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**This newsletter describes the research activities and output of the Research Division at Sveriges Riksbank during 2011.**

## Staff at the Research Division, 2011

*Johan Almenberg*, visiting researcher until March 2011 (finance, financial literacy)

*Roberto Billi*, researcher (macroeconomics, monetary and fiscal policy)

*Mikael Carlsson*, researcher (macroeconomics, econometrics, labor markets)

*Ferre De Graeve*, researcher (macro-finance, monetary policy, macroeconometrics, banking)

*Daria Finocchiaro*, (on leave April-December 2011) researcher (monetary economics, applied macro)

*Martin Flodén*, visiting scholar (macroeconomics)

*Paolo Giordani*, (on leave until October 2011) researcher (Bayesian econometrics, forecasting, nonlinear models)

*Karl Harmenberg*, research assistant

*Karolina Holmberg*, guest PhD student (empirical macro and financial frictions)

*Tor Jacobson*, head of research (econometrics, banking and credit risk)

*Thomas Jansson*, researcher (household finance, credit risk, and financial markets and institutions)

*Michael Koetter*, visiting researcher until September 2011 (banking, financial stability)

*Per Krusell*, visiting scholar (macroeconomics)

*Mats Levander*, (on leave for PhD studies at the Stockholm School of Economics) research assistant

*Lena Löfgren*, secretary

*Virginia Queijo von Heideken*, researcher (monetary economics, credit markets, empirical macro)

*Matias Quiroz*, (on leave for PhD studies at Stockholm University) research assistant

*Kasper Roszbach*, deputy head of the monetary policy department (banking, credit risk, corporate governance)

*Tommy von Brömsen*, research assistant

*Erik von Schedvin*, (on leave for PhD studies at Tilburg University) research assistant

*Karl Walentin*, researcher (macroeconomics, financial economics, labor markets)

*Andreas Westermarck*, researcher (macroeconomics, labor markets)

## Reflections by the Head of Research

2011 has been a very productive year at the Research Division. Or, rather, this is a year when the harvest has been unusually rich. The work and effort put into various projects over the past years has resulted in a number of good publications. This is very reassuring and suggests that we are doing the approximately right things. The publication list for 2011 includes articles in journals such as the *American Economic Review*, the *Journal of Financial Economics*, and the *Journal of Monetary Economics*. Of course, the challenge is to keep going and realize that we will have to work even harder in the future to maintain the current standard.

I would like to take the opportunity to comment on a few events of particular significance for the Research Division. This is a year when two of the more senior researchers decided that it was time to move on. Hence Ulf Söderström is now Head of the Modeling Division at the Riksbank, one of the more important responsibilities in the monetary policy process. Mattias Villani has returned to the academic world and taken up a position as Professor of Statistics at Linköping University. Both Ulf and Mattias have been very important in forming the Research Division. Not only by being excellent researchers, but also by providing tons of policy support over the years.

Since mid-2010 the Research Division has had two consultants/visitors that regularly spend entire workdays here at the Riksbank in order to interact with the research staff. This has proven to be very valuable, in many ways, and thus we hope to continue to have Professors Martin Flodén and Per Krusell from Stockholm University as consultants well into the future. I would like to mention two concrete effects of their contributions. First, the initiative to create the so called Greater Stockholm Macro Group, a monthly seminar series at the Riksbank, where macro oriented researchers from Stockholm and Uppsala meet to present and discuss ongoing research. Second, the September research conference on "Beliefs and Business Cycles" that presented a very attractive program. We hope that next year's event, preliminary entitled "Sovereign Debt and Default" will be able to match that quality and relevance.

In the past year an internal inquiry about research and policy work at the Research Division has been carried out by Kasper Roszbach, Ulf Söderström, and Björn Segendorff. Their assignment was to investigate how the division can become more effective and efficient in its research and policy support work with respect to the Riksbank's two core policy areas: monetary policy and, in particular, financial stability. As a consequence of the conclusions drawn in the lucid inquiry, the Executive Board has among other things decided to allocate resources for three new research positions in Financial Stability. When these positions are filled the Research Division will be about even-legged in terms of number of researchers focusing on macro/monetary policy and banking/financial stability, respectively. It's my hope that this will also result in a better balanced mix of research and policy output for the two policy fields.

Related to the above point the Research Division has recently introduced a new set of performance indicators. One novelty worth mentioning is the explicit division of output measurement for the two policy areas; something we think will strengthen financial stability oriented research. Another novelty concerns the qualitative aspect of journal publications. Up until now we have simply strived towards a quantitative target of annual publications, which has served us well enough as a disciplining device. However, we believe that by adopting similar journal ranking schemes as the best central banks use, we will achieve better performance in the long run.

*Tor Jacobson*

## Changes in the Research Staff

**Ulf Söderström, Mathias Trabandt and Mattias Villani** left the research division during the year. Ulf became head of the modeling division at the bank, Mathias joined the Federal Reserve Board and Mattias became a full professor at Linköping University.

