

# CQER Letters

Number 1, 2009

Federal Reserve Bank of Atlanta

## Director's Note

by Tao Zha

This issue of *CQER Letters* reports on the conference “Quantitative Approaches to Monetary Policy in Open Economies,” held May 15–16, 2009, and sponsored by the Atlanta Fed’s Center for Quantitative Economic Research (CQER) and the Americas Center®. The goal of this conference was to convene studies that cover three important areas. The first is the estimation of useful models for open economies. In many countries the data are not as stationary as U.S. data, and studies on how to proceed under these circumstances are particularly useful. The second area is a quantitative version of flexible inflation targeting, implemented by Riksbank and Norges Bank. The third area is the integration of financial frictions into dynamic stochastic general equilibrium (DSGE) models and an analysis of how those frictions can help with forecasting and with other policy questions.

Guests from universities and central banks around the world—including Norway, Japan, New Zealand, Uruguay, Colombia, Chile, Argentina, and Peru—engaged for two fruitful days in intense discussion and probing scholarship. Papers presented covered topics such as monetary policy communication strategies, incorporating financial frictions into preexisting models, examining the “sudden stop” phenomenon, and tailored DSGE models of central banks. In lively discussion and debate, presenters were engaged with their peers’ criticisms, and participants refined future research agendas. We were also honored to have Guillermo Calvo of Columbia University giving a dinner speech.

On the first day of the conference, Lars Svensson discussed optimal monetary policy in the context of the main DSGE model used at the Riksbank for forecasting and policy analysis. Svensson explored whether past Riksbank policy is best described as following an instrument rule or optimal



Guillermo Calvo (left) of Columbia University, the conference keynote speaker, chats with Steve Kay, coordinator of the Atlanta Fed’s Americas Center, which cosponsored the conference.

policy under commitment and how the model’s projections can be useful for real-time policy decisions. The second speaker, Carlos Montoro, talked about the development of MEGA-D, the DSGE model used by the Central Reserve Bank of Peru. The model incorporates the main features of the Peruvian economy, “dollarization” in particular. The third speaker, Andrés González Gómez, addressed how to forecast monetary policy’s effect in a DSGE model with imperfect data (namely, unbalanced and uncertain data often found in developing countries). Gómez contended that such a model can indeed be useful if this data set is incorporated.

In the afternoon session, Enrique Mendoza discussed his paper, “Sudden Stops,” which uses a DSGE model with an endogenous collateral constraint to explain the key features of the “sudden stop” experience. Ippei Fujiwara then

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Roundtable discussant Gerardo Licandro with moderator Mike Bryan



Roundtable discussants John McDermott and Lars Svensson

spoke about the impact of international financial frictions on central banks' goal to achieve financial stability. Then Guillermo Escudé, exploring the calibration/estimation of ARGEMmy, a DSGE model for Argentina, showed that a "managed" exchange rate rule was preferable to either a fixed exchange rate rule or a flexible exchange rate rule. Finally, Larry Christiano examined financial and labor market frictions in a small open economy model. His paper addressed questions such as what drives the variation in the intensive and extensive margin of labor supply and what the spillover effects of financial market disturbances to unemployment are in a small open economy.

On the second day, Chris Sims began by sharing his thoughts on the expansion of the Federal Reserve's balance sheet, the impact of paying interests on reserves, and the effect of rising bank reserves on the economy. Next, Amund Holmsen used Norges Bank's experience to discuss how to best communicate monetary policy and what the optimal degree of transparency is for such communication. The conference concluded with a roundtable discussion between Gerardo Licandro, John McDermott, and Lars Svensson about the practice of monetary policy in the current financial crisis.

## CQER Letters

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Many thanks to Andrew Flowers and Quan Wen for providing excellent summaries of the conference presentations and Elaine Clokey and Valerie Crosby for their invaluable help in organizing the conference reported on in this issue.

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## Coming Events

The CQER conference "New Approaches to Fiscal Policy" will be held January 8–9, 2010, at the Federal Reserve Bank of Atlanta.

A conference on dynamic stochastic general equilibrium modeling, sponsored by the CQER and the National Bureau of Economic Research, will be held October 8–9, 2010. For updated information as the conference approaches, visit [frbatlanta.org/cqer/eventscq/](http://frbatlanta.org/cqer/eventscq/).

## Meet the CQER Advisers

Four distinguished economists currently serve as advisers to the CQER.



**Lawrence J. Christiano** is the Alfred W. Chase Chair in Business Institutions at Northwestern University, where he joined the faculty in 1992. From 1985 to 1992 he was first an economist, then a research officer, and finally the director of the Institute for Empirical Macroeconomics at the Federal Reserve Bank of Minneapolis. Prior to

joining the Minneapolis Fed, he was a visiting assistant professor at Carnegie-Mellon University and an assistant professor at the University of Chicago.

