# Research News 2016

Research Division at Sveriges Riksbank

SVERIGES RIKSBANK

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This newsletter describes the research activities and output of the Research Division at Sveriges Riksbank in 2016.

**Staff at the Research Division, 2016**

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*Paola Boel*, research economist
*Marieke Bos*, research economist
*Tobias Broer*, visiting scholar
*Jesper Böjeryd*, research assistant
*Mikael Carlsson*, visiting scholar
*Emilio Dermani*, research assistant
*Daria Finocchiaro*, research economist
*Isaiah Hull*, research economist
*Tor Jacobson*, research economist (acting head of research)
*Thomas Jansson*, research economist
*Per Krusell*, visiting scholar
*Mats Levander*, PhD student at SSE
*Jesper Lindé*, head of research (on leave)
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*Matias Quiroz*, post-doctoral fellow
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*Mattias Villani*, visiting scholar
*Erik von Schedvin*, research economist
*Karl Walentin*, research economist
*Andreas Westermark*, research economist
*Xin Zhang*, research economist

## Reflections by the acting head of research

In 2016, the research division at the Riksbank was subject to an external evaluation of its ability to meet the main objectives of providing good research and support towards the central bank's policy analysis. This was the second external evaluation since research was first started up in the late 1990s, and the previous one happened eight years ago; my guess is that a third one will be carried out in 2024, or so. So what is the value gained by going through the ordeal of exposing your state of affairs to external evaluators who, from a neutral position, will gauge evidence at face value? Well, I would say exactly the latter is the value-added. In-house appreciation, or deprecation, will always be more or less biased because of the lack of neutrality and the vested interests necessarily involved. Outsiders may provide a candid view, which is precisely what you want to base your ideas for restructuring on, going forward. Thus, I would like to thank our evaluation committee – Rodney Ramcharan, Frank Smets, Greg Udell, and Jonathan Wright – for their earnest work and for providing such a basis. Since its presentation in September, the report has resulted in much discussion: first and foremost, within the research group itself, but also across the various policy departments of the Riksbank, and not least with the executive board. By now a plan has emerged for the more important steps and measures to take in order to ensure a sustainable role for research within the Riksbank. For those interested in the finer details of the evaluation, a link to the report is provided on page 18. To summarize my reading, I would say that we have done well enough, but there is plenty of scope for future improvements.

The 2016 research conference at the Riksbank centered on the equally broad and interesting theme of interconnectedness among various agents in the economy. The two keynote speakers—Rob Townsend, MIT, and Stijn Van Nieuwerburgh, NYU—presented work on network centrality measures and a general equilibrium model to evaluate quantitative effects of macroprudential policy, respectively. A novelty for the 2016 research conference was that for the first time it was carried out in collaboration with a foreign institution, namely the MacCaLM project run by Professor John Moore and colleagues at the University of Edinburgh. I am happy and proud that we were asked by John to join forces for this conference, and hope very much for further collaboration with their project in the future. John very kindly agreed to an interview in this issue of the Research News, where he explains the ideas going into the MacCaLM project and why they are so important. I warmly recommend the reading of his interview below.

*Tor Jacobson*

## Interview with John Moore

### Professor of Economics, University of Edinburgh and London School of Economics

*Q1.* *The Research Division at Sveriges Riksbank, in conjunction with MacCaLM, the research group you lead at the University of Edinburgh, held a conference at the Riksbank in September of this year. Perhaps you could introduce MacCaLM, and explain why the joint conference was a good idea?*

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# Changes in the research staff

From August 1, 2016, **Jesper Lindé** is on a one year leave. He is currently a resident scholar at the International Monetary Fund (IMF) in Washington DC. During Jesper's leave, **Tor Jacobson** is acting head of research. In August 2016, **Marieke Bos** joined the Research Division as a part-time research economist for one year. Marieke divides her time between the Swedish House of Finance at the Stockholm School of Economics and the Riksbank. She also holds a visiting scholar position at the Federal Reserve Bank of Philadelphia. Marieke's research focuses mainly on issues within the fields of household finance and empirical banking.

# Summary of featured article

*The following is a summary of the article by Isaiah Hull titled "Amortization requirements and household indebtedness: An application to Swedish-style mortgages," which was published in the European Economic Review, vol. 91, 2016, pp. 72-88.*

I evaluate mortgage amortization requirements as a tool for reducing household indebtedness and income shock vulnerability in the long run. I use an incomplete markets model with three types of debt and a novel mortgage contract specification that is calibrated using Swedish micro and macro data. I evaluate Swedish-style mortgage contracts prior to the implementation of the amortization requirements; and compare them to new contracts specified by the Swedish FSA. Contracts previously required households to amortize down to a 0.70 LTV ratio, but allowed purely voluntary amortization thereafter. Current contracts require households to amortize mortgages at a rate of 2% until a 0.70 LTV ratio is achieved; and then 1% until a 0.50 LTV ratio is achieved.

I find that the policy effect in the fully-specified model is small. The debt-to-income (DTI) ratio drops, but only by 4.99%. I also compute the average difference in consumption between employed and unemployed agents in the model. I find that the size of this gap does not decrease substantially when the new contracts are implemented, which suggests that the amortization requirements do not reduce household consumption's vulnerability to income shocks. I also consider a contract that requires households to amortize at a rate of 2% until they reach an LTV ratio of 0.50. This increases the magnitude of the DTI ratio drop from 4.99% to 5.47%; however, requiring households to amortize at a rate of 2% for the entire duration of the contract (i.e. to an LTV ratio of 0) lowers the magnitude of the reduction from 5.47% to 1.93%. This suggests that Swedish-style contracts may be more effective at curbing equity withdrawal than fully-amortizing contracts. This is because households in the model have the option to refinance at a cost. Thus, requiring amortization for the full duration of the contract primarily serves to remove the liquidity benefit of amortizing down to an LTV ratio of 0.50. This induces households to deviate from their contract's intended amortization path, holding more debt than they would under a contract with only front-loaded amortization.

I also explore the role of the debt-service-to-income (DSI) ratio constraint, which limits household borrowing by restricting the size of debt service payments (i.e. interest and principal) to a fraction of household income. I find that loosening the DSI constraint in the baseline version of the model substantially reduces the impact of amortization requirements on the debt-to-income ratio in aggregate, over the lifecycle, and across employment statuses. Furthermore, regardless of contract type, the debt-to-income ratio increases when the DSI constraint is weakened. This suggests that the policy's efficacy will rely on amortization requirements having a substantial impact on credit supply decisions. If banks use the required rate of amortization to determine how much to lend to households, then the policy impact may mechanically reduce indebtedness; however, if this channel is weak, then the effect may be even smaller. It is important to note, however, that agents unconstrained by the DSI condition may actually increase indebtedness in response to the policy, since the model does not force all agents to stay on the intended amortization path, as is often assumed in the literature.

If the prepayment penalty is increased, the DTI ratio drops relative to the baseline specification. However, this reduction does not come primarily from enforcing the intended amortization path. Instead, it reduces housing demand among agents who are likely to need to extract equity in the future. It also causes households to delay buying until they are further along in the lifecycle and have accumulated a sufficient capital buffer to smooth consumption in response to income shocks.

Overall, the impact of the proposed policy is small relative to the increase in indebtedness in Sweden since the mid-1990s. One possible reason for this is that required amortization may not be an effective channel for reducing household indebtedness. Even with a reasonably calibrated prepayment penalty and a time cost of refinance equal to 1% of annual net income, households do not appear to dramatically deviate from their optimal amortization paths to follow the one intended by a particular mortgage contract. Rather, they refinance as needed to achieve a similar path after the change in amortization requirements. Implausibly large refinance costs or tight DSI requirements are needed to generate a reduction in indebtedness; however, these effects are not primarily driven by their interaction with amortization requirements.

# Research projects pursued in 2016

## ASSET PRICING

### Default Exposure to Downside Risks and the Cross-section of Expected Returns

*Roméo Tédongap and Xin Zhang*

Intertemporal consumption-based equilibrium asset pricing, featuring downside risks through disappointment aversion preferences, implies that investors value assets through their undesirable exposure to two regular (market return and volatility) and three downside risk factors (the disappointment factor, the market downside factor, and the volatility downside factor). We show that these factors have both a predictive and a contemporaneous relationship with credit derivative swap spreads. Our results are robust to including macroeconomic factors, firm characteristics and other tail risk factors in the literature. We measure individual firm credit risk exposure to regular and downside risk factors using the CDS term structure. We find that the exposure information is also incorporated in the cross-section of expected stock returns and CDS spreads.

(continuing from previous year)

### Measuring Systemic Downside Risk Component of Asset Prices

*Roméo Tédongap and Xin Zhang*

We develop a representative agent consumption-based general equilibrium asset pricing model featuring generalized disappointment aversion preferences and multi-frequency long-run volatility risk, and which allows for closed-form bond prices, stock prices, credit derivatives and inflation derivatives. We estimate the model parameters and state dynamics to match moments of the daily stock index return and yield curve, and the default parameters by fitting moments of the daily term-structure of credit default swap spreads. We analytically decompose asset prices into two major components: a regular component and a systemic risk component. Our results point to a significant contribution of systemic risk to asset prices that is more important during crisis times.

(continuing from previous year)

## CREDIT AND BANKING

### Curbing Shocks to Corporate Liquidity: The Role of Trade Credit

*Niklas Amberg, Tor Jacobson, Robert Townsend and Erik von Schedvin*

This paper quantifies firms' use of trade credit to handle shortfalls in liquidity. We find that firms manage declines in cash flow by increasing the amount of drawn trade credit from suppliers and contracting the amount issued to customers. The compounded adjustments in the amount of drawn and issued trade credit dominate adjustments in cash holdings, which suggest that trade credit positions are economically important sources of reserve liquidity. We tackle fundamental endogeneity concerns arising when relating cash flow to trade credit utilization by studying how losses from a fraudulent scheme initiated by a cash-in-transit firm affected its customers.

