

SARGENT INSTITUTE OF QUANTITATIVE ECONOMICS AND FINANCE NEWSLETTER



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SARGENT INSTITUTE OF **QUANTITATIVE ECONOMICS** AND FINANCE

SIQEF NEWSLETTER

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SIQEF **Mission Statement**

"Our institute strives to put mathematics and statistics at the service of quantitative analysis of questions about economics, finance, and government policy. Scientists use mathematics because we want our models to be coherent. We use statistics because we want our models to describe data well. Our purpose is to learn, teach, and apply an array of methods made possible by the availability today of powerful and inexpensive computational methods and large data sets. We provide a platform for developing computational economics and finance based on user friendly and powerful open source languages, especially Python and Julia."

- Thomas Sargent

AND FINANCE



News

SARGENT INSTITUTE OF QUANTITATIVE ECONOMICS AND FINANCE

PHBS Holds Inaugural Search and Matching Workshop in Asia-Pacific

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The Inaugural Search and Matching Workshop in Asia-Pacific was held at PHBS on November 14 and 15, 2022. Hosted by the Sargent Institute of Quantitative Economics and Finance at PHBS, the workshop attracted more than 50 scholars from both Chinese universities such as Tsinghua University and Fudan University, and foreign institutes such as University of Missouri, New York University, National University of Singapore, University of Queensland, Kyoto University, and the Bank of Japan. he first keynote speaker is Professor Chao Gu from the University of Missouri. She presented the paper "Credit Condition, Inflation and Unemployment," which studies the impact of firms' financing conditions on the labor market and the Phillips curve. Professor Gu argued that the flattening of the Phillips curve in the past few decades is due to the improvement of firms' financing conditions. This paper builds a general equilibrium model with financing constraints and search frictions to study the impact of financing conditions and monetary policy. When firms' financing conditions improve, real wages rise, unemployment falls, and the Phillips curve flattens. In addition, the impact of firms' financing conditions on unemployment and the effect of inflation on unemployment are of a similar magnitude.

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- Scholars attend the workshop online





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- Plenary Speakers

Their research has proved that industrial land sales in China are not subsidized relative to residential land sales; and for policy implication, the tax sharing scheme between the central and local governments can be carefully designed to achieve desired land allocation outcomes. The second keynote speaker is Professor Ricardo Lagos from New York University. He presented the paper "Onetary Economics: How It Started, How It's Going," which investigated whether the role of money plays a vital role as the medium of exchange in monetary economics. Previous research found that monetary equilibrium is continuous with respect to a certain "cashless limit" and money plays a small quantitative role in high-velocity calibrations. However, existing research ignores the possibility that the rate of return on money affects the cost of transactions that don't involve money. Professor Lagos argues that an economy with monetary frictions but sufficiently high velocity cannot be approximated by a "cashless economy" without monetary frictions. Monetary equilibrium is not continuous with respect to the cashless limit if there is market power in credit, payment, and settlement intermediation.

This year's workshop also featured four sessions, including empirical evidence, intermediation, digital currency, and labor.

In the empirical evidence session, Professor Mei Dong from University of Melbourne presented the paper "Price Cycles and Prices: Theory and Evidence." By using the Nikkei point-of-sale scanner data from March 1988 to December 2017, the paper documents the following stylized facts: the product cycle is about 9 quarters, the proportion of new products entering the market fluctuates more than the proportion of exiting product, the price of new products fluctuates more than the average price, and the proportion of products entering the market is positively correlated with the price. The results suggest that endogenous product entry and price discounting can increase the standard deviation of inflation. The author then uses the model to explain the Japanese deflation puzzle since the 1990s. Dr. Michael Wong from the University of Hong Kong presented the paper "What is Money? Evidence from Introducing Redeemable Currency to a Barter Community." Using data from natural experiments in a barter community in Toronto, Wong explored the effect of large monetary expansion and sudden reduction in token redemption. The result shows that monetary expansion dramatically raised token-mediated transactions, but did not change barter volume, illustrating money's role as a medium of exchange. In addition, this paper finds that fewer redemption opportunities could reduce both token and barter transactions, which means that redemption encourages money acceptance. Those findings are consistent with a search-theoretic model of money where redemption eliminates non-monetary equilibrium.

In the intermediation session, Dr. Yilei Liu from Southwestern University of Finance and Economics presented the paper "Optimal Banking Regulation and Monetary Policy." This paper uses a tractable model with endogenous liquidity provision by banks to explore optimal banking regulation, where banks provide deposits as a means of payment and invest in projects with costly monitoring. The results show that banking regulations are necessary

to improve liquidity provision and commercial banks' (CB) profits. In addition, high IOER improves liquidity if CB receives fiscal resources. Under high inflation and scarce private asset, IOER improves both welfare and CB profit. Dr. Mengbo Zhang from Shanghai University of Finance and Economics talked about the paper "Disintermediating the Federal Funds Market." The paper tries to explain the sharp decline in the scale of fed fund market after the Global Financial Crisis (GFC) in 2007-2008 by exploring the disintermediation channel. Professor Zhang built a search-and-match model for Fed fund markets with endogenous searching activity and tested the model predictions using bank-level data. The findings show that the demand for fed funds is jointly driven by post-GFC, unconventional monetary policy and regulation; disintermediation channel is guantitatively important for fed fund market size, and reallocation of excess reserves and over-search reduces the total welfare of all banks through search-related transaction costs.

In the currency session, Senior Economist Daisuke Ikeda from the Bank of Japan presented his paper "Digital Money as a Medium of Exchange and Monetary Policy in Open Economies." Using an open economy search model featuring global digital money, the author shows that when global digital money and national money coexist, monetary policy (MP) autonomy may be lost. However, MP autonomy can be preserved by government policies that limit the amount of global digital money or incentivize mechanisms that prevent counterfeiting. The details of global digital money are crucial for MP autonomy. Dr. Kohei Iwasaki from University of Osaka presented his work "Cryptocurrency Bubbles and Costly Mining." The author develops a general-equilibrium model of a cryptocurrency and proposes a notion of equilibrium refinement based on the features of cryptocurrency systems.



- Presenters of four sessions

This refinement eliminates all equilibria where the value of the cryptocurrency is zero at some point in time or converges to zero as time passes; Moreover, mining is not only a solution to the double-spending problem but also a coordinating device.

In the labor session, Dr. Bo Hu from Fudan University presented his paper "A Bumpy Job Ladder Model of Executive Compensation," which evaluates the impact of managerial labor market competition on executive incentive contracts. The paper first constructs a novel dataset of executive job mobility and compensation by linking BoardEx with standard data sources, including Execucomp, Compustat, and CRSP, and then builds a dynamic contracting model that features moral hazard, search frictions and poaching offers The paper shows that poaching generates a new source of incentives that explains a newly documented empirical puzzle — the firm-size incentive premium. Dr. Paul Jackson from the National University of Singapore presented his paper "The Underemployment Trap." This paper uses data from the National Longitudinal Survey of Youth 1997 and Occupation Information Network (O*NET), documents several stylized facts about underemploy, and then builds a directed search model featuring mismatch. Quantitative analysis shows that unobserved heterogeneity accounts for nearly 97% of observed duration dependence.

During the two-day workshop, Professor Liang Wang from University of Hawaii, Professor Takashi Shimizu from University of Kobe, Professor Jianxiu Zhong from Hong Kong Baptist University, and Professor Serena Rhee from Cheng-Ang University, exchanged their views with presenters and offered suggestions in terms of modelling, research methods, and data sourcing.

The Search and Matching Workshop in Asia-Pacific will be held twice a year to provide a high-level platform for academic exchanges among researchers in the Asia-Pacific area.



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The Fifth PHBS Workshop in Macroeconomics and Finance **PHBS SIQEF's Fifth Anniversary Celebration**

December 28-29.2022 | Shenzhen · China

5th PHBS International Workshop in Macroeconomics and Finance

By Annie Jin, Chen Yongqiao, Guo Xinran, Li Kexin, Li Tuoda, Sun Bo, Wu Yi, Xia Yuanqiong, and Zhan Xingyi

he 5th PHBS International Workshop in Macroeconomics and Finance and the 5th Anniversary of Sargent Institute of Quantitative Economics and Finance (SIQEF) were held online recently. More than 100 young scholars in the field of macroeconomics and finance attended the event to exchange academic achievements and keep track of the latest breakthroughs with distinguished scholars from University College London, University of Pennsylvania, Columbia University, New York University, University of Rochester, University of Colorado, Peking University, University of International Business and Economics, etc.; and industry experts from the Research Department of the Federal Reserve Bank of St. Louis.

On behalf of all the PHBS faculty members, Pengfei Wang, dean of PHBS, extended his warm welcome to this year's participants. He introduced the academic achievements of the school in 2022: our faculty and students published a total of 90 academic papers, among which 72 papers were published in first-class academic journals at home and abroad (SSCI / SCI), such as the American Economic Review, Information Systems Research, and Journal of Economic Theory. 29 articles were published in top journals and top academic publications increased by 93.3% compared with 2021. He pointed out that the outstanding academic achievements demonstrated the school's determination to become an academic center, and expressed his hope to take this academic opportunity to enhance exchanges and cooperation.



Scholars attend the workshop online

A total of 10 high-quality papers were presented at the conference. The 2011 Nobel Laureate in Economics and Finance Thomas Sargent and PHBS Visiting Associate Professor Shengxing Zhang, also attended the workshop and participated in online exchanges and discussions.



5th PHBS International Workshop in Macroeconomics and Finance



Miguel Faria-e-Castro Senior economist from research division of the Federal Reserve Bank of St.

Miguel Faria-e-Castro, a senior economist from research division of the Federal Reserve Bank of St. Louis, presented his research on evergreening. Evergreening refers to the idea that banks revive a loan close to default by granting further credit to the same firm at discounted rates. Dr. Miguel wants to investigate whether evergreening is a general feature of financial intermediation and the macro implications of this phenomenon. The static model he builds shows that it is rational for banks to grant their financially distressed borrowers new loans with discounted lending rates. He then uses the US data to detect the existence of evergreening. Lastly, he sets up a full-fledged dynamic model to examine the optimal behavior of banks in evergreening and the efficiency loss resulting from capital misallocation.



Xingtan Zhang Assistant Professor, University of Colorado

Improvements in terms of trade for one party come at the expense of another party. This feature of financial markets is analogous to "arms races". The paper by Xingtan Zhang, an assistant professor of finance at the University of Colorado Boulder, models how the sales of trading advantages (e.g., data or co-location services) affect traders' endogenous participation in financial markets and vice-versa. The results show that sellers of trading advantages (e.g., data providers or securities exchanges) maximize profits by picking prices that may lead to inefficiently low levels of market participation and liquidity in equilibrium. Optimal sales of trading advantages lead less sophisticated investors to conclude that financial markets are too "rigged" and to exit these markets.



Sergio Salgado Ibanez Assistant professor of finance at the Wharton School of the University of Pennsylvania

Sergio Salgado Ibanez, an assistant professor of finance at the Wharton School of the University of Pennsylvania, presented the paper "Why are the Wealthiest so Wealthy? A Longitudinal Empirical Investigation." Using Norway's population-wide income data from 1993 to 2005, Professor Sergio and his coauthors studied life-cycle wealth dynamics of the rich, that is, why rich people get richer and how wealth inequality evolves. They also estimated an OLG model to quantify the importance of different forces, such as labor income and bequests. By documenting patterns of wealth, portfolio shares, returns, and income sources across wealth distribution, they find that inheritances play an essential role in explaining wealth inequality, especially earlier in life and that the rate of return heterogeneity becomes increasingly important over their lifetime.



Christopher Sleet Professor of Economics, Department of Economics, University of Rochester

Dr. Christopher Sleet, a professor of Economics, Department of Economics, University of Rochester, presented his work, "Optimal Taxation and Discrete Choice". Professor Sleet applied the discrete choice model to the optimal tax design problem, given the phenomenon that the agent's discrete choice in the real world and the wide use of discrete model in empirical analysis. He further discussed the model's behavior under unstructured choice sets and tax conditioned on income alone. This innovation highlights the role of semi-elasticities of choice probabilities to utility perturbations in shaping optimal taxes and broadens the application of optimal tax.



Morten Ravn Professor from the Department of Economics at University College London

aggregate risk.

Professor Morten Ravn from the Department of Economics at University College London presented his paper, "Financial Frictions: Micro vs Macro Volatility". The authors study the impact of frictional financial intermediation in an incomplete market model with aggregate and idiosyncratic risks. They formulate a Heterogeneous-Agent New Keynesian (HANK) model to show that frictions in financial intermediation have first-order consequences for welfare because the frictions limit households' ability to insure themselves against idiosyncratic risk. They also show that the model does well in accounting for aggregate moments, including the cyclicality of credit spreads and leverage. Lastly, the authors suggest that financial-sector regulation needs to avoid impending on households' ability to smooth consumption since households face much greater idiosyncratic risk than



Ricardo Lagos

Professor from New York University

Professor Ricardo Lagos from New York University presented his paper, "Q-Monetary Transmission". The Q-theory proposed by James Tobin in 1969 implies that monetary policy can influence firms' investment by affecting stock prices. Professor Lagos models Q-transmission through a two-market model of asset trading and financing for investment and tests it empirically. In the model, investors trade stocks in the over-the-counter market, and entrepreneurs make financing and investment decisions based on stock prices. Professor Lagos also exploits the property that stocks with different liquidity respond differently to the shocks of interest rates, and identifies the effect of stock prices on investment by using the cross-product of interest rate changes and turnover rates as instrumental variables. The results show that the Q-monetary transmission explains about a quarter of the effect of interest rates on investment. The presentation concludes with a discussion on topics such as the response of book value to interest rate shocks.

5th PHBS International Workshop in Macroeconomics and Finance



Anna Helmke

Ph.D. candidate from the Wharton School of the University of Pennsylvania

Anna Kelmke, a Ph.D. candidate from the Wharton School of the University of Pennsylvania, presented the paper "Are ETFs Better Than Mutual Funds?" The advent of ETFs has led the public to believe that mutual funds will be replaced by ETFs. ETFs can be traded in the secondary market but face the risk of mispricing. Mutual funds are traded in the primary market, but they are exposed to run risk. Dr. Kelmke constructs a portfolio choice model to explore the optimal portfolio of the two investment technologies. In the model, investors are exposed to liquidity risk and will redeem midway with a certain probability. The analysis of the model shows that ETFs and mutual funds provide liquidity in different maturities. ETFs are preferred by investors with low liquidity risk. The share of ETFs rises when market liquidity declines or when the proportion of inattentive investors declines. Overall, ETFs are not necessarily better than mutual funds. The presentation concludes with a discussion on the topics of investors' liquidity risk and investment preferences.



Jaroslav Borovička Associate Professor from New York University

Associate Professor Jaroslav Borovička from New York University presented his paper, "Robust Bounds on Optimal Tax Progressivity". Tax design issues have been widely studied, and the design depends on objects that are difficult to measure. An ideal tax design should take into account the uncertainty of individual income and wealth distributions. Professor Borovička uses a households-government two-sector model to explore how to determine tax design under uncertainty about the distributions. In the model, the government minimizes the value of the entropy penalty function of distribution deviation while maximizing households' welfare. The analysis shows that the marginal tax rate of the left tail of the productivity distribution is not affected by the uncertainty, while the marginal tax rate of the right tail is greatly reduced. In addition, the primary source of differences among different productivity groups is the efficiency term of the Diamond-Saez formula. Overall, distributional uncertainty points to lower progressive tax rates. After his presentation, people discussed such topics as analysis in a small open economy and the government budget constraint under uncertainty.



Laura Veldkamp Professor from the School of Business of Columbia University

Professor Veldkamp from the School of Business of Columbia University introduced her paper "A Model of the Data Economy". Data is a production of the information age. But does the data economy have new economics? This paper establishes a new dynamic equilibrium model with data and applies it to study the aggregate economic consequences of data accumulation. The paper shows that data as a type of capital is like traditional capital in capital accumulation in the long run because of diminishing returns; in the short run, data, as new ideas and technologies, exhibits new characteristics, such as increasing returns and negative profits. After the presentations, the participants of the workshop and the author discussed issues such as the model setup, data classification and usage, and examples of the data economy.



Shenghao Zhu Professor from International Business and Economics University

Professor Shenghao Zhu from International Business and Economics University, presented his work, "Income Distribution in a Dynamic Assignment Model". To study how positive assortative matching between managers and workers in the labor market determines income distribution, he built a dynamic matching model with human capital accumulation. He solved the stationary equilibrium and examined the effects of technology improvement on income inequality. He found that the effect of technological improvements on income inequality is different in the dynamic model from a static model because managers accumulate human capital in the dynamic model. Technological improvements increase income inequality in the dynamic model.

The workshop has been held successfully in the past five years. It has promoted academic exchanges between macroeconomic and financial research institutions from home and abroad. It has also enhanced the understanding of experts and scholars on macroeconomic and financial issues in China and promoted applications of the research findings in China's macroeconomic and financial reform and development.





- The group photo of participants

PHBS Holds the Sixth International Workshop in Macroeconomics and Finance

By Annie Jin, Hu Die, Liu Qiaoqiao, Liu Yifu, Ren Hangdong, and Zhang Wenrui

ponsored by Peking University HSBC Business School (PHBS), the Sargent Institute of Quantitative Economics and Finance (SIQEF) at PHBS and the Center for Macroeconomy and Finance (CMF) of Peking University organized the Sixth International Workshop in Macroeconomics and Finance on June 16-17. The workshop invited renowned scholars and experts from prestigious universities and institutions worldwide, including Columbia University, Boston University, University of Pennsylvania, University College London, Peking University, Hong Kong University, Hong Kong University of Science and Technology, and University of International Business and Economics. They converged to exchange research insights and explore cutting-edge research areas with young researchers from home and abroad.



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Initiated in 2018, PHBS Workshop in Macroeconomics and Finance has provided an effective platform for some of the most prominent scholars and young researchers to promote academic exchanges among macroeconomic and financial research institutions, deepen the understanding of China's macroeconomic and financial issues, and facilitate the application of research findings into China's reform and development.

- Attendees listen to the presentation

PHBS Holds the Sixth International Workshop in Macroecomics and Finance



From left to right: HUANG Ji and WANG Neng

Professor Thomas J. Sargent

PHBS



From left to right: MIAO Jianjun and XU Zhiwei

Professor Miao Jianjun from Boston University introduced his paper "Fiscal and Monetary Policy Interactions in a Model with Low Interest Rates". This paper presents a dynamic new Keynesian model that incorporates credit constraints and uninsurable idiosyncratic investment risk faced by entrepreneurs. The study explores the implications of low interest rates and high public debt and examines the coordination of monetary and fiscal policies needed to maintain nominal anchor and price stability. The authors find that multiple steady states with positive public debt values can be sustained, and the steady-state interest rates are lower than the economic growth rate. The paper also analyzes determinacy regions of policy parameter space and identifies various policy combinations that can achieve debt and inflation stability. The findings have implications for the challenges faced by policymakers and researchers in the context of low interest rates and high public debt. PHBS Associate Professor Xu Zhiwei discussed this paper. He made comments on the necessity of bubbles to generate sustainable debt deficit under low interest rate and provided alterative story about a two-country economy with capital flows.

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Professor Zhu Xiaodong from the University of Hong Kong presented the paper 'Bottom-up Institutional Change and Growth: Theory and Evidence from China.' Professor Zhu gave the introduction of China's institutional changes, mainly about the 1978 to 1984 agricultural reform, which is also an important driving force for China's agricultural productivity improvement. In this paper, a bottom-up institutional change model is established. In the preliminary numerical analysis, the author generates the bottom-up institutional change that will spill over between regions, and successfully predicts the regional growth path that is consistent with China's growth. In addition, the author also introduces some ongoing research at the end. Jiang Shenzhe, assistant professor at the Institute of New Structural Economics at Peking University, commented on the empirical and theoretical modelling of the paper and suggested that there might be more extensions behind China's institutional changes, such as considering "crossing the river by touching the stones."

Chair Professor Wang Neng from Columbia University presented his paper A P Theory of Government Debt and Taxes. The article presents a theoretical framework for understanding government debt and taxes, building on the work of Barro (1979). The authors introduce a concept called marginal p, which represents the cost of servicing government debt, and discuss the factors that determine the optimal debt-GDP ratio. They incorporate features such as options for default, risk management policies, and government impatience. The model demonstrates that the debt-GDP ratio is influenced not only by the primary deficit, interest payments, and GDP growth but also by hedging costs. The authors calibrate the model and provide quantitative statements about the dynamics of the debt-GDP ratio and the time it would take for the US to reach its debt capacity. Assistant Professor Huang Ji from Chinese University of Hong Kong discussed this paper. He provided comments on the link between sovereign default model and the p theory paper. He also listed some key ingredients for this paper, including large open economy sovereign default, and domestic cost of default.



From left to right: ZHU Xiaodong and JIANG Shenzhe



From left to right: LIU Xuewen and 7HAO Bo

Professor Liu Xuewen from the University of Hong Kong introduced the paper "Consumption-led Industrial Upgrading". The purpose of the paper is to understand development and industrial upgrading in a catching-up economy, the corresponding optimal development policies, as well as the implications for the world. This paper emphasizes that for a catching-up economy, production externality and spillover largely occur in the consumption goods sector. This paper provides a formal model of consumption-induced market sizes and demand-driven technology progress in a standard growth framework. In particular, the model has implications for optimal development policies. The right policy affects not only the growth in the transitional path but also the long-run growth in the steady state. Associate Professor Zhao Bo from the Institute of National Development of Peking University summarized the paper's modification, sorted out its contribution, and finally put forward some suggestions for modification in the setting of utility function.

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From left to right: ZHANG Shengxing and ZHU Yu

Zhang Shengxing, visiting associate professor at PHBS, introduced the paper "Valuing Platforms and Tokens: a Q-theory with Search and Matching." This paper develops a dynamic model to value a token platform, where trading between buyers and sellers is subject to search and matching frictions and transactions use the platform-issued token as a medium of exchange. The value of the token platform and token issuance policy depends on the extensive margin and intensive margin of trade. After the presentation, Zhu Yu, associate professor at Renmin University gave comments on why platform issued the token and the issuance of CBDC.

PHBS Assistant Professor Wang Yicheng introduced the paper "Foreign price shocks, production networks, and monetary policy". This paper mainly studies: How to design monetary policy in real open economies with intersectoral input-output linkages? This paper establishes a framework involving SoE, multi-sector production function network to study how to formulate monetary policy to minimize distortions, using inflation index and DC (Divine coincidence) index as monetary policy targets. Professor Wang introduced the mechanism of the DC index in detail and explained the economic intuition of the index with examples. It is found that the direct or indirect use of domestic factors by a department greatly affects its weight in the DC index, and the more labor-intensive departments and departments with higher price stickiness are given more weight in the DC index. The study found that using the DC index as a monetary policy target increases welfare compared to the traditional Domar index. Associate Professor Wang Bin from Jinan University suggested the possible expansion of the research areas: for example, dynamic exchange rate issues, energy or food sectors, supply chain disturbances, etc.



From left to right: WANG Yicheng and WANG Bin

Chen Kaiji, associate professor of Economics at Emory University, introduced the paper "Monetary Policy Transmission under Financial Repression." This paper proposes a banking model with deposit rate ceilings, which shows the enhancing effect of wholesale funding on monetary policy transmission, opposite to the conventional view. PHBS Associate professor Li Kai, gave comments on confounding effects in empirical specifications and suggested to endogenote interbank wholesale funding market.



From left to right: CUI Wei and SU Dongling



From left to right: CHEN Kaiji and LI Kai

Wei Cui, associate professor from University College London, introduces the paper A Ramsey Theory of Financial Distortions. Response to the puzzle about government optimal tax and low government bond return, professor Cui proposes a Ramsey model with financial friction and shows that it is optimal to tax capital if financial binds and government indebtedness is high. Su Dongling, assistant professor at Shanghai University of Finance and Economics gave comments on the robustness on capital supply, the presence of asset bubbles, and time consistency of government policy.

From left to right: ZHU Shenghao and YANG Yucheng

Professor Zhu Shenghao from the University of International Business and Economics introduced the paper "Optimal Nonlinear Taxes in an Economy with Aggregate Shocks". The main research guestion of this article is: what is the optimal nonlinear tax schedule in a heterogeneous agent economy with aggregate shocks, and what kind of algorithm should we use to find this optimal tax scheme. In order to study this problem, the authors used a variational approach to investigate the optimal nonlinear tax schedule. They established a recursive dynamic game model with the heterogeneous agent to theoretically study this problem, and finally attempted to use machine learning to solve the model. The paper has aroused the interest of many scholars and has generated heated discussions. Dr. Yang Yucheng from Princeton University commented on the use of variational methods and machine learning in the topic of optimal nonlinear taxes, and expanded the future application prospects of the model.

Professor Ai Hengjie from the University of Wisconsin introduced his latest paper "Identifying Preference for Early Resolution (PER) from Asset Price". The background of this article is that PER is used in multiple leading asset pricing models, such as long-run risk model and robust control, but the empirical evidence between PER and asset prices is not clear. Professor Ai attempted to confirm the existence of PER preference using a theoretical model of a thought experiment, as well as empirical research on the relationship between the US FOMC announcements and asset prices. The results strongly support the PER hypothesis. Fang Xiang, assistant professor from the University of Hong Kong, discussed topics such as using more heterogeneous assumptions in the model.