Christiano is currently a visiting scholar at the Federal Reserve Bank of Cleveland and an adviser at the Federal Reserve Bank of Atlanta. He is a research associate with the National Bureau of Economic Research and a fellow of the Econometric Society. He has been a visiting scholar at the International Monetary Fund and the European Central Bank and has served as a consultant at the Federal Reserve Board and the Federal Reserve Bank of Chicago. In addition, he has taught short courses on monetary economics at numerous universities in Europe and the Middle East.

The author of many articles and papers, Christiano is an associate editor of the *Journal of Money, Credit, and Banking* and a former associate editor of eight other academic journals, including the *International Economic Review* and the *American Economic Review*.

Christiano earned a BA in history and economics and an MA in economics from the University of Minnesota, an MSc in econometrics and mathematical economics from the London School of Economics, and a PhD in economics from Columbia University.

**Martin Eichenbaum** is the Ethel and John Lindgren Professor of Economics and the codirector of the Center for International Economics and Development at Northwest-



ern University. He joined the Northwestern faculty in 1988. In addition, he has taught at Carnegie Mellon University and has been a visiting professor at the Chicago Booth and the Wharton School of Business.

His research focuses on business cycles and international economics. His most recent work has examined the effects of changes in monetary and fiscal policy on aggregate economic fluctuations.

Eichenbaum is an associate editor of the *American Economic Journal: Macroeconomics* and the *Journal of Monetary Economics*. He is also a consultant for the Federal Reserve Banks of Atlanta and Chicago and a research associate of the National Bureau of Economic Research. He has also served as a consultant for the International Monetary Fund and the World Bank.

He earned his bachelor's degree from McGill University and his PhD in economics from the University of Minnesota.



**Thomas J. Sargent** is the William R. Berkley Professor of Economics and Business at New York University's Stern School of Business. Before he joined NYU in 2002, he was the Donald Lucas Professor of Economics at Stanford University and a senior fellow at Stanford's Hoover Institution.

Previously, he was a professor of economics at the University of Minnesota from 1975 to 1987 and a first lieutenant and captain in the U.S. Army from 1968 to 1969.

Sargent is an adviser to the Federal Reserve Bank of Minneapolis and a research associate for the National Bureau of Economic Research. He has been a member of the Brookings Panel on Economic Activity and was a Ford Foundation visiting research professor of economics at the University of Chicago. He was awarded the Mary Elizabeth Morgan Prize for Excellence in Economics by the University of Chicago in 1979 and the Erwin Nemmers Prize for Economics by Northwestern University in 1996.

In 1983 Sargent was elected a fellow of the National Academy of Sciences and a fellow of the American Academy of Arts and Sciences. He is a former president of the Econometric Society, a former president of the American Economic Association, and a past president of the Society for Economic Dynamics.

A recognized leader in the field of macroeconomics, Sargent is the author of numerous articles and several books, including *Recursive Macroeconomic Theory* (with Lars Ljungqvist); *The Big Problem of Small Change* (with Francois Velde); *The Conquest of American Inflation*; *Dynamic Macroeconomic Theory*; and *Rational Expectations and Econometric Practice* (with Robert E. Lucas Jr.). Sargent earned his BA at the University of California at Berkeley and his PhD from Harvard University.

**Christopher A. Sims** is the Harold H. Helm '20 Professor of Economics and Banking at Princeton University. He joined the Princeton faculty in 1999 and served as the director of graduate studies in economics from 2003 to 2008. Previously he was the Henry Ford II Professor of Economics at Yale University, an associate professor and then professor at the University of Minnesota, and an



instructor and assistant professor at Harvard University. Sims was the chair from 2003 to 2009 of the economic sciences section of the National Academy of Sciences, of which he has been a member since 1989, and is a former president of the Econometric Society. He is currently a visiting scholar at the New York and Atlanta Feds. He

has served as a visiting scholar or consultant at several Federal Reserve Banks and other organizations.

A pioneer of vector autoregression (VAR) methods in econometrics, Sims has published numerous important papers on econometrics and macroeconomic theory and policy. He is a former coeditor of *Econometrica* and has served as an associate editor or editorial board member of several academic journals.

Sims earned a BA in mathematics, magna cum laude, from Harvard College and a PhD in economics from Harvard University.

## A Conversation with James Hamilton



A visiting scholar in the Center for Quantitative Economic Research in 2009, **James D. Hamilton** is a professor of economics at the University of California, San Diego. He is the author of *Time Series Analysis*, the world's leading text on forecasting and statistical analysis of dynamic economic relationships.

Hamilton developed the GDP-based recession indicator index, a tool to determine when recessions begin. He is also an authority on oil's place in the world economy.

In an interview with Charles Davidson, a staff writer in the Atlanta Fed's public affairs department, Hamilton shares his thoughts on the recession and the world oil supply.

