

# DNB Research Program 2021

DeNederlandscheBank

EUROSYSTEEM





# Content



# Monetary policy

The global financial crisis had a profound impact on the practice of monetary policy in a range of countries. The crisis challenged important elements of the pre-existing dominant view that monetary policy should be aimed at price stability and should use just one instrument: a short-term policy interest rate. Being confronted with a massive financial crisis and its repercussions as well as stubbornly low inflation rates, central banks resorted to a large number of unconventional policy tools. When they encountered the effective lower bound (ELB), central banks extended the set of assets they were willing to purchase, these operations being known generically as Quantitative Easing (QE). This changed the composition and vastly increased the size of their balance sheets.

In light of these changes, four sets of important questions arise:

## 1. Effects of unconventional monetary policies

Although a substantial amount of research suggests that unconventional policies have contributed to increasing output growth and inflation, less is known about their impact on the exchange rate and how this in turn affects the macro economy (changing exchange rate pass-through to inflation). In addition, more research is needed on the (unintended) consequences of unconventional monetary policies on: housing markets, risk taking by financial institutions and markets, zombie-lending (misallocation of capital), and the behaviour of (different types of) consumers (e.g. due to shortfalls in the pension system). With interest rates still at or close to the ELB the effectiveness of

unconventional monetary policies going forward increasingly depends on fine-tuning the fiscal-monetary policy mix while controlling sovereign risk.

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## 2. The new normal for monetary policy

Important changes in the economy, notably the low level of inflation and sluggish economic growth, created new challenges for monetary policy decision-making. A major issue here is that some key variables (like the natural rate and expectations) are non-observable, while they play a key role in theoretical models. Important questions include: how reliable are estimates of the natural real rate of interest and its drivers; can monetary policymakers influence the natural rate, and if so, how? What is the role of expectation formation in relation to wage and price dynamics? To address these issues, a proper theoretical


framework is needed, in which the uncertainty about key variables is taken into account. If and when economic conditions turn more favourable, how should monetary policy be normalized (exit from QE; should central banks eventually return to the traditional mode of intervening at the short end of the market; what is the optimal size and composition of the central bank balance sheets) and what operational framework is best suited to effectively and efficiently transmit the desired monetary stance?

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## 3. Dynamics of inflation

It seems that the dynamics of wage and price inflation has changed. This raises several important questions: do we need new theories to explain (wage) inflation, what is the role of (expected) fiscal policy in this regard, what is the role of technological developments (ICT), globalization and changes in market structures (platforms, contestability), how do changes in labour market composition affect wage growth, is central bank independence enough to deliver price stability? Has the relationship between the output gap, unemployment and (wage) inflation dynamics fundamentally changed? If so, how should the Phillips curve be modelled? What determines the equilibrium labour income share on the macro and sectoral level?





How are (inflation) expectations formed? What is the role of inflation expectations in wage and inflation dynamics? What are the implications of these issues for the ECB's monetary policy – and in particular for the appropriateness of its current strategy?

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#### 4. Credit supply

In the aftermath of the crisis, credit supply by euro area banks dropped. This raises several issues: Why are banks not lending (demand or supply constraints)? What can monetary policy do to stimulate bank lending? What is the relationship between capital and liquidity requirements and bank lending? What are the consequences of lower access to bank credit

for small and medium-sized enterprises in the euro area? What impact does a distressed banking sector have on productivity growth? For the last two questions: what can be learned from the US where banks were recapitalized much faster after the crisis? In order to address several of these questions, high priority will be given to develop theoretical models for realistically modelled monetary policy in which debt overhang of firms and/or banks is combined with demand shocks. Such models can also be used to analyse asymmetric effects of monetary policy in a heterogeneous monetary union and can give guidance for identification in empirical work on several of the issues raised above.

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# Theme 1 Effects of unconventional monetary policies

New projects

Continued projects



## New projects

### 1. The macroeconomic effects of the ECB's balance sheet policies

Gavin Goy and Gregor Boehl (University of Bonn)

We estimate a large-scale DSGE model based on previous work to estimate the effects of the ECB's liquidity measures and asset purchases since the global financial crisis on euro area GDP and inflation. To this extent, we extend our previous model by central bank reserves in order to allow for negative interest rates and the accompanied negative effects on bank's profitability.

### 2. A tolerance band around the inflation target: (when) does it work?

Dennis Bonam and Gavin Goy

We study the effectiveness of adopting a tolerance band around the central bank's inflation target using an estimated DSGE model that accounts for the effective lower bound. The tolerance band is modelled as an endogenous regime switching process in which the central bank responds more aggressively to inflation once deviations from target exceed some predetermined margin. We find that the relative performance of the tolerance band in stabilizing inflation, compared to a baseline in which the central bank follows a point inflation target, depends on the type of shock hitting the economy. Moreover, the gains from adopting a tolerance band are particularly large when inflation exhibits more persistence or when expectations are more backward looking. Finally, the tolerance band does not necessarily imply more frequent ELB spells, despite interest rate cuts being more fierce when inflation falls below the band.

### 3. Has the relationship between sovereign yields and macro fundamentals changed since QE?

Leo de Haan and Jan Willem van den End

The sovereign bond purchases (QE) by the ECB that started in 2015 have become an important determinants of sovereign yields. We test (1) whether macroeconomic fundamentals of individual EMU countries have become less important for price formation on sovereign bond markets and (2) whether sovereign yields in the EMU have become less sensitive to financial market stress. We test both hypotheses by estimating a panel regression model, which describes the relationship between sovereign yields on the one hand and macro fundamentals and proxies for financial market stress and monetary policy on the other. We assess whether this relationship has changed through time and if so, whether this change has differed between countries (core versus periphery). The policy relevance of the project is that the outcomes may tell whether QE has affected the disciplinary effect that financial markets exert on governments, as reflected in the relation between countries' yield spreads and economic and budgetary developments.

# Continued projects

## 1. Unintended effects of quantitative easing: An assessment of the safety premium channel

Gavin Goy, Dennis Bonam and Ansgar Rannenberg (NBB)

The objective of this project is to show that quantitative easing, when aimed at purchasing long-term government bonds, can have contractionary effects insofar as long-term government bonds are considered as exceptionally safe and liquid, and thereby hold a safety premium over other assets. As QE reduces the supply of such safe assets, the safety premium rises which implies an increase in the spread on other assets, through which potential contractionary effects of QE may ensue. Of course, these effects may be offset through other positive effects of QE, such as lowering the term premium. However, in times of excessive stress, when demand for safe assets is particularly high, and during a liquidity trap, when long-run yields are already low, the contractionary effects may dominate. We aim to illustrate the safety premium channel of QE in a sticky price general equilibrium model with financial frictions. We also show that, if the safety premium channel is very strong, it may be better to gear QE towards the purchase of assets that do not hold a safety premium, such as private bonds.

