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SARGENT INSTITUTE OF
QUANTITATIVE ECONOMICS
AND FINANCE

SIQEF
NEWSLETTER

GUANGDONG PROVINCE UNIVERSITY KEY
LABORATORY OF PHILOSOPHY AND SOCIAL SCIENCES

SHENZHEN KEY RESEARCH BASE OF HUMANITIES
AND SOCIAL SCIENCES

ISSUE 07 / 2025

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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*

SARGENT INSTITUTE OF QUANTITATIVE ECONOMICS AND FINANCE

News

SARGENT INSTITUTE OF QUANTITATIVE ECONOMICS AND FINANCE

Warm Congratulations! Professor Sargent Wins the Chinese Government Friendship Award!

Written by Zi Jing, You Mi
Translated by Dong Xiao

> As the 20th anniversary of Peking University HSBC Business School approaches, the school has received exciting news about its efforts to build an international faculty team. Recently, Professor Thomas J. Sargent—winner of the 2011 Nobel Prize in Economics and Honorary Director and Senior Advisor of the Sargent Institute of Quantitative Economics and Finance at Peking University HSBC Business School—was awarded the 2024 Chinese Government Friendship Award.

- CCTV report on the Ceremony of the Chinese Government Friendship Award

As one of the most distinguished scholars in global macroeconomic research, Professor Sargent joined Peking University HSBC Business School in 2017, where he led the establishment of the Sargent Institute for Quantitative Economics and Finance and served as its director. He has actively invited scholars from world-renowned universities and research institutions to collaborate with PKU faculty, forming an international and high-level research team that advances both theoretical and applied research in quantitative economics and finance in China. Professor Sargent personally designed and directed the school's PhD program in economics and taught courses such as Advanced Macroeconomics. To date, the Sargent Institute has admitted seven cohorts of doctoral students and organized eight international conferences on macroeconomics and finance, significantly promoting exchanges between Chinese scholars and leading experts in economics and finance worldwide.

- Professor Sargent in the classroom

- Group photo of some of the participants at the 8th PHBS Workshop in Macroeconomics and Finance

> Since its founding, Peking University HSBC Business School (PHBS) has vigorously implemented an internationalization strategy, placing great emphasis on the leadership and influence of top foreign experts. The school has actively expanded exchanges and collaborations with overseas universities, promoted cross-cultural understanding through initiatives such as establishing a UK campus and hosting an International Cultural Festival, and continually enhanced its global reputation and impact.

In November 2017, Professor Sargent promoted the joint establishment of the Peking University Macroeconomics and Finance Research Center in collaboration with Ping An Technology Co., Ltd. This center aims to conduct policy-oriented research projects, macroeconomic forecasting, and special studies on macroeconomic topics, providing valuable insights and recommendations for national and regional economic development. He has also been committed to providing objective and fair assessments of China's economic progress and has been invited to participate in high-level think tank conferences in China.

Since its founding, Peking University HSBC Business School (PHBS) has vigorously implemented an internationalization strategy, placing great emphasis on the leadership and influence of top foreign experts. The school has actively expanded exchanges and collaborations with overseas universities, promoted cross-cultural understanding through initiatives such as establishing a UK campus and hosting an International Cultural Festival, and continually enhanced its global reputation and impact. Currently, 21% of the school's faculty members are not Chinese nationals. They are from diverse countries including the United States, South Korea, and Italy, with five of them promoted to tenured associate professor positions. The school has established partnerships with 68 universities in 28 countries across five continents, cultivating 594 degree students and 547 exchange students from nearly 100 countries, including the United States, Canada, Thailand, Malaysia, Germany, and Russia. Associate Dean Young Joon Park has received both the "Yanyuan Friendship Award" from Peking University and the inaugural "Guangdong Province Friendship Award."

- Professor Sargent was invited to attend the 2024 Annual Conference of the China Development Forum.

Background Information

The Chinese Government Friendship Award is the highest honor established by the Chinese government to recognize foreign experts who have made outstanding contributions to China's modernization and reform efforts. It was authorized by the State Council and established by the State Administration of Foreign Experts Affairs in 1991 to express gratitude and appreciation to foreign experts for their remarkable achievements and dedication in China's social development, as well as in economic, technological, educational, cultural endeavors, and talent cultivation. In 2024, a total of 100 foreign experts were awarded the Chinese Government Friendship Award.

Advanced Macro Workshop on Machine Learning, Mechanism Design, and Heterogeneous-Agent Models Held at PHBS

By Dong Xiao, Wang Weirong, Xiong Zichao, and Annie Jin

On November 2, the Advanced Macro Workshop on Machine Learning and Heterogeneous-Agent Models was held at Peking University HSBC Business School (PHBS), co-hosted by the Sargent Institute of Quantitative Economics and Finance (SIQEF) at PHBS, Institute for Advanced Study (IAS) and Economics and Management School at Wuhan University, as well as the University of International Business and Economics. During the event, more than 30 scholars from Chinese mainland and Hong Kong participated in discussions on the latest academic research in macroeconomics, machine learning, mechanism design, and heterogeneous-agent models.

-Scholars and students attend the workshop

- The group photo of participants

> This workshop not only provided an academic platform for researchers in related fields to exchange ideas but also injected new impetus into the development of machine learning and heterogeneous-agent models, fostering integrated development across interdisciplinary areas.

Nie Jun

Professor Nie Jun gave a brief introduction to the workshop, highlighting its significance in bringing together researchers and experts from diverse institutions across mainland China and Hong Kong to discuss topics in machine learning, mechanism design, and heterogeneous agent models. In addition, the workshop also aimed to foster connections and collaborative learning between professionals in mathematics, data science, and economics.

Lv Qi

Professor Lv Qi from Sichuan University presented his coauthored paper titled “Optimal Control of Stochastic Evolution Equations: Some Recent Progresses,” discussing advancements in control theory for Stochastic Distributed Parameter Systems (SDPSs). Since existing methods for deterministic distributed parameter control systems and stochastic finite-dimensional control systems do not apply to SDPSs, it is necessary to develop new mathematical tools even for simple SDPSs. The paper mainly focuses on the controllability of stochastic hyperbolic equations and the Pontryagin-type maximum principle for controlled stochastic evolution equations, concluding with open questions and future research directions in SDPS control theory.

Thomas J. Sargent

Professor Thomas Sargent introduced the current research status and challenges surrounding the framework of decision problems known as “equilibrium Markov processes.” He emphasized that, despite the conceptual simplicity, this high-dimensional structure poses significant challenges in fully characterizing it. However, with recent advancements in statistics, function approximation, and computing power, researchers are now better equipped to delve into the realms of machine learning and artificial intelligence. Professor Sargent expressed his hope that the presentations at the workshop would showcase innovative applications of these breakthroughs.

Mathieu Laurière

Mathieu Laurière, assistant professor at New York University Shanghai, delivered a speech on his collaborative paper, “A Machine Learning Method for Stackelberg Mean Field Games.” He introduced an innovative single-layer numerical method designed to tackle the Stackelberg mean field game problem. This method utilizes a penalty approach to convert the two-level problem involving the leader and the agents into a single-layer mean field optimal control problem. The findings demonstrate that the proposed reconstruction method converges to the original problem. Additionally, the research proposes a machine learning method utilizing feed-forward and recurrent neural networks and showcase its application through various examples from existing literature.

Jentzen Arnulf

Jentzen Arnulf, professor at the Chinese University of Hong Kong (Shenzhen) and University of Münster, presented his collaborative paper titled "Overcoming the Curse of Dimensionality: From Nonlinear Monte Carlo to the Training of Neural Networks". This paper proposes an efficient machine learning algorithm for approximating solutions to high-dimensional partial differential equations (PDEs). The authors pointed out that deep artificial neural networks (ANNs) could effectively overcome the curse of dimensionality, making them suitable for a broad class of semilinear parabolic PDEs. Furthermore, the research findings indicate that certain smooth functions cannot be approximated by shallow ANNs without succumbing to the curse of dimensionality; however, they can be approximated by deep ANNs without this limitation.

Tang Qing

Tang Qing, a lecturer from China University of Geosciences, presented a paper titled "Cournot Mean Field Game of Controls: Theory and Numerical Algorithms." In this paper, Tang explored a sophisticated economic model where multiple agents optimize their production decisions in a Cournot competition setting. The model is particularly relevant for industries with finite resources, such as oil or other exhaustible commodities, where individual agents are influenced by the collective output of all players, thereby forming a Cournot Mean Field Game (MFG) framework. This framework integrates optimal control theory with mean field games, allowing agents to adapt their production strategies over time in response to fluctuating market prices and resource scarcity.

Zhu Shenghao

Professor Zhu Shenghao from University of International Business and Economics, presented a paper titled "Kantorovich Meets Sargent: A New Perspective of Rational Expectations". This paper explores an innovative approach to studying rational expectations within macroeconomic models, to examine how distributions or beliefs evolve theoretically and leverage machine learning to calculate these abstract constructs in macroeconomics. The author established a link between optimal transport theory, specifically through the Kolmogorov-Fokker-Planck equation, and rational expectations. This linkage offered a robust framework to trace the evolution of the density function of expectations within a heterogeneous agent model. By integrating machine learning techniques, the model elucidated intricate distributions of economic agents' beliefs and actions, thereby refining the accuracy of depicting belief evolution in dynamic economic environments.

Chen Nan

Professor Chen Nan from the Department of Systems Engineering and Engineering Management of The Chinese University of Hong Kong shares his paper, "Collusion or Compete: A Two Timescale Evolutionary Game Approach to Algorithmic Collusion Study." This paper solves the multi-agent reinforcement learning problems by replacing the Q-value function with the Nash Q-value function. To maintain stability, the authors slowed down the learning of policy function and belief function, and accelerated the learning of value function, therefore relaxing some restrictive assumptions for equilibrium and provide possibility for agents to reach the Nash equilibria in more complex cases. This research helps to understand algorithmic collusion of agents.

Zhang Lichen

Assistant Professor Zhang Lichen from Business School of the University of Hong Kong introduced the paper titled "College Access and Intergenerational Mobility." The authors combined the Aiyagari lifecycle model and the overlapping generations' model to analyze parents' investment decisions in their children's education. The parameters of the model were determined through a two-step estimation process based on data from the China Family Panel Studies (CFPS). The paper found that an expansion of college capacity leads to a widening gap between high-income and low-income households, as high-resource households continue to have an advantage in investing in their children's human capital. Additionally, the paper revealed that education policies, such as increasing public education spending and reducing college costs, have only limited effects on improving intergenerational mobility in China. It suggested that policymakers should take into account family responses to achieve the desired effects.

Fan Hua

Assistant Professor Fan Hua from the Institute for Advanced Economic Research at Dongbei University of Finance and Economics introduced the paper titled "Equilibrium Wealth and Consumption Inequality under Ambiguity Aversion." In this paper, the authors developed a continuous-time general equilibrium heterogeneous-agent model incorporating ambiguity aversion to investigate its impact on wealth and consumption inequality. They demonstrated that a higher degree of ambiguity aversion leads to lower inequality in both wealth and consumption, whereas higher risk aversion exacerbates such inequality. However, they also found that price effects from the general equilibrium may counteract or even reverse these outcomes. As aversion behavior can decrease demand and prices, higher ambiguity aversion may actually increase welfare.

At PHBS, Engage in Face-to-Face Dialogue with Nobel Laureate

By Annie Jin

On October 30, 2024, the event "Nobel Dialogue: A Tea Party for PHBS Student " was held at Peking University HSBC Business School (PHBS). Thomas J. Sargent, the 2011 Nobel laureate in economics and honorary director of the Sargent Institute of Quantitative Economics and Finance (SIQEF) at PHBS, engaged in an informal discussion with thirty full-time master's and doctoral students over tea. The event was hosted by Associate Professor Shi Jiao, deputy director of SIQEF.

- The face-to-face dialogue with Professor Sargent

- Professor Sargent shares his insights and takes questions from students

At the tea party, Professor Sargent, drawing on his extensive academic background and rich research experience, engaged in insightful discussions on topics such as "posing new research questions" and "generating fresh ideas." He used examples like "Ptolemy's Model," "Copernicus's Challenge," " Tycho Brahe and Data Refinement," and "Kepler's Refinement to Ellipses" to demonstrate how scientists achieved theoretical breakthroughs by refining models and challenging existing paradigms. He highlighted that scientific advancement frequently stemmed from the combination of intuition, aesthetics, and mathematical knowledge, and encouraged students to uphold a mindset of inquiry and exploration in their economic research endeavors, continually expanding the frontiers of knowledge.

During the interactive session, students actively posed questions and engaged in in-depth discussions on topics such as "Lessons Learned from Economic History," "The Impact of Artificial Intelligence," and "Large Language Models." Professor Sargent listened patiently and provided professional and specific answers to each question, offering valuable insights and advice.

At the tea party, Professor Sargent, drawing on his extensive academic background and rich research experience, engaged in insightful discussions on topics such as "posing new research questions" and "generating fresh ideas."

Selected Questions & Answers

Q: Will artificial intelligence change some micro foundation of macro research?

A: There are a lot of questions about artificial intelligence circulating on WeChat and the Internet. Many of these questions are broad, partly because AI itself is often misunderstood. What does AI really mean? At its core, it's just a function—a mapping of X into Y—essentially fitting a function. X can be high-dimensional, and Y can be high-dimensional too, but fundamentally, it's about function fitting. When it comes to the micro foundations of macro research, AI doesn't fundamentally change them. I could show you cutting-edge machine learning work, but it's still about doing tasks we've always wanted to do, just with larger computers and more data. The algorithms themselves aren't entirely new. For the true foundations, consider the essential structure defined in foundational economic theory, such as in a paper I saw this morning. It outlines the basics: a collection of individuals with specific goals, constraints, resources, production functions, technologies, and markets. Some markets might be missing, but overall, there's a coherent system of optimization problems that fit together, with a government that can influence the environment. Those are the true foundations. AI, including tools like ChatGPT, isn't going to propose a new foundation that excludes people or governments—and if it does, it's simply hallucinating.

Q: Have you ever held a theory you once believed to be true but later realized—perhaps much later—that it was flawed or needed modification? Could you share an example? Specifically, I'd like to know what signals or insights led you to recognize that the theory needed adjustment and how you realized it was wrong.

A: It's pretty straightforward. When you have a quantitative theory, especially in macroeconomics, it's built to explain specific datasets or time series. After working hard to fit the parameters, you move to validation. Often, during this process, the data reveal that the model doesn't work well in certain dimensions. By drilling down, you can identify precisely where it falls short and adjust accordingly. Classic examples include longstanding puzzles like the equity premium puzzle or the volatility puzzle.

Take Robert Shiller's famous volatility puzzle. It's been the starting point for decades of research, but recently, someone re-evaluated it, questioning whether the data was constructed in line with the theory's intended definitions for dividends and returns. Using more refined definitions, they found that a big part of the puzzle disappears. This is a reminder of the risks of accepting data as-is, without re-examining it in light of theory.

Another approach is more intuitive—what Bob Lucas did, for example. He sometimes dismissed elements he found aesthetically unconvincing, saying, "I don't believe it; it just doesn't ring true to me." He trusted his instincts, which not everyone gets to do. But that's what makes economics both challenging and exciting; it combines rigorous data analysis with intuition.

Q: Before you became the renowned Sargent, did your ideas come naturally, or did they evolve over time through hard work? Were they the result of intuition and creativity, or did they stem from persistent effort? And how did you know which direction to pursue?

A: It's simpler than it seems. Don't get caught up in whether ideas are "great" or "important." For example, I once got interested in a technical problem through a paper by Milton Friedman. James Tobin and Robert Solow, two economists I admired, wrote mathematical versions of Friedman's ideas, only to end up disproving them. Their work fascinated me, even though I was just an average student at the time. While in the Army, I studied time series analysis to understand Solow's paper. After a year, I finally felt ready to apply what I'd learned, and I spotted a flaw in Solow and Tobin's interpretation. I wrote a four-page paper on this, but my first submission was harshly rejected. I shelved it until an older friend shared it with Carl Bruner, who published it in a new journal. Over time, even people like Tobin and Lucas read it. This wasn't a breakthrough; it was just a long journey to understand others' work better. Most discoveries aren't lightning bolts of genius—they're slow, deliberate efforts. If great minds can work this way, so can the rest of us.

Comments from Students

During the discussion, Professor Sargent illuminated the path to innovative research by tracing the evolution of theories that describe the laws of celestial motion. He emphasized that innovations can stem from various sources, ranging from the desire to comprehend the laws of nature more deeply to the aesthetic pursuit in theoretical modeling. On this basis, he believed that to answer the question of how to choose a research direction, one should follow one's heart, do research that one is interested in, and enjoy the research process without fear of failure. After learning his philosophy of life, I benefited a lot.

—Zhou Enze
Master of Quantitative Finance, 2022 Intake

I was fortunate to attend a brilliant lecture by Professor Sargent. He adeptly cited the stories of great scientists such as Copernicus, Kepler, and Newton exploring the mysteries of the cosmos, which stimulated our passion for scientific research and deep contemplation. Professor Sargent believes that having an interesting idea is vital when selecting research topics. Such an idea can guide us into the unknown, ignite our curiosity and desire to explore, and thereby drive the advancement of science.

— Liu Jiaming
Master of Management, 2022 Intake

Professor Sargent has unique insights and profound thinking. In the sharing, he explained complex economic theories clearly and concisely, sharing cutting-edge research results, explaining the difficulties and joys of academic research based on personal experience, and also providing many suggestions for students who want to engage in economic research. I have benefited greatly and gained a deeper understanding of economics.

—Liu Wanqin
Master of Economics, 2022 Intake

The discussion with Professor Sargent was a wonderful academic feast. He approached the topic by addressing "what constitutes good research and how to conduct meaningful research." He drew parallels from historical events to contemporary developments, highlighting that the advancement of science is never easy, but what remains constant is the awareness of problems and the curiosity and determination to solve them. As a student majored in Financial Media, this discussion gave me a fresh understanding of the profound insights in economics and the importance of interdisciplinary approaches. His views on research and rigor in academia, and the valuable questions raised by my peers have been incredibly enlightening.

—Jiang Yulu
Master of Financial Media, 2024 Intake

Professor Sargent discussed the origins of the heliocentric theory and Kepler's laws, clearly explaining how the research methods and paradigms from the natural sciences are also applicable in the field of economics. He emphasized that contemporary economic research should be data-driven, focusing on the economic models underlying the data, and utilizing these models for causal identification and counterfactual analysis. This aligns closely with his original intent for the design of our PhD program and deepened my understanding of cutting-edge research methods.

—Feng Xiaoruo
PhD Candidate in Western Economics, 2024 Intake

Professor Sargent's insights have resonated deeply with students from a wide range of academic fields. As we explore the core of their feedback, it becomes apparent that his guidance has served as a potent catalyst for intellectual growth and a beacon of inspiration for their future academic pursuits.

Sargent Institute of Quantitative Economics and Finance Awarded 'Key Research Base for Humanities and Social Sciences in Shenzhen'

Written by Zi Jing
Translated by Ding Ying

Recently, the Propaganda Department of the Shenzhen Municipal Committee and the Shenzhen Social Sciences Federation launched the selection activity for Key Research Bases for Humanities and Social Sciences in Shenzhen (2025-2027). The Sargent Institute of Quantitative Economics and Finance at Peking University HSBC Business School was awarded the 'Key Research Base for Humanities and Social Sciences in Shenzhen' (funded category). Among the 9 key research bases selected in this round, only 3 are funded bases.

- Scene of the Plaque Awarding Ceremony

Founded in June 2017 by Professor Thomas Sargent, the 2011 Nobel laureate in Economics, the Sargent Institute of Quantitative Economics and Finance at Peking University HSBC was selected as a 'Key Laboratory of Philosophy and Social Sciences in Guangdong Provincial Universities' in 2021. Currently, Professor Thomas Sargent serves as Honorary Director, and Professor Wang Pengfei, a Boya Distinguished Professor at Peking University and Dean of HSBC Business School, serves as Executive Director. In recent years, the Institute has secured multiple research grants from the National Natural Science Foundation of China, published more than ten papers in influential international journals, and made significant phased progress in analyzing and forecasting China's macroeconomy, cultivating high-end talent, and promoting economic and financial development in Shenzhen and the Greater Bay Area.

In the future, the Sargent Institute of Quantitative Economics and Finance at Peking University HSBC will focus on developing economic theories rooted in China's national conditions, establishing a high-end intellectual resource team bringing together renowned economists at home and abroad, and building a platform for cooperation and exchange among top global economic research talent.

The Inaugural PHBS-IER Conference Held at PHBS

By Hu Weiping, Yu Qi, Sun Bo, and Annie J

PHBS

The inaugural PHBS-IER Conference, jointly organized by Peking University HSBC Business School (PHBS) and the International Economic Review (IER), took place at PHBS in Shenzhen, China, from December 22 to 23. Centered on the theme " Financial Frictions for Firms and Households: Implications for Economic Development and Government Policies," the conference attracted over 130 senior professors and young scholars from prestigious universities worldwide, including Princeton University, University of Pennsylvania, Boston University, University of Southern California, Emory University, University College London, The Chinese University of Hong Kong, Peking University, Tsinghua University, Fudan University, and Cheung Kong Graduate School of Business. Furthermore, the live-streamed sessions garnered a cumulative audience of over 8,600 viewers, which showcased the great influence of PHBS and IER.

The conference, which garnered widespread attention and participation from the public, received a total of 211 high-quality paper contributions through an open call for submissions. Among these, eight were ultimately selected for inclusion, six of which were featured in a Special Issue of the IER. Chen Kaiji, Fang Hanming, Dirk Krueger, Li Kai, and Wang Pengfei formed the organizing and editorial team for this special issue and were present at the conference. Leveraging this opportunity, PHBS and IER aim to deepen their collaboration, establishing an annual exchange platform that will ignite research vitality, promote high-level economic research, and contribute valuable insights to the advancement of economics in Asia and across the globe.