From left to right: Al Hengjie and FANG Xiang



From left to right: Winston DOU and LUO Ye

Winston Dou, assistant professor at University of Pennsylvania, presented his paper "Al-Powered Trading, Algorithmic Collusion, and Price Efficiency". Al trading, the combination of algorithmic trading and reinforcement learning, plays a significant part in capital markets. Professor Dou and his coauthors adopt a model of imperfect competition among informed traders with asymmetric information to investigate how Al-powered informed investors trade differently from humans. They find that AI trading profitability tends to be above the non-collusive level. When the pricing rule of market makers is dogmatic, collusion by price trigger punishment is pronounced when information asymmetry is not severe. When the pricing rule of market makers is adaptive, collusion by biased learning is the domination force. Consequently, in a market with prevalent Al-powered trading and collusion through punishment threat, perfect price efficiency remains unattainable. Luo Ye, associate professor at the University of Hong Kong, gave some comments on the limitation of algorithmic design.



From left to right: WANG Pengfei and JI Yan

Professor Wang Pengfei delivers closing remarks

In the closing remarks, Professor Wang Pengfei expressed his heartfelt appreciation for the scholars who delivered excellent presentations and engaged in lively discussions and his gratitude to Professor Sargent for his support in the workshop. Professor Wang also introduced the recent development of the PHBS MA-PhD program: the school admitted around 300 outstanding students from prestigious universities worldwide each year. Among the 2023 master's graduates, many have chosen to pursue doctoral degrees at overseas universities, including the University of Toronto, Harvard University, and Princeton University; moreover, the school's Ph.D. program also yielded impressive results. The 2023 doctoral graduates, as the first batch of students trained after the establishment of the Sargent Institute of Quantitative Economics and Finance, will pursue academic research at prestigious universities like Sun Yat-sen University, Jinan University, and Macau University of Science and Technology.

Initiated in 2018, PHBS Workshop in Macroeconomics and Finance has provided an effective platform for some of the most prominent scholars and young researchers to promote academic exchanges among macroeconomic and financial research institutions, deepen the understanding of China's macroeconomic and financial issues, and facilitate the application of research findings into China's reform and development.

Professor Wang Pengfei, vice chancellor of Peking University Shenzhen Graduate School and PHBS dean, presented his research "Reference-dependent Preferences and Sentiments". Large fluctuations are always witnessed in the asset prices. Reference dependence has been a core topic in behavioral economics. Professor Wang and his coauthors link Reference-Dependent Preference with Keynes-Shiller's notation of sentiments by using an overlapping generation model with borrowing constraint. They found that sunspot equilibria exist if the agents have Reference-Dependent Preferences. There is an excessive co-movement between asset prices. Sentiment-driven fluctuations are symmetric, which is more likely when economy is in a recession. Ji Yan, associate professor at Hong Kong University of Science and Technology, gave some comments on economic intuitions of results and generation of sunspot equilibrium.

PHBS Holds the Sixth International Workshop in **Macroeconomics and Finance**

PHBS-CUHKSZ

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The PHBS-CUHKSZ Economics and Finance workshop is committed to stimulating the research potential of young scholars, facilitating academic exchanges among them, and promoting the academic development as well as research cooperation in the fields of economics and finance in the Guangdong-Hong Kong-Macao Greater Bay Area. Initiated in 2021, the first workshop was held at Shenzhen Finance Institute, CUHK-Shenzhen and will be held every six months by PHBS or Shenzhen Finance Institute, CUHK-Shenzhen.

The 2nd PHBS-CUHKSZ Economics and Finance Workshop Held at PHBS

By Annie Jin, Cao Yawen, Hu Chuan, Lin Tianye, and Zhu Bairu

o-hosted by Peking University HSBC Business School (PHBS) and Shenzhen Finance Institute at the Chinese University of Hong Kong, Shenzhen (SFI, CUHK-Shenzhen), and organized by Center for Macroeconomy and Finance at Peking University and Center for Macro-Financial Stability and Innovation at SFI, the 2nd PHBS-CUHKSZ Economics and Finance workshop

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The 2nd PHB2-CUHKSZ Economics

and Finance Workshop

Organizers: Peking University HSBC Business School The Chinese University of Hong Kong, Shenchen

PHBS

- The workshop kicks of

was held on June 11 at PHBS. This year's workshop attracted more than 160 scholars from world-class universities in China, the United States, and Singapore, among others, to have in-depth discussions on the latest academic topics in the fields of economics and finance.



The 2nd PHBS-CUHKSZ Economics and Finance Workshop

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The 2nd PHBS-CUHKSZ Economics and Finance Workshop Held at Wang Pengfei, dean of PHBS, and Wang Jian, associate director of Shenzhen Finance Institute, delivered opening remarks. Professor Wang Pengfei expressed his gratitude to the faculty, staff, and student volunteers for their efforts in organizing this workshop and hoped that this event could continue to strengthen the relation between the



- Professor WANG Pengfei gives opening remarks



two schools and to keep track of academic advancements. Professor Wang Jian held that this conference is a precious opportunity for face-to-face interactions among scholars. He hoped that it could become an excellent academic platform for Shenzhen and even for the whole China.



- Professor WANG Jian delivers opening remarks

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Organizers: Peking University HS

YU Yongding

Ph.D. in Economics from Oxford University, academician of the Chinese Academy of Social Sciences, member of the State Planning Commission, and former member of the Monetary Policy Committee of the People's Bank of China.

Dr. Yu Yongding delivered a keynote speech titled "China's Growth and Macro-Regulation over the Past 40 Years: The Formation of Judgment." Professor Yu systematically reviewed the evolution of China's economic policies over the past 40 years since the reform and opening up. He pointed out that though China confronted different challenges at every period, including foreign exchange shortage, inflation, and deflation, its macroeconomic policies proved successful in general. Dr. Yu also discussed some shortcomings of China's macro regulations. He concluded that the 10-year slowdown of China's economy could not be entirely attributed to long-term structural reasons and that we must keep pursuing the goal of stable growth.

The 2nd PHBS-CUHKSZ Economics and Finance Workshop Held at PHBS

Shern, June 11, 2022 Seking hime Shern, June 11, 2022

> LU Guangli Assistant professor of CUHK-Shenzhen

Lu Guangli, assistant professor of CUHK-Shenzhen, introduced his paper "Owner Culture and Pay Inequality within Firms," coauthored with Jan Bena and Iris Wang. Based on a unique employee-employer matched dataset linked with firm ownership and immigrant records in Canada over the 2001 – 2017 period, the authors found that a firm owner's cultural background could play a significant role in determining the within-firm pay inequality: firms owned by individuals from more individualistic countries tend to have a higher level of pay inequality. Pan Yihui, associate professor at the University of Utah, commented on the paper from the perspective of economic mechanism and suggested that within-country cultural variations could be taken into account as an alternative channel.



ZHAO Lingxiao

Assistant professor of PHBS

Zhao Lingxiao, assistant professor of PHBS, presented her paper "Winners from Winners: A Tale of Risk Factors," coauthored with Siddhartha Chib and Zhou Guofu. Starting from the twelve distinct factors from the existing papers, plus twelve principal components of anomalies unexplained by the initial factors, a Bayesian comparison of approximately 17 million models in terms of marginal likelihoods and posterior model probabilities shows that eight initial factors plus three non-consecutive principal components are the best-supported risk-factors. Zhao pointed out that their model scan methodology could be used for computing expected returns, assessing investment strategies, and building portfolios. He Ai, assistant professor from the University of South Carolina, gave suggestions on the economic interpretation of principal components in the paper.



WANG Yicheng

Assistant professor of PHBS

Wang Yicheng, assistant professor of PHBS, presented his paper "Taxation and Entrepreneurship in the United States," coauthored with Han Holter and Serhiy Stepanchuk. Using state-level tax variations across time to study the impact of tax progressivity on entrepreneurial activity, Wang found that there was a robust, negative relationship between tax progressivity and entrepreneurship. Based on quantitative analysis in a structural model, Wang pointed out that the model can account for empirical facts reasonably well, and heterogeneous agents would respond differently to tax progressivity changes. Zhang Lichen, assistant professor at the University of Hong Kong, suggested that it would be helpful to provide more economic intuition on how risk preference heterogeneity could affect the strength of return effect and insurance effect.

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SHI Jiao Assistant professor of PHBS

Shi Jiao, assistant professor of PHBS, introduced her paper "The Role of Exchange Rate in Monetary Policy Rules: A Welsh-based Re-examination." Using the standard two-country New Keynesian model, Shi investigated how exchange rate fluctuations could affect social welfare under demand shocks, monetary shocks, and financial shocks. In contrast to the conclusion from the optimal open-economy monetary policy literature, her quantitative analysis showed that exchange rate stabilization could improve welfare at low values of exchange rate targeting strength, but too strong a response could reverse the effect. She pointed out that the potential welfare gain from optimal exchange rate stabilization could be sizable, equivalent to 21-44% of perfect stabilization, and coordinated multilateral policies would be required to fully reap the gain. Xu Sichuang, assistant professor of the School of Economics and Management at CUHKSZ, gave suggestions on the relevance of wage gap mechanism, cross-country asymmetries, and implementation considerations.

The 2nd PHBS-CUHKSZ Economics and Finance Workshop Held at PHBS



ZHANG Bohui Professor of the School of Economics and

Management at CUHK-Shenzhen

Zhang Bohui, professor of the School of Economics and Management at CUHK-Shenzhen, introduced his paper "Sensing Economic Activities Based on the Laws of Thermodynamics," co-authored with Huang Feng and Zhao Xiaofeng. Based on the correlation between the emitted heat and the economic output under the Carnot engine model, Zhang and his coauthors studied economic growth from a thermodynamic perspective. They used satellite data to track the emitted heat and measure economic activities, and show that a city's thermal infrared radiation (TIR) is positively related to its GDP, and the correlation between TIR and GDP is stronger where the local productivity and energy efficiency are higher. Xu Zhiwei, associate professor of PHBS, provided a discussion on issues related to the study, such as economic activity counting, measurement error caused by pollution, and model setting.



YE Shuai

Assistant professor of CUHK-Shenzhen

Ye Shuai, assistant professor of CUHK-Shenzhen, talked about his paper "How Urbanization Affects Regional Wealth Inequality: the Housing Channel," co-authored with Hu Jiaofen. Using housing price data from China and the U.S., they found that lowprice houses appreciate faster than high-price houses in the same city. Ye provided two explanations for fluctuations in house prices during the process of urbanization: firstly, the shift of the house price distributions enables more households to afford low-price houses; secondly, the location value of high-price and low-price houses would gradually converge. In addition, since most low-price houses are owned by less wealthy households, the faster appreciation of low-price houses would mitigate wealth inequality. Qian Wenlan, professor at National University of Singapore, discussed several potential issues with respect to the authors' proposed interpretation, such as wealthy households' investments in low-price houses and the prevalence of rental households.

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Featured Articles

SARGENT INSTITUTE OF QUANTITATIVE ECONOMICS AND FINANCE

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As one of the leaders of the "rational expectations revolution", Thomas J. Sargent devotes himself into the establishment and development of New Classical Macroeconomics. In 1970s, Thomas J. Sargent, Robert Lucas, Robert Barro and Neil Wallace pioneered the rational expectations school, which uses econometric models to analyze the lasting effects of economic policies. Today, this theory is mainstream thinking in economics, he also ranks among the most cited economists in the world.



Thomas Sargent:

2011 Nobel Prize laureates in Economics Honorary Director of PHBS Sargent institute of Quantitative Economics and Finance

Thomas Sargent: Digital RMB is a Fascinating and Progressive Thing

Source: PKU Financial Review

In the interview with PKU Financial Review, Thomas J. Sargent, the 2011 Nobel laureate in economics, Director of the Sargent Institute of Quantitative Economics and Finance, states that, China's experimenting with a digital RMB is a fascinating and progressive thing. It seems to be very "democratic" and "egalitarian" in the sense that it provides common people access to the sophisticated "ledger-based" banking arrangements that, until now, only wealthy people and institutions have had access to.

PKU Financial Review: At a forum event, you pointed out that China could become the largest economy. However, the status of the RMB is seriously mismatched with China's economic strength. How do you see the future development and global status of RMB?

Thomas J. Sargent: This is a great question. There have been long periods of time during which the largest or strongest national economy was not also the economy whose currency was widest used internationally. For example, the British pound continued to be the leading international currency even after the US had surpassed the UK in GDP. There are many more examples. The currency of Amsterdam became a leading international currency in the early 1700s when Amsterdam was still small relative to its neighboring economies. Which currency becomes dominant for international transactions is only partly influenced by decisions of governments. Much depends on what lawyers and bankers and private businesses decide and how they choose to write contracts and in which jurisdictions they choose to enforce them.

PKU Financial Review: You have pointed out that there may be another world currency in 100 years. We are curious that will US dollar suffer the same fate as pound sterling? During the 1930s, although Britain's economy was no longer the strongest, pound sterling remained to be the world's currency, and it was eventually replaced by US dollar. In your opinion, will any currency have the possibility to replace US dollar in the future? Or will there be new weighted currencies, such as gold + SDRS?

Thomas J. Sargent: Another really interesting question. I don't know – it will be a surprise perhaps, and surprises are difficult or impossible to predict. Might it be some sort of digital currency – not actually paper at all but a sophisticated electronic ledger to which all citizens have access? It will depend partly on technologies – not only electronic but "economic theoretic" and "legal theoretic" in terms of setting up sustainable regulations that can keep transactions secure and risk-free.





PKU Financial Review: You once mentioned that blockchain will make central banks better managers. During this Winter Olympics, China is vigorously promoting digital RMB. What do you think of the fact that some central banks have entered the field of digital currency? Also, which do you think is the preferred attitude of central banks towards private crypto currencies? Should it be banned like in China, or managed with a 30% transaction fee like in India, or should it be strongly encouraged like in Japan?

Thomas J. Sargent: Good questions again! China's experimenting with a digital RMB is a fascinating and progressive thing. It seems to me to be very "democratic" and "egalitarian" in the sense that it gives common people access to the sophisticated "ledger-based" banking arrangements that until now only wealthy people and institutions have had access to.

PKU Financial Review: What do you think is the biggest change that the COVID-19 epidemic has brought to the world? Is it a change in the functioning of government, a change in society (such as inequality), or a change in global collaboration?

Thomas J. Sargent: All of the above and more, including a huge impulse to research in biology, medicine, and public health arrangements. Huge changes in the way we work – e.g., various ways of having meetings electronically facilitated by high tech companies. In some ways, strangely, this has helped foster "globalization" of scientific and academic work. I have attended a number of great online conferences in China and other places far from the US during the pandemic and these have opened my mind to new ideas. **PKU Financial Review:** During the epidemic, many people are quarantined or blocked and unable to go to work. Should they receive short-term unemployment benefits? But does the implementation of these unemployment benefits fuel their incentive to work inactively, and they are happy to be locked down, thereby eroding economic incentives in the future?

Thomas J. Sargent: A great question that highlights the tension between compassionate provision of social insurance, on the one hand, and the potential adverse incentives provided by public benefits, on the other. Some fine economic theorists have been pioneering ways of balancing these contending forces, some of the best work having been done recently in China. It goes under the term "dynamic mechanism design".

PKU Financial Review: You are one of the leaders of the "rational expectations revolution". Do you think "rational expectations equilibrium" still applies in this era of high inflation?

Thomas J. Sargent: Yes, I do think it applies. It is the equilibrium concept used by excellent young researchers in China and Europe and the US who are trying to understand the surge in inflation that has occurred most in Europe and the US after the pandemic.

HAI Wen: Broader and Deeper Reform and Opening is Necessary to Boost Economic Confidence and Expectation

Source: National Business Daily Reporter: Fu Keyou

> Hai Wen, a student of the first class (Class of '77) of Political Economy at Peking University after the resumption of the college entrance examination, is the first self-funded student who studied abroad from Peking University in 1982. In 1995, he resigned from his tenured professorship at an American university. Along with Lin Yifu, Yi Gang, Zhang Weiying and other "returnees", he founded the China Center for Economic Research at Peking University. He later served as Vice President of Peking University and founded the Peking University HSBC Business School in Shenzhen. Hai Wen has been committed to China's economic research for many years and has a deep understanding and keen insight into the development and internal structure of China's economy.



n an interview with the "Daily Economic News", Hai Wen gave a deep interpretation of the current challenges faced by domestic and international economies and how to improve the private economy.

Despite the significant impact of the epidemic on China's economy, renowned economist Professor Hai Wen expressed optimism about next year's economy in an interview with the "Daily Economic News". He said, "Because of the latest policy changes, I think GDP growth rate can reach at least at 5% next year, or even exceed 6%."

As the epidemic changes, our country is also constantly adjusting and optimizing epidemic prevention measures, and accelerating the full recovery of the economy has been put in a more important position. On December 6, the Central Political Bureau held a meeting to analyze and study the economic work in 2023. idemic prevention and control and economic and social development, better coordination of development and safety, comprehensive deepening of reform and opening up, vigorously boosting market confidence", at the same time, entrepreneurial vitality of the whole society, let cadres dare to act, localities dare to venture, enterprises dare to do, and the masses dare to

Working hard to boost the economy, fighting for a good "end-of-year battle", and "start well" for next year is becoming a common action in all places. Some economists have also proposed "opening up economic activities".

In Hai Wen's view, if you want to recover the economy as soon as possible, the biggest challenge domestically is how to enhance the confidence and expectations of private entrepreneurs and consumers for the future, especially to improve the business environment for private enterprises, giving them equal status in policy, finance, industry access etc. The biggest challenge internationally is to truly achieve broader and deeper openness.

At the same time, Hai Wen believes that encouraging and supporting industrial transformation and upgrading is itself a boost to the economy. The healthy and rapid growth of China's emerging industries will drive better economic development; while China's real estate market has been adjusted for several years, there is temporarily not much demand for speculation in housing. However, there is a need to encourage demand for improved housing. This provides space for macroeconomic policies. Facing with economic downturns, Hai Wen believes that fiscal policy is more directly effective in stimulating the economy than monetary policy.



Five Major Strategies for China's Economy, edited by HAI W Peking University Press, 2023

Discussing Economic

Recovery:

Boosting Confidence and Expectations Domestically, **Seeking Broader and Deeper Opening Up Internationally.**

Hai Wen: The Chinese economy is currently facing the most difficult situation since the early 1990s. China's GDP growth in the first three guarters of 2022 was only 3.1%, far from the annual growth target of 5.5% proposed at the beginning of the year. The data for the urban unemployment rate nationwide in October is 5.5%, and the average unemployment rate for the first 10 months is 5.6%. The unemployment rate for young people aged 16 to 24 in October was 17.9%, although it was down from 19.9% in July, it is still quite high.

There are two reasons for this. The domestic reasons, as emphasized by the central government, are mainly three pressures: contraction of demand, supply shock, and weakening expectations. International reasons are mainly global inflation, economic recession, and international relations environment represented by Sino-US friction.

Among the domestic factors causing China's economic downturn, demand contraction is a direct cause, but it is also a result of supply shock and weakening expectations.

Since this year, the spread of the epidemic and some places' excessive prevention and control of the epidemic have not only affected normal production of goods and normal operation of services but also led to interruptions in some industrial chains, and then the aggregate supply; at the same time, due to production decline, an increase in unemployment rate, a decrease in corporate and personal income has also severely affected consumption. In the first three quarters of this year, consumption growth was only 0.7%, compared with an average of 8% before the epidemic, consumption demand is seriously insufficient. The same goes for investment, with investment growth in the first three quarters of this year only 5.9% (11.5% last year).

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quickly as possible, the biggest challenge domestically is how to boost the confidence and expectations of private entrepreneurs and consumers for the future. This cannot be achieved solely by macroeconomic policies such as increasing government spending and monetary supply.

To recover the economy as

Reporter: The epidemic has brought a huge impact to the global economy. In your opinion, what difficulties are our economy facing at present?

One important reason for insufficient investment and consumption is that people's expectations for the future have weakened. In the first three quarters, the growth rate of private fixed investment fell to 2%, far lower than state-related investment growth rate (10.6%). The consumer confidence index has been hovering around 87 since April, lower than 92.4 during the global financial crisis in 2008.

Reporter: Facing with such difficulties, some economists call for "opening up economic activities". How to understand "opening up"? What is the biggest challenge to recover the economy as soon as possible?

Hai Wen: I think the "opening up" mainly means giving up excessive and outdated epidemic prevention practices, turning to more scientific, more humane epidemic prevention measures with smaller economic and social costs so that people can quickly resume normal life and engage in normal economic activities as soon as possible. Epidemic prevention is a scientific issue, but also a social and economic issue. Any policy implementation will have social and economic costs; we need to use minimal costs to achieve and safeguard maximum social welfare.

To recover the economy as quickly as possible, the biggest challenge in domestic is how to boost confidence and expectations for private entrepreneurs and consumers about future prospects.

This cannot be achieved solely by cyclical macroeconomic policies such as increasing government spending and monetary supply. More

important things are improving the business environment for private enterprises, giving them equal status in policy, finance, industry access etc., encouraging private enterprises to grow bigger and stronger, and to play an active role in innovation and entrepreneurship. At the same time, relying on private economy to create more job opportunities, increase residents' income so that consumption can be quickly restored thereby restoring economic growth.

As for internationally, the biggest challenge is how to truly achieve broader and deeper opening up through preventing economic and technological decoupling, maintaining and expanding economic trade cooperation with countries around the world, maintaining promoting multilateral trade system, and truly building a community with a shared future for mankind to achieve win-win sharing.

2023 / ISSUE 05 FEATURED ARTICLES

Reporter: Indeed, the private economy plays an important role in the national economy and has also suffered a greater impact under the epidemic. But why do you particularly emphasize improving the business environment and equal treatment for private enterprises?

Hai Wen: Regarding the confidence and development issues of private enterprises, it is not just a problem of epidemic impact. There are some fundamental problems that need to be solved, including social prejudices against private enterprises, system policy restrictions on the development of private enterprises, and some local business environments that are unfavorable to private enterprises.

Firstly, there are still prejudices against private enterprises in society. They always think that private enterprises are profit-oriented and have no social responsibility. When the COVID-19 epidemic broke out, public medical systems undertook a large amount of medical rescue work. Some public opinions came out to condemn that private medical systems were unreliable. When summarizing that a city's epidemic prevention work was done well, it was even said that it was because they did not hire private enterprises to do nucleic acid testing. Some remarks regard the bad behavior of individual people and individual enterprises as the overall image of private enterprises.

Secondly, the private economy is an important part of the socialist market economy. But because of distrust, some important industries are still not open to private enterprises. In some local government meetings,

Discussing the Private

Economy:

Eliminate Prejudices Against Private Enterprises, Treat Private Enterprises Equally.



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In theory, institution, and policy, we must truly understand and value the important role of the private economy in the development of the new era. Many tasks and challenges we are facing in the new era, including demand-driven economy, rural revitalization and common prosperity, innovation-driven development, alleviating aging pressure, strengthening international cooperation and competition, all cannot be separated from the development of the private economy.

leaders of state-owned enterprises can participate, while representatives of private enterprises cannot. It is okay for government leaders to participate in activities of state-owned enterprises. If they participate in activities of private enterprises, they may not be allowed or even questioned. The same goes for bank loans. Bad debts lent to state-owned enterprises at most are mistakes. Bad debts lent to private enterprises need to be checked for any behind-the-scenes benefits. In recent years, there have even been articles suggesting that "the private economy has completed its historical mission and should exit."

Thirdly, some local business environments are unfavorable to private enterprises. If local governments do not provide services normally but ask for "sponsorship" from private companies when needed; if supervision is "strict", law enforcement is arbitrary, and policies often change arbitrarily - under such circumstances, it is difficult for private enterprises to develop healthily. Some companies breed illegal behaviors in order to survive or obtain benefits.

Reporter: So what are your suggestions for supporting the development of the private economy and boosting confidence in private enterprises?

Hai Wen: Firstly, in theory, institution, and policy, we must truly understand and value the important role of the private economy in the development of the new era. Many tasks and challenges we are facing in the new era cannot be separated from the development of the private economy.

For this reason, the report of the 20th National Congress of the Communist Party pointed out: "To build a high-level socialist market economic system, adhere to and improve the socialist basic economic system, unswervingly consolidate and develop public ownership economy; unswervingly encourage, support, and guide non-public ownership economy development." And for the first time clearly proposed "to promote development and growth of private economy", "to improve modern enterprise system with Chinese characteristics, promote entrepreneurial spirit, and accelerate construction of world-class enterprise", "to support development of small- and micro-enterprises".

Private enterprises should truly be treated equally in terms of law, industry access, financial investment etc. Of course, they should be subject to equal requirements for supervision and social responsibility. Local governments should strive to create a market-oriented, legalized, and internationalized business environment.

Guangdong, Fujian and Zhejiang provinces have done relatively well. This year marks 20th anniversary since General Secretary Xi Jinping proposed "Jinjiang Experience". The reason why Jinjiang's private enterprises have developed well is mainly due to local government's consistent adherence to developing social productivity as fundamental direction for reform and development, adhering to market-oriented economic development, adhering to encouraging companies win through hard work, adhering to promoting healthy development of market economy with integrity, adhering to accelerating economic development based on local advantages, choosing best way that suits their own conditions, adhering to strengthen government's guidance and service to market economy.