## 2. QE and (international) portfolio rebalancing

Tom Hudepohl and Renske Maas

The portfolio rebalancing channel is often cited in literature as one of the most important, and perhaps one of the most effective channels through which QE can affect the economy. Most studies that look at portfolio rebalancing consider the euro area as a closed economy. However, QE also comes with important open-economy aspects. In order to address the open character of the euro area, we will look at international portfolio rebalancing. Addressing the question of international portfolio rebalancing will be done in two ways. One particular way investors can resort to portfolio rebalancing is by means of carry trades. By taking a look at the positions of euro area investors, we will investigate the impact of QE on carry trades. This will first be done by looking at whether euro area investors increased their risk-taking via an increase in exposure on liquid instruments in other currencies. Second, we will look at whether euro area investors resorted to international portfolio rebalancing by increasing instrument risk on their balance sheets.

## 3. Risk management principles for central banks: Towards a better understanding of interest rate risks in the central bank balance sheet

Michael Kurz, Dirk Broeders and Paul Wessels

The aim of this project is to contribute to the understanding of interest rate risks in central bank balance sheets. Interest rate risk in central bank balance sheets may result from asset-liability mismatches as a consequence of quantitative easing, when central banks finance long duration bond portfolios with short term deposits. Since central banks cannot hedge this interest rate risk due to their unique position in financial markets and their mission, it is important to better understand interest rate risks in central bank balance sheets in a broader economic context. On the one hand the central bank needs to be able to absorb these risks in a standalone capacity to remain independent. On the other hand the asset-liability mismatch determines the central bank's future profits that are paid in the form of dividends to the government (society). Our set-up of the central bank and its policy options follow the basic framework of central banking outlined in Hall and Reis (2015) and Mayes, Siklos, Sturm, and Reis (2019).



#### 4. The impact of negative interest rates on bank intermediation

Jorien Freriks and Jan Kakes

This project studies the effect of negative interest rates on bank intermediation and the transmission of monetary policy. Using bank-individual data (IBSE, IMIR), we investigate to how changes in interest rates affect banks' deposit and lending rates, as well as corresponding interest rate margins. In addition, we relate these effects to bank-specific characteristics, such as their funding profile, size and risk profile.





## Theme 2 The new normal for monetary policy

New projects

Continued projects





## New projects

### 1. Monetary policy, productivity and market concentration

Andrea Colciago and Riccardo Silvestrini  
(Erasmus University)

We use Compustat data to identify the effects of a monetary policy shock on average firm productivity. To explain our findings, we build a New Keynesian model where the pool of heterogeneous producers is endogenous. By reducing borrowing costs, an unexpected monetary easing attracts low productivity firms in the market. This initially reduces average productivity. After few periods, the increase in competition resulting from market crowding cleanses the market from firms which are not productive enough to breakeven on their costs. As a result productivity overshoots its initial level, while entry undershoots. Market concentration alters the transmission of the shock in a way consistent with the empirical findings.

### 2. Monetary policy and productivity in a small open economy

Andrea Colciago, Maurice Bun and Riccardo Silvestrini  
(Erasmus University)

We provide empirical evidence for the Netherlands on the effects of monetary policy shocks on productivity. Average measures of productivity will be estimated using Dutch firm-level data. We will then identify the effects of monetary policy shocks on average Dutch productivity and firm dynamics. We further address the empirical evidence by a small open economy, New Keynesian model where the pool of heterogeneous producers is endogenous.

### 3. The role of monetary policy in mitigating uncertainty shocks

Valeriu Nalban (IMF) and Andra Smadu

We ask whether there is a role for uncertainty in the reaction function of the monetary authority. To examine the impact of uncertainty shocks on aggregate fluctuations and the role played by monetary policy during episodes of heightened uncertainty and financial disruptions, we propose a New Keynesian model augmented with financial frictions. We will use third-order perturbation methods and the pruning techniques proposed by Andreasen et al. (2018) to solve the model. Then, we opt to implement a standard calibration – using the already relevant literature contributions – and to perform a sensitivity analysis with respect to a set of structural parameters that are of interest (e.g. the degree of price and wage stickiness), studying to what extent the central bank can stabilize the economy by directly reacting to uncertainty disruptions.

#### 4. The reversal of the bank lending channel under scrutiny

Andra Smadu and Irina Stanciu (London School of Economics)

Banks have faced increasing financial regulation following the Global Financial Crisis, aimed at mitigating financial fragility. These regulations lead to financial frictions on the supply side of finance that create wedges between the monetary policy rate and the funding costs of the real economy. In addition, banks' binding constraints may even revert a loose monetary policy stance. Brunnermeier and Koby (2018) introduce the idea of a reversal interest rate, defined as the rate at which accommodative monetary policy becomes contractionary for bank lending.

In essence, the reversal rate is an effective lower bound on nominal interest rates. Yet, Repullo (2020) argues that "(i) there is no single reversal rate, since it depends on bank-specific characteristics, and (ii) a reversal rate does not exist for low deposit banks." These remarks motivate the following question: what is really driving the reversal of the bank lending channel? To capture general equilibrium effects, we plan to incorporate a banking sector, constrained by financial regulations, into an otherwise standard New Keynesian

macroeconomic model. While, the setup is still aimed to capture the reversal rate conceptually, our modelling assumptions will depart from Brunnermeier and Koby (2018) aiming to match more closely bank characteristics and stylized facts.

#### 5. The effects of monetary policy and the role of the fiscal policy stance

Roben Kloosterman (Radboud University),  
Dennis Bonam and Koen van der Veer

One of the most important challenges facing policymakers in the coming years is the interaction between monetary and fiscal policies, particularly in the euro area where the former (latter) is conducted at the supranational (national) level. In the past, monetary and fiscal policy have not always been properly aligned with one another, even though theory predicts that their respective stabilizing properties hinge, to an important extent, on the close coordination between them. In this paper, we investigate empirically the role of the fiscal policy stance for the effects of monetary policy shocks in the euro area. In particular, we ask to what extent discretionary tightening of primary budget balances impinge on the ability of accommodative monetary policy to lift inflation and output.

# Continued projects

## 1. Drivers of the Euro area economy: A nonlinear semi-structural approach

Gavin Goy, Claus Brand (ECB), Carlos Montes-Galdon (ECB), Mario Porqueddu (ECB) and Mate Toth (ECB)

What are the long-term drivers of the euro area economy? To answer this question, we estimate a non-linear semi-structural model with stochastic volatility for the euro area. We show how lower productivity growth, rising risk aversion as exemplified by a rise in the convenience yield and demographics have contributed to a fall in the natural rate of interest. Together with a decline in neutral inflation this explains the observed fall in nominal rates to historical lows. Using the model, we also document a declining elasticity of inflation to demand shocks.