Wang Pengfei and Dirk Krueger

Professor Wang expressed his gratitude to the IER editorial board, faculty members, and student volunteers for their exceptional efforts in organizing the conference. He shared his hope that the event would become a premier academic platform, not only for Shenzhen but also for the entire country and the world, further elevating the international influence of PHBS and IER. Professor Krueger thanked both the participants and organizers, highlighting the distinguished academic contributions of Professor Thomas Sargent. He also expressed his hope that IER would continue to attract outstanding research in the future.

Professor Thomas Sargent delivered the keynote address on the topic “Fiscal Consequences of the US War on COVID.” He began by tracing the historical evolution of U.S. fiscal and monetary policy from the 19th to the 21st century. Professor Sargent examined the early development of financial and monetary systems in 19th-century America, the establishment of U.S. dollar dominance in the 20th century, and the fiscal and monetary challenges faced in the 21st century, including ongoing deficits and inflationary pressures. He highlighted the long-term impact of wars on fiscal and monetary policy, noting that such crises often lead to fiscal deficits, significant price volatility, and enduring institutional changes. Furthermore, Professor Sargent discussed the complex interactions between fiscal, monetary, and tax policies, particularly emphasizing the role of “game theory” in shaping policymaker decisions. He underscored the importance of “budget constraints,” “coordination between monetary and fiscal policies,” and “power distribution” in managing these challenges.

Thomas Sargent delivers the keynote

> Wang Pengfei, Peking University Boya distinguished professor and dean of PHBS, and Dirk Krueger, professor at the University of Pennsylvania and editor-in-chief of IER, each delivered speeches on behalf of the organizers.

Ma Xiao and Lyu Dan

PHBS Assistant Professor Ma Xiao presented a paper titled “How Do Multinationals Impact China’s Technology? The Role of Quid Pro Quo Policy and Technology Spillovers.” The paper quantitatively assessed the influence of multinational corporations on China’s technological development from a technological perspective, revealing that foreign direct investment (FDI) has facilitated significant technology transfers and large-scale technology spillovers. To explore this, the paper developed a global trade and innovation model, incorporating the effects of the “Quid Pro Quo” policy on China’s economy. The findings showed that removing the “Quid Pro Quo” policy would directly boost China’s economic output but would also lead to a decline in its knowledge stock. Assistant Professor at Lyu Dan from the Chinese University of Hong Kong provided comments on the paper, addressing issues such as stylized facts, model mechanisms, and algorithms.

Wang Neng and Li Kai

Wang Neng, professor at Cheung Kong Graduate School of Business, presented the paper titled “Reallocating and Pricing Illiquid Capital: Two Productive Trees.” The paper developed a two-sector general equilibrium growth model that incorporates capital accumulation and adjustment costs. In this model, consumers face a trade-off between the benefits of diversification and the costs of redistribution and productivity losses. The allocation of capital between the two sectors influences key economic factors such as the risk-free rate, the risk premium, investment, and Tobin’s Q, both at the sectoral and aggregate levels. Through this framework, Professor Wang highlighted the critical role of sectoral heterogeneity and capital mobility in driving economic growth and asset pricing. Li Kai, professor and assistant dean of PHBS, noted that this framework could provide valuable insights into a range of topics, including the important risk premium channel that drives business cycles, changes in the aggregate risk premium in financial markets, and the risk-return tradeoff across different sectors.

Miao Jianjun and Xu Zhiwei

Professor Miao Jianjun from Boston University, presented the paper titled "Inflation and Debt Rollover under Low Interest Rates." Using a New Keynesian model with overlapping generations, the paper explored the impact of both temporary and permanent increases in fiscal deficits financed through debt rollover policies, particularly when interest rates are lower than economic growth rates. The findings revealed that while the debt rollover policy can be feasible within the monetary regime, it results in very slow-moving debt. Specifically, this policy leads to persistent inflation in response to a temporary increase in fiscal deficits, but causes persistent disinflation when the fiscal deficit increase is permanent. Professor Xu Zhiwei from Fudan University provided feedback on the paper, offering suggestions such as addressing the issue of multiple equilibria in the model and examining the welfare effects of debt expansion policies.

Fang Hanming and Chen Kaji

Professor Fang Hanming from the University of Pennsylvania presented the paper titled "Collateral-Based Monetary Policy: Evidence from China." The paper used the People's Bank of China's June 2018 policy, which expanded the eligible collateral for medium-term lending facilities (MLF), as a natural experiment to examine the causal impact of collateral-based unconventional monetary policy on asset prices and corporate financing costs. Using a triple-difference approach and leveraging China's dual bond markets, the study found that the policy significantly reduced both secondary market interest rate spreads and primary market financing costs for the targeted bonds, while also triggering spillover effects on non-targeted bonds. Professor Chen Kaiji from Emory University praised the paper's innovative methodology and suggested further differentiation between collateral-based and conventional monetary policies, as well as stronger empirical validation of market segmentation and a deeper exploration of spillover mechanisms.

PHBS Assistant Professor Wang Yicheng presented the paper "Quantifying the Macroeconomic Impact of Credit Expansions," which examines and quantifies how credit expansion influences economic activity by analyzing demand and supply channels. Using a New Keynesian model with heterogeneous agents in a small open economy, the paper highlights that in the short run, expansionary credit shocks primarily affect household demand, while in the long run, reduced corporate borrowing costs play a crucial role in fostering new business investment. Associate Professor Cui Wei from University College London recommended further exploration for the impact of different forms of financial frictions on the model mechanism. Associate Professor Cui Wei from University College London recommended further exploration for the impact of different forms of financial frictions on the model mechanism.

Wang Yicheng and Cui Wei

Assistant Professor Zhu Wu from Tsinghua University presented the paper titled "Tiered Intermediation in Equity-Holding Networks." The study examined how financial shocks propagate through equity-holding networks in China, using a comprehensive dataset that covered all registered firms in the country. The findings showed that parent companies transmit bank credit shocks to their subsidiaries, while redistribution between subsidiaries, or from subsidiaries back to parent companies, is minimal. The paper emphasized that tiered intermediation plays a key role in efficiently allocating resources to financially constrained firms with high investment opportunities, offering valuable insights for resource optimization and policy design. Professor Vincenzo Quadrini from the University of Southern California suggested further investigation into inter-subsidiary resource redistribution and its potential effects on macroeconomic stability, as well as a comparison with international banking systems to draw broader policy implications.

Zhu Wu and Vincenzo Quadrini

Dong Feng and Jia Dun

Dong Feng, tenured associate professor of the School of Economics and Management at Tsinghua University, presented the paper titled "A Macroeconomic Model of Structural Monetary Policy in China." After providing an overview of the history and current state of structural monetary policy (SMP), the paper developed a quantitative DSGE model based on China's two-sector economy to examine the transmission of SMP. It highlighted the importance of assessing the effectiveness of SMP in conjunction with other conventional monetary policy tools. Professor Feng argued that SMP could be more effective than traditional monetary policies in mitigating the redistributive effects of credit shocks. PHBS Assistant Professor Jia Dun offered feedback on the paper, suggesting that the model should incorporate the coordination between monetary and fiscal policies and provide additional empirical evidence to support the assumptions and mechanisms underpinning the model.

Su Yang and Xiong Wei

Assistant Professor Su Yang from the Chinese University of Hong Kong presented the paper titled "Mobility and Housing: Cash Resettlement in China's Shantytown Renovation." The study explored how cash-based resettlement during China's 2015-2018 shantytown renovation program affected intercity migration and housing market dynamics by alleviating household financial constraints. Using data from China Development Bank loans and population censuses, the authors found that cash resettlement significantly prompted migration from lower-priced to higher-priced cities, exacerbating housing price disparities. Professor Xiong Wei from Princeton University recommended further investigation into the unintended consequences of policy design and suggested enhancing the explanatory power of the data to better understand immigration behaviors.

Professor Hai Wen Named China Newsweek Economist of the Year 2024

Source: China Newsweek
Translated by Liang Haoxi

- Zhang Zhuoyuan, recipient of the national honorary title "Outstanding Contributor to Economic Research" and Research Fellow at the Institute of Economics, Chinese Academy of Social Sciences, engages in a dialogue with Professor Hai Wen (left).

On January 1, 2025, China Newsweek officially released its 2024 Annual Cover Personalities Edition. Professor Hai Wen, Vice Chair of the Peking University Council (former Vice President of Peking University) and Founding Dean of the Peking University HSBC Business School, was named China Newsweek's Economist of the Year 2024.

At the release event, Zhang Zhuoyuan, a recipient of the national honorary title of "Outstanding Contributor to Economic Research" and a research fellow at the Institute of Economics, Chinese Academy of Social Sciences, served as a guest presenter. He and Hai Wen engaged in a discussion on the topic "Is Finance No Longer a Popular Major?" Hai Wen commented, "Finance was indeed very popular before, but now its popularity has waned somewhat. Any industry or major experiences a boom when it first rises. For example, investment: at certain times, people flock to specific industries. The same applies to choosing a major—there will be adjustments over time, and I believe such adjustments are normal. But this doesn't mean finance is unimportant. When choosing a major, students should remain rational. Not everyone is suited for finance. Don't follow trends blindly; what's more important is to choose based on your own interests and abilities."

The year 2024 marked the 25th anniversary of the founding of China Newsweek. With the mission of "influencing those who influence," since 2009 the magazine has reviewed individuals and groups each year who have made significant social impact in fields such as economy, science, education, culture, and sports—driving progress in Chinese society—

- China Newsweek 2024 Economist of the Year Cover and Commemorative Plaque

☆☆☆ REASON FOR SELECTION ☆☆☆

Professor Hai Wen is a serial entrepreneur in the field of higher education. Over the last 30 years, he has been involved in the founding of the China Center for Economic Research at Peking University (now the National School of Development), led the establishment of the Peking University HSBC Business School, the School of Transnational Law, and Peking University's UK campus, among other renowned research institutions. He is also a distinguished economist, with in-depth research in international economics and development economics. His course, Principles of Economics, has become one of the most popular introductory classes among Peking University students. He remains deeply engaged with real-world issues and firmly believes in the immutable power of economic laws, maintaining integrity and creativity amid an era of great change.

and has featured them as annual cover personalities, promoting positive values and upward social momentum. This year, 17 individuals and groups were selected as cover personalities. China Newsweek noted, "Their names and stories were widely spoken of in 2024. They are changing industries and shaping the future."

In recent years, Professor Hai Wen has received multiple honors, including the Lifetime Achievement Award from the Chinese Economists Society (CES), NetEase's 2017 Most Influential Economist, CNR's 2021 Business Education Leader of the Year, and one of the Top Ten Economists of the Year 2021 by China Economic Review, all testifying to the profound academic strength, insightful understanding of the times, and deep sense of historical responsibility held by Chinese economists.

The 2025 PHBS Meeting on Theoretical and Empirical Macroeconomics Held at PHBS

Written by Fang Chongyu, Wang Shiyao, Zha Jiajing, Zi Jing
Translated by Xiong Zichao

On the afternoon of January 4th, the 2025 PHBS Meeting on Theoretical and Empirical Macroeconomics, hosted by the Sargent Institute of Quantitative Economics and Finance at Peking University HSBC Business School (PHBS), was held. Wang Pengfei, Boya Distinguished Professor and Dean of PHBS; Thomas Sargent, the 2011 Nobel laureate in economics and honorary director of the Sargent Institute of Quantitative Economics and Finance (SIQEF) at PHBS; along with over 20 faculty members and doctoral students in the field of macroeconomic research from the school, gathered to discuss the latest academic topics in macroeconomics.

In her welcome address, Associate Professor Shi Jiao, Vice Director of Sargent Institute of Quantitative Economics and Finance, noted that the meeting aims to promote communication and collaboration among the school's faculty and to provide students with opportunities to engage with the academic frontier. She expressed her hope that the paper discussions would inspire research ideas for both faculty and students, thereby advancing high-level economic research.

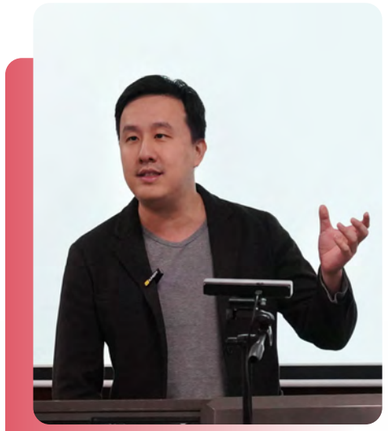
> The Sargent Institute of Quantitative Economics and Finance was selected as a "Guangdong Provincial Key Laboratory of Philosophy and Social Sciences in Colleges and Universities" in 2021 and was recognized as a "Key Research Base for Humanities and Social Sciences in Shenzhen" in 2024. In recent years, the Institute has secured National Natural Science Foundation funding for multiple research projects, published over ten papers in influential international journals, and hosted more than ten international academic conferences. In the future, the Institute will focus on developing economic theories rooted in China's national conditions, assembling a high-end intellectual resource team of renowned economists from home and abroad, and building a platform for cooperation and exchange among the world's top economic research talents.

Wang Pengfei

Professor Wang Pengfei presented his paper "Synchronization Risk and Price Stickiness: Theory and Evidence." He pointed out that customer aversion (i.e., reputational cost) is a key factor causing price stickiness, and that strategies for price adjustments are influenced by market power, information friction, and external shocks. By analyzing review data from online consumption platforms, the authors find that when firms reduce prices, customers who previously purchased items at higher prices feel dissatisfied, increasing the firm's reputational cost; if a firm delays price adjustments compared to its peers, this cost can be mitigated. The partial equilibrium model constructed in the paper shows that under conditions of information friction, firms may rationally choose to postpone price changes to avoid reputational losses. Furthermore, firms with greater market power tend to maintain original prices for longer, while significant external shocks prompt firms to adjust prices more quickly.

Thomas Sargent

Professor Thomas Sargent presented the paper “Machine Learning a Ramsey Plan.” Building upon Calvo’s model, he innovatively employed a linear-quadratic government utility function and a gradient ascent algorithm, utilizing modern machine learning techniques to solve for the central planner’s optimal monetary policy plan. The research finds that machine learning can effectively solve Ramsey problems under different formulations. This study combines economic theory with modern data science tools, offering a new perspective for studying complex, dynamic policy issues.



Jake Zhao

Tenured Associate Professor Jake Zhao presented the paper “Financial Constraints vs. Financial Distress.” The author proposes the viewpoint that “financial constraints and financial distress are two distinct sources of financial pressure that need to be treated differently.” Using firm-level data from Compustat North America, Compustat Global, and Bureau van Dijk Orbis, combined with model analysis methods, the research investigates the relationship between corporate financial constraints and financial distress. The findings indicate that the model can effectively identify firms in states of “financial constraint” versus “financial distress” and possesses a certain degree of explanatory power in bankruptcy prediction.

Assistant Professor Ma Fangyuan presented her paper “Competition, Cannibalization, and New Product Introductions: Evidence from the Pharmaceutical Industry,” which explores how competition influences economic growth by affecting firm innovation. She argued that when firms consider introducing new products, they assess the market entry threat faced by their existing products: on one hand, they might delay the launch fearing the new product will cannibalize the market share of existing ones; on the other hand, intensified competitive pressure might accelerate the introduction of new products. The study uses data from the U.S. Food and Drug Administration (FDA) Orange Book and IQVIA, combined with quantitative modeling analysis, to examine the relationship between the competitive threats faced by firms and their new product introductions in the pharmaceutical industry. The research indicates that when firms face threats from new entrants, they tend to expedite the launch of new products that could potentially replace existing ones or are innovative.

Ma Fangyuan

Professor Li Kai presented the paper “Allocative Efficiency of Green Finance Instruments.” To systematically evaluate the role of various green finance policies and tools in achieving carbon neutrality, the author proposes categorizing green finance instruments into ex-post and ex-ante types based on the timing of policy implementation, which have differentiated impacts on allocative efficiency. Employing a general equilibrium model with heterogeneous firms and financial constraints, along with quantitative dynamic analysis methods, he investigates the allocation relationship between “dirty” capital and green capital in financial markets. The research indicates that ex-post instruments tend to transfer dirty capital to firms facing more severe financing constraints, while ex-ante instruments concentrate dirty capital more in firms with fewer financing constraints, thereby offering important implications for the design of green finance policies.

Li Kai

Ma Xiao

Assistant Professor Ma Xiao presented the paper “Who Pays for Training? Theory and Evidence on Firm-Level Differences in Training Investments.” Against the research backdrop of lifelong human capital theory and intra-firm training mechanisms, what are the impacts of training investment and cost-sharing, characterized by different firm attributes, on firm performance and labor income? He utilizes survey data from over 100 countries worldwide, along with administrative data from Mexico and China, combined with quantitative modeling analysis, to investigate the relationship between firm size, total factor productivity (TFP), labor share, and training investment. The research findings indicate that smaller, less productive firms and those with higher labor shares invest significantly less in training. Furthermore, when firms bear training costs, they often fail to fully internalize the benefits accrued to employees and potential external employers, leading to insufficient training investment.

Cai Xiaoming

Tenured Associate Professor Cai Xiaoming presented the paper “Search, Risk Aversion, and Assortative Matching.” The paper introduces heterogeneity in workers’ risk preferences and develops a directed search model to study assortative matching between heterogeneous workers and firms with production complementarity and risk-averse workers. The research finds that workers’ risk attitudes influence the equilibrium conditions of the model. Positive assortative matching occurs if and only if the elasticity of complementarity of the production function times that of the matching function exceeds the coefficient of the relative risk aversion of the logarithm of the utility function. If positive assortative matching is assumed to hold for all matching functions, this condition takes a concise form – the utility gain from consuming the match output is log-supermodular.

Professor Hai Wen Attends UAE International Investment Summit and Delivers Keynote Speech

Written by Jiang An, Mu Nan
Translated by Wang Weirong

On the afternoon of April 9 local time, the “Investing in the Greater Bay Area” forum, part of the 14th UAE International Investment Summit (AIM), was held at the Abu Dhabi National Exhibition Centre. Professor Hai Wen, Member of the Peking University Council (former Vice President) and Founding Dean of the Peking University HSBC Business School (PHBS), attended the forum and delivered a keynote speech.

- Forum venue

-Professor Hai Wen delivers a keynote speech

In his speech titled “The Greater Bay Area: The Engine of China’s Economic Growth and a Platform for China-Arab Cooperation”, Professor Hai Wen elaborated on two key aspects: “Why focus on the Guangdong-Hong Kong-Macao Greater Bay Area (GBA)” and “Opportunities for collaboration between the GBA and the Middle East.”

Professor Hai Wen highlighted that the GBA is a leading global bay area economy, contributing over 10% of China’s total GDP and ranking among the top tier of bay area economies worldwide. With its international competitiveness in manufacturing, finance, and other industries, the GBA is home to China’s “Silicon Valley” and serves as a hub for technological innovation. As the most open, internationalized, and developed region in China, it holds immense opportunities for cooperation and development.

Professor Hai Wen emphasized the vast potential for economic collaboration between Middle Eastern countries and China’s GBA. The two sides can deepen industrial cooperation in sectors such as new energy vehicles and electronics, while strengthening ties in financial market connectivity and innovation. He also underscored the significant potential for educational collaboration, including joint academic initiatives to foster bilateral exchanges.

- Professor Hai Wen in discussions with senior officials from the Dubai Chamber of Commerce

Before and after the conference, Professor Hai Wen conducted research and inspections on the educational and business environments in Abu Dhabi, Dubai, and Sharjah. He met with officials from the Chinese Embassy in the UAE, Chinese financial institutions, and the Dubai Chamber of Commerce, engaging in extensive discussions with relevant leaders to gain insights into the economic landscape of the Middle East, particularly the Gulf region, and to lay the groundwork for deepening China-UAE cooperation.

"Internationalization" is a core philosophy and distinctive feature of PHBS. The school currently hosts nearly 120 international faculty members and students and operates campuses in Shenzhen, China, and Oxford, UK, providing an open, diverse, and integrated international environment for research and learning. Leveraging its comparative advantages, the PHBS Think Tank focuses on key regions along the Maritime Silk Road, including Southeast Asia and the Middle East, producing a series of influential research findings.

Moving forward, PHBS will further advance its internationalization efforts, offering talent and intellectual support for enterprises in the GBA to expand globally, as well as enhancing China's foreign economic and trade exchanges and cooperation.

- Professor Hai Wen poses with officials from the Dubai Knowledge and Human Development Authority (left) and the Dubai International Financial Centre (right)

The 9th Asian Quantitative Finance Conference Held at PHBS

By Wu Yixing, Xia Xinyu, Zha Jiajing, Yan Xihe, Wu Yi, Jiang An

- Scholars attend the conference

The 9th Asian Quantitative Finance Conference (AQFC) was held from April 26 to 28 at Peking University HSBC Business School (PHBS) in Shenzhen. Jointly organized by PHBS, the Shenzhen Research Institute of The Hong Kong Polytechnic University, and The Chinese University of Hong Kong, Shenzhen, the event brought together more than 180 scholars from leading institutions worldwide. Participants engaged in in-depth discussions on cutting-edge topics in quantitative finance, including financial technology, machine learning, stochastic control, asset pricing, portfolio selection, financial derivatives, financial modeling, and risk management.

From left to right: Wang Pengfei, Dai Min, Chen Nan, Peng Xianhua

In his welcome address, Wang Pengfei, Boya Distinguished Professor and Dean of PHBS, highlighted China's rapid development in quantitative finance and emphasized the growing importance of AI-driven innovation in the field. He expressed hope that the conference would foster deeper academic-industry dialogue and breakthroughs in financial innovation.

Dai Min from The Hong Kong Polytechnic University recalled the founding journey of the AQFC and extended his appreciation to the co-organizers. Chen Nan from The Chinese University of Hong Kong extended his best wishes for fruitful academic exchanges throughout the conference.