(continuing from previous year)

### Bad Times, Good Credit

*Bo Becker, Marieke Bos and Kasper Roszbach*

Banks' limited knowledge about borrowers' creditworthiness constitutes an important friction in credit markets. Is this friction deeper in recessions, thereby contributing to cyclical swings in credit? Alternatively, is the depth of this friction reduced in recessions, as tough times reveal information about firm quality? We test these alternative hypotheses using internal ratings data from a large, Swedish bank. This banks' ability

to sort borrowers by credit quality is best in recessions, and worst in good times. Our results suggest that information frictions are counter-cyclical in corporate credit markets.

## Impulsive Consumption and Financial Wellbeing: Evidence from an Increase in the Availability of Alcohol

*Zahi Ben-David and Marieke Bos*

Increasing the supply of temptation goods might harm individuals if they have time-inconsistent preferences and consume more of these goods in the present at the expense of their future consumption plan. We test this hypothesis by studying the credit behavior of low-income Swedish households around the expansion of the opening hours of retail liquor stores in some counties. Consistent with the theory, the expansion in opening hours led to an increase in the take-up rate and balances of consumer credit (mainstream and pawn credit). Furthermore, default rate increased in treated populations. Thus, our results show that inconsistent-time preferences reinforce the conditions of poverty through borrowing and default.

## The Importance of Reallocation for Productivity Growth: Evidence from European and US Banking

*Jaap Bos and Peter van Santen*

To what extent has input reallocation contributed to aggregate productivity growth in the banking sectors of Europe and the United States? Interestingly, under-performing banks capture market share, while more productive banks lose market share, in particular in the US. The pattern of reallocation is markedly different between the geographical regions: European productivity has grown by reallocating inputs through the first half of the sample period, at the same time when reallocation diminished growth in the US. The long-run positive effects of creative destruction are especially apparent in the US, where reallocation is an important driver of increases in productivity.

(continuing from previous year)

## The Labor Market Effects of Credit Information

*Marieke Bos, Emily Breza and Andres Liberman*

Credit information affects the allocation of credit, but its effects on other markets are unknown, in particular among vulnerable populations. This paper measures the effect of credit information on the employment outcomes of Swedish individuals at the margins of formality in credit and labor markets. We exploit a policy that varies the retention time of past delinquencies on credit reports. Among this population, one additional year of retention causes a $1,000 reduction in wage earnings, four times the decrease in credit. Negative credit information also increases self-employment and decreases mobility. Employers observe a strict subset of the information available to lenders, causing relatively more creditworthy individuals to bear this cost inefficiently.

## Economic Distress and Consumers' Credit Choice

*Marieke Bos, Chloé le Coq and Peter van Santen*

This paper documents that increased scarcity right before a payday causally impacts credit choices. Exploiting a transfer system that randomly assigns the number of days between paydays to Swedish social welfare recipients, we find that low educated borrowers behave as if they are more present-biased when making credit choices during days when their budget constraints are exogenously tighter. As a result their default risk and debt servicing cost increase significantly. Access to mainstream credit or liquidity buffers cannot explain our results. Our findings highlight that increased levels of economic scarcity risk to reinforce the conditions of poverty.

(continuing from previous year)

## Inter-Firm Lending: An Empirical Analysis of Trade Credit Contracts

*Tore Ellingsen, Tor Jacobson and Erik von Schedvin*

We study around 52 million trade credit contracts, issued by 50 suppliers over 9 years to 199.000 customers. The data contain information on contract size, due dates, time to payment, and firm characteristics. This data allows us to explore how changing conditions affect contract terms at the level of suppliers-customers pairs. We find that opportunity cost of funds, market power, and information asymmetries impact on the contract terms, where the former dominates, especially for the transacted volume. Financial frictions have little

impact on agreed contract duration, but firms with higher liquidity needs draw more credit from suppliers by postponing payments.

(continuing from previous year)

### Amortization requirements and household indebtedness: An application to Swedish-style mortgages

*Isaiah Hull*

Since the mid-1990s, many OECD countries have experienced a substantial increase in household indebtedness. Sweden, in particular, has seen indebtedness rise from 90% of disposable income in 1995 to 179% in 2015. The Swedish Financial Supervisory Authority (FSA) has identified mortgage amortization requirements as a potential instrument for reducing indebtedness; and has drafted guidelines that will intensify the rate and duration of amortization. In this paper, I characterize Swedish-style mortgage contracts, which differ substantially from U.S.-style contracts. I then evaluate the policy changes in an incomplete markets model with three types of debt and a novel mortgage contract specification that is calibrated to match Swedish micro and macro data. I find that intensifying the rate and duration of amortization is largely ineffective at reducing indebtedness in a realistically-calibrated model. In the absence of tight restrictions on the maximum debt-service-to-income ratio or implausibly large refinancing costs, the policy impact is small in aggregate, over the lifecycle, and across employment statuses.

(accepted for publication)

### Evaluating the Loan-to-Value Cap in Sweden

*Tor Jacobson, Mats Levander and Kasper Roszbach*

In October 2010 the regulatory supervisor in Sweden issued a recommendation to banks to cap their mortgage lending at 85%. Using a recent micro dataset on mortgage loans from a large Swedish retail bank we try to discern the effects of the cap for changes in borrowers' behavior. The richness of the data allows us to control for a wide range of important aspects such as households' uncollateralized borrowing from the incumbent bank, as well as their borrowing in general from other banks.

(continuing from previous year)

### Diversification Advantages during the Global Financial Crisis

*Mats Levander*

I investigate if being part of a business group mitigated the effects of the global financial crisis for Swedish firms. The crisis is used as an exogenous shock to external financing. Investment of business group firms are compared to investment of standalone firms. I find that being part of a business group had a mitigating effect on the impact of the crisis on firm investment. Firms that were part of a business group reduced their investment significantly less than for standalone firms. These differences are driven by a diversification effect for business group firms due to use of internal capital markets and easier access to external finance. I present evidence of increased internal capital market activity during the crisis.

### The Effect of Cash Flow on Investment: An Empirical Test of the Balance Sheet Channel

*Ola Melander, Maria Sandström and Erik von Schedvin*

Using a large data set on investments and accounting information for private firms, we put the balance sheet theory to test. We find that firm cash flow has a positive impact on investment and that the effect is enhanced for firms which are more likely to be financially constrained. We also find that the investment-cash flow sensitivity is significantly larger and more persistent during the first half of our sample period, which includes a severe banking crisis and recession. Our results suggest that financial constraints matter more in periods characterized by adverse economic conditions.

(accepted for publication)

## ECONOMETRICS

### Binary Response Models with Misclassified Dependent Variables: The Annuity Puzzle revisited

*Rob Alessie, Adriaan Kalwij and Peter van Santen*

We study the problem of misclassification of the dependent variable in a binary choice setting. We apply both static and dynamic models to ownership of annuity policies for a panel of Dutch households. The

survey data is likely to be error-ridden, as we document transition probabilities in ownership at the household level which seem too large. Moreover, for a subset of households, we know the duration of the policies, and therefore can construct an ownership variable which should be closer to the true value. We use this measure to benchmark our results. Our estimates of the misclassification probabilities suggest that part of the "annuity puzzle" can be explained by underreporting ownership of annuities.

(continuing from previous year)

## Speeding up MCMC by Efficient Data Subsampling

*Matias Quiroz, Mattias Villani, Robert Kohn and Minh-Ngoc Tran*

We propose Subsampling MCMC, a Markov Chain Monte Carlo (MCMC) framework where the likelihood function for n observations is estimated from a random subset of m observations. We introduce a general and highly efficient unbiased estimator of the log-likelihood based on control variates obtained from clustering the data. The cost of computing the log-likelihood estimator is much smaller than that of the full log-likelihood used by standard MCMC. The likelihood estimate is bias-corrected and used in two correlated pseudo-marginal algorithms to sample from a perturbed posterior, for which we derive the asymptotic error with respect to n and m, respectively. A practical estimator of the error is proposed and we show that the error is negligible even for a very small m in our applications. We demonstrate that Subsampling MCMC is substantially more efficient than standard MCMC in terms of sampling efficiency for a given computational budget, and that it outperforms other subsampling methods for MCMC proposed in the literature.

(continuing from previous year)

## Speeding Up MCMC by Delayed Acceptance and Data Subsampling

*Matias Quiroz*

The complexity of the Metropolis-Hastings (MH) algorithm arises from the requirement of a likelihood evaluation for the full data set in each iteration. Payne and Mallick (2015) propose to speed up the algorithm by a delayed acceptance approach where the acceptance decision proceeds in two stages. In the first stage, an estimate of the likelihood based on a random subsample determines if it is likely that the draw will be accepted and, if so, the second stage uses the full data likelihood to decide upon final acceptance. Evaluating the full data likelihood is thus avoided for draws that are unlikely to be accepted. We propose a more precise likelihood estimator which incorporates auxiliary information about the full data likelihood while only operating on a sparse set of the data. It is proved that the resulting delayed acceptance MH is asymptotically more efficient compared to that of Payne and Mallick (2015). The caveat of this approach is that the full data set needs to be evaluated in the second stage. We therefore propose to substitute this evaluation by an estimate and construct a state-dependent approximation thereof to use in the first stage. This results in an algorithm that (i) can use a smaller subsample m by leveraging on recent advances in Pseudo-Marginal MH (PMMH) and (ii) is provably within $O(m^{-2})$ of the true posterior.

(continuing from previous year)

## Exact Subsampling MCMC

*Matias Quiroz, Mattias Villani and Robert Kohn*

Speeding up Markov Chain Monte Carlo (MCMC) for datasets with many observations by data subsampling has recently received considerable attention in the literature. Most of the proposed methods are approximate, and the only exact solution has been documented to be highly inefficient. We propose a simulation consistent subsampling method for estimating expectations of any function of the parameters using a combination of MCMC subsampling and the importance sampling correction for occasionally negative likelihood estimates in Lyne et al. (2015). Our algorithm is based on first obtaining an unbiased but not necessarily positive estimate of the likelihood. The estimator uses a soft lower bound such that the likelihood estimate is positive with a high probability, and computationally cheap control variables to lower variability. Second, we carry out a correlated pseudo marginal MCMC on the absolute value of the likelihood estimate. Third, the sign of the likelihood is corrected using an importance sampling step that has low variance by construction. We illustrate the usefulness of the method with two examples.

