Payments and Networks conference participants in December, 2008.

Director's Message
by Finn Kydland

Most of this issue is devoted to reporting on our conference entitled "Payments and Networks." Sometimes called the "plumbing" of the financial system, a payments system consists of the procedures and associated computer networks used by both domestic and international financial institutions to transfer funds, securities and derivatives. On a typical business day in the United States, transactions valued at over $13 trillion, roughly equivalent to the annual gross domestic product, flow through this system. The sheer volume, as well as the complexity of making these transactions, implies that dislocations, or just a sudden loss of confidence in the system, has the potential to amplify, or even generate, liquidity shortages and credit exposures, impairing financial stability. This risk is even more pertinent during times of financial market stress. This conference not only explored advances in payment economics, but also brought to bear insights from network models in other disciplines.

In January, LAEF hosted a public lecture by Morris Davis (see last page) on the current state of the U.S. housing market. The lecture was open to the public. Davis's presentation began with an overview of housing prices in the United States and an examination of evidence available as of 2005 that housing was "overvalued." He then discussed the decline in housing prices and how it led to the collapse of almost all of our largest financial intermediaries. The presentation concluded with a discussion of the impact of declining housing prices and subsequent collapse of financial intermediaries on GDP.

Morris Davis has recently completed the manuscript for a new textbook titled "Macroeconomics for MBAs and Masters of Finance." In the concluding section of my Nobel lecture (available on the Nobel Web site and reprinted in the December 2006 issue of the *American Economic Review*), I lament the problem in macro that, "in the past 20 years, the gap between research and textbooks has grown wider and wider." Almost all interesting macroeconomic phenomena are dynamic in nature. Accordingly, the economic models we use in research to address important macroeconomic questions and issues contain explicit descriptions of the decision problems faced by forward-looking people. But, it's not straightforward to do dynamics on paper, and so most textbooks largely shy away from it. In the process, students are done a disservice. Morris Davis changes all of that. He has succeeded in introducing dynamics in a manageable way. At the same time, the book is fun to read. What's also interesting is his ability, from time to time, to connect with issues commonly discussed only in finance.

In May 2009, LAEF hosted a conference entitled "Financial Frictions and Segmented Asset Markets." The proceedings will be summarized in the next issue of From the Lab. *Our next conference, "Health and the Macroeconomy," takes place October 2-3, 2009.*

LAEF Visitors

Bryan Engelhardt of the College of the Holy Cross was a visitor at LAEF for one week in August, 2008. Professor Engelhardt received his Ph.D. from the University of Iowa in 2008. His current research interests include:

- Estimating search models of the labor market
- Efficiency of the labor market
- Crime and labor market policies

While at LAEF, Engelhardt worked with Peter Rupert on ideas related to directed and random search. In addition, he presented a paper on "Efficient Labor Force Participation with Search and Bargaining" at the LAEF Summer Workshop. The paper, joint work with Professor David L. Fuller from Carnegie Mellon University, focused on estimating the type of contract observed in the labor market, and if inefficient, what the gains would be in moving to an efficient contract.

Igor Livshits is an Associate Professor of Economics at the University of Western Ontario. He obtained his Ph.D. in Economics from the University of Minnesota in 2002. He is a scholar in the Institutions, Organizations and Growth program of the Canadian Institute for Advanced Research, and is also currently serving as an off-site academic director of the Belarus Economics Outreach and Research Center.

Professor Livshits's research interests include consumer credit and consumer bankruptcy, foreign debt and sovereign default, political economy, sources of cross-country income differences, and investment in human capital and productivity. His recent work includes constructing quantitative models of consumer bankruptcy for the purpose of policy analysis, accounting for the rise in consumer bankruptcies, study of prudential regulation in the presence of sovereign default risk, and studying the sources and implications of cross-country differences in labor market institutions. Livshits's research has been supported by SSHRC grants and the Arts, Humanities and Social Sciences Fund at the University of Western Ontario, and has been published in the *American Economic Review*, the *Journal* of *Economic Theory*, the *Journal of Monetary Economics*, and *Economics Letters*.