The opening session was chaired by Peng Xianhua, Associate Professor at PHBS.

In the keynote sessions, several internationally renowned scholars shared their latest research findings.

Martin Schweizer, professor at ETH Zurich, presented his paper titled "Dynamic Monotone Mean-Variance Portfolio Optimisation with Independent Returns." The Monotone Mean-Variance (MMV) utility is a refinement of the classical Markowitz utility, designed to ensure that the utility function is strictly increasing with respect to terminal wealth—thus addressing the non-monotonicity issue in traditional mean-variance analysis. Building on his previous research, Prof. Schweizer provides a complete and explicit solution to the dynamic portfolio optimization problem under the MMV framework, within a semi-martingale asset pricing model where returns are independently distributed. The model assumes only return independence and the absence of local weak arbitrage, making the results broadly applicable to various market settings and offering a robust theoretical foundation for dynamic investment decisions under uncertainty.

Johannes Muhle-Karbe, professor at Imperial College London, presented his research titled "Liquidity and Asset Prices," which examines how transaction costs affect asset pricing through a general equilibrium model with two representative investors. Solving the model with transaction costs involves complex forward–backward stochastic differential equations, as optimal strategies include endogenous trading boundaries. Given that transaction costs are typically small, Prof. Muhle-Karbe proposes an asymptotic approximation method based on the closed-form solution of the frictionless benchmark case. After calibrating the model with real-world turnover data, he finds that theoretical predictions significantly overstate the impact of transaction costs on asset prices—suggesting that in real markets, only a small fraction (possibly around 10%) of trades are driven by hedging demands. The findings point to a gap between theoretical models and empirical behavior, calling for further research to better understand trading motives in markets.

Martin Schweizer
Johannes Muhle-Karbe

Jussi Keppo and Hyeng Keun Koo

Professor Jussi Keppo from the National University of Singapore presented his paper titled "Misaligned Clocks: Incentives for Differently Patient Boards and CEOs." The study builds a principal-agent model to examine how boards with longer time horizons can design compensation contracts that incentivize CEOs—who may have shorter time horizons—to make decisions aligned with the board's patience level. The research shows that while it is possible to partially align the CEO's behavior with the board's preferences through contractual incentives, this alignment is limited by information asymmetry and behavioral constraints. Importantly, the paper highlights a novel mechanism through which changes in the interest rate influence corporate investment behavior—not only via market signals, but also by altering the optimal design of incentive contracts. This sheds light on the role of dynamic contract design in mitigating short-termism and fostering long-term value creation.

Professor Hyeng Keun Koo from Ajou University introduced his paper titled "Optimal Consumption and Portfolio Rules with Dynamic Adjustment of Consumption Bounds." The study addresses an optimal consumption and investment problem in which investors pre-commit to upper and lower bounds on consumption: the lower bound provides utility as a form of consumption guarantee, while dynamically adjusting these bounds incurs utility loss. To solve this problem, Prof. Koo reformulates it as a dual singular control problem, which is further transformed into an optimal switching problem. He also analyzes the structure of the optimal policy when the utility function is of the CRRA type. The model offers theoretical insights with practical relevance for corporate dividend policies and institutional asset management, where trade-offs between stability and flexibility are critical.

Chen Zengjing and Jia Yanwei

Professor Chen Zengjing from Shandong University presented his research titled "Nonlinear Robust Limit Theorems for a Set of Probability Measures." In complete markets such as the Black-Scholes model, option prices are given by the discounted expectation of payoffs under a unique risk-neutral measure. However, real-world markets are often incomplete, requiring a family of probability measures to define nonlinear probabilities and expectations. This framework enables robust pricing based on nonlinear expectations of asset returns. Prof. Chen introduces the notion of measure ambiguity, illustrating that a one-armed bandit corresponds to a single probability measure, while a two-armed bandit captures ambiguity through a set of binary Bernoulli models. The paper establishes strong law of large numbers and central limit theorems under such nonlinear settings, where limiting behavior is characterized by Brownian motion or backward stochastic differential equations. These results lay a theoretical foundation for robust asset pricing under model uncertainty.

Assistant Professor Jia Yanwei from The Chinese University of Hong Kong presented the paper titled "Mean–Variance Portfolio Selection by Continuous-Time Reinforcement Learning: Algorithms, Regret Analysis, and Empirical Study." The study proposes a continuous-time reinforcement learning algorithm for the dynamic mean-variance portfolio selection problem. The algorithm is model-free and data-driven, enabling practical implementation without relying on specific market assumptions. He proves that, under a multi-asset Black-Scholes framework, the algorithm achieves a sublinear upper bound on regret measured by the Sharpe ratio, ensuring its asymptotic efficiency. Empirically, using daily data from S&P 500 constituents over the period 1990–2020, the algorithm demonstrates superior and more robust performance compared to 14 benchmark portfolio optimization methods.

Since its inception in 2013, the Asian Quantitative Finance Conference has grown into one of the most influential annual academic gatherings in the field. Previous conferences have been hosted by institutions such as the National University of Singapore, Shandong University, The Chinese University of Hong Kong, Osaka University, KAIST, Sun Yat-sen University, the Vietnam Institute for Advanced Study in Mathematics, and Taipei University of Technology.

- Parallel sessions

In addition to the keynote speeches, the three-day conference featured 27 parallel sessions, covering a wide range of emerging topics such as fintech, machine learning, asset pricing, quantitative investing, corporate finance, derivatives, asset allocation, and stochastic control. Over 100 scholars presented their latest research findings. The 9th AQFC marked another milestone in promoting scholarly exchange and advancing theoretical and practical frontiers in quantitative finance across Asia and beyond.

- The group photo of the participants

Professor Wang Pengfei Attended the Inauguration of the Hunan Xiangjiang New Area Greater Bay Area Cultural and Technological Industry Research Institute and the Opening of the "Wenrun Xiangjiang Lecture Hall" and Delivered a Keynote Speech

Translated by Dong Xiao

-The Launch Ceremony of the Hunan Xiangjiang New Area Greater Bay Area Cultural and Technological Industry Research Institute.

At the event, Professor Wang Pengfei, together with Zhong Jun, Party Secretary and President of the Hunan Academy of Social Sciences; Hu Daisong, Party Secretary and Vice Chairman of the Hunan Federation of Social Sciences; Tan Yong, Deputy Secretary of the Changsha Municipal Committee, Party Secretary of the Hunan Xiangjiang New Area Working Committee, and Party Secretary of the Yuelu District Committee; as well as other key leaders and distinguished guests, jointly pressed the launch button, officially announcing the establishment of the Hunan Xiangjiang New Area Greater Bay Area Cultural and Technological Industry Research Institute.

> On the morning of May 18, the Hunan Xiangjiang New Area Greater Bay Area Cultural and Technological Industry Research Institute was inaugurated, and the opening ceremony of the "Wenrun Xiangjiang Lecture Hall" was held at Wenzheng Academy in Hunan Xiangjiang New Area. Professor Wang Pengfei, Boya Distinguished Professor at Peking University and Dean of Peking University HSBC Business School, was invited to attend the event and delivered a keynote speech.

-Wang Pengfei Delivers a Speech

At the inaugural session of the "Wenrun Xiangjiang Lecture Hall", Professor Wang Pengfei delivered a keynote speech titled "Culture, Technology, and Economic Growth." He emphasized that economic growth depends not only on the accumulation of traditional production factors such as savings (physical capital) and education (human capital) but more fundamentally on technological progress and improvements in total factor productivity (TFP). He pointed out that TFP growth is profoundly influenced by cultural factors.

Drawing on concrete examples, he analyzed the determinants of TFP from three perspectives: innovation, technology diffusion, and resource allocation efficiency, highlighting their significance in explaining income disparities between nations. He further elaborated that culture, as a form of collective mental programming and an informal institution, deeply shapes people's attitudes toward risk, time, education, family, wealth, and more. These cultural factors determine a society's propensity to defer consumption and its savings rate, and also shape risk attitudes, entrepreneurial spirit, innovation and cooperation, wealth perspectives, resource allocation efficiency, scientific thinking, and rational traditions, thereby indirectly but profoundly influencing economic development.

He emphasized that countries and regions that successfully overcome the middle-income trap often share cultural characteristics, including valuing education and investment in human capital, openness, high savings and investment rates, and entrepreneurial spirit. He concluded that culture, technology, and economic growth are deeply intertwined and mutually reinforcing. For a society to achieve sustainable growth, it must not only adopt policies that encourage technological innovation and institutional reform but also recognize the crucial role of deep-rooted cultural structures that stimulate educational investment, entrepreneurship, and social trust—all of which are key elements of cultural capital.

The Hunan Xiangjiang New Area Greater Bay Area Cultural and Technological Industry Research Institute was jointly initiated by Hunan Xiangjiang New Area and Hong Kong Economic Herald. Its mission is to implement the integration of "culture and technology" by leveraging the resource advantages of the Guangdong-Hong Kong-Macao Greater Bay Area to build an international collaborative platform linking government, industry, academia, research, finance, and application. The "Wenrun Xiangjiang Lecture Hall" is the first initiative launched by the Institute, featuring keynote speeches, systematic training, research projects, and distinctive exchange activities. It aims to connect Hunan Xiangjiang New Area with the Greater Bay Area, injecting new momentum into the deep integration and innovative development of culture and technology.

In recent years, Peking University HSBC Business School has actively responded to China's regional development strategy by promoting the integration of cutting-edge academic research with local industry practices. Professor Wang Pengfei's keynote at the inaugural session of the "Wenrun Xiangjiang Lecture Hall" exemplifies the school's commitment to serving national strategies and empowering regional development. Moving forward, the school will continue to leverage its strengths in academic research and talent cultivation to provide sustained intellectual support for the integration of regional economies, culture, technology, and high-quality development.

The Workshop on Expectation and Information Friction in Macro and Finance Held at PHBS

Written by Chen Shiqi
Translated by Fang Chongyu

> From May 23 to 24, 2025, the Workshop on Individual Expectations and Information Frictions in Macro-Finance was held at Peking University HSBC Business School. The event was co-organized by the Sargent Institute of Quantitative Economics and Finance at Peking University HSBC Business School and the Department of Accountancy, Economics and Finance at the School of Business of Hong Kong Baptist University. Over 60 scholars from leading universities in China and abroad gathered in Shenzhen to share research findings and discuss cutting-edge topics in the field.

- Conference Venue

Building on the success of this conference, Peking University HSBC Business School will continue to collaborate with scholars around the world to explore cutting-edge issues and inject new momentum into academic research and innovation in the field of macro-finance.

Pengfei Wang

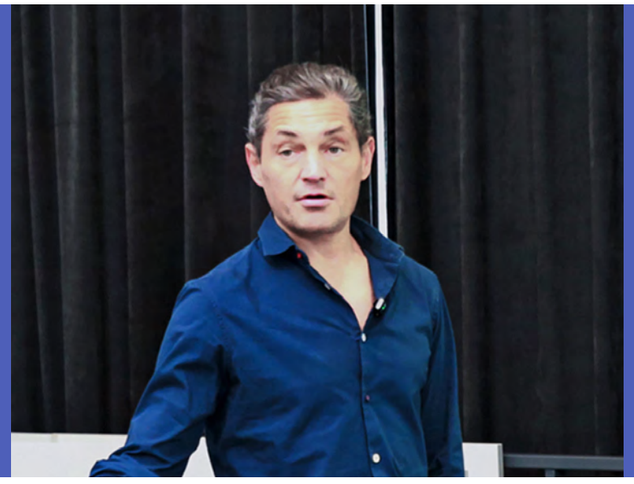
In his opening remarks, Pengfei Wang, Boya Distinguished Professor of Peking University and Dean of Peking University HSBC Business School, emphasized that the workshop aims to bring together leading experts in macroeconomics and finance to explore a systematic framework for modeling economic expectations, drawing on new data perspectives that capture the dynamics of consumer behavior and information presentation.

Franck Portier

During the keynote session, Professor Franck Portier from University College London presented his co-authored paper titled "How Do Strategic Complementarity and Substitutability Shape Equilibrium Dynamics?". Building on dynamic optimization and bifurcation theory, the study develops a dynamic model that incorporates consumption habit formation and firm-level production externalities. The paper reveals that when agents' actions are strategically complementary to a limited extent, the system displays either sustained long-term growth or cyclical fluctuations. If the complementarity is strong, the economy may exhibit multiple equilibria or endogenous oscillations. In contrast, when actions are strategic substitutes, the system returns to stability. These findings offer a novel mechanism to explain phenomena such as financial frictions, including collateral constraints. The presentation sparked active discussion among participants on the model's assumptions and the characterization of dynamic paths.

Nicola Gennaioli

Professor Nicola Gennaioli from Bocconi University delivered a keynote speech titled "Expectations in Macro and Finance: Data and Theory". The presentation combined theory with empirical evidence to illustrate the multifaceted impact of expectations on macroeconomic outcomes and financial markets, covering areas such as business cycle fluctuations, asset price formation, and credit market dynamics. Gennaioli highlighted two prominent behavioral biases in expectation formation: (1) excessive reactions to long-term growth expectations regarding the stock market and the broader economy; and (2) pronounced overreactions in forecasts of inflation, interest rates, and bond yields. The talk also emphasized how expectations systematically diverge due to overweighting of personal or salient events, and how overreaction is particularly prevalent in less persistent series and long-term projections. The presentation sparked active discussion among attendees, focusing especially on the use of data and models in capturing and testing these expectation-driven dynamics.



Francesco Zanetti

Professor Francesco Zanetti from the University of Oxford presented his co-authored paper "Agreed and Disagreed Uncertainty", which proposes a dual-channel framework for understanding economic uncertainty: agreed uncertainty, driven by increased volatility in fundamental shocks (which reduces disagreement among agents), and disagreed uncertainty, arising from noisier heterogeneous signals (which amplifies disagreement). Drawing on data from the Michigan Survey of Consumers, high-frequency expectations data from the New York Fed, and a DSGE model, the paper finds that agreed uncertainty shocks have significant negative effects on output, employment, and consumption. In contrast, disagreement uncertainty can generate a mild short-run stimulus to the economy. The presentation prompted active discussion among participants, particularly around the modeling of heterogeneous expectations and the empirical identification of uncertainty types.

Shihan Xie, Yang Lu

Shihan Xie, Assistant Professor at the University of Illinois at Urbana-Champaign, presented the co-authored paper "Fiscal Policy: Financing and Indebtedness". Using a large-scale survey experiment conducted across five Eurozone countries, the study finds that the effect of public debt levels on individuals' expectations varies depending on the financing method—whether government spending is debt-financed or tax-financed. The paper incorporates fiscal discipline, defined as the gap between the steady-state debt level and the long-term debt target, into a standard New Keynesian model. The analysis shows that when the steady-state debt is below the long-term target, the government can afford to borrow more and postpone tax increases; conversely, when the steady-state debt is above the target, the government must begin deleveraging sooner. This framework highlights how the fiscal multiplier under debt financing becomes more sensitive to the debt-to-GDP ratio compared to tax-financed fiscal expansions. Yang Lu, Associate Professor at the Hong Kong University of Science and Technology, provided comments on the paper and offered suggestions, including refining the calibration of tax rules.

Dun Jia, Leyla Jianyu Han

Assistant Professor Dun Jia from Peking University HSBC Business School presented the co-authored paper "Vague FOMC Communications". The study focuses on the effectiveness of central bank communication and constructs an innovative quantitative index to measure the ambiguity of Federal Reserve statements. The empirical analysis reveals that the Fed systematically employs vague language when describing economic conditions, and that the degree of ambiguity exhibits procyclical patterns. Moreover, unexpected fluctuations in communication ambiguity accelerate the adjustment of market expectations, indicating heightened sensitivity to such vagueness. The paper further shows that vague communication strategies significantly weaken the transmission of monetary policy to financial markets, thereby reducing policy effectiveness. Assistant Professor Leyla Jianyu Han from Boston University provided thoughtful comments on the paper, offering suggestions on the construction of the ambiguity index, the modeling framework, and the identification of underlying mechanisms.

Heng Chen, Yifan Zhang

Heng Chen, Associate Professor at the University of Hong Kong, presented the co-authored paper "Trend, Cycle and Expectation Formation". The study is based on the core assumption that forecasters cannot perfectly distinguish between the trend and cyclical components of underlying state variables. Through qualitative analysis, the paper shows that this informational friction can successfully account for a range of empirical patterns observed at both the micro (individual) and macroeconomic levels. The paper also examines the impact of the 2012 policy that explicitly introduced an inflation target, finding that this framework exhibits strong extensibility: it can incorporate elements of cognitive bias and offers a new perspective for studying expectation formation mechanisms. Yifan Zhang, a Ph.D. candidate at the University of Oxford, provided comments on the paper and proposed potential directions for future research.

Chenyu Hou, Shengliang Ou

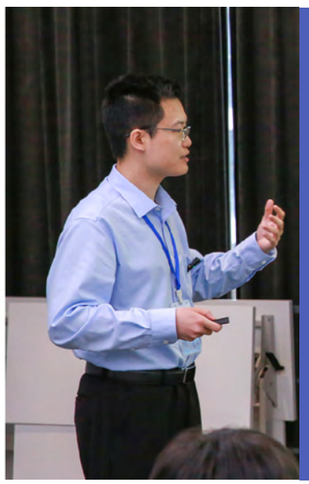
Chenyu Hou, Assistant Professor at Simon Fraser University, presented the co-authored paper "Uncovering Subjective Models from Survey Expectations". Using multi-source data and a rolling-window approach, the study finds a significant positive correlation among household expectations, while the correlations observed in objective data and professional forecasts are close to zero. A joint learning test based on a Kalman filter shows that this divergence arises from households' subjective models, rather than purely from information frictions. Shengliang Ou, Associate Professor at Shanghai Jiao Tong University, praised the paper for its empirical rigor and raised questions regarding the methodology and the role of feedback mechanisms in the analysis.

Leyla Jianyu Han, Xiaoji Lin

Leyla Jianyu Han, Assistant Professor at Boston University, presented her co-authored paper "How Does Monetary Policy Fuel Anomalies?", which explores a novel mechanism through which monetary policy affects financial markets—by amplifying asset pricing anomalies. The dynamic model developed in the paper shows that the sensitivity of stock prices to interest rate shocks depends on the degree of mispricing. Overpriced stocks, driven by biased subjective expectations, tend to exhibit longer durations. As a result, they respond more strongly to monetary policy shocks. The paper also documents that mispricing around FOMC announcement days tends to be corrected on earnings announcement days. Xiaoji Lin, Professor at the University of Minnesota, commented on the paper and recommended clarifying the underlying economic mechanisms behind the observed cross-sectional return differences surrounding FOMC policy announcements.

Le Xu, Alexandr Kopytov

Le Xu, Assistant Professor at Shanghai Jiao Tong University, presented the co-authored paper "Supply Chain Adjustments at Risks", which introduces a conceptual distinction between "turbulence" and traditional "uncertainty" risks. Using data from Compustat and FactSet, the authors develop a dynamic heterogeneous-firm model and find that turbulence not only lowers the overall supplier adoption rate but also triggers a reallocation of supply chain links from high-productivity firms to low-productivity ones. Alexandr Kopytov, Assistant Professor at the University of Rochester, discussed the paper and suggested extending the model to a multi-sector network framework to better capture the complexity of supply chain dynamics.



Alistair Macauly , Zhaorui Li

Alistair Macaulay, Research Fellow at the University of Surrey, presented the co-authored paper "The Misallocation of Corporate News". The study finds that corporate news coverage is heavily concentrated on large firms. While media coverage is positively correlated with firms' financing and investment activities, it is negatively correlated with firms' responsiveness to news. The paper highlights the limitations of media in alleviating information asymmetries and suggests that redistributing media attention could improve aggregate investment and economic growth. Zhaorui Li, Postdoctoral Fellow at the Hong Kong University of Science and Technology, emphasized that the paper builds a macro-finance model with endogenous news coverage, which explains the observed empirical patterns and quantifies the overall impact of news allocation.