## Block-Wise Pseudo-Marginal Metropolis-Hastings

*Minh-Ngoc Tran, Robert Kohn, Matias Quiroz and Mattias Villani*

The pseudo-marginal Metropolis-Hastings approach is increasingly used for Bayesian inference in statistical models where the likelihood is analytically intractable but can be estimated unbiasedly, such as random effects models and state-space models, or for data subsampling in big data settings. In a seminal paper, Deligiannidis et al. (2015) show how the pseudo-marginal Metropolis-Hastings (PMMH) approach can be

made much more efficient by correlating the underlying random numbers used to form the estimate of the likelihood at the current and proposed values of the unknown parameters. The proposed approach greatly speeds up the standard PMMH algorithm, as it requires a much smaller number of particles to form the optimal likelihood estimate. We present a closely related alternative PMMH approach that divides the underlying random numbers mentioned above into blocks so that the likelihood estimates for the proposed and current values of the likelihood only differ by the random numbers in one block. Our approach is less general than that of Deligiannidis et al. (2015), but has the following advantages. First, it provides a more direct way to control the correlation between the logarithms of the estimates of the likelihood at the current and proposed values of the parameters. Second, the mathematical properties of the method are simplified and made more transparent compared to the treatment in Deligiannidis et al. (2015). Third, blocking is shown to be a natural way to carry out PMMH in, for example, panel data models and subsampling problems. We obtain theory and guidelines for selecting the optimal number of particles, and document large speed-ups in a panel data example and a subsampling problem.

### The tail shape impact of ECB asset purchases

*Xin Zhang and Bernd Schwaab*

We study the tail shape impact of central bank asset purchases on bond yields during turbulent times based on high-frequency data. To this purpose we derive a novel observation-driven model that allows us to estimate the time variation in the tail shape of time series observations from a wide class of fat-tailed distributions, and to relate it to observed covariates. Monte Carlo experiments suggest that the model reliably captures tail shape variation in a variety of settings. We find that asset purchases helped reduce the tail shape (risk) associated with holding certain sovereign bonds during the euro area sovereign debt crisis.

(continuing from previous year)

## FINANCIAL THEORY

### A Wake-up Call Theory of Contagion

*Toni Ahnert and Christoph Bertsch*

We offer a theory of contagion based on the information choice of investors after observing a financial crisis elsewhere. We study global coordination games of regime change in two regions with an unobserved common macro shock as the only link between regions. A crisis in the first region is a wake-up call to investors in the second region. It induces them to reassess the regional fundamental and acquire information about the macro shock. Contagion can even occur after investors learn that regions are unrelated (zero macro shock). Our results rationalize empirical evidence about contagious bank runs and currency crises after wake-up calls. We also derive new implications and discuss how these can be tested.

(continuing from previous year)

### Fire Sale Bank Recapitalization

*Christoph Bertsch and Mike Mariathasan*

We develop a general equilibrium model of banks' capital structure, featuring an imperfectly elastic supply of equity stemming from financial market segmentation. Banks are ex-ante identical. When selecting their equity buffer, they trade off an endogenous wedge between the cost of equity and debt with better protection from bankruptcy. Ex-post, portfolio risk is heterogeneous and banks may need to recapitalize. When a capital short-fall simultaneously arises in a large number of banks, the market for equity becomes crowded and the elevated cost of issuing new shares dilutes old shareholders' claims. Reminiscent of asset fire sales, banks do not fully internalize the effect of their individual equity issuance on the endogenous cost of equity and -importantly- on their future ability to recapitalize. Provided higher initial equity buffers are associated with a reduction in the future equity issuance volume, banks are under-capitalized in equilibrium, and the incidence of insolvency is inefficiently high. This constrained inefficiency provides a new rationale for macro-prudential capital regulation that arises despite the absence of deposit insurance and moral hazard; it is also relevant for the regulation of payout policies and the communication of stress test results.

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## FISCAL POLICY

### Jump-Starting the Euro Area Recovery: Would a Rise in Core Fiscal Spending Help the Periphery?

*Olivier Blanchard, Christopher Erceg and Jesper Lindé*

We show that a fiscal expansion by the core economies of the euro area would have a large and positive impact on periphery GDP assuming that policy rates remain low for a prolonged period. Under our preferred model specification, an expansion of core government spending equal to one percent of euro area GDP would boost periphery GDP by over 1 percent in a liquidity trap lasting three years, nearly half as large as the effect on core GDP. Accordingly, under a standard ad hoc loss function involving output and inflation gaps, increasing core spending would generate substantial welfare improvements, especially in the periphery. The benefits are considerably smaller under a utility-based welfare measure, reflecting in part that higher net exports play a material role in raising periphery GDP.

(accepted for publication)

### Fiscal Consolidations under Imperfect Credibility

*Matthieu Lemoine and Jesper Lindé*

This paper examines the effects of expenditure-based fiscal consolidation when credibility as to whether the cuts will be long-lasting is imperfect. We contrast the impact limited credibility has when the consolidating country has the means to tailor monetary policy to its own needs, with the impact when the country is a small member of a currency union with a negligible effect on interest rates and on nominal exchange rates of the currency union. We find two key results. First, in the case of an independent monetary policy, the adverse impact of limited credibility is relatively small, and consolidation can be expected to reduce government debt at a relatively low output cost given that monetary policy provides more accommodation than it would under perfect credibility. Second, the lack of monetary accommodation under currency union membership implies that the output cost may be significantly larger, and that progress in reducing government debt in the short and medium term may be limited under imperfect credibility.

(accepted for publication)

## GROWTH

### Fuel for Economic Growth

*Johan Gars and Conny Olovsson*

Using data on energy inputs for 134 countries, we document that countries that derive a larger share of their energy from fossil energy sources are richer and grow faster. We then set up an endogenous growth model in which the efficiency of both capital and fossil energy can be improved, whereas that of an alternative energy source is limited. With capital and energy as complements, there exist two steady states: one stagnant where energy is fully derived from the alternative source, and one with balanced growth where energy is fully sourced from fossil fuel. Heterogeneity in initial technology levels can generate the Great Divergence. The demand for fossil fuel in technologically advanced countries drives up its price and makes fossil fuel too costly in less advanced countries that choose the alternative and stagnant energy input.

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## HOUSEHOLD SAVING

### Households' Housing and Borrowing Decisions

*Joao Cocco, Tor Jacobson, Thomas Jansson and Paolo Sodini*

In this project we have access to a new unique micro dataset, which includes detailed information not only on a large sample of Swedish households' financial and real assets but also on their liabilities. In the dataset the exact composition of households' asset portfolios and the conditions of their debt (amounts, interest rates, variable or fixed rates, collateral etc.) are reported. We also have detailed income data, which enables us to estimate labor income volatility (separated into transitory and permanent components) at the individual level and at the household level. Hence, our dataset enables us to estimate a household's total exposure to various risk factors. The purpose of a first project is to use micro data to calibrate a lifecycle model. Our focus will be on how households' housing and borrowing decisions are affected by the evolution

of house prices, labor incomes and mortgage interest rates. The predictions of the life cycle model will then be confronted with empirical results from estimated on the micro data.

(continuing from previous year)

### How Parents Influence the Wealth Accumulation of their Children

*Peter Englund, Thomas Jansson and Todd Sinai*

We decompose the channels through which parents and children have correlated net worth using a novel administrative data set from Sweden that follows a panel of parents matched to their grown children. We find that children's initial endowments of net worth and their subsequent net worth accumulations are positively correlated with parents' net worth. There are two main channels of intergenerational wealth correlation. Children of wealthy parents have higher earnings, even conditional on intergenerational correlation in earnings, most of which they consume. The intergenerational correlation in net worth comes largely from housing wealth. We argue that arises from correlated home ownership among high net worth parents and their children, the propensity of home owners to save, and from children of high net worth parents spending more on housing at the time of first purchase. We also consider the impact of bequests, intervivos transfers, portfolio choice, and savings propensities.

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### Incompatible European Partners? Cultural Predispositions and Household Financial Behavior

*Michael Haliassos, Thomas Jansson and Yigitcan Karabulut*

The recent influx of migrants and refugees into Europe and elsewhere raises questions as to whether migrant behavior reflects cultural predispositions and whether assimilation through exposure to host institutions can be expected. The paper focuses on financial behavior and uses high-quality administrative data on migrants and refugees to Sweden. It uncovers differences across cultural groups in how behavior relates to household characteristics, and shows that differences diminish with exposure to host country institutions, even for large cultural distances. Interestingly, robust cultural classification of European countries based on genetic distance or on Hofstede's cultural dimensions fails to identify a single 'southern' culture but points to a 'northern' culture. Our results also have implications for the potential of European institutional harmonization, exogenously imposed during the fiscal crisis, to alleviate cultural differences in financial behavior.

(accepted for publication)

### Uncertain Pension Income and Household Saving

*Peter van Santen*

I study the relationship between household saving and pensions, and estimate both the displacement effect of pensions on private saving and the precautionary saving effect due to uncertainty in pension income. In a lifecycle model, the consumption function depends on expected pension benefits and pension risk. I estimate the savings equation implied by the model using survey data for Dutch households, with subjective expectations on pension benefits and uncertainty. Exploiting exogenous variation due to pension fund performance, I show that savings decrease significantly with expected pension income, and that households save more due to uncertainty in pension income.

(continuing from previous year)

## LABOR MARKETS

### The Aggregate Significance of Labor Reallocation

*Susanto Basu, Mikael Carlsson and Peter van Santen*

We analyze the impact of workers switching between firms on aggregate productivity growth. The GDP decomposition in Basu and Fernald (2002, European Economic Review) identifies the contributions of firm-level productivity growth, worker and capital flows and technological change on aggregate productivity growth and subsequently GDP. This paper quantifies the importance of worker reallocation on aggregate productivity growth. In a nutshell, worker flows boost GDP if high-productivity firms expand and low-productivity firms shrink. Our data spans the population of workers and firms in Sweden between 1997 and 2011, and allows us to match workers to firms. Separating out the firm-specific component of wages and under the assumption of cost minimization, we show that there is no systematic flow of workers towards high-productivity firms, resulting in a near-zero contribution of worker reallocation to aggregate productivity growth. This holds for both the aggregate economy, as well as for virtually all sectors of the

economy in isolation. This result is in contrast with previous studies of the manufacturing sector, where between-firm reallocation is an important component of aggregate growth. Quantifying the methods used in previous studies shows that Sweden is no different when looking at market share reallocation, yet that whatever is causing between-firm growth is not due to labor flows. The lack of direction in labor flows is robust to various specifications of the marginal product of labor.