The experience of Jinjiang government supporting development of private companies can be summarized by four principles i.e., "no interferences without request, assist when requested, walk the talk, service thoughtfully" which is very worth learning from by other local governments.

Discussing Industrial

Upgrading:



Industry 4.0

Encouraging and Supporting Industrial Transformation and Upgrading Boosts the Economy.



Reporter: At present, on the one hand, we need to boost the economy, on the other hand, we also need to intensify industrial transformation and upgrading. How to balance these two goals?

Hai Wen: Boosting the economy and industrial transformation and upgrading are not contradictory. The Chinese economy has reached a middle-income stage. After meeting basic material needs, people begin to pursue quality of life. The main contradiction in society has become "the contradiction between people's growing need for a better life and unbalanced and inadequate development."

A better life includes not only a comfortable living environment, adequate medical health protection, rich cultural and educational resources, but also high-quality and high-tech consumer goods, high-intelligence and high-efficiency services, etc. New generation information products, artificial intelligence, new energy vehicles and other emerging industries are gradually becoming an important part of China's economy.

Therefore, encouraging and supporting industrial transformation and upgrading is itself a boost to the economy.

Reporter: How should we support these emerging industries in terms of industrial policy?

Hai Wen: For the development of these emerging industries, the government should provide more support in basic research and development, rather than just providing financial subsidies. We should encourage cooperation in research and development and talent training between educational research institutions and enterprises. At the same time, we must strengthen the protection of intellectual property rights to protect enterprises' technological innovation in these fields. We need to improve the capital market, encourage enterprises to obtain funds through the capital market for faster and better development, and allow emerging industry enterprises to enhance their innovation and competitiveness through the market from the beginning.

Only in this way can China's emerging industries grow healthily and quickly, driving better economic development.



We should improve the capital market, encourage enterprises to obtain funds through the capital market for faster and better development, and allow emerging industry enterprises to enhance their innovation and competitiveness through the market from the beginning. 40

Discussing Real Estate

Regulation:

Speculative Demand for Housing is Not Large, The Problem is The Weakness for Necessary and Improvement Demand.

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On the one hand, we need to further adjust real estate policies in large and medium sized cities to release effective necessary and improvement demand for housing. On the other hand, we need to support real estate companies with relatively low leverage and relatively stable operations to alleviate their liquidity pressure and curb the spread of real estate debt risk among companies.

Reporter: The development of the real estate industry has a great impact on the entire economy. How do you think of the current situation of the real estate industry? What is the problem?

Hai Wen: Real estate is an important industry for both countries in the process of industrialization and urbanization and developed countries. The real estate industry chain is very long, involving land, construction, furniture, durable consumer goods, catering retail, property management, transportation etc.

At present, developed countries' real estate industry accounts for more than 10% of GDP. In America it's about 14%, and about 7% in China. In recent years the investment growth rate of the real estate sector, and its proportion to GDP have been declining due to China's regulatory policies. The proportion in first three quarters this year was only 6.4%.

China's real estate has been adjusting for several years. There is temporarily not much speculative demand for housing. Necessary and improvement demand for housing are also relatively weak. Sales and investment have witnessed quite obvious negative growth since the beginning this year. There are financial reasons, income decline caused by economy downturn, and also severe epidemic control measures. If the epidemic passes, population mobility normalizes along with gradual economic recovery, it is expected that the real estate demand should increase in the second half of next year.

However, improvement in real estate demand may still be relatively weak. Because there is some excess housing and house prices still have room for further adjustment in small- and medium-sized cities. Many cities are still holding up house prices. But if prices are not adjusted properly, market demand will not grow much. For large cities there are still many restrictive policies affecting the release of effective demand.

Reporter: So, what are your suggestions for optimizing real estate regulatory policies and promoting the development of the real estate market?



Hai Wen: On the one hand, we need to further adjust the real estate policies of large and medium-sized cities to release effective rigid demand and improvement demand.

On the other hand, we need to support real estate companies with relatively low leverage and relatively stable operations, alleviate the liquidity pressure of these companies, and curb the trend of real estate debt risk spreading among companies. For companies with high leverage and many operational problems, we should adopt a market-oriented clearing method to alleviate the operational pressure brought by the contraction of industry demand. We can notice that the financing policy of housing enterprises is currently being adjusted in a positive direction.

Discussing Macroeconomic

Policies:

Compared with Monetary Policy, **Fiscal Policy is More** Effective in Stimulating the Economy.

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Facing with economic downturns, fiscal policy is more directly effective in stimulating the economy than monetary policy. Increasing fiscal expenditure matched with necessary monetary policies to reduce the "crowding-out effect" of government debt on private investment and achieve the goal of quickly restoring normal economic growth.

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Reporter: In response to the impact of the epidemic, our country has also taken powerful measures in monetary policy and fiscal policy. How do you evaluate the current effect?

Hai Wen: In recent years, in the face of economic downturns, both the central bank and the Ministry of Finance have initiated proactive measures in hopes of stimulating economic growth. In terms of monetary policy, through reserve requirement ratio (RRR) cuts and interest rate cuts, M2 broad money supply has grown by 12.1% in the first three quarters of this year. In terms of fiscal policy, through tax cuts and infrastructure construction, broad fiscal expenditure has grown by 12.8%. In addition, the state issued a package plan of "33 measures in 6 aspects" in May, involving a total of about 12 trillion yuan in stimulus measures such as tax refund, special bonds for railways and aviation, and small and micro loans. It can be noticed that monetary and fiscal policies are constantly making efforts.

But at present, investment and project progress seem to be not fast enough, and economic recovery is also very slow. Here there are both "lag" problems from policy introduction to project implementation and to actual production and consumption, as well as reasons for weak expectations and insufficient confidence among enterprises and residents.

Reporter: To boost development confidence, open up economic activities, what are some "weapons" that can be provided in terms of monetary policy and fiscal policy? How to form an effective policy combination?

Hai Wen: Further efforts can be made to reduce corporate costs and enhance corporate expectations for future returns. For example, further RRR cuts and interest rate cuts can be made, especially further lowering mortgage rates to promote housing sales. China's deposit benchmark interest rate has not changed for many years. By lowering the deposit benchmark interest rate, it can reduce costs on financial institutions' liability side, encouraging financial institutions to lower loan interest rates to support the real economy

In terms of fiscal policy, special bonds can be increased to strengthen support for infrastructure construction, consumer spending by residents, medical infrastructure construction etc. The central government can increase debt financing or issue special national bonds to increase transfer payments to local governments and alleviate local fiscal pressure. The central government can also increase special bond replacement intensity for local government's hidden debts to prevent real estate risks from spreading to city investment platform-type enterprises. At the same time, relevant departments should supervise governments to implement tax cuts and fee reductions effectively. Especially, increase supervision intensity on local governments to avoid situations where local governments instead "raise taxes" indirectly when finance become more difficult.

In summary, compared with monetary policy, fiscal policy is more directly effective in stimulating economy when we are facing economic downturns. While increasing fiscal expenditure it can be matched with necessary monetary policy, reducing "crowding out effect" of government debt on private investment, and guickly restoring normal economic growth.



Algorithm Auditing is an Important Step to Ensure Data Security

Source: Economic View

n December 19, 2022, the Central Committee of the Communist Party of China and the State Council officially released the "Opinions on Building a Data Base System to Better Play the Role of Data Elements" (hereinafter referred to as "Twenty Articles on Data"). For the first time, it clearly proposed a system framework in four aspects: data property rights, data circulation and trading, distribution of benefits from data elements, and governance of data elements. The "Twenty Articles on Data" is another historic policy document after it was clearly stated that data had become a new factor of production. The important innovations in data rights confirmation. data trading, and data governance will have a profound impact on the development pattern of China's digital economy. Of course, establishing a data system is a brand new challenge. A good start has been made, with many issues still open for further discussion. The data system can also be continuously improved in exploration.

Data Confirmation System

The primary innovation introduced by "Twenty Articles on Data" is the proposal of a "three rights separation" property rights system, which involves the data resource ownership, data processing and usage rights, and data operation rights. This innovative arrangement is well-suited to the unique characteristics of the digital economy. There are many participants in the formation process of data elements, which means that it is difficult to clearly determine ownership of data like land, labor, and capital. This "three rights separation" framework does not dwell on the traditional perspective of "who owns the data", but starts from the three forms of data, clarifying the corresponding ownership, processing and usage rights, and operation rights. Centered around the "three rights separation" framework, it defines "whose data" from three dimensions: public data, corporate data, and personal data; at the same time, it also clearly states that the basis for confirming rights is "data source and data generation characteristics", which protects the rights and interests of data sources, data processors, and data users.



SHEN Yan



HUANG Yiping

The three forms of data resources, data, and data products proposed by the "Twenty Articles on Data" are the basis for establishing a property rights separation system. From accurately understanding the characteristics and functions of data, we can further clarify the "three states of data". Data resources include recorded information in the form of data that exists in various parties such as public institutions, nature, enterprises, individuals, etc.; Data products are results formed by collecting, cleaning up and processing data resources; Data assets are forms when data

Data Circulation and Trading System

products are applied to business activities.

Another significant breakthrough of "Twenty Articles on Data" is it proposes a full-process compliance and regulatory rule system based on the characteristics of data elements. This document systematically answers six major questions in data trading and circulation: first, what kind of data can circulate; second, how to assess data quality; third, what hardware and software preparations are needed for data circulation; fourth, where is data circulation completed; fifth, how is data priced; and sixth, how to control data quality.

This framework fully considers the challenges in supply, demand, and trading links caused by the characteristics of data elements, which are different from traditional production elements. Data contains personal privacy and commercial secrets, and also is characterized by non-exclusivity, non-competitiveness, and non-exhaustibility. At the same time, the conflicts of information asymmetry are very prominent, so data cannot circulate in the market like land, labor, and capital. Therefore, to establish a sound data trading market system, it is necessary to solve the difficulties in the data supplier, data demander, and data trading link. The most prominent problem may be the lack of effective supply of data and the lack of brand data. There are many demands for data, but the benefits of trading or circulation are small, and the compliance risks and security risks are high, making the data supplier not want to sell or dare not sell. There is a lack of effective supply, and there are also problems for the data demand such as difficulties in finding suitable data, comparing three goods, internal and external integration, and security protection. In addition, in the trading link, there are also problems such as the rigid mechanism of data trading and difficulties in resolving disputes over data trading.

The "Twenty Articles on Data" is strongly innovative and leaves room for future development by breaking through in two dimensions: increasing effective supply and improving data trading efficiency. In terms of trading venues, the focus is mainly on "coordinating the construction of standardized and efficient data trading venues", proposing "guiding various types of data trading venues to develop together, highlighting the compliance supervision and basic service functions of national-level data trading venues". In the foreseeable future, it may be necessary to pay special attention to the importance of over-the-counter transactions, at least as an important supplement to regular exchange transactions.

At present, there are three common types of data trading models: the first type is the point-to-point mode, primarily involving companies that spontaneously sign contracts for data or data development transactions; the second type is the data intermediary. The most common one is the data broker who acts as an intermediary to connect the supply and demand sides of data transactions. On the one hand, they collect and develop data; on the other hand, they provide data or value-added services related to data according to specific needs; the third type is the data bazaar mode that builds a platform for data transactions. Data exchanges are one form of the data bazaar mode.

From a global perspective, establishing data markets is quite challenging, and their scale remains relatively small. According to Maximize Market Research, the global data brokerage trade was approximately \$257.2 billion in 2021 and is expected to reach \$365.7 billion by 2029. Meanwhile, Grand View Research's statistics show that the global data market size was \$780 million in 2021 (with B2B data markets accounting for 58% of revenue share), and it is expected to reach \$5.09 billion by 2030. There are also numerous examples of data markets failing or closing, such as Microsoft's Azure DataMarket (closed in 2018), Kasabi (operational from 2010-2012), Austria's Data Market Austria, Swivel.com, etc.

The data shows that the prevailing model relies on branded data brokers for data trading. In the United States, many industries have typical data brokers, such as Corelogic, which covers more than 99% of residential and commercial real estate data in the United States.

The challenge of data trading lies in the high degree of information asymmetry and the difficulty of establishing trust. A successful trading model must effectively solve this problem. Point-to-point is feasible because the supply and demand sides meet and match directly. Data brokers dominate because intermediaries can help reduce information asymmetry and increase trust. The progress of exchanges is limited because it is difficult to standardize data products unless the exchange also acts as a data broker or introduces a large number of data brokers. Now that the data trading market system has just begun to be established, it is advisable for both the "effective market" and "active government" to work together. If data brokers have the ability to solve problems, there is no need to worry too much about whether it is on-exchange or off-exchange trading. Of course, off-exchange trading must also be fully regulated.

Exploring the Algorithm Review System

The "Twenty Articles on Data" proposes that the goal of data governance is to "create a safe and trustworthy, inclusive and innovative, fair and open, and effectively regulated data element market environment", and for the first time mentions the establishment of an "algorithm review" system. Algorithms have made significant contributions to improving operational efficiency in the digital economy and controlling credit risks. At the same time, problems such as algorithm black boxes and algorithm discrimination are also frequently reported. The key is that most collaborators and consumers in the digital economy cannot judge the fairness of algorithms at all, and regulatory authorities cannot truly achieve penetrating supervision under the current policy framework. Therefore, "algorithm review" is an important step in ensuring legal and compliant operations.

But the "Twenty Articles on Data" does not clearly specify who will conduct algorithm reviews and how to implement it. The core of algorithm governance has three levels: the first one is for enterprises to implement compliance management themselves and formulate technology ethics guidelines, adhering to the orientation of technology for good; the second one is to establish an algorithm filing mechanism, which can at least make rules transparent to regulatory authorities; the third one is for regulatory authorities or entrusted third parties to organize algorithm audits regularly or irregularly, and can also be initiated when receiving complaints from other market participants. A feasible path in the future is "algorithm auditing" executed by market institutions with rules set by regulatory authorities.

Algorithm auditing refers to collecting data generated by algorithms in specific contexts and evaluating the legality and fairness of algorithms based on this information. The U.S. President's Office clarified the direction of promoting algorithm auditing in a report in 2016. From industry experience, leading audit companies are also actively participating in algorithm auditing, such as Deloitte's external algorithm auditing services for government clients, setting up algorithm auditors, and clarifying algorithm auditing toolboxes etc. China can learn from international experience, further clarify the path of algorithm auditing, specific framework and evaluation scale, and build an algorithm auditing system.

Algorithm auditing generally has two ideas: one emphasizes algorithm code transparency, and the other emphasizes evaluation of input/output and results. In arrangements that emphasize algorithm code transparency, companies are required to provide core algorithm programs for independent third-party companies or public institutions to directly evaluate whether the algorithm program is reasonable. The downside of this arrangement is that it may involve core business secrets of audited companies, and thus result in being rejected, and review agencies cannot verify whether the provided algorithm is actually used. In audit arrangements that emphasize input/ output and results evaluation, input audits require platforms to clarify what key dimensions they rely on when providing personalized services. Output audits require platforms to report what kind of goals they are pursuing based on algorithms, and report related performance of algorithms and evaluate related performance.

Algorithm-using organizations should report algorithm arrangements from multiple dimensions: the first one is predictive or optimization goals and specific indicators, clarifying the consideration of the interests of different stakeholders during algorithm design; the second one is data used in algorithm training, evaluation, and selection, including data collection, exclusion, and representativeness; the third one is algorithm technology, especially the comparison and selection of different technologies; the fourth one is algorithm operation performance, including prediction accuracy and the interests of stakeholders; the fifth one is arrangements for personal information protection and data security. Additionally, algorithm auditing should consider some basic indicators, including discrimination, effectiveness, transparency, direct impact, safety, and accessibility. Of course, in the specific execution process, some specific choices and arrangements can be made for evaluation indicators according to the characteristics of the business. By scoring algorithms according to compliance levels in the above dimensions and their sub-items, it helps stakeholders and the public to have a comprehensive understanding of the platform's algorithm compliance level, thereby encouraging enterprises to develop themselves with compliant algorithms and promote the healthy growth of China's digital economy.

2023 / ISSUE 05 FEATURED ARTICLES

01

Search and Matching In Macro Finance

Reporter: The first part of our question is mainly about this course - Search and Matching in Macro Finance. Can you briefly introduce the field of macro finance? How is the analytical framework of macroeconomics combined with financial economics?

Zhang Shengxing: The theme of this course is the application of search and matching theory in macro finance. I think this issue is important because traditional macro financial analysis usually assumes that markets are frictionless, that is, they are all completely competitive markets, but it is not a reasonable assumption. The development of research in the field of macro finance now is to investigate how to break through the previous analytical framework so that we can understand how market frictions in reality affect resource allocation and policy transmission of the real economy. In this context, search and matching theory has a very good application because the basic assumption of search and matching theory is that there are these search and matching frictions in the market. In macroeconomic modeling and financial market structure, introducing market frictions can enable us to better understand the price determination mechanism and transaction occurrence mechanism in reality, make our models more realistic, and be able to get some more reasonable policy suggestions.

Reporter: You and Professor Ricardo Largos recently published an article on *Econometrica* "The Limits of onetary Economics: On Money as a Constraint on Market Power" which deeply explores the medium of exchange function of money. How to understand "onetary economics", and the constraint on market power formed by money?

Zhang Shengxing: The starting point of our article title is monetary economics itself. We just removed the letter m from monetary economics. The main object of analysis for monetary economics is money, but in modern popular monetary economics analytical framework, which is New Keynesianism's analytical framework, money does not play a role as a medium of exchange. Their analytical framework is actually an environment without money. In this environment, money only plays a role as a unit of account, which is an accounting measure. So we humorously removed m from

ZHANG Shengxing

Department of Economics at LSE, a visiting associate professor at Peking University HSBC Business School, a Ph.D. in Economics from New York University, and an alumnus of the School of Economics at Fudan University, is a young leader in the field

ZHANG Shengxing: Search and Matching in Macro Finance

e is engaged in research on monetary theory, monetary policy, financial markets, safe assets, etc., and has published many influential papers in economic journals such as *American Economic Review*, *Econometrica, Review of Economic Studies*, and *Journal of Economic Theory*. He serves as a member of the editorial board of the *Review of Economic Studies* and the associate editor of the *Journal of Economic Theory, International Journal of Economic Theory and Mathematics and Financial Economics*. In March 2023, Professor Zhang was invited

to visit Fudan University to give a lecture on Jiang Xuemo's economics lecture course: Search and Matching in Macro and Finance; and gave a lecture on the quantitative economics and finance lecture series: International Trade Finance and Learning Dynamics. During his visit to Fudan University, Professor Zhang had exchanges with many teachers in the School of Economics, answered academic questions for students, and accepted our interview to further give his views on issues of interest to people. monetary economics and called it onetary economics. This is why we chose this name. The basis for New Keynesian analytical framework is a frictionless financial market. What our article wants to explain is that his starting point was biased. At least in reality, there are frictions in the financial system. Therefore, these analyses based on frictionless assumptions will have some limitations. We believe that the most important friction is the monopoly power of financial intermediaries and private payment clearing systems. Using monopoly power to seize value in the market will bring negative impacts to the entire real economy. Against this backdrop, money will play a very important role in constraining these monopoly powers. Our analysis found that this constraint effect still works even when money is not actively used. So even if reality is a cashless society, central bank money can still have an actual impact on the real economy through trading media channels by constraining these private payment clearing system's monopoly power.

Reporter: The last part of our lecture talked about search and matching frictions in the real estate market. How do you understand the role of search and matching frictions in the real estate market? Can you give some examples from reality?

Zhang Shengxing: I think search and matching theory has a good application in the real estate market because the real estate market in reality is a market with not small frictions. When people buy houses, they may need to spend a long time looking for houses that meet their needs, and different types of real estate will have large differences in returns. The empirical papers we mentioned in class also found this phenomenon. This heterogeneous return tells us that there is a large segmentation in the real estate market. The so-called segmentation refers to the fact that although we regard the real estate market of a country or a city as a market, it actually contains many small markets. There will be some kind of barrier between each small market in a certain sense. Barriers may include income level, since poor people may trade in places with lower house prices, while rich people will go to other real estate markets; barriers may also include work location, for example, if I work near Fudan University, then the real estate market I am interested in is limited to the area near Fudan University. These various heterogeneities in the market will bring about segmentation of the real estate market, so the government's real estate policy makers need to analyze what kind of impact such segmentation will bring. Therefore, search and matching theory is very useful in this context.

02 Applications of Monetary Economics

Reporter: With the rise of digital currency and the rapid development of the platform economy, how will the functions of money change under the current background? And how will it affect the direction of monetary policy?

Zhang Shengxing: The paper we just mentioned about onetary economics discusses a cashless monetary economy. In the current digital economic environment, the banknotes or digital currency issued by the central bank are not often used by people, but they still play a "minimum guarantee" role. The so-called "minimum guarantee" refers to the fact that if there is no central bank currency, then everyone can only use payment platforms like Alipay. Then Alipay will have a large market monopoly power and it may be able to use this monopoly power to charge high usage fees to merchants or individuals. The reason why this situation has not happened in reality is because the central bank provides us with a backup option -- digital currency. As long as the cost of using digital currency is not that high, even if it is not actively used, it can also restrain platforms like Alipay from charging too much because if they charge too much, people may turn to use digital currency. From this perspective, building a digital currency system has great practical significance.

Of course, digital currency also has many other applications. For example, digital currency can make everyone's transaction information generated when using these currencies concentrated on the central bank or government's hands so that the information can be uniformly managed and coordinated to provide some additional information for some credit policies such as loan policies. If there is no digital currency, the information may be concentrated on private platforms like Alipay, causing information fragmentation. Even if the central bank's digital currency itself does not have higher value, it has government endorsement behind it. Therefore, it can enhance the welfare of the whole society, prevent information fragmentation, prevent repetitive production and repeated investment, and effectively improve the efficiency of economic operation.

Reporter: Are there search and matching frictions in international capital markets, such as the foreign exchange market? What role do multinational financial intermediaries play in alleviating these frictions and providing market liquidity? In the context of international financial or international trade imbalances, how to understand the global transmission of monetary policy?

Zhang Shengxing: One issue that is highly emphasized in international finance research is that which currency is used to price international trade and international capital flows. The reason why pricing is so important is that it goes back to the New Keynesian analytical framework. For example, if it is priced in US dollars, and the price in US dollars has a certain stickiness, then changes in monetary policy can be transmitted to the real economy through price stickiness. Another angle that people pay less attention to is that in addition to playing the role of a unit of account in the international economy, money also plays the role of a medium of exchange. The most important medium of exchange in international trade now is the US dollar. It is not only a unit of account that people tend to use, but also a currency that people need to use in actual payments. For example, if trade needs to be paid in advance, then what currency people generally use to pay is relatively important because it will affect the different exchange risks faced by importers and exporters.

Reporter: The next question is about some frontier issues in monetary economics research. Previously, the market expected the Federal Reserve's interest rate meeting this month might raise interest rates by 75 basis points, but due to the scandal at Silicon Valley Bank, the meeting only raised interest rates by 25 basis points. The Federal Reserve's monetary policy changes have attracted wide-spread attention around the world and will have a significant impact on global bank liquidity and financial risks. So what areas do you think researchers can explore in monetary economics that can be combined with reality?

Zhang Shengxing: I think this collapse of Silicon Valley Bank and the bank crisis that may still be fermenting tell us a very important research direction, which is the impact of monetary policy on the financial system. This angle is largely ignored in the mainstream New Keynesian monetary economics analytical framework because their analysis is based on the assumption that there are no frictions in the financial system. The mainstream analytical framework mainly focuses on how monetary policy affects the real economy and how it affects inflation, etc., and the Federal Reserve's interest rate hike policy is largely influenced by this mainstream analytical framework. They raise interest rates because they are worried about high inflation, but they may not pay much attention to the negative impact that raising interest rates will have on the financial system. Then, if monetary policy is too tight, it may lead to a huge crisis in the global financial system. However, we cannot make a judgment now because the incident may continue to ferment. So these events tell us a very important research direction, which is to explore how monetary policy affects the operation of the financial system.

03

Academic Experience Sharing and Guidance Suggestions

Reporter: How did you first become interested in the field of macro-finance? In the process of transitioning from "student" to "researcher", what do you think is the most important thing?

Zhang Shengxing: I think the most important thing is to find a research question that you are interested in. The socalled interest is not mainstream issues that everyone pays attention to, but what issues we have the most personal feeling from our own experience. Research interest is a basic starting point for scientific research and learning. Of course, whether your research is successful or not may not only depend on your own research interest, but also depend on the relevance of your research interests to current social hotspots. But I think this is the second step. If you have your own research experience based on this interest, and then you can apply your research experience to issues that the society is more interested in.

I personally became interested in macro finance mainly because I studied finance during my master's degree and economics during my doctorate. I think I have some knowledge reserves in both areas, so I might have some advantages in doing macro finance research. On the other hand, my initial research interest was not in macro finance at all, but more in traditional search and matching theory issues, such as the bilateral matching problems in marriage markets. But I accumulated some experience through my preliminary research attempts, and then my doctoral advisor Ricardo Lagos suggested that I apply the experience accumulated in research to discuss search matching theory in financial markets, so I gradually turned to macro finance research. Namely, I found an overlap between the society's interests and my own interest.