**Davidson:** *Why is it important to know when recessions start?*

**Hamilton:** Something very different happens during a recession. Instead of getting more people working and producing more, everything seems to go into reverse. It's important for all of us to recognize when that's happening. It's important for people in private business making their plans; it's important for policymakers figuring out what to do about it. The kinds of policies that promote long-run growth—for example, encouraging additional savings—are not at all effective when we're talking about a recession and demand coming down. And just in terms of understanding what's going on in the economy, it's very nice to have this designation. And it's also nice to have an ability to quantify it, to be able to say that's not just somebody's opinion.

**Davidson:** *If the economy is bad, people tend to know it, right? So why is it important that we label it a recession?*

**Hamilton:** I think there's something real that happens. There's a critical mass of businesses falling down at the same time. The place you might have gone to get another job is facing problems simultaneously with everybody else. My view is that that introduces a different dynamic to the

economy, that it's not just a word we use; it's something pretty striking in the data. That's why I think it's interesting from a statistical perspective to say, if you're someone who doesn't believe in recessions and you looked at these data, would you see them?

**Davidson:** *Should the layman care about this distinction, in particular the question of whether we are technically in recession?*

**Hamilton:** If you don't have a job, you may not care what kind of label someone puts on it, except in some situations it's going to be tougher to find a new job than in others. I think it's important if you want to understand what's going on and have a picture of it. I believe in education; I believe in understanding the world.

**Davidson:** *The economy dominates the news and day-to-day conversation in 2009. Does that mean more people are interested?*

**Hamilton:** Oh, yes. There's a big increase in our applications for graduate study in economics, partly because the jobs in finance have gone away. But also, of course, there's a lot of interest. We have to be careful. There's a lot we got wrong as economists in this episode. And I see a fair bit of anger at economists and at anybody they can blame, and that's understandable. It's interesting from an intellectual perspective to try to sort it out. It's a lot more critical to get it right.

**Davidson:** *Is it too soon to look at some of the mistakes and learn from them?*

**Hamilton:** It's not too soon at all. I think to get going again we've got to fix some of these problems. My view—of course these are not the views of the Federal Reserve—is that the capital markets were seriously malfunctioning, with huge sums of money pouring into investments that economically didn't make sense, and taking risks that really weren't warranted as a result of miscalculations, and as a result of assuming somebody else was going to bail them out if things went bad. Those were profound problems, which as I say a lot of us were guilty of underestimating as they developed. But we darn well better see that straight, and the sooner the better. That's exactly what economists are doing and need to be doing—to really ask what went wrong, how can we fix it, and how can we prevent it next time. That's the number one job for us.

**Davidson:** *Turning to oil, can you foresee a day when oil will not be as fundamental to the economy as it is today?*

**Hamilton:** I'm afraid we don't have a choice about that. World oil supplies are ultimately limited, and there's such

a booming demand from elsewhere in the world—China's now buying more cars than the United States, and there are a whole lot of Chinese who don't have a car. And no matter what kind of discoveries (of oil) there are in the next few years, the ability of the world to fuel that growth for ten or twenty or thirty years just isn't there, in my opinion.

So we need some kind of alternative. The big question is, What does that look like? I like to think in terms of practical, near-term solutions. It looks to me like, at the moment, we have natural gas in abundance. You can actually drive vehicles on natural gas. That is a resource people don't get as excited about as wind or solar, but it's here and now. We've got it in our country; it's cleaner than oil. I always like a bird in the hand, and that one's in our hand. To me, nuclear energy is another technology [worth considering].

**Davidson:** *Is the notion of energy independence realistic for the United States?*

**Hamilton:** It's not realistic because our production of oil has been continually going down and our consumption has been continually going up. So the realistic thing you can do is try to reverse the trend a little. Even that's a hard job; even that takes a big commitment. I want to think in terms of incrementalism. Let's steer this ship the direction we want to be going. A journey of a thousand miles begins with one step. Let's take that step.

**Davidson:** *Does changing behavior depend mostly on hard economics?*

**Hamilton:** No question that's a big driver. But some of the other things we're talking about, like infrastructure, that's not up to any one person to change. And that's the kind of issue where it does make sense to have some government spending and some thinking ahead about what we want to be encouraging here, and if we created a market for this that could be a catalyst to get something going.

**Davidson:** *The traditional school of thought is that if we use less oil, that means the economy is not growing as much. Will that change?*

**Hamilton:** The U.S. consumes twenty million barrels a day. I guess what I would like, though, is when we use those resources we've set aside, such as the Arctic National Wildlife Refuge, I'd like to see us go to that resource at a point where we all recognize that this is part of a transition we're making to something else. If we went into these other resources with that mindset, I think that might leave us in better shape for making that transition. I think we were kind of fooling ourselves for a while that we didn't have to change; the popularity of these vehicles that really were not very efficient [is an example of that].

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See the full text of the papers and the conference agenda online at [frbatlanta.org/cqer/eventscq/](http://frbatlanta.org/cqer/eventscq/).

