# Research Statement

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With this research statement I want to give a concise outline on the research I have conducted in the last 5 years, and aim to give an idea about the work I want to carry out in the future. Accordingly, I split this statement in two logical subsections.

## Current projects

Since the completion of my PhD thesis, the main focus of my work was related to understanding the great recession from the perspective of structural economic models. To serve this aim I had to forge new computation tools. On one side, fast, accurate and robust solution techniques are required to endogenously account for the nonlinearities imposed by the effective lower bound on interest rates (ELB). On the other end, efficient approximative nonlinear filtering techniques are essential to assess the likelihood in the context of Bayesian estimation techniques and to filter the distribution of exogenous innovations for economic analysis. Both, solution technique and a new Bayesian filter are presented in Boehl (2019).

Together with my coauthor I successfully applied this methodology in Boehl and Strobel (2019a) and Boehl and Strobel (2019b). In the first paper we investigate the drivers of the Great Recession and analyse the effects of interest rate policies in the aftermath of the crisis. For that purpose we estimate a medium-scale DSGE model and use it to decompose the recent dynamics of US macroeconomic aggregates. We find that the Great Recession was caused by an increase in the risk premium, which persisted after the recession and weighed heavily on real activity. Our analysis suggests that the long duration of the zero lower bound was a reaction to the weak economic development as opposed to a pure commitment by the central bank. Nonetheless, the sharp cut in the Fed Fund rate prior to the ELB period attenuated the fall in output by roughly 1 percent. At the ELB, expansionary forward guidance shocks had an strengthening effect on output, whereas inflation dynamics are largely untouched by this policy due to a flat Phillips Curve. We find that the cost of the ELB was substantial and lowered output by two percent. This result stands in contrast to others, that either find very low or unrealistically high effects of forward guidance. Likewise, we argue that others might underestimate the impact of the ELB on macroeconomic performance. It is my opinion that the difference in results can largely be attributed to the robustness of my methodology.

As a natural extension, in Boehl and Strobel (2019a) we seek to answer the question if the quantitative easing measures (QE) conducted by the Fed induced real effects. Extending our model by financial frictions and a banking sector and again estimating it to US data while accounting for the ELB, we conclude that from 2009 to 2015 the overall QE measures contributed about 0.5 percent to output. We find, whereas QE stimulates asset prices in the short-run, the persistent reduction of excess spreads lowers banks' net worth, the loan supply, and hence real economic activity in the mid-run. Forecasts suggest that, through the link between banks balance sheet and investment, shutting down the QE program will have a strong recessionary "hangover" effect, leading to a negative net-effect on output in the years after the end of QE. Thanks to my

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novel methodology, we are the first to be able to estimate such a nonlinear model and use it for a structural evaluation of the mentioned policy measures.

Using an estimated model with credit constraints in which excess volatility of stock markets is endogenously amplified through behavioral speculation, I study in Boehl (2017) whether monetary policy can mitigate spillovers. I find that endogenous speculation and its feedback to the price level are central features to replicate empirical key moments, whereas standard monetary policy rules can be shown to amplify stock price volatility. Numerical analysis suggests that asset price targeting can offset the impact of speculation on either output or inflation (but not on both) and can dampen excess volatility. The dampening effect of this policy is limited due to its undesirable response to non-financial shocks.

In Boehl and Hommes (2017) we analyse the interaction of perfectly rational agents in a market with coexisting boundedly rational traders. Whether an individual agent is perfectly rational or boundedly rational is determined endogenously, depending on the market performance of each type. Perfect rationality implies full knowledge of the model including the non-linear switching process itself. I use projection methods to find a recursive minimal state variable solution of the highly nonlinear system. Depending on the parameterization, agents' interaction can trigger complicated endogenous fluctuations that are well captured by the solution algorithm. In such financial market setup boundedly rational agents are not necessarily driven out of the market. While up to a certain point the presence of fully rational agents tends to have stabilizing effects it may later even amplify endogenous fluctuations. The methodological contribution of this work – combining endogenous, potentially chaotic dynamics with iterative solution methods – is completely novel to my best knowledge.

Studying the causes of the dynamics of wealth inequality, we show in Boehl and Fischer (2017) that the degree of capital gains taxation can retrace the US data from the 1920s up to the most recent observations. Precisely matching up- and downturns and levels of top shares, it has high overall explanatory power. This result is drawn from an estimated, micro-founded portfolio-choice model where idiosyncratic return risk and disagreement in expectations on asset returns generate an analytically tractable fat-tailed Pareto distribution for the top-wealthy. This allows us to decompose the sample into periods of transient and stationary wealth concentration. The model generates good out-of-sample forecasts. As an addition we predict the future evolution of inequality for different tax regimes.

## Future Work

For the near future I aim to continue working within the nexus of structural empirical analysis with the ELB and the methodology suggested in Boehl (2019). In particular, and similar to the work in Boehl and Strobel (2019a), the method also allows to analyze the measures of unconventional monetary policy during and after the financial crisis in Europe. As such it can answer the question whether the large-scale bond purchases in the Euro area (EA) were successful in preventing worse outcomes. A second and much debated question that I can potentially answer is, whether the ELB was – at all – binding in the EU or if the policy of negative interest rates was able to circumvent the problem. So far, the literature was unable to provide a structural analysis of these matters, which is mainly due to the technical difficulties tackled by my methodological contribution. I will furthermore focus efforts to see the papers discussed above published.