(continuing from previous year)

## Labor Market Frictions and Optimal Steady-State Inflation

*Mikael Carlsson and Andreas Westermark*

In central theories of monetary non-neutrality, the Ramsey optimal steady-state inflation rate varies between the negative of the real interest rate and zero. This paper explores how the interaction of nominal wage and search and matching frictions affect the policy prescription. We show that adding the combination of such frictions to the canonical monetary model can generate an optimal inflation rate that is significantly positive. Specifically, for a standard U.S. calibration, we find a Ramsey optimal inflation rate of 1.16 percent per year.

(accepted for publication)

## Endogenous Separations, Wage Rigidities and Employment Volatility

*Mikael Carlsson and Andreas Westermark*

We show that in micro data, as well as in a search and matching model with endogenous separations and rigid wages, separations and hence employment volatility are non-neutral to wage rigidities of incumbent workers. In contrast to when all wages are flexible, the standard deviation of unemployment in a model with rigid wages for incumbent workers (only) matches the standard deviation in the data. Thus, the degree of wage rigidity for newly hired workers is not a sufficient statistic for determining the effect of wage rigidities on macroeconomic outcomes in this class of models.

(continuing from previous year)

## The Optimal Inflation Target under Downward Nominal Wage Rigidity

*Mikael Carlsson and Andreas Westermark*

We study the implications for optimal average inflation when there is both a role for money as a medium of exchange and when nominal wages are downwardly rigid. The model also features transaction costs, as in Dotsey, King & Wolman (1999), and a non-Walrasian labor market with search frictions as in Trigari (2009). The introduction of downward nominal wage rigidities into a model with flexible wages can be decomposed into two effects; first, introducing (symmetric) wage adjustment frictions and, second making them asymmetric. Productivity growth is important for the level of inflation and also affects the size of the effect of the asymmetric wage friction. Without productivity growth, symmetric wage adjustment frictions leads to a yearly inflation rate of approximately 1.0%, while introducing an asymmetry on top of this increases the inflation rate by an additional 0.7%. With productivity growth, inflation is almost a percent lower and the effect of adding asymmetric wage frictions is also somewhat smaller - about 0.5%. Overall, we find an optimal inflation rate of about 0-2 percent.

(continuing from previous year)

## Involuntary Unemployment and the Business Cycle

*Lawrence Christiano, Mathias Trabandt and Karl Walentin*

We propose a monetary model in which the unemployed satisfy the official US definition of unemployment: they are people without jobs who are (i) currently making concrete efforts to find work and (ii) willing and able to work. In addition, our model has the property that people searching for jobs are better off if they find a job than if they do not (i.e., unemployment is `involuntary'). We integrate our model of involuntary unemployment into the simple New Keynesian framework with no capital and use the resulting model to discuss the concept of the `non-accelerating inflation rate of unemployment'. We then integrate the model into a medium sized DSGE model with capital and show that the resulting model does as well as existing models at accounting for the response of standard macroeconomic variables to monetary policy shocks and two technology shocks. In addition, the model does well at accounting for the response of the labor force and unemployment rate to the three shocks.

(continuing from previous year)

## Learning on the Job and the Cost of Business Cycles

*Karl Walentin and Andreas Westermark*

We show that cyclical variation in vacancies and unemployment reduces the aggregate level of employment, output and welfare in a labor market search model with learning on-the-job. The key mechanism is the following: Due to the concavity of the standard matching function in vacancies and unemployment, aggregate volatility reduces employment. Then, since learning on-the-job imply that human capital is an increasing function of employment, it follows that aggregate volatility reduces human capital. This, in turn, reduces the incentives to post vacancies, further reducing employment. We quantify this mechanism using a carefully calibrated model and find the output cost of business cycles to be large.

(continuing from previous year)

## MACROECONOMICS

### Macroeconomic costs of deleveraging

*Daria Finocchiaro, Magnus Jonsson, Christian Nilsson and Ingvar Strid*

The goal of our paper is to analyze the long-run macroeconomic consequences of different economic policies which aim at stabilizing households' debt to more sustainable levels. More precisely, we build a set-up where credit markets conditions substantially amplify house price fluctuations. We estimate our model on Swedish data, one of the countries with the highest degree of household indebtedness in the world, and study the impact of regulatory changes in LTV, LTI, mortgage amortization schedules and the degree of interest rate deductibility on consumption, GDP, house prices and monetary policy. We then evaluate the re-distributional effects between borrowers and lenders of different policies and explicitly compute their welfare consequences.

### Macroeconomic Stability and Securitization

*Daria Finocchiaro, Giovanni Lombardo and Karl Walentin*

We study the impact of securitization on banks' balance sheets and macroeconomic stability. We build a model where securitized assets can improve on the enforcement problem faced by banks in the funding market. In our set-up, securitization affects both sides of banks' balance sheets and increases financial interconnectedness. We show under which conditions a high degree of financial innovation increases macroeconomic volatility and to what extent policy interventions can mitigate the problem.

### Financial shocks, co-movement and credit frictions

*Daria Finocchiaro and Caterina Mendicino*

In models with frictional financial markets, the specification of the borrowing constraint is crucial to generating co-movement between macro variables and asset prices after credit shocks. The interaction between financial frictions and labor demand is key to the results.

(accepted for publication)

### International business cycles propagated through the world market for oil?

*Johan Gars and Conny Olovsson*

It is well documented that business cycles of developed countries tend to move together. Specifically, output, consumption, investment, and employment are all positively correlated across countries. Standard model typically fails completely to replicate these empirical observations. In fact, they tend to predict that many variables instead should be negatively correlated across countries. We show that a simple real-business cycle with energy as an input can generate positive comovements for the all these variables even if shocks are uncorrelated and the countries do not trade final output with each other. The reason is that the shocks affect factor demands in the different countries, which affects the oil price.

### Energy-saving technical change

*John Hassler, Per Krusell and Conny Olovsson*

How do markets economize on scarce natural resources? In this paper we emphasize technological change aimed at saving on the scarce resource. We develop a neoclassical macroeconomic theory that is quantitatively oriented and that views technical change as directed: it can be used to save on different inputs. At a point in time, the elasticity between inputs - in our application a capital-labor composite and fossil energy - is given by a production function with fixed parameters, but because the future values of these parameters can be changed with R&D efforts today, the long-run elasticity between the inputs is higher than it is in the short run. We demonstrate how the theory can be used to robustly derive predictions for the long-run cost share accruing to the scarce resource as well as for its rate of depletion. In an

application, we look at postwar U.S. data, estimate the short-run elasticity between inputs using an aggregate CES production function, and also estimate the implied input-saving technology series. From these technology series, we can gauge what the historical tradeoff has been in the choice between allocating R&D to save on one or the other input. The implied parameter estimates are then used in our aggregate model to make long-run predictions, which indicate a marked increase in the share of costs going to fossil energy.

(continuing from previous year)

## What Broke? Structural Change during the Great Moderation and Great Recession

*Isaiah Hull*

Much of the Great Moderation literature emphasizes the role of "good luck"–smaller shocks–as an explanation for the decline in aggregate economic volatility since 1984. Disagreement remains over whether this good luck continued until the Great Recession. This paper contributes to the literature by dramatically expanding the scope of the analysis. While most work has focused exclusively on the volatility of GDP and its components, we consider all testable series in the St Louis Fed's FRED database. In addition to reproducing the good luck finding for GDP and its component series for the post-1984 period, we also show that the Great Moderation was a broader phenomenon that extended to many additional categories of series. Finally, we demonstrate that GDP component series experience a divergence in volatility from other series prior to the Great Recession. While GDP and its components see an extension of the Great Moderation until 2007, most other series see a rise in volatility breaks that starts as early as 2000.

(continuing from previous year)

## The impact of foreign shocks on the Swedish economy

*Jesper Lindé, Henrik Lundvall, Conny Olovsson and Spyridon Sichlimiris*

It is well documented that business cycles of developed countries tend to move together. Backus, Kehoe and Kydland (1993) document that output, consumption, investment, and employment are all positively correlated across countries. Later studies verifies these findings and show that also nominal variables such as inflation and nominal interest rates are positively correlated (see for example Justiniano and Preston, 2010). Standard model typically fails completely to replicate these empirical observations. In fact, they tend to predict that many variables instead should be negatively correlated across countries. This project aims at closing the gap between the empirical and theoretical predictions. Specifically, we analyze the potential importance of durables. Improving the understanding of the underlying reasons for the positive correlations, and to what extent foreign shocks spill over to the Swedish economy is of crucial importance for the Swedish monetary policy process.

## Challenges for Macro Models Used at Central Banks

*Jesper Lindé, Frank Smets and Rafael Wouters*

In this paper we discuss a number of challenges for structural macroeconomic models in the light of the Great Recession and its aftermath. It shows that a benchmark DSGE model that shares many features with models currently used by central banks and large international institutions has difficulty explaining both the depth and the slow recovery of the Great Recession. In order to better account for these observations, the paper analyses three extensions of the benchmark model. First, we estimate the model allowing explicitly for the zero lower bound constraint on nominal interest rates. Second, we introduce time-variation in the volatility of the exogenous disturbances to account for the non-Gaussian nature of some of the shocks. Third and finally, we extend the model with a financial accelerator and allow for time-variation in the endogenous propagation of financial shocks. All three extensions require that we go beyond the linear Gaussian assumptions that are standard in most policy models. We conclude that these extensions go some way in accounting for features of the Great Recession and its aftermath, but they do not suffice to address some of the major policy challenges associated with the use of non-standard monetary policy and macroprudential policies.