Reporter: Do you have any advice for students who want to engage in or are already engaged in macro-financial research? What are some important issues that students need to pay special attention to in this field?

Zhang Shengxing: From my current perspective, it is best to start from the problem when doing research. First, consider which problem you think is particularly important, and then think about what tools you can use to study this problem. With such a problem-oriented starting point, and then based on the research tools needed for this problem to accumulate some research experience, this targeted approach can make your scientific research more efficient. The important thing when doing macro research is to be able to grasp some important issues and then continuously deepen everyone's understanding of these issues.

Reporter: We understand that Professor Zhang, you graduated from New York University and are now teaching at the London School of Economics. During your economic research, you have worked with many top scholars, such as Nobuhiro Kiyotaki, John Moore, Ricardo Lagos, etc. Could you please share some of your experiences studying in the United States or your experiences working with these scholars?

Zhang Shengxing: I think this is a bit like a random match in search and matching. I think I am also guite lucky to have found a good mentor like Ricardo Lagos, with whom I discussed some of our research problems during my Ph.D. After graduating with my doctorate, I was able to go to a school like the London School of Economics to start my academic career, where I had the opportunity to come into contact with famous economists like Nobuhiro Kiyotaki and John Moore. After having these opportunities, I gradually learned a lot of experience from them. At the same time, I also learned the rigorous academic spirit. When writing a paper, I need to scrutinize every aspect of the theory and study all kinds of situations in the model. In terms of choosing research questions, Professor Kiyotaki often says that scholars should be lions, looking for important research questions that no one has yet addressed, rather than hounds, waiting for leftovers behind lions. This also prompts me to constantly think about finding important research questions.



Xiao Ma

Assistant Professor, HSBC School of Business, Peking University, Ph.D. in Economics, University of California (San Diego), United States

From 1980 to 2005, the share of global trade of "Made in China" goods grew from 0.8% to 13%, solidifying China's position as the "world's factory." However, quantitative research on sources causing China's export surge remains relatively scarce in academia. Assistant Professor Xiao Ma and coauthors found that labor migration contributes to export promotion not only through optimizing labor allocation across regions (labor flows into more productive provinces and industries, thus enhancing China's overall productivity) but also through an increase in export intensity (labor flows into export-oriented provinces and industries, thereby boosting China's overall export strength). Empirical analysis indicated that labor inflow also leads to local enterprise growth, and changes in import tariffs prompt companies to alter their trading modes.

Based on empirical evidence, Assistant Professor Xiao Ma and coauthors constructed a spatial general equilibrium economic model that considers labor mobility, firm location and regime choices, and inter-sectoral input-output linkages. Quantitative analysis based on the model revealed that the reductions in tariffs and migration costs jointly account for 30% of China's export growth between 1990 and 2005. Further research suggested a positive interaction between reduced migration costs and changes in tariffs: decreased migration costs encourage labor inflow into export-oriented provinces and industries, thereby enhancing the impact of trade liberalization. Finally, this study showed that considering interregional mobility of firms and labor is crucial for estimating the effects of China's labor and tariff policies.

Academic Frontier

HIGHLIGHTS OF ACADEMIC FINDINGS BY PHBS FACULTY

Migration, Tariffs, and China's Export Surge

Journal of International Economics (Volume 140, January 2023)



WANG Pengfei

Vice Dean of Shenzhen Graduate School of Peking University, Dean of HSBC School of Business and Chair Professor of Economics at Peking University

A Theory of Housing Demand Shocks

Journal of Economic Theory (Volume 203, July 2022)

In standard business cycle models, housing demand shocks are a primary source of housing price fluctuations and can lead to macroeconomic volatility through the credit collateral channel (lacoviello and Neri, 2010; Liu et al., 2013). However, in macroeconomic theory, this crucial shock has lacked a clear microeconomic foundation. Additionally, because housing demand shocks simultaneously affect the utility of renting and buying, such models often struggle to explain the pro-cyclicality and high volatility of the price-to-rent ratio (sale-to-rent ratio) observed in reality.

Professor Pengfei Wang and coauthors address this gap by developing a heterogeneous expectations general equilibrium model that provides a microeconomic basis for commonly used housing demand shocks in the literature. In this model, individual investors have varying expectations about the utility generated by future housing. Investors with positive future expectations choose to buy houses with mortgage constraints, while pessimistic investors opt not to hold real estate. Housing rents primarily depend on income levels and housing utility, unaffected by credit conditions.

The research shows that an expansion in credit supply increases the housing demand of optimistic buyers, pushing up prices without affecting rents. Credit supply shocks also explain the positive correlation between housing transaction volume and prices. The study's conclusions are grounded in empirical observations and receive confirmation through empirical testing, providing reliable theoretical guidance for studying real estate regulatory policies.



Xiaoming Cai

Associate Professor at HSBC School of Business, Peking University, PhD in Economics, Free University of Amsterdam

In competitive search (also known as "directed search") models, workers can observe the **explicit wages** for job vacancies in the market **before applying**. Higher explicit wages attract more job seekers, but also imply lower company profits. Existing literature identifies two micro foundations for competitive search equilibrium: the first assumes that there is no market maker and companies can choose explicit wages, while the second assumes that market makers organize search markets by coordinating the explicit wages of different companies. In classic models, since workers can only apply to one company in one period, the competitive search equilibrium results in the above two different micro foundations are the same.

Associate Professor Xiaoming Cai and coauthors took into account the important practical feature of workers being able to apply to multiple companies at the same time, and found that the two different micro foundations mentioned above can lead to different equilibrium results. Under No Market Maker Hypothesis, companies independently choose explicit wages without intermediaries. In this case, when a company selects a new, non-equilibrium explicit wage, workers applying to that company will also apply to other firms with equilibrium wages. Since different companies may compete for the same worker (a phenomenon known as "poaching" in the labor market), such companies impose negative externalities on other firms adhering to equilibrium wages. Consequently, competitive search market equilibrium is not efficient, and expected returns for companies are lower than their marginal contributions to social surplus.

In Market Maker Framework, when a market maker organizes a new, non-equilibrium search market, workers deciding to participate in the new market allocate all their applications to it. The market maker can internalize the negative externalities caused by multiple applications from workers to companies. In this case, due to the absence of externalities, competitive search market equilibrium is effective.

On the Foundations of Competitive Search Equilibrium with and without Market Makers

Journal of Economic Theory (Volume 208, March 2023)



Aoxiang Yang

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The Price of Higher Order Catastrophe Insurance: The Case of VIX Options

The Journal of Finance (Volume 77, Issue 6, December 2022)

The VIX options based on the VIX index were launched by the Chicago Board Options Exchange (CBOE) in 2006, and are widely traded today. Both VIX call options and SPX put options serve as "disaster insurance" for investors, and their functions highly overlap. However, why do investors still demand VIX options when SPX options are already widely traded? This is the question addressed by the paper.

The empirical part of the paper investigates two main issues. First, **pricing of VIX options**. This paper uncovers some interesting findings not explored in previous literature. Second, **relationship between VIX call options and SPX put options**. The study reveals that the relationship between the two significantly varies with the economic cycle. During "recession" periods, the two are closely related; during "expansion" periods, their correlation is weak.

The theoretical part of the paper develops a general equilibrium model based on consumption to explain these findings. In "expansion" periods, cash flow risk dominates, affecting only SPX options. In contrast, during "recession" periods, discount rate risk becomes more critical, impacting both VIX and SPX options. The model not only explains VIX and SPX derivative data but also sheds light on traditional asset pricing puzzles such as equity premiums, low risk-free rates, variance risk premiums, and short-term predictability of equity returns. As such, the model represents a cutting-edge contribution to the literature on general equilibrium asset pricing models. Additionally, the model reveals the necessity of considering "recursive preferences" and "two factors" when interpreting VIX derivative prices¹.



Karol Mazur

Assistant Professor at HSBC School of Business at Peking University, Ph.D. in Economics from the European University College in Italy.

In many countries, student loans are essential tools of financing higher education for students from disadvantaged backgrounds. This policy is considered a welfare measure to enhance students' educational opportunities. However, investing in higher education also carries risks, such as student enrollment uncertainty, high dropout rates, and potential future income shocks. To address this, policymakers in many countries have adopted an "Income-Contingent Loan" (ICL) program to finance higher education, under which repayments depend on the borrower's current labor income. How do we assess the welfare benefits of this policy and the moral hazards and adverse selection it may trigger?

The author highlights that the level of outstanding student debt in the United States currently reaches nearly \$1.8 trillion, and at the same time, almost half of college enrollees in the US drop out before obtaining a bachelor's degree. To evaluate the impact of the ILC reform in the US in 2009, the author constructs a general equilibrium lifecycle model of college education risk, and conducts empirical research using microdata (the Current Population Survey, Panel Study of Income Dynamics, and National Longitudinal Survey of Youth) and aggregate data.

The study reveals that after implementing income-contingent loan policies in the United States, college enrollment rates increased by approximately 5%, and graduation rates improved by about 2%. Clearly, by reducing risks associated with student debt repayments and subsidizing education, this policy stimulates higher college enrollment and graduation, benefiting most people in the economy. Furthermore, the moral hazards and adverse selection triggered by this policy are second-order importance in equilibrium. Intuitively, moral hazard is found to be secondary because it is primarily driven by significant wage premiums (currently around 190% in the United States) available upon successful graduation from college. Similarly, considering insufficient human capital supply due to economic forces, adverse selection remains mild. The financing adjustments required for this policy are also minimal due to increased equilibrium supply of human capital for production. The study also finds that the endogeneity of skill premium slightly improves effectiveness of income-contingent loan policies. Overall, the positive welfare benefits gained from this policy are equivalent to approximately a 1% increase in lifetime consumption for all members of society.

Finally, through two comparative static exercises, the author investigates how poverty threshold, repayment rate, and the upper repayment limit affect effectiveness and incentives generated by income-contingent loan policy. For instance, setting a high enough level of the poverty threshold can increase welfare gains from this policy by up to 25%, while reducing the upper repayment limit to a quarter of status-quo may boost welfare effects by at most 15%.

College Education and Income Contingent Loans in Equilibrium

Journal of Monetary Economics (Volume 132, November 2022)



Baixiao Liu

Associate Professor of Finance, HSBC School of Business, Peking University, PhD in Finance, Purdue University, USA

Media Partisanship and Fundamental Corporate Decisions

Journal of Financial and Quantitative Analysis (Volume 57, Issue 2, March 2022)

In 2000, Professor Luigi Zingales of the University of Chicago pioneered a groundbreaking research direction on the impact of news media on financial markets in his classic article "In Search of New Foundations" published in the Journal of Finance (JF). Over the next two decades, numerous research papers in related areas emerged and were published in top international finance journals. Most of these studies treat all media as a unified entity that fairly, justly, and objectively reports factual information. They analyze the combined textual content of all media regarding the same economic entities or events, concluding that media play a significant role as an information intermediary in financial markets and optimal decision-making for companies.

However, news media's objective is not always accurate information reporting; it aims to maximize audience engagement and, consequently, media profits. As a result, competition among media outlets for audience attention can lead to biased reporting due to confirmatory bias. So, does the reporting bias of different media outlets influence corporate decision-making?

Professor Baixiao Liu and coauthors address this question by applying interdisciplinary theory. They introduce research findings from political journalism that examine how news media's reporting bias due to partisan differences affects U.S. political elections into the study of corporate decision-making. Their research reveals that Fox News, which has a Republican-leaning bias, systematically alters its reporting on macroeconomic data based on the party affiliation of the U.S. president. For instance, during the George W. Bush presidency, Fox News was significantly more optimistic in its coverage of macroeconomic data than other mainstream news outlets, while during the Bill Clinton presidency, it was more pessimistic.

Leveraging this exogenous variation in media bias and considering that Fox News was expanding significantly around 2000 (reaching over 50% of households by 2003 from an initial 20%), their study finds that Republican-leaning corporate managers located where Fox News was accessible became significantly more optimistic and aggressive in their investment and financing decisions. Specifically, they increased fixed asset investments, R&D expenditures, the number of employees, and financial leverage.

This study provides the first empirical evidence of the negative impact of media reporting bias on corporate decision-making. It challenges long-standing assumptions about how news media influence financial markets and corporate decision-making, and opens up new dimensions for future research in this field.



Yicheng Wang

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In this research, the authors collected **Norwegian government** official data spanning the past **30 years**, including tax data, wealth data, employer-employee matching data from the labor market, and investment data from financial markets. They constructed panel data that encompassed specific information about family income, wealth, different components of wealth, consumption, and labor market details. Using a range of econometric tools such as instrumental variable analysis and difference-in-differences analysis, they investigated the causal relationship between individual income volatility shocks and risk assets.

Consistent with a set of characteristic facts, the authors developed a **quantity-structured model** based on heterogeneous microeconomic agents and conducted counterfactual analysis. The baseline model effectively predicts the relationship between family income volatility and risky financial assets, aligning closely with empirical findings.

The study reveals that when individual income risk doubles, families reduce their holdings of risky financial assets by 5%. The quantity-structured model analysis indicates that if family income risk can remain stable due to policy interventions (i.e., not varying over time), social welfare would increase by approximately 4%. Conversely, if families cannot freely adjust their financial asset positions, social welfare would decrease by around 1%.

This paper contributes in three main ways to the study of income volatility shocks. First, it utilizes rich household consumption and investment survey data with consistent and compelling empirical results. Second, it constructs a novel quantity-structured model that incorporates elements including finite lifecycles, individual income volatility shocks, and incomplete financial markets. The model creatively introduces **Idiosyncratic volatility shocks**, which capture second-moment impacts. Calibration and estimation are performed for this structural model. Finally, the paper conducts welfare analysis for different households and examines how progressive income tax systems influence households' choices of financial assets.

Income Volatility and Portfolio Choices

Review of Economic Dynamics (Volume 44, April 2022)



WANG Pengfei

Vice Dean of Shenzhen Graduate School of Peking University, Dean of HSBC School of Business and Chair Professor of Economics at Peking University

Asset Bubbles and Foreign Interest Rate Shocks

Review of Economic Dynamics (*Volume 44, 2022*)

The global financial crisis of 2008 reignited people's attention to asset bubbles. It is commonly believed that the U.S. Federal Reserve's excessively low interest rate policy in the early 21st century fueled the U.S. real estate bubble, and its collapse eventually led to the unprecedented financial crisis. When bubbles emerge, asset prices, investments, and capital inflows all appear prosperous, but sudden and significant reversals often follow. By contrast, emerging economies seem more susceptible to the influence of these "bubble-driven" crises. Therefore, understanding and quantifying the impact of foreign interest rates on bubbles is crucial for explaining business cycles in emerging economies.

Professor Pengfei Wang and coauthors establish and evaluate a dynamic stochastic general equilibrium (DSGE) model that incorporates asset bubbles, aiming to understand how foreign interest rate shocks affect macroeconomic fluctuations and asset prices in emerging economies. The paper extends recent work on asset bubble theory within infinite-horizon models based on idiosyncratic shocks and credit frictions to a small open economy framework.

The study conducts steady-state analysis regarding the impact of foreign interest rates on bubbles in an infinite-horizon small open economy. The results demonstrate that low foreign interest rates lead to capital inflows and lower domestic interest rates, thereby fueling domestic asset bubbles. As foreign interest rates rise, bubble sizes decrease, and when foreign interest rates become sufficiently high, asset bubbles burst. These findings extend existing research results for closed economies.

The paper's most significant contribution lies in its quantitative assessment of the impact of foreign interest rate shocks with Bayesian estimation methods by applying their model to Mexican economic data from 1990 Q1 to 2011 Q4. The study finds that their estimated model broadly aligns well with actual data on Mexican business cycles (including stock prices). Moreover, the model's impulse responses to foreign interest rate shocks estimated in the paper closely match observed responses. Overall, this research highlights the crucial role of foreign interest rate shocks in explaining various economic indicators, such as net exports/GDP ratios, stock prices, and investment changes. The amplification and transmission mechanisms provided by asset bubbles play a significant part in generating these effects. Additionally, by comparing models without asset bubbles, the paper further explores the origins and propagation mechanisms of bubbles.



Karol Mazur

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In rural areas where agriculture dominates, **irrigation** provides valuable insurance against aggregate weather shocks. Besides, rural communities in many developing countries have established insurance (or risk-sharing) networks to mitigate shocks on rural income through informal loans or physical transfers. Economic cooperation in rural areas is largely voluntary, and **irrigation** and **informal insurance** mechanisms can interact: insurance achieved through **irrigation investments** may affect the demand for informal insurance, and vice versa.

In rural India, **irrigation policy** is particularly high on the government's agenda. To explore this intertwined relationship, researchers conducted empirical studies in Indian villages, quantitatively analyzing the dynamics. They constructed a structural equilibrium model of risk-sharing and irrigation investment under voluntary participation (or "limited commitment"), which shows that the two institutions reinforce each other under a decentralized management structure. Communities have an advantage over external government institutions because they can adjust irrigation channels based on local insurance network cooperation. Thus, **irrigation infrastructure** serves a dual purpose: providing insurance against weather shocks and incentivizing deeper cooperation in risk-sharing. Furthermore, as risk-sharing network functionality improves, communities can allocate irrigation investments more effectively. However, when irrigation management is undertaken by external government agencies, it is perceived as a traditional non-excludable public good. Therefore, increasing government-managed irrigation supply may crowd out incentives to participate in local insurance networks.

The authors drew dynamic evidence from long-term panel data spanning from the late 1970s to the early 2000s in three Indian rural villages. They estimated a structural model and conducted counterfactual analysis. In the first counterfactual analysis, they confirmed mutual reinforcement effects under decentralized irrigation management. The study revealed that without risk-sharing, social welfare would decrease by an average of 6%, reflecting losses in efficiency of consumption insurance and irrigation investment. If cooperation in irrigation investment is lacking, the reduction in social welfare would be equivalent to an average permanent consumption decline of 3%. As informal insurance network functionality deteriorates, this figure represents not only insurance losses against aggregate shocks but also losses against specific shocks. In the second counterfactual analysis, the authors indicated that although government-managed irrigation appears free from a local community perspective, it has a negative impact on incentives for local cooperation, while simply canceling government-managed irrigation could significantly improve welfare. The authors suggested that public funds from central government should be better used to jointly support locally managed irrigation investments.

Sharing Risk to Avoid Tragedy: Informal Insurance and Irrigation in Village

Journal of Development Economics (Volume 161, March 2023)

Economies



JIA Dun

Associate Professor at HSBC School of Business, Peking University, Ph.D. in Economics, University of Maryland, United States

Dynamic Price Competition, Learning-By-Doing and Strategic Buyers

American Economic Review (Volume 112, April 2022)

The goal of maximizing market efficiency often faces a contradiction between the concentration of production by a single efficient firm or the decentralized operation of multiple firms to maintain market competition mechanisms. Classic dynamic pricing competition theory finds that aggressive pricing strategies adopted by firms during market competition can lead to premature firm exits, resulting in medium to long-term market monopolies. Especially when firms experience "learning-by-doing" effects during production, aggressive pricing significantly reduces overall social welfare. Antitrust policies often regulate and penalize such firm behavior.

Professor Jia Dun and coauthors model the often-overlooked demand side within the classical framework by introducing consumers with both "strategic and forward-looking" behavior. These consumers can choose from which firm to obtain products for consumption, indirectly balancing the operational efficiency of different firms to maximize their own long-term utility. Demand-side strategic behavior can render aggressive pricing strategies ineffective, thereby maintaining a competitive market environment with multiple firms in the medium to long term, and enhancing consumer welfare and overall social welfare in the meantime.

This research has significant theoretical contributions and practical implications:

1. The study finds that even with a small proportion or low level of strategic consumers, the multiple equilibrium problem inherent in classic dynamic firm pricing frameworks is no longer significant, especially the market monopoly equilibrium can be eliminated. And the market has a high probability of achieving full competition equilibrium in the medium to long term.

2. The study makes important methodological contributions to solving firm pricing game models. By using a novel recursive, backtracking induction algorithm as an alternative to the classic homotopy algorithm for determining "equilibrium sets," it verifies whether equilibria with certain features exist (where, once a leading firm surpasses an experiential threshold, its competitor's exit leads to permanent monopoly). This provides evidence supporting the uniqueness of market equilibrium and helps avoid equilibria resulting from aggressive pricing.

3. At the industry level, this research reveals that considering supply-side pricing behavior alone is insufficient evidence for antitrust scrutiny. Many industries have significant "strategic and forward-looking" buyers whose behavior significantly shapes industry structure. Antitrust policies need to simultaneously consider dynamic balance between supply and demand.

4. At the macroeconomic level, different industries exhibit varying levels of seller concentration and buyer concentration. Pricing stickiness at the aggregate level has a micro basis at the industry level, leading to heterogeneous effectiveness of monetary policy transmission across industries.



Jake Zhao

Associate Professor at HSBC School of Business, Peking University, Ph.D. in Economics, University of Wisconsin (Madison), United States

For countries, cross-sectional **misallocation between capital and labor** is a significant reason for lower total factor productivity (TFP) in developing countries. For firms, apart from capital and labor misallocation, **financial debt misallocation**, the appropriateness of financing amounts, and the optimal mix of debt and equity all impact company profits. How does the misallocation of debt and equity affect Chinese and American firms?

This paper shifts the focus of firm misallocation from the asset side of the balance sheet to the liability side. Through empirical analysis of annual observations from 1,262,887 Chinese and American firms, it estimates real losses arising from cross-sectional misallocation of financial liabilities. Building on the theoretical framework developed by Hsieh and Klenow, Professor Jake Zhao models the financial liabilities that underlie the factors contributing to misallocation and potentially lead to TFP distortions. Different types of financial liabilities are specified as original inputs into the production process. The study suggests that various capital structure models may lead to reduced capital efficiency due to significant dispersion in leverage ratios. To ensure a frictionless baseline, the Modigliani-Miller (MM) model is augmented with additional flexibility, allowing different forms of finance to be either perfect or imperfect substitutes and subject to Modigliani-Miller pricing. Regarding sample data, the authors select data from mining, manufacturing, and utility sectors sourced from the National Bureau of Statistics (NBS) of China and Compustat for companies with more than 5 million Chinese yuan (CNY) or 600,000 U.S. dollars (USD) in sales from 1999 to 2007. The research reveals severe debt and equity misallocation in Chinese firms. If China's debt and equity markets were as developed as those in the United States, firms would produce gains of 51% to 69% in real value-added. Within this growth, 79% to 83% of gains result from improper financing amounts—suboptimal matching of firm productivity with resources—while the remaining 17% to 21% stems from misallocation related to financial types. Notably, mismatch between firm productivity and size is more critical than inefficient combinations of debt types.

The paper further analyzes cross-sectional patterns in Chinese debt costs, finding significantly lower costs for larger firms and those located in more developed cities. By comparing similar-sized Chinese and American companies, significant potential reallocation gains are evident.

The study not only successfully detects frictions present in optimal investment and leveraged dynamic models from previous research but also reveals that different forms of finance are not equivalent. Any form of finance exhibits diminishing marginal returns, emphasizing that optimal combinations of debt and equity can mitigate these frictions to the greatest extent possible. Importantly, this paper provides an easily tractable alternative using dynamic equilibrium models for assessing the societal value of well-functioning financial systems.

The Misallocation of Finance

The Journal of Finance (Volume 76, Issue 5, 2021)

Reviews

SARGENT INSTITUTE OF **QUANTITATIVE ECONOMICS AND FINANCE**

NOTES Liquidity

Reviews of Classic Papers on Liquidity

This section contains a selected subset of reviews of classic papers written down by Ph.D. students of quantitative economics in a study group devoted to studying the concept of liquidity in economics. It opens with Professor Thomas Sargent's excellent article on liquidity, which serves as a roadmap for the study group's exploration. Each student in the study group learned at least one paper in depth, and wrote down a comprehensive review to present to other students. Members of the group discussed these summaries and asked questions to each other. Due to limited space, technical parts of the summaries are left out. The full version will be uploaded to the website of the Institute.

Notes on "Liquidity": **Multiple Meanings of a Word**

By Thomas J. Sargent

Introduction

This is a very incomplete survey as well as a personal glossary and commentary about a set of "liquidity" concepts that play roles in some models in macroeconomics and finance. "Liquidity" has meant different things to different authors. So has "illiquidity." I find it helpful to recognize these differences as they appear inside alternative settings in which analysts have have imagined exchanges of good, services, and assets to be accomplished. This essay is organized as a sequence of comments about alternative models and relationships among them. The literature is vast and my knowledge is limited, so my essay is necessary incomplete and biased by my limited knowledge. I hope that the essay can provide a guide to some readers who want to learn about how some thoughtful and creative economists have thought about liquidity. The topic remains unfinished and wide open for more discoveries.

Concepts of "liquidity" are to economists what "frictions" are to physicists and engineers. To isolate and analyze effects of some important forces, it is convenient completely to ignore all frictions. This is how some widely used models in economics and physics are constructed. We'll begin this essay with some leading benchmark "frictionless" models that are at the cores of many applied models. To understand gaps between observations and predictions

from these benchmark models, applied economists add various frictions that give rise to illiquidities that impede trades. We'll inspect a variety of frictions and authors' reasons for putting them into their models.