## 2. Nowcasting Dutch GDP with machine learning methods

Andreas Pick

This project compares the GDP nowcasting abilities of several methods in a pseudo real-time setting. The analysis covers Dutch real GDP over the years 1992- 2018 using a broad data set of monthly indicators and dives into the performance and interpretability of models based on factors, shrinkage, and ensemble

learning. We investigate the fore- and nowcasting performance of these methods and how to interpret the results from the methods. We further analyse how time variation can be integrated into the machine learning methods and whether this increases the accuracy of the fore- and nowcasts.

## 3. Detecting liquidity traps

Paolo Bonomolo, Yildiz Akkaya (Konjunkturinstitutet) and Ingvar Strid (Sveriges Riksbank)

Major economies experienced a period of low interest rates and low inflation. A possible explanation is that they fell in a liquidity trap. This is an equilibrium situation in which the policy rate is at the effective lower bound and inflation fluctuates around a negative or very low value. Ending in a liquidity trap is a big risk for the policy maker and we develop an econometric strategy to quantify this risk. We show that the methodology is able to recognize when the probability of converging to a liquidity trap is high before the interest rate approaches the lower bound. We analyze data about four economies: Japan, Euro area, US and Sweden.

## 4. Look for the stars: Estimating the natural rate of interest

Irma Hindrayanto, Mengheng Li and Siem Jan Koopman (Free University Amsterdam)

The natural rate of interest ( $r^*$ ) and the growth rate of potential output are important policy benchmarks widely used by central banks to determine the stance of an economy. It is well recognized that  $r^*$  is subject to low-frequency fluctuations as shown in the seminal paper of Laubach and Williams (2003). To track its evolution over time in a parsimonious manner, we propose a 2-stage multivariate unobserved components (MUC) model with similar cycles. In the first stage we pin down the time-varying trend growth rate of real output using Okun's law. In the second stage we model the necessary gap variables using similar cycles and insert the calculated trend growth rate in the full MUC model to estimate  $r^*$ . We apply our model to US, UK and EA data.

## 5. Estimating DSGE models with finite horizons

Kostas Mavromatis, Joep Lustenhouwer (Bamber University), Mike Tsionas (Lancaster University) and Giorgio Motta (Lancaster University)

We augment the Smets-Wouters (2007) model to account for households' and firms' bounded rationality. In particular, we assume that both form decisions up to a finite number of periods to the future. We estimate the model using a novel estimator. Our estimates show that the planning horizon of agents varies from 20 to 25 quarters ahead. Moreover, given the finite horizon in agents' decisions, we show that the responses of output, inflation and investment in the U.S. are more pronounced following fundamental shocks.



## Theme 3 Dynamics of inflation

New projects

Continued projects





## New projects

### 1. Forecasting Dutch inflation using machine learning methods

Robert-Paul Berben and Jasper de Winter

Despite the benefits of forecasting inflation accurately, improving simple models has proved challenging. This research explores advances in machine learning (ML) methods to forecast Dutch inflation. We investigate whether ML models with a large number of covariates are systematically more accurate than simple benchmark models, such as AR and RW. Amongst other we will investigate (polynomial) shrinkage methods, (targeted/boosted) factor models, ensemble methods, random forests and neural networks.

### 2. Consumers' inflation expectations: insights from a new survey

Richhild Moessner (BIS), Gabriele Galati and Maarten van Rooij

There is an increasing interest among policy makers and academics in the formation of inflation expectations of consumers. This projects aims to better understand inflation expectations using results from a new consumer survey. Topics include the level and probability of inflation expectations, anchoring of long-term inflation expectations, developments

during a pandemic period, and the role of information provision.

### 3. Bounded rationality, noisy signals and monetary policy assessment

Kostas Mavromatis, Tolga Ozden and Joep Lustenhower (University of Heidelberg)

We introduce household bounded rationality in a closed economy where firms have noise signals as regards the demand for their products. We follow Hommes et al. (2019) and Slobodyan and Wouters (2012) and assume that households use simple heuristics to forecast inflation, output, consumption and the future monetary policy stance. Firms operate in a monopolistically competitive environment and set the price of their goods infrequently. Firms are uncertain about the demand conditions in their sector. In particular, we assume that when setting the price, firms observe the demand for their product with some noise. This channel introduces an additional layer of uncertainty in our model. We assess the performance of simple monetary policy rules, namely inflation targeting, average inflation targeting and price level targeting. Subsequently, we compare our results to those from the rational expectations benchmark where households and firms share the same information set.

### 4. Did the Phillips curve flatten endogenously?

Emmanuel de Veirman

Inflation has remained stable notwithstanding substantial changes in output gaps. There is debate as to whether the Phillips curve "is alive". I confirm earlier evidence that inflation has become less responsive to output gap fluctuations. I examine to which extent this is consistent with endogenous changes in the Phillips curve slope predicted by endogenous pricing models. If the answer to both questions is yes, that would suggest that the Phillips curve is present – but it would be endogenously flat.



# Continued projects

## 1. Private beliefs formation and macroeconomic risk

Paolo Bonomolo, Guido Ascari (University of Oxford and University of Pavia) and Leonardo Melosi (Federal Reserve Bank of Chicago)

We study how the time variation in the expectation formation process affects the dynamics of inflation. The goal is to understand the determinants of inflation expectations, and quantify the risk that a shift in expectations can lead to high inflation. First, we identify the empirical determinants of the expectation formation process and its time variation through a time-varying parameter VAR. Then, we build a model with time-varying expectations to study the relation between expectations and macroeconomic instability.

## 2. On the sources of business cycle fluctuations in small open economies: Sweden 1995-2015

Paolo Bonomolo, Vesna Corbo (Sveriges Riksbank) and Jesper Lindé (Sveriges Riksbank)

We study how much small open economies are dependent on global factors. We use Swedish data (and in a later phase, possibly Dutch data) to quantify the big role of financial linkages in explaining the

dynamics of GDP and inflation after the financial crisis. In particular, when global financial stress increases, the effects are similar to a supply shock: inflation and GDP move in opposite direction. This can account for the so called "twin puzzle": the missing disinflation during the financial crisis, and the low inflation during the financial recovery.

## 3. Inflation fluctuations and liquidity constraints

Jakob de Haan and Irina Stanga

This project is motivated by two factors. First, in the euro area as well as in the Netherlands, core inflation has declined relatively little during the Great Financial Crisis and its aftermath and is increasing relatively little during the current recovery. Second, it is likely that liquidity constraints were more pronounced during the Great Financial Crisis and its aftermath than at other times. We link these two factors by investigating how liquidity constraints affected firms' pricing actions in the Netherlands, not unlike what Gilchrist et al. (AER 2017) do for the United States. We use a micro dataset on prices and liquidity of Dutch firms, which we construct for this purpose.