**Roberto Billi** joined the research division in the summer of 2011. Roberto obtained his PhD in economics from Goethe University Frankfurt in 2005. He was an economist at the Federal Reserve Bank of Kansas City from 2005 to 2011. He is an expert on optimal inflation goals and the design of monetary policy strategies in the presence of a zero lower bound on nominal interest rates. He also investigates monetary and fiscal policy interactions, as well as financial regulation and macroprudential policies.

**Tommy von Brömsen** has worked in the Research division since June 2011, and his job is primarily concerned with programming in SAS, Python and MATLAB. During the years 2003-2011, Tommy first studied economics at the University of San Diego (B.B.A), and then financial mathematics at Chalmers University of Technology (M.Sc.). The long duration of the studies can be explained by professional footballing for some years.

**Karl Harmenberg** started working as a research assistant in February 2011. He did his undergraduate studies at Harvard University 2006-2010, majoring in mathematics. Karl enjoys programming in Matlab, SAS and Python although his preferred set of tools is {pencil, paper, trash can}.

**Johan Almenberg** was visiting the division from December 2010 until March 2011. Johan was on leave from the Ministry of Finance, and does research on financial literacy and its relation to economic outcomes. The project he did at the Riksbank is related to housing.

**Michael Koetter** visited the research division from March to September 2011. He was on leave from his position as Associate Professor at University of Groningen. Michael's main research area is empirical banking, but he has also published papers in other areas, e.g. on technology and growth.

## Summary of Featured Article

*The following is a summary of the article by Mikael Carlsson and Oskar Nordström Skans, forthcoming in the American Economic Review with the title "Evaluating Microfoundations for Aggregate Price Rigidities: Evidence from Matched Firm-Level Data on Product Prices and Unit Labor Cost"*

A number of competing business cycle models has recently emerged, all of which can explain why nominal shocks have real effects. A key difference between these models lies in the assumptions of how firms set prices and process information. This paper uses detailed Swedish data on product prices and unit labor cost merged at the firm level to evaluate competing sets of assumptions regarding firms' price-setting behavior directly at the micro level.

Much of recent research on aggregated fluctuations focuses on staggered contracting at the micro level and the implied forward looking price-setting behavior, building on the work by Taylor (JPE, 1980), Calvo (JME, 1983) and others. Mankiw and Reis (QJE, 2002) instead suggest that information, rather than prices, is sticky. In their model, a firm updates its information set with a fixed probability in each period and, when updating, decides upon a price path that will remain in place until the next time information is received. Thus, nominal disturbances have real effects due to information staggering. Recently, a third alternative model was proposed by Mackowiak and Wiederholt (AER, 2009), where (some) information also disseminates slowly. As in the Sticky Information model of Mankiw and Reis, prices can be freely changed by the firm in any period, but the firm faces a constraint on the amount of information that can be processed in each time period. The firm then makes an (optimal) choice about the relative attention to be paid to idiosyncratic versus aggregate conditions based on their relative volatility. In the Mackowiak and Wiederholt Rational Inattention model, the firm allocates almost all its attention to idiosyncratic conditions. This gives rise to a situation where firms react as strongly and quickly to idiosyncratic conditions as if they had perfect information. In contrast, firms react in a dampened and delayed fashion to aggregate conditions, giving rise to real effects of aggregate nominal disturbances.

We find a price-cost elasticity of about one third. This incomplete adjustment to idiosyncratic changes in marginal cost is not in line with the Mackowiak and Wiederholt Rational Inattention model. In addition, we perform a test to see if the pass-through of idiosyncratic marginal cost onto the price depends on the idiosyncratic shock variances we observe in the data. We find that firms facing high idiosyncratic shock variances and firms facing low idiosyncratic shock variances (but facing the same sectoral and aggregate conditions) do not differ in their responses to idiosyncratic movements in marginal cost. Moreover, we do not find that firms react fully to changes in marginal cost that could have been forecasted by the vast

majority of information vintages of firms. Thus, the data does not align well with the baseline Mankiw and Reis Sticky Information model. However, we also show that the latter model's predictions can be brought to match the data if it is augmented with suitable extensions. When estimating the Calvo pricing equation, we find that firms consider both current and future expected marginal cost when setting prices. Furthermore, the magnitudes of the estimated parameters are in line with what is expected from previous macro and micro studies.

It is worth pointing out that the Calvo model is not the only model in the literature that can explain infrequent price changes or that the expectation of future marginal cost affects the price set today. However, the finding that the expectation of future conditions matter for pricing strongly points towards models emphasizing impediments to continuous price adjustments as a driver of non-neutrality of nominal disturbances. Importantly, the notion that expectations of future conditions affect current pricing decisions is a keystone for much of the current monetary policy analysis and the implied policy advice.

