

Evaluating the macroprudential stance in a growth-at-risk framework



By Dominic Cucic, Ianna Georgieva Yordanova, Niels Framroze Møller, and Simon Gade Søndergaard
Danmarks Nationalbank

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The ultimate objective of macroprudential policy is to contribute to financial stability by curbing the build-up of systemic risks and alleviating negative outcomes for the economy should risks materialise. Measuring and communicating whether policy goals are achieved is challenging, as financial crises are rare and risks are often only measurable in case they materialise.

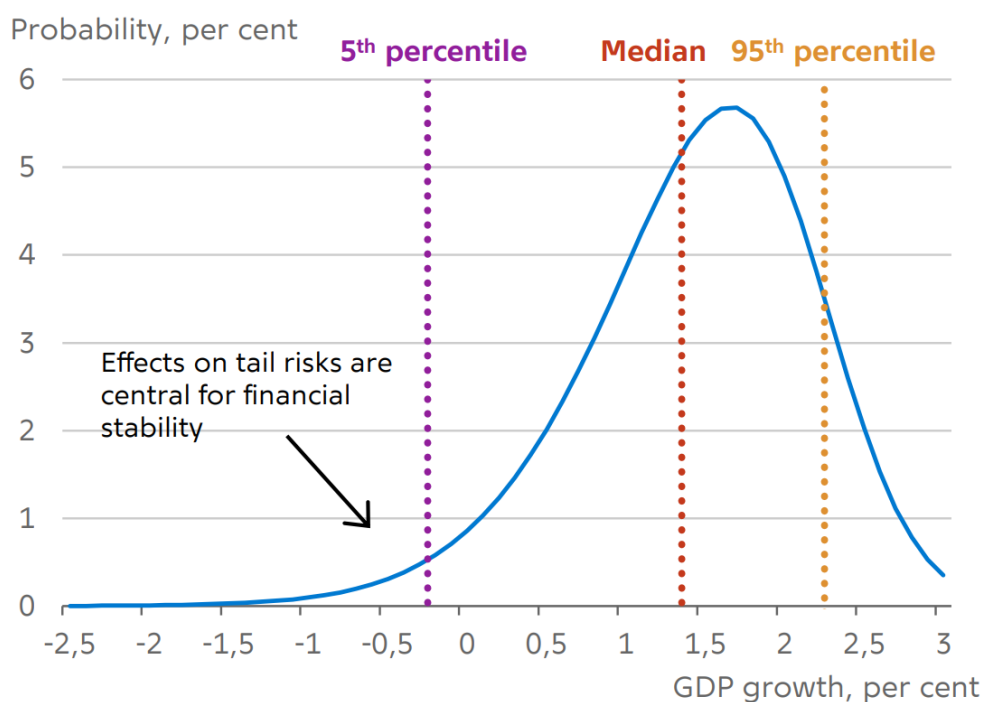
In a recent paper ([link](#)), we outline the advantages and disadvantages of using growth-at-risk for evaluating the macroprudential policy stance in Denmark. We look at two applications of the growth-at-risk framework for assessing the macroprudential stance: GDP-at-Risk and House prices-at-Risk. We showcase that the framework can illustrate the goal of macroprudential policy and facilitate discussions of questions policymakers often face: are policies effective to curb risks or alleviate downturns; do policies have different effects in the short vs. medium run; can build up of financial imbalances boost economic growth today while increasing risks of sharp downturns in the future.

Growth-at-risk: A tool for evaluating macroprudential policy actions

The fundamental idea behind the growth-at-risk approach is to estimate the probability of different outcomes of future growth in e.g. GDP, house prices, consumption, etc., given the current financial and economic conditions. While traditional forecasting often focuses on the average growth scenario, growth-at-risk allows us to explore the risk of sharp falls in GDP or house prices, which is central for financial stability analysis and macroprudential policy, see Chart 1. The framework allows to investigate whether the effects differ across the distribution of GDP or house prices, and evaluate the potential costs and benefits of different policy actions. We look at two specific applications: **Application 1: GDP-at-Risk**; **Application 2: House Prices-at-Risk**.

Given the early stage in the experience with and understanding of macroprudential policies, the development of a fully-fledged measure of the macroprudential stance will rely on the experience gained over the coming years. The stance assessment is complicated by the fact that there is no single definition of financial stability, and the key variables for capturing systemic risk continue to evolve.