## 4. Heterogeneity in inflation forecasts

Kostas Mavromatis, Jakob de Haan, Cars Hommes (University of Amsterdam), Domenico Massaro (Catholic University of Milan) and Adriana Cornea Madeira (University of York)

We use a unique dataset on Consensus Forecast data to analyse inflation and output growth dynamics accounting for heterogeneity in expectations. Specifically, respondents in our dataset are called upon forming expectations about inflation, output growth, interest rates and other macro aggregates in the US, one and two years ahead. Our dataset contains monthly forecasts of individuals and spans from 1989 to 2017. We develop and estimate a behavioural model of inflation dynamics with heterogeneous agents. Heterogeneity in agents refers to their forecasting rules. Each agent has her own forecasting rule but we allow agents to switch among those rules over time, depending on the forecasting performance of each rule in the past. We experiment with both forward-looking and backward-looking forecasting rules.







## 5. Does it matter how you target? Performance of point, band, and range targets for inflation

Anna Samarina

We construct a new database of inflation targets for 55 countries over the period 1990-2018. We distinguish three types of inflation targets used by central banks: point target, point target with a tolerance band, and range target. Using this database, we examine how effective are different types of targets in achieving price stability. That is, whether the distinction between inflation target types matters for inflation performance, its volatility, and expectations.





# Theme 4 Credit supply

New projects

Continued projects





# New projects

## 1. Integration of funding and market liquidity in real estate

Dorinth van Dijk, Yumei Wang (University of Amsterdam) and Marc Francke (University of Amsterdam)

In commercial real estate markets, market liquidity tends to commove stronger than returns. As trading requires capital, we hypothesize that part of the strong co-movements in market liquidity are determined by changes in capital markets, i.e. funding liquidity. Because capital markets, as opposed to space markets, are mostly nationally or even internationally integrated, this provides a reasonable explanation why commercial real estate market liquidity is so strongly integrated across markets. By using and constructing several measures for funding liquidity, we provide robust evidence that changes in funding liquidity drive common changes in market liquidity.



## Continued project

### 1. IBRN project on consequences of low interest rates

Anna Samarina, David-Jan Jansen and Jakob de Haan

This IBRN project examines the consequences of low and/or negative interest rates on bank profits, bank funding and bank credit. Using confidential data, project teams will estimate the same models for the participating countries.

# Financial stability and financial regulation

The financial crisis has also led to major changes in financial sector supervision. Micro-prudential requirements have become stricter, although there is also a tendency (at least in some countries) towards less regulation. Within the euro area, the SSM has become responsible for banking supervision, but not for supervision of other financial institutions. Nowadays most central banks have become responsible for maintaining financial stability. A wide array of macro-prudential instruments can be applied, but so far, there is only limited experience. Early detection of (systemic) risks is important to successfully use both micro- and macro-prudential instruments. This calls for a further development of quantitative tools (using granular data) that can inform policymakers on (systemic) risk both in the banking and non-banking financial sector, such as early warning indicators, financial or credit cycle models, contagion mechanisms, and stress test models. As residential and commercial properties make up a substantial part of non-financial private sector assets, and relate to a significant share of financial sector lending and investment, developments in these markets have a profound impact on economic and financial stability. It is important to better understand the strong boom-bust pattern in the housing market, the causes of the slow reaction of the supply side of the housing market, and the relationship of the housing market with the business cycle.

In light of this, several important questions arise concerning financial stability and financial regulation including:

Which tools and policies can help to reduce the pro-cyclicality of the housing market? How do macro-prudential policy changes and regulatory reforms affect the transmission mechanism of monetary and macro-prudential policy? What is the impact of a country's financial structure (bank-based vs. market-based financing) on systemic risk? What is the impact of "fintech" and financial innovation

(like CoCos) on the sustainability of the (successfulness of) business models of financial institutions and what are the implications for financial services provision, the sustainability of business models of financial institutions, financial markets, financial stability and micro- and macro-prudential supervision? How does financial criminality impact the reputation of financial institutions and prudential risks? Do developments like low interest rates, high levels of debt and leverage, and increasing protectionism threaten financial stability?

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# Theme 5 Financial Stability and financial regulation

New projects

Continued projects



# New projects

## 1. Central bank digital currencies and financial stability: Market discipline in the era of digital money

Michiel Bijlsma (SEO Amsterdam/Tilburg University),  
Nicole Jonker, Jelmer Reijerink and Razvan Vlahu

Central Bank Digital Currency (CBDC) is a highly debated topic. Various central banks are currently considering whether and how to introduce this new type of fiat money. The introduction of a CBDC raises questions relating to, among others, the optimal design and potential consequences for financial stability. Some argue that under stress conditions, the presence of CBDC can increase the likelihood of bank runs. Concerns about a bank's health might encourage depositors to convert their money into CBDCs (since this digital money is backed up by sovereign credibility and thus risk-free). The financial stability implications of a CBDC would depend on depositors' behavior, which also depends on the specific attributes of the CBDC. This research project's main goal is to gain insights into the implications of the adoption of CBDC on financial stability. We answer the following questions: (1) How does the presence of CBDCs alter the nature of bank runs?, and (2) To what extent does the impact on bank deposits depend on the design features of a CBDC (such as interest rates and limits on convertibility)?

## 2. Global commercial real estate market spillovers

Dorinth van Dijk, Bing Zhu (Technische Universität München) and Colin Lizieri (University of Cambridge)

We examine global commercial real estate spillovers by studying how private commercial real estate market shocks in terms of liquidity and pricing propagate through space and time. We quantify the degree of diffusion per the method from Holly et al. (2011).

We consider diffusion through three channels:

(i) a dominant market channel, (ii) a 'neighbouring' market channel based on the degree of overlap in ownership, and (iii) through macro-economic factors.

We empirically find that London is the dominant market and document significant propagation from this city to 22 other global cities in the short run. Following Zhu and Lizieri (2020), we define neighbouring markets based on the degree of overlap of investors between markets.

## 3. Collateral scarcity and reuse in the European repo-market

Justus Inhoffen



We study the effects of collateral scarcity on re-use in the European repo market. Using transaction data of the 53 largest dealer banks in the Eurozone, we

estimate the daily bank- and security-specific reuse rate. We find that about 10% of the collateral obtained through reverse repo transactions is sold onwards. Regression results indicate that re-use increases as collateral becomes scarce through the ECB's asset purchasing programs.