## **Optimal Monetary Policy in an Operational Medium-Sized DSGE Model**

*Malin Adolfson, Stefan Laséen, Jesper Lindé, and Lars Svensson*

The paper shows how to construct optimal policy projections in a linear-quadratic open-economy DSGE model—the primary model used at Riksbank for forecasting and policy analysis. Optimal monetary policy minimizes an intertemporal loss function under commitment. This study chooses a quadratic loss function that corresponds to flexible inflation targeting and is the weighted sum of three terms: the squared inflation gap between four-quarter CPI inflation and the inflation target, the squared output gap between output and potential output, and the squared quarterly change in the Riksbank’s instrument rate, the repo rate. To make an assessment of the extent to which the formulation of output gap in the loss function affects the optimal policy projections, the paper also examines three alternative definitions of potential output, which lead to three definitions of output gap—trend, unconditional, and conditional.

The paper estimates the model parameters with Bayesian techniques under two different assumptions about the conduct of monetary policy: the instrument rule and loss minimization rule. The authors find that the parameters of the model are invariant to the alternative formulations about the conduct of monetary policy; hence, the Ramses model can be treated as a structural model. An interesting empirical question is whether the Riksbank’s past policy is better explained as following a simple instrument rule or the optimal policy under commitment. The paper finds that the answer depends on whether the simple instrument rule has a white-noise policy shock. Without a shock, optimal policy fits better; with a shock, the simple instrument rule fits better. Since optimal policy under commitment in a timeless perspective also raises the question of what initial set of Lagrange multipliers to use to represent the commitment in the first period of optimization, the paper illustrates the difference in projections when these multipliers are either zero (corresponding to no commitment in the first period of optimization) or computed under the assumption that past policy was optimal. The authors find that optimal policy projections are little affected by whether the initial Lagrange multipliers are nonzero or zero. The paper also concludes that optimal policy projections in the Ramses model and similar DSGE models can now be applied in a real-time policy process and provide policymakers with useful advice for their decisions.

During the seminar, participants discussed how optimal policy under commitment is statistically preferred. Discus- sant Lee Ohanian noted that when changes in output are

decomposed into changes in productivity, capital, and labor, the data show that Sweden has two very different economies: one from 1980 to 1993 (with stable and slow growth and close to a steady state growth path) and another from 1994 to 2007 (when productivity growth almost tripled). He suggested that, henceforth, the model incorporate the shift between the two economies. He asked what the source of low productivity before the crisis was and why productivity was higher after the crisis. Is this phenomenon the result of higher trade, increased competition, or government policies? How long will it persist? These issues are central for welfare, policy, and modeling. One participant expressed some reservation regarding the objective function and asked why the preference of households is not used as the objective function. Svensson responded that a quadratic loss function is consistent with the Riksbank’s mandate.

## **Monetary Policy Forecasting in a DSGE Model with Data That Is Uncertain, Unbalanced, and about the Future**

*Andrés González Gómez, Lavan Mahadeva, Diego Rodríguez G., and Luis Eduardo Rojas*

Real-world data, when used in modeling, are always awkward for two main reasons: They are unbalanced, and they are subject to time-varying measurement uncertainty. Thus, the data that are informative for making monetary policy decisions come in many shapes and sizes and are uncertain. From a policymaker’s perspective, a policy forecast should relate to all the data that feature in the public debate, even if they come in an awkward variety of shapes and forms. This paper proposes one possible way of putting that awkward but still useful data set to work in forecasting from a linear forward-looking DSGE model that is distinguished by a larger theoretical input. The authors contend that a model can provide both decent predictions and useful explanations only if it takes into account the real-world data set.

Through the method described in this paper, a forecast can bring this rich but awkward information to bear in forming a policy forecast with a forward-looking DSGE model. The basic idea is to first solve the model for rational expectations under the assumption that the data up until the end of the forecast horizon are perfectly known. Then, in a second stage, the data uncertainty problem is wrapped around these solutions, which are the state equations of a Kalman filter.

This method has advantages over alternative strategies. First, it allows for measurement error of future data. Second, the model does not need to be rewritten each

time the shape of a data series changes. One only has to fill in the parts of the data set where data are available and put blanks in where they are not. Third, the measurement equations can be adapted to push the forecast toward where there is interesting information without having to extend the economic part of the model. Fourth, this approach derives decompositions of forecasts according to the contributions of the data and not just to the typical contributions of an economic shock.

Besides the data contributions, there remain some important aspects of the policy forecasting problem that have not been taken into account. First, there is evidence that a large part of the forecast error associated with DSGE models is drift in economic relations, which are assumed to be fixed in the steady state of these models. Second, the paper does not discuss how the parameters of the economic model are estimated or calibrated.