Chart 1: Growth-at-risk offers a metric for measuring and communicating the policy goals of macroprudential policy



Note: Fitted density distribution of average annualized GDP growth 8 quarters ahead.

Using GDP-at-risk to assess the macroprudential stance

We use a quantile regression model to estimate the impact of cyclical systemic risks (SRI) and macroprudential policy (capital-based measures and borrower-based measures) on the growth distribution of GDP over a horizon of eight quarters. The results of the model suggest that increasing cyclical systemic risk has historically had a significant negative impact on both the tail (5th percentile) and the median of the growth distribution at an 8-quarter horizon.

It is important to recognise that the model does not imply causality, but rather reflects correlations between the different variables, thereby describing past co-movements. The results should therefore be interpreted with caution.¹ Nonetheless, the estimates suggest that an increase in systemic risks indicates a lower median and lower tail growth while the impact is somewhat more limited on the upper tail. That is, most likely it will lower growth – both in the most likely outcome and in the event of a crisis – but it will not have much of an impact on the strength of a strong expansion.

The macroprudential stance measures the distance between the median and the tail

Following the approach suggested by the ESRB, the macroprudential stance is measured by the distance between the median and the tail (5th percentile) of the GDP growth distribution.²

This stance metric offers an intuitive interpretation. Risk-neutral policymakers would focus on maximising expected growth disregarding any potential trade-offs for the tail of the distribution. An infinitely risk-averse policymaker would on the contrary aim at lowering downside risks regardless of the implications for expected growth. The specific trade-off which policymakers would find acceptable will depend on the tolerance for downside risks, but also on the effectiveness of macroprudential policy instruments to counteract changes in expected median and tail growth from macro-financial shocks.

Evaluating the macroprudential stance

Evaluating whether the macroprudential stance is loose or tight would ultimately depend on the policymakers' preferences. As the policymakers' "optimal level" of policy is ultimately not observable, the historical distribution can be used to put the level of the macroprudential stance into perspective. The current macroprudential stance for Denmark is around its historical median level, and in that sense, could be considered neutral, see Chart 2.

The interpretation of the stance is not entirely straightforward, even when using the historical distribution as a benchmark. The capital reforms following the financial crisis were a response to the extremely loose financial conditions and risk build-up in the period preceding the financial crisis. It could therefore be discussed whether the historical distribution should be based on the entire historical sample, or whether the stance should be compared to specific subperiods.³

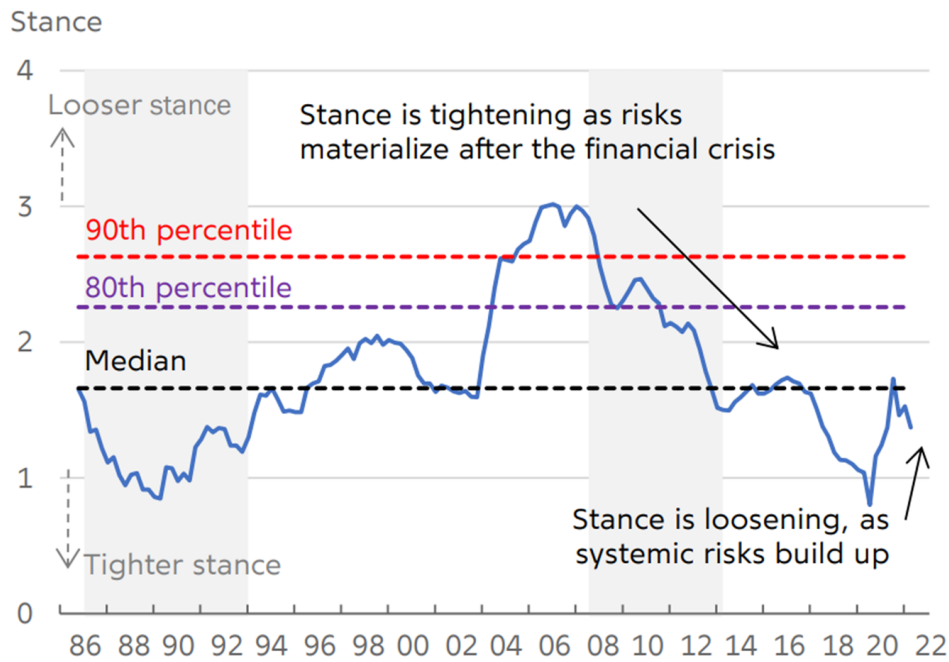
It might also be relevant to consider how far above/below a specific historical threshold the stance metric is, as well as whether the stance metric is *increasing* or *decreasing*. An increase in the stance metric would signal an overall *loosening* in the macroprudential stance. That could be due to either an increase in systemic risk or a loosening of macroprudential policies. In the macroprudential stance for Denmark, the distance between the median and the tail is increasing, suggesting loosening of the stance.