The Workshop on Expectation and Information Friction in Macro and Finance Held at PHBS

Featured Articles

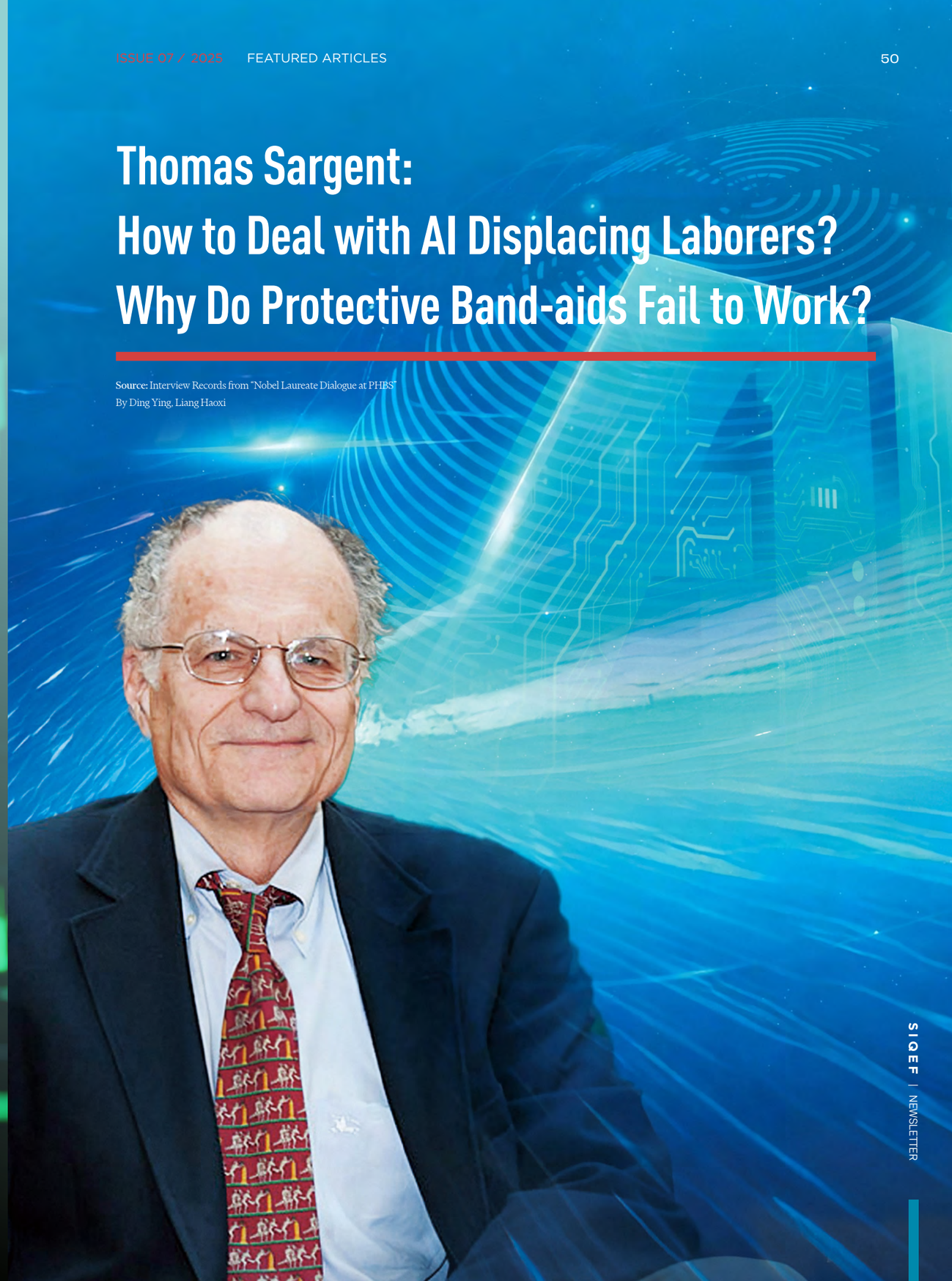
SARGENT INSTITUTE OF QUANTITATIVE ECONOMICS AND FINANCE

FEATURED ARTICLES

Thomas Sargent: How to Deal with AI Displacing Laborers? Why Do Protective Band-aids Fail to Work?

Source: Interview Records from "Nobel Laureate Dialogue at PHBS"

By Ding Ying, Liang Haoxi



Jiao Shi:

In Wuhan, there were these automatic driving like a taxi that operates at less than half of the price of a human driver. And what people see is that they are quickly replacing taxi drivers in these cities. Taxi drivers are concerned. Should we postpone the application of these automatic driving cars like the taxi drivers has petitioned, or should we use other regulations to make transfers that everybody is happy? What do you think about that?

Thomas Sargent:

It is not a new question. The cars and the taxi driver, that is a new question. But I can give you example after example, where there's a technical change that basically eliminates a bunch of jobs, like my father's job. He is an intelligent man, his whole life, his job is done by a computer. Now, when that happens to a person, it can be a personal tragedy, and it could be an opportunity.

So I think first, to your question, what a lot of us would like to do is say even if we wanted to, we cannot stop the adoption of these new technologies. We have to adopt in a good ways and we have to do things to protect and help the other people make transitions. Lots of time actually, if you look at data, I know this state in the United States, there are not lifetime jobs in the United States. Most people have multiple jobs. People get fired and they have to adjust. So one thing is you want to prepare yourself to be flexible enough that you can adapt and have the ability to learn. So people need an education system that teaches them general skills where they can adapt. Then the other thing is you said, if there is some new technology, you could devise tax and transfer schemes that are targeted at those people that helps them.

Jiao Shi:

So people ask these questions about machine replacing people during the industrial revolution. Are there any historical episodes from which we can learn from? How do the society or the governments help people to cope with this or to better adapt?

Thomas Sargent:

We can look out at history and see if some countries tried something that we were thinking of doing and see how it worked out. That is what economic historians are doing, and why we should read them. So what you just said, there are examples in Europe. There are examples in various US states. The spectacular examples are Europe in which they have done, said we want to protect jobs. So they did things like they imposed costs on firing people and made it hard for you to be fired. France has done this. Spain has done this. Various European countries have done this. These were inspired by benevolence to protect the jobs of these people, like that you are talking about that technical change is threatening. When you thought through the whole thing, the tax and firing people turned out to be almost the same as a tax on hiring people. Now what a firm is going to do is a firm has to make enough money to pay its workers. It realizes that if I hire you, I cannot fire you. I am going to think hard about hiring you. I might not hire you. So when you make it costly, in something you got to think through the whole. What that makes you wary about is the unanticipated consequences of doing something to help over here that might cause a problem to pop up over there.

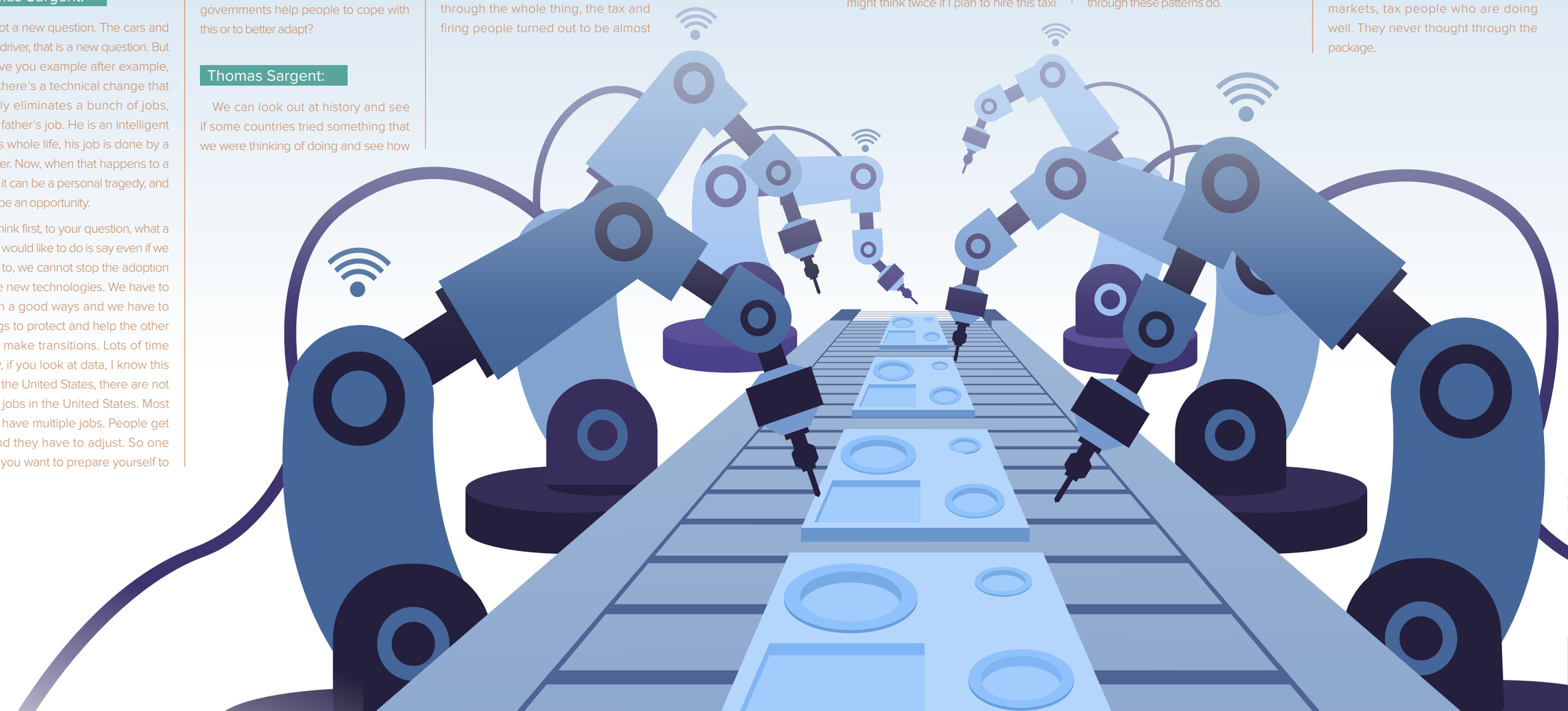
Jiao Shi:

That is right. If I am a taxi company, I might think twice if I plan to hire this taxi driver. If I know that I have a problem laying him off, I'd rather probably buy an AI driving car because nobody is going to say you cannot fire that car.

Thomas Sargent:

So Spain and Europe have all sorts of examples where there were labor market regulations that were benevolent, but they weren't thought through and they ended up hurting. They ended up maybe helping particular people, but they hurt groups of people more than they helped. So you can learn from other countries. And that's what economists sorting through these patterns do.

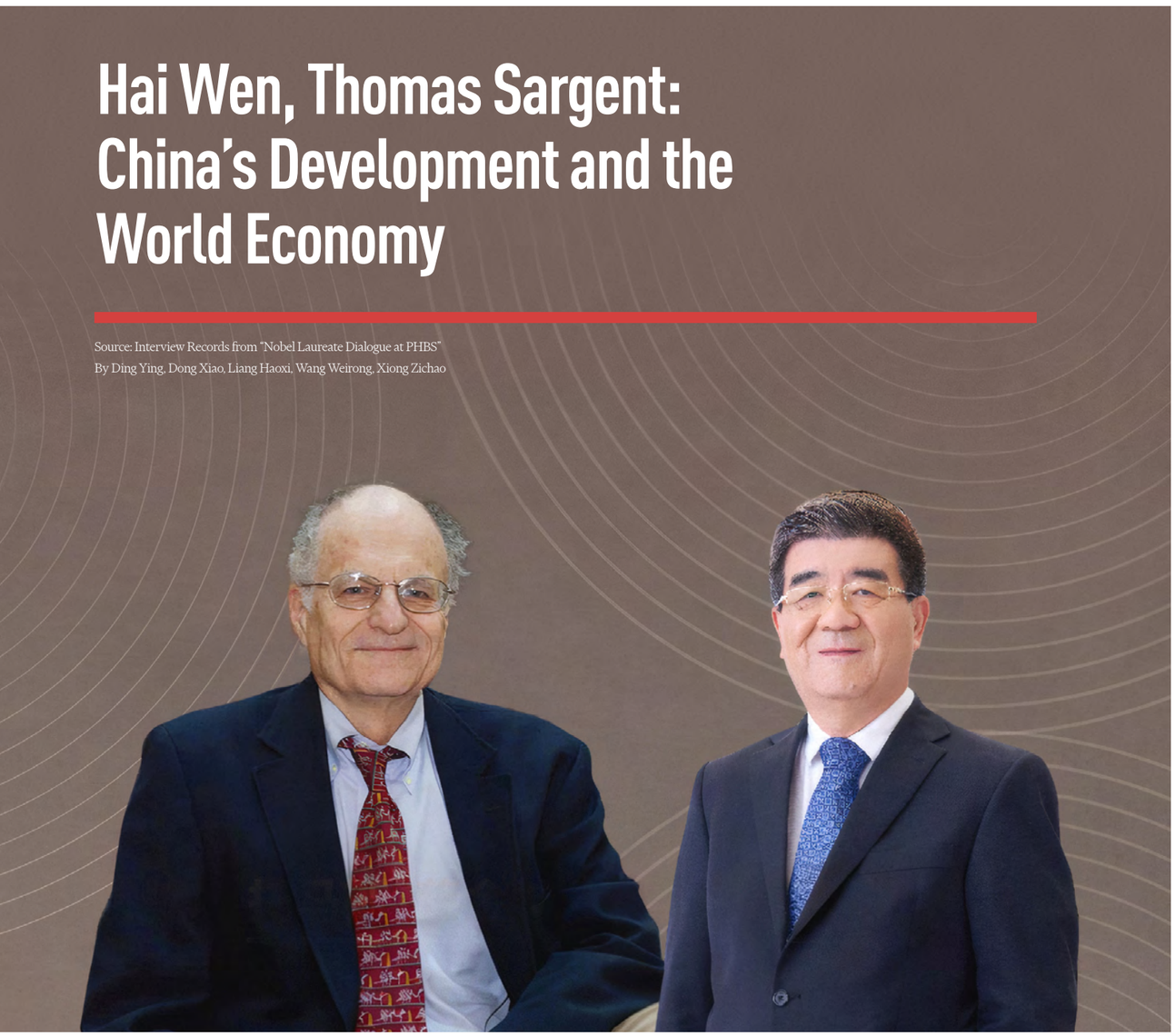
Argentina was a very wealthy country hundred and twenty years ago. And they did one intervention here to help some group, help that group, and hurt this group. Then they have an economy with a mass of entitlements and regulations and people who think they own those entitlements, they think they have property in them. So it is very hard for the current president to take them off. It is trying to take them off, but does not even know where to start because they fit together. But if you look at what's happened to productivity in Argentina was, they did tariffs, protected industries, picked winners, cut themselves off from markets, tax people who are doing well. They never thought through the package.



Hai Wen, Thomas Sargent: China's Development and the World Economy

Source: Interview Records from "Nobel Laureate Dialogue at PHBS"

By Ding Ying, Dong Xiao, Liang Haoxi, Wang Weirong, Xiong Zichao



Wen Hai:

Welcome back, Tom. It's very happy to see you back to Shenzhen again. I have a couple of questions want to discuss with you. By this stage, the demand become much more important for economic growth. However, how to stimulate consumption? The consumption needs income, and income needs job creation. So, I think currently our problem is we do not have enough job created especially for young people. From our statistical point of view, you can see China private industry, including foreign companies, and also including agriculture, they provide more than 80% of job in China. So from this of point of view, in order to create consumption, we need to create more jobs. Then, in order to create more jobs, we should stimulate the development of the private company. How do you think we should make a China's private company grow much healthily? What are the key issues to guarantee that a private company has a very good confident and a very positive expectation for the future, and they are enthusiastic to invest more and create more jobs?

Thomas Sargent:

Thank you. Here is the way I think about it. The answer to that question, I can take off the name China, it is about any advanced modern economy. And for an entrepreneur, there has to be prospects for success. They know their prospects of failure because many of their ideas are going to fail. The entrepreneur's ideas failed, the investors failed, the businesses are closed, their assets are liquidated, there is bankruptcy, and then those resources are reallocated to people who try again. How does society create that machinery and rewards those people? It's a challenging thing for any society to do, because the newspapers or the press only shows entrepreneurs who made a lot of money. But many of the people, they are so called capitalist entrepreneurs, they failed. And the paradox is you have to reward the people who are successful in order to keep bringing out the people who are going to take their chances. The record is private companies tend to do that better than government companies the worldwide.

Wen Hai:

In China, we have both state-owned enterprise and private enterprise. How can we balance these two types of enterprises from the government policy point of view?

Thomas Sargent:

In the market, private companies have one advantage over the government, that is they have market signals about profits and losses, and they get signals from the market whether they are doing something well. The problem inside governments is if there are not those signals, you need something else to substitute. And you know in the United States, you hear that President Trump has asked Mr. Musk to help him make the government more efficient. We are going to see. So far, he has not had any concrete ideas, how to do that, because he does not know what is going on inside the government.

Wen Hai:

Recently, not only China but also United States launched a lot of industrial policy. I think they listed the most important reason as strategical competitiveness. Everybody think it is crucial to use the government support to support the industrial innovation development. How do you see the current trend and how do you evaluate those industrial policies? Pro and Con?

Thomas Sargent:

I could just speak of my own country, United States. Economists, or most economists in my country, do not like industrial policy. The government makes decisions about which entrepreneurs or which companies to give funds to. And often it's the company that wants the funds to devote a lot of resources to lobby the government. And often those funds are awarded to companies that are inefficient. The stock market is valuating Intel less and less, because there is all sorts of competition for the chips that they make. And the United States government is putting billions of dollars into it. There is industrial policy that the government gets in the business of becoming a referee in my country and where it should not be. There is a big United States steel company that wants to merge with a company from abroad. The US government stopped it because of so-called strategic. When I hear strategic competition, often it makes no sense.

Wen Hai:

Because of COVID-19 and geopolitics, many countries become more cautious about international trade and investment. When discussing trade and investment with other nations, they believe it is safer to favor friendly countries. What do you think about the impact of national security, values, and ideology on international trade?

Thomas Sargent:

The history is that breaking into trade blocks based on political ideology is not good for anybody. Trade is a good way to promote friendship. Because businessmen are trading with each other, they have relationships and become friends. Exchange of ideas brings people together. So I think in my own country, we can learn a lot from the history of trade wars. If you look in the nineteen thirties where there were trade wars, they did not end well. And that was a lesson that the United States took into and out of World War II when we were trying to be a foster of free trade. There is a big tradition of free trade coming to the United States. I think we should be loyal to it.

Wen Hai:

I think what you said is very important. We should not just trade among friends, we should use trade to create friendship. We have to continue to open up, continue to promote free trade with all countries. Then we can make the world much more friendly. Thank you for your comments, and wish you a very happy new year.

Thomas Sargent:

Thank you, Professor Hai. I wish you a happy new year.

Thomas Sargent: Tariffs and International Trade Regime

Source: Interview Records from "Nobel Laureate Dialogue at PHBS"
By Ding Ying, Dong Xiao, Liang Haoxi, Wang Weirong, Xiong Zichao

Baixiao Liu:

Professor Sargent, it is a great pleasure that we have the chance to have this discussion today. From a long-term and short-term perspective, how would you analyze the impact of the tariffs on a nation's economic welfare?

Thomas Sargent:

High tariffs on the United States, if we impose them, they are going to be bad for the United States. We had high tariffs before, and they were bad then. Tariffs and trade quotas could go along with them, what do they do? They protect particular producers in our country from competition and they give them local monopolies.

A very good American economist, he is in the Federal Reserve in Minneapolis, has done studies about United States had tariffs and trade quotas on particular products in the 1970s.

One was iron ore, believe it or not, those tariffs were so high, and it's a tariff with a quota. They were so high that there was a monopoly in Minnesota and it was very inefficient. It was a combination of inefficient labor and inefficient management. They had no incentive to compete.

They took the tariffs off because people bought a free trade argument like the United States was pushing after World War II. It took a long time, but they took them off. When they took them off, suddenly that company did not have a monopoly and had to compete. And various US company started importing iron ore from Brazil and other places. Guess what? That company changed the labor rules and became much more efficient. Productivity went up, prices went down. Who did that help? That helped almost everybody in the United States. Elsewhere, it hurt a few people. It hurt those managers of that company, the labor union with that company, and the few workers. It helped a very small number of people at the cost of the society as a whole.

Baixiao Liu:

So how do firms suggest their expectations to this negative tariff uncertainty? Does rational expectation theory still explain current corporate investment behaviors?

Thomas Sargent:

This is a great question. It is actually a deep question. The so-called rational expectations theory is a hypothesis that is made by economists like myself. We build artificial economies with people in it that are like you and me and they are making decisions about the future. And just like you said, if they're making decisions about the future, they have to have some view of the future about how things are going to unfold. The fun thing is that how things are going to unfold is like a big game. How things are going to unfold depend on what both of us are going to do and about what both of us think about the future. That can get complicated. Your beliefs matter, my beliefs matter. So the idea of rational expectations, I like to say it is communism of a certain kind. It is that things have settled down so that things like about government policy, they are predictable. And you and I share the same prediction of them. Why? Because it has been regular in the past. There are the reliable things. So rational expectations are kind of we all agree about that. And we agree because the government set a policy that we can forecast.

Now, your question, what if it is chaos and smoke bombs all over and I am going to do this with there. Well, that means it creates a lot of uncertainty. You can see it in the data. The example would be you look at the imports and cargo ships arrive in the US ports last few months. It's just huge surge of imports because we are trying to get things when it is still cheap. You are betting on. So you say, I'm going to put these tariffs on in three months. And when three months come, you say, I was just kidding. That creates great chaos.

Baixiao Liu:

Along these lines, when the trade tension escalates, I am very curious how the central banks will respond. Cause there seems to be a lot of argument between the president and the chair of the fed recently. The central banks face a dilemma between stabilizing inflation and supporting growth. So how should monetary policy balance these priorities?

Thomas Sargent:

One thing Milton Friedman said long time ago, it was about this trade off. He was a great economist in the 20th century. Actually, he came to China and had great faith in China. Almost 60 years ago, he said, it cannot do both. It is not feasible for it to do. At most, it can do one. That is, if it does the right thing, it can control inflation, it cannot control unemployment. So now, each job has got much harder. You could ask the same thing in China. The United States did not have a Federal Reserve until about 110 years ago. Instead, you could say this was Trump's dream or his nightmare. From the start of our country until 1914 in some almost 150 years, the congress ran monetary policy.

Baixiao Liu:

So, they vote on it? They vote on monetary policy?

Thomas Sargent:

Yes. And they designed , they designed the money, they did that. And guess what? It was a pain. People would come saying we think money should be increasing, we think it should be decreasing. The congressman said, basically the idea is, we're going to hand this to an independent agency. It is your problem, and you tell the public. Go blame him and it is independent. It is not really independent but you go run it and don't come to me. So, the congressmen did that for a reason. The US constitution say we run by rules, written rules. It is not actually true. There are written rules and there is a constitution. Then the congress over the years has written exceptions. The constitution says that the congress sets tariffs not the president. What has happened in the last 80 years is congress has gradually said setting tariffs is really a pain. Because all these manufacturers come and say, I want you to impose a tariff and give me tariff protection. So they got tired and started delegating it. Anyway, that is how we got into this.

Baixiao Liu:

I see.

Thomas Sargent:

Tariffs are not the reason for inflation. The Fed is not doing the right thing. I had a fed official explain this to me. Tom, you do not really understand why the fed was put together. You think it is there to optimally control the economy. That is not why. It is there to take the blame.