Before we dive in. I make a confession. Because we'll encounter so many notions of "illiquidity," it can be challenging to keep track of them, even for me. So please just view this essay as a "helicopter tour" of a forest of frictions that can provoke liquity and illiquidity.

An appendix includes some disorganized scattered thoughts that amount just to my "thinking out loud."

Benchmark models

A workhorse of finance and macroeconomics continues to be the general equilibrium models of (Kenneth J. Arrow and Debreu 1954). There are two variants, features of which set the stage for all subsequent discussions of liquidity. In both variants, there are no bilateral trades. All trades are multilateral. Exchanges of all valuable objects between each person and all other people are "netted out" or "cleared" by a Walrasian auctioneer, an articial actor that is outside the model. The auctioneer sets a high dimensional price vector that verifies all budget constraints.



1. The Arrow-Debreu model with time zero trading. At time zero, a comprehensive list of time- and history-contingent commodities is traded. By indexing commodities by time and histories of random events, then proceeding with general equilibrium 'business as usual,' the framework makes 'dynamics and randomness a special cases of statics and certainty.' All trades occur once at time 0. At future dates, deliveries occur, but no new trades. A tell-tale sign of an Arrow-Debreu model is that every agent has a single budget constraint. To repeat, at time 0, there is a vast centralized clearing arrangement that we can imagine being effected by a Walrasian auctioneer who allows any trades that satisfy all budget constraints. There is a vast number of trades at time 0, none later.

2. Arrow's model of sequential trading with Arrow securities. K. J. Arrow (1964) described a trading arrangement that supports the same equilibrium allocations as the Arrow-Debreu model, but in which people trade fewer things (one-period-forward Arrow history contingent securities) more often, meaning every period in a discrete

time model.² Arrow's discovery is a wonderful illustration of the dictum that 'finding the state is an art.' Two keys to sustaining Arrow's trading arrangement (still multilateral) are: (a) attaching to each consumer a time t, history h_t state variable that summarizes his past consumption-savings behavior and that also describes his future obligations; this magic state variable is the household's continuation wealth evaluated at continuation Arrow-Debreu prices; and (b) a description of some state-by-state borrowing limits for each household that assure that it is feasible for the household to meet its state-contingent obligations next period. There is a vast number of these borrowing limits – one for each household for each date and each (realized?) history and for each value of a next period state on which payoffs are contingent. Notice that a hypothetical auctioneer in an Arrow-securities economy has to name not only

¹ This is what Robert E. Lucas, Jr. was referring to when, perturbing Tolstoy's first words in Anna Karenina, he said that 'All complete markets models are alike, while all incomplete markets are incomplete in their own ways ' See J Lucas Robert E (2013). ² Continuously in a continuous time model

economy

3. Digression. In an Arrow-Debreu or Arrow economy, do assets trade for their 'fundamental' values? The answer depends what you mean by "fundamental." These complete markets frameworks allow heterogeneous beliefs, so people can disagree about prospective payouts and values. They trade on the basis of their own beliefs about values. Equilibrium prices are a complicated function of people's beliefs about fundamentals. Do more accurate beliefs ultimately prevail? Blume and Easley (2006) describe technical conditions under which the answer is yes, but they also showed that even when those conditions are satisfied it can take a long time for more accurate beliefs to prevail and be encoded in equilibrium prices.

4. Complete liquidity. In the complete markets models of Arrow and Debreu and Arrow, all assets are 'perfectly liquid' – there are no bid-ask spreads or delays in executing trade. The 'Walrasian auctioneer' (who as we have noted lives outside the model) costlessly 'supplies liquidity' because it is costless to supply. The multilateral clearing systems works like a charm – there are no limits to 'pledging future income.'

Minimal framework

a price vector each period, but many quantities in the form of a list of vectors of one-period borrowing constraints for each household. (The auctioneer is very busy.) Trading is multilateral and the auctioneer now runs a vast clearing system each period, but it much smaller than that for the Arrow-Debreu





Darrell Duffie

Adams Distinguished Professor of Management and Professor of Finance at Stanford University

A comparison of the time 0 trading Arrow-Debreu setting and the Arrow sequential trading setup sets the stage for an important class of models whose authors use them to formulate notions of 'illiquidity.' These all use some device to tighten borrowing constraints and thereby impede trades of Arrow securities. Trades continue to be multilateral but now they are impeded by some enforcement or information frictions

1. I call these modifications 'minimal' because they assume that agents are 'as present' and 'as connected' as they are in the Arrow-Debreu model. What impedes trades is not locational separation (as in the Townsend (1980) turnpike model and in Duffie, Garleanu, and Pedersen (2005) and Weill (2007) style high frequency search models).

2. The Kehoe-Levine model. In the Arrow-Debreu model, contracts are assumed to be costlessly enforced. Not so in the model of (Kehoe and Levine 1993). Here the same set of Arrow-securities are traded as in Arrow's model, but contracts must be self-enforcing. To Kehoe-Levine, this means that equilibrium allocations must be arranged so that each household wants to honor its contract at each moment even though it is always

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free to walk away and thereafter live in 'autarky' (or maybe, as in the work of Genicot and Ray (2003), into some other 'society' of trading arrangements). Technically, what Kehoe and Levine do is to tighten the history-contingent state-by-state borrowing constraints in Arrow's model, tighten them in a way that embeds 'participation constraints' that are cleverly designed to make it in everybody's interest to always to honor his contracts. Kehoe and Levine show how these these tightened borrowing constraints lead to additional *history dependence* in allocations and how they affect equilibrium prices of Arrow securities. Zhang (1997) and Alvarez and Jermann (2000) use related setups to explain asset pricing 'puzzles' (puzzles in the sense that data are not consistent with at least some empirical implementations of the Arrow version of the sequential trading model).

In models in the Kehoe-Levine tradition an auctioneer still clears markets with multilateral trades. (There is no need for 'money' or a medium of exchange.) But there is a sense in which some consumers' assets are 'illiquid.' Here "illiquidity" could be quantified state-by-state by comparing the borrowing constraints that Arrow would assign and the *tighter* constraints that Kehoe and Levine assign. You can regard Kehoe and Levine's as having thus contributed an elegant model of 'non-pledgable' income. Similarly, some assets, namely, the non-pledgable income streams, are not priced in a Kehoe-Levine equilibrium.

In models in the Kehoe-Levine tradition, there is an *enforcement friction but* no information friction.

3. Models with repeated moral hazard.

Models of Thomas and Worrall (1990), Phelan and Townsend (1991), Atkeson and Lucas (1992) and others turn off Kehoe-Levine's enforcement friction and replace it with an information friction that gives individuals incentives to misreport their incomes and preference shocks. In various versions of these models, incomes or endowments or efforts are observable only to the individual agent receiving them, not to others. It is possible to design history-dependent contracts that use an individual agent's desire to insure himself against what for him are bad states as a motive to get him truthfully to reveal his information about himself in what for him are good states. Such contracts trade off supplying *intratemporal* insurance against agents' desire for intertemporal consumption smoothing, with the outcome that neither insurance across states nor smoothing across time is as perfect as it is in the Arrow-Debreu benchmark without the information friction.

In such optimal contracting models, trades are bilateral - not multilateral. They occur according to exclusive contract between individual households and a 'social planner' or a 'financial intermediary.' The contracts have continuation values as state variables. In response to the agent's report of his income or preference shock, the planner awards a transfer in the current period and also adjusts the continuation value that the agent will bring into the next period. The contract takes the form of a pair of functions, one that maps the agent's report of his current income or preference shock into a current transfer from the 'planner,' another that maps the agent's report of his current income or preference shock into a next period continuation value. By iterating these functions through time, the contract makes today's transfer a function of the *history* of the agent's reports to the planner. The contract is designed to induce the agent to report truthfully.

In the Atkeson-Lucas model, the 'shock' is a privately observed preference shock to be imperfectly insured by a social arrangement. The Atkeson-Lucas model can be viewed as or modified to be a multi-period general equilibrium of a Diamond and Dybvig (1983) model of bank runs.



Andrew Atkeson

Stanley M. Zimmerman Professor of Economics and Finance at University of California, Los Angeles

4. Models with both repeated moral hazard and enforcement. The gold standard here is Atkeson (1991). Again, contracts are bilateral. Atkeson's model explains 'sudden stops' of credit in international credit markets in the sense of withdrawals of capital triggered by bad output realizations as part and parcel of an incentive compatible contract. There is a sense in which 'liquidity' crises occur in Atkeson's model. These would not occur if the private information problem weren't there.

5. Justification of bilateral contracts:

The repeated private information settings of Thomas and Worrall (1990), Atkeson and Lucas (1992), Phelan and Townsend (1991) are models of an enduring bilateral relationship. That the relationship is long-lasting with well understood consequences of the agent's reports to the "insurer" or "planner" lets the arrangement improve the alloca-

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tion of risk by trading off intratemporal risk-sharing against intertemporal consumption smoothing. We can regard these setups as elementary models of 'banks,' 'insurance companies', and other 'financial intermediaries.' These institutions 'do something important' by presiding over exclusive (meaning bilateral) enduring arrangements that facilitate risk sharing and consumption smoothing.

6. Competition? Sustaining the bilateral risk-sharing and borrowing-lending relationships just described requires prohibiting or substantially limiting competition among financial intermediaries. For example, an agent might be prevented from buying insurance from more than one company. Nevertheless, some types of competition among intermediaries have been included and have played important roles in models of bilateral relationships, for example, Atkeson and Lucas (1992). Here competition among intermediaries at time 0, each intermediary offering an exclusive long-term relationship between itself and a prospective agent, can be used to restrict the present value of the financial intermediary's profit from the long-term contract.



Truman Bewley

Alfred Cowles Professor of Economics at Yale University

7. Bewley models. General equilibrium models in the incomplete markets tradition of Bewley (1977, 1983), Huggett (1993), and Aiyagari (1994) shut down many Arrow securities markets. Some of them tighten borrowing constraint. Tightening borrowing constraints enough makes room for fiat currencies. Trade remains multilateral in these models.

8. Or is it? The Townsend (1980) turnpike model can be regarded as a twist on a Bewley model that through an ingenious patterns of locations and exogenous agent itineraries makes some physically feasible and welfare improving trades incentive infeasible. Townsend's physical environment contains a notion of a 'liquidity shortage' that no private party can provide. A social institution like fiat money or government debt can provide it.

From a particular and perhaps peculiar (but nevertheless valid) perspective, the overlapping generations model of Samuelson (1958) is a special case of the Arrow-Debreu model that arranges life-spans and endowments in a way designed simultaneously to

a. Torpedo the two fundamental theorems of welfare economics.

b. Open the way to welfare-improving equilibria with valued fiat money.

c. Give rise to a valued fiat money that can't exist in environments in which the two welfare theorems prevail. Valued fiat money is an excellent and basic example of a welfare improving 'bubble'. Fiat money is a claim to a stream of zero payments so it seems that its "fundamental" value would be zero in an Arrow-Debreu complete markets economy fulfilling 'ordinary' regularity conditions. But when some of those conditions are violated, as they are in the setting analyzed by Samuelson (1958), there can exist rational expectations equilibria in which unbacked fiat money is worth more than its fundamental value.

10. Cash-in-advance models. There is no room for valued fiat money in the special versions of the Arrow-Debreu structure that underlies "real business cycle" and other models that remain

9. Overlapping generations models.



Paul Samuelson

American Economist The Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel 1970

workhorses for asset pricing theory. That means that those models don't provide theories of the price level and its movements over time. That they are entirely "non-monetary models" mean that they leave open the challenge of modeling how aggregate price levels are determined. J. Lucas Robert E (1980; R. Jr. Lucas 1982) took a direct approach to 'integrating monetary and value (general equilibrium) theory' that he purposefully designed to

-retain all or most of an Arrow-Debreu theory for pricing assets.

-but then to add a cash-in-advance friction for some types of purchases that would give rise to a 'liquidity preference' for a government (or bank) issued asset that is dominated in rate of return in equilibrium.

-create a framework for analyzing interactions of monetary and fiscal policies in determining nominal prices and interest rates

The monetary equilibria in such models leave open arbitrage opportunities for a central bank or a private bank that can offer a risk-free nominal claim to dollars that is 100% backed by a safe portfolio of interest-earning Arrow securities. The model builder has to shut down exploitation of these potential



Robert Lucas

American Economist

The Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel 1995

arbitrages by private intermediaries, by regulations that effectively prohibit the emergence of "free banking." When in place, such regulations in effect give the central bank and the regulators a monopoly on the right to exploit those arbitrage profits.

Lucas arrested the history-dependence that would ordinarily be produced by wealth effects originating from open market operations and other monetary disturbances. Arresting that history dependence was a key to preserving those convenient asset pricing formulas and preventing the distribution of private wealths as being a state variable.³ The device introduced by Lucas here is also used in the popular Lagos and Wright (2005) model that creates a role for an unbacked currency by separating day and night transactions.

³ Milton Friedman used to emphasize those forces shut down by Lucas as part of the 'transmission mechanism!'

⁴Such policies were just "mental experiments" in the mind of Friedman when he wrote about them. Since the 2008 financial crisis, they have been a mainstay of US Federal Reserve policy.

⁵ Does anyone in the US now understand how interest payments on bank reserves in the US will be financed in the medium term future?Lucas as part of the 'transmission mechanism!'

11. Friedman rule as a response to the shortage of liquidity in those models.

The rule that delivers the optimal quantity of money of Milton Friedman (1969) restricts both monetary and fiscal policies. This mixture is evident in policies to pay interest on reserves in order to implement what has come to be known as a "Friedman rule."⁴ A footnote on page 4 of Friedman (1960) stresses the importance of how paying interest on reserves is financed (e.g., taxes, interest on the central bank portfolio, printing money and how those necessary supplementary financing arrangements will influence equilibrium allocations. Another footnote in the first chapter of Friedman (1960) indicates that within the class of models in which he was reasoning, two superficially very different regulatory arrangements could lead to virtually equivalent equilibrium allocations of resources:

-A quantity theory regime in which the government monopolizes the issue of bank notes and pays interest on reserves at the risk-free nominal interest rate; and

-Free banking.

A quarter of a century later, Friedman and Schwartz (1986) revisited this issue with perhaps more of a tilt toward free banking.



Milton Friedman

American Economist

The Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel 1976 12. How many fiat currencies? When

the developed world left the Bretton-Woods pseudo gold standard in 1971, the following abstract theoretical question suddenly became of substantial policy importance: in a multi-country overlapping generations or cash-in-advanced model, how many fiat currencies is there room for? J. Kareken and Wallace (1981) presented a striking answer in settings with flexible prices, namely, one and only one. The analytical basis of their answer was contained in an exchange rate indeterminacy proposition. A minor extension of their analysis indicates that in their flexible price environment. any martingale is an equilibrium exchange rate. That result was the nemesis of a "monetary theory of exchange rates" formalized elegantly in R. Jr. Lucas (1982). He rendered exchange rates determinate by imposing a particular set of cash-in-advance constraints that shut down the extensive "nickels and dimes" currency substitution that drives the J. Kareken and Wallace (1981) analysis. The Lagrange multipliers in the country-resident specific cash in advance constraints in R. Jr. Lucas (1982) are a theory of "liquidity."

In a sticky price version of the J. Kareken and Wallace (1981) and R. Jr. Lucas (1982) environments, is there room for multiple fiat currencies? Perhaps. It would depend on where and how the model maker would put the stickiness.

13. Financial accelerator models.

Models of liquidity like Chien and Lustig (2010) can be regarded as living within the multilateral trades tradition of Kehoe and Levine (1993) and Alvarez and Jermann (2000). They tack on collateral constraints to create 'liquidity premia' for assets that qualify as collateral. Deteriorations of value of collateral impede borrowing and lending and denigrate allocations.

Collateral constraints generate motives for precautionary savings. With high discount factors β , precautionary savings offers such a useful way of circumventing the collateral constraint



Hanno Lustig

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that it can attenuate effects of collarateral constraints on equilibrium allocations. This creates a troublesome problem that authors in this tradition have fought in various ingenious ways such as by shortening agents' lives and lowering their subjective discount factors. The force that these "repairs" are designed to arrest is that occasionally binding collateral constraints reshape indirect utility functions in ways that, relative to an Arrow-Debreu benchmark allocation, lead to precautionary savings, socially excessive savings, and distorted interest rates and intertemporal prices, distorted. These models provide an easy case for government interventions that relax collateral constraints

Collateral constraints as justification for quantitative easing Araújo, Schommer, and Woodford (2013).

14. Collateral constraints and 'good bubbles.' Collateral constraints affect equilibrium asset prices, causing them to deviate from what they would be in corresponding economies without those constraints. In some models, 'bubbles' in asset prices can improve outcomes by relaxing collateral constraints, thereby redirecting lending to socially worthwhile projects.

Lucas Robert E (1980; R. Jr. Lucas 1982) used cash-in-advance constraints to produce indirect utility functions that allowed him to "integrate monetary and real theory" in a way that preserved many of the asset pricing implications of Arrow-Debreu modeling. A "shallower" but insightful approach to achieve a similar analytical purpose was simply to put money or monies into private agent's utility functions (e.g., Brock (1974) and Croushore (1993)). Nowadays some authors even put bonds of different maturities in the utility function models to rationalize liquidity premia on them (e.g., Krishnamurthy and Vissing-Jorgensen (2012)). These models impose on utility functions things that theorists seeking "higher" (or "deeper") foundations prefer to derive as properties of indirect utility functions identifying sources of liquidity preferences. But they yield readily workable theories of rate of return discrepancies and liquidity premiums. These setups provide boilerplate models of exchange rate determinacy and exchange rate risks.

Larger modifications of the Arrow-Debreu model come from breaking the locational and temporal links that allow multilateral trade and clearing arrangements in that model. These models arrange meetings of people in time and space that are designed to make all trade be *bilateral*, thereby making room for middlemen who are recognizable as 'liquidity providers.'

1. Models of Duffie, Garleanu, and Pedersen (2005), Weill (2007) and others create search set ups in which buyers and sellers of an asset arrive randomly via distinct Poisson processes. Prospective buyers and sellers who randomly meet then might or might not trade bilaterally, depending on the countervailing offers they make to one another.

2. These models are open to having several classes of traders:

- a. Sellers for 'nonfundamental reasons,' i.e., reasons not connected to their opinion about the fundamental value of the asset (e.g., rebalancing, death, divorce, marriage).
- **b. Sellers** whose opinions about the fundamental value of the asset has deteriorated.
- C. Buyers for 'nonfundamental reasons,' i.e., reasons not connected to their opinion about the fundamental value of the asset (e.g., rebalancing, death, divorce, marriage).
- d. Buyers whose opinions about the fundamental value of the asset has improved.
- e. Liquidity providers. These 'buy into' temporary decreases in prices caused by surges in arrivals of nonfundamental sellers. They 'sell into' temporary increases in prices caused by surges in arrivals of nonfundamental buyers.
- f. Liquidity providers want to 'avoid' or 'front run' traders who buy or sell for fundamental reasons, meaning their opinions about the fundamental valuations of the asset. They have incentives to figure out whether someone is a fundamental or nonfundamental trader.
- 9. Size of trades can help dealers infer whether a trader is fundamental or non-fundamental. (When they step in as dealers in response to what they see as contagion, governments sometimes mistakenly infer the *opposite* from a surge in trades.)
- h. This literature provides a definition of liquidity: *rates* of arrival of buyers and sellers.
- There seems to be a 'frequency domain' specialization among dealers with dealers carrying on basically the same activities, but specializing in markets with different arrival rates (e.g., minutes, days, weeks).

3. Liquidity providers earn excess returns for taking risk involved in inferring fundamental from non fundamental customers.

4. Are liquidity providers private (e.g., hedge funds) or public (central banks and treasuries)?

5. Weill (2007) describes a beautiful model in which an intermediary or central bank improves outcomes by 'leaning against the wind.' In the model, the intermediary needs not be a government institution.

6. What we want: 'limit theorems' in which trading arrangements approach Arrow-Debreu allocation outcomes as contact rates go to infinity.

7. Models in the Kiyotaki and Wright (1989) tradition. Here an asset is liquid if it is used as the medium of exchange. Kiyotaki and Wright (1989) is a beautiful modern version of the Wicksell triangle.

Models of contagion

1. Benchmark models here are Bryant (1980) and Diamond and Dybvig (1983). These papers describe Nash equilibria that have earmarks of bank runs and that are Pareto inferior to equilibria without runs.



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2. These papers set off a productive literature about alternative ways to improve allocations by arresting threatened runs.

3. Atkeson and Lucas (1992) and Phelan and Townsend (1991) can be viewed as providing a dynamic versions of the physical environment of a Diamond and Dybvig (1983) model. Such models are needed to predict outcomes and design institutions and contracts to implement optimal allocations that eradicate runs. This context provides fertile ground for applying implementation theory.

4. Jacklin (1987, 1993) provides a fruitful application of implementation theory in this type of environment. These papers analyze the role of sequential-service constraint coupled with deposit contract in setting the stage for bank runs.

5. Please remember the caveat about moral hazard brought up in the concluding section of Diamond and Dybvig (1983) where they drew attention to the fact that they ignored moral hazard and recommended that the reader keep in mind the warnings issued by J. H. Kareken and Wallace (1978). That paper focused on the adverse effects of deposit insurance unless accompanied by appropriate regulation of bank portfolios.

Scattered thoughts

We have just touched the surface of how economists think about liquidity nowadays. In this appendix, I list just some of the many questions and topics that recent work has studied.

Sources of illiquidity

1. Search frictions - low contact rates.

2. Asymmetric information – lemons problems.

3. Asymmetric beliefs.

4. An agent is said to be liquidity constrained when he can't borrow against the discounted present value (whose discount factor?) of his future income (of what types? labor income? financial income?).

Collateral?

What determines what assets can be used as collateral?

1. Potentially anything with a small enough haircut. (Pawn shops)

2. Coordination of people who favor 'on the run' securities.

3. Why use Treasury bills and not commercial paper? 'Informationally insensitive' versus 'informationally sensitive' assets.

4. Public information about an individual's payments history?

Alternative definitions of 'liquidity'

1. An asset is said to be 'liquid' or the state of a market for that asset is said to be 'liquid' if you can rapidly find someone to write a repo against it with a small haircut. "Contact rates are high."

2. An asset is liquid if its default rate is low.

3. An asset is liquid if bid-ask spreads are low.

4. An asset is liquid if people agree about its value.

5. An asset is liquid if it is a medium of exchange.

6. An asset is said to be illiquid when its value is less than the discounted present value of its dividends. But whose stochastic discount factor? (The property stressed in this definition is the opposite of the property of an asset on a bubble.)

7. An asset is said to be liquid when big trades don't affect its price much. (Liquidity providers work to produce that outcome when they infer that demands and supplies are driven by noise and other liquidity-driven traders trading not because they forecast changes in fundamental values; liquidi-



ty providers work *against* that outcome when they infer that traders have information about changes in fundamental values.)

8. An asset is liquid if big trades have at most temporary effects on prices.

Global liquidity

1. Provision of insurance against exchange rate risk.

2. Who or what generates exchange rate risk?

3. Is insurance against exchange rate risk to be supplied by private liquidity providers or by (some) government institutions? Are the government institutions that would provide the insurance distinct from the government institutions contributing to exchange rate risk?

4. Who decides what currency or currencies trades are to be conducted in? (Evolution of the gold standard; collapse of the gold standard. Case study provided by court cases after the US civil war and after 1933. The government abrogated contracts, thereby redistributing resources between creditors and debtors. Was that redistribution intentional?)

Governments as liquidity providers?

1. Government guarantees of interest and principal payments – US New Deal effort to jump start private lending.

2. WWI payment of insurance premiums for ships before US entry into WWI.

3. Deposit insurance – should the government provide it? To what financial institutions? Can private insurers provide it? How should it be priced?

4. Unintended consequence of incorrectly priced deposit insurance? Shifting of risks to tax payers? Or a heterogeneous beliefs explanation where the government has more accurate probability assessments.

Heterogeneous beliefs

1. Heterogenous beliefs create wedges that can look like bid-ask spreads and impede or shut down trade. Contributions by Dow and Werlang (1992) andAraujo, Novinski, and Páscoa (2011) provide examples of fruitful ways of

framing the topic. Such models provide approaches to how model ambiguity provides endogenous heterogeneous beliefs. Baliga, Hanany, and Klibanoff (2013) provide an intriguing example endogenous 'polarization' of beliefs fostered by model ambiguity.

2. The classic Harrison and Kreps (1978) paper on bubbles with heterogeneous beliefs makes one think hard about alternative concepts of 'fundamental values.'

References

Aiyagari, S. Rao. 1994. "Uninsured Idiosyncratic Risk and Aggregate Saving." The Quarterly Journal of Economics 109 (3): 659-84. https://EconPapers.repec.org/RePEc:oup:qjecon:v:109:y:1994:i:3:p:659-684.

Alvarez, Fernando, and Urban J. Jermann, 2000, "Efficiency, Equilibrium, and Asset Pricing with Risk of Default," *Econometrica* 68 (4): 775–98. https://ideas.repec.org/a/ecm/emetrp/v68y2000i4p775-798.html.