## Research Projects Pursued in 2011

### ■ ■ CREDIT AND BANKING

#### Firm-Level Evidence of Shifts in the Supply of Credit

*Karolina Holmberg*

This paper investigates whether firms are subject to shifts in the supply of credit over the business cycle. Shifts in the supply of credit are identified by exploring how firms substitute between commitment credit -- lines of credit -- and non-commitment credit. It is an empirical study and the micro data employed is an extensive data set of small and large Swedish firms. I use three different measures to capture potential variation in credit availability over the business cycle: the central bank policy rate, banks' loan losses in percent of total bank lending and the stock market valuation of banks. The results support that firms on average rely more on commitment credits when monetary policy is tight and when the financial health of banks is weaker. Various robustness tests confirm the inference. The results are consistent with a bank lending channel of monetary policy and with shifts in the supply of credit following deteriorations in banks' balance sheets.

#### Lines of Credit and Investment: Firm-Level Evidence of Real Effects of the Financial Crisis

*Karolina Holmberg*

This paper studies how the 2008 financial crisis affected corporate investment in Sweden through its effect on credit availability. The micro data set used in the study has been created by merging data from three different sources: Swedish bank lending data, investment data and accounting data of non-financial firms. A differences in differences approach is used to compare investments of firms before and after the onset of the crisis as a function of their ex ante sensitivity to a credit supply shock, controlling for fundamental determinants of investments. Sensitivity to a credit supply shock is measured as credit reserves, defined as unused credit on lines of credit. Consistent with a casual effect of a credit supply shock, I find that firms with low credit reserves prior to the crisis reduced investment significantly more than other firms. To address endogeneity concerns, I measure a firm's financial position a year prior to the crisis. I also verify that similar results do not follow from placebo crisis in 2005, 2006 and 2007. In addition, I examine the extensive margin of lines of credit and find that the probability that a firm had access to a line of credit was reduced after the onset of the crisis. However, this tightening of credit standards does not appear to have added to the decline in investments.

#### Collateralization, Bank Loan Terms and Monitoring: Evidence from a Natural Experiment

*Geraldo Cerqueiro, Steven Ongena and Kasper Roszbach*

This paper identifies the value of collateralization and its impact on borrower quality and bank monitoring exploiting a change in the Swedish company mortgage law as a unique natural experiment that exogenously and unambiguously reduced the value of company mortgages. Using a differences-in-differences approach, we study the impact on the entire business loan portfolio of a major Swedish bank. We find that collateral is valuable for the bank and that following a loss in collateral value higher interest rate are charged on business loans, that borrowers credit ratings deteriorate and that monitoring efforts of collateral and borrower are reduced.

(continuing since previous year)

## Credit Ratings and Bank Monitoring Ability

*Leonard Nakamura and Kasper Roszbach*

This paper uses credit rating data from two large Swedish banks to elicit evidence on banks' loan monitoring ability. Our tests reveal that banks' credit ratings indeed include valuable private information from monitoring, as theory suggests. However, our tests also reveal that publicly available information from a credit bureau is not efficiently impounded in the bank ratings. We investigate explanations for these findings and show that they are not due to the staggered timing of rating information updating and are unlikely to be due to the discrete nature of the ratings. We tentatively conclude that it has proved difficult to aggregate soft and hard information. The methods used in this paper represent a new basket of straightforward techniques that enable both financial institutions and regulators to assess the performance of credit rating systems. In the meantime, risk analysis of the banks' portfolios should be based on both internal bank ratings and public credit bureau ratings.

(continuing since previous year)

## Firm Default and Aggregate Fluctuations

*Tor Jacobson, Jesper Lindé and Kasper Roszbach*

This paper studies the relationship between macroeconomic fluctuations and corporate defaults while conditioning on industry affiliation and an extensive set of firm-specific factors. Using a panel data set for virtually all incorporated Swedish businesses over 1990-2009, a period which includes a fullscale banking crisis, the paper finds strong evidence for a substantial and stable impact from aggregate fluctuations on business defaults. A standard logit model with financial ratios augmented with macroeconomic factors can account surprisingly well for the outburst in business defaults during the banking crisis, as well as the subsequent fluctuations in default frequencies. Moreover, the effects of macroeconomic variables differ across industries in an economically intuitive way. Out-of-sample evaluations show that our approach is superior to models that exclude macro information and standard well-fitting time-series models. Firm-specific factors are found to be useful in ranking firms relative riskiness, but macroeconomic factors are necessary to understand fluctuations in the absolute risk level.

(accepted for publication)

## A Microbased Macroprudential Indicator: Future Firm-Failure Frequencies

*Tor Jacobson, Erik von Schedvin, and Ingvar Strid*

The purpose of this project is to explore stress testing of the Swedish corporate sector with respect to firm failure risks as a tool for enhanced macroprudential policy analysis. It can be shown that the aggregate firm failure frequency in Sweden is highly correlated with the Swedish banks' credit losses over time (.98 for the period 1990-2009). Hence, by means of reasonably accurate forecasts of future failure frequencies one could hope to make inference about future credit losses. Moreover, if such forecasts are model based, then the model can serve as a basis for stress testing the corporate sector's vulnerability in various scenarios. We propose to estimate a logistic model of firm failure similar to Jacobson, Lindé and Roszbach (2011) and evaluate the model's forecasting properties for horizons up to 3 years. Firm-failure frequency forecasts will be calculated by conditioning on the macroeconomic scenarios generated by the Riksbank DSGE model "Ramses".