Baixiao Liu:

Thank you very much for the discussion today, and we learned a lot from your insights.

Thomas Sargent:

Thank you.

Hai Wen: Strengthen Private Enterprises and Break Through Development Dilemmas

Source: Peking University Campus Newspaper (Issue No. 1689)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- Peking University Campus Newspaper (Issue No. 1689), Front Page

Recently, the 'Power Nation Forum' column on the front page of Peking University Campus Newspaper (Issue No. 1689) published a signed article titled Strengthening the Private Economy and Breaking Through Development Dilemmas by Hai Wen, Deputy Director of the Peking University Council (former Vice President), Chair Professor of Economics at Peking University HSBC Business School, and Founding Dean. The full text is reprinted below for readers.

On February 17 of this year, a symposium on private enterprises was convened. General Secretary Xi Jinping had face-to-face conversations with private enterprise leaders from various industries and encouraged private enterprises and entrepreneurs to make new and greater contributions to advancing Chinese-style modernization. This symposium sent a clear signal: private enterprises should have the confidence and capability to become the primary driving force for China's future economic growth.

Following the symposium, the PHBS Think Tank at Peking University promptly launched a survey using a questionnaire among private enterprises across different industries and regions. The results indicated that the vast majority of private enterprises reported that the symposium played a significant role in boosting their confidence and improving future expectations, reducing concerns about policy uncertainty. However, anxieties about unfair competition, difficulties, and high costs in financing, and the uncertainty of future business environments still persist. Therefore, we need to deeply explore historical contexts, practical significance, and key issues to formulate policy measures that align with economic development laws and current realities, thereby truly implementing the spirit of the symposium.

Hai Wen

Vice Chairman of Peking University Council
(Former Vice President of Peking University)

Chair Professor of Economics, Founding Dean of Peking University HSBC Business School

Not Just a 'Supplement to the State-Owned Economy'

Globally, private enterprises have existed since the emergence of market economies. Throughout human history, private enterprises have played crucial roles in promoting economic growth, driving technological innovation, creating jobs, and providing products and services. They are an important force behind the development and progress of human economic societies.

In China, the most significant measure of reform and opening-up has been the liberalization of the private economy. Over the past 40-odd years, the booming private economy has formed the "5-6-7-8-9" characteristics, namely contributing over 50% of tax revenue, over 60% of GDP, over 70% of technological innovation achievements, over 80% of urban and rural employment, and over 90% of enterprise numbers. As of January 2025, there are 56.707 million registered private enterprises in China, accounting for over 92% of the total enterprise population. Additionally, the private economy concentrates over 80% of national "Little Giant" enterprises specializing in precision, uniqueness, specialization, and newness, over 92% of national high-tech enterprises, and over 60% of A-share listed companies. Evidently, private enterprises are not just a "supplement to the state-owned economy" but a vital component of China's national economy.

Regions with developed private economies such as Guangdong, Fujian, and Zhejiang, have not only fostered a number of renowned private enterprises and entrepreneurs but also generated valuable experience in developing the private economy. In 2002, Comrade Xi Jinping, then Governor of Fujian Province, conducted in-depth research in Jinjiang and systematically summarized the "Jinjiang Experience" of "six persistent adherences" and "handling five major relationships" from the perspective of reform and opening-up and China's economic integration into the global landscape. Guided by the "Jinjiang Experience," the Jinjiang government's "four arrivals"—"not arriving unless called, arriving immediately when called, delivering as promised, and providing thorough service"—have become a benchmark for governments across the country to learn from. This epitomizes the nurturing, growth, and strengthening of China's private enterprises and embodies the exploration and practice of the socialist path with Chinese characteristics.

Since reform and opening-up, China's economy has undergone two major changes: first, it is no longer poor and backward, with per capita income reaching the upper-middle level; second, material shortages have been eliminated, with relative overcapacity emerging in some sectors. Correspondingly, two other important changes have occurred: consumers have increasingly higher demands for products and services, and economic growth has gradually shifted from supply-driven to demand-driven. Who can better understand people's needs through the market and produce products and services that satisfy people's aspirations for a better life? Who can innovate and create more job opportunities, continuously increase people's incomes, and boost demand-driven economic growth through consumption? Both theory and experience demonstrate that the ability to adapt to these changes largely depends on whether private enterprises can grow and thrive.

For this reason, the Report to the 20th National Congress of the Communist Party of China, while reemphasizing the two "unswerving commitments," for the first time explicitly proposed specific policy highlighting the importance of the private economy, such as "promoting the development and growth of the private economy," "improving the modern corporate system with Chinese characteristics, carrying forward the entrepreneurial spirit, and accelerating the building of world-class enterprises," and "supporting the development of small, medium, and micro enterprises."

- Unitree Technology

The 'Main Force' in New Era Development

In recent years, China has entered a new era of realizing the great rejuvenation of the Chinese nation. High-quality economic development, rural revitalization, common prosperity, innovation-driven development, addressing aging challenges, and advancing economic globalization have all become important strategic tasks for China's future development. As the vanguard of China's reform and opening-up, private enterprises will once again become the driving force in the new era of development.

"High-quality development" does not merely refer to high technological content in products and services but also to improved production efficiency and effective resource utilization. High-quality economic development means giving full play to the market's important role in resource allocation, with enterprises' investments and production meeting people's pursuit of a better life. The pressure of competition and the drive for profitability make private enterprises' investments and production more attuned to market demands, becoming effective investments that promote high-quality economic development.

Similarly, competitive pressures and profit motives also make private enterprises the vanguard of "innovation-driven development." After over 40 years of reform and development, China's economy is no longer in short supply, and consumers have increasingly higher standards for products and services. Facing fierce market competition, private enterprises will be quickly eliminated if they fail to innovate. "Continuous innovation" has become a prerequisite for their survival. Therefore, without government funding or planning, private enterprises must continuously pursue innovation. In recent years, most Chinese enterprises listed in various "innovative enterprise" rankings by domestic and international institutions have been private enterprises. Examples include Huawei, BYD, DJI, and DeepSeek.

"Common prosperity" is one of our important economic development goals. To achieve common prosperity, we must focus on the "unprosperous population" and strive to help them become wealthy. China's "unprosperous population" is mainly in rural areas. Currently, agriculture accounts for less than 7% of GDP, while rural residents make up about 35% of the population, and the agricultural workforce constitutes over 20%, with their per capita income far below the national average. Therefore, to achieve "common prosperity," we must first achieve "rural revitalization." The core of "rural revitalization" is to increase the income of existing farmers, which can be achieved through urbanization and creating more non-agricultural job opportunities locally—and this task can only be accomplished by private enterprises.

Moreover, China has entered an "aging" society, and addressing aging has become a challenge of the new era. Instead of merely regarding the elderly as a burden, we should better leverage the capabilities of older adults. Compared with developed countries, China's average retirement age is lower, and the employment rate among the elderly is even lower. In reality, with increasing life expectancy, improved health, and the growing service sector, a significant proportion of Chinese elderly wish to, and are capable of, extending their working years, as this not only increases their income but also meets their spiritual needs. Private enterprises, which can flexibly provide various job opportunities, are a key means for China to effectively address the challenge of "aging."

As China's economic strength grows and the international community emphasizes "fair competition," state-owned enterprises often face international skepticism, while private enterprises are more readily recognized by the international community due to their market-oriented nature. Experience has shown that the "going global" of private enterprises can not only reduce geopolitical frictions and avoid trade rule disputes but also enhance China's voice and influence in global industrial chains, increasingly becoming the main force in China's participation in international competition and cooperation.

China's Current Economic Challenges: Primarily Micro - Level Issues

Professor Thomas Sargent, the 2011 Nobel laureate in Economics and Honorary Director of the Sargent Institute for Quantitative Economics and Finance at Peking University HSBC, once said, "The most critical factor determining a country's economic prosperity is its microeconomy." The micro-level factors here mainly refer to enterprises. Whether enterprises can develop healthily determines a country's economic prosperity. In a market economy, these "enterprises" mainly refer to private enterprises.

In recent years, China's economy has faced difficulties due to insufficient demand. The government has continuously strengthened macroeconomic policies, even proposing "moderately accommodative" monetary policies and "more proactive" fiscal policies for the first time in 15 years. However, economic growth remains less than ideal, specifically reflected in the lack of significant growth in private enterprises' fixed asset investments, which affects both investment demand and employment, thereby impacting residents' incomes and consumption. Therefore, China's current economic issues stem not from inadequate macro policies but from a micro-level mechanism problem: private enterprises lack investment enthusiasm.

Under accommodative monetary policies, why do private enterprises still lack investment enthusiasm? Mainly because private entrepreneurs still lack confidence in future development and trust in the implementation of specific policies. The main reasons for this phenomenon include:

Firstly, private enterprises have often not been treated as equals politically, with public opinion in recent years even suggesting a "withdrawal of private enterprises."

Secondly, from a legal perspective, private enterprises have not received effective protection. Some local governments' improper practices, such as "non-payment of debts," "overfishing," and "arbitrary fines," have left many private entrepreneurs feeling insecure.

Thirdly, in terms of industry access and market competition, private enterprises—especially small and medium-sized enterprises—lack fair treatment.

To address these issues, we need to further improve the micro-level mechanisms, provide a favorable environment for the continuous emergence and growth of private enterprises, and create a safe, stable, and predictable development ecosystem to fundamentally boost or rebuild private entrepreneurs' confidence and trust.

Specific efforts can be made in the following three areas:

Firstly, continue to emphasize the promotion and education of the theory of the primary stage of socialism in the new era of socialism with Chinese characteristics, clarify the importance of the private economy, and foster a strong atmosphere of respecting and supporting private enterprise development throughout society, especially among government agencies at all levels.

Secondly, earnestly govern according to law, maintain policy stability, and eliminate any policies or actions that lack a legal basis. Such actions should be promptly stopped and held accountable.

Thirdly, draw clear economic responsibility and industry boundaries between state-owned and private enterprises to minimize direct interest conflicts. In industries where the two compete, governments and state-owned banks should maintain fair and consistent policies. The government needs to create a microeconomic framework and set clear "rules of the game," enabling enterprises, consumers, and government agencies at all levels to coordinate decisions. By ensuring equal treatment for all types of ownership enterprises in legal regulations, industry access, financial investment, market regulation, and social responsibility, and by building a market-oriented, law-based, and internationalized business environment, the government can ensure the long-term stability, prosperity, and development of the national economy.

Traditional economic theories identify labor, land, and capital as the main factors of economic development, while modern economic theories also recognize "entrepreneurial spirit and talent" (entrepreneurship) as important production factors. In modern market economies, entrepreneurs are not ordinary human resources but special production factors capable of effectively integrating land, capital, human resources, science and technology, and other elements for commodity and service production. The same resources can be organized differently by different entrepreneurs, leading to different productivity outcomes. Supporting entrepreneurs and creating a lenient, equal, law-based, and stable environment for private entrepreneurs to innovate and start businesses is a necessary guarantee for the growth of China's private enterprises.

General Secretary Xi Jinping has pointed out, "The private economy is an inherent element of China's economic system, and private enterprises and entrepreneurs are our own people." Since reform and opening-up, the Party has unswervingly and continuously deepened its stance on upholding the basic economic system, from the "two unswerving commitments" to the "three unchanges." Under the current circumstances, only by fully understanding the historical context, deeply grasping the practical significance, accurately addressing key issues, and continuously promoting the development and growth of private enterprises can we break through the current growth dilemmas and ensure the country's long-term sustainable development.

-DeepSeek

Hai Wen: The Development of the Big Health Industry from an Economic Perspective

Source: Xinhua News Agency, Peking University HSBC Business School Public Relations Office

From March 23 to 24, the China Development Forum 2025 Annual Meeting, hosted by the Development Research Center of the State Council, was held at the Diaoyutai State Guesthouse in Beijing. Premier Li Qiang of the State Council attended the opening ceremony and delivered a keynote speech. The theme of this year's forum was "Fully Unlocking Development Momentum, Jointly Promoting Global Economic Stability and Growth." Distinguished guests from China and abroad—including political leaders, scholars, executives of Fortune Global 500 companies and leading industry enterprises, as well as heads of international institutions—engaged in in-depth discussions on a range of topics such as macroeconomic policy and economic growth.

Professor Hai Wen, Vice Chairman of Peking University Council (former Vice President of Peking University) and Founding Dean of Peking University HSBC Business School, attended the forum and delivered a speech at the thematic seminar on "High-Quality Development of the Big Health Industry." The following is the content of Professor Hai Wen's speech.

-Remarks by Professor Hai Wen

China's big health industry has enormous development potential, which can be examined from both the demand and supply sides. From the demand perspective, China's per capita income has already reached an upper-middle level. After the basic needs of material life are met, health becomes one of the most important demands. From the supply perspective, current provisions still fall far short of meeting people's needs. According to incomplete statistics, the share of the healthcare industry in China's GDP is only about 6%, which is lower than the global average of around 10%. In the United States, this figure exceeds 15%, suggesting that there is significant room for growth in China's big health industry, including the medical sector.

This "room for growth" is mainly reflected in two aspects. First, there is a shortage of medical personnel. Currently, China has fewer than five healthcare workers per 1,000 people, whereas in developed countries the number exceeds 10, with Norway reaching as high as 22.3. Therefore, in terms of medical staffing, we are still far from meeting the needs of the public. Second, there is a lag in new drug development. Although some progress has been made, there is still a considerable gap between current capabilities and actual needs. In critical situations, there is still reliance on imported drugs.

In short, as stated in the report of the 19th National Congress of the Communist Party of China, the current big health industry—like other industries—faces the contradiction between the people's growing demand for a better life and unbalanced and inadequate development.

-Scene of the Seminar

How can we resolve this issue? First, we need to strengthen the training of medical personnel and create more space for their career development, while also utilizing new technologies such as artificial intelligence to enhance the service capacity of the healthcare sector. Second, we must continue to advance healthcare system reform and attach greater importance to the research, development, and application of new medicines.

In terms of new drug development, the government should further emphasize and support basic research. In addition to pharmaceutical companies, universities should also increase their investment in basic research related to new drug development. Moreover, we should pursue open cooperation with countries around the world in the field of pharmaceutical innovation. Finally, we must expand financing channels and cultivate patient capital to provide long-term funding for pharmaceutical enterprises.

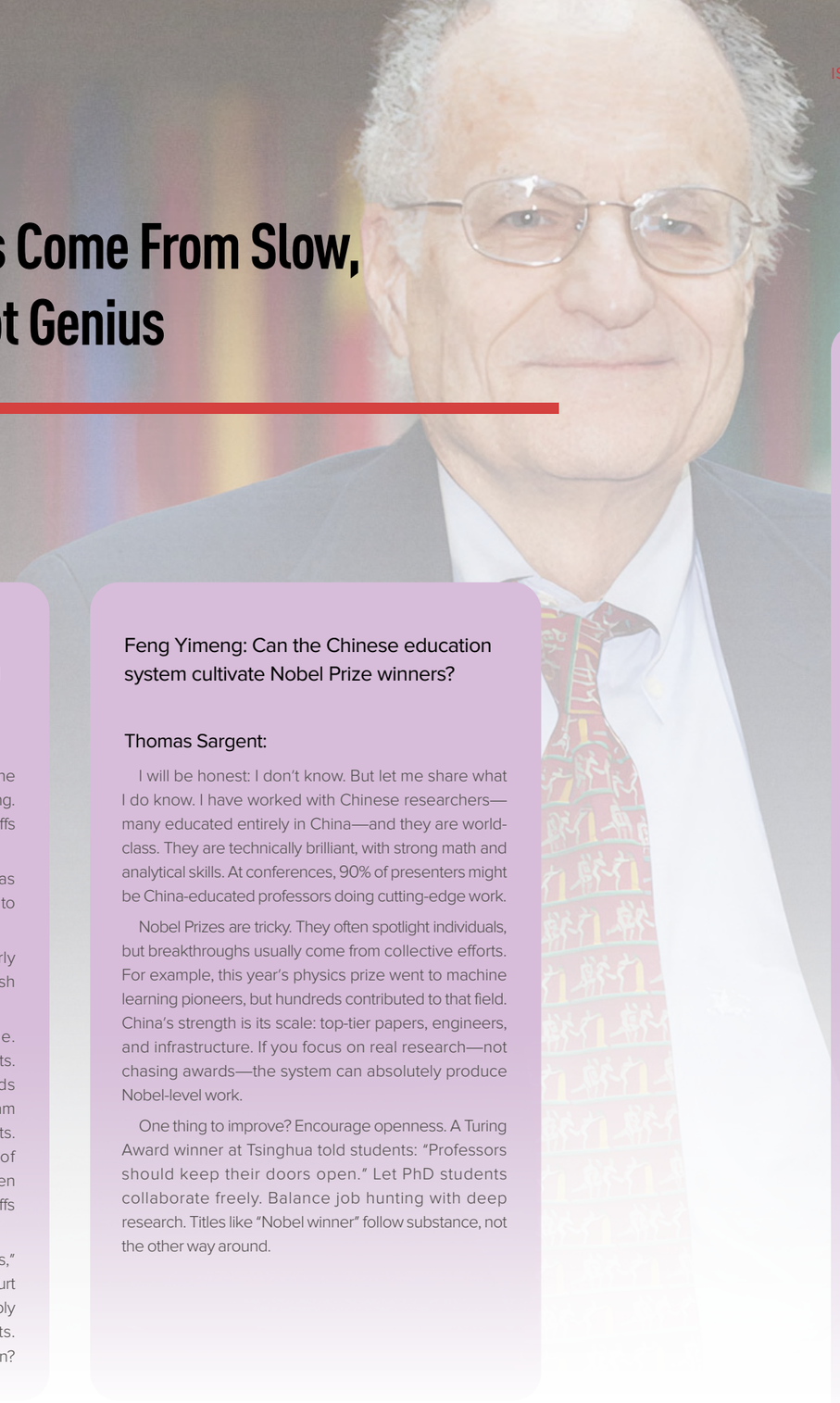
It is also crucial to consider how pharmaceutical companies can generate profits after developing new drugs. Due to the public's sensitivity to medical costs, finding a balance between market incentives and public needs becomes a key issue. We must meet the healthcare and medication needs of low-income populations while ensuring that companies and institutions involved in drug development can benefit financially. New drug development involves large investments and high risks of failure, and it cannot proceed without adequate incentives. The government can implement reasonable subsidy policies for the use of new medicines or low-income patients, rather than simply reducing drug prices. Only by ensuring sufficient incentives can we promote the research and production of new drugs, achieve economies of scale, and gradually lower costs and prices to benefit more patients.

-Scene of the Seminar

In addition, healthcare reform requires breaking away from the traditional view that low-cost medical care equates to basic public welfare. As income levels rise, health demands become increasingly diversified. Today, many people are willing to pay higher prices for better healthcare services. In addition to addressing market failures and ensuring basic healthcare for the disadvantaged, the government should also allow market mechanisms to meet higher-tier health and medical needs in order to optimize the allocation of resources.

In conclusion, China's health industry has substantial development potential. Only through continued healthcare system reform, increased training of medical personnel, the promotion of technological innovation, and the improvement of financing systems to support new drug development can we better meet the growing health needs of the people.

Thomas Sargent: Most Breakthroughs Come From Slow, Stubborn Effort—Not Genius



Source: Records from "Nobel Dialogue: A Tea Party for PHBS Student"
By Chai Yuheng

Zha Jiajing: What is the impact of recent tariff policies on the US, Chinese, and global economies?

Thomas Sargent:

Let me start by saying tariffs are not a new idea. In the US, they have been around since the country's founding. Alexander Hamilton and George Washington used tariffs for two main reasons:

1. To fund the government. Back then, the US was poor, and collecting taxes was hard. Tariffs were easy to enforce at ports.

2. To protect infant industries. For example, early American shipbuilders could not compete with British manufacturers, so they lobbied Congress for tariffs.

But here's the catch: tariffs hurt most people. Consumers end up paying more for worse products. Imagine buying cheap, high-quality British goods versus expensive, poorly made American ones. Adam Smith hated tariffs because they distort free markets. Businesses start lobbying politicians instead of innovating—this is cronyism. Free markets work when producers compete selfishly to please consumers. Tariffs break that cycle.

Now, when politicians say, "China will pay the tariffs," that is false. Tariffs are taxes on our own imports. They hurt US consumers and businesses reliant on global supply chains. The real winners? Politicians and lobbyists. History shows tariffs create inefficiencies. The solution? Promote competition, not protectionism.

Feng Yimeng: Can the Chinese education system cultivate Nobel Prize winners?

Thomas Sargent:

I will be honest: I don't know. But let me share what I do know. I have worked with Chinese researchers—many educated entirely in China—and they are world-class. They are technically brilliant, with strong math and analytical skills. At conferences, 90% of presenters might be China-educated professors doing cutting-edge work.

Nobel Prizes are tricky. They often spotlight individuals, but breakthroughs usually come from collective efforts. For example, this year's physics prize went to machine learning pioneers, but hundreds contributed to that field. China's strength is its scale: top-tier papers, engineers, and infrastructure. If you focus on real research—not chasing awards—the system can absolutely produce Nobel-level work.

One thing to improve? Encourage openness. A Turing Award winner at Tsinghua told students: "Professors should keep their doors open." Let PhD students collaborate freely. Balance job hunting with deep research. Titles like "Nobel winner" follow substance, not the other way around.

Xia Xinyu: How can machine learning be combined with unstructured uncertainty in research?

Thomas Sargent:

First, strip away the hype. ML is just statistical function fitting. You take data (X) and map it to outcomes (Y), whether linear regression or neural networks. The "magic" comes from more data and computing power.

To combine ML with uncertainty:

1. Define the problem. For example, financial mispricing or policy impacts.

2. Use ML to find patterns, but ground them in theory.

Take the Black-Litterman model. The classic Markowitz portfolio theory failed because it gave crazy weights—like investing 300% in one stock. Black and Litterman fixed this by adding Bayesian priors (the "Minnesota prior"). Their tweak? Blend investor views with market equilibrium. That's ML's role: refine models with data, but stay rooted in economics.