## 4. The impact of central bank refinancing operations on bank equity offerings

Dimitris Mokas, Jan Kakes and Massimo Giuliodori (University of Amsterdam)

We study how the Eurosystem's long-term refinancing operations affect the market response following banks' SEO announcements. Previous empirical studies have found that equity offering announcements have a lower impact on stock prices of banks relative to nonfinancial firms, because offerings are less prone to agency conflicts as capital regulation plays a bigger role. As the availability of attractive long-term central bank funding (TLTROs) makes it relatively easier for banks to improve their capital ratios, forced recapitalizations may become less likely. We investigate the hypothesis that, as a result of TLTRO funding, offering announcements are increasingly associated with agency problems and therefore cause stronger share price corrections.



Further, we examine whether the price corrections depend on banks' (leverage, size, profitability) and characteristics of offerings (type, purpose).

## 5. Interconnectedness in collateral reuse markets

Magdalena Jurgiel

The collateral reuse market accounts for USD trillions worth of transactions globally. It is an important activity for both bank and non-bank financial intermediary (NBFI) institutions that use it on a large scale to efficiently allocate assets and to generate profits and liquidity. In addition to its many benefits, collateral reuse also comes with potential downsides, one of them being increased interconnectedness of the reusing institutions, which might lead to formation of contagion channels and transmission of stress within sectors and from one sector to the other. Despite these serious risks, the interconnectedness aspect of collateral reuse remains largely unexplored to date. This research aims to fill in this gap, with the key goal to gain a better theoretical and empirical understanding of the interconnectedness involved in collateral reuse markets and to use this understanding to derive implications for policy and regulation. The study will also generate important insights into interconnectedness in the context of NBFIs.

## 6. Evaluating systemic risk in the Dutch banking and insurance sector

Daniel Dimitrov and Sweder van Wijnbergen

We develop a framework to identify the build-up of system risk over time which can quantify hot spots in the banking and insurance sector. We argue that monitoring the financial risk of an institution in isolation of the risks of its counterparties and the system as a whole may offer a misleading picture of systemic stability by not taking into account the downside risks the institution is exposed to when potential systemic risk drivers materialize. Systemic linkages arise naturally through the direct channels by which those institutions operate on the interbank or derivatives markets for example, but may also be due to exposure to common shocks either on the liability side or on the asset side. We quantify the losses of the financial system given that a single institution is in severe distress (CoVaR), and the expected losses of a single institution given that the system is in distress (Marginal Expected Shortfall). We use information from the credit default swap (CDS) market, relying on the fact that the market value of a company's assets can be implied through the market value of its debt.



## Continued projects

### 1. Are there arbitrage possibilities in the trade of crypto currencies?

Timothy Aerts, Segun Bewaji (Payments Canada), Ronald Heijmans, Jeff Stewart and Ellen van der Woerd

Crypto currencies receive much attention lately as a potential means of payments in the near future. Especially since the announcement of the Libra coin by Facebook. The question is whether these or at least some of the cryptos are a suitable means of payments. Two aspects that are relevant in this discussion is their trading value against fiat currency and the volatility of the price. To get a better understanding of crypto currencies as a means of payments we study the volatility of the most traded cryptos (top 55) across 280 globally recognized exchanges and the possibility for arbitrage between different exchange platforms and currencies. Different algorithms will be tested in order to detect this arbitrage possibility.

### 2. Foreign bias in equity portfolios

Martijn Boermans, Ian Cooper (London Business School), Piet Sercu (KU Leuven) and Rosanne Vanpee (KU Leuven)

The literature on international equity holdings distinguishes between home bias (overweighting of home stocks) and foreign bias (relative underweighting for more 'distant' countries). The two biases can be integrated into one distance-based model. This paper builds on the work on Cooper et al. (2018) to measure the foreign bias. We analyse how benchmarking explains the prior findings in the literature. We collect portfolio holdings among households in stocks. The findings are important to better explain international investment patterns and may carry implications for financial stability.

### 3. Does search for duration make investment behaviour procyclical?

Stijn Claessens (BIS) and Robert Vermeulen

We investigate, using security level data covering all euro area countries, how various classes of investors adjust their portfolios in response to changes in interest rates considering the duration of investable securities. Investors with long term liabilities, e.g. insurance companies and pension funds, face sharp increases in these liabilities when discounted with lower interest rate. This effect can trigger investors to purchase more long-term bonds with a high duration, which creates a feedback loop. The results provide information on investor behaviour during the ECB's asset purchasing programs and can provide guidance on investor responses when the ECB will decrease its balance sheet again.

#### 4. Regulation, supranational bank supervision, and the corporate structure of foreign affiliates

Razvan Vlahu and Natalya Martynova  
(Deutsche Bundesbank)

In the context of cross-border banking, we study how differences between home and host country regulatory arrangements, as well as the introduction of a supranational supervisor, affect the corporate structure of foreign affiliates. When going abroad, banks can operate as either a subsidiary or as a branch. Subsidiaries are separate legal entities regulated and supervised by host country's authorities, thus protected by limited liability. Branches are an integral part of the parent bank, enjoying no limits on the ability to transfer funds cross-border within the banking group. They are also subject to regulation and supervision on a consolidated basis in the home country. We show that when the host country's regulation allows for both structures, foreign banks may circumvent stricter regulation abroad and prefer to operate through a branch structure. We also show how the presence of a supranational supervisor, who limits the scope of "ring-fencing" arrangements in the host country, may affect the structure of foreign affiliate. By increasing subsidiaries' ability to easily move funds cross-border, while leaving the limited liability of the affiliate unaffected, a centralized supervision may increase the preference for a subsidiary structure.

#### 5. Pension fund equity performance: herding does not pay off

Matteo Bonetti

Using a unique data set including the holding of pension funds in the Netherlands, I document that pension funds herd in individual securities. I introduce two pension-fund-level measures of herding. The first measure identifies the extent to which a pension fund acts as a leader. I show that leader pension funds do not outperform non-leader pension funds indicating that leaders and non-leaders have similar investment skills. The second measure identifies the extent to which a pension fund acts as a follower. I show that follower pension funds underperform non-follower pension funds by 1.32% on an annualized basis indicating that herding has a negative impact on performance. Herding is related to reputational concerns, as large corporate pension funds and industry-wide pension funds are more likely to be leaders.



# Trust

Public trust in financial institutions and financial supervisors is vital because low trust may undermine financial stability and damage the financial services industry, which is detrimental for the well-functioning of the economy. It is important to know what drives consumers' trust in financial institutions and central banks, especially in turbulent times, and how to contribute to improving it. Moreover, good knowledge about the economic and social benefits of trust and the impact of a lack of trust is very valuable. Likewise, trust in the central bank may enhance the effectiveness of monetary policy. Furthermore, trust in the central bank is crucial for its political legitimacy. DNB will continue researching trust in financial institutions, financial sector supervisors, and central banks in the upcoming years.