(continuing since previous year)

## Taking the Twists into Account: Predicting Firm Bankruptcy Risk with Splines of Financial Ratios

*Paolo Giordani, Tor Jacobson, Erik von Schedvin, and Mattias Villani*

We demonstrate improvements in predictive power when introducing spline functions to take account of highly non-linear relationships between firm failure and earnings, leverage, and liquidity in a logistic bankruptcy model. Our results show that modeling excessive non-linearities yields substantially improve bankruptcy predictions, on the order of 70 to 90 percent, compared with a standard logistic model. The spline model provides several important and surprising insights into non-monotonic bankruptcy relationships. We find that low-leveraged and highly profitable firms are riskier than given by a standard model. These features are remarkably stable over time, suggesting that they are of a structural nature.

(continuing since previous year)



## ■ ■ INTERACTION BETWEEN ASSET RISK AND OTHER RISKS

### Hedging Labor Income Risk

*Sebastien Betermier, Thomas Jansson, Christine Parlour, and Johan Walden*

We use a detailed panel data set of Swedish households to investigate the relation between their labor income risk and financial investment decisions. In particular, we relate changes in wage volatility to changes in the portfolio holdings for households that switched industries between 1999 and 2002. We find that households do adjust their portfolio holdings when switching jobs, which is consistent with the idea that households hedge their human capital risk in the stock market. The results are statistically and economically significant. A household going from an industry with low wage volatility to one with high volatility will *ceteris paribus* decrease its portfolio share of risky assets by up to 35%, or USD 15,575.

(accepted for publication)

### Households' Mortgage Debts

*Thomas Jansson, Tor Jacobson, and Paolo Sodini*

Empirical research on households' financial decisions has been hampered due to lack of high-quality household micro data. For 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. Hence, our dataset enables us to estimate a household's total exposure to various risk factors. One of the purposes of this project is to use the micro data to test theoretical models that models households' optimal choice between variable and fixed interest rates, depending on the composition of their asset portfolio, their labor income risk etc. From a systemic risk perspective, we will also estimate how sensitive single borrowers are for changes in interest rates, shocks to their labor income etc.

## ■ ■ MONETARY POLICY AND PRICE SETTING

### Output Gaps and Robust Monetary Policy Rules

*Roberto Billi*

Policymakers often use the output gap to assess economic conditions and set an appropriate stance for monetary policy. Unfortunately, the output gap is a noisy signal of economic activity because it depends on potential GDP, which is unobservable, and because it depends on estimates of GDP that are subject to revision. This paper uses a standard model to examine the performance of simple rules for monetary policy in the presence of errors in measuring the output gap. A novel feature of the analysis is that it takes account of the zero lower bound on nominal interest rates. The paper shows how errors in measuring the output gap affect the optimal coefficients of the policy rules.

### Price-Level Targeting and Risk Management in a Low-Inflation Economy

*Roberto Billi*

Commitment to price-level stabilization may be an effective way of preventing deflations and exiting from deflationary traps. Price-level targeting can outperform inflation targeting when policymakers are unable to commit in advance to future policies. The value of policy commitment for economic performance is even more evident when monetary policy is constrained by the zero lower bound on nominal interest rates. The zero lower bound is a key determinant of the optimal inflation goal for monetary policy. This paper uses a standard model and takes account of the zero lower bound. The paper shows the implications of price-level targeting for optimal monetary policy and the optimal rate of inflation.

### Distortionary Fiscal Policy and Monetary Policy Goals

*Roberto Billi and Klaus Adam*

We study interactions between monetary policy, which sets nominal interest rates, and fiscal policy, which levies distortionary income taxes to finance public goods, in a standard, sticky-price economy with monopolistic competition. Policymakers' inability to commit in advance to future policies gives rise to excessive inflation and excessive public spending, resulting in welfare losses equivalent to several percentage points

of consumption each period. We show how appointing a conservative monetary authority, which dislikes inflation more than society does, can considerably reduce these welfare losses and that under optimal policy the monetary authority is mainly concerned about inflation. Exclusive focus on inflation, however, can lead to severely suboptimal economic outcomes.

## Stylized (Arte)facts on Sectoral Inflation

*Ferre De Graeve and Karl Walentin*

Research on disaggregate price indices has found that sectoral shocks generate the bulk of sectoral inflation variance, but no persistence. Aggregate shocks, by contrast, are the root of sectoral inflation persistence, but have negligible relative variance. We argue that these findings are largely an artefact of using overly simple factor models to characterize inflation. Sectoral inflation series are subject to particular features such as sales and item substitutions. In factor models, these blow up the variance of sectoral shocks, while reducing their persistence. Controlling for such effects, we find that inflation variance is driven by both aggregate and sectoral shocks. Sectoral shocks, too, generate substantial inflation persistence. Both findings contrast sharply with earlier evidence from factor models. However, these results align well with recent micro evidence. Our results have implications for the foundations of price stickiness, and provide quantitative inputs for calibrating models with sectoral heterogeneity.