While at LAEF, Professor Livshits presented the paper "Costly Contracts and Consumer Credit," joint with J. MacGee and M. Tertilt. The paper investigates the importance of technological improvements in the credit markets for the recent changes in unsecured consumer credit and personal bankruptcy filings. The paper combines a novel theoretical approach with interesting new data.

Christian Zimmermann is Associate Professor of Economics at the University of Connecticut. He spent three weeks at LAEF in October 2008. A 1994 Ph.D. graduate of Carnegie Mellon University, he is interested in applications of stochastic dynamic general equilibrium models, in particular:

- Optimal generosity of unemployment insurance systems
- The impact of bank capital regulation on entrepreneurial activity
- Access to health prevention in developing economies

While in residence at LAEF, Zimmermann made three presentations to professors and graduate students at the Economics Department Seminar Series and the Macroeconomics Reading Group: one on the measurement of unemployment insurance generosity, one on the link between GDP and malaria, and one on RePEc, the Economics bibliography initiative.

Payments and Networks

December 12-13, 2008

In December 2008, the Laboratory for Aggregate Economics and Finance (LAEF) sponsored a conference entitled "Payments and Networks." The conference organizers were UCSB Economics professors Peter Rupert and Rod Garratt. Professor Rupert also serves as Associate Director of the Laboratory for Aggregate Economics and Finance.

The conference included eleven presentations over two days. UCSB Economics Department faculty and graduate students participated.

Visiting conference participants were:

Enghin Atalay, *University of Chicago*

Morten Bech, *Federal Reserve Bank of New York*

Carl Bergstrom, *University of Washington (Biology)*

Ted Bergstrom, *University of California, Santa Barbara*

James Chapman, *Bank of Canada*

Jernej Copic, *University of California, Los Angeles*

Rod Garratt, *University of California, Santa Barbara*

Edward Green, *Penn State University*

Charles Kahn, *University of Illinois (Finance)*

William Roberds, *Federal Reserve Bank of Atlanta*

Guillaume Rocheteau, *University of California, Irvine*

Stacey Schreft, *The Mutual Fund Research Center, LLC*

Irina Telyukova, *University of California, San Diego*

Summaries of each of the presentations follow. Note that speakers are highlighted in author listings.

December 12, 2008

Which Bank Is the "Central" Bank? An Application of Markov Theory to the Canadian Large Value Transfer System
Morten Bech, James Chapman and **Rod Garratt**

Credit Risk Stress in Payments and Settlement Systems
Morten Bech, Jamie McAndrews and Dennis Kuo

Mapping Change over Time in Large Networks and *Mapping Change in Large Networks*
Carl Bergstrom and Martin Rosvall

Identifying Community Structures from Network Data via Maximum Likelihood Methods
Jernej Copic, Matthew Jackson and Alan Kirman

Estimating the Structure of the Payment Network in the LVTS: An Application of Estimating Communities in Network Data
James Chapman and Nellie Y.N. Zhang

Data Breaches and Identity Theft
William Roberds and Stacey Schreft

December 13, 2008

A Monetary Approach to Asset Liquidity
Guillaume Rocheteau

Liquidity, Payment and Endogenous Financial Fragility
Charles Kahn and João A.C. Santos

Precautionary Demand for Money in a Monetary-Search Business Cycle Model
Irina A. Telyukova and Ludo Visschers

The Welfare Effects of a Liquidity-Saving Mechanism
Enghin Atalay, Antoine Martin and James McAndrews

Pricing of Central Bank Payment Services
Edward Green

Which Bank Is the "Central" Bank? An Application of Markov Theory to the Canadian Large Value Transfer System
by Morten Bech, James Chapman and Rod Garratt

Garratt and his co-authors propose a method resembling Google's PageRank algorithm to analyze the relative importance of banks in the Canadian Large Value Transfer System (LVTS). The bank with the highest daily liquidity holdings is considered to be the central bank in the Canadian LVTS. Bilateral Credit Limits (BCLs), which determine how much money can be transferred by one bank to another without offsetting funds, along with unobserved processing times for transactions, are used to uncover the structure of the network.