Asked whether the model should include different trends in data, Gomez referenced earlier literature, which showed that stochastic trends can be added to the transition equation. A participant suggested that the paper incorporate stochastic trends into the canonical form for linear rational expectation models because the current government spending depends both on shocks now and shocks in previous periods. Another participant suggested extending the vector of shocks known to agents. A seminar participant observed that there are no anticipated policy deviations in the estimated model and questioned the credibility of the regime change. Gomez acknowledged that model expectations can be helpful in model comparison: that is, expectations help discriminate across models and signal extraction because agents in the economy have more information than the econometrician—information that can be exploited for forecasting.

### **Development of MEGA-D: A DSGE Model for Policy Analysis**

*David Florian and Carlos Montoro*

In recent decades, academic research has emphasized the development of dynamic stochastic general equilibrium (DSGE) models, whose key feature is the use of microeconomic foundations for modeling the behavior of the aggregate economy. This type of model offers several advantages. First, microfoundations prevent equations arising from these models from erring, as shown by Lucas's critique (1976). Second, the individual rationality behind the aggregate behavior is useful to analyze the impact of monetary policy on private agents' expectations. Third, the general equilibrium structure maintains in the model the

consistency between flow and stock variables, such as investment with respect to capital and the current account balance with respect to net foreign assets. Last but not least, recent empirical evidence shows that DSGE models can have a better forecasting performance than purely



Carlos Montoro

statistical models. Because of the advantages previously mentioned, DSGE models are gradually being incorporated as tools for policy analysis at central banks.

Florian and Montoro introduce the development of a DSGE model (MEGA-D) for policy analysis at the Central Reserve Bank of Peru (BCRP). The MEGA-D denotes an aggregate general equilibrium model with dollarization and has been designed to include the main features of the Peruvian economy, including partial dollarization, in a medium-scale model that can be easily extended to explain different stylized facts or economic episodes and has several features to replicate the main stylized facts of the Peruvian economy. The model allows firms to pay a risk premium when borrowing on top of the interest rate set by the central bank, a typical feature of little-developed financial markets such as Peru. The model allows real wages to deviate from their competitive equilibrium, taking into account the presence of unemployment and the low response of real wages to fluctuations in aggregate demand, as observed in the Peruvian economy. The model also allows for flows of goods, services, and financial assets between domestic and foreign agents, typical of open economies. It also assumes that the internal conditions of the Peruvian economy have no effect on the global economy, consistent with the relative size of the Peruvian economy to the rest of the world.

The first main finding is that dollarization reduces monetary policy's power to affect output and increases the economy's vulnerability to shocks from the external interest rate. Second, the estimation of model parameters by Bayesian econometrics shows that financial dollarization is important in explaining Peruvian data. Third, compared

with developed economies, prices in Peru's economy are more flexible and the volatility of shocks is greater.

During the seminar, participants discussed the differences between Peru's economy and developed economies. A participant commented that because of distortions in the labor market, interactions between the informal sector and formal labor market become relevant. Another participant mentioned the role of dollarization in price-setting. A participant expressed some reservation regarding the elements absent in most New Keynesian-DSGE models but useful in describing the Peruvian economy. Montoro responded that flexible movements between the formal and the informal labor market are definitely a problem because they are not substitute markets.

### **Sudden Stops, Financial Crises, and Leverage: A Fisherian Deflation of Tobin's Q**

*Enrique G. Mendoza*

The Great Depression and the recessions that hit emerging economies in the aftermath of the financial crises in the late 1990s showed that market economies can experience deep recessions that differ markedly from typical business cycle downturns, the phenomenon now commonly referred to as a "sudden stop." Sudden stops in the model presented by this paper are preceded by periods of economic expansion and external deficits, followed by large recessions and reversals in the external accounts when a sudden stop hits, and then followed by a gradual and long recovery. A large class of DSGE small open economy (SOE) models, including frictionless real business cycle models and models with nominal rigidities, fail to explain sudden stops. This failure stems from these models' typical assumption that perfect world credit markets act as an efficient vehicle for consumption smoothing and investment financing. In contrast, the literature on sudden stops emphasizes the role of credit frictions. Mendoza proposes a DSGE model with an endogenous collateral constraint aiming to support a stochastic steady state in which infrequent sudden stops are nested together with normal business cycles. The quantitative predictions of this model are consistent with key features of the emerging markets' experience of sudden stops.

The model introduces an endogenous collateral constraint with a debt-deflation mechanism into a DSGE-SOE model driven by three standard exogenous shocks, affecting total factor productivity (TFP), the foreign interest rate, and the price of imported intermediate goods. This constraint imposes an upper bound on the economy's leverage ratio by limiting total debt, including working capital loans, not to exceed a fraction of the

market value of collateral assets, but only in states when the leverage ratio is sufficiently high; in turn, these high-leverage states are an endogenous outcome of the model's business cycle dynamics.