In light of this, regarding trust an important research question that arises is: How has the COVID-19 pandemic affected public trust in financial institutions and central banks? On the one hand, the economic downturn during the pandemic may have lowered public trust in financial institutions and central banks. On the other hand, the measures taken by central banks and financial institutions may have had a positive effect on consumers' trust.

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# Theme 6 Trust

New projects





## New projects

### 1. Trust in the European Central Bank during the covid-19 crisis

Carin van der Cruijssen and Anna Samarina

This project aims to investigate consumers' trust in the European Central Bank (ECB) during the covid-19 crisis. We will use the monthly ECB Consumer Expectations Survey (CES) pilot microdata that covers six euro area countries: Belgium, France, Germany, Italy, the Netherlands, and Spain. First, we will examine the evolution over time of trust in the ECB compared to trust in other European institutions, namely the European Commission and the European Parliament. Second, we will analyze how trust in the ECB depends on consumers' experiences during the covid-19 crisis, their personal characteristics, financial literacy, as well as the aggregate country-specific economic situation. Third, we research whether trust in the ECB matters for the anchoring of inflation expectations.

### 2. The impact of the COVID-19 pandemic on public trust in financial institutions and their financial supervisors

Carin van der Cruijssen, Jakob de Haan and Ria Roerink

The COVID-19 pandemic has drastically changed our daily lives and hugely impacted economies all around the globe, but what has been its impact on public trust in financial institutions and its supervisors? On the one hand, the economic downturn may have lowered public trust as trust tends to be lower in bad times than in good times. On the other hand, central banks and supervisors took measures to support lending to consumers and firms. Financial institutions have tried to weaken the detrimental impact of COVID-19 on its customers by granting them payment moratoria. These policies may have had a positive effect on consumers' trust. We use the DNB Trust Survey (DTS) to research the evolvement of trust in these turbulent times in the Netherlands.

### 3. Drivers of consumers' trust in a changing retail payment ecosystem

Carin van der Cruijssen and Nicole Jonker

For central banks it is key to understand what drives consumers' trust in retail payments. Retail payment systems are currently drastically changing due to PSD2, the entrance of new (BigTech) players into retail payments and other technological developments. The purpose of this research is to cast light on consumers' trust in retail payments and the drivers. We analyse the impact of the pandemic, the relationship with sociodemographic characteristics, and the relevance of various potential trust triggers. We use data from the De Nederlandsche Bank/Dutch Payments Association Survey on Consumers' Payments.





#### 4. Data sharing and privacy

Michiel Bijlsma (SEO Amsterdam/Tilburg University),  
Carin van der Crujisen and Nicole Jonker

PSD2 has increased the possibilities for new and traditional players in the payments landscape to use payments data of consumers. Policymakers want to have insight into consumer attitudes towards payments data usage. They also want to learn about the drivers of these attitudes and monitor their evolution over time. In addition, they want to know to what degree traditional players experience competition from large new players, such as bigtechs. This research shows privacy attitudes of Dutch consumers. It compares their attitudes towards payments data usage with their attitudes towards the usage of other types of data such as data on their health. It also shows how these attitudes depend on the type of user, financial incentives and whether the data is anonymized.

#### 5. The impact of providing information on monetary policy on inflation expectations and trust in the ECB

Nils Brouwer and Jakob de Haan

Using experimental data gathered via the DHS, we address two research questions. First, does providing information about the ECB's (unconventional) monetary policies enhance trust in the ECB? And secondly, does this information lead to inflation expectations which are closer to the inflation target of the ECB?



# Sustainability

The sustainability of economic growth has become a major issue, not only for monetary policy-making but also for financial supervision. Fundamental changes in the environment (e.g. due to the COVID-19 pandemic) could affect economic and financial stability and the safety and soundness of financial firms, with clear potential implications for monetary and supervisory policies alike. Changes in public policy to address environmental risks, as well as wider factors, such as technological innovation, may affect the economy and financial system. For instance, in view of the Paris Agreement, a major goal for governments is to reduce the emission of carbon dioxide which implies a transition towards more sustainable energy sources. This may affect the macro-economic environment for monetary policy. Likewise, it may affect the riskiness of portfolios of financial institutions (e.g. there may be a risk that carbon-intensive assets may become 'stranded' as part of a low carbon transition). These portfolios may also be affected by other possible environmental developments, such as climate change and the increasing adoption of sustainable investment practices. How can these risks be measured? Sustainability also has a socio-economic aspect, reflecting the need for the fruits of sustainable economic growth to be shared among the population. For instance, the wealth and income distribution (between households but also between production factors) is often considered an important dimension of sustainability. Likewise, sustainability may require social security arrangements (such as pensions) to be self-financed so that the risks are not transmitted to future generations.

As to sustainability, DNB research will address issues like: how will the energy transition affect economic sectors? How will (sudden) changes in the energy transition affect exposures of financial institutions and financial stability? How are climate risks priced in at financial markets? How can the energy transition be implemented efficiently and effectively, given its international dimension and sometimes conflicting (short-term) interests of jurisdictions? What role

do financial markets and new financial instruments have in financing the transition? How should the energy transition and the transition towards a circular economy be financed?

As pointed out above, sustainability is more than climate risk. From that perspective DNB research will also address issues like: What are the drivers of TFP-growth at the firm or sector level? What is the

contribution of access to finance, zombification, capital misallocation and inter-firm spillovers for TFP-growth at the aggregate level? How do monetary policy and macro-prudential policies affect wealth and income distribution? How does incompleteness of financial markets and the implied heterogeneity in terms of access to liquidity affect macro-economic demand? In view of several changes (like increasing share of temporary workers, reduced bargaining power of trade unions) another important issue is how will the future labour market look like. What is the relationship between income and wealth distribution and robust growth? How can the pension systems be designed (and reformed) in such a way that the risks are shared optimally between generations (including future generations)?

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# Theme 7 Sustainability

New projects

Continued projects







# New projects

## 1. Optimal Collective Defined Contribution Pension Schemes

Ilja Boelaars (ING), Dirk Broeders and Annick van Ool

Collective Defined Contribution (CDC) pension schemes become increasingly popular. In a CDC scheme, participants share the investment risks on their collective retirement savings by allowing pension benefits to fluctuate over time. From a sustainability perspective, CDC schemes should be designed in a fair and efficient way. Fairness requires that no ex-ante transfers of value occur between the generations in the scheme, and efficiency implies that individual participants have an optimal exposure to investment risks based on their preferences and life-cycle. We offer the design features for a general class of fair and efficient CDC schemes through the combination of a benefit adjustment mechanism and an investment policy, in the presence of equity market risk and interest rate risk.