¹Also, the method employs aggregate macroeconomic data at a quarterly basis providing relatively small samples. While 40 years of quarterly GDP growth data is a reasonably long time-series sample, it also means that only 8 of the observations are below the 5th percentile.

² ESRB (2021), [Report of the Expert Group on Macroprudential Stance – Phase II \(implementation\)](#) (europa.eu).

³ A selective approach to determining the evaluation window is rather common in the literature of early warning indicators. The choice is motivated by the fact that policymakers would typically seek to address risks well ahead of a crisis in order to avoid extreme outcomes.

Chart 2: Predicted GDP growth distribution
Stance reflects distance between median and tail



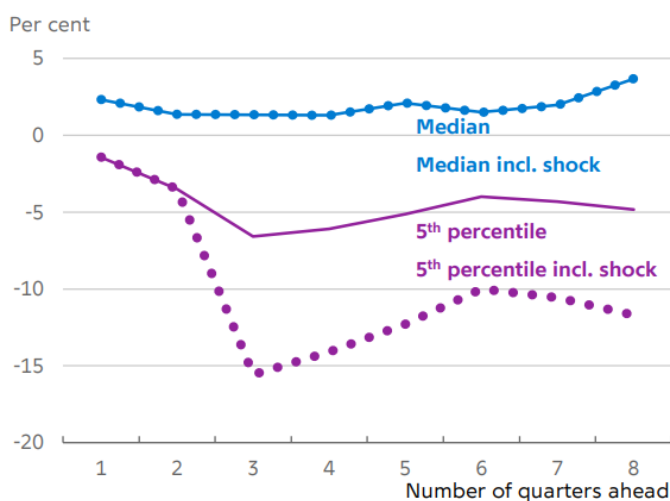
Note: Fitted density distribution of average annualized GDP growth 8 quarters ahead.

Macroprudential policy curbs tail risks

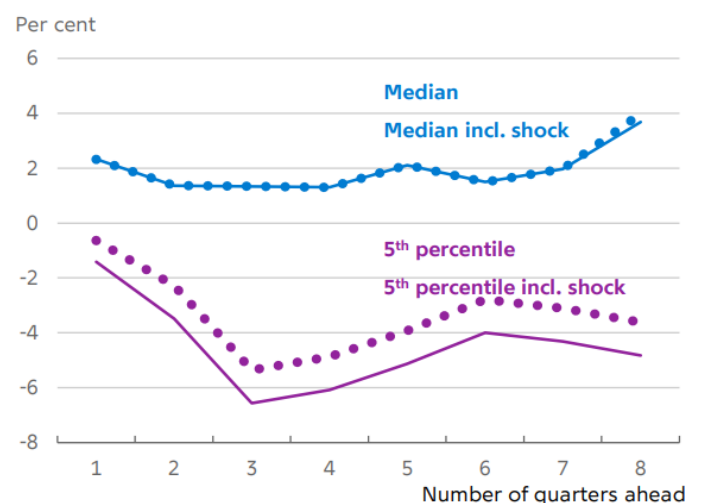
Policy makers often face the challenge of containing downside risk to GDP growth stemming from the financial system without hampering current growth when these risks do not materialise. The GDP-at-risk model can be used to provide more insight in the expected effects of policy measures and kick-off policy discussions, e.g. whether it is necessary to implement new measures given the level of risks. Also, it is possible to evaluate the effects of increasing risk or tightening policies at different time horizons. Policy conclusions should, however, be carefully interpreted considering the limitations of the framework.

Chart 3: Systemic risks decrease tail growth while tightening capital requirements increase tail growth

Shock to systemic risk



Tightening of capital requirements



Note: Left: Shock to systemic risk. Right: Shock to capital requirements. In both charts insignificant coefficients are set to zero. Source: Own calculations.

Increases in systemic risks exacerbate tail risk scenarios

A one-time increase in the systemic risk indicator, SRI, by 1 standard deviation, for example, has no significant impact on the median expected GDP growth, see Chart 3, left. However, the increase contributes to a downward and persistent decrease in the 5th percentile of GDP-growth. This indicates that the tail risk of GDP-growth is increasing when systemic risks build up. The increase in tail risk is especially pronounced after two quarters.