BCLs are used to construct the initial distribution of daily liquidity holdings in the system as well as the probabilities of interbank transfers. The model incorporates waiting times by allowing banks to send money to themselves with a positive probability. While waiting time is unobserved, processing time can be estimated via Bayesian techniques, and estimates can then be used to construct waiting time probabilities. The implied probability flow of random walks on the network is then used as a proxy for the actual flow of daily liquidity holdings. The authors find that the stationary distribution of liquidity holdings can be significantly different from the initial distribution, and that by augmenting the stochastic matrix with waiting time yields good predictions of the observed distribution of daily liquidity holdings.

The model implies the stochastic matrix is fixed during a given day. A conference participant asked whether banks could adjust BCLs more than once a day. Garratt and Chapman noted that while banks can adjust their BCLs any time they expect a larger transfer from another bank, the adjustment is usually done once, upward, and earlier in the day. Garratt added that data revealed BCLs to be fairly constant in any given day, justifying the assumption. Another question was whether banks' transfers were always of the size of their BCLs. Garratt granted that it is possible for banks to make many small transfers throughout the day. However, the success of the model in predicting actual liquidity holdings suggests BCLs are a useful proxy.

Credit Risk Stress in Payments and Settlement Systems
by Morten Bech, Jamie McAndrews and Dennis Kuo

The United States financial system consists of a number of markets that provide the means for domestic and international financial institutions to allocate capital and manage their exposure to liquidity, market, credit, and other types of risks. Critical to the smooth functioning of these markets is a set of wholesale payments systems and financial infrastructures that facilitate clearing and settlement. The backbone of the payment and securities settlement system in the United States is the Federal Reserve's Fedwire Funds Service (Fedwire), which is used by over 9,500 participants to send or receive about 525,000 time-critical and/or large-value payments for a total value of 3 trillion USD per day. The current crisis has exposed deficiencies in well-established settlement arrangements.

Bech and his co-authors document how intra-day liquidity was affected by the events following the bankruptcy of Lehman Bros. LLC, and the supplemental liquidity arrangement for American Insurance Group, Inc. (AIG) in mid-September, 2008. The authors use network mapping tools to provide a visualization of the degree of intra-day liquidity, and show how it deteriorated as uncertainty in the financial system increased. The results corroborate Kahn, McAndrews, and Roberds (2003) who showed that increased uncertainty concerning participants' credit worthiness can lead to significant delays in settlements, which may further constrain the credit flow in the economy. The authors also discuss the extent to which the dislocations were due to a combination of large values clogging up the system, late arrival of payment instructions to banks, reduced intra-day credit extensions to customers, and delayed settling of ancillary systems.

A conference participant questioned the need for ratings released by credit rating agencies when Credit Default Swap data contain similar information, but are released on a timelier basis. Bech responded, saying that while CDS data contain up-to-date information, banks' behavior is usually tied to its regulatory body, which relies on credit risk ratings from agencies. Another question was whether the Federal Reserve Bank was responsible for the resolution of the freeze up in the payment transfer system after September 26, 2008. While policies in response to the delays that followed 9/11 included lowering transfer fees, which effectively provided cheaper liquidity, Bech pointed out that if credit risk was the main concern, lowering liquidity cost cannot be a less effective tool.

Mapping Change over Time in Large Networks and Mapping Change in Large Networks
by Carl Bergstrom and Martin Rosvall

The availability of increasingly large data sets on biological and social systems necessitates tools to extract and present information in a usable form. Network mapping tools provide powerful representations of the data, but may remain too complex to be useful for a large data set. Furthermore, network representations do not distinguish between meaningful trends and statistical noise, making it difficult to analyze structural change in a network over time. Bergstrom and Rosvall propose methods that address the above shortcomings.