## 2. Monetary policy and business dynamism in the pandemic

Andrea Colciago, Guido Ascari (University of Oxford and University of Pavia) and Riccardo Silvestrini (Erasmus University)

We will introduce an epidemiological SIR model in a dynamic New Keynesian industry model with endogenous pools of producers and endogenous productivity. We will use this framework to assess the effectiveness of alternative monetary interventions at preventing business closures and eventual long run adverse effects of the pandemic. Additionally, we will study the effects of lockdown policies on business dynamism.

## 3. Embedding of sustainability in the financial sector

Danijela Piljic, Joris van Toor and Justin Dijk

The research focuses on the question to what extent banks, insurers and pension funds have embedded sustainability in their business operations. The research consists of two parts. First, financial institutions are exposed to physical and transition risks as a result of sustainability challenges such as climate change, biodiversity loss, water scarcity and human rights

controversies. We conduct a survey to gain insight into how and to what extent financial institutions integrate these risks into their credit, investment and insurance portfolios. The survey design follows the framework of the Task Force Climate Related Financial Disclosures (TCFD). Second, financial institutions also strive for a positive impact on sustainability challenges with their investments and financing. Based on three analyzes, we investigate the extent to which financial institutions are committed to their sustainability ambitions:

1. in the survey we ask a number of questions about the objectives that institutions have set themselves for sustainable finance;
2. we provide insight into how the CO<sub>2</sub> footprint of Dutch financial institutions develops over time;
3. together with the 2<sup>o</sup> Investing Initiative, we investigate to what extent the balance sheets of Dutch financial institutions are in line with the Paris Agreement by using the Paris Agreement Capital Transition Assessment (PACTA) tool.





#### 4. Misallocation and productivity growth: a meta-analysis

Maurice Bun and Tolga Ozden

In the last decades many countries experienced a slowdown in aggregate productivity growth. An important factor behind these declining productivity growth rates is misallocation of production factors. Recent studies have shown that empirical measures of misallocation based on the dispersion in marginal revenue products have increased over time within many countries. There are different sources of this observed misallocation, however, and there is in the literature no consensus about their relative impact on productivity growth. In this study we therefore conduct a meta-analysis of the extensive theoretical and empirical literature quantifying the productivity impact of the various origins of misallocation.

#### 5. Does green trump home? An assessment of investors' relative preferences for green over domestic bonds

Anouk Levels, David Cesar Heymann (ECB),  
Claudia Lambert (ECB) and Michael Wedow (ECB)

We investigate whether euro area investors have a preference for green bonds over domestic bonds. This question is relevant in the context of the European Commission's sustainable finance agenda. To realize Europe's climate ambitions, substantial private sector investments are needed. Resilient and well integrated capital markets may help achieve these goals. Insights into investor's preference may inform policy discussions in the context of the CMU/Sustainable finance agenda.



# Continued projects

## 1. Inequality and household financial decisions

Dimitris Georganakos (ECB), Yuriy Gorodnichenko (University of California Berkeley), Olivier Coibion (University of Texas Austin) and Maarten van Rooij

This project aims to better understand the effect of income and wealth inequality on household financial decisions (borrowing, housing investment and other spending categories) and the channels through which comparisons with peer groups affect household decisions. Also, we shed light on sustainability from the viewpoint of Dutch household perceptions about current levels of inequality.

## 2. Pricing the carbon factor for Europe's equity market

Kristy Jansen, Rianne Luijendijk and Sweder van Wijnbergen

This paper uses firm specific CO<sub>2</sub> emission data to augment the standard Fama-French three-factor model with a fourth "carbon factor". By constructing portfolios based on CO<sub>2</sub> emissions we examine whether there is a systemic return from investing in a CO<sub>2</sub> efficient European equity portfolio. In this way the paper will assess whether investors demand a

carbon-specific risk premium as compensation for exposure to carbon risk. If there is no difference in pricing between CO<sub>2</sub> intensive firms and low CO<sub>2</sub> emitting firms, investors apparently do not value or possibly underestimate climate risk. If investors do price in a significant carbon factor this would have extensive consequences for the efficient allocation of investments and the cost of hedging carbon risk.

## 3. The effect of ESG integration on the environmental performance of stock portfolios

Guan Schellekens and Anouk Levels

Integration of Environmental Social and Governance (ESG) considerations into investment decision-making is rapidly becoming mainstream. Numerous studies have been performed to assess the impact of ESG integration on financial performance. These studies show that ESG integration has little, or potentially a slightly positive, effect on risk-adjusted returns. Little research has been done, however, on the effect of ESG integration on the environmental performance of stock portfolios. In this study we will assess the impact of ESG integration on three metrics of environmental performance: i) the contribution of the portfolio to sustainability goals, ii) the number and severity of

environmental controversies associated with the firms in the portfolio and iii) the environmental damage costs associated with the portfolio. This analysis will be performed on the basis of securities holdings statistics of Dutch financial institutions.

## 4. Zombie firms and productivity growth in the Dutch economy

Maurice Bun and Jasper de Winter

Recent theoretical and empirical research indicates the causal link between weakly performing, highly indebted firms (so-called zombie firms) and economy-wide productivity growth. The evidence for the Netherlands is limited, and largely neglects feedback loops from the business cycle on the growth of the number of zombie firms. In this research, we investigate the links between distressed firms, debt overhang and productivity growth for the Netherlands using a novel database containing the population of Dutch firms and their balance sheet data.





## 5. The employment effects of corporate income tax shocks: New evidence and some theory

Andrea Colciago, Vivien Lewis (Bundesbank) and Branka Matyska (Leuven University)

We aim to assess whether cuts to corporate income tax rates can be a useful tool to boost job and business creation. We will provide empirical evidence concerning the effects of corporate tax income shock on firm creation (and destruction) and employment. Then we will estimate reduce forms effects using panel-regressions estimated on US state data. We will then provide a DSGE model with search in the labour market and endogenous firms dynamics along the lines of Colciago and Rossi (2015), augmented with a fiscal side. The model will be aimed at addressing the main facts identified in the empirical analysis.

## 6. Asymmetric shocks in EMU: private or public risk sharing?

Patrick Kosterink, Dennis Bonam, Matthijs van Zaal (Ministry of Social Affairs and Employment) and Jakob de Haan

We examine the importance of asymmetric shocks in EMU by replicating and extending some recent work on this issue and discuss the implications for the need to have more private risk sharing (via financial markets) and/or public risk sharing by some form of European risk sharing scheme.

## 7. Financial literacy and pension expectations

Maarten van Rooij, Rob Alessie (University of Groningen) and Remko Struik

A side-effect of low interest rates is that many pension funds are underfunded, have not been able to index the pensions for a number of years and may have to cut pensions when shortfalls do not recover. We investigate whether employees have updated their expectations regarding retirement age and replacement rate (both in terms of levels and uncertainty), also in view of the major policy changes since 2013 (gradual increase in statutory retirement age and reduced accrual rates). Moreover, we analyse whether the updating of pension expectations is related to financial literacy or other personal characteristics.