My advice? Do not force originality. Start by replicating existing work. If you spot a flaw—like I did with Solow's paper—dig deeper. ML tools will not replace theory, but they can make good researchers 10x more efficient.

Maguette Fall: I think economics is like philosophy, exploring how the world works. So, what are the limitations of using so much math in economics? And what are the pros of using math?

Thomas Sargent:

Firstly, I don't think you should say you're not good at math. It's probably not true. Even if it is, you should still say you are not good at math. I was very slow at it too and avoided math in college. But I admire its beauty and power. Despite struggling with it, I have made myself learn enough to be useful. So, why do economists find math useful? The basic reason is that many economics problems, like resource allocation, quickly become optimization problems. You need to define what's "good" and the constraints. This leads to constrained optimization and game theory, which form a very powerful framework.

If you know a little math, you can be creative and make progress. Even if you are not very good at math, you are still more empowered than someone who only knows English. There are economists like Adam Smith who did not use much math. Carl Marx was a good economist but did not use math either. He had insights but struggled to express them due to limited math knowledge. Similarly, there are brilliant economists who rely on verbal arguments, but they may not have students who can carry on their work. Robert Solow used a little math and had many students who followed his approach.

So, the advantages of using math are clear. However, there are limitations. Overusing math can make it hard for those without strong math skills to understand the core ideas of economics. It might also oversimplify complex economic phenomena. Additionally, focusing too much on math could lead economists to neglect the philosophical and social aspects of economics. But overall, math is a useful tool in economics.

Aleksandr Kuzmin: What advice do you have for master's students balancing career and research?

Thomas Sargent:

Thomas Sargent: Don't overplan. At your age, I wanted to be a football player, not a professor! Here is what worked for me:

1. Follow curiosity. Research ideas that keep you awake at night.

2. Learn continuously. I spent years studying math without aiming to publish—it paid off later.

3. Embrace uncertainty. Careers are not linear. My co-author Bob Litterman left academia for Goldman Sachs and thrived.

If you are torn between internships and research, ask: What teaches you more? Internships offer real-world skills; research builds deep expertise. Neither is "better"—just different paths.

Aleksandr Kuzmin: How do you balance life and research?

Thomas Sargent:

Poorly, according to my wife! Seriously:

1. Routine: I spent afternoons learning math, even if it felt unproductive. Progress compounds.

2. Exercise: I jogged 5 miles daily. Physical health fuels mental clarity.

3. Reading: Skim papers quickly, but dive deep into pivotal ones. Some papers took me weeks to digest—that is okay.

Balance is not about equal time. It is about sustainability. If research feels like a chore, rethink your topic.

Xiao Zhangyineng: Can unions effectively counter automation?

Thomas Sargent:

Short-term, yes; long-term, no. Unions might secure higher wages, but they accelerate automation. In California, a $25/hour minimum wage for coffee shops led to job losses—robots replaced baristas.

Automation is inevitable. The solution is not blocking technology but retraining workers. Economies evolve. The 1950s auto jobs are not coming back; today's factories need engineers, not assembly-line workers.

Zampieri Solange: How to detect biased models or narratives in economics?

Thomas Sargent:

All models are biased—they simplify reality. The key is transparency:

1. Acknowledge assumptions. Copernicus assumed heliocentrism; modern models assume rational agents.

2. Test rigorously. If data contradicts the model (e.g., Shiller's volatility puzzle), revise the theory.

3. Question narratives. Historians and economists cherry-pick facts to tell stories. Stay skeptical.

For example, politicians might claim tariffs "save jobs," but data shows they rarely do. Follow the evidence, not the headline.

Final Remarks:

Economics is messy, human, and endlessly fascinating. Whether you are studying tariffs or AI, stay humble, stay curious, and remember: most breakthroughs come from slow, stubborn effort—not genius.

Wang Pengfei: Culture, Technology, and Economic Growth

Source: Record from Speech at the Inauguration of the Hunan Xiangjiang New District Greater Bay Area Culture and Technology Industry Research Institute and the Opening of the "Culturally Nourished Xiangjiang Lecture Institute"
By Yan Xihe

Wang Pengfei

Peking University Boya Distinguished Professor, Dean of Peking University HSBC Business School

For macroeconomic researchers, a key question is: Why is there such a huge income disparity among nations? Global income maps show per capita GDP ranges from under $500 in low-income countries to $60,000 in high-income ones, a difference of over 100 times. Specifically, Luxembourg's per capita GDP is $135,000, the US $83,000, China $13,000, and India $2,487. This implies that two months of earnings in the US are equivalent to one year's income in China, and annual earnings in India equate to two weeks' earnings in the US. This stark disparity raises a crucial question: How can these differences be explained?

Neoclassical growth theory attributes economic growth to capital, labor, and technological progress. While capital investment and labor quality matter, their marginal returns diminish. Only continuous technological progress can break through growth bottlenecks. Empirical studies show:

1. Savings rate differences explain 60% of income disparities among nations.

2. 80% of US economic growth comes from total factor productivity (broadly, technological progress).

3. In China's post-reform 8% average annual growth, 3.16 percentage points stemmed from technological progress.

4. 82.9% of the income gap between developing countries and the US is due to technological disparities.

What drives technological progress? There are three main drivers:

1. Innovation and R&D: This is the core engine of technological advancement. Take Shanghai's tech firms as an example. A 10% increase in R&D investment boosts total factor productivity by 1.29%. With collaborative R&D and external knowledge acquisition, efficiency can rise by about 4%.

2. Technology diffusion: Critical for developing countries. Research indicates 93% of developing nations' total factor productivity growth comes from technology introduction and imitation, versus 75% from independent innovation in developed countries. This suggests China must strengthen original R&D as it progresses toward high-income status.

3. Resource allocation efficiency: Optimizing resource allocation, especially capital, can significantly enhance technological effectiveness. Studies show if China reaches US capital allocation efficiency, its total factor productivity could rise by 50%, potentially doubling per capita GDP. However, factors like administrative monopolies and labor mobility barriers often cause resource misallocation. Japan's "zombie companies" draining resources and hindering emerging industries is a prime example.

Finally, let us explore culture's profound impact on economic growth and technological progress. Culture influences the economy through four main channels:

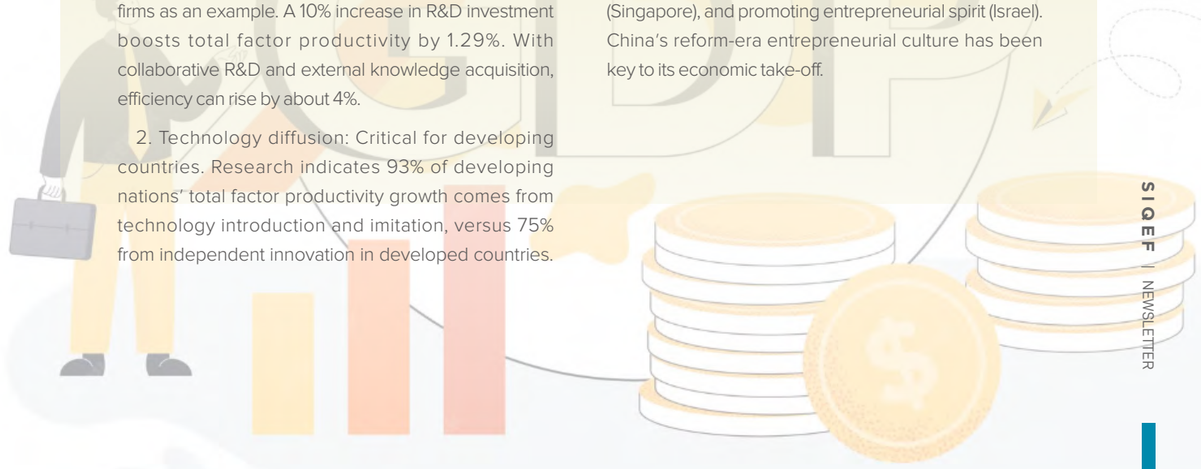
1. Saving propensity: Traditions like Protestant ethics and Confucian culture that encourage saving facilitate capital accumulation.

2. Risk attitude: A culture like Silicon Valley's "failure as learning" significantly reduces perceived innovation risks, fostering breakthrough innovations.

3. Spirit of cooperation: High-trust cultures in Germany and Japan enable efficient social division of labor and cooperation networks.

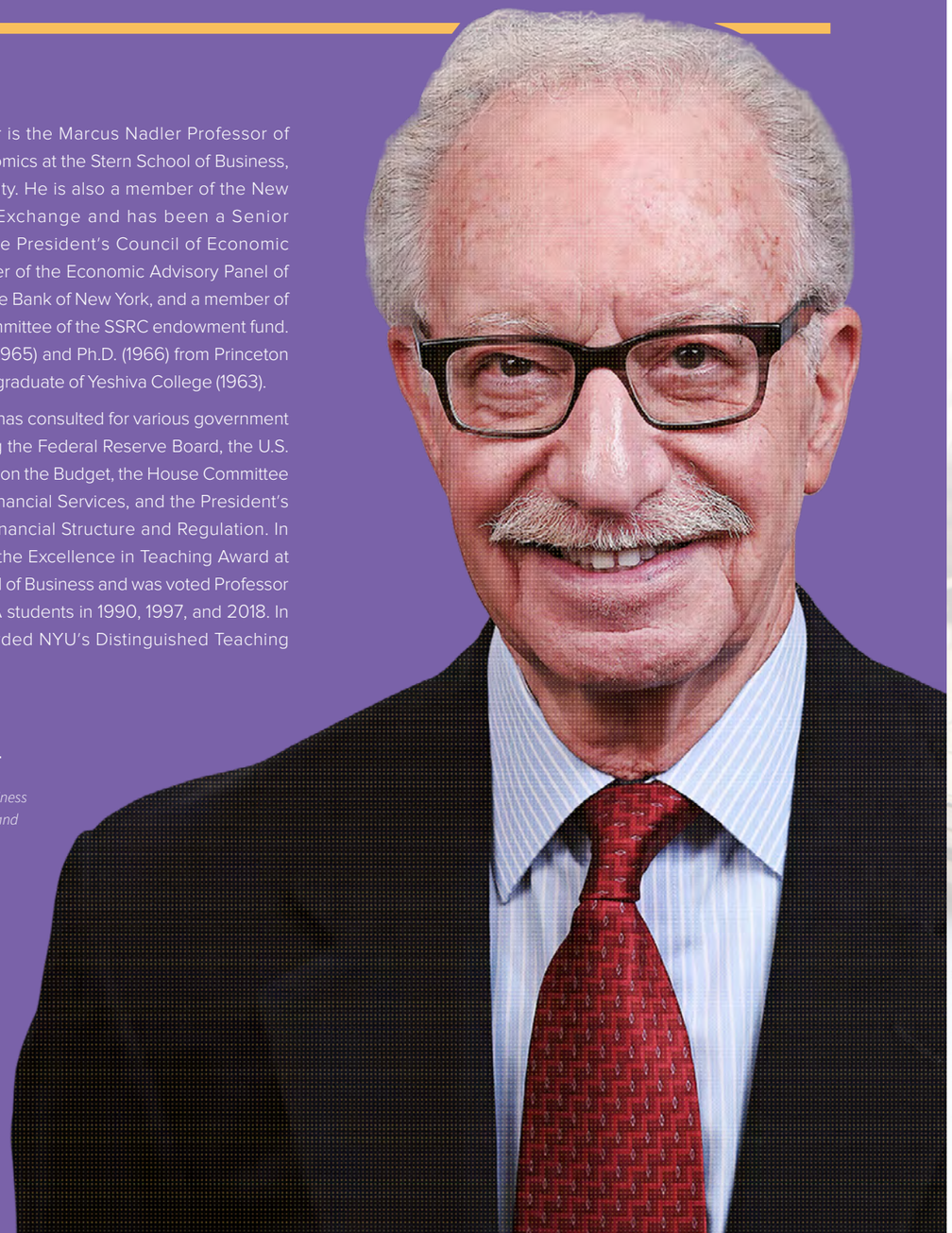
4. Scientific thinking: Traditions emphasizing quantification, logic, and empiricism enhance the precision and efficiency of resource allocation and management.

Countries that have overcome the "middle-income trap" typically share three cultural traits: valuing education (South Korea), being open and inclusive (Singapore), and promoting entrepreneurial spirit (Israel). China's reform-era entrepreneurial culture has been key to its economic take-off.



A Series of Brief Paragraphs on Economics and Finance

By William Silber



William L. Silber is the Marcus Nadler Professor of Finance and Economics at the Stern School of Business, New York University. He is also a member of the New York Mercantile Exchange and has been a Senior Economist with the President's Council of Economic Advisors, a member of the Economic Advisory Panel of the Federal Reserve Bank of New York, and a member of the investment committee of the SSRC endowment fund. He holds an M.A. (1965) and Ph.D. (1966) from Princeton University and is a graduate of Yeshiva College (1963).

Professor Silber has consulted for various government agencies, including the Federal Reserve Board, the U.S. Senate Committee on the Budget, the House Committee on Banking and Financial Services, and the President's Commission on Financial Structure and Regulation. In 1980 he received the Excellence in Teaching Award at NYU's Stern School of Business and was voted Professor of the Year by MBA students in 1990, 1997, and 2018. In 1999 he was awarded NYU's Distinguished Teaching Medal.

William Silber

NYU Stern School of Business
Professor of Economics and Finance

Here is a collection of the most popular 200-word paragraphs from my Linkedin posts for the first half of 2025. All are verbatim as they appeared on Linkedin on the date that appears below each paragraph.

The Squid Game and Reckless Presidential Decisions

Netflix recently released Season 2 of the dramatic hit series, The Squid Game. As in Season 1, which debuted in 2021, the new episodes show heavily-indebted South Koreans imprisoned in an arena where they compete in children's games whose losers are killed. Conversations among the contestants show they are aware of the murderous stakes, but continue 'playing' because they have been promised life-changing prize money if they win compared with their hopeless existence beyond the arena. Many commentators dismiss the gruesome framework as a dystopian fantasy, an unrealistic horror story. However, my book, "The Power of Nothing to Lose: The Hail Mary Effect in Politics, War, and Business" (http://bit.ly/TPONTLB) shows that similar asymmetric payoffs, big upside with limited perceived downside, have encouraged real-life recklessness.

Nothing-to-lose behavior is no surprise to those familiar with financial options. Most investors are cautious but become risk-takers when buying a call option. Calls give the owner the right, but not the obligation, to buy stock at a fixed price. Rights, without obligations, give these options a skewed payoff: profits increase with rising stock prices but losses are limited to a relatively small fixed fee, called the option premium. This immunity against big losses makes call options on volatile stocks especially valuable. Downside protection, the unique feature of an option, encourages risk taking.

But the reckless decisions in The Squid Game are hard to believe because death rather than financial penalty is at stake. Truth, however, can be stranger than fiction. My book shows how lethal asymmetric payoffs have proliferated throughout the world. For example, suicide bombers sacrifice themselves to achieve immortality because their existence is trivial in comparison. And asylum seekers risk death on the high seas to gain a better life and escape hopelessness.

The consequences of such risk-taking ripple far and wide. For example, the growth of asylum seekers has given rise to anti-immigrant sentiment in many countries, leading to the victory in national elections of populist presidential candidates, who respond with their own brand of recklessness.

How will it all end? Perhaps Season 3 of the Squid Game in June 2025 will provide a clue. In the meantime, read my book for real-life stories of the collateral damage of nothing-to-lose behavior, including reckless second term presidents no longer constrained by the ballot box.

Good Luck,
Bill Silber,
March 2, 2025, 4:00pm

Seeds of Fake Economic News

Republicans blamed recent declines in the stock market on last year's economic policies. According to President Trump's Commerce Secretary, Howard Lutnick: "You're looking at Biden data." I was no fan of Bidenomics but the stock market is forward looking and last week's gyrations more likely responded to the expected fallout from the contemporaneous news of Trump tariffs. But a more substantive announcement by Secretary Lutnick worries me more, one that has been almost overlooked in the press and contains seeds of fake economic news going forward.

Last week Howard Lutnick disbanded the Federal Economic Statistics Advisory Committee, a group that advised the government on producing accurate economic statistics. According to the Wall Street Journal, Lutnick explained in an email that the committee's mission "has been fulfilled." The Commerce Department also disbanded another group concerned with the accuracy of economic releases by the government: the Bureau of Economic Analysis Advisory Committee.

Secretary Lutnick's explanation for the termination strains credulity. Ongoing input from disinterested experts drawn from a broad spectrum of industry and academia seems like a good idea. Moreover, members of these advisory groups served in an unpaid capacity so it is unlikely they were victims of Musk's chain saw. The reasons for termination go deeper and are potentially unsettling.

The economic releases by the Department of Commerce and its agencies make headlines. For example, the Federal Reserve's favorite inflation measure, the personal-consumption expenditure's price index, and the overall indicator of economic performance, gross domestic product, are all released by Commerce. And these numbers not only make headlines -- they also influence prices and profits in the stock and bond markets.

Actions that impugn the integrity of the Commerce Department's statistical releases add risk and uncertainty to investor decisions. Almost nothing would do more harm than Fake News in economic data.

Beware,
Bill Silber,
March 9, 2025, 4pm.

How to Neuter Lame-Duck Recklessness

Donald Trump is not the first lame-duck president to roll the dice with public welfare. History shows that second-term presidents become reckless because they are no longer restrained by the ballot box. They want to preserve their long-term legacy but their lame-duck status confers "downside protection," so they try to accomplish that goal by taking more risks. My book, "The Power of Nothing to Lose: The Hail Mary Effect in Politics, War, and Business" (http://bit.ly/TPONTLB) shows how Congress can protect the public from a reckless president. Read Chapter 2 for the full story but here is a brief overview.

Two natural experiments in the twentieth century demonstrate lame-duck risk-taking. The first is with Woodrow Wilson, elected president in 1912, reelected in 1916, and facing the problem of World War I during both terms. Wilson avoided entering the Great War despite provocation in his first term, but on April 6, 1917, five months after his reelection, he signed a declaration of war against Germany. The second case is with Franklin D. Roosevelt, first elected in 1932, and a presumptive lame duck when reelected in 1936. FDR had discussed with his cabinet an aggressive move to pack the Supreme Court in 1935 after the Court had struck down key parts of his New Deal legislation. But his advisors viewed the upcoming 1936 election too close to call, so Roosevelt delayed his plans. And then, on February 5, 1937, three months after his landslide victory, FDR proposed legislation to expand the Supreme Court to fifteen judges.

A confident Roosevelt expected support from his fellow Democrats who controlled Congress, but they had other ideas. The Senate Judiciary Committee rejected what became known as the Court-packing bill, ending its report on the proposed legislation with a scathing denunciation: "It is a measure which should be so emphatically rejected that its parallel will never again be presented to the free representatives of the free people of America."

FDR's court-packing scheme stained his reputation but Congress showed that it would not be a rubber stamp. Today's legislators need to grow a similar backbone. The stock market decline after the release of Trump's tariff plans resembles a classic event study in finance, and measures the expected damage to economic activity. Congress should reclaim its control over tariffs to avoid this unforced error in public policy.

See you April 27th.
Bill Silber,
April 9, 2025, 9:15am.

History Predicts the Collapse of the U.S. Dollar

Yale University economist Robert Triffin, who died in 1993, became famous for making the prediction of a lifetime. Under the Bretton Woods international monetary system crafted in 1944, the U.S. Treasury promised to pay gold in exchange for dollars at a fixed $35 an ounce to any foreign central bank demanding payment. In 1960, the Belgian born Triffin warned that the system was unstable. He said that the buildup of dollar deposits owned by foreign central banks, combined with America's relatively small gold stock, doomed the U.S. Treasury's promise. As with all great ideas, in retrospect it was obvious, but it took 11 years for Triffin to be hailed a modern Nostradamus. On August 15, 1971, the system collapsed. President Nixon upended the financial world by suspending America's promise to exchange dollars for gold at $35 an ounce.

A modern version of Triffin's problem is the tension between growing international reserves in the form of foreign holdings of U.S government bonds and America's credibility to service that debt without inflating. Today's flexible exchange rates and free market price of gold soften the danger but do not eliminate it. The use of dollars as international reserves requires a strong U.S. currency so that it is a reliable store of value, like gold. And that comes with relatively high U.S interest rates; but high rates impair American credibility to service its growing debt.

Today, President Trump's push to lower interest rates exacerbates the tension in a symmetrical way. Lower U.S. rates would reduce the burden of our growing government debt but they will weaken the demand for dollars as international reserves, especially when inflation runs high. Reducing the Federal deficit would help to resolve the problem but few in Congress seem to care. The U.S. dollar has remained the world's currency until now because it is hard to supplant the established international medium of exchange. To paraphrase Winston Churchill, the dollar is the worst currency except for all the others. But Triffin would give American politicians less than 11 years before the dollar-based system of international finance collapses...perhaps much less considering how fast the financial world moves today.

Good Luck,
Bill Silber,
May 18, 2025, 4pm.

The Excess Burden of No Tax on Tips

It is time to revisit the foolishness of No Tax on Tips now that it appears in the bill just passed by the House of Representatives. At the very least, this provision violates the equity principle of taxation – that people with similar incomes should be taxed the same. For example, the dishwasher and server in a restaurant should pay the same tax on the same amount of income, which would not be the case if the server's tips were exempt from taxation. But No Tax on Tips violates a more subtle principle of taxation called excess burden, a principle that has united Republicans and Democrats in the past.