Previous theories on sudden stops also hinge entirely on unexplained "large and unexpected" shocks; in contrast, this paper shows that a debt-deflation-style collateral constraint can provide an explanation for endogenous sudden stops that do not require large, unexpected shocks. This paper finds that sudden stops are driven by two "credit channels" that induce amplification, asymmetry, and persistence in the effects of exogenous shocks. The first is an endogenous financing premium that affects one-period debt, working capital loans, and the return on equity because the effective cost of borrowing rises when the collateral constraint binds. The second is the debt-deflation mechanism: When the collateral constraint binds, agents liquidate capital in order to meet margin calls. This fire sale of assets reduces the price of capital and further tightens the constraint, setting off a spiraling collapse of asset



Enrique Mendoza

prices. However, because of precautionary saving, sudden stops are infrequent events nested within normal business cycles in the long run.

During the seminar, one participant asked for clarification about what drives sudden stops. Mendoza explained that sudden stops are driven through two credit channels: the endogenous financing premium and the debt-deflation mechanism. The discussant, Martin Eichenbaum, questioned why the model depends on exogenous drops in TFP to generate sudden stops and their aftermath. He added that, for emerging market economies, the data required to get decent estimates of TFP are not available and pointed out that matching this kind of model to the capital-price data (that is, the data on Tobin's Q) is a challenging task. Another participant expressed his concern with the use of collateral constraints in international markets. The participant argued that these constraints do not apply to

sovereign debt since one cannot seize the collateral. The constraints can apply only to private sector loans.

## Financial Stability in Open Economies

*Ippei Fujiwara and Yuki Teranishi*

Does international financial stability matter for central banks? How do developments in international financial markets alter the form of optimal monetary policy? Should central banks conduct monetary policy cooperatively when financial markets are internationally integrated? To answer these questions, Fujiwara and Teranishi have constructed a new open economy macroeconomic (NOEM) model that incorporates international loan contracts and use it to analyze the nature of optimal monetary policy when financial markets are internationally integrated.

In this paper, financial markets are characterized by staggered loan contracts, and the financial accelerator is incorporated in a DSGE model where net worth (the state variable) causes the deviations of loan rates from the policy interest rate. The staggered loan contract model can be considered a simplification of another type of financial market friction. Hence, the paper aims to capture the dynamics of loan rates by staggered loan contracts instead of through net worth dynamics. This approach has an advantage because optimal monetary policy can be derived in a closed form that delivers intuitive results.

Fujiwara and Teranishi demonstrate that when international financial frictions are incorporated and financial markets are internationally integrated, the main aim of the central bank is to achieve financial stability—which means eliminating the inefficient fluctuations in loan interest rates. Yet, at the same time, the heterogeneity in international financial markets makes optimal monetary policy very complicated, suggesting that central banks face a trade-off unrevealed by previous studies. The authors also show that if the exchange rate risk is partially shared among goods-producing firms, the central bank should aim to stabilize the nominal exchange rate in achieving financial stability because fluctuations in the nominal exchange rate increase firms' average markup and are detrimental to welfare. Future extensions include incorporating sticky prices in open economies, which would enable a quantitative investigation of the policy trade-off between stabilizing distortions in goods and financial markets.

During the seminar, one participant questioned the assumption of sluggishness in loan rates. He observed that bank markups seem to be even more countercyclical in emerging economies, where the bank system is more concentrated. This fact goes against the story of sluggish-

ness on loan rates. Another participant noted that credit is not a differentiated good; hence, nothing prevents firms from pooling resources from different banks. Thus, he suggested exploiting differentiation in credit. Fujiwara answered that this paper uses ad hoc microfoundations. A participant also suggested another direction, which is to examine the role of fiscal policy in addition to monetary policy under internationally integrated financial markets.

## ARGEMmy: An Intermediate DSGE Model Calibrated/Estimated for Argentina

*Guillermo J. Escudé*

The purpose of this paper is to advance the construction and calibration/estimation of an intermediate DSGE model with two policy rules for Argentina and explore to what extent two policy rules can be better than one. The new model includes banks as well as the ability to model a managed exchange rate regime by means of two simultaneous policy rules (which may be feedback rules or not): the usual policy rule for achieving an operational target for the nominal interest rate and an additional policy rule that reflects the central bank's intervention in the foreign exchange market. The model uses a feedback rule on the rate of nominal currency depreciation that includes a long-run target for international reserves (as a ratio to GDP). This setup seems closer to the way central banks that systematically intervene in the foreign exchange market actually interpret their intervention, caring for the level of the exchange rate in the short to medium run and the level of foreign exchange reserves in the longer run.

Argentina experienced two hyperinflation episodes; hence, making concrete assumptions on monetary and exchange rate policy is difficult. Because of the diversity of exchange rate regimes Argentina has had in the last few decades (and the possibility of future changes in the regime), Escudé builds the model so that it can handle



Guillermo Escudé

different regimes. In particular, he includes two policy rules (one for the interest rate and another for the rate of nominal depreciation), which may or may not be feedback rules. When they are both feedback rules, policy responds to deviations of the year-over-year “consumption” inflation rate from a target (that defines the nonstochastic steady state inflation) and deviations of GDP and the trade balance ratio (to GDP) from their nonstochastic steady state values.