## 8. Misleading footprints: Inflation and exchange rate effects in relative carbon disclosure metrics

Artjom Janssen, Justin Dijk and Patty Duijm

Relative carbon footprint metrics, such as the Weighted Average Carbon Intensity (WACI), are increasingly used by organisations as an indicator of their respective portfolio's exposure to carbon-intensive companies. These kinds of metrics depend on monetary variables, and their unit usually is 'CO<sub>2</sub> eq / M EUR invested'. While one can compare portfolios at a static point in time, inflation and exchange rate fluctuation issues arise when one wants to observe a portfolio over time, and/or the currency composition of the portfolio changes. In this research we propose a method to adjust relative carbon footprint metrics for inflation and exchange rate fluctuations, thereby contributing to the creation of a globally harmonised environmental reporting standard.



# Payments and market infrastructures

Both innovation-driven developments and regulatory measures like PSD2 are transforming the payments ecosystem rapidly. Payment behaviour changes, e.g. there is a downward trend in the use of cash. New players enter the scene. The market structure can change. This will affect the way the central bank can pursue its goal of promoting the smooth functioning of the payment system as well as DNB's supervisory role. Fintech may also have an impact on monetary policy transmission. Moreover, financial market infrastructures may be affected by developments in potential new payment methods or financial instruments, such as crypto-currencies and the underlying technologies. It must remain possible for over-the-counter transactions to be settled in cash as long as consumers still want this.

In the light of the changing landscape, the following research questions on payments and market infrastructures are key: Research on payment innovations, notably the block chain technology, is important, as well as research on the effects of new regulation. What drives the acceptance of traditional and new payment instruments? Is there a minimum level of cash usage below which commercial parties are not interested anymore in maintaining a good infrastructure for cash? How can we improve the banknote in terms of cost and usage? What is the impact of e-commerce on payment use? What is the influence of new regulation and "fintech" on retail payments? How much trust do people have in new and traditional payment instruments and payment service providers, and does it matter? Market infrastructures such as TARGET2, TARGET2-Securities and central counterparties produce a lot of granular transaction

data on a daily basis. How can we use that data to obtain information on a. the monetary policy implementation of the Eurosystem, b. risk indicators within an FMI and between FMIs, c. potential liquidity problems, and d. detect outliers? Many innovations in this field are technology-driven, notably the distributed ledger technology. It is key to investigate their disruptive consequences (not only in the financial sector) and to gain detailed hands-on experience of such new technologies in order to answer questions that relate to their suitability of a potential implementation by central banks and how they need to be supervised.

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# Theme 8 Payments and market infrastructures

New projects

Continued projects



# New projects

## 1. Consumer research Central Bank Digital Currency

Michiel Bijlsma (SEO Amsterdam/Tilburg University), Carin van der Crujisen, Nicole Jonker and Jelmer Reijerink

The use of cash is declining and policymakers are discussing the introduction of a digital alternative: Central Bank Digital Currency (CBDC). They want to know the factors that will contribute to the adoption of CBDC and how CBDC can be best designed to match the preferences of consumers. Goal of this research to measure consumer attitudes towards CBDC, learn about the factors that influence the adoption of CBDC, and what this implies for the design of CBDC.

## 2. Attention guiding for faster banknote authentication

Frank van der Horst, Joshua Snell (VU) and Jan Theeuwes (VU)

People have the possibility to authenticate a banknote using public security features, but they seldom do so, because they have trust in the system. Also in general people hardly know which security features exist. Furthermore, cash transactions take very little time. So in order to help people in situations that authentication is needed, security features should be found quickly. This scientific study tries to find out if guiding attention to a security feature helps in faster and easier recognition. To that end we will design banknotes with and without attention guiding objects and test participants behind a computer screen how fast and accurate their performance is.

## 3. Use of payments data for nowcasting consumption

Wilko Bolt, Carin van der Crujisen, Nicole Jonker and Jelmer Reijerink

For policy analyses it is important to have good insight into consumption quickly. However, macroeconomic consumption data get published with a delay. In contrast, payments data are available quickly. The goal of this project is to build a model that makes a reliable estimation of consumption using payments data. We use the De Nederlandsche Bank/Dutch Payments Association Survey on Consumer Payments data and build on prior research results by Verbaan, Bolt and van der Crujisen (2017).



# Continued projects

## 1. E-commerce: Use, growth and pricing

Wilko Bolt and Bas Butler

E-commerce is rapidly growing. Buying online represents a technology that will fundamentally change the way industries operate. Although E-commerce sales remain a smaller percentage of overall sales than “brick-and-mortar”, yet the percentage continues to increase at a (much) faster rate than overall sales. Who are the online users, how do they pay and what preferences do they have? What does it mean for market structure, competition and its effect on product pricing? How do network effects come into play? Using recent Dutch survey results (‘two waves’) on E-commerce this paper tries to empirically assess above questions by applying multivariate logit/ probit regression models, identifying demand and preference characteristics and its potential effect on payment use, production cost, price levels and inflation (“the Amazon effect”).

## 2. Virtual currencies: Dynamics and monetary aspects

Wilko Bolt and Maarten van Oordt (Bank of Canada)

Bitcoin was launched in 2009 and has recently attracted much attention from economists, financial media, and even governments. Its increased attention was fueled by the sudden “explosion” and volatility in the exchange rate of Bitcoin by the end of 2013. Can economic theory help explaining these extreme price movements and its dynamics, and does virtual currency pose a threat or an opportunity for monetary policy? Building on Bolt and van Oordt (JMFB, 2019), this research project tries to further assess the dynamics and monetary aspects of virtual currency.

## 3. Contactless payments, the pain of paying, and financial troubles

Carin van der Cruijssen

An increasing number of people are using their debit card or phone to pay contactless at the point-of-sale. This is a quick and user-friendly way of paying. However, given the speed of paying a contactless payment may feel less like a real payment than a cash or standard debit card payment; the pain of paying may be lower. We use consumer survey data to

examine the link between payment instrument choice, the pain of paying and financial problems. Thereby, we examine the role of age and other personal characteristics.

## 4. Predicting the use of Emergency Liquidity Assistance

Richard Heuver, Yvo Mudde and Ron Triepels (Maastricht University)

The usage of Emergency Liquidity Assistance (ELA) often starts when banks face severe liquidity problems. Central banks therefore desire early signaling of liquidity problems. In DNB working paper 642 “Liquidity stress detection in the European banking sector” we show that liquidity stress can be successfully detected using granular payments data and machine learning techniques. In this research project we will use granular payments data and aim at prediction of liquidity assistance by looking for signals in the preceding period. Furthermore, we will look for ways to interpret machine learning outcomes in order to follow the origins of signaling as well as ways to present the end results.