Economists on the left and right agree that taxes should be imposed without distorting decisions that reduce economic welfare. A tax that distorts creates an excess burden. For example, high marginal income tax rates create an excess burden by reducing the incentive to work and cutting the production of goods and services enjoyed by consumers. President Reagan, along with Republicans and Democrats in both Houses of Congress, supported The Tax Reform Act of 1986 because it lowered the marginal income tax rate from 50% to 28%, among other changes, precisely to reduce the excess burden of the income tax.

The excess burden of No Tax on Tips has a wide footprint and is a giant step backward. Individuals will try to shift income into tips, no matter how hard the Internal Revenue Service tries to segregate this favored compensation. It would not take a lawyer long to change the payment due a stock broker or real estate agent from commissions to tips. The legal resources devoted to such activities, as well as IRS efforts to prevent it, are an excess burden of the program. But that is just the beginning. Sports agents representing NFL linebackers will no longer negotiate guaranteed payments for their clients, but will focus instead on tips that team owners will pay for each quarterback sack. And lawyers could rewrite NBA contracts to include tips for three-pointers. Congress will try to minimize such trickery by limiting tip favoritism to low-income households. But my money is on the lawyers – who no doubt will be earning tips rather than billable hours.

Good Luck,
Bill Silber,
May 25, 2025, 4pm.

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The Technical Default Spread

Recently, Professor Li Kai of Peking University HSBC Business School published a collaborative paper titled "The Technical Default Spread" in The Review of Financial Studies (Volume 37, Issue 11, November 2024, Pages 3386–3430). The co-authors of the paper are Emilio Bisetti, Assistant Professor of Finance at the Hong Kong University of Science and Technology, and Yu Jun, Assistant Professor of Finance at the University of Melbourne, Australia.

Li Kai

Li Kai is a professor of finance at Peking University HSBC Business School, deputy editor-in-chief of Economics (quarterly), and a PhD in economics from Duke University. His main research areas are asset pricing, macro-finance, green finance, financial economics, and China's financial markets. His research focuses on building, verifying, and applying a set of asset pricing theories based on financing constraints and applying them to China's financial markets. He has published nearly 20 papers in important domestic and foreign journals such as the Journal of Finance, Review of Financial Studies, Journal of Financial Economics, Journal of Monetary Economics, Review of Finance, and Comparative Studies. His research on green finance was selected as a highly cited paper in the top finance journal, Journal of Finance, and won the Best Empirical Finance Paper Award at the Western Finance Association (WFA) and the Amundi-ESSEC ESG Award.

Review of Financial Studies (RFS) is one of the top three international financial academic journals, published by Oxford University Press on behalf of the Institute for Financial Studies. The journal is one of the top 24 academic journals of business schools selected by the University of Texas (Dallas) (UTD 24 for short), the top 50 business school journals rated by the Financial Times (FT 50 for short), and one of the 50 core journals of the "China Business and Management Discipline International Research Publication Data Retrieval System" (PHBS 50 for short) released by Peking University HSBC Business School. The impact factor in the past five years is 9.7.

Traditional macro-finance theoretical models usually assume that banks can only act as passive bystanders in corporate financing and cannot interfere with the decision-making of borrowing companies, such as the financial accelerator model of Bernanke, Gertler, and Gilchrist (1999) and the financial intermediary credit constraint model of Gertler and Kiyotaki (2010). However, in reality, in order to ensure that companies repay loans on time, banks often set a variety of restrictive clauses (debt covenants) in loan contracts to constrain corporate behavior. If the company's financial indicators (such as leverage ratio, interest coverage ratio, etc.) exceed the range specified in the terms, it will trigger a technical default, thereby transferring part of the company's control to the bank. When banks have the investment decision-making power of the company, they usually make more conservative investment choices than shareholders to ensure the safety of loan recovery.

Technical default is different from actual credit default and usually occurs before actual credit default. Technical default is common among companies. For example, among listed companies in the United States, an average of 6.5% of companies will have technical defaults every quarter. In view of the limitations of traditional macro-financial models, the author proposed and constructed an extended model that includes technical default and corporate control transfer mechanisms to study how this common self-protection mechanism of banks affects macroeconomic fluctuations, as well as corporate risks and equity financing costs.

The author introduces restrictive clauses, endogenous technical defaults and transfer of corporate control into the traditional financial accelerator model. In this model, if the profitability of an enterprise is lower than a pre-set critical value, the enterprise will trigger a technical default, and the investment control will be transferred to the bank, which will make more conservative investment decisions than entrepreneurs. The results show that this mechanism can mitigate the financial accelerator effect at the macro level. Its economic intuition is that the technical default and control transfer mechanism enable banks to protect their own interests through intervention when the profitability of enterprises is poor. Therefore, banks are more willing to lend ex ante, thereby alleviating the financial accelerator effect caused by financing difficulties.

At the micro-enterprise level, the model predicts that the conservative investment strategy of banks during intervention will reduce the exposure of enterprises to systemic risk. Therefore, enterprises with a higher probability of technical default will have lower systemic risk exposure and correspondingly lower expected stock returns. The authors constructed a technical default probability indicator at the enterprise level and established an investment portfolio for empirical analysis, and found that the annualized expected stock return of enterprises with a higher probability of technical default is 4.12% lower than that of enterprises with a lower probability of default, verifying the validity of the theoretical prediction.

The author believes that the new mechanism based on technical default and transfer of corporate control is of great significance for policy and practice. For example, financing constraints are a typical problem faced by small and medium-sized enterprises in my country. Optimizing the mechanism of technical default and bank intervention can help increase banks' willingness to lend, thereby alleviating financing constraints. In addition, stock investors should also pay attention to the potential impact of bank intervention on the expected return of corporate stocks (i.e., the cost of corporate equity financing) when making investment decisions.

Social Security Reforms, Capital Accumulation, and Welfare: A Notional Defined Contribution System vs A Modified PAYG System

Recently, a paper co-authored by Lin Shuanglin, professor at Peking University HSBC Business School and deputy director of the PHBS Think Tank, titled "Social security reforms, capital accumulation, and welfare: A notional defined contribution system vs a modified PAYG system" was published in Journal of Population Economics (Volume 37, Issue 1, article number 27, March 2024). The co-author is Li Shiyu, associate professor at the School of Finance and Economics of Renmin University of China.

Journal of Population Economics was founded in 1988 and is jointly sponsored by the Center for Population, Development and Labor Economics of the United Nations University, Maastricht Institute for Economic Innovation and Technology and the Global Labor Organization. It mainly publishes original academic articles on theoretical and applied research in various fields of population economics, focusing on individuals, families, family behavior, population policies, savings and pensions, social security, housing and health care. In the field of demography, the journal's Journal Impact Factor and Journal Citation Indicator ranked first in 2022; the journal's impact factor ranked fifth and the journal citation indicator ranked second in 2023.

Lin Shuanglin

Lin Shuanglin is a professor at Peking University HSBC Business School, deputy director of the PHBS Think Tank, and honorary director of Peking University China Public Finance Research Center. He holds a bachelor's degree in economics from Peking University, a master's degree in economics from Northwestern University, and a doctorate in economics from Purdue University. His research areas include China's public finance, public economics, and economic growth. His researchers have appeared in journals such as Journal of Economic Theory, Journal of Public Economics, Journal of Population Economics, Journal of International Money and Finance, Journal of Comparative Economics, Economic Inquiry, Economics Letters. His monograph "China's Public Finance: Reforms, Challenges and Options" was published by Cambridge University Press.

With the aging of the population (declining birth rate and increasing life expectancy), fewer and fewer young people have to support more and more elderly people. The existing pension insurance system is facing great pressure, and reform has become an inevitable trend. In order to deal with the insufficient income of the pension insurance fund, there are currently two options: one is to establish a nominal personal account system, also known as the nominal accumulation system (NDC), to replace the current pay-as-you-go (PAYG) system; under the new system, individuals pay into the nominal personal account, and the state guarantees the repayment of principal and interest in the future; this is done to mobilize the enthusiasm of young people to pay; it is called a nominal account because the fees paid by young people are immediately paid to the elderly, and the account is empty and there is no actual accumulation; many European countries implement this system. The other is to save part of the income under the pay-as-you-go system for future social security expenditures, that is, pay-as-you-go, which the author calls the modified pay-as-you-go system; the United States began to implement this system in the early 1980s to ensure that young people in the future will not be overburdened by the excessive elderly population.

This paper establishes an overlapping generation model that divides the population into skilled workers (high-income earners) and unskilled workers (low-income earners) according to their skill levels. The decline in fertility and the increase in life expectancy lead to an increase in the pension insurance burden rate for future young people. The study found that the shift from the pay-as-you-go system (PAYG) to the nominal contribution system (NDC) is beneficial to high-income earners. Specifically: (1) If the rate of return is equal to the total wage growth rate, the labor supply of low-income earners will increase, while the labor supply of high-income earners will decrease; the capital-effective labor ratio will decrease in the short term and remain unchanged in the long term; high-income earners will benefit from the reform, while low-income earners will suffer. (2) If the rate of return is equal to the interest rate, the labor supply of everyone will increase, especially low-income earners; the capital-effective labor ratio will decrease in the short term, and the long-term trend depends on the relationship between the interest rate and the economic growth rate; this reform is beneficial to the current older generation, but not to the younger generation and future generations, and high-income earners will benefit more or suffer less.

If the system is changed from pay-as-you-go to a modified pay-as-you-go system, when the interest rate is greater than the economic growth rate, the labor supply will increase in the short term, the capital-effective-labor ratio will decrease, and then the situation will reverse; this reform will be more harmful to the current low-income elderly population, but more beneficial to the low-income population in the future. If the interest rate is lower than the economic growth rate, the accumulated funds will not be enough to balance the pension insurance budget.

The reform of the pension insurance system is a complex process. It not only involves the interests of the elderly, but also affects young people, workers with different skills, and the operation of the entire economy. Different reform plans will have different impacts on different groups. Therefore, the interests of all parties need to be taken into account in the reform to find a balance. This paper uses Chinese data for simulation.

Price Rigidities and the Value of Public Information

Recently, a co-authored paper by Xie Jin, Assistant Professor at the Peking University HSBC Business School (PHBS), titled "Price Rigidities and the Value of Public Information," was published in the Journal of Accounting Research (Mar 2024, Volume 62, Issue 1, pages 137–179). The co-author is Gu Lifeng, Tenured Associate Professor at Yeshiva University's Sy Syms School of Business and the Southern University of Science and Technology Business School.

Xie Jin

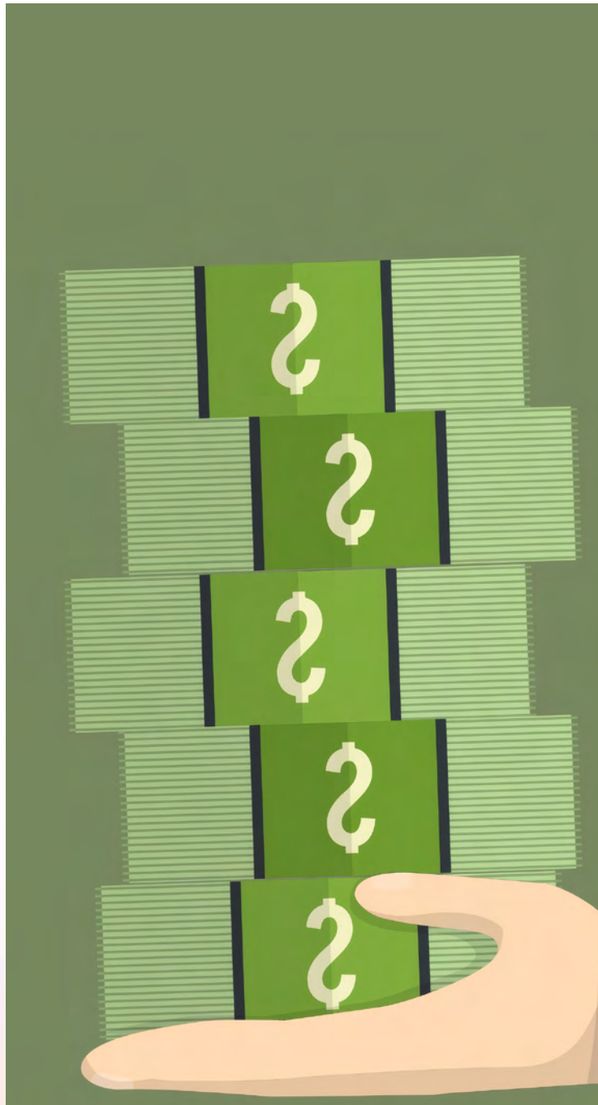
Xie Jin, an Assistant Professor at Peking University HSBC Business School; Ph.D. in Accounting from the Hong Kong University of Science and Technology. Research areas include financial accounting, international accounting standards, corporate finance, macroeconomics, macro-finance, antitrust, and the Chinese economy. His work has been published in journals such as the Journal of Monetary Economics, Journal of Accounting Research, and AEA Papers and Proceedings, and was awarded the Best Paper Award at the 2018 China Financial Research Conference. His research has been covered by Bloomberg and Chicago Booth Review.

The Journal of Accounting Research (JAR) is one of the 24 leading business journals selected by the University of Texas at Dallas (UTD 24), one of the 50 top-tier journals designated by the Financial Times (FT 50), and one of the 50 core journals included in the "PHBS 50" system for international research publications in economics and management released by Peking University HSBC Business School. It is renowned as one of the "Top Three Journals in Accounting" alongside the Journal of Accounting and Economics and The Accounting Review. JAR publishes original research spanning all areas of accounting, as well as finance, economics, statistics, psychology, and sociology. Its 2023 impact factor is 7.8.

During the COVID-19 pandemic, aggressive U.S. fiscal and monetary policies triggered inflation. Despite soaring raw material costs, companies were slow to adjust product prices. Since product prices reflect costs, industry experts worried that inflexibility in price adjustments (i.e., price rigidities) would hinder investors' understanding of corporate profitability, exacerbating information asymmetry in financial markets.

Wall Street's concerns presented a research opportunity. Using cost data from the U.S. Census Bureau and production networks, the authors constructed a cost transparency index for S&P 1500 companies from 1997 to 2013. They found that higher cost transparency correlates with lower bid-ask spreads, reduced probability of informed trading, and smaller analyst forecast dispersion for firms with price rigidities. Additionally, executives at such firms are more likely to face analyst inquiries about costs—unless their cost structures are highly transparent. Finally, earnings announcements by price-rigid firms trigger stronger market reactions, further underscoring the value of public information.

These findings prompt a re-evaluation of the financial markets' role in monetary policy transmission. Existing theory posits two independent channels: price rigidities and financial constraints (Bernanke, Gertler, and Gilchrist, 1999; Christiano, Eichenbaum, and Evans, 2005). Price rigidities enable monetary policy to stimulate the real economy (beyond nominal variables), while easing financial constraints boosts corporate investment. However, if price rigidities themselves amplify information asymmetry about costs, the interplay between these mechanisms demands renewed scrutiny.



China's Commuting-Based Metropolitan Areas

Recently, Gu Yizhen, an associate professor at Peking University HSBC Business School, published the paper "China's Commuting-Based Metropolitan Areas" in the Journal of Urban Economics (Volume 144, November 2024, 103715). The co-authors of the paper are Associate Professor Chen Ting from Hong Kong Baptist University and Associate Professor Zou Ben from Purdue University.

The Journal of Urban Economics was founded in 1974. It is one of the leading journals in the field of empirical microeconomics and also a top journal in the field of urban economics. The journal focuses on research related to urban and regional economic behaviors, including urban development, real estate markets, transportation, environmental economics, and regional policies, etc. In 2024, the impact factor of the journal is 5.7.

Gu Yizhen

Gu Yizhen, an associate professor at Peking University HSBC Business School, holds a Ph.D. degree from the University of California, Berkeley. His main research fields include urban economics, transportation economics, applied microeconomics, and so on. He has published many papers in important domestic and foreign journals, such as American Economic Review: Insights, American Economic Journal: Applied Economics, Review of Economics and Statistics, Journal of Urban Economics, Journal of Environmental Economics and Management, and so on.

Over the past few decades, urbanization has played a significant role in promoting the rapid growth of China's economy and has also sparked a strong interest in studying Chinese cities. However, there is no widely accepted definition of a metropolitan area in China. Almost all studies have to rely on administrative boundaries, which usually fail to accurately reflect the economic radiation range of a city and the constantly expanding urban area.

The author, using the commuting traffic obtained from mobile phone positioning data at the fine geographical level, delineated China's commuter metropolitan areas for the first time. The size distribution of these metropolitan areas follows the Power law, that is, larger metropolitan areas have more highly skilled workers, higher enterprise productivity, and offer higher wage premiums. Compared with countries such as the United States, Brazil, and Mexico, China's commuter metropolitan areas exhibit some remarkable characteristics. Firstly, the commuting time and distance are both very short, and it rarely crosses administrative boundaries. Secondly, compared with the land area of China, the scale of metropolitan areas in China is relatively small, and the scale of metropolitan areas is highly correlated with the administrative level. The author also discussed the existing policies that might lead to these characteristics, such as the fragmentation of local public finances and the cultivated land indicators in various regions.

Metropolitan areas based on commuting are significantly different from Chinese cities defined by other definitions. Such differences are also closely related to the local economic development level. In economically developed regions such as the Pearl River Delta, commuter metropolitan areas usually "swallow up" parts of neighboring jurisdictions. It is just the opposite in less prosperous areas. For instance, the commuter metropolitan area in Chongqing accounts for only 40% of the city's (administrative definition) population and 20% of its area.

For policymakers, commuter metropolitan areas have significant guiding significance for the provision of public goods such as subways and buses. Commuter metropolitan areas provide a valuable tool for researchers to define Chinese cities based on local labor markets. Researchers can choose the appropriate threshold by themselves as needed and impose additional restrictions, such as population or density.

Asset-Market Sentiments and Business-cycle Fluctuations

A collaborative research paper by Professor Wang Pengfei, Peking University Boya Distinguished Professor and Dean of PHBS, is published in the International Economic Review (Vol. 65, No. 4, November 2024, Pages 1795-1819). The paper, titled "Asset-Market Sentiments and Business-cycle Fluctuations," is co-authored by Professor Liu Xuewen from the HKU Business School and Assistant Professor Xu Sichuang from the School of Management and Economics at The Chinese University of Hong Kong, Shenzhen.

The International Economic Review (IER) is recognized as "one of the leading journals in economics in the world." It was founded in 1960 by Professor Lawrence Robert Klein from the University of Pennsylvania (Nobel Laureate in Economics) and Professor Morishima Michio from Osaka University. The journal is published by the University of Pennsylvania. Since its inception, the International Economic Review has advanced economic research worldwide by publishing cutting-edge academic papers in fields including econometrics, economic theory, macroeconomics, and applied economics.

Wang Pengfei

Wang Pengfei, Peking University Boya Distinguished Professor and Dean of PHBS, specializes in macroeconomics, financial economics, and monetary economics. Professor Wang Pengfei has published over forty papers in leading international journals, including Econometrica, American Economic Review, Journal of Finance, Journal of Economic Theory, Journal of Monetary Economics, Journal of Financial Economics, and American Economic Journal: Macroeconomics. He has made notable research achievements in dynamic stochastic general equilibrium (DSGE) theory, asset bubbles and financial crises, multiple equilibria, and endogenous economic fluctuations. Professor Wang Pengfei is an internationally influential figure in the field of macroeconomics.

For decades, economists have acknowledged the significant influence of market sentiment and expectations on business cycles. However, quantifying this view and integrating it into economic models has remained challenging. Using a dynamic stochastic general equilibrium (DSGE) model, this paper analyzes how sentiment in the housing market affects macroeconomic variables such as investment and output, thereby elucidating its pivotal role in economic fluctuations.

This DSGE model incorporates borrowing constraints and links fluctuations in housing prices to shifts in household sentiment. Within the model, households' risk perceptions regarding housing prices generate self-fulfilling fluctuations. These are transmitted to the macroeconomy through the borrowing capacity of entrepreneurs. Furthermore, the researchers quantitatively estimated the model using Bayesian methods and compared its outcomes with actual economic data—such as land prices, consumption, and investment—to validate its predictive power.

The research finds that sentiment shocks constitute a significant driver of asset price and investment fluctuations, accounting for 87% of land price volatility, 43% of investment volatility, and 23% of output volatility. Via counterfactual experiments, the paper's model successfully replicates the characteristic features of the 2007-2009 financial crisis—namely, falling house prices, declining investment, and shrinking output—demonstrating that sentiment fluctuations can amplify the impact of economic crises. Furthermore, the model also explains common phenomena in housing prices such as excess volatility, trending increases (momentum effects), and reversals. These phenomena have long been difficult to explain using traditional models.

This paper proposes an operational theoretical framework that links asset market sentiment to macroeconomic fluctuations and offers a new perspective for understanding financial crises. Compared with traditional DSGE models, this model provides a superior explanation for housing price fluctuations and their linkage with the macroeconomy. The study also enhances understanding of how sentiment drives economic fluctuations, offering valuable insights for policymakers seeking to steer market sentiment to mitigate economic volatility.

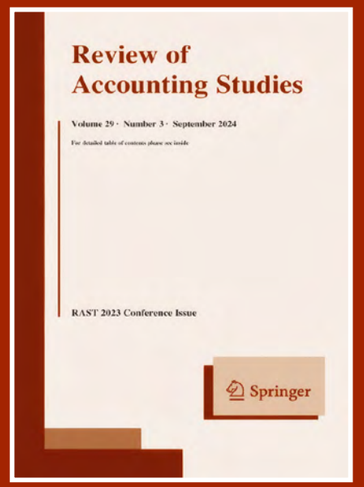
Outside Directors' Insider Trading Around Board Meetings

Boards meetings are critical venues where directors discuss and approve major corporate decisions, such as dividend distributions, investment strategies, and CEO appointments. For high-stakes matters—such as mergers and acquisitions or amendments to corporate charters—unanimous board approval is typically required. In preparation for these meetings, outside directors receive non-public information essential for informed decision-making, thereby gaining an informational advantage. While such access is vital for effective governance, it also opens the door to potential opportunistic insider trading. This paper investigates whether outside directors trade on non-public information obtained prior to board meetings.