The feedback rules reflect a simultaneous concern for inflation, output, and current account stabilization. By using data from the post-convertibility period and Bayesian estimation of a subset of the parameters, Escudé finds that a model with only a simple policy rule for the rate of nominal currency depreciation yields a better fit than one with two simple policy rules. He places the model within a linear-quadratic optimal control framework under commitment and perfect information, introducing an ad hoc quadratic central bank intertemporal loss function. The preliminary result is that two policy rules are usually better than one. Hence, having a model that can reflect two policy rules is not only of greater generality than conventional models but, at least for many central bank styles, is the only way to represent a policy regime that moves the central bank closer to its objectives.

A seminar participant asked for clarification about the intuition behind optimal policy. He pointed out that it is hard to interpret a large set of coefficients in this model. Another participant suggested an impulse response function and variance decompositions using instrument rules to describe interplay between transmission mechanisms and contributions of shocks and policy constraints. The participant also suggested comparing welfare losses from single versus multiple instrument rules. Escudé explained the intuition behind the optimal policy and roles of the shocks.

### **Introducing Financial Frictions and Unemployment into a Small Open Economy Model**

*Lawrence J. Christiano, Mathias Trabandt, and Karl Walentin*

How important are financial and labor market frictions for the business cycle dynamics of a small open economy? What are the quantitative effects of increased financial risk on output and inflation? What drives the variation in the intensive and extensive margin of labor supply? What are the spillover effects of financial market disturbances to unemployment?

To address these questions, this paper extends the small open economy model in previous literatures in two



Mathias Trabandt

important dimensions. First, the paper incorporates financial frictions in the accumulation and management of capital; this feature reflects fundamentally that borrowers and lenders are different and have different information. Second, the paper includes the labor market search and matching framework into the small open economy model. In addition, the paper allows for endogenous separation of employees from their jobs, a step that has been strongly motivated by empirical evidence. This final feature is an important contribution to the literature.

In addition to the main two new features described above, this paper integrates the following other new features: imported goods directly used for export production, unit-root investment, specific technological progress, working capital loans for all monopolists, possible price and wage dispersion in steady state, capital tax timing and allowances, and the specification and estimation of a VAR that represents the foreign economy. These new features prove useful when taking the model to the data. The full model, which contains the financial frictions as well as the labor market frictions, is estimated with Bayesian techniques. Surprisingly, the dynamics of the model with unemployment frictions are remarkably similar to the established labor market modeling, which has no extensive margin of employment. Another finding is that the entrepreneurial wealth shock plays a very large role in





the variance decomposition: It is the main determinant of investment and is very important for GDP and the nominal interest rate.

During the seminar, participants discussed that the paper incorporates two important factors of the macro labor model. First, it includes a representative household with a continuum of ex ante identical workers with no human capital. Second, the labor preference shock is the biggest contribution to wages and unemployment. A participant suggested that the paper incorporate more features—including aging, death, and human capital, which is costly to acquire and then depreciates. Another participant noted consumption sharing is absent. Christiano commented that financial frictions are important as a source of shocks and/or propagation in aggregate small open economy data. Labor market frictions are also important in real business cycles.

## **Fiscal Policy and Monetary Policy Coordination**

*Chris Sims*

Sims talked about the role of the Federal Reserve's balance sheet and its relationship with fiscal policy. In normal times, when interest rates are positive and there is no interest on reserves, an expansion of the Fed's balance sheet results in approximately proportionate expansion of the money stock and commercial bank balance sheets (the standard money multiplier). In a time of crisis like the current financial crisis, when interest on reserves is at or above the rate on T-bills and the perceived return on private sector loans, high-powered money no longer has high power. In effect, the policy rate is now the interest rate on reserve deposits, and commercial banks are not using the fed funds market. On the one hand, a commitment to a path for inflation or the price level makes the Federal Reserve's balance sheet matter. On the other hand,

raising the interest rate on reserves can create a strong contractionary effect without requiring sale of (illiquid) assets to control inflation.

In relation to fiscal policy, Sims argues that if central bank balance sheets go into the red because of extraordinary circumstances, the Treasury may then recapitalize it by creating, and giving to the central bank, new government debt. In his view, therefore, the Federal Reserve has tried to minimize the balance sheet risk it is taking on; the TARP legislation was intended to provide a mechanism for taking on risk that would free the Fed from exposing itself to that risk.

Finally, Sims addressed what he considers are fallacies of understanding the interaction of monetary and fiscal policies: (1) the Federal Reserve needs to be allowed to issue debt on its own account; (2) the Fed could have trouble unwinding its balance sheet as fast as necessary to control inflation; (3) the vast expansion of reserves in itself poses an inflationary threat; (4) fiscal stimulus can get the economy out of a recession, and then a resolute Federal Reserve can prevent inflationary consequences; and (5) the administration should set targets now for when it will have the budget back in surplus.