In the longer term I plan to concentrate my research on three pillars. The first is concerned with improving the empirical performance of macroeconomic models. Second, I want to investigate a potential connection of secular stagnation and inequality. Third, I want to continue to contribute to computational advances in my field.

**Making macroeconomics great again**

It is an acknowledged but little discussed fact that contemporary macro models do a bad job in accounting for the empirical data. As a prominent example, it is the well documented (Del Negro et al., 2007; Linde et al., 2017; Gust et al., 2017; Boehl and Strobel, 2019a,b) artefact that the New Keynesian Phillips Curve not only seems to be flat, but that it would even cease to exist if sufficiently tight priors were not preventing it. It is also a widely accepted view that the monetary transmission channel through *direct* effects on households is at odds with the empirical evidence.[1]

Such misalignment between theory and empirics pushes towards a reevaluation of alternatives. The recent literature suggests the use of global nonlinear solution techniques (e.g. Lindé and Trabandt, 2018; Born and Pfeifer, 2017) and heterogeneous agents (Khan and Thomas, 2007; Krueger et al., 2015; Kaplan et al., 2018) as potential solutions. I believe that nonlinearities can play a crucial role, especially with regard to financial stability, and think that a detailed model of heterogeneity is central when evaluating policy measures and can be fruitful to understand long-run macroeconomic phenomena. However, I don not see how the fully fledged implementation of both is crucial for the assessment of short-run phenomena such as the flat PK and the monetary transmission mechanism. As such, the HANK response (Kaplan et al., 2018), which emphasises how supply-sided reactions to monetary policy affect labor income and in turn consumer expenditures, relies on second-round effects that are also initially caused by intertemporal substitution. Likewise, the effects of uncertainty on the business cycle – especially during financial distress – are certainly non-negligible but may not be crucial to understand aforementioned fundamental macroeconomic phenomena.

Given that a good share of the macroeconomic literature since Bernanke et al. (1999) has underlined the importance of financial frictions, we should likewise acknowledge the importance of credit in the monetary transmission channel (see e.g. Sanches, 2016 and Gu et al., 2016). In particular, it seems necessary to study the supply sided effects caused by the firms borrowing channel as a direct response to monetary policy.[2] Although also the recent structural-empirical research suggests that modelling financial intermediation is essential in order to understand the last two decades of macroeconomic data, advances in this field since Gertler and Karadi (2011) have rather been marginal. As such, I find it promising to reevaluate the role of endogenous money creation with regard to the transmission channel as well as for financial shocks (see e.g. McLeay et al., 2014; Jakab and Kumhof, 2015).

Naturally, a shift towards alternative explanations for economic phenomena bears the potential of alternative answers when revisiting classical questions such as government spending/redistribution multipliers, and new questions such as the effects of unconventional monetary policy.

**Effects of economic inequality**

While the bulk of the new literature on heterogeneity in macroeconomics stresses the importance of inequality when reevaluating macroeconomic phenomena, Auclert and Rognlie (2017, 2018) focus on the effects of the concentration of income itself on aggregate demand. This analysis centers around the idea that households with different income have different marginal propensities to consume. I would suggest that similar mechanism suggests itself in the light of the current debate on *secular stagnation*. Looking at the data, the sharp increase in US wealth concentration in the last decades seems to translate almost one-to-one to the decrease in estimates of natural interest rates. Complementary to the work of Auclert, the main driving mechanism might be that, when wealth concentration increases, different propensities to save of the rich lead to too much saving in aggregate. As a result, aggregate overinvestment – hence a large supply – is a plausible explanation to the observation of the rapid decline in natural interest rates, which are the price for investment.

[1] See Kaplan et al. (2018) for a survey.

[2] Khan and Thomas (2007) points towards this direction.

**Computational methods**

Lastly, much of the contemporary research in macroeconomics is constrained by methodological and computational boundaries. Given my personal background, I feel that there is much room for improvement in particular at the computational frontier. To quickly sum up, we (1) seek accurate approximation of relevant features of nonlinearities in very short computation time.[3] We (2) would like to advance in the field of simulations with heterogeneous agents (see f.i. Den Haan and Rendahl, 2010). And lastly (3), we want to estimate nonlinear models and obtain good approximations of the distribution of hidden states at low computation cost.

It is apparent that we are dealing with increasingly complex methods. Solving, simulating and estimating a nonlinear model easily involves several ten thousand lines of code. I identify two core-problems here. First, with the complexity of the methods used, the quality of their implementation increases in relevance (see e.g. Coleman et al., 2018). Unfortunately, macroeconomists lack profound computational training to get this right. Second, as the size of the code increases, interaction of different groups of researchers and sharing of code becomes more important. Due to my strong background in programming and IT, I want to support projects such as `quantecon.org` to make it easier for generations to come to work with proper code. As an advocate of free and open source software (as opposed to propietary programs) I aim to reach out for third party funding to concentrate efforts in this field.

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[3] E.g. Meyer-Gohde (2014) shows how to capture motives of risk aversion in a linear representation.

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