(accepted for publication)

## Oil prices in a real-business-cycle model with precautionary demand for oil

*Conny Olovsson*

This paper analyzes the interaction between oil prices and macroeconomic outcomes by incorporating oil as an input in production alongside a precautionary motive for holding oil in a real-business-cycle model. The driving forces are factor-specific technology shocks and supply shocks that can be imprecisely forecasted by noisy news shock. These shocks explain most of the U.S. business cycle as well as the empirical distribution

of oil prices. Oil shocks are mainly driven by increasing precautionary/smoothing demand, but supply shocks contribute substantially to both the oil-price volatility and the magnitude of oil shocks mainly through their effect on oil reserves.

## MONETARY POLICY AND THEORY

### Monetary Normalizations and Consumer Credit: Evidence from Fed Liftoff and Online Lending

*Christoph Bertsch, Isaiah Hull and Xin Zhang*

On December 16th of 2015, the Fed initiated "liftoff," a critical step in the monetary normalization process. We use a unique panel dataset of 640,000 loan-hour observations to measure the impact of liftoff on interest rates, demand, and supply in the online primary market for uncollateralized consumer credit. We find that the average interest rate dropped by 16.9-22.6 basis points, driven by a 16% decline in the spread. Our findings are consistent with an investor-perceived reduction in default probabilities; and suggest that liftoff provided a strong, positive signal about the future solvency of borrowers.

### Output Gaps and Robust Monetary Policy Rules

*Roberto Billi*

Policy makers often use the output gap to guide monetary policy, even though nominal gross domestic product (GDP) and prices are measured in real time more accurately than the output gap. Employing a small New Keynesian model with a lower bound on nominal interest rates, this article compares the performance of monetary-policy rules that are robust to errors in measuring the output gap, nominal GDP level, or price level. It shows that a robust policy rule that focuses on stabilizing the price level improves the tradeoffs faced by the central bank, especially when the analysis accounts for persistent measurement errors as faced in practice.

(continuing from previous year)

### Price Level Targeting and Risk Management

*Roberto Billi*

Many argue that, because the economic outlook is inherently uncertain, central banks should apply a risk management approach to monetary policy, by raising the policy interest rate gradually from its lower bound. Using a small New Keynesian model with the central bank operating under optimal discretion, I compare the effects of uncertainty on economic performance, respectively under strict price level targeting and nominal gross domestic product (GDP) level targeting. As the results clarify, even though uncertainty hampers the effectiveness of monetary policy, the extent to which a central bank mitigates uncertainty depends crucially on its policy framework.

(continuing from previous year)

### The Distributional Effects of Inflation when Money and Bonds Coexist

*Paola Boel*

A monetary economy is constructed with heterogeneity in discounting and consumption risk. All trades must be monetary, but agents can insure against consumption risk with money and one-period nominal bonds traded in financial markets with limited participation. As long as the extent of disparities in individual discount factors is limited, agents hold a diversified portfolio with money and bonds in equilibrium. The model is then calibrated using harmonized microdata from the Luxembourg Wealth Study to quantify the distributional effects of expected inflation in a sample of OECD countries. Inflation hurts mostly the wealthier agents, but the magnitude of such effect differs substantially across countries and depends not only on wealth distribution but also on the shape of money demand in each country.

(continuing from previous year)

### Money, Credit and Banking and the Cost of Financial Activity

*Paola Boel and Gabriele Camera*

We extend the study of banking equilibrium in Berentsen, Camera and Waller (2007) by introducing an explicit production function for banks. Banks employ labor resources, hired on a competitive market, to run their operations. In equilibrium this generates a spread between interest rates on loans and on deposits, which naturally reflects the efficiency of financial intermediation and underlying monetary policy. In this

augmented model, equilibrium deposits yield zero return in a deflation or very low inflation. Hence, if monetary policy is sufficiently tight then banks end up reducing aggregate efficiency, soaking up labor resources while offering deposits that do not outperform idle balances.

(continuing from previous year)

## Money, Credit and the Redistributive Effects of Inflation

*Paola Boel, Julian P. Diaz and Daria Finocchiaro*

We construct a micro-founded model of money with heterogeneity in discounting and trading risk. Agents can insure against this risk with money and have also access to financial markets that issue via inter-period contracts. A form of limited participation in financial markets leads to both coexistence of money and credit in the economy and heterogeneity in money and debt holdings. The model is then utilized to quantitatively assess the effects of debt on the redistributive effects of inflation.

(continuing from previous year)

## On the Theoretical Efficacy of Quantitative Easing at the Zero Lower Bound

*Paola Boel and Christopher Waller*

We construct a monetary economy in which agents face aggregate demand shocks and heterogeneous idiosyncratic preference shocks. We show that, even when the Friedman rule is the best interest rate policy the central bank can implement, not all agents are satiated at the zero lower bound and therefore there is scope for central bank policies of liquidity provision. Indeed, we find that quantitative easing can be welfare improving even at the zero lower bound. This is because such policy temporarily relaxes the liquidity constraint of impatient agents, without harming the patient ones. Moreover, due to a pricing externality, quantitative easing may also have beneficial general equilibrium effects for the patient agents even if they are unconstrained in their holdings of real balances. Last, our model suggests that it can be optimal for the central bank to buy private debt claims instead of government debt.

(continuing from previous year)

## Seigniorage, Gesell Taxes and Monetary Policy in the Middle Ages

*Roger Svensson and Andreas Westermark*

Gesell taxes on money holdings have received attention in recent decades as a way of alleviating the zero lower bound on interest rates. Less known is that such a tax was the predominant method used to generate seigniorage in large parts of medieval Europe for around two centuries. When the Gesell tax was levied, current coins ceased to be legal tender and had to be exchanged into new coins for a fee - an institution known as renovatio monetae or periodic re-coinage. This could occur as often as twice a year. Using a cash-in-advance model, prices increase over time during an issue period and falls immediately after the re-coinage date. Agents re-mint coins and the system generates tax revenues if the tax is sufficiently low, if the time period between re-coinages is sufficiently long, and if the probability of being penalized for using illegal coins is sufficiently high.

(continuing from previous year)

## Differences in views

*Oreste Tristani and David Vestin*

Markets and central banks frequently disagree on the outlook for future interest rates. This paper models a situation when both parties are learning from the others actions, but where differences in views can persist due to the presence of imperfect information and private signals. We apply the model to Swedish data since the start of the published interest rate forecasts and discuss the economic effects of differences in views and how they are resolved.

## The forward guidance puzzle – under the hood

*David Vestin*

The paper examines the forward-guidance puzzle under different price-setting assumptions (Calvo and Mankiw-Ries) and focus on the intuition for the emergence of the puzzle in the Calvo model and why the Mankiw-Reis version resolves the large output effects. A future version of the paper will examine mixing different price-setting behavior across sectors or across wages and prices.

# Publications accepted in 2016

Blanchard, Olivier, Christopher Erceg and Jesper Lindé (2016), "Jump-Starting the Euro Area Recovery: Would a Rise in Core Fiscal Spending Help the Periphery", *NBER Macroeconomics Annual*, Vol. 31. University of Chicago Press: Chicago

Carlsson, Mikael, Julián Messina and Oskar Nordström-Skans, "Wage Adjustment and Productivity Shocks", *Economic Journal*, vol 126 (595), 2016, pages 1739–1773

Carlsson, Mikael and Andreas Westermark, "Labor Market Frictions and Optimal Steady-State Inflation", *Journal of Monetary Economics*, 2016, pages 67–79

Cerqueiro, Geraldo, Steven Ongena and Kasper Roszbach, "Collateralization, Bank Loan Rates and Monitoring", *Journal of Finance*, vol 71 (3), 2016, pages 1295–1322

De Graeve, Ferre and Jens Iversen, "Central bank policy paths and market forward rates: A simple model", forthcoming in *Journal of Money, Credit, and Banking*

Finocchiaro, Daria and Caterina Mendicino, "Financial shocks, comovement and credit frictions", *Economics Letters*, vol. 143, 2016, pages 20-23

Haliassos, Michael, Thomas Jansson and Yigitcan Karabulut, "Incompatible European Partners? Cultural Predispositions and Household Financial Behavior", forthcoming in *Management Science*

Hull, Isaiah, "The Development and Spread of Financial innovations", *Quantitative economics*, vol 7 (2), 2016, pages 613-636

Hull, Isaiah, "Amortization Requirements and Household Indebtedness: An Application to Swedish-Style Mortgage", *European Economic Review*, vol 91, 2016, pages 72-88

Lemoine, Matthieu and Jesper Lindé, "Fiscal Consolidations under Imperfect Credibility", *European Economic Review*, vol 88, 2016, pp. 108-141.

Lindé, Jesper, Frank Smets, and Rafael Wouters (2016), "Challenges for Central Banks' Macro Models", Chapter 28 in John B. Taylor and Harald Uhlig, Editor(s), *Handbook of Macroeconomics*, Elsevier, Vol. 2, pp. 2185-2262.