During the discussion, participants agreed that the vast expansion of reserves does not pose an inflationary threat because most of the increased high-powered money is being held as excess reserves. The discussant, Tim Cogley, pointed out that a large proportion of the increase in high-powered money is in the form of short-term loans, many of which will run off on their own as the crisis subsides. He argued that since the adjustment of interest on reserves and the manipulation of Treasury balances have become key parts of the Fed's new operating procedures, caution needs to be taken. One participant commented that by changing interest on reserves, the Federal Reserve effectively uses lump-sum tax policy, not open market operations. Sims responded that once inflation occurs, it is hoped that the Fed does not change the

interest on deposits to match the interest earned on Treasury bills, as this would result in indeterminacy (addressed by Sargent and Wallace).

## **Communicating Monetary Policy Intentions: The Case of Norges Bank**

*Amund Holmsen*

Monetary policy works mainly through private agents' expectations. How precisely future policy intentions are communicated has, according to theory, implications for the outcome of monetary policy. This paper introduces the practices of Norges Bank, the central bank of Norway, in communicating its policy intentions to the public. The paper describes Norges Bank's communication approach and analyzes the effects of increased transparency on market interest rates.

The majority of central banks communicate indirectly through forecasts based on technical interest rate assumptions and by giving verbal signals about future interest rate decisions in policy statements and speeches. With such indirect communication, market participants gain information about the direction of future interest rate decisions but may have less information about the magnitude. At one point, Norges Bank used technical interest rate assumptions in its monetary policy reports. Since then, the bank has used endogenous interest rate forecasts, becoming the second central bank that publishes interest rate forecasts, following the Reserve Bank



Amund Holmsen

of New Zealand, which introduced the practice in 1997. Specifically, the bank uses optimal policy in a timeless perspective as the normative benchmark when assessing policy intentions. Given the reaction pattern based on the timeless perspective, the bank identifies and explains the factors that bring about a change in the interest rate forecast from one monetary policy report to the next.

This paper also discusses the disagreement among both academics and central bankers on whether such a high degree of transparency is beneficial or not. The key issue in the debate is whether such communication implies guidance or noise. Some of the arguments for transparency relate to the beneficial effects when private agents understand the central bank reaction function, such that market interest rates adjust appropriately to economic news. Publishing the interest rate forecast may not be sufficient for communicating the central bank's reaction function as one specific forecast does not in itself convey much information about how the central bank responds to various shocks. The main finding of this paper is that even if several arguments against publishing the interest rate forecast have been raised in the academic literature, Norges Bank's experiences are so far reasonably good. The market seems to understand that the interest rate path is conditional on economic developments, and monetary policy appears to have become more predictable after the bank started to publish interest rate forecasts.

Seminar participants discussed that not so long ago central banks were very secretive, but now they worry about communications strategy. Participants also talked about the benefits and costs of transparency. Transparency raises several costs. First, there are concerns regarding the noise and commitment to policy path. Second, the public might interpret the interest path as a promise, and any deviation might be interpreted as discretion. A participant questioned the omission of an oil price shock in Norges' small-scale medium-sized DSGE model. Holmsen answered that it is because Norway's oil revenues are invested abroad. Another participant commented that transparency is a problem because it discourages the private sector from gathering information for forecasting. A participant also expressed some concern about how the coefficients in the objective loss function are determined.

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### **Liquidity Needs in Economies with Interconnected Financial Obligations**

**Julio J. Rotemberg**

CQER Working Paper 09-01 (July)

In this financial system model where firms must settle their debts using liquid assets, limits on the amount of liquid assets can lead to more defaults when financial firms are more interconnected.

### **Causes and Consequences of the Oil Shock of 2007–08**

**James D. Hamilton**

CQER Working Paper 09-02 (October)

Exploring similarities and differences between the oil price run-up in 2007–08 and earlier oil price shocks, the author examines what caused the price increase and what effects it had on the economy.

### **Sources of Variation in Holding Returns for Fed Funds Futures Contracts**

**James D. Hamilton and Tatsuyoshi Okimoto**

CQER Working Paper 09-03 (October)

This paper investigates the extent to which changes in regime can account for predictable gains from positions in fed funds futures contracts.

### **Comparing and Evaluating Bayesian Predictive Distributions of Asset Returns**

**John Geweke and Gianni Amisano**

CQER Working Paper 09-04 (October)

Using five different models, the authors compare and evaluate the quality of predictive distributions over multiple horizons for asset returns of the S&P 500 index from 1972 through 2005.

### **Optimal Prediction Pools**

**John Geweke and Gianni Amisano**

CQER Working Paper 09-05 (October)

This study finds that linear pools of prediction models generally yield predictions superior to those of any single model as assessed by a conventional log score function.

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