Bergstrom began by presenting an information-theoretic approach to reveal community structures in complex networks. The method decomposes the network into modules by compressing a description of the probability flow generated by random walks over the network. The result is a map that both simplifies and highlights the regularities in the structure and their relationships. Nevertheless, arranging data into a map, no matter how informative, is analogous to looking at a single data

point. Bergstrom continued by introducing a statistical method based on the parametric bootstrap, which allows the addition of statistical significance to network structures. In this case, the resampling is done by drawing weights of links between nodes from a Poisson distribution with a mean from the original network map. Modules that are found more than 95% of the time in the collection of resampled networks are considered significant. Structural changes of the network can then be visualized with the aid of an alluvial diagram, which effectively maps the evolution of the significant and non-significant modules over time.

Bergstrom concluded by mentioning that future research would study how structural changes of the network relate to changes in the properties of the network. In relation to economics, Bergstrom suggested this would allow one to ask, for example, not only how does the federal funds market structure change after a market freeze-out, but also how changes in network structure relate to loan rates and payment types.

Identifying Community Structures from Network Data via Maximum Likelihood Methods
by Jernej Copic, Matthew Jackson and Alan Kirman

The availability of increasingly large data sets on social, biological, and physical systems is accompanied by a widening array of network mapping tools, used to reveal latent community structures. The heterogeneity of the methods available, and the current lack of a unifying framework for them, often leave the researcher with very different answers for one question, and little means to discriminate among them. The authors provide a first step toward establishing a framework within which the relative merits of different methods can be assessed.

The model assumes there exists an unobserved community structure partitioning the nodes of the network into groups, as well as unobserved random communications among the nodes. Two nodes from the same partition are assumed to be more likely to communicate than two nodes from different partitions. The problem lends itself to maximum likelihood estimation, where a search for the partition and the probability of communication between nodes is most likely generated by the observed network. The authors use the properties of the maximum likelihood estimator to propose a set of axioms defining a class of procedures. The set of axioms allows the researcher to assess the relative performance of current and future methods from the same class, effectively testing the reliability, or adequacy, of the answers.

The optimization algorithm to solve the maximum likelihood problem suffers from an exponentially increasing number of partitions among which to search. A conference participant inquired whether some partitions could be discarded based on *a priori* information. Copic granted that while it is in principle possible, the nature of the maximum likelihood problem makes it difficult, especially when a large number of partitions have (true) low probabilities. Carl Bergstrom suggested that analyzing resampled data before starting the search algorithm could help to highlight the problems likely to arise during the optimization.

Estimating the Structure of the Payment Network in the LVTS: An Application of Estimating Communities in Network Data
by James Chapman and Nellie Y.N. Zhang

Chapman and Zhang apply the method of Copic and his co-authors to the Canadian Large Value Payment System (LVTS) to study the flow of liquidity between participants, and to assess the efficiency of the system in settling payments. The study does not look for the most important bank in the system, but rather for the most important group (or community) of banks. The paper provides further insights on the hidden structures of the LVTS network, which are necessary to understand and curb potential future freeze-ups such as that which occurred in September, 2008.

The application of the Copic, *et al.* maximum likelihood method to LVTS data not only takes into account the network aspect of the data, but also uncovers transactions patterns among LVTS participants without specifying a community structure *a priori.* Chapman and Zhang use two measures of transaction intensity. One is based on average daily payments sent by one bank to another, along with BCLs as in Garratt, *et al.* (2008). The other is based on the number of days on which a bank's daily transactions value sent to the other banks exceeds its daily average. The results suggest a robust partition, including a community made up of the five big Canadian banks, and another with banks based in the same province.

A recurrent question from seminar participants was whether the topology measures used, and the communities they implied, had a particular economic interpretation. In general equilibrium, for instance, network topologies are likely to be endogenous. Chapman responded, saying that while the measures are chosen arbitrarily, they yield reasonably robust results, and provide a first pass at extracting new information from network data. This in turn may motivate the construction of a model explaining the measures and arrangements. Regarding the search algorithm, Carl Bergstrom suggested convergence might be improved by adjusting the level of interaction within the communities while searching through the network's partitions.