(continuing since previous year)

## Monetary Policy and Financial Innovation

*Daria Finocchiaro and Caterina Mendicino*

The purpose of this project is to study the role of monetary policy in a model with an explicit role for debt and equity financing. First, we investigate how the degree of access to different sources of external financing affects both welfare and the transmission mechanism of monetary policy. Then, we study optimal monetary policy in the presence of shocks generated in the financial sector.

(continuing since previous year)

## News Shocks and Long-Term Interest Rates

*Virginia Queijo von Heideken*

The paper attempts to contribute to the existing literature on long-term interest rates by adding news shocks to a simple new Keynesian model. Using data from 1960 until today the model shows which are the main shocks contributing to long-term rates' volatility.

## Monetary Policy with Unanchored Expectations

*Ulf Söderström, David Vestin and Andreas Westermarck*

We analyze a situation where private expectations deviate from the forecasts made by the central bank, and study the consequences for central bank "nowcasts" and forecasts, and for monetary policy in general. In particular, we are interested in the following issues: (i) How do different perceptions of private agents' expectation formation process affect the central bank's estimates of the current state (its "nowcast")? What errors can the central bank make in its nowcasting by misspecifying the expectation formation of private agents? (ii) How do private expectations and central bank forecasts respond to shocks? How do differences in expectations evolve over time? How should a forecast take into account the expectation formation process of private agents? (iii) What can a central bank do to better anchor private expectations? What policy is robust to different models of expectation formation? Does it help if the central bank publishes its forecasts (even if these are imperfect)?

(continuing since previous year)

## Do Central Banks React to House Prices?

*Daria Finocchiaro and Virginia Queijo von Heideken*

The substantial fluctuations in house prices recently experienced by many industrialized economies have stimulated a vivid debate on the possible implications for monetary policy. In this paper, we investigate whether the U.S. Fed, the Bank of England and the Bank of Japan have reacted to house prices. We study the responses of these central banks by estimating a structural model for each country where credit-constrained agents borrow against real estate. The main result is that house price movements did play a separate role in the U.S., U.K. and Japanese central bank reaction functions.

(continuing since previous year)

## Household Indebtedness and the Macroeconomy

*Daria Finocchiaro, Martin Flodén and Virginia Queijo von Heideken*

The aim of this paper is to identify and quantify the different mechanisms that could explain the observed increase in households' debt in the last 20 years in many industrialized economies. Some of the potential factors cited in the literature determining households' indebtedness are changes in credit markets, the "Great Moderation" and increasing earnings inequality. We develop a model with housing markets and volatile asset prices where we can quantify the contributions of these factors.

(continuing since previous year)

## Housing Demand in an Overlapping Generation Model

*Peter Englund, Thomas Jansson and Todd Sinai*

In this project we use a detailed panel data set of Swedish households to investigate the impact of bequests on households' saving and investment decisions. By estimating correlations between the housing costs of parents and grown-up children we get household-specific estimates of the effective house price risk and investment horizon, which we in the second step use to estimate parents' and grown-up children's optimal investments in owner-occupied housing.

(continuing since previous year)

## Owner-Occupied Housing and the Composition of the Financial Portfolio

*Thomas Jansson*

In this project I use a detailed panel data set of Swedish households to investigate the impact of real estate holdings on the composition of the financial portfolio. Since local macroeconomic shocks hit households and firms within a certain geographical area in a similar way, home prices are more correlated to the returns of local stocks than to the returns of global stocks. My empirical findings indicate that homeowners who are highly exposed to the local housing market reduce their exposure to directly-held local stocks and increase their exposure to globally diversified equity mutual funds. The results are statistically and economically significant.

(continuing since previous year)

## Housing Collateral and the Monetary Transmission Mechanism

*Karl Walentin*

This paper quantifies the implications for the monetary transmission mechanism of the increase in the housing loan-to-value (LTV) ratio that has taken place in the last two decades. We set up a two sector DSGE model with collateral constraints and production of goods and housing. Using Bayesian methods we quantify the component of the monetary transmission mechanism that is generated by housing collateral. We find that this component is strongly increasing in the LTV. We conclude that to properly understand the monetary transmission mechanism we need to take into account the effects of housing related collateral constraints and their changing nature over time.

(continuing since previous year)

## Labor Market Distortions and Optimal Inflation

Mikael Carlsson and Andreas Westermark

Most central banks today target an inflation rate of two percent, whereas the current monetary models prescribe an (Ramsey) optimal steady state inflation rate that is slightly negative. This reflects a trade off between, on the one hand, a motive for pushing the opportunity cost of holding money towards zero by setting nominal interest rates to zero (the Friedman rule) and, on the other hand, the desire of price stability in the presence of nominal rigidities. In this project we study how far adding labor-market search frictions and staggered wage bargaining can take us in understanding the inflation target choice of most central banks.