Araujo, Aloisio, Rodrigo Novinski, and Mário R. Páscoa. 2011. "General equilibrium, wariness and efficient bubbles." Journal of Economic Theory 146 (3): 785–811. https://ideas.repec.org/a/eee/jetheo/v146y2011i3p785-811.html.

Araújo, Aloísio, Susan Schommer, and Michael Woodford. 2013. "Conventional and Unconventional Monetary Policy with Endogenous Collateral Constraints." In Lessons from the Financial Crisis for Monetary Policy. Vol. NBER Chapters. National Bureau of Economic Research, Inc. https://ideas.repec.org/h/nbr/nberch/13305.html.

Arrow, K. J. 1964. "The Role of Securities in the Optimal Allocation of Risk-Bearing." Review of Economic Studies 31 (2): 91–96.

Arrow, Kenneth J., and Gerard Debreu. 1954. "Existence of an Equilibrium for a Competitive Economy." Econometrica 22 (3):

Atkeson, Andrew. 1991. "International Lending with Moral Hazard and Risk of Repudiation." Econometrica 59 (4): 1069–89. https:// ideas.repec.org/a/ecm/emetrp/v59y1991i4p1069-89.html.

Atkeson, Andrew, and Robert E. Lucas. 1992. "On Efficient Distribution With Private Information." Review of Economic Studies 59 (3): 427-53. https://ideas.repec.org/a/oup/restud/v59y1992i3p427-453..html.

Baliga, Sandeep, Eran Hanany, and Peter Klibanoff. 2013. "Polarization and Ambiguity." American Economic Review 103 (7): 3071–83.

Bewley, Truman F. 1977. "The Permanent Income Hypothesis: A Theoretical Formulation." Journal of Economic Theory 16 (2):

------. 1983. "A Difficulty with the Optimum Quantity of Money." *Econometrica* 51 (No. 5): 1485–1504.

plete Markets." Econometrica 74 (4): 929-66. https://ideas.repec.org/a/ecm/emetrp/v74y2006i4p929-966.html.

Brock, William A. 1974. "Money and Growth: The Case of Long Run Perfect Foresight." International Economic Review 15 (3): 750-77. https://ideas.repec.org/a/ier/iecrev/v15y1974i3p750-77.html.

Bryant, John. 1980. "A model of reserves, bank runs, and deposit insurance." Journal of Banking & Finance 4 (4): 335-44. https:// ideas.repec.org/a/eee/jbfina/v4y1980i4p335-344.html.

Chien, YiLi, and Hanno Lustig. 2010. "The Market Price of Aggregate Risk and the Wealth Distribution." Review of Financial Studies 23 (4): 1596–1650. https://ideas.repec.org/a/oup/rfinst/v23y2010i4p1596-1650.html.

Croushore, Dean. 1993. "Money in the utility function: Functional equivalence to a shopping-time model." Journal of Macroeconomics 15 (1): 175–82. https://ideas.repec.org/a/eee/jmacro/v15y1993i1p175-182.html.

401–19. https://doi.org/10.1086/261155.

Dow, James, and Sergio Ribeiro da Costa Werlang. 1992. "Uncertainty Aversion, Risk Aversion, and the Optimal Choice of Portfolio." Econometrica 60 (1): 197–204. https://ideas.repec.org/a/ecm/emetrp/v60y1992i1p197-204.html.

Duffie, Darrell, Nicolae Garleanu, and Lasse Heje Pedersen. 2005. "Over-the-Counter Markets." Econometrica 73 (6): 1815-47. https://ideas.repec.org/a/ecm/emetrp/v73y2005i6p1815-1847.html.

Friedman, Milton, and Anna J. Schwartz. 1986. "Has government any role in money?" Journal of Monetary Economics 17 (1): 37–62. https://ideas.repec.org/a/eee/moneco/v17y1986i1p37-62.html.

87–113. https://ideas.repec.org/a/oup/restud/v70y2003i1p87-113.html.

tions." The Quarterly Journal of Economics 92 (2): 323–36. https://ideas.repec.org/a/oup/gjecon/v92y1978i2p323-336..html.

Dynamics and Control 17 (5-6): 953–69. https://EconPapers.repec.org/RePEc:eee:dyncon:v:17:y:1993:i:5-6:p:953-969.

edited by Edward C. Prescott and Neil Wallace. University of Minnesota Press.

-----. 1993. "Market Rate Versus Fixed Rate Demand Deposits." Journal of Monetary Economics 32 (2): 237–58.

of Business 51 (3): 413–38. https://doi.org/10.1086/296006.

(2): 207-22.

https://ideas.repec.org/a/oup/restud/v60y1993i4p865-888..html.

https://doi.org/10.1086/261634.

Economy 120 (2): 233-67. https://doi.org/10.1086/666526.

Economy 113 (3): 463-84. https://doi.org/10.1086/429804.

oup/ecinqu/v18y1980i2p203-20.html.

https://ideas.repec.org/a/eee/moneco/v10y1982i3p335-359.html.

Fconomic Studies 58 (5): 853–81.

Journal of Political Economy 66: 467–67. https://doi.org/10.1086/258100.

pal-agent problem." Journal of Economic Theory 51 (2): 367–90. https://ideas.repec.org/a/eee/jetheo/v51y1990i2p367-390.html.

Townsend, Robert M. 1980. "Models of Money with Spatially Separated Agents." In Models of Monetary Economies, 265–304. Minneapolis, Minnesota: Federal Reserve Bank of Minneapolis.

a/oup/restud/v74y2007i4p1329-1354.html.

https://ideas.repec.org/a/bla/jfinan/v52y1997i5p2187-2209.html.

- Genicot, Garance, and Debraj Ray. 2003. "Group Formation in Risk-Sharing Arrangements." Review of Economic Studies 70 (1):
- Harrison, J. Michael, and David M. Kreps. 1978. "Speculative Investor Behavior in a Stock Market with Heterogeneous Expecta-
- Huggett, Mark. 1993. "The Risk-Free Rate in Heterogeneous-Agent Incomplete-Insurance Economies." Journal of Economic
- Jacklin, Charles J. 1987. "Demand Deposits, Trading Restrictions, and Risk Sharing." In Contractual Arrangements for Intertemporal Trade,
- Kareken, John H, and Neil Wallace. 1978. "Deposit Insurance and Bank Regulation: A Partial-Equilibrium Exposition." The Journal
- Kareken, John, and Neil Wallace. 1981. "On the Indeterminacy of Equilibrium Exchange Rates." *Quarterly Journal of Economics* 96
- Kehoe, Timothy J., and David K. Levine. 1993. "Debt-Constrained Asset Markets." Review of Economic Studies 60 (4): 865–88.
- Kiyotaki, Nobuhiro, and Randall Wright. 1989. "On Money as a Medium of Exchange." Journal of Political Economy 97 (4): 927-54.
- Krishnamurthy, Arvind, and Annette Vissing-Jorgensen. 2012. "The Aggregate Demand for Treasury Debt." Journal of Political
- Lagos, Ricardo, and Randall Wright. 2005. "A Unified Framework for Monetary Theory and Policy Analysis." Journal of Political
- Lucas, Jr, Robert E. 1980. "Equilibrium in a Pure Currency Economy." *Economic Inquiry* 18 (2): 203–20. https://ideas.repec.org/a/
- -----. 2013. "The Effects of Monetary Shocks When Prices Are Set in Advance." In Collected Papers on Monetary Theory, edited
- Lucas, Robert Jr. 1982. "Interest rates and currency prices in a two-country world." Journal of Monetary Economics 10 (3): 335–59.
- Phelan, Christopher, and Robert M. Townsend. 1991. "Computing Multi-Period, Information-Constrained Optima." Review of
- Samuelson, Paul A. 1958. "An Exact Consumption-Loan Model of Interest with or Without the Social Contrivance of Money."
- Thomas, Jonathan, and Tim Worrall. 1990. "Income fluctuation and asymmetric information: An example of a repeated princi-
- Weill, Pierre-Olivier. 2007. "Leaning Against the Wind." Review of Economic Studies 74 (4): 1329–54. https://ideas.repec.org/
- Zhang, Harold H. 1997. "Endogenous Borrowing Constraints with Incomplete Markets." Journal of Finance 52 (5): 2187–2209.

Equilibrium in a Pure Currency Economy

The paper: Lucas, R. E. (1980). Equilibrium in a pure currency economy. Economic inquiry, 18(2), 203. Reviewers: Li Kexin, Yin Huanyu

Research Question

This paper studies the determination of the equilibrium price level in a stationary economy in which all exchange involves the trade of fiat money for goods. It wants to make a step forward models which capture more and more features which monetary economists believe to be important in understanding actual monetary systems.

Specifically, the model posts a cash-in-advance constraint, as suggested by Clower (1967), to guarantee the use of money in exchange. This constraint requires that purchases of goods must necessarily be paid by currency held over from the previous period. Another way to think of this paper is an attempt to study the transactions demand for money in a general equilibrium setting.



Robert Lucas — American Economist The Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel 1995

Main Conclusion

The paper posts cash-in-advance constraint and derives the transaction demand for fiat money. Then this paper discusses the determination of equilibrium price level in a stationary equilibrium. It figures out that the determinants include "institutional" factors, such as the length of a "period", and "economic" factors. If the length of a payment period was reduced, the velocity of money would rise and reduce the real demand of fiat money. The economic factors are preferences (*U*), the discount factor (β), the volatility (*F*) of the shocks (θ) and income (*y*). Thus, the amount of risk (*F* and θ) and people's attitude toward money (*U*), the rate of time preference (β), and current income (*y*) will affect money demand. In other words, the model is well-established to capture the factors, which are long thought to be important in reality, i.e., the precautionary motive (captured by the amount of risk and people's attitude toward it (*U* and *F*)) and the rate of time preference, that will affect money demand.

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The paper posts cash-inadvance constraint and derives the transaction demand for fiat money. Then this paper discusses the determination of equilibrium price level in a stationary equilibrium.



Contribution

This paper develops a model to introduce individual's transactions demand for money and discuss the determinants of the equilibrium price level in a stationary economy. The model captures the economic factors long thought to be important in reality and provides a perspective in understanding the monetary system.

Discussion

In the paper "Equilibrium in a Pure Currency Economy", Lucas (1980) establishes the role for fiat money by introducing a cash-in-advance friction into trading. In other words, he studies the determination of the equilibrium price level in a stationary economy from the perspective of the transaction demand for money.

This paper provides a definition of liquidity: rates of arrival of buyers and sellers. As a medium of exchange, fiat money is acceptable immediately in trading and reduces the transaction costs essentially to zero. Therefore, fiat money is "liquid".

The cash-in-advance constraint is also used by Lucas (1982). In the two papers, currency, under certain circumstances, can serve as an inexpensive record-keeping device for decentralized transactions, enabling a decentralized system to imitate closely a centralized Arrow-Debreu system. Under this framework, analyzing interactions of monetary and fiscal policies in determining nominal prices and interest rates is possible. The constraint introduced by Lucas here is also used in the model of Lagos and Wright (2005) that creates a role for an unbacked currency by separating day and night transactions.

On the Indeterminacy of Equilibrium Exchange Rates

The paper: Kareken, J., & Wallace, N. (1981). On the indeterminacy of equilibrium exchange rates. The Quarterly Journal of Economics, 96(2), 207-222.

Reviewers: Liu Yifu, Li Kexin

Research Question

Exchange rate is a classic and hot topic for it plays a crucial role in international trade, capital flows, and the implementation of monetary and fiscal policies. The determinacy of exchange rate attracts surprisingly many attention from researchers and policy makers, especially after 1970s when Nixon announced the collapse of the Bretton Woods system and the developed countries started to accept flexible exchange rate policy. The Laissez-Faire (LF) policy regime is appreciated by many economists among all the international economic policy regimes, for it is distinguished by free trade in goods, unrestricted portfolio choice and floating or market-determined exchange rates. However this paper shows that LF regime is not economically feasible under the perspective of the determinacy of exchange rates.

How many fiat currencies can exist in a multi-currency overlapping generations (OLG) model? Kareken's paper answers the question by examining the feasibility of a Laissez-Faire policy regime that allows unrestricted portfolio choice and floating exchange rates. The paper claims that this regime does not have a determinate equilibrium exchange rate, and that any equilibrium exchange rate is unstable and subject to self-fulfilling expectations.

Main Conclusion

By using an OLG model, Kareken derives several conclusions: The equilibrium exchange rate can be indeterminate, with multiple potential equilibria arising due to the complex interactions of various factors, such as expectations, financial intermediaries, and non-linearities in the model. The OLG model derives a proposition that in LF regime, monetary equilibrium exists for every possible (unchanging) value of the exchange rate. This result implies that LF regime along with multiple fiat currencies will not have a stable exchange rate and therefore, the LF regime is not economically feasible. The indeterminacy of equilibrium exchange rates complicates the design and implementation of policy interventions, as it creates uncertainty about the future path of exchange rates.

The paper also provides a determinate equilibrium by using the portfolio autarky (PA) regime where there is no government intervention in the exchange market but restricted portfolio choice. This result provides an economically feasible but not politically feasible regime with stable exchange rate where cooperation ensures adequate supplies of government monies.

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Contribution

This paper contributes to the literature on the international cash flow. It shows that the LF regime of unrestricted portfolio choice and floating exchange rates, which is often assumed to be optimal and efficient, is not economically feasible because it does not have a determinate equilibrium. The paper demonstrates that under certain conditions, such as overlapping generations, equilibrium exchange rates are indeterminate and depend on expectations and conventions. This implies that there is no unique solution to the international asset market equilibri and that multiple equilibrium are possible. In a multi-country OLG model, there is one and only one room for many fiat currencies under flexible exchange rate. The paper also shows that the indeterminacy of equilibrium exchange rates can lead to instability and volatility in the international economy. This paper challenges the conventional view of exchange rate determination and provide a new perspective on the role of expectations and conventions in the international economy. The paper also raises important policy implications for the choice of exchange rate regime and the coordination of monetary and fiscal policies across countries.

Discussion

In the influential work "On the Indeterminacy of Equilibrium Exchange Rates," Kareken and Wallace (1981) dissect the laissez-faire policy regime, characterized by unrestricted portfolio choice and floating exchange rates. The authors challenge the economic feasibility of this regime, favored by many economists, arguing that it does not lead to a determinate equilibrium.

The departure from the complete markets benchmark model in this paper lies in the critical examination of an overlapping-generations model to highlight market imperfections and to demonstrate how different generations interact over time. This model aids in satisfying the indicated requirements that money is valuable and to be dominated, and illustrates the indeterminacy inherent in the laissez-faire policy regime.

In their work, the notion of 'liquidity' is closely tied to the functionality of money. In a world where trades are paramount, money is desired not for its own sake, but for the liquidity it offers. The concept of liquidity here pertains to money's role as a universally accepted medium of exchange that facilitates transactions. Kareken's paper presents a striking answer to the question "How many flat currencies?" in an exchange rate indeterminacy proposition. Lucas (1982), another paper in the "Liquidity Series", rendered exchange rates determinate by imposing a particular set of cash-in-advance constraints that conflicts Kareken and Wallace (1981) assumptions. Their work also attracts many followers to imply their model and conduct further research on the LF policy (Lagos 2013)

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The paper also provides a determinate equilibrium by using the portfolio autarky (PA) regime where there is no government intervention in the exchange market but restricted portfolio choice. This result provides an economically feasible but not politically feasible regime with stable exchange rate where cooperation ensures adequate supplies of government monies. The paper: Kiyotaki, N., & Wright, R. (1989). On money as a medium of exchange. Journal of political Economy, 97(4), 927-954. Reviewers: Xia Yuangiong

Research Question

How does money emerge as a medium of exchange in an economy? What commodity can be used as money? Can fiat money with no intrinsic value improve welfare? To answer these problems, Kiyotaki and Wright(1989) provided a simple and tractable model of money where individuals specialize in production and consumption and trade randomly over time in a way that implies that trade must be bilateral and guid pro guo. The model can accommodate both commodity money and fiat money and study their effects on equilibrium and welfare. This medium of exchange function is the essential feature of money and the one emphasized by the classical and early neoclassical economists; yet formal modeling has been illusive. This paper is important because it contributes to the literature on monetary theory by formally modeling the medium of exchange function of money using a random matching framework and analyzing the role of intrinsic attributes and extrinsic beliefs in determining the acceptability of money as a medium of exchange. The paper also proved that when a commodity is more marketable (i.e. more acceptable to the market), even the commodity with highest storage cost can serve as commodity money. What's more, this paper proved that there exist an equilibrium with fiat money, and this equilibrium can improve welfare.

Main Conclusion

This paper found that there exist a steady-state Nash equilibrium in which some types of consumption goods can serve as the medium of exchange, depending on the intrinsic attributes (lower storage costs) and extrinsic beliefs (superior marketability). There are also equilibria with genuine fiat currency circulating as the general medium of exchange. Equilibria are not generally Pareto optimal and introducing fiat currency into a commodity money economy may unambiguously improve welfare.

The underlying logic goes back to Adam Smith (1776, chap. 4), the driving force behind the use of money is specialization, which implies that agents do not necessarily consume what they produce. Here, they will also meet randomly over time in a way that implies that trade must be bilateral and guid pro guo. This leads to Jevons's (1875) "double coincidence of wants" problem, you not only have to have what I want but also have to want what I have, which is behind the genesis of indirect trade and the use of media of exchange. As was also stressed by the early monetary economists, the authors assume that different objects have different intrinsic properties (here it will be storability), or



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extrinsic beliefs (whether agents believe that it will be accepted). Since fiat money has the lowest storage cost and is accepted by everyone, transactions can still take place and equilibrium exists even if it has no intrinsic value. Since fiat money acts as a lubricant in commodity trade, reducing transaction costs and increasing trade opportunities, so it may unambiguously improve welfare.

There are some other results: velocity is a very poor indicator of moneyness, while acceptability is a much better measure of moneyness. Another measure of moneyness is liquidity, commodities that are cheaper to store and more marketable are more liquid, which is easier to be accepted as a medium of exchange by agents.

Contribution

The main contributions of the paper are: It provides a simple and tractable model of money as a medium of exchange that can accommodate both commodity and fiat money. It analyzes the emergence of commodity money as a function of both intrinsic properties and extrinsic beliefs of the agents. It shows that fiat money can circulate as a general medium of exchange under some conditions and may improve welfare by reducing transaction costs and increasing trade opportunities.

The paper belongs to the literature on monetary theory, which studies the role and functions of money in the economy. Jones (1976) provides an interesting framework in which one can examine which of many commodities will circulate as media of exchange, although his traders are somewhat naive concerning both the equilibrium matching distribution and their choice of' strategies. Formally, the structure of this paper in this paper is similar to some recent advances in search and sequential bargaining theory, such as Mortensen (1982), Rubinstein and Wolinsky (1985), and Gale (1986a), although these papers do not discuss monetary issues. Diamond (1984) and Gale (1986b) do present monetary versions of the matching framework but impose a medium of exchange exogenously via a cash-in-advance constraint. To be perfectly clear, the goal of the present paper is to use the sequential matching model to derive commodity and/or fiat money endogenously.

How does the theory presented here compare with existing models? The cash-in-advance model has proved useful, but the means of payment in the model are exogenous. What's more, these theories give up the postulate of intrinsic uselessness by putting money in utility or production functions. The overlapping generations model has proved useful and enlightening also, but its implications have been challenged because it fails to capture the medium of exchange role and money in the OLG model, works too well, and money completely overcomes the friction. However, the model in this paper has several implications for velocity that standard overlapping generations (or cash-in-advance) models do not: it demonstrates that velocity is not a very good indicator of moneyness. This model can also generate rate-of-return dominance, a fundamental issue in monetary theory. Objects with a low rate of return (i.e., a high storage cost in the existing setup) may become equilibrium media of exchange without auxiliary assumptions. As for friction, a genuine role for media of exchange arises from real frictions in this model, which money may help lubricate but not dissolve.





This paper found that there exist a steady-state Nash equilibrium in which some types of consumption good can serve as the medium of exchange, depending on the intrinsic attributes (lower storage costs) and extrinsic beliefs (superior marketability).

Discussion

Kiyotaki and Wright (1989) presented a simple and tractable model of money to accommodate both commodity money and fiat money. In comparison to Arrow and Debreu's (1954) general equilibrium model, the main modifications in this paper's model involve breaking the spatial and temporal connections that allow for multilateral trade and clearing arrangements. Instead, in the Kiyotaki and Wright's model, transactions have costs and some transactions are subject to credit constraints, hence there are no complete markets. They adopt a bilateral trade framework where trading parties randomly encounter each other. Furthermore, in Kiyotaki and Wright's model, transactions occur privately between parties, as opposed to being "cleared" by a Walras auctioneer. Additionally, in this model, there are no prices. Even if fiat money exists, its function is solely as a medium of exchange rather than a measure of value. Moreover, the agents in this model are heterogeneous, primarily consisting of three types of agents who produce and consume different goods. Finally, unlike Arrow and Debreu's complete market, the goods and fiat money in this model do not flow perfectly. Sometimes trades fail due to search frictions, meaning that during a period, one can only randomly encounter another trader for bilateral trade due to low contact rates, and money cannot completely eliminate friction.

In this paper, liquidity is the capacity for a medium of exchange to be widely accepted as means of exchange. The liquidity of a particular agent's goods refers to the average time it takes for them to exchange their owned goods for the goods they want to consume. During this process, the agent doesn't have to hold on to the original goods but can exchange them for other intermediate goods before ultimately acquiring the desired goods for consumption. Generally, goods with lower storage costs have higher liquidity. However, if goods with higher storage costs are more marketable, meaning they are more widely recognized and accepted in the market, they may also have higher liquidity. Fiat money combines low storage costs with marketability, making it the most liquid form of money.

Duffie et al. (2005), and Weill (2007) have developed models that create search settings where buyers and sellers of assets randomly arrive through different Poisson processes. Potential buyers and sellers who randomly encounter each other may or may not engage in bilateral trades, depending on the compensatory quotes they offer to each other. This is similar to the setup in Kiyotaki and Wright's model, but the differences are there are no buyers and sellers with differing views on assets, no liquidity providers, and no intermediary institutions in Kiyotaki and Wright's model.

Compared to Lucas's (1980) paper, the cash-in-advance model has proved useful, but the means of payment in the model are exogenous. What's more, these theories give up the postulate of intrinsic uselessness by putting money into utility or production functions. However, the model in this paper has several implications for velocity that standard overlapping generations (or cash-in-advance) models do not: it demonstrates that velocity is not a very good indicator of moneyness. This model can also generate rate-of-return dominance, a fundamental issue in monetary theory. Objects with a low rate of return (i.e., a high storage cost in the existing setup) may become equilibrium media of exchange without auxiliary assumptions. The model in this paper demonstrates the rationale for the existence of fiat money, while Kareken and Wallace (1981) addressed the question of how many types of fiat money should exist. They provided a remarkable answer in settings with flexible prices: one and only one. The analytical foundation for their answer was encapsulated in a proposition of exchange rate indeterminacy.

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Computing Multi-period, Informationconstrained Optima

The paper: Phelan, C., & Townsend, R. M. (1991). Computing multi-period, information-constrained optima. The Review of Economic Studies, 58(5), 853-881. Reviewers: Chen Yongqiao, Wu Yi⁶

Research Question

Macroeconomic models with a complete market setting (which implicitly assumes full information) always imply full consumption insurance, meaning that an individual's consumption does not depend on his idiosyncratic shocks. In the absence of either aggregate shocks or individual preference shocks, this implies constant consumption for each individual over time. In the absence of ex-ante agent heterogeneity, this implies equal consumption levels across individuals at a point in time. Such predictions seem implausible and thus require theorists to account for the variation in individual consumption.

One promising way to solve this problem is to introduce unobserved actions or so-called "*incentive problems*". The idea is that full consumption insurance has adverse incentive effects on effort when information asymmetry exists. For example, when employers cannot monitor their employees, those who sign a contract guaranteeing that their consumption is independent of their output will shirk. As a result, total production falls, which inevitably brings down individual consumption, explaining the positive correlation between consumption and labor effort. Despite simple logic, this idea is hard to be executed in analytical models, due to the history-dependent nature of solutions. Fudenberg, Holmstrom, and Milgrom (1986) attempt to solve for the analytical solution, which is possible only with some stringent assumptions. Acknowledging the difficulty in analytical solution, this paper resorts to computational methods to tackle this problem.

Main Conclusion

In this paper, a social planner wants to maximize social surplus (defined as output net of consumption) by assigning labor effort (or action) and consumption, subject to each of the agents receiving exactly a pre-specified ex ante expected utility (a proxy for wealth). Individual output is random but monotonically increasing in action. Two scenarios are considered. In the first case full information is available, while in the second case actions are unobserved. In the former, agents have



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to work at the level assigned by the social planner. In the latter, however, the social planner can't monitor the action of agents, allowing the possibility for shirking. To avoid shirking, the social planner needs to design a new incentive-compatible contract for each agent, resulting in all the differences. They find that social surplus and agents' action is lower because of the possibility of shirking. More importantly, consumption varies with wealth, action, and output. In particular, higher consumption is associated with higher outputs, implying that individuals are now bearing the risk of their production outcome, which is more realistic.