Data Breaches and Identity Theft
by William Roberds and Stacey Schreft

Identity theft in the United States was estimated to cost more than $60 billion in 2006. The constantly falling cost of information technology lowers the cost of collecting detailed personal information that facilitates identification. However, imperfect security of information storage increasingly led to identity theft in cases of breach. Roberds and Schreft analyze the above trade-off in a monetary-theoretic framework.

The model incorporates the possibility of identity theft through data breaches. Credit card networks are modeled as clubs in which the sharing of members' personal information is essential for inter-temporal trade. Each club decides how much personal information should be collected from its members, and how much security to impose on the information storage. The benefit

of more detailed information to identify basic fraud attempts is weighted against the cost of the spillover effect when data from one club are use to create fake identities in another club. The network can choose to deter fraud by increasing security, or collecting more information on members. The authors predict too much information is collected, and information is insufficiently protected in the non-cooperative equilibrium outcome.

A conference participant asked for a clarification of the difference between fraud skills and fraud types. Roberds used the credit-card application process as an example for which one is required to provide extensive personal information, which is more difficult to manufacture by unskilled agents. Several comments were made about the specification of costs in the model, in particular, the motivation for introducing a fixed resolution cost imposed on a club when fraud is discovered, and a breach cost born equally by club members whose data were stolen to gain fraudulent access to another club.

A Monetary Approach to Asset Liquidity
by Guillaume Rocheteau

The value of an asset is typically attributed to its future income stream and the liquidity services it provides. Fiat money, which generates no income, derives its value solely from the liquidity services it provides as a medium of exchange. Rocheteau proposes a tractable monetary theory of asset liquidity that emphasizes the role of assets in payments arrangements. The model follows Kiyotaki and Moore (1989), and considers an economy with a real asset and fiat money in which some trade occurs in bilateral meetings, and a double coincidence of wants problem creates the need for a medium of exchange. Introducing an asymmetry of information where agents who pay with a real asset are better informed about the asset's future value than the agents who receive it, endogenizes the liquidity of the real asset.

The model implies that fiat money, which is not subject to the asymmetry of information, is strictly preferred as a mode of payment. Furthermore, this insures the existence of a monetary equilibrium irrespective of the per capita supply of real assets, provided that inflation is not too high. The model predicts that risky assets tend to be less liquid. Rocheteau argues the model has macroeconomic implications by reinterpreting fiat money as risk-free government bonds. In this case, the model predicts a rate of return on government bonds that is less than the rate of time preference, and a return on risky equity that is higher than the return on risk-free bonds, even with risk-neutral preferences. The model also predicts the asset rate of return is negatively correlated to inflation, corroborating Krishnamurthy and Vissing-Jorgensen (2008), who find a negative relationship between the corporate-Treasury yield spread, and the United States government debt/GDP ratio.

Liquidity, Payment and Endogenous Financial Fragility
by Charles M. Kahn and João A.C. Santos

The creation of liquidity is an important role that the financial system fulfills. Financial intermediaries, such as commercial banks, create liquidity by transforming relatively illiquid assets such as factories, machinery or small business loans into relatively liquid liabilities such as transactions deposits. Financial intermediaries protect themselves against liquidity shocks by trading mutual insurance contracts, which leads to a high degree of connectedness. Over-connectedness is often regarded as financial fragility, as bank runs, for instance, may lead to full-blown financial or macroeconomic crisis via contagion effects. Kahn and Santos argue that financial fragility and liquidity creation are linked, in the sense that banks choose to create liquidity in a way that increases financial fragility beyond the socially optimum level.