Lucas, André and Xin Zhang, "Score-driven exponentially weighted moving averages and Value-at-Risk forecasting", *International Journal of Forecasting*, vol 32, 2016, pages 293 – 302

Melander, Ola, Maria Sandström and Erik von Schedvin, "The Effect of Cash Flow on Investment: An Empirical Test of the Balance Sheet Channel", forthcoming in *Empirical Economics*

# Working papers

No. 334, Hanna Armelius, Isaiah Hull and Hanna Stenbacka Köhler, "The Timing of Uncertainty Shocks in a Small Open Economy"

No. 333, Michael Haliassos, Thomas Jansson and Yigitcan Karabulut, "Financial Literacy Externalities"

No. 332, Conny Olovsson, "Oil prices in a real-business-cycle model with precautionary demand for oil"

No. 331, Paola Boel and Gabriele Camera, "Money, Credit and Banking and the Cost of Financial Activity"

No. 330, Peter van Santen, "Uncertain pension income and household saving"

No. 329, Marieke Bos, Chloé Le Coq and Peter van Santen, "Economic Scarcity and Consumers' Credit Choice"

No. 328, Michael K. Andersson, Ted Aranki and André Reslow, "Adjusting for Information Content when Comparing Forecast Performance"

No. 327, Roger Svensson and Andreas Westermark, "Renovatio Monetae: Gesell Taxes in Practice"

No. 326, Mikael Carlsson and Andreas Westermark, "Endogenous Separations, Wage Rigidities and Employment Volatility"

No. 325, Bo Becker and Victoria Ivashina, "Covenant-light Contracts and Creditor Coordination"

No. 324, Rafael B. De Rezende, "The interest rate effects of government bond purchases away from the lower bound"

No. 323, Jesper Lindé, Frank Smets and Rafael Wouters, "Challenges for Central Banks' Macro Models"

No. 322, Matthieu Lemoine and Jesper Lindé, "Fiscal Consolidation under Imperfect Credibility"

No. 321, Paola Morales-Acevedo, "Firms' Strategic Choice of Loan Delinquencies"

No. 320, Niklas Amberg, Tor Jacobson, Erik von Schedvin and Robert Townsend, "Curbing Shocks to Corporate Liquidity: The Role of Trade Credit"

No. 319, Christoph Bertsch, Isaiah Hull and Xin Zhang, "Monetary Normalizations and Consumer Credit: Evidence from Fed Liftoff and Online Lending"

No. 318, Jens Iversen, Stefan Laséen, Henrik Lundvall and Ulf Söderström, "Real-Time Forecasting for Monetary Policy Analysis: The Case of Sveriges Riksbank"

No. 317, Anna Grodecka, "Subprime Borrowers, Securitization and the Transmission of Business Cycles"

No. 316, Anna Grodecka and Antonis Kotidis, "Double Liability in a Branch Banking System: Historical Evidence from Canada"

No. 315, Tore Ellingsen, Tor Jacobson and Erik von Schedvin, "Trade Credit: Contract-Level Evidence Contradicts Current Theories"

# Non-refereed publications in 2016

## Thinking about the Future of Money and Potential Implications for Central Banks

*Paola Boel*

Sveriges Riksbank Economic Review *(Penning- och valutapolitik)* 1, 2016

Technological innovation could potentially lead to a diminished lending role from the traditional banking sector if phenomena such as peer-to-peer lending and cryptocurrencies become mainstream and grow. At the same time, the role of central banks could change in a world without cash. Regulators and central banks therefore need to understand how these innovations could potentially transform the banking sector as we know it today and fundamentally change the traditional channels through which monetary policy affects the economy. The paper outlines some of the insights that monetary theory can offer in this important analysis.

## Revisiting the role of central banks as liquidity providers – old and new challenges

*Christoph Bertsch and Johan Molin*

Sveriges Riksbank Economic Review *(Penning- och valutapolitik)* 2, 2016

This article offers a review of the role of central banks as providers of public liquidity. Against the backdrop of the global financial crisis of 2007-2009, we discuss various challenges for public liquidity provision and the effectiveness of central bank lending facilities. These challenges help us identify potential gaps in existing mechanisms and frameworks governing liquidity assistance. We discuss how the available liquidity policy tool kit can be used to deal with the challenges. Furthermore, we highlight modifications to existing central bank facilities during and after the global financial crisis. We point at trade-offs faced by policy makers and describe potential pitfalls for public liquidity providers. Lastly, we attempt to look ahead and outline some specific challenges posed by more recent structural, regulatory, and technological developments in the financial system.

## Is a bubble forming in Swedish housing prices?

*Emilio Dermani, Jesper Lindé and Karl Walentin*

Sveriges Riksbank Economic Review *(Penning- och valutapolitik)* 2, 2016

A discussion has been ongoing for some time on house prices and household indebtedness in Sweden, and whether their current levels are sustainable in the long term. In this article we study this issue for single-family house prices, both in Sweden as a whole and in various municipalities. Our results do not support the notion that Swedish houses are evidently overvalued in the country as a whole, if we assume that their prices are influenced by the relevant economic variables in the same way as in a number of other countries. When we change our perspective and look at how house prices on the municipal level have developed relative to earned income in the same municipalities, we cannot find any strong evidence for abnormal price differences among municipalities. However, the current high valuations of housing is only sustainable in the long term if households' housing costs remain low in relation to their income. Concern over the current developments on the Swedish housing market is therefore justified.

## Macroeconomic effects of reducing household debt

*Daria Finocchiaro, Magnus Jonsson, Christian Nilsson and Ingvar Strid*

Sveriges Riksbank Economic Review *(Penning- och valutapolitik)* 2, 2016

The Riksbank has for a long time emphasized that rising household debt is a concern for financial stability that needs to be addressed. Tighter macroprudential measures or tighter mortgage interest deduction are two alternative ways of tackling this problem. In this article, we study how these two approaches would affect different households using a macroeconomic model. We show that, contrary to what is often argued in the public debate, a tightening of the loan-to-value cap, the loan-to-income cap and the amortization requirements would lead to a redistribution of resources from lenders to borrowers in the long-run. Moreover, tighter mortgage interest deduction affects households in different ways, depending on how the Government chooses to use the released budgetary resources. If borrowers are compensated, this policy could have positive effects for their consumption other than housing. We also analyze the implications for monetary policy of different measures to dampen household debt and show that the extent of mobility on the housing market plays an important role. In some cases, monetary policy might need to be more expansionary, and in other cases more contractionary. Finally, we study how household debt affects the transmission mechanism of monetary policy on inflation. The higher the indebtedness, the greater the effects of a rate hike on the interest expense and disposable income of borrowers. The effects of a rate hike on demand – and hence on inflation – are therefore greater today than when the inflation target was introduced in the mid-1990s.

## Rethinking the central bank's mandate - A summary of a conference of international experts

*Jesper Lindé and Anders Vredin*

Sveriges Riksbank Economic Review *(Penning- och valutapolitik)* 3, 2016

In recent years, the discussions on what central banks should do have intensified around the world, both among experts at academic institutions as well as in the media, among politicians and among the broader general public. This is due mainly to the crisis in the financial system which adversely affected many countries in 2007-2009 and its lasting repercussions, but also to some extent to more long-term trends in the global economy, including innovations on financial markets and "globalization". This article summarizes the presentations made by international experts at the conference "Rethinking the central bank's mandate", arranged by Sveriges Riksbank on 3-4 June 2016.

## Definitions of Debt and Income in Sweden

*Peter van Santen and Dilan Ölcer*

Economic Commentaries No. 4, 2016

The debt-to-income (DTI) ratio is frequently discussed in conjunction with possible macroprudential measures to restrict the build-up of vulnerabilities among Swedish households due to rising household debt and to increase the resilience of the Swedish economy. This Economic Commentary illustrates how the DTI ratio, a measure often used to describe household indebtedness, can vary depending on the definition of income and debt used, and whether the ratio is based on individuals or households. Because different households have different marginal propensities to consume, the DTI definition employed is likely to influence the effect of any DTI policy implemented.

### The indebtedness of Swedish households: Update for 2016

*Peter van Santen and Dilan Ölcer*
Economic Commentaries No. 5, 2016

Household indebtedness has been increasing since the mid-1990s in Sweden. This Economic Commentary uses household-level data to describe the distribution of debt over time and across income and age groups as well as regions and banks. We show that household debt continues to grow faster than income, and that low-income, young and urban households are most indebted.

### Does the Riksbank sufficiently take into account Sweden's international dependence in its forecasts?

*Jesper Lindé, André Reslow and Karl Walentin*
Account of monetary policy 2015

A small, open economy like Sweden is to a large degree affected by developments abroad. One question one might ask is whether the Riksbank has sufficiently taken into account Sweden's international dependence in its forecasts. This article analyses how the Riksbank during the period 2007–2015 has changed its domestic forecasts when the international forecasts changed. The analysis shows that the Riksbank has given due consideration to international developments in its revisions to the forecasts for inflation.

## Other research activities

**External Review of the Riksbank Research Division**

During a few days in May 2016, an external committee of four (Rodney Ramcharan, Frank Smets, Jonathan Wright, Greg Udell) visited the Riksbank to evaluate the research division on the basis of its research and policy contributions. A similar evaluation of the research division was conducted in 2008 by Marvin Goodfriend, Lucrezia Reichlin and Greg Udell. Read more about the external review of the Research Division here: http://www.riksbank.se/en/The-Riksbank/Research/About-us/

**Conferences**

On June 3-4 2016, the Riksbank organized the "Rethinking the Central Bank's Mandate" conference. Developments in the global economy and on the financial markets in recent years have led to a more in-depth, international debate among researcher and politicians on the central bank's mandate. The aim of the conference was to provide an overview of current issues and topics from leading international experts to provide new insights and inspiration for continued discussion on central banks' activities and mandates. The organizing committee consisted of Magnus Georgsson (Riksbank), Eric Leeper (Indiana University), Jesper Lindé (Riksbank), Cecilia Skingsley (Riksbank), David Vestin (Riksbank) and Anders Vredin (Riksbank). The program is available at:
http://www.riksbank.se/Documents/%c3%96vrigt/Konferenser/Program%20Rethinking%20final%20long%20version%20NY.pdf

In September 2016, the Research Division organized a conference on "Challenges in Interconnected Financial Systems" jointly with the MacCaLM research project. The workshop featured eight conference papers as well as keynote speeches by Stijn van Nieuwerburgh (NYU) and Robert Townsend (MIT), all organized around the topic of networks.

Financial integration, globalization, and developments in information technology have increased interconnectedness and interdependency in the financial system. Links between households, firms, and financial institutions help channel credit, reallocate capital, and share risks in the economy. At the same time, links can transmit, and even amplify, negative economic shocks throughout the financial system as a result of cross-holdings and counterparty exposures. The propagation of shocks may cause contagion and lead to cascading failures in the system, imposing high costs to society.

The conference covered both theoretical and empirical work on these topics, to advance our knowledge of what drives network formation, how interconnectedness amplifies shocks, and the tension between risk sharing and systemic risk. The organization committee consisted of Tore Ellingsen (SSE), Tor Jacobson (Riksbank), Thomas Jansson (Riksbank), Alexander Ljunqvist (NYU), Peter van Santen (Riksbank) and Xin Zhang (Riksbank). The program is available at:
http://www.riksbank.se/Documents/Forskning/Konferenser_seminarier/2016/foe_program_interconnectedness_160901.pdf

## Courses

During 2016, the Research Division organized a second-year PhD course on monetary economics. The course was held at the bank, and was taught by faculty from Stockholm University and by Riksbank researchers. The purpose of the course was to introduce students to modern New Keynesian models for monetary policy and business cycle-analysis.