The results imply that an acceleration in build-up of systemic risks might not have material effects on median GDP-growth. From a macroeconomic perspective, the development would thus appear benign for current developments in GDP. However, from a financial stability perspective, the results also imply that the development might increase the risk of sharp downfalls in GDP.

Policy tightening curbs downside risks without weighing on growth

Similarly, it is possible to investigate the effect of tightening capital requirements. Tightening capital requirements by 1 percentage point could reduce tail risks (lifting the expected growth outcome at the 5th percentile), while not having a negative effect on median GDP growth based on the historical observations, see Chart 3, right.

The model signals need for policy action

The above results could be useful to kick off an initial discussion of whether a tightening of policies would help curb increasing systemic risks. The model, however, cannot be used to identify which instrument is most appropriate to use, or how to calibrate a given instrument. Further analysis using other models and methods would be necessary in order to identify the most appropriate instrument to use and how to calibrate it.

House Prices-at-Risk can provide insight into policies targeting households

The Growth-at-Risk approach can also be applied to the housing market. Negative developments in the property market may have implications for the financial system and the economy, and vice versa. Housing market busts are common causes of banking crises, not least given the importance of real estate in the balance sheets of households and credit institutions.⁴ Denmark is among the advanced economies where the correlation between the real economy, credit and real estate prices is the highest.⁵ The close relationship between the housing market, the real economy and the banking sector means that it is highly relevant to explore a version of the macroprudential stance based on house price growth. Following the same approach, we estimate the impact of cyclical and structural risks as well as macroprudential policy on the house price growth distribution 8 quarters ahead.

⁴ See, for example, Hartmann, P., "Real estate markets and macroprudential policy in Europe", Working Paper Series, No 1796, ECB, 2015.

⁵ Grinderslev et al. (2017), Financial Cycles: What are They and What Do They Look Like in Denmark? Danmarks Nationalbank, Working Paper series No 115.

Measuring tail risks of house prices over time

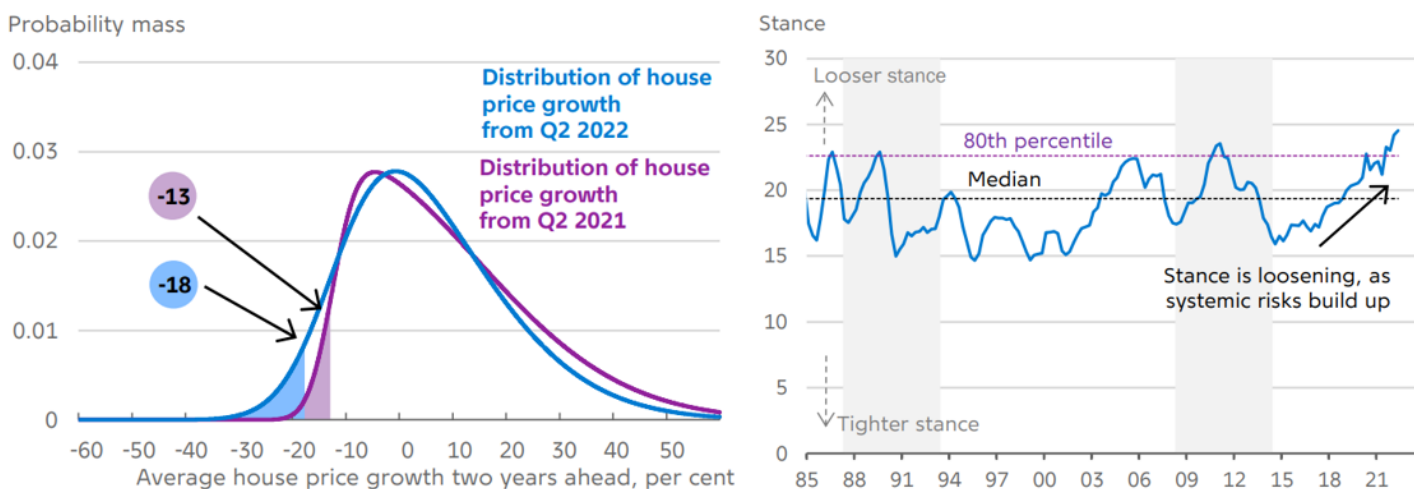
Using this model, we consider the development in tail risks and uncertainty surrounding house prices in Denmark. Similarly to the GDP-at-Risk, the exact levels of the tail estimates should be used with caution. However, the changes in e.g. the tail estimates can be used as an indication of growing tail risks. The 5th percentile of house price growth rates signals the build-up of risks in the run up to the financial crisis of 2008. Examining the build-up towards this event, there is a gradual decrease from 2000 to 2005, see Chart 4, right. This suggests a gradual worsening of risk scenarios of future house price growth suggesting the build-up of risks on the housing market.

