5	Real economy and business cycle
labour market	2	Labour market and wages
wage formation	3	Labour market and wages
NAIRU	5	Labour market and wages
ECB	2	Institutions and actors
IMF	3	Institutions and actors
money market participants	3	Institutions and actors
exchange rate	2	Exchange rate and external sector
net exports	3	Exchange rate and external sector
terms of trade	5	Exchange rate and external sector
capital	2	Financial markets and stability
bond	3	Financial markets and stability
systemic risk	4	Financial markets and stability
forecast	2	Forecasting, modelling and methodology

Concept	Weight	Category
uncertainty interval	3	Forecasting, modelling and methodology
DSGE	5	Forecasting, modelling and methodology
purchasing power	2	Households, income and housing
disposable income	3	Households, income and housing
financial saving	4	Households, income and housing
fiscal policy	2	Fiscal policy and public finances
government debt	3	Fiscal policy and public finances
structural saving	5	Fiscal policy and public finances

Properties of the ENCC formula

ENCC's theoretical minimum is 0, which occurs if a text contains no concept from the lexicon (N=0, giving log(1+0)=0). For a text that does contain at least one technical concept, however, there is a practical floor: since the lexicon's lowest weight is 2 (weight-1 terms having been excluded, see above), the smallest possible value for such a text is $(1+0) \times 2 \times \log(2) \approx 1.39$.

A maximum value also exists, though not immediately apparent: since N is bounded by the size of the lexicon (256 concepts), ENCC can theoretically never exceed $(1+1) \times 5 \times \log(257) \approx 55.5$ (all 256 concepts at maximum weight, all pairwise co-occurring within the same sentence). This value is practically unattainable – no real text will contain every concept in the lexicon at uniformly maximum weight and interconnection – but it means that, contrary to first impressions, ENCC is in fact bounded.

Normalising ENCC to the [0,1] interval is therefore possible by dividing by this theoretical ceiling. The drawback is that all realistic text values then cluster very close to 0 (P3's value of 9.62, for instance, corresponds to only 0.17 on such a scale), making the scale mathematically correct but difficult to interpret in practice.

An alternative is to instead normalise against the highest value empirically observed within the corpus under study (e.g., the most complex report in a given time series). This yields a more readily interpretable scale within the study, but two limitations should be noted. First, it breaks absolute comparability across different studies or corpora, since the normalising value differs (the same normalised figure then does not represent the same thing in two different studies). Second, the reference value must be permanently fixed rather than updated as new texts are added – otherwise already-published normalised values would retroactively change without the underlying

texts having changed, undermining the very stability over time that is one of ENCC's principal advantages. We have therefore chosen to report ENCC in its unscaled form in this commentary.

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