(continuing since previous year)

## The Optimal Inflation Target under Downward Nominal Wage Rigidity

Mikael Carlsson and Andreas Westermark

The starting point for this project is the empirical observation that nominal wages almost never falls. To study the effect of downward nominal wage rigidity on the optimal (Ramsey) steady state inflation rate and the dynamics around steady state, we develop a general equilibrium model where this rigidity is a rational outcome, stemming from the fact that the wage bargaining parties face asymmetric conflict-costs in the bargaining problem in the spirit of Holden (see Holden, 1994, *European Economic Review* and Carlsson and Westermark, 2008, *B.E. Journal of Macroeconomics, Advances*).

(continuing since previous year)

## Wage Adjustments and Productivity Shocks

Mikael Carlsson, Julian Messina and Oskar Nordström-Skans

Differences in wages paid between firms are a large and growing part of the overall wage dispersion in many countries (Lazear and Shaw, 2009, University of Chicago Press). From the extensive literature building on Abowd, Kramarz, and Margolis (1999, *Econometrica*), it is by now an established fact that some firms pay higher wages than others, even to identical workers. In parallel, a large literature has established an empirical association between wages and firm level profits. Yet, surprisingly little is known regarding the deep determinants of these persistent differences. In this project, we aim to study how individual wage growth is affected by firm/sector specific TFP driven variation in labor productivity using matched employer-employee data.

(continuing since previous year)

## Firms, Shocks and Wages

Mikael Carlsson, Julian Messina and Oskar Nordström-Skans

In this project, we aim to extend the analysis in the project discussed above (Wage Adjustment and Productivity Shocks) by identifying and studying the effects of a richer set of structural firm-level disturbances by applying structural VAR methods to the matched employer-employee data.

(continuing since previous year)

## Productivity, Efficiency and Labor Reallocation

Mikael Carlsson and Susanto Basu

Building on the empirical observation that some firms pay higher wages than others, even to identical workers (Abowd, Kramarz, and Margolis, 1999, *Econometrica*, AKM) we study how reallocation of identical workers (constructed using the methods developed by AKM) between firms affect aggregate productivity and output using a matched employer-employee dataset covering the Swedish private sector between 1996 and 2004.

(continuing since previous year)



## Evaluating Microfoundations for Aggregate Price Rigidities: Evidence from Matched Firm-Level Data on Product Prices and Unit Labor Cost

*Mikael Carlsson and Oskar Nordström-Skans*

In this project, we study the empirical relationship between price-setting and unit labor cost (which can be shown to be a measure of marginal cost under standard assumptions) on the firm level using matched employer-employee data. The idea here is to test the empirical relevance for different proposed microfoundations for price-setting used in competing models of the business cycle, as well as, collecting stylized facts useful for model building.

(accepted for publication)

## 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. We then integrate the model into a medium sized DSGE model 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. Finally, we explore the welfare cost of business cycles in our model, i.e. taking into account the heterogeneity implied by imperfect insurance to unemployment risk.

(continuing since previous year)

## Labor Market Institutions, Unemployment and Wage Setting

*Vesna Corbo and Andreas Westermarck*

The project aims at empirically evaluating the effect of different labor market institutions on wage setting behavior and unemployment in a standard DSGE model incorporating firm-specific labor and bargaining between the firm and the workers with staggered wage and price contracts. Moreover, the relationship between labor market institutions and wage setting and unemployment will also be studied using reduced form IV methods that are standard in the literature to investigate whether general equilibrium DSGE models perform better than reduced form methods.

(continuing since previous year)

## Efficient Estimation of Covariance Matrices

*Paolo Giordani, Robert Kohn and Xiuyan Mun*

This paper provides an approach to the regularization of covariance matrices that can be applied to any model for which the likelihood is available in closed form, and is computationally feasible in dimensions (e.g. number of assets) up to a few hundreds. We are aware of no alternative solution to the problem of covariance matrix regularization that is both equally general and practical in medium and large problems. Efficient estimation of covariance matrices is important for portfolio choice, and it is well documented that standard, un-regularized estimates are statistically inefficient, unstable, and often lead to poor portfolio selection. The problem of covariance estimation for financial returns is compounded by the fact that the normality assumption is typically inappropriate. Our approach is ideally suited to more complex models and distributions, and we document very promising performance of our approach in several models of interest to financial econometrics (student; mixtures of normals, mixtures of experts, copulas, etc), for both simulated and real data.

## On Some Properties of Markov Chain Monte Carlo Simulation Methods Based on the Particle Filter

*Paolo Giordani, Michael Pitt, Robert Kohn and Ralph Silva*

Andrieu et al. (2010) prove that Markov chain Monte Carlo (MCMC) samplers still converge to the correct posterior distribution of the model parameters when a simulated likelihood estimated by the particle filter is used instead of the true likelihood. We add the following contributions. First, we provide analytically derived, practical guidelines on the optimal number of particles to use. Second, we build on the first result and show that a partially or fully adapted auxiliary Particle Filter (PF) can drastically decrease computing time compared to a standard PF. Third, we show that adaptive samplers, particularly an adaptive independent Metropolis Hastings (AIMH) sampler, can be very effective in this setting. A proof of the convergence of the AIMH sampler is given. This is important in practice because, due to the non-continuity of the simulated likelihood, it is difficult to apply standard methods of forming proposals. Fourth, we illustrate the methodology with real and simulated examples. The unbiasedness of the simulated likelihood is fundamental to using the PF for MCMC sampling: Our final contribution is to provide a proof of unbiasedness for the auxiliary PF that is more direct and accessible than Del Moral (2004). This methodology promises the possibility of routinely estimating nonlinear and non-Gaussian state space time series models that have until now been difficult or impossible to estimate.