Contribution

Phelan and Townsend (1991) are innovative to introduce computational methods into macroeconomic models in the 1980s. More significantly, they provided solid mathematical proof to convince readers of the existence and uniqueness of the numerical solution in this paper. This work is derived mainly from three distinct lines of research in the literature. One line is represented by Prescott and Townsend (1984a, b), who demonstrated the ability to analyze economies with incentive constraints. Relatedly, Townsend (1987, 1988) numerically simulated a wide variety of static incentive-constrained economies using linear programming techniques. Another line of research is represented by Abreu, Pearce, and Stacchetti (1986), and Spear and Srivastava (1987) who provided the key insight into the nature of history-dependent solutions needed to yield a computationally-feasible repeated formulation of the problem. Lastly, Green (1987) analyzed an economy with private information concerning individual endowments.

This paper builds directly on Spear and Srivastava (1987) but extends the single principal-agent problem to a continuum of agents and uses a formulation consistent with the measure-space techniques of Prescott and Townsend (1984a, b). These steps allow the computation of numerical solutions. In terms of modeling, this paper borrows from Green (1987) the idea and justification of maximizing a social surplus in a context where society has access to an unlimited linear borrowing-lending technology. This paper sets a paradigm for introducing the principal-agent problem in general equilibrium models in the subsequent research (Kocherlakota 1996; Sannikov 2008).

Discussion

This paper departs from the benchmark model in a complete market in terms of information friction. Put differently, the liquidity in this paper is referring to the degree of information symmetry. In a complete market, information is common knowledge for each agent in the economy so that trade across all contingencies is possible, ensuring each agent with perfect foresight of idiosyncratic risk. As a result, agents are able to perfectly smooth consumption to achieve the highest utility. But this corollary is unrealistic, posing theoretical challenges for economists. The way this paper tackle this challenge is to introduce moral hazard motives, induced by the inability of the social planner to observe the action of each agent (so called "information friction"). In this case, agents are able to shirk to maximize their own utility, leading to a fall in total production and inevitably bringing down individual

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In this paper, a social planner wants to maximize social surplus (defined as output net of consumption) by assigning labor effort (or action) and consumption, subject to each of the agents receiving exactly a prespecified ex ante expected utility (a proxy for wealth). consumption. This positive correlation between consumption and labor effort is satisfactory because it accords with empirical data. When it comes to modeling, the moral hazard problem is realized by the introduction of incentive compatibility constraint into the social surplus maximization problem. The Model shows that with the presence of information friction, consumption is positively associated with outputs, indicating that agents bear the risk of production. The ability to generate the response of consumption to idiosyncratic shock is a huge step forward in literature.

This paper shares a similar topic with Kehoe & Levine (1993). Both papers attempt to explain the partial insurance of consumption against shocks from the perspective of moral hazard motives, although the moral hazard motives are different. As opposed to this paper which discusses the possibility of shirking, Kehoe & Levine (1993) introduce the moral hazard motive (or default option) and the limited enforceability into the debt contract problem. In a complete market, agents perfectly smooth consumption through borrowing and lending with perfectly enforceable contract. However, in the paper of Kehoe & Levine (1993), contract is partly enforceable because borrowers have private endowment that can't be seized. This property gives incentive for borrowers to default. To rule out default, an optimal debt contract has to consider special terms that result in partial insurance in consumption.

Thomas & Worrall (1990), Atkeson & Lucas (1992) also study the connection between consumption and private information but in the context of optimal contract design. Thomas & Worrall (1990) consider the borrowing and lending contract between a risk-averse borrower with unobservable income and a risk-neutral lender. The private information on income incentivizes the borrower to misreport his income as low. According to their research, an effective contract can prevent this cheating behavior at the expense of stabilizing borrower's consumption over time. In the paper of Atkeson & Lucas (1992), private information is the individual taste shocks, which affect their marginal utility of consumption. Since social planer can't observe these taste shocks, agents have the incentive to acquire more consumption by misreporting their taste shocks. To achieve a fair allocation, the social planer has to design an incentive-compatible contract that ensures agents to truthfully report their taste shocks. They find that such as arrangement leads to rising inequality in consumption among agents.



International Lending with Moral Hazard and Risk of Repudiation

Literature resource: Atkeson, A. (1991). International lending with moral hazard and risk of repudiation. Econometrica: Journal of the Econometric Society, 1069-1089. Reviewers: Wu Yi, Xia Yuanqiong

Research Question

The pattern of capital flow, the consumption and investment of indebted countries, and debt crises are the thesis of Andrew Atkeson's 1991 Econometrica paper. In the past centuries, we have seen many sovereign debt crises, in which indebted countries, attacked by an adverse shock, couldn't get new loans and were asked to repay their debts by reducing their consumption and investment. During the crisis, capital reallocates undesirably to the U.S. from the borrowing countries that need it most. These phenomena suggest that the international lending market is not a complete market with perfect risk sharing.

Main Conclusion

Atkeson explained the pattern of capital flows and debt crisis by studying the optimal contract between international lenders and borrowers. He found that under this optimal contract, borrowers would inevitably fall into illiquidity when they were unfortunately in the low realizations.

There are two market imperfections impeding risk sharing: the risk of repudiation and moral hazard. The risk of repudiation means that sovereign borrowers can refuse to repay their debt when the repayment in the contract is too high. Moral hazard means the lenders have limited ability to monitor the behavior of the borrowers, so they can only deduce whether their money is made good use of by observing the outcome. Therefore, capital will flow out of the countries when a low realization happens.

Contribution

Atkeson's paper studies liquidity crisis for sovereign countries resulted from the combination of enforcement constraint and moral hazard. Sovereign debt crises have been an interesting topic since the 1980s when many developing countries fell into debt crisis. Several papers explored the property of sovereign debt before Atkeson's paper. Bulow and Rogoff (1989) showed that reputation



Andrew Atkeson — Stanley M. Zimmerman Professor of Economics and Finance at UCLA

couldn't increase the developing countries' ability to borrow due to the possibility of repudiation. Considering the repudiation risk, Grossman and Van Huyck (1985) viewed the sovereign debt in a state-contingent way. Fernandez and Rosenthal (1990) studied the bargaining game between debtors and creditors. Worrall (1990) proved that, in the long run, indebted countries can stabilize their consumption. However, little is explored between capital flow and sovereign debt crisis. Atkeson's paper inspired the literature on sovereign debt. Following his work, Atkeson and Lucas Jr (1992), and Phelan (1995), studied the moral hazard problem in debt contracts. Rose (2005), Aguiar and Gopinath (2006), Sandleris (2008), and Arellano (2008) explored the default risk of sovereign debts and renegotiation. Kletzer and Wright (2000), Cole, Dow, and English (1995), Cole and Kehoe (1998) followed the sequential game framework and added more ingredients, like signaling, reputation, and competition, into the model.

Discussion

Atkeson (1991) is a seminal model of international credit markets with repeated moral hazard and limited enforcement. The model aims to capture the phenomenon of 'sudden stops' of credit, characterized by capital outflows and consumption drops. Compared to the benchmark model of frictionless complete markets, the key features of the model are asymmetric information and enforcement frictions, which lead to a reduction in liquidity. Due to information asymmetry, international lenders cannot observe the borrower's consumption level, and the borrower can choose to default on its debt obligations.

The term 'liquidity' in this paper refers to the borrower's ability to access international credit in times of low output. The borrower faces an incentive compatibility constraint that imposes a penalty for over-consumption when output is low. However, the penalty is bounded by the threat of default, which limits the lender's ability to enforce repayment. As a result, the borrower may experience a liquidity crisis and fail to smooth its consumption. Convention wisdom believes that borrowers seek liquidity to smooth consumption, and thus improve welfare. But Atkeson tells us that under some frictions, liquidity itself can be procyclical and will function as an amplifier of exogeneous shocks.

This paper contributes to the literature on moral hazard, such as Thomas and Worrall (1990), Phelan and Townsend (1991), and Atkeson and Lucas (1992). These papers typically solve a maximization problem subject to incentive compatibility and individual rationality constraints. The individual rationality constraint specifies a reservation value for the borrower, which is often exogenous. In contrast, this paper endogenizes the reservation value by modeling the default risk as a period-by-period individual rationality constraint.



Atkeson explained the pattern of capital flows and debt crisis by studying the optimal contract between international lenders and borrowers. He found that under this optimal contract, borrowers would inevitably fall into illiquidity when they were unfortunately in the low realizations.



On Efficient Distribution with Private Information

The paper: Atkeson, A., & Robert E. Lucas, Jr. (1992). On efficient distribution with private information. The Review of Economic Studies, 59(3), 427-453. Reviewers: Yan Shuo, Guo Wu

Research Question

This paper is a study of the dynamics of the efficient distribution of consumption in an exchange economy with private information. Each period, these consumers experience unpredictable, idiosyncratic, privately observed taste shocks affecting their marginal utility of current consumption. A natural intuition for the allocation is that more resources ought to be allocated to those consumers who, in any given period, have a high marginal utility of current consumption. However, with the arise of private information, all other consumers have an incentive to misreport their current taste shock to receive a better treatment, which increases the cost of screening.

As said above, the arise of private information results in the failure of incentive compatibility. For this reason, the authors aim to construct a mechanism to implement incentive compatible allocations, which differs largely from the full-information cases. They made it via conditioning each consumer's consumption allocation not only on his current report of his taste shock, but also on the history of his past report, serving as a punishment for the cheaters. A particular case for



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Andrew Atkeson

this is to induce consumers to report their taste shocks truthfully by promising agents who report that they have a high marginal utility of consumption in the current period that they will receive more current consumption at the expense of less consumption in future periods, and versa visa.

Main Conclusion

Having introducing the mechanism, the authors characterize efficient allocations in this informationally constrained environment and examine the dynamics of the distribution of consumption that are implied on normative as opposed to positive grounds. They reformulate the problem as a recursive problem and establish a Bellman equation which characterizes the efficient allocation of resources and then solve this Bellman equation for two classes of current utility function.

The authors come to a conclusion that, in an efficient allocation the degree of inequality continually increases, with a diminishing fraction of the population receiving an increasing fraction of the resources. They also investigate find that under some certain conditions, the allocations in this paper can be decentralized via market arrangements to a certain extent.

Contribution

This paper aims to study the dynamics of the efficient distribution of consumption in an exchange economy with consumers whom is subject to private, idiosyncratic taste shocks and then design incentive compatible allocations. Main contribution includes points listed below:

1. Design the incentive compatible allocation for all agents subject to a constraint that the total consumption handed out each period to the population of agents cannot exceed some constant endowment level. The basic Bellman equation that the authors study is quite different from those studied by earlier writers.

2. This paper not only construct efficient allocation rules but also show the existence of efficient allocation rules at the level of generality through some examples. In addition, the authors verify clearly that the efficient allocation rules the authors have constructed satisfy the boundness condition and develop some other properties of these kinds of rules.

3. This paper shows how prices can be used to decentralize the overall planning problem into component planning problems. This decentralization provides a connection between the efficiency problem addressed in this paper and the principal-agent problem studied by others.

Robert Lucas

American Economist The Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel 1995

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The authors come to a conclusion that, in an efficient allocation the degree of inequality continually increases, with a diminishing fraction of the population receiving an increasing fraction of the resources.

Debt-Constrained Asset Markets

Kehoe, T. J., & Levine, D. K. (1993). Debt-Constrained Asset Markets. The Review of Economic Studies, 60(4), 865–888. https://doi.org/10.2307/2298103 Reviewers: Yin Huanyu, Chen Yongqiao

Research Question

In light of traditional complete market theory, individual consumption should be perfectly correlated with aggregate consumption because of the ability to perfectly smooth consumption according to aggregate shock with the help of complete asset markets. However, this observation is not true in reality. One way to model this phenomenon is to impose constraints on the collection of debts, which lack theoretical justification. Thus, the goal of this paper is to provide a micro foundation for such models. This paper considers an infinite-horizon general equilibrium model in which endogenous debt limits have the form of individual rationality constraints. The key points here are the moral hazard motive (or the default option) and the rational contract design that prevents default. The contract stipulates that if an agent defaults on a contract, he will be excluded from future contingent claims markets trading and will have his assets seized. But due to the limited enforceability assumption, he cannot be excluded from spot market trading, and he has some private endowments that cannot be seized. These market imperfections result in partial insurance, which explains the imperfect correlation between private and aggregate consumption.

The paper finds that under identically homothetic preferences, the first and second welfare theorems hold, and second-best equilibria with active intertemporal markets are possible. A kind of" Folk theorem" is proposed that for discount factors close to one, first-best allocations may be sustained. Moreover, the paper shows by example that, even when the first-best is not attainable, intertemporal and interstate trades are still possible, giving rise to partial insurance in this model.

The primary contribution of this paper is the introduction of a theory that incorporates endogenous debt limits as constraints for individual rationality, which is particularly relevant for the case of identically homothetic preferences. The theory has the potential to explain the lack of correlation between private and aggregate consumption and serves as a foundation for a mechanism design theory, which could help identify cases where certain types of trade cannot be prevented.



Timothy Kehoe — Professor of Economics at University of Minnesota

Debt constraints have been observed in individual consumption patterns (Hayashi (1985) and Zeldes (1989)), but their theoretical explanation is primarily studied in monetary theory where the inability to sell money short creates a debt constraint. In contrast to the aforementioned papers, this paper incorporates the endogenous debt limits to prevents agents from the default option due to moral hazard motive. Inspired by Prescott and Townsend (1984a), Prescott and Townsend (1984b) and Atkeson and Lucas Jr (1992), which collectively focus on incentive compatibility constraints, Kehoe and Levine (1993) focus on individual rationality constraints. The constraints this paper imposes are similar to those in the international debt literature, such as Schechtman and Escudero (1977) and Manuelli (1986).

Discussion

In the paper "Debt-Constrained Asset Markets", Kehoe and Levine impose endogenous debt limits in form of individual rationality constraints to explain the imperfect correlation between private and aggregate consumption. In the Kehoe-Levine model, contracts must be self-enforcing, meaning that individuals have the incentive to honor their contracts at each moment, even if they can walk away and thereafter live in "autarky". This introduces an enforcement friction in the model.

Therefore, the key difference between the Kehoe-Levine model and the benchmark model of complete markets lies in the enforcement friction, that is, the introduction of individual rationality constraints. The Kehoe-Levine model introduces tighter history-contingent state-by-state borrowing constraints compared to the benchmark model, which embed "participation constraints" designed to make it in everyone's interest to always honor their contracts.

The liquidity in this paper can be understood as the degree of ease with which individuals can borrow or trade assets. In the Kehoe-Levine model, some consumers' assets are considered "illiquid", meaning that they are facing tighter borrowing constraints compared to the benchmark model.

It's worth noting that Zhang (1997) and Alvarez and Jermann (2000) use related setups to explain asset pricing "puzzles", in the sense that data are not consistent with at least some empirical implementations of the Arrow version of the sequential trading model.



The liquidity in this paper can be understood as the degree of ease with which individuals can borrow or trade assets. In the Kehoe-Levine model, some consumers' assets are considered "illiquid", meaning that they are facing tighter borrowing constraints compared to the benchmark model.

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Endogenous Borrowing Constraints with Incomplete Markets.

The paper: Zhang, H. H. (1997). Endogenous Borrowing Constraints with Incomplete Markets. The Journal of Finance, 52 (5), 2187-2209.

Reviewer: Zhang Lekang





Aiyagari, 1994

Research Question

Borrowing constraint is important in both reality and theory, but is always arbitrarily assumed to be exogenous. This paper tries to solve the risk premium puzzle by introducing endogenous borrowing constraints into the complete market model.

Main Conclusions

First, the nonnegative consumption borrowing constraint (Aiyagari, 1994) is very loose, having little impact on asset returns.

Second, the no default borrowing constraint (proposed by this paper, Zhang, 1997) for certain sets of parameters can be much less stringent than current literature, but much tighter than the nonnegative consumption borrowing constraint. Moreover, as the risk aversion or discount factor increases, the borrowing limit given by the no default borrowing constraint also increases.

Third, the locus of the stochastic discount factor (SDF) in the model lies above the locus of SDF in the complete market.

Last, while the no default borrowing constraints for certain parameter sets generate a low risk-free rate, they fall short of generating sufficient volatility, indicating a potential need for more incompleteness.

Contribution

To solve the risk premium puzzle, this paper endogenizes the nonnegative consumption borrowing constraint (Aiyagari, 1994) by introducing a stochastic interest rate and proposes a new endogenous no default borrowing constraint, which allows an investor borrow no more than what she has incentive to pay back. It is found that the no default borrowing constraint can be much less stringent than current literature, but more stringent than nonnegative consumption borrowing constraint

Discussion

The tightness of borrowing constraint or the value of borrowing limits connects with the market liquidity rate naturally. In previous works, there were mainly two kinds of borrowing constraints.

1. Ad hoc borrowing constraint: It takes the form of a lower bound on an investor's bond holdings, which is a certain percentage of total income or per capita income. For example,

Lucas (1994): Allow borrow up to 20% of total income

• Telmer (1993): Allow borrow up to the maximum of 25% of total income and one-time exogenous endowment income. (Intuition: rule out the negative consumption cases.)

2. Nonnegative consumption borrowing constraint (Aiyagari, 1994): It allows borrow up to the capitalized value of her worst possible sequence of income shocks y_{\min} discounted at some constant interest rate r, i.e., $\frac{y_{\min}}{y_{\min}}$.

The no default borrowing constraint proposed by this paper can be much less stringent than ad hoc borrowing constraints, but more stringent than nonnegative consumption borrowing constraint. In the end, the no default borrowing constraint fails to generate enough volatility to meet the Hansen-Jagannathan bound and match the moments in real data. This implies the model needs more incompleteness. Therefore, this paper points a direction to update but also leaves some space for improvement.

Afterwards, Alvarez and Jermann (2000) use related setups to explain asset pricing puzzles in the sense that the real data are inconsistent with the theoretical sequential trading model. They mainly find that asset prices depend only on the valuation of agents with substantial idiosyncratic risk.

Efficiency, Equilibrium, and Asset Pricing with Risk of Default

The paper: Alvarez, F., & Jermann, U. J. (2000). Efficiency, equilibrium, and asset pricing with risk of default. Econometrica, 68(4), 775-797. Reviewers: Guo Wu, Li Tuoda



The tightness of borrowing constraint or the value of borrowing limits connects with the market liquidity rate naturally. In previous works, there were mainly two kinds of borrowing constraints.

Research Question

In previous literature of incomplete financial markets, agents cannot eliminate all idiosyncratic risk, which brings about two drawbacks when compared with complete markets models:

First, they require more or less arbitrary assumptions about which set of securities is available, and the conclusions may in turn crucially depend on these assumptions.

Second, they lose tractability. Because finding equilibria of these models involves solving a complicated fixed point problem, it has been difficult to analyze the case of many assets or many agents.

In this paper, the authors study a class of models whose equilibria, in general, entail limited risk sharing and avoid these drawbacks.



Fernando Alvarez

Professor of Economics at the University of Chicago

Main Conclusions

The authors study a market equilibrium with explicit endogenous portfolio constraints for an environment with risk of default. They derive the first and second welfare theorems, and characterize the corresponding asset pricing kernel. Then they further compare the pricing kernel with the one for economies without solvency constraints and find that: First, interest rates are lower, regardless of the precautionary savings motive; Second, the risk premium for a claim that depends only on next period's aggregate endowment is identical if individual and aggregate shocks are independent; Third, asset prices are determined by agents with substantial individual risks. In particular, agents whose income process is similar to the aggregate are irrelevant for asset prices.

Contribution

A main marginal contribution of this paper is the introduction of a new equilibrium concept that emphasizes portfolio constraints: a competitive equilibrium with solvency constraints. The equilibria of these models, in general, entail limited risk sharing and avoid the drawbacks of canonical models with incomplete financial markets.

Intuitively, they suppose a system where, if agents default on some debt, they can be punished by seizing all the assets that they own, but their labour income cannot be garnished. In such an environment, risk sharing may be effectively reduced because agents with low income realizations can only borrow up to the amount they are willing to pay back in the future.



Urban Jermann

Safra Professor of International Finance and Capital Markets, Professor of Economics, Professor of Finance at the University of Pennsylvania

Discussion

1. The difference with the benchmark model

In this model, the same set of Arrow-securities are traded as in Arrow's model, but contracts must be self-enforcing. Equilibrium allocations must be arranged so that each household wants to honor its contract at each moment even though it is always free to walk away and thereafter live in 'autarky'. There is an enforcement friction but no information friction.

On this basis, the paper introduces a new equilibrium concept that emphasizes portfolio constraints: a competitive equilibrium with solvency constraints. The equilibria of these models, in general, entail limited risk sharing and avoid the drawbacks of canonical models with incomplete financial markets. Then authors use related setups to explain asset pricing 'puzzles'.

2. The liquidity of the model:

In this model, some illiquidity of consumers' assets arises since the borrowing constraint is tighter than that in canonical Arrow model, where income can be thought of some kind of 'non-pledgable'.

3. Relationship with other papers:

Kehoe and Levine (1993), Zhang (1997) and Alvarez and Jermann (2001). In these three papers, the same set of Arrow-securities are traded as in Arrow's model, but contracts must be self-enforcing. And the equilibrium allocations are arranged with tighter budget constraints.

Zhang (1997) and Alvarez and Jermann (2001) use related setups to explain asset pricing 'puzzles' (puzzles in the sense that data are not consistent with at least some empirical implementations of the Arrow version of the sequential trading model).

Kehoe and Levine (1993) and Alvarez and Jermann (2001) both tack on collateral constraints to create 'liquidity premia' for assets that qualify as collateral. And the trades are multilateral

The authors study a market equilibrium with explicit endogenous portfolio constraints for an environment with risk of default. They derive the first and second welfare theorems. and characterized the corresponding asset pricing kernel.

Group Formation in Risk-Sharing Arrangements

The paper: Genicot, G., & Ray, D. (2003). Group Formation in Risk-Sharing Arrangements. Review of Economic Studies, 70(1), 87-113.

Reviewers: Hu Die, Cui Chang

Research Question

Coalitions are necessary for individuals to smooth income fluctuations. For those groups mainly in rural areas, informal (not written) insurance or quasi-credit agreements are popular choice. To satisfying self-enforcing and voluntary participation, the expected net benefits from participating in the agreement must be at any point in time larger than one time gain from defection.

This paper investigate why informal insurance exists among small communities, while formal ones may be destabilized among them. Specifically, if a "large" group - the village community or a particular caste or kinship group within the community – can foresee the benefits of risk-sharing and reach an agreement, what leads to the absence of self-enforcing (or stable) agreement in smaller groups?



Garance Genicot — Professor of Economics at Georgetown University

Main Conclusions

Despite allowing for every potential group size in principle, only a finite number of group sizes can be stable.

• This is different from previous literatures in a way that there does not exist infinitely many stable sizes in the coalition.

Marginal benefit from insurance group decreases with group size. Large groups may collapse into smaller ones, and decrease the extent of risk-sharing among the population.

• Stability in small communities is likely to render the bankruptcy of stability in larger communities.

There may be more fundamental reasons for group splintering, such as region, caste or ethnicity reasons. In spite of these reasons, there is generally a significant group of people still available in a group.

Contribution

Several literatures record "individual deviations" framework. Deaton (1992), Townsend (1994), Udry (1994), Grimard (1997), Jalan and Ravallion



Debraj Ray

Silver Professor, Professor Of Economics at New York University (1999), Gertler and Gruber (2002), Ligon et al. (2002) discussed efficient group size in risk sharing. However, these works of literature do not place any bounds on group size. By endogenizing the extent and the formation of risk-sharing groups, this paper takes group size into consideration. This will help to identify confounding factors of the formation of large groups, such as caste, kinship and informational decay.

Several literatures focus on endogenous coalition formation (Bloch, 1996, 1997; Ray and Vohra, 1997, 1999, 2001) and coalition-proof Nash equilibrium. They discussed the "participation constraint" but ignore "incentive constraints" in coalition formation. This paper posits the latter constraint by adding a simplifying assumption that each coalition, once formed, attempts to implement some symmetric and stationary risk-sharing arrangement.

Discussion

This paper investigates the reason for the absence of self-enforcing agreement in smaller groups. By developing the theory of group enforcement constraints under a simplifying assumption, this paper gives insights on how coalitions implement arbitrary arrangements among their members.

In complete market, all information is publicly held and common knowledge, and there is a complete set of contingent claims markets. An agent can be fully insured with risk-sharing agreement and will not deviate in any state due to perfect contract enforcement. However, when a "large" group can foresee the benefits of risk-sharing and reach an agreement, some subgroups can also be able to do so, and jointly defect and share risk among themselves. This is of great concern for informal contracts which are widely used in rural areas. This paper relax assumption of "completer market" by allowing subgroups to deviate. It assumes groups, once formed, attempt to implement some symmetric and stationary risk-sharing arrangement. Some minimal need for insurance is required for a group to be individually stable. With a relatively higher insurance need, community with less people is likely to render the bankruptcy of stability in more-person communities.

The risk-sharing agreement in this paper has "illiquidity". "Illiquidity" means that trades of assets are impeded by some enforcement or information frictions. In this case, contracts of risk-sharing agreement is illiquid in the sense that it must be self-enforcing. Allocations in equilibrium must be arranged so that each individual wants to honor its contract even though he/she can deviate into some other coalitions of trading arrangements.