Considering the recent developments of the tail risks surrounding house prices, the results suggests a corresponding and gradual increase in tail risks (decrease in the estimate for the 5th percentile) of house price growth from 2017 up until today. Covid-19 does however momentarily generate larger fluctuations.

Macroprudential stance on the housing market

The macroprudential stance, i.e the distance between the median house price growth and the lower 5th percentile has been loosening as shown in Chart 4, right. This is the case both during the build-up to the financial crisis in 2008 and since 2017. The model prescribes this loosening stance to increased risks, while borrower-based measures haven't addressed this sufficiently to avoid an increased stance.

Chart 4: Systemic risks decrease tail growth while tightening capital requirements increase tail growth



Note: Left: Density distribution of house price growth 8 quarters into the future as of first and second quarter of 2022. The model includes house prices-to-income ratio, housing investments-to-GDP ratio, debt service rate, as well as an index for borrower-based measures. House-prices-to-income captures the valuation of housing relative to household income, and is used as a proxy for the build-up of cyclical risks. The housing investment ratio is used as a proxy for structural factors that might amplify the effects of a negative shock. From a macroeconomic point of view, the indicator captures the supply of housing, which would influence expected house price growth. In the context of macroprudential policy and systemic risks, the indicator is used to describe the size of the real estate sector (housing construction and real estate firms) relative to the size of the economy. A high ratio might signal a business structure highly concentrated in the real estate sector. Real estate and construction comprise 17 per cent of the gross value added in Denmark. Furthermore, a larger share of housing investments relative to GDP might mean that the economy and the financial sector are more exposed to fluctuations in activity. Right: The macroprudential stance is defined as the median minus the tail. Latest observation Q2 2022. The median and the 80th percentile illustrated in the chart are based on the full sample from 1974-2022.

Source: Cucic, Dominic; Yordanova, Ianna Georgieva; Møller, Niels Framroze; Søndergaard, Simon Gade, *Evaluating the Macroprudential stance in a growth-at-risk framework*, Danmarks Nationalbank Economic Memo (November 2022, [link](#)).

Borrower-based measures reduce tail risks

Similarly to the GDP-at-Risk it is possible to investigate how increasing systemic risks and tightening borrower-based measures impact tail risks. The estimates suggest, that increasing risks may be addressed by tightening borrower-based measures. Tightening borrower-based measures affects the 5th percentile of house price growth positively and thereby reduces a potential decrease of house prices in risk scenarios. The costs of such a tightening is reflected in the effect on median house price growth. The model results point to a decreased median growth rate of house prices. ■

About the authors

Dominic Cucic is an Economist in the Research Unit of Danmarks Nationalbank since 2020. His research focuses on Financial Intermediation, Financial Regulation and Corporate Finance. He has recently studied the effect of monetary policy on shadow banks and the regulation of liquidity risk in mutual funds. He holds a Ph.D. in Economics from CEMFI (2020).

Ianna Georgieva Yordanova is Principal Macroprudential Expert at Danmarks Nationalbank. She joined the central bank in 2015 and has mainly worked on topics related to systemic risk analysis and macroprudential policy. Recent work includes issues related to capital buffer usability, development of the policy framework for setting capital buffers in Denmark as well as evaluating the macroprudential policy stance.

Niels Framroze Møller is Senior Climate Analyst at Danmarks Nationalbank. He joined the central bank in 2020 and has mainly worked on topics related to climate-related financial risk. Recent work includes analyses of the influence on house prices of energy renovation and rising energy prices.

Simon Gade Søndergaard is Financial Stability Expert at Danmarks Nationalbank. He joined the central bank in 2018 and has primarily worked with issues related to systemic risk analysis and macroprudential policy. Recent work includes analyzing interest rate sensitivity of Danish homeowners taking out new mortgages as well as evaluating the macroprudential policy stance including house prices at risk.

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SUERF Secretariat
c/o OeNB
Otto-Wagner-Platz 3
A-1090 Vienna, Austria
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