## Improving Multivariate Density Estimators by Marginal Adaptation

*Paolo Giordani, Xiuyan Mun, Minh-Ngoc Tran and Robert Kohn*

This paper is concerned with multivariate density estimation. We discuss deficiencies in two popular multivariate density estimators – mixture and copula estimators, and propose a new class of estimators which combines the advantages of both mixture and copula modeling while being more robust to their weaknesses. Our method adapts any multivariate density estimator using information obtained by separately estimating the marginals. We propose two marginally adapted estimators based on multivariate mixture of normal and mixture of factor analyzers estimators. Simulations and real data examples show that the marginally adapted estimators are capable of improving on their original estimators and compare favourably with other existing models.

## Resuscitating Long-Run Restrictions

*Ferre De Graeve and Andreas Westermarck*

Despite methodological critiques, macroeconomic research often relies on vector autoregressions (VARs) identified with long-run restrictions to uncover empirical regularities. In large part, the critiques argue the method goes awry due to lag truncation. Reduced form models with short lag lengths provide poor approximations to DSGE models. Yet short lag lengths are deemed a necessity as increased parameterization would lead to prohibitively large uncertainty. We show that the trivial solution to the critique, i.e. dramatically increasing lag length, actually works. Truncation is a form of misspecification. In the face of misspecification, increasing lag length may in fact reduce uncertainty. As a result, VARs with lag lengths of, say, ten years can lead to unbiased and precise inference when identified with long-run restrictions. We document this tradeoff between bias reduction, degrees of freedom reduction and its resulting increase in uncertainty, and misspecification.

## Publications Accepted in 2011

Adolfson, Malin, Stefan Lasén, Jesper Lindé and Lars Svensson, "Optimal Monetary Policy in an Operational Medium-Sized DSGE model", *Journal of Money, Credit, and Banking*, Volume 43, Issue 7, October 2011, Pages: 1287–1331.

Betermier, Sebastien, Thomas Jansson, Christine Parlour and Johan Walden, "Hedging Labor Income Risk", forthcoming in the *Journal of Financial Economics*.

Buch, Claudia, Cathérine Koch and Michael Koetter, "Size, productivity, and international banking", forthcoming in the *Journal of International Economics*.

Carlsson Mikael and Oskar Nordström-Skans, "Evaluating Microfoundations for Aggregate Price Rigidities: Evidence from Matched Firm-Level Data on Product Prices and Unit Labor Cost", forthcoming in the *American Economic Review*.

Christiano, Lawrence, Mathias Trabandt and Karl Walentin, "Introducing Financial Frictions and Unemployment into a Small Open Economy Model", *Journal of Economic Dynamics and Control*, Volume 35, Issue 12, Pages 1999–2041.

Finocchiaro Daria, "Inattention, Wealth Inequality and Equilibrium Asset Prices", *Journal of Monetary Economics*, Volume 58, Issue 2, March 2011, Pages 146–155.

Jacobson, Tor, Jesper Lindé and Kasper Roszbach, "Firm Default and Aggregate Fluctuations", forthcoming in the *Journal of the European Economic Association*.

Nott, David, Siew Li Tan, Mattias Villani and Robert Kohn, "Regression Density Estimation with Variational Methods and Stochastic Approximation", forthcoming in the *Journal of Computational and Graphical Statistics*.

Trabandt, Mathias and Harald Uhlig, "The Laffer Curve Revisited", *Journal of Monetary Economics*, Volume 58, Issue 4, May 2011, Pages 305–327.

## Working Papers

No. 256 Giordani, Paolo, Tor Jacobson, Erik von Schedvin and Mattias Villani, "Taking the Twists into Account: Predicting Firm Bankruptcy Risk with Splines of Financial Ratios"

No. 255 Betermier, Sebastien, Thomas Jansson, Christine A. Parlour and Johan Walden, "Hedging Labor Income Risk"

No. 254 De Graeve, Ferre and Karl Walentin, "Stylized (Arte) Facts on Sectoral Inflation"

No. 253 Carlsson, Mikael, Julián Messina and Oskar Nordström Skans, "Wage Adjustment and Productivity Shocks"

No. 252 Blix Grimaldi, Marianna, "Up for count? Central bank words and financial stress"

No. 251 Adolfson, Malin and Jesper Lindé, "Parameter Identification in an Estimated New Keynesian Open Economy Model"

No. 250 Vilmi, Lauri "The Effects of Endogenous Firm Exit on Business Cycle Dynamics and Optimal Fiscal Policy"

No. 249 Bårdsen, Gunnar, Ard den Reijer, Patrik Jonasson and Ragnar Nymoen, "MOSES: Model of Swedish Economic Studies"

No. 248 Lasén, Stefan and Lars E.O. Svensson, "Anticipated Alternative Policy-Rate Paths in Policy Simulations"

## Other Research Activities

### Book and Database Publication

The ongoing project 'Historical Monetary Statistics of Sweden 1668–2008' published a first volume entitled "Historical Monetary and Financial Statistics for Sweden: Exchange Rates, Prices, and Wages, 1277–2008" in April 2010. Since then work on a second volume on historical series on GDP, money supply, interest rates, and house prices has progressed. This second volume is planned to be published in late 2012, or in early 2013.