This paper is related to Kehoe and Levine (1993), where an incomplete market is described with endogenous debt limits in the form of individual rationality constraints. A rational contract design is used to prevent default. If an agent defaults on a contract, he will be excluded from contingent market even though he can still trade in spot markets. It is extended by Genicot and Roy (2003) in a way that deviation may result from any fundamental reasons, not necessarily limited to moral hazard motive. More specifically, illiquidity in Kehoe and Levine (1993) comes from penalties on default options, while that in Genicot and Roy (2003) comes from a general tradeoff between marginal benefits and cost of deviation.



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A Unified Framework for Monetary Theory and Policy Analysis

The paper: Lagos R, Wright R. A unified framework for monetary theory and policy analysis[J]. Journal of Political Economy, 2005, 113(3):463-484.

Reviewers: Wu Yizou, Zhang Wenrui

Research Question

The paper aims to provide a unified micro-founded framework for the analysis of monetary policy. The paper is one of the search-theoretic models of monetary exchange, which are based on explicit descriptions of the frictions that make money essential.

Main Conclusions

As for the main findings of this paper, they propose an analytically tractable and easily quantifiable framework, based on explicit micro-foundations, within which macro policy can be studied. They calibrate the model to standard observations and use it to measure the cost of inflation. They find that going from 10 percent to 0 percent inflation is worth between 3 and 5 percent of consumption-much higher than previous estimates. The following figure shows the welfare cost of different levels of inflation.

Welfare cost $(1-\Delta_0)$



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Contribution

Most monetary models in macroeconomics are reduced-form model which makes assumptions, such as putting money in the utility function (Feenstra, R. C. (1986); Matsuyama, K. (1990)) or imposing cash-in-advance constraints (Abel, A. B. (1985); Svensson, L. E. (1985); Hodrick, R. J., Kocherlakota, N., and Lucas, D. (1991); Dotsey, M., & Sarte, P. D. (2000)). However, this paper (Lagos and Wright (2005)) models the role of money explicitly.

This paper also differs from other search-theoretic models of monetary exchange which are based on explicit descriptions of the frictions that make money essential. Tractable versions of these models typically make strong assumptions that render them ill-suited for monetary policy analysis. For example, Shi (1995) has analytic results only for the case that money holding is 0 or 1.

The Lagos and Wright (2005) framework provides insights into various topics, such as the role of money in business cycles, the optimal design of monetary policy, and the welfare implications of different monetary arrangements. It has been influential in shaping research in monetary economics and has provided a foundation for further theoretical and empirical investigations. There are many papers using this framework, such as Lagos, R., & Zhang, S. (2022), Lagos, R., & Zhang, S. (2019), Keister, T., & Sanches, D. (2023).

Discussion

Compared to the complete market benchmark model, this paper introduces search friction, models the role of money explicitly and provides a micro foundation for monetary economics. What complicates the analysis in previous papers with search models is the endogenous distribution of money holdings. But this paper makes the assumption of quasi-linear preferences to make the distribution degenerate. In this paper, there is no credit, and money provides liquidity. More specifically, in the decentralized market, agents interact with anonymous bilateral matching. Since meetings are anonymous, there is no scope for trading future promises in this market, that is to say credit is not allowed, therefore agents must use money to trade.

This paper is related to Duffie et al. (2005)("Over-the-Counter Markets") as they both employ the search model to study liquidity. The difference is that this paper focus on the role of money as the liquidity provider while Duffie et al. (2005) focus on liquidity of the over-the-counter markets.









Professor of Economics at New York University

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As for the main findings of this paper, they propose an analytically tractable and easily quantifiable framework, based on explicit micro-foundations, within which macro policy can be studied. They calibrate the model to standard observations and use it to measure the cost of inflation.

Over-The-Counter Markets

The paper: Duffie, D., Gârleanu, N., & Pedersen, L. H. (2005). Over-the-counter markets. Econometrica, 73(6), 1815-1847. Reviewers: Liu Qiaogiao, Ren Hangdong

Research Question

In the over-the-counter market, sellers must match with buyers. The search and matching process may incur a cost which could explain the existence of intermediaries. And trading prices between investors and bid-ask spread charged by intermediaries are determined through bargaining due to counterparties' availability of alternatives. The search-and-bargaining feature makes sense in many markets such as mortgage-backed securities, real-estate markets, etc.

There are many researches studying asset pricing with exogenous frictions (Mendelson1986, Constantinides1986). There are, in addition, also two strands of literature explaining the bid-ask spreads from inventory (Gatman1976, Amihub and Mendelson1980) and information (Glosten and Milgrom1985, Kyle1985) considerations. This paper constructs a dynamic asset pricing model that endogenizes trading frictions arising through search and bargaining to study the price determination and equilibrium allocations.



Nicolae Gârleanu — Professor of Finance at Washington University

Results

In the model presented in this paper, market makers have no inventory risk, and agents are symmetrically informed. In the baseline analysis they have reached a different conclusion from that of information-based model, and have found that bargaining position of investors improves if they are more sophisticated or better informed (i.e., they can find each other or other marketmakers more easily). They have also done extended research in terms of heterogeneous investors and have come to the same conclusion. Besides these, this paper has explored the case that marketmaker has total bargaining power as well. On the contrary, however, more frequent contact and monopolistic marketmaker imply that it becomes harder for investors to find counterparty by himself and the marketmaker has already executed most of the efficient trade. As a result, bid-ask spread becomes wider.

Contribution

This paper is a theoretical study that examines the impact of search and bargaining on price determination in over-the-counter markets. set-pricing model which involves investors' searching abilities, intermediaries' accessibility and



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bargaining powers to compute trading price between investors, as well as bid and ask price offered by marketmakers. The result shows that the bid-ask spreads are tighter if investors are able to find each other or other marketmakers easily provided that there is no monopolistic marketmaker.

Discussion

There are lots of researches studying the asset pricing from the perspective of inventory (Bollen et al., 2004; Colliard et al., 2021) or information-based trading (Babus & Kondor, 2018; Glode & Opp, 2016). Aside from these above, there are many papers like this one that lie at asset pricing in OTC market with particular emphasis on search and bargaining positions, as well as imperfect competition(Lagos & Rocheteau, 2007; Vayanos & Weill, n.d.; Yavaş, 1993). In reality, as this paper says, 'search' can be viewed as necessary delay to verify counterparties' credit standing and make thorough arrangement. This paper is viewed as a pioneering work in this field.

There has been some research progress in this direction in recent years. For example, Feldhütter (2012) uses the difference between prices paid by small traders and large traders to identify the impact of selling pressure on the difference between market price and fundamental value. Cujean and Praz (2015) construct a search-and-matching model taking into account both inventory and asymmetric information, to study the impact of liquidity needs' information transparency on the functioning of an over-the-counter market. Weill (2020) provides a review on the search-and-matching theory and setup a model which summarizes key assumptions and economic forces at play in existing work. Even more to the point, researches considering the role of network has emerged (Babus & Hu, 2017; Chang & Zhang, 2021; Gofman, 2011; Hendershott et al., 2020, 2020; Li & Schürhoff, 2019), which is a promising research direction in the future.



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In the model of this paper, marketmakers have no inventory risk and agents are symmetrically informed. In the baseline analysis they have reached a different conclusion from that of information-based model, and have found that bargaining position of investors improves if they are more sophisticated or better informed (i.e., they can find each other or other



Leaning Against the Wind

The paper: Weill, P. O. (2007). Leaning against the wind. The Review of Economic Studies, 74(4), 1329-1354. Reviewers: Zhang Wenrui, Chen Bixiao

Research Question

The research question of this paper is: How can market makers provide optimal liquidity during a market crash?

The motivation for this research question stems from the fact that during financial disruptions, market makers, such as NYSE specialists and NASDAQ market makers, typically provide liquidity by absorbing external selling pressure. They buy large quantities of assets and build up inventories when selling pressure in the market is high, then dispose of those inventories after the selling pressure has subsided.

However, the optimal amount and timing of liquidity provision in such situations is not well-understood. Moreover, capital market imperfections can prevent market makers from raising sufficient capital to supply the socially optimal amount of liquidity, which can have important implications for financial stability and the role of central banks in providing liquidity during times of crisis.

Therefore, the paper seeks to address these gaps in our understanding by developing a model of optimal dynamic liquidity provision and exploring the conditions under which competitive market makers supply the socially optimal amount of liquidity, as well as the potential policy implications of capital market imperfections on liquidity provision during financial disruptions.



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Main Conclusions

The main conclusion of the paper is that Pareto-optimal liquidity provision is consistent with a discrete price decline at the time of the crash, deviating from the traditional objective of maintaining price continuity. During a financial crisis, requiring market makers to maintain price continuity can result in a welfare loss. The paper argues that market makers' capital constraints affect their ability to provide liquidity during such a crisis, and if they do not maintain sufficient capital, they cannot purchase as many assets as prescribed by the socially optimal allocation. The study shows that lenient central bank lending during a crash can improve welfare if capital market imperfections prevent market makers from raising sufficient capital before the crash.

Contribution

The paper makes important contributions to our understanding of the role of market makers in providing liquidity during financial disruptions and the potential implications of capital constraints on their behavior. It has important implications for policy debates on financial regulation and central bank lending during times of crisis.

In the literature, there is a common argument that market makers should provide liquidity to ensure price continuity and stabilize asset prices. However, this paper takes a different approach and evaluates liquidity provision from a Pareto optimality perspective. The findings suggest that the optimal level of liquidity provision may result in a discrete price decline during a crash. Thus, requiring market makers to maintain price continuity during a crisis could actually lead to a loss in social welfare.

The related literature discussed the traditional inventory-based models of market making that analyze liquidity provision in normal times, assuming exogenous and time-invariant supply and demand curves (see Chapter 2 of O'Hara, 1995, for a review). This paper, however, derives time-varying supply and demand curves from investors' inter-temporal utility maximization problems to address the welfare impact of liquidity provision under unusual market conditions. The paper also studies the impact of scarce market-making capital on market makers' profit and price dynamics, which differs from previous literature. In Grossman and Miller (1988) and Greenwald and Stein (1991), the social benefit of market makers' liquidity provision is to share risk with sellers before the arrival of buyers. The social benefit of liquidity provision in this model is to facilitate trade and allocate assets from initial sellers to later buyers, whereas other models focus on sharing risks with sellers. Furthermore, Bernardo and Welch (2004) explain a financial market crisis in a two-period model, along the line of Diamond and Dybvig (1983), and they study the liquidity provision of myopic market makers. This paper's richer inter-temporal structure sheds light on the optimal timing of liquidity provision. While other papers have explained financial market crises, this paper aims to develop a model of market makers' optimal liquidity provision after an aggregate liquidity shock.

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The main conclusion of the paper is that the Pareto-optimal liquidity provision is consistent with a discrete price decline at the time of the crash, which is a departure from the traditional objective of maintaining price continuity. During a financial crisis, requiring market makers to maintain price continuity can result in a welfare loss.



The present paper is related to search-and-matching models of financial markets. These models focus on the impact of trading delays in security markets and the investment in market-making capacity to provide liquidity in the long run. The present paper builds specifically on the work of Duffie, Gârleanu, and Pedersen (2005) and focuses on liquidity provision in the short run, with market makers providing liquidity by adjusting their inventory positions. The paper also distinguishes itself by studying intermediation during a financial crisis, where the size of the market-making sector is taken as given and the market-making sector can only gain capacity by increasing its capital, resulting in fluctuations in aggregate inventories over time.

This paper has over 300 citations and has a significant impact on literature of liquidity. from the perspective of market microstructure. Valentin, Moreira, and Muir (2021) follow the present paper, it reports on the disruption that occurred in debt markets during the COVID-19 crisis. It describes how this disruption manifested as a severe price crash, coupled with significant dislocations at the safer end of the credit spectrum. Moreover, Kargar et al. (2021) study liquidity conditions in the corporate bond market during the COVID-19 pandemic. They find that trading costs significantly increased for immediate trades, leading customers to switch to slower agency trades. By analyzing the eligibility requirements, they demonstrate that the Federal Reserve's corporate credit facilities had a positive impact on market liquidity.

Discussion

The paper examines the optimal liquidity provision by market makers during financial disruptions. Market makers buy assets during periods of high selling pressure and sell them when the pressure eases. The study develops a

model for determining socially optimal liquidity provision and discusses the policy implications.

Discrete price declines during crises can be consistent with optimal liquidity provision. The paper discusses about quantifying welfare gains, and also notes the broader view that liquidity provision helps prevent financial system meltdowns and supports the macroeconomy.

I will provide the following discussion from the perspective of the meaning of 'liquidity' in this paper, since it is the central theme of this reading group. In the context of this paper, "liquidity" refers to the ability to buy or sell assets guickly, at a fair price, without causing significant disruptions to the market. It represents the ease with which an asset can be converted into cash or other assets without incurring substantial costs or price impacts.

More precisely, liquidity refers to the availability of buyers and sellers in a market and the ability to execute transactions promptly and efficiently. It encompasses factors such as the depth of the market (sufficient number of buyers and sellers), the immediacy of trading (quick execution of trades), and the bid-ask spread (the difference between the prices at which buyers are willing to purchase and sellers are willing to sell).

In this article, liquidity provision by market makers refers to their role in facilitating trading by absorbing selling pressure and providing a ready market for buyers. Market makers supply liquidity by buying assets from sellers when there is high selling pressure and accumulating inventories. They then sell those assets when the selling pressure subsides, providing liquidity to buyers. This dynamic liquidity provision helps maintain orderly and efficient markets, ensuring that buyers and sellers can transact smoothly even during periods of financial disruptions.

References

Cortes, F. (2003). Understanding and modelling swap spreads. Bank of England Quarterly Bulletin, Winter.

Dow, J., & da Costa Werlang, S. R. (1992). Uncertainty aversion, risk aversion, and the optimal choice of portfolio. Econometrica:

- Greenwald, B. C., & Stein, J. C. (1991). Transactional risk, market crashes, and the role of circuit breakers. Journal of Business,

nance, 75(2), 683-734.

Hernandez, A., & Santos, M. S. (1996). Competitive equilibria for infinite-horizon economies with incomplete markets. Journal of Economic Theory, 71(1), 102-130.

Hodrick, R. J., Kocherlakota, N., & Lucas, D. (1991). The variability of velocity in cash-in-advance models. Journal of Political Economy, 99(2), 358-384.

Jalan, J. and Ravallion, M. (1999), Are the poor less well insured? Evidence on vulnerability to income risk in rural China. Journal of Development Economics, 58, 61-81.

Jones, R. A. (1976). The origin and development of media of exchange. Journal of Political Economy, 84(4, Part 1), 757-775.

Kareken, J., & Wallace, N. (1981). On the indeterminacy of equilibrium exchange rates. The Quarterly Journal of Economics, 96(2), 207-222.

Kargar, M., Lester, B., Lindsay, D., Liu, S., Weill, P. O., & Zúñiga, D. (2021). Corporate bond liquidity during the COVID-19 crisis. The Review of Financial Studies, 34(11), 5352-5401.

Kehoe, T. J., & Levine, D. K. (1993). Debt-constrained asset markets. The Review of Economic Studies, 60(4), 865-888.

Keister, T., & Sanches, D. (2023). Should central banks issue digital currency? The Review of Economic Studies, 90(1), 404-431.

Kiyotaki, N., & Wright, R. (1989). On money as a medium of exchange. Journal of Political Economy, 97(4), 927-954.

Kletzer, K. M., & Wright, B. D. (2000). Sovereign debt as intertemporal barter. American Economic Review, 90(3), 621-639.

Knight, F. H. (1921). Risk, uncertainty and profit (Vol. 31). Houghton Mifflir

Kocherlakota, N. R. (1996). Implications of efficient risk sharing without commitment. The Review of Economic Studies, 63(4), 595-609.

Krishnamurthy, A. (2002). The bond/old-bond spread. Journal of Financial Economics, 66(2-3), 463-506

Lagos, R. (2013). Moneyspots and coexistence in the pure theory of money: A reply to Neil Wallace. Journal of Political Economy, 121(4), 796-801.

Lagos, R., & Rocheteau, G. (2007). Search in asset markets: Market structure, liquidity, and welfare. American Economic Review, 97(2), 198-202.

Lagos, R., & Rocheteau, G. (2008). Money and capital as competing media of exchange. Journal of Economic Theory, 142(1), 247-258

Lagos, R., & Wright, R. (2005). A unified framework for monetary theory and policy analysis. Journal of Political Economy, 113(3), 463-484.

Lagos, R., & Zhang, S. (2019). The limits of monetary economics: on money as a medium of exchange in near-cashless credit ecor omies.

Lagos, R., & Zhang, S. (2022). The limits of ONETARY ECONOMICS: On money as a constraint on market power. Econometrica, 90(3), 1177-1204.

Levine, D. K., & Zame, W. R. (1996). Debt constraints and equilibrium in infinite horizon economies with incomplete markets. Journal of Mathematical Economics, 26(1), 103-131.

Li, D., & Schürhoff, N. (2019). Dealer networks. The Journal of Finance, 74(1), 91-144

Ligon, E., Thomas, J., & Worrall, T. (2002), Mutual insurance and limited commitment: Theory and evidence in village economies. Review of Economic Studies, 69, 115-139.

Longstaff, F. A. (2004). The flight-to-liquidity premium in us treasury bond prices. The Journal of Business, 77(3), 511-526.

Longstaff, F. A., Mithal, S., & Neis, E. (2005). Corporate yield spreads: Default risk or liquidity? new evidence from the credit default swap market. The Journal of finance, 60(5), 2213-2253.

Lucas, D. J. (1994). Asset pricing with undiversifiable income risk and short sales constraints: Deepening the equity premium puzzle.

Journal of Monetary Economics, 34 (3), 325-341.

ucas, R. E. (1978). Asset prices in an exchange economy. Econometrica, 46(6), 1429-1445.

ucas, R. E. (1980). Equilibrium in a pure currency economy. Eco.

Lucas, R. E. (1982). Interest rates and currency prices in a two-country world. Journal of Monetary Economics, 10(3), 335-359.

Luttmer, E. G. (1996). Asset pricing in economies with frictions. Econometrica: Journal of the Econometric Society, 1439-1467.

Magill, M., & Quinzii, M. (1994). Infinite horizon incomplete markets. Econometrica: Journal of the Econometric Society, 853-880.

Mankiw, N. G. (1986). The equity premium and the concentration of aggregate shocks. Journal of Financial Economics, 17(1), 211-219.

Manuelli, R. E. (1986). TOPICS IN INTERTEMPORAL ECONOMICS (STOCHASTIC MODELS, MONETARY ECONOMICS). University of Minnesota.

Marimon, R. and Marcet, A. (1990). Communication, commitment, and growth. Unpublished manuscript, Carnegie Mellon University. Matsuyama, K. (1990). Sunspot equilibria (rational bubbles) in a model of money-in-the-utility-function. Journal of Monetary Econom-

Matsuyama, K. (1990). Sunspot equilibria (rational bubbles) in a n ics, 25(1), 137-144.

McCallum, B. T. (1985). Bank deregulation, accounting systems of exchange, and the unit of account: a critical review. National Bureau of Economic Research Working Paper Series, No. w1572.

Mehra, R., & Prescott, E. C. (1985). The equity premium: A puzzle. Journal of Monetary Economics, 15(2), 145-161.

Mortensen, D. T. (1982). The matching process as a noncooperative bargaining game. in J. J. McCall *The Economics of Information* and Uncertainty, University of Chicago Press, 233-258.

Mundell, R. A. (1963). Capital mobility and stabilization policy under fixed and flexible exchange rates. Canadian Journal of Economics and Political Science, 29(4), 475-485.

Obstfeld, M. (1981). Macroeconomic policy, exchange-rate dynamics, and optimal asset accumulation. Journal of Political Economy, 39(6), 1142-1161.

O'Hara, M. (1998). Market Microstructure Theory. Blackwell, Cambridge, MA.

Pástor, L., & Stambaugh, R. F. (2003). Liquidity risk and expected stock returns. Journal of Political Economy, 111(3), 642-685.

Peter C. B. Phillips, & Ploberger, W. (1996). An asymtotic theory of Bayesian inference for time series. Econometrica, 64(2), 381-412.

nelan, C. (1995). Repeated moral hazard and one-sided commitment. Journal of Economic Theory, 66(2), 488-506.

Phelan, C., & Townsend, R. M. (1991). Computing multi-period, information-constrained optima. The Review of Economic Studies, 58(5), 853-881.

Prescott, E. C., & Townsend, R. M. (1984a). General competitive analysis in an economy with private information. International Economic Review, 1-20.

Prescott, E. C., & Townsend, R. M. (1984b). Pareto optima and competitive equilibria with adverse selection and moral hazard. Econometrica: Journal of the Econometric Society, 21-45.

Ray, D., & Vohra, R. (1997). Equilibrium binding agreements. Journal of Economic Theory, 73(1), 30-78.

Ray, D., & Vohra, R. (1999). A theory of endogenous coalition structures. Games and Economic Behavior, 26(2), 286-336.

Ray, D., & Vohra, R. (2001). Coalitional power and public goods. Journal of Political Economy, 109(6), 1355-1384.

Rissanen, J. (1986). Stochastic complexity and modeling. The Annals of Statistics, 14(3), 1080-1100.

Rose, A. K. (2005). One reason countries pay their debts: renegotiation and international trade. Journal of Development Economics, 77(1), 189-206.

omic Inquiry, 18(2), 203.

Rubinstein, A., & Wolinsky, A. (1985). Equilibrium in a market with sequential bargaining. Econometrica: Journal of the Econometric Society, 1133-1150.

Sandleris, G. (2008). Sovereign defaults: Information, investment and credit. Journal of International Economics, 76(2), 267-275.

Sannikov, Y. (2008). A continuous-time version of the principal-agent problem. The Review of Economic Studies, 75(3), 957-984.

Santos, M. S., & Woodford, M. (1997). Rational asset pricing bubbles. Econometrica: Journal of the Econometric Society, 19-57.

Schechtman, J., & Escudero, V. L. (1977). Some results on "an income fluctuation problem". Journal of Economic Theory, 16(2), 151-166.

Shi, S. (1995). Money and prices: a model of search and bargaining. Journal of Economic Theory, 67(2), 467-496

Smith, A. (1776). An Inquiry into the Nature and Causes of the Wealth of Nations. BoD–Books on Demand.

Spear, S. E., & Srivastava, S. (1987). On repeated moral hazard with discounting. The Review of Economic Studies, 54(4), 599-617.

Svensson, L. E. (1985). Money and asset prices in a cash-in-advance economy. Journal of Political Economy, 93(5), 919-944.

Taub, B. (1990a). The equivalence of lending equilibria and signalling-based insurance under asymmetric information. RAND Journal of Economics, 21, 388-408.

Taub, B. (1990b). Dynamic mechanisms on a continuum. Unpublished manuscript, University of Illinois.

Telmer, C. I. (1993). Asset-pricing puzzles and incomplete markets. The Journal of Finance, 48(5), 1803-1832.

Thomas, J., & Worrall, T. (1990). Income fluctuation and asymmetric information: An example of a repeated principal-agent problem. Journal of Economic Theory, 51(2), 367-390.

Townsend, R. M. (1982). Optimal multiperiod contracts and the gain from enduring relationships under private information. Journal of Political Economy, 90(6), 1166-1186.

Townsend, R. M. (1987). Economic organization with limited communication. The American Economic Review, 954-971.

Townsend, R. M. (1988). Information constrained insurance: the revelation principle extended. Journal of Monetary Economics, 21(2-3), 411-450.

Townsend, R. M. (1994), Risk and insurance in village India. Econometrica: Journal of the Econometric Society, 62, 539-591.

Tsiang, S. C. (1956). Liquidity preference and loanable funds theories, multiplier and velocity analysis: A synthesis. The American Economic Review, 46(4), 539-564.

Udry, C. (1994). Risk and insurance in a rural credit market: An empirical investigation in northern Nigeria. The Review of Economic Studies, 61(3), 495-526.

Vayanos, D., & Weill, P. O. (2008). A search based theory of the on the run phenomenon. The Journal of Finance, 63(3), 1361-1398.

Weill, P.-O. (2020). The search theory of over-the-counter markets. Annual Review of Economics, 12(1), 747-773.

White, L. H. (1984a). Free banking in Britain: Theory, experience, and debate, 1800–1845

White, L. H. (1984b). Competitive payments systems and the unit of account. The American Economic Review, 74(4), 699-712.

Worrall, T. (1990). Debt with potential repudiation. European Economic Review, 34(5), 1099-1109.

Yaari, M. E. (1976). A law of large numbers in the theory of consumer's choice under uncertainty. Journal of Economic Theory, 12(2), 202-217.

Yavaş, A. (1993). A simple model of bid-ask spread and search. Review of Financial Economics, 2(2), 73-84

Zeldes, S. P. (1989). Consumption and liquidity constraints: an empirical investigation. Journal of Political Economy, 97(2), 305-346.

Zhang, H. H. (1997). Endogenous borrowing constraints with incomplete markets. The Journal of Finance, 52 (5), 2187-2209.