The model assesses the efficiency of inter-banking arrangements by considering the constrained optimal decentralized *ex-ante* contracting problem with common information, *à la* Prescott and Townsend (1984), and compares it to the case where a decentralization of liquidity provision occurs because *ex-ante* contracting among all relevant parties is no longer feasible. In the latter case, banks must create liquidity to meet demand, and the authors show banks choose a sub-optimal degree of mutual insurance against liquidity shocks. The authors argue that the over-connectedness in the financial system may justify intervention by financial authorities, as the social cost of having all banks fail may be higher than having some banks fail.

A conference participant asked how zero-profit maximizing banks coordinate to join and exercise a monopoly power. Kahn responded by saying that *ex-ante* identical banks choose consolidation, as it is a joint profit-maximizing strategy (by decreasing the face value of debt), and the lender finds it more desirable to lend to consolidated banks than to unconsolidated ones.

Precautionary Demand for Money in a Monetary-Search Business Cycle Model
by Irina A. Telyukova and Ludo Visschers

Business cycle literature typically concentrates on explaining the fluctuations of real aggregate variables in the economy. Models designed to explain the movement of nominal aggregates generally fail to generate credible dynamics. Telyukova and Visschers argue that this failure can be attributed to the systematic use of a deterministic demand for money; that is, money demand should not only be determined by aggregate shocks, but also by idiosyncratic ones. The authors study the implications of their hypothesis by introducing a precautionary demand for money in a monetary search business cycle model. Once the model is calibrated (in progress at the time of the conference), it should shed light on the ability of search models to generate credible macroeconomic dynamics, as well as on the explanatory power of search frictions with respect to business cycle data.

The model introduces a precautionary demand for money into a stochastic search model of money with a real sector and a monetary sector. The real sector incorporates a standard real business cycle model that is set up with productive capital, while the monetary sector is modeled using competitive search, which allows for the study of effects associated with nominal shocks. Telyukova and Visschers show that introducing a precautionary demand for money significantly improves the explanatory power of the model relative to models with a deterministic demand for money. Search frictions, on the other hand, were found to be only moderately successful in amplifying real effects of monetary policy.

A conference participant asked why it was necessary to have both nominal and real bonds coexist in the model economy. Telyukova explained that having the two types of bonds simplifies the notation by keeping track of retailers who are matched in the decentralized market and pay in goods, and those that are not and pay with money. Many conference participants questioned the need to have search frictions on top of precautionary demand for money. Telyukova argued that the primary objective of the paper is to study the quantitative effect of precautionary saving in a business cycle model, while the study of the effects of search frictions is of secondary importance. Nevertheless, Telyukova granted the modest effects attributed to the search frictions suggest writing a version of the model without the search component.

The Welfare Effects of a Liquidity-Saving Mechanism
by Enghin Atalay, Antoine Martin and James McAndrews

Intertemporal trade theory predicts that efficient allocations are achieved over time among agents with heterogeneous preferences and incomes when they are allowed to trade claims at market-clearing intertemporal prices. There is, however, no organized market for intraday credit in the Large Value Transfer System (LVTS). Under conventional arrangements, would-be borrowers have the choice between borrowing from a central bank at a fixed price and delaying payments until funds are received from other banks. This situation leads, in practice, to undesirable and unpredictable surges of payments toward the end of the day.

Martin and McAndrews (2008) provide a qualitative analysis of a Liquidity-Saving Mechanism (LSM) to be used in conjunction with the LVTS. An LSM offers a bank participant in the LVTS the option to settle the payment immediately or send the payment to the LSM, which is a queue with a predetermined rule to release payments. Martin and McAndrews (2008) showed that the introduction of an LSM may increase or decrease welfare depending on the value of key parameters. Atalay, Martin and McAndrews study the planner's solution to the model of Martin and McAndrews (2008), and show that the planner would use an LSM for certain parameter values. The authors proceed to derive the potential welfare benefit from adopting an LSM by calibrating the parameters of the model using Fedwire data. The results suggest welfare gains can be significant.