## Greater Stockholm Macro Group

Together with Per Krusell (IIES, Stockholm University), the Research Division continued to organize a monthly internal seminar series for macro researchers from all major institutions in Stockholm and Uppsala. The series is known as "Greater Stockholm Macro Group" and aims at fostering exchange of ideas and cooperation among macro researchers in the Stockholm area.

## Internship Program

As customary, the Research Division hosted four PhD interns in 2016. This year's interns were Kristina Bluwstein (European University Institute), Christian Höynck (Pompeu Fabra), Thomas Seiler (Stockholm School of Economics) and Yingjie Qi (Stockholm School of Economics).

## Research Seminars

The Research Division organizes weekly research seminars, mainly by invited international speakers. The seminars usually take place on Tuesdays at 1 pm and attendance is open to Riksbank employees as well as to academics. A complete list of both upcoming and past seminars is available on the homepage of the Riksbank's Research Division: http://www.riksbank.se/en/The-Riksbank/Research/Seminars/

## Teaching and Advising

Daria Finocchiaro taught half of the first-year graduate macro course at Uppsala University in the fall of 2016. Her lectures dealt with classical consumption theory, asset prices and overlapping generation models, while also touching upon fiscal and monetary policy issues. Karl Walentin taught half of the Macro II course for PhD students at Stockholm University. The course covered inequality facts, macroeconomic modelling of inequality and heterogeneity as well as labor markets. David Vestin taught half of the Macro II course for PhD students at Uppsala University. Andreas Westermark taught part of the second-year PhD course on monetary economics held at the Riksbank.

Conny Olovsson taught part of the master course "The Climate and the Economy" during the spring of 2016 at Stockholm University. The course explained how economic tools can be used to analyze environmental issues and, in particular, climate change: its causes and effects and the role for economic policy in influencing our future. The focus was on economic methods in theory and practice but the course also covered the basic aspects of the natural sciences involved. Jesper Lindé and David Vestin taught a master course "Monetary Policy" at the Stockholm School of Economics. The course was intended to provide a thorough understanding of some basic theoretical and empirical models for analyzing business cycles and monetary policy, with a main focus on small-scale models with nominal rigidities.

Karl Walentin taught a course on DSGE-modelling at the Central Bank of Iceland. The emphasis of the course was on estimation and policy use of DSGE models. Andreas Westermark has, together with Magnus Jonsson and Magnus Åhl at the monetary policy department, as part of the Riksbank's technical assistance activities, taught a course in DSGE-modelling at the central banks of Ukraine and Kenya. The purpose of the course is to introduce the staff at the central banks to DSGE modelling and estimation. The course is divided into two parts, where the first part builds the theoretical foundations for DSGE models and presents a simple open-economy DSGE model that could be used by the central banks.

The first part starts by describing key mechanism, e.g. the consumption savings decision, investment, in dynamic models in a simple neoclassical closed economy model. Then sticky prices is introduced in a simple new Keynesian framework. Moreover, in order to match the empirical evidence better, habit formation and price indexation is added to the model. Finally, since both Ukraine and Kenya are small open economies, a small open economy model is described. The second part is focused on estimating DSGE models. We first look at methods for estimating such models and then continue to estimate a model using Kenyan and Ukrainian data, respectively. The estimated models are intended to be used by the central banks of Kenya and Ukraine for policy analysis and forecasting.

In the fall 2016, they taught the first part of the course and the second part will be given in the spring of 2017. The course was in general well received and both in Ukraine and Kenya the central bank staff attending the course showed a lot of interest in DSGE modelling.

Karl Walentin advised a PhD student, Glenn Mickelsson, at Uppsala University and Jesper Lindé advised four master students at the Stockholm School of Economics. On May 25, 2016, Jesper Lindé discussed Rachatar Nilavongse´s dissertation on "Housing, Banking and the Macroeconomy" at Uppsala university.

Conny Olovsson gave a guest lecture on "The climate and the economy" at the Royal Academy of Science.

**Miscellanea**

Christoph Bertsch was a member of the Scientific Committee of the IFABS 2016 Barcelona Conference. Paola Boel was in the program committee for the IMF-CEP workshop on "Monetary Policy, Macroprudential Regulation and Inequality". Conny Olovsson was in the program committee for the conference "Central Banking, Climate Change and Environmental Sustainability" organized by the Council on Economic Policies and the Bank of England. Thomas Jansson participated at the ECB Household Finance and Consumption Network (HFCN) meetings and Christoph Bertsch was a member of a CFGS (Committee on the Global Financial System) work group.

Jesper Lindé conducted a peer review of the Riksbank Monetary Policy Department forecasting process. David Vestin co-authored a report on how the central bank balance sheet may evolve in the coming years with a focus on how movements in interest rates will affect bond prices and the cost of the central banks financing cost of the bond purchases made for monetary policy reasons. Valentina Gavazza, Conny Olovsson and Andreas Westermark authored a policy report titled "Monetary policy under risk and uncertainty". Jesper Lindé, Jessica Radeschnig and Anders Vredin edited the special issue of the *Sveriges Riksbank Economic Review* entitled "Rethinking the central bank's mandate" (2016:3).

Conny Olovsson was awarded the Myrdal prize for best essay in *Ekonomisk Debatt* during 2015.

# Upcoming events in 2017

Next year's research conference is devoted to the field of economic history, and in particular the histories of central banks. In recognition of the Riksbank 350 year anniversary in 2018, we have launched a book project in collaboration with the Cambridge University Press (CUP), aiming at presenting the Riksbank's historical development, along with those of a selection of interesting, and in some cases important and dominating central banks world-wide. The book is intended to be published in the CUP's series *Studies in Macroeconomic History*, edited by Professor Michael Bordo, Rutgers University, and comprises 13 chapters of which eleven present the histories of Sveriges Riksbank, Norges Bank, Bank of England, Federal Reserve, Peoples Bank of China, Banca d'Italia, Banque de France, De Nederlandsche bank, Banca de España, Bundesbank, and Bank of Japan. All in all, 22 renowned scholars are currently writing up first drafts of the chapters for presentation at the conference in April, 2017. An editorial team including Rodney Edvinsson, Tor Jacobson, and Daniel Waldenström is guiding the project.

In the spring of 2017, a second year PhD course on monetary economics will be given at the Riksbank. The course will be taught by faculty from Stockholm University and the Riksbank. The purpose of the course is to introduce students to modern New Keynesian models for monetary policy and business cycle analysis. These models are dynamic stochastic general equilibrium models based on optimizing behavior and rational expectations. At the same time, they incorporate price and wage rigidity, permitting an important role for aggregate demand shocks and monetary policy to affect activity. They have become a standard tool for central banks and are used as a framework for much modern research in macroeconomics. The course will cover the basic New Keynesian model, optimal policy, labor market frictions, open economy, and also introduce methods for solution and simulation. Throughout, we will emphasize the microeconomic foundations of these models. We hope that, after finishing this course, participants will feel comfortable working with these models.

# Interview with John Moore (continuing from page 1)

*Q1. The Research Division at Sveriges Riksbank, in conjunction with MacCaLM, the research group you lead at the University of Edinburgh, held a conference at the Riksbank in September of this year. Perhaps you could introduce MacCaLM, and explain why the joint conference was a good idea?*

MacCaLM is an international research group of economists, centred at the University of Edinburgh, brought together to re-examine macroeconomic theory, with a focus on malfunctions in labour and financial markets and their role in macroeconomic failure. Because we are based in Scotland, we thought it would be good to have a name that sounds like a satisfyingly smooth single-malt whisky. In truth, though, MacCaLM is an acronym for Macroeconomics: Credit and Labour Markets. We want to 'ground' our theorising – our model

building – by working alongside fellow researchers with real-world expertise. The Research Division at the Riksbank has an enviable reputation, and we were very pleased and proud to join forces. Our hope is to continue the collaboration by having a regular joint conference.

*Q2. Why was MacCaLM set up?*

Following the crisis of 2007/8, there has been a debate about the state of macroeconomics and the need for new approaches. It can be argued that recent developments in macroeconomics have had little impact on current policy debates – debates which often have been conducted in terms with which graduates from the 1970s would be familiar. One new approach in macroeconomics is to build on the foundations of modern research in credit and labour markets. The University of Edinburgh is well placed to develop this research: as part of a deliberate recruitment strategy begun in 2000, a number of the world's leading researchers in labour economics, credit markets and macroeconomics have been hired, who in turn have long-established collaborations with key researchers elsewhere in Europe and North America. Among my Edinburgh-based co-investigators are Professors Michele Belot, Mike Elsby, Maia Guell, Philipp Kircher, Sevi Rodriguez Mora, Andy Snell, Jonathan Thomas, Ludo Visschers and Tim Worrall.

The funding for MacCaLM came from a grant of roughly £6 million from the UK Economic and Social Research Council, and covers a five-year horizon. A lot of intellectual discovery can happen in five years, and it is impossible to predict what may be found. The hope is that new insights will emerge from considering credit and labour markets in a more integrated fashion.

*Q3. Why the focus on credit and labour markets?*

The workhorse macroeconomic model, as taught to graduate students and as used in many central banks and treasuries, does not have a well-articulated financial sector. Consequently, issues such as the drying-up of credit markets, as experienced during the crisis, can play no role in this model. Likewise, the crisis has thrown into relief the poor performance of current models of labour markets. For example, the relatively muted response of employment and unemployment in the UK to the output slowdown has been a major surprise; and nominal wages across most industrialised economies have also appeared surprisingly unresponsive to increased unemployment. In short, there is much theoretical work to do, on rethinking macroeconomic models from scratch. The crisis has been a shock of such magnitude that, with the type of detailed datasets now available, there is the prospect of real advances in our understanding.