## Conferences

### **Monetary Policy in an Era of Fiscal Stress**

Sveriges Riksbank and SNS (the Swedish Centre for Business and Policy Studies) organized a research conference and a policy forum on the topic “Monetary Policy in an Era of Fiscal Stress”. The aim was to discuss recent research on the interaction between monetary and fiscal policy in times of fiscal stress and uncertainty.

### **Day-Ahead Conference on Financial Markets Research**

The European System of Central Banks organized a Day-Ahead Conference on Financial Markets Research, hosted and sponsored by Sveriges Riksbank. The main objective of the conference was to create an opportunity for central bank research economists to interact and have a conference outlet for high-quality research that is oriented towards banking, finance and macro-finance topics with a high degree of policy relevance.

### **Beliefs and Business Cycles**

Sveriges Riksbank hosted a workshop on the topic “Beliefs and Business Cycles”. The aim of the workshop was to discuss new research on the importance of information frictions for macroeconomic fluctuations. Specific topics included information and sentiments as sources of aggregate movements and heterogeneity in information, beliefs and expectations.

For detailed information regarding our conferences, see [www.riksbank.com/research/conferences](http://www.riksbank.com/research/conferences)

### **External Computing Cluster**

Monetary policy and financial stability analysis are making increasing use of models and methods that require high-performance computing solutions. The research division and the IT department performed a public procurement process, won by the Gothenburg-based firm GridCore, to host an external computing cluster dedicated to the Riksbank. The cluster currently has 72 cores for parallel computing in Linux with Matlab, C/C++, Fortran and Dynare. The manager of the cluster is Roberto Billi.

### **Greater Stockholm Macro Group**

On the initiative of Per Krusell (IIES, Stockholm University) we started a monthly internal seminar series for macro researchers from all major institutions in Stockholm and Uppsala. The purpose is to strengthen the macro research field by encouraging exchange of ideas and cooperation.

### **Internship Program**

As usual, the research division hosted four PhD interns in 2011. For the first time we scheduled the interns work during the fall instead of during the summer to maximize interaction with the researchers. This year's interns were Yigitcan Karabulut (Goethe University Frankfurt), John Owsley (Cornell University), Ettore Panetti (IIES at Stockholm University), and Tim Willems (University of Amsterdam).

### **Reading Group on Financial Stability**

Since spring 2011 the Research Division and the Financial Stability Department are jointly organizing a financial stability reading group. The purpose of this reading group is to read and discuss research frontier papers in finance and financial stability with a direct relevance for policy. For questions regarding the reading group please contact Kasper Roszbach or Martin W. Johansson.

### **Research Seminars**

The Research Division organizes weekly research seminars, mainly by invited international visitors. The seminars normally take place on Tuesdays at 1 pm and attendance is open to Riksbank employees as well as to all academics. See [www.riksbank.com/research/seminars](http://www.riksbank.com/research/seminars) for listings of upcoming and historical seminars.



## Sabbaticals

During March and April 2011 Mikael Carlsson visited the department of economics at Boston College. He spend his time there mainly working on the project "Productivity, Efficiency and Labor Reallocation" together with Susanto Basu.

Tor Jacobson spent the academic year 2010-2011 at the Einaudi Institute for Economics and Finance in Rome, working on empirical research projects in firm default modelling and banking.

Virginia Queijo von Heideken is visiting the Federal Reserve Bank of Boston from November 2011 until February 2012. During her visit at the Fed she is working on theoretical and empirical research projects regarding long-term interest rates and the macroeconomy.

## Teaching

Andreas Westermark taught a part of a graduate first-year course in macroeconomics. The material covered macroeconomic fluctuations, wage and price adjustment and monetary policy. Kasper Roszbach gave guest lectures in finance at the Stockholm School of Economics and the University of Groningen.

## Upcoming Events in 2012

### Conference on Sovereign Debt and Default

The research division intends to host a conference preliminary entitled "Sovereign Debt and Default" in the fall of 2012.

### Course on Monetary Economics

In the spring of 2012, a second year PhD course on monetary economics will be given at the bank. The course is taught by faculty from Stockholm and Uppsala University, as well as by Lars E.O. Svensson, deputy governor at 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 they 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.

### *Correspondence to the editor:*

Karl Walentin  
Research Division  
Sveriges Riksbank  
103 37 Stockholm, Sweden  
Phone +46 8 787 04 91  
Email: karl.walentin@riksbank.se

This newsletter, as well as other online information about the research division at Sveriges Riksbank, is available at [www.riksbank.com/research](http://www.riksbank.com/research)