Several conference participants inquired about the broader importance of analyzing efficiency gains from the implementation of an LSM in the LVTS. Atalay explained that central bankers around the world are becoming increasingly concerned about the flow of intraday payment. In particular, 35% of the daily transfers are settled during the last hour of trading, and the failure of Lehman Brothers brought on significant delay which forced the Fed to extend Fedwire's hours of operations. Atalay pointed out that the root of the problem is the lack of an organized market for intraday payments in the LVTS, and therefore suggests the possibility of implementing an LSM. Regarding the social planner's problem, a conference participant suggested the interest rate paid by the LVTS participants to the Fed should be included in the welfare function.

Pricing of Central Bank Payment Services
by Edward Green

Payment and securities settlement systems have become a core part of modern monetary systems. There are two primary networks for interbank funds transfer payment orders in the United States: the Clearing House Interbank Payments System (CHIPS) and the Fedwire Funds Service (Fedwire). CHIPS is a privately-operated, real-time, multilateral, payments system used for large payments, and owned by financial institutions. Any banking organization with a regulated U.S. presence may become an owner and participate in the network. Fedwire is a real-time gross settlement system enabling participants to transmit and receive payment orders between each other and on behalf of their customers. Banks typically prefer to make payments of higher value, and of a less time-sensitive nature via CHIPS instead of Fedwire, as it is less expensive both by charges and by the funds required. Green reflects on the problems central banks face to finance the operation of their payment systems, delimits the scope of the theory of non-linear pricing to address this problem, and provides some ideas for further research.

Price discrimination is currently used by regulators and by central bankers to deal with payment pricing issues. Green reasons that marginal cost, non-discriminatory pricing in addition to a subsidy for the revenue shortfall financed by a non-distortionary tax might yield higher welfare than the non-subsidized, discriminatory pricing outcome. If, as in the United States, a subsidy cannot be implemented, then full cost recovery might only be achieved through price discrimination. Green warns, however, that the scope for cost recovery through price discrimination may be too small, as the current structure of the monetary system makes it difficult to prevent bypass and resell. For the above reasons, Green warns against adopting a retail business plan for a wholesale system, and argues in favor of extracting revenue from participants with the highest total willingness to pay. Green concludes by mentioning that the other alternative of having only one clearinghouse, either public and subsidized, or private and charged a high fee, should be given careful consideration by academic experts.
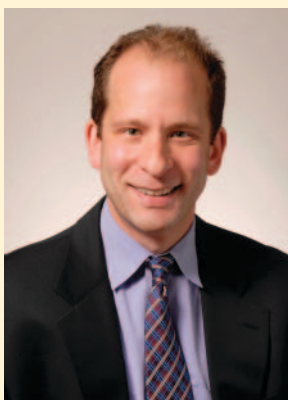
LAEF Hosts Professor Morris Davis

In January 2009, the Laboratory for Aggregate Economics and Finance was pleased to present *"House Prices, the Credit Crunch and the Macroeconomy,"* a public lecture by Morris A. Davis. Davis is an Assistant Professor in the Department of Real Estate and Urban Land Economics at the University of Wisconsin-Madison, School of Business. Widely regarded as an expert on U.S. housing markets and land price issues, Davis is frequently quoted on NPR Marketplace, and often cited in the *Wall Street Journal*, the *Economist*, and other major news venues. He testified in December 2007 before the U.S. Senate Finance Committee on the future of house prices and the macroeconomy.

Davis holds a Ph.D. in Economics from the University of Pennsylvania, and is currently on the Academic Advisory Council of the Federal Reserve Bank of Chicago. In 2007 he was a Research Associate at the Federal Reserve Bank of Cleveland. From August 2002 through August 2006, he served as an Economist at the Federal Reserve Board working in Macroeconomics and Quantitative Studies and Flow of Funds Groups. In this capacity, he frequently briefed Fed Chairman Greenspan on the state of housing markets.

Davis's lecture was attended by members of the campus community and from the broader Santa Barbara area. In addition to his public lecture, Davis gave a presentation at the Economics Department Seminar Series entitled "Agglomeration and Productivity: New Estimates and Macroeconomic Implications."