The credit and labour markets should arguably be the two most prominent components of any macroeconomic framework, given that, when things go wrong in the economy, it is the apparent malfunctioning of those two markets that stands out most – be it a financial crisis, a rise in unemployment, or both. We believe the two markets are deeply connected too, in ways that economists have yet to appreciate fully. Credit and labour market transactions are most often long-term, and so rely on some form of contract, either explicit or implicit. Moreover, the underlying sources of contractual incompleteness/failure are the same, whether writing a financial contract or a labour contract: viz., the inability to commit effort; the shortage of collateral; the difficulty of writing enforceable contingent penalties. To put this in the most general terms: financial contracting and labour contracting are both intimately to do with the economics of power and control through time. By looking at the credit and labour markets through a common lens, and by delving more into their common contractual foundations, it is expected that deeper connections will be discovered that will feed into building better macroeconomic models.

*Q4. So MacCaLM rests on two pillars, credit frictions on the one hand, and labour frictions on the other. Do these frictions interact?*

Absolutely. In light of the disruptions in credit markets during the crisis, and the concomitant sharp rises in unemployment, it is natural to postulate an empirical link between financial and labour market frictions. We also think there are deep economic reasons for why these frictions might be linked, and may even be mutually reinforcing, amplifying and propagating the effects of shocks across both capital and labour markets. Since the size and persistence of unemployment fluctuations has been an – perhaps even the – enduring macroeconomic problem since Keynes, and remains largely unresolved, we think this is extremely important.

At its simplest, one link between credit and labour frictions emerges from the banal, but crucial observation that capital and labour are complementary in production. A direct implication is that the demand for labour

will inherit all the pathologies of capital demand induced by financial frictions, and vice versa. To cite an example especially familiar to me (from my work with Nobuhiro Kiyotaki), the propagation and amplification of business cycles induced by the collateral multiplier will, via this channel, naturally spill over onto labour demand. Worsening credit conditions may cause some firms to downsize, laying-off part or all of their current workforce. And other firms may be prevented from investing and growing as much as they otherwise would wish, depressing hiring.

In addition to this simple channel, however, there are interesting potential spillovers from frictions in the labour market back to the financial constraints themselves. Of particular importance is the role of the wage bill in shaping a firm's net worth, and therefore its ability to invest. A key insight is that, through this channel, rigidities in wages can further depress capital demand by exacerbating a firm's financial position in the wake of negative shocks. That is, if workers' wages do not fall sufficiently in recessions, this in turn can intensify the positive feedback between capital and labour markets.

After formalising and fleshing out these theoretical predictions, we want to confront them with available panel datasets that combine firm-level data on employment, the wage bill, investment, as well as financial indicators such as leverage, bond and equity issuance. Among the critical relationships we will consider are those between a firm's net worth, its employment at both job creation and job destruction margins, and their interaction with the firm's wage bill.

*Q5. Turning to the credit market, may I ask how you think about, and model, money?*

Since the late 1990s, Nobuhiro Kiyotaki and I have been thinking about money. That sounds bad, doesn't it? What I mean is: we've been wrestling with how to incorporate money into a macroeconomic framework. We think liquidity is the key – indeed, perhaps Monetary Economics should be supplanted by Liquidity Economics. Our ideas came together in a paper "Liquidity, Business Cycles, and Monetary Policy", first aired back in 2001 here in Sweden, in a lecture I gave to the Society for Economic Dynamics Annual Meeting held at the Stockholm School of Economics.

The paper presents a model of a monetary economy where there are differences in liquidity across assets. Money circulates because it is more liquid than other assets, not because it has any special function. There is a spectrum of returns on assets, reflecting their differences in liquidity. The model is used, first, to investigate how aggregate activity and asset prices fluctuate with shocks to productivity and liquidity; second, to examine what role government policy might have through open market operations that change the mix of assets held by the private sector. With its emphasis on liquidity rather than sticky prices, the model harks back to an earlier interpretation of Keynes, following Tobin.

The model is seen as providing some intellectual underpinning for the kind of unconventional policy – purchasing private bonds, or credit easing – that has been undertaken in response to the recent crisis.

*Q6. I understand that, in your own recent research, you have been modelling systemic failure in financial markets. How?*

The recent crisis featured a significant disruption of financial intermediation, with the interbank market as an epicenter. There are deep questions raised here. Why do banks (financial intermediaries more generally) borrow from other banks and simultaneously lend to the other banks? How do these interbank loans interact with finance from ultimate lenders to ultimate borrowers? Do these gross positions create systemic risk?

An answer I propose is that banks have two types of financing opportunities. One is to lend to non-financial entrepreneurs, partly financed by borrowing from other banks. The other is to lend to another bank, partly financed by borrowing from households. To fix ideas, consider an example in which a lead bank L provides finance to an entrepreneur, partly borrowing from non-lead bank N, and N raises funds from households. L can lend to the entrepreneur, because L has a specific skill to judge the entrepreneur's business and collateral. N can lend to L, because N can judge L's loan to the entrepreneur. The households cannot judge L's loan to the entrepreneur, but they can observe that N has certified L's entrepreneurial loan. Thus the households are willing to lend to bank N, taking N's loan to L as security. In equilibrium, the rate of return on entrepreneurial loans is higher than the interbank interest rate, which in turn is higher than the deposit interest rate offered to households.

Now suppose that banks do not always have the opportunity to lend to entrepreneurs. Then banks with the opportunity will lend to entrepreneurs, levered by interbank borrowing. The banks without the entrepreneurial loan opportunity will lend to the other banks, levered by borrowing from households. Crucially, because the rate of return on making new interbank loans, levered by fresh borrowing from

households, is strictly higher than the opportunity cost of rolling over their existing interbank debts, they choose to maintain a gross borrowing and lending position in the inter-bank market.

In short, the banks hold gross financial positions among themselves: they simultaneously borrow and lend to each other. The difference between a financial system with netting, and one without, is that the latter is susceptible to systemic failure: the failure of one intermediary to meet its debt obligations can cause other intermediaries to fail too. This begs the question: does the private benefit of holding such mutual gross positions offset the potential social and private costs of domino default?

Notice that, from society's point of view, when banks lend to and borrow from each other, the interbank loans serve to certify each other's entrepreneurial loans and thus offer additional security to households. Because of this additional security, the banking system is able to transfer more purchasing power from households to entrepreneurs, stimulating aggregate investment and production. But the economy is more susceptible to systemic failure.

*Q7. Wages play a central role in economic fluctuations. How does the MacCaLM project approach wage determination?*

One of the ideas we have been looking at is the way wages might respond asymmetrically to macroeconomic shocks. In particular we are interested in whether wages exhibit downward rigidity, at least to some extent. There have been extensive analyses documenting how flexible wages are in response to aggregate shocks, with a fairly consistent picture of individual wages responding procyclically to shocks. There is surprisingly little in the literature, however, either on the empirical side or on the theoretical, which specifically analyses asymmetries of the type we have in mind.

Using matched employer-employee data from Germany, we find evidence of asymmetric wage adjustments with respect to positive and negative shocks. Moreover our results suggest that while in downswings both the wages of incumbents and those who are newly hired are relatively downwards inflexible, the same is not true in upswings where there is evidence of new hire wages responding positively and substantially to the fall in unemployment, but incumbent wages responding less so. We've been looking for a theoretical framework consistent with these results. The fact that wages of new hires and incumbents seem to move together, at least in downturns, speaks against some contracting models where each cohort of hires contracts with a firm independently of other cohorts. In these models, in a downturn new hires are in a relatively weaker bargaining position and will be paid less than incumbents employed in better times.

One model we have worked out links wages of new hires and incumbents through the threat of employers using cheaper new hires to replace incumbents. As this ex post optimal action by firms may be ex ante sub-optimal, the equilibrium outcome is for firms to offer contracts where incumbent wages will fall to match new hire wages (to prevent undercutting). But incumbents may be averse to variable wages, and are prepared to sacrifice present value average wages for less variability. To benefit from this, but to stop undercutting, the optimal contract makes wages of both new hires and incumbents relatively inflexible in response to negative shocks. Positive shocks, though, lead to larger increases in new hire wages.

Of course we would also like to understand better the downward rigidity of nominal wages, and we see some of these ideas we've been looking at which concern real wages as being relevant to nominal wage rigidity too.

In related work, we have being trying to understand how shocks affect wages throughout the firm. While there is much variation that is due to individual heterogeneity -- and one of the stylised facts is that individual wages follow an approximate random walk – we are interested in looking at common components driving wages. To do this we use microdata from Germany and also from Portugal. What we find is that there are common shocks at the firm level, that these shocks are persistent, and in fact largely account for the persistence in individual wages. This suggests that within-firm wage structures, or "wage policies", play a substantial role in how wages respond to persistent shocks including macroeconomic shocks.

*Q8. How might MacCaLM's work on labour markets affect the life of the unemployed?*

As part of our project, we are carrying out deeper background work on the macroeconomy that we hope will eventually lead to better policy choices aimed at both reducing unemployment and reducing the mismatch of skills to job requirements. This is concretely aimed at helping job seekers in practical terms – while still providing scientific evidence.

For example, we aim to advise job seekers about how to better find employment. In particular, during an online job search, we will show them not only vacancies in their own occupation, but also vacancies in other related occupations. For this, we use readily available statistical information that we, as labour economists, know about, but the job seekers themselves might find hard to access. If someone looks for jobs in a particular occupation, we can tell where other people in that occupation are finding jobs: some stay in the occupation, but others find jobs in related occupations. We can direct people towards these jobs in related occupations, especially towards those jobs where the transferability of skills is high.

While there is a risk that this extra information could distract job seekers – and therefore there remains a relevant scientific question to be answered on how useful such information actually is – this is a very practical intervention that we will assess with a randomised controlled experiment involving, if all goes well, tens of thousands of long-term unemployed. We hope that this will lead to better job-finding rates for the long-term unemployed, to insights on how we might provide better information to job seekers in general, and to help us economic theorists discover what is missing from our search-theoretic models of the labour market. By the way, this intervention is attractive because it does not force individual workers to do anything – in contrast to many incentive-based treatments. Rather, our intervention is built around genuinely helping the unemployed by giving them better information.

*Q9. Paradoxically, it sounds as though the future of macroeconomics, and even of macroeconomic theorising, lies in the detailed exploration of large microeconomic data sets?*

Exactly! And it is across that bridge that we at MacCaLM would like to walk with our friends in the Research Division of the Sveriges Riksbank.



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