Drawing on a unique dataset that captures the scheduled board meetings of U.S. public firms, the study provides compelling evidence of informed trading by outside directors. Specifically, these directors execute larger and more profitable buy transactions in the days leading up to board meetings—a pattern not observed outside this window. In contrast, inside directors—who have continuous access to material non-public information—show no such timing-related trading pattern. Furthermore, the profitability of outside directors' trades is strongly correlated with subsequent firm-specific news disclosures, suggesting that these trades are driven by confidential boardroom information.

The findings highlight a delicate trade-off between effective corporate governance and the risk of insider trading. While board meetings are central to corporate oversight, they also create opportunities for informed trading that may compromise market integrity. The paper recommends enhanced regulatory scrutiny of director trading around board meetings and suggests that public or confidential disclosure of meeting schedules could help mitigate these risks.

Recently, Seungjoon Oh, Tenured Associate Professor at Peking University HSBC Business School, published a co-authored paper titled "Outside Directors' Insider Trading Around Board Meetings" in the Review of Accounting Studies (Volume 29, Issue 3, September 2024, Pages 2617–2649). His co-author is Seil Kim, Associate Professor at Baruch College, City University of New York.



Review of Accounting Studies (RAST) is widely recognized as a top-tier international journal in the field of accounting. It is included in both the FT 50—the list of 50 leading business journals compiled by the Financial Times—and the PHBS 50, a list of core international journals in economics and management curated by the China International Research Publication Index System of Peking University HSBC Business School. Over the past five years, the journal has maintained an impact factor of 6.2.

Seungjoon Oh

Seungjoon Oh is a Tenured Associate Professor of Finance at Peking University HSBC Business School. He holds a Ph.D. in Finance from the University of Michigan. His research interests include entrepreneurial finance, corporate innovation, corporate governance, and venture capital. His work has appeared in leading academic journals such as the Accounting Review, Journal of Financial Intermediation, Journal of Corporate Finance, Journal of Banking & Finance, and Journal of Business Research.

Analyzing the Impact of the Change in Trade Tariff Policy on the Provincial Income Gap: A General Equilibrium and Quantitative Approach

Recently, the collaborative paper "Analyzing the Impact of the Change in Trade Tariff Policy on the Provincial Income Gap: A General Equilibrium and Quantitative Approach", authored by Ma Xiao, Assistant Professor at Peking University HSBC Business School, was published in China Economic Quarterly (Vol. 24, No. 6, November 2024, pp. 1834–1850). His co-authors are Zhang Yiran, Assistant Professor at the School of Economics, Fudan University, and Meng Zikai, a 2024 Master's graduate in Economics from Peking University HSBC Business School and a current PhD student in Agricultural Economics and Management at Renmin University of China. The paper was funded by the National Natural Science Foundation of China Youth Projects (No. 72203012, 72203046) and the Shanghai Pujiang Talent Program (2022PJC024).

China Economic Quarterly was launched in October 2001. It is a comprehensive academic journal in economics supervised by Peking University, sponsored by the China Center for Economic Research at Peking University, and published by Peking University Press. The journal publishes original theoretical, empirical, review, and commentary articles in Chinese, and is considered one of the core journals in the field of economics in China.

Ma Xiao

Ma Xiao is an Assistant Professor at Peking University HSBC Business School. He holds a PhD in Economics from the University of California, San Diego. His research interests include international trade, macro-development economics, and economic growth. He has published extensively in journals such as International Economic Review, Journal of International Economics, Journal of Political Economy Macroeconomics (JPE Macro), Review of Economics and Statistics, Economic Research Journal, The Journal of World Economy, and China Economic Quarterly. He is also the recipient of the 2023 WTO Essay Award for Young Economists.

Maintaining a high level of openness to the outside world is a crucial step in China's pursuit of high-quality development. This paper investigates how trade liberalization affects household income and interprovincial disparities. To this end, the authors use changes in import and export tariffs following China's accession to the WTO to characterize the process of trade liberalization. They develop a regional general equilibrium model incorporating interprovincial trade and labor mobility to analyze the impact of tariff changes on China's regional economy.

The authors calibrate the structural model using Chinese data. Drawing on trade, tariff, total output, and labor data from 30 Chinese provinces and 34 foreign countries across 29 industries, they apply the Exact-hat Algebra method proposed by Dekle et al. (2008) to conduct counterfactual analysis. The main findings are as follows:

1. Changes in import tariffs led to an average 3.85% decline in nominal wages across Chinese provinces. This reflects how tariff reductions increased external competition for Chinese firms, thereby reducing labor income. At the same time, lower labor costs and falling consumer prices led to an average 4.95% decrease in the price index of final consumption goods. As a result, net living standards rose by 1.10%.

2. Changes in export tariffs resulted in an average 2.43% increase in nominal wages, indicating that lower export tariffs boosted foreign demand for Chinese products and increased domestic labor demand. However, higher labor costs also caused the final product price index to rise by 2.19%. On balance, net living standards increased by 0.24%.

3. The wage effects of trade liberalization varied significantly across provinces. In provinces more oriented toward exports (where exports account for a larger share of manufacturing output), changes in import and export tariffs had more positive impacts on wage levels.

4. Tariff changes increased interprovincial inequality in nominal income and real income by 5.9% and 4.2%, respectively. Labor migration across provinces exacerbated the nominal income inequality, as more workers moved to the more developed coastal regions.

Property Rights and Firm Scope

Not long ago, the joint paper "Property Rights and Firm Scope" by Tenured Associate Professor Li Zhimin of the Peking University HSBC Business School was published in the Journal of Management (Volume 51, Pages 637-669, 2025). The co-authors of the paper are Professor Tony Tong from the University of Colorado (Boulder) and Associate Professor Xu Mingtao from Tsinghua University.

Li Zhimin

Li Zhimin is a Tenured Associate Professor at the Peking University HSBC Business School. He holds a Ph.D. from the University of California, Berkeley. His main research areas are international economics and development economics. He has published numerous papers in internationally authoritative journals such as the Review of Financial Studies, the Journal of Development Economics, and the Journal of Management.

Journal of Management (JOM) is a comprehensive academic journal published by the Academy of Management in the United States. It is dedicated to publishing empirical and theoretical research articles that have a significant impact on the entire field of management, with a primary focus on areas such as organizational behavior, strategic management, human resource management, and organizational theory. JOM ranks third in the management field and first in the applied psychology field in the SSCI (JCR). It is also one of the 50 top business school journals, as rated by the Financial Times (referred to as the FT 50), and is a four-star journal according to the European ABS. Its average impact factor over the past five years has been 14.7.

The decision-making mechanism for firm scope has always been a core research topic in the fields of organizational economics and strategic management. Although existing literature has explored the definition of firm scope from perspectives such as resource allocation efficiency, transaction cost theory, and agency theory, these studies generally assume that firms always operate in a stable environment with a well-developed property rights system. However, in reality, there are significant differences in the level of property rights protection across countries worldwide, and even within the same country, property rights systems may undergo fundamental restructuring over time. This disconnection between theory and reality highlights the academic importance of examining the impact of property rights systems on firm scope.

Based on the property rights theory framework, this study uses the implementation of China's 2007 "Property Law of the People's Republic of China" (the law has been invalidated) as a quasi-natural experiment to systematically investigate the impact of strengthened property rights protection on firm scope decisions and its underlying mechanisms. The empirical research reveals differentiated effects of improved property rights protection on horizontal expansion and vertical integration of firms. In the early stages of an underdeveloped property rights system, firms tend to invest in unrelated industries to build risk hedging mechanisms. However, as property rights protection is institutionally strengthened, firms significantly increase their diversification in related business fields, and horizontal expansion exhibits a clear business-related characteristic. In the vertical dimension, the improvement of property rights protection reduces the value of residual control rights in vertical integration, leading to a decreased willingness of firms to integrate upstream and downstream industrial chains. Notably, this institutional effect is significantly weakened in politically connected firms, indicating that informal institutions can mitigate the shocks brought by formal property rights system reforms through a substitutive effect.

This research provides new empirical support for the application of property rights theory in corporate strategy studies and reveals the complex interrelationships among property rights systems, corporate strategies, and political connections. For policymakers, the improvement of property rights systems not only affects firms' investment patterns but also has profound implications for market competition and cooperation dynamics as well as economic development paths. Therefore, in advancing property rights system reforms, it is essential to fully consider their impact on corporate strategic choices to promote market efficiency and economic growth.

Guilty by Political Association: The Impact of Political Scandals on Connected Firms

Tenured Associate Professor Liu Baixiao's paper, titled "Guilty by Political Association: The Impact of Political Scandals on Connected Firms" is published in The Journal of Law & Economics (Volume 67, Number 4, November 2024). This paper is coauthored with Professor April M. Knill at the University of South Carolina, Professor John J. McConnell at Purdue University and Assistant Professor Cayman Seagraves at the University of Tulsa.

The Journal of Law & Economics, founded in 1958 and published by the University of Chicago Press, primarily focuses on research at the intersection of law and economics. It is widely recognized as one of the top journals in the field of law and economics. The journal is also included in the "PHBS 50" — a list of 50 core international journals compiled by the Peking University HSBC Business School for economics and management disciplines. Its publications cover a broad range of topics, including tort law, corporate governance, antitrust law, regulatory policy, intellectual property, and public choice theory.

Liu Baixiao

Liu Baixiao is a Tenured Associate Professor at Peking University HSBC Business School and the Associate Editor of Peking University Financial Review. He holds a Ph.D. in Finance from Purdue University. His primary research interests include financial media, asset management, short selling, and political economy. His academic work has been published in leading international journals such as the Journal of Financial Economics, Management Science, Journal of Financial and Quantitative Analysis, Journal of Corporate Finance, Journal of Banking and Finance, and Journal of Accounting and Public Policy.

The paper focuses on the potential negative effects of political connections between firms and members of the U.S. Congress, examining how political scandals impact firm value. While previous studies have generally found that ties to U.S. politicians can provide economic benefits—such as policy support, reduced regulatory risks, or better financing conditions—such relationships may also impose underappreciated costs, particularly when the connected politicians become embroiled in scandals. Based on data from 1992 to 2018, this study is the first to systematically investigate the impact of U.S. political scandals on the market value and reputation of affiliated firms.

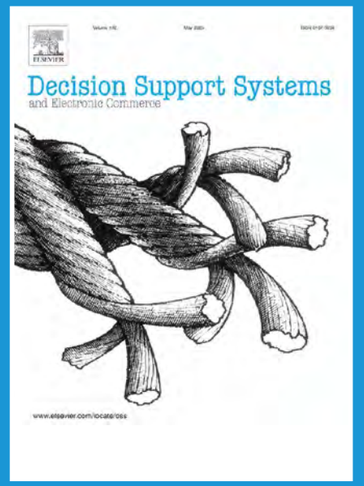
The research employs multiple empirical strategies, including panel regressions, difference-in-differences (DiD) analysis, and event study methodology. The results show that when a U.S. congressperson connected to a firm is first exposed in a media-reported scandal, the market value of the affiliated firm declines significantly, with an average drop of 2.9%. Moreover, the extent of the scandal's impact is closely related to its severity. Scandals involving criminal behavior or receiving broader media attention lead to larger market value declines. Notably, when the politician does not resign following the scandal, the negative impact on the firm is even more pronounced.

The paper further explores the specific mechanisms through which scandals affect firms. On one hand, scandals involving U.S. politicians generate reputational spillover effects for the affiliated firms, leading to a decline in trust among customers, suppliers, and investors. On the other hand, such scandals weaken the ability of politicians to provide policy support to firms—for example, by reducing their capacity to secure government contracts. The study finds that firms often respond proactively to these adverse effects by adjusting their political networks: increasing donations to other politicians, establishing ties with more influential lawmakers, and even engaging in bipartisan political cooperation.

The conclusions of this study carry significant implications. They not only highlight the potential risks inherent in firms' relationships with U.S. politicians but also offer a new perspective on the strategic choice of whether to engage in political donations. The research demonstrates that the reputational damage and diminished effectiveness of political support resulting from scandals can substantially affect a firm's market performance. These hidden costs must be considered as part of a firm's cost-benefit analysis, thereby informing strategic corporate decision-making.

What happens when platforms disclose the purchase history associated with product reviews?

Recently, a paper co-authored by Zeng Xiaohua, a Tenured Associate Professor at Peking University HSBC Business School, titled "What happens when platforms disclose the purchase history associated with product reviews ?" was published in Decision Support Systems (DSS) (Volume 188, January 2025). The paper's co-authors are Liu Miaomiao, assistant professor at the School of International Business at Xi'an Jiaotong-Liverpool University, Zhang Cheng, professor at the School of Management at Fudan University, and Liu Yong, professor at the Eller College of Management at the University of Arizona.



Decision Support Systems is an international academic journal that focuses on theory and technology and is dedicated to improving the decision-making capabilities of decision support systems (DSS). The journal mainly publishes important research related to the foundation, function, interface design, implementation process, impact, and evaluation of decision support systems. Its latest impact factor is 6.7.

Zeng Xiaohua

Zeng Xiaohua is a Tenured Associate Professor of management at Peking University HSBC Business School and holds a PhD in marketing from the University of British Columbia, Canada. His research focuses on the impact of social networks, user-generated content, and new technologies on marketing. His research papers have been published in journals such as Marketing Science, Information Systems Research, Journal of Management Information Systems, and International Journal of Research in Marketing.

This paper takes the impact of the "Verified Purchase"(VR) label on the review system on e-commerce platforms as the research topic, and explores how platform policy adjustments change user behavior and perception. This study originated from a practice commonly adopted by major e-commerce platforms around the world in the past decade - adding VR labels to product reviews to enhance the credibility of reviews. The setting of this label is intended to indicate that the reviewer has indeed purchased the product, thereby distinguishing it from users who may have other motivations for commenting. However, what is the actual effect of this measure, which is intended to improve the transparency and trust of the platform?

The article selected the introduction of VR tags on the Amazon platform in 2009 as the "natural experiment"node for the research. Based on a large amount of review data from multiple categories between 2007 and 2011, the article used the difference-in-differences (DID) method and combined text analysis with machine learning to conduct a systematic analysis of users' review behavior and readers' reactions.

The study found that the introduction of VR tags had a significant impact on reviewer behavior. In order to improve the credibility of their reviews, reviewers with no purchase records tended to write longer and more detailed reviews, while users with verified purchases showed more personalized language styles, trying to prove to readers that they are not only "loyal buyers" but also have independent judgment. This difference reflects the reviewers' adaptive adjustment to the platform labeling mechanism.

In terms of reader perception, the study came to a rather unexpected conclusion: VR tags do not necessarily enhance the persuasiveness of reviews, but rather arouse users' suspicion in certain situations. Especially when the ratings are high, VR reviews are more likely to be considered biased, and readers will think that such reviews reflect "buyer preferences" rather than rational evaluations. This bias makes VR reviews score lower than non-verified reviews in "helpful" votes. However, under certain specific conditions, such as when the reviewer is experienced, the product is expensive, or the review object is a new product, the trust and helpfulness of VR reviews are still high, showing that users perceive VR tags differently in different situations.

The most valuable innovation of this study is that it reveals a "counterintuitive effect" in platform governance - that is, label design that increases transparency may lead to trust issues that are contrary to expectations. The behavioral changes of commentators are not completely consistent with the psychological expectations of readers, and there is even a cognitive misalignment. This finding is not only of great reference value to platform designers, but also provides a new perspective for the academic community to understand the evolution mechanism of user-generated content. The study emphasizes that platforms should pay more attention to the dynamic feedback of user behavior when formulating governance policies, and comprehensively consider the possible unexpected consequences of label design.

Special Topic

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MACROECO-NOMICS

Macroeconomics After Lucas

This sequel to Lucas and Sargent (1978) tells how equilibrium Markov processes underlie much applied dynamic economics today. It recalls how Robert E. Lucas, Jr. saw Keynesian and rational expectations revolutions as interconnected transformations of economic theories and econometric practices. It describes rules that Lucas used to guide and constrain his research by restricting himself to equilibrium Markov processes and to conserving quantitative successes achieved by previous researchers, including those attained by quantitative Keynesian macroeconometric modelers.

KEYWORDS:

Macroeconomics After Lucas*

By Thomas Sargent

| Abstract |

This sequel to Lucas and Sargent (1978) tells how equilibrium Markov processes underlie much applied dynamic economics today. It recalls how Robert E. Lucas, Jr. saw Keynesian and rational expectations revolutions as interconnected transformations of economic theories and econometric practices. It describes rules that Lucas used to guide and constrain his research by restricting himself to equilibrium Markov processes and to conserving quantitative successes achieved by previous researchers, including those attained by quantitative Keynesian macroeconometric modelers.

Keywords: simultaneous equations, rational expectations, crossequation restrictions, Markov processes, dynamic programming, causality, direct problem, inverse problem, equi-librium Markov process, master equation.

1. Introduction

For more than a decade, most economists ignored two papers (Muth (1960, 1961)) that used optimal linear prediction theory to model economic agents' beliefs about the future within coherent probabilistic settings. In the early 1970s, Robert E. Lucas, Jr. used Muth's ideas to make the artificial people who live inside a system of stochastic difference equations solve well-posed intertemporal optimization problems. Lucas resolved pressing theoretical issues, reduced dimensions of parameter spaces, and started a research program that has been pursued fruitfully in macroeconomics, industrial organization, public finance, labor economics, and other applied fields.[1]

Section 2 describes Lucas's tools and prejudices. Section 3 describes rules that constrained and guided his research. Section 4 describes how Lucas respected and responded to the Keynesian revolution. Section 5 describes how he started another revolution by formulating equilibrium Markov processes. Section 6 recalls what Lucas meant by "rational expectations" and how other uses of that phrase annoyed him. Section 7 explains how economists who want to advise monetary and fiscal policy makers think about causality, and also how the artificial people who live inside an equilibrium Markov process think about it. Section 8 lists examples of equilibrium Markov processes. Section 9 describes how equilibrium Markov processes are accompanied by non-linear impulse response functions, some uses of which Lucas found uninteresting. Section 10 describes "rational expectations econometrics" intrinsic in the likelihood function associated with an equilibrium Markov process. Section 11 describes how planners who choose among alternative equilibrium Markov processes assume a communism of statistical models. Section 12 describes connections between techniques for approximating equilibrium Markov processes numerically and limiting behaviors of models in which agents inside a model statistically learn about objects that agents in an equilibrium Markov model already know. Section 13 describes how, like Copernicus, Lucas thought that a beautiful simple model that fits less well than a more complicated ugly model is somehow closer to the truth. It also describes how his preference for simplicity along with constraints imposed by his section 3 rules for research influenced Lucas's use of rational expectations econometrics. Section 14 illustrates commotions that Lucas's writings provoked by citing his opinions about price rigidities, macro-labor models, Samuelson's neoclassical synthesis, reconciling Phelps islands and Arrow-Debreu complete markets models, and ways to implement Ramsey plans. Section 15 concludes with remarks about how Lucas responded to economists who didn't like equilibrium Markov processes.

Lucas was a gifted writer, not just for an economist. I quote Lucas (1987) often.

Robert E. Lucas, Jr.
—
American Economist, recipient of the Nobel Memorial Prize in Economic Sciences in 1995

> "Lucas was a gifted writer, not just for an economist. I quote Lucas (1987) often."

2. Influences

Milton Friedman's tools, research questions, and prejudices influenced Lucas. Friedman ac-complished so much partly because when young he had mastered much of what had then been known about probability theory and statistics. He thought hard about uses and limits of Neyman and Pearson's frequentist approach to testing hypotheses and about parameter identification as exclusion restrictions in systems of simultaneous equations. His appreci-ation of dynamics and general equilibrium made him cautious about inferring "causality". Through his interactions with Harold Hotelling and Abraham Wald, he helped invent se-quential likelihood ratio tests for statistical model selection. He investigated subjective and objective expected utilities as alternative ways to model economic decision makers. He thought about decision theoretic consequences of misspecified statistical models. He worked on stochastic approximation and learning. He appealed to survival of the fittest to justify what later came to be called rational expectations. In work with Savage, he laid foundations of "machine learning" when he proposed an early version of stochastic approximation to maximize an unknown function by statistical sampling. He foresaw possibilities for spectral analysis of economic time series.

Armed with those techniques, Friedman approached macroeconomics with a set of prej-udices, i.e., personal prior probabilities over models, that included an affection for Burns-Mitchell NBER reference-cycle techniques; a present-value-equalization model of professional incomes that he deployed in his PhD thesis and that he eventually published jointly with Si-mon Kuznets; consumption-smoothing models and associated Euler equations he had learned from reading Irving Fisher; a plan to assemble US data that would let him complete Irving Fisher's statistical verification of the quantity theory of money; the principle that intertem-poral government budget balance means that monetary and fiscal policies must either be consolidated or coordinated; and an exponential smoothing statistical model for forecasting, i.e., adaptive expectations.

Constrained by his tools and prejudices, Friedman proceeded to interpret Burns-Mitchell business cycle patterns with statistical models whose parameters encode the demand and sup-ply curves of Marshall's "representative agents;" to extend Irving Fisher's work by using the accounting framework of Appendix B of Friedman and Schwartz to measure monetary aggre-gates; to formalize "short-run" versus "long-run" distinctions; to convert "perfect foresight" models into statistical models of vector stochastic processes by using adaptive expectations and imposing long run restrictions; to put micro-foundations underneath Phillips curve; to take randomness and model ambiguity into account in framing monetary and fiscal policies; to acknowledge "long and variable" distributed lags while professing ignorance about their sources; to practice a "neo-classical synthesis" that separates redistribution and social insur-ance from macroeconomic stabilization; and to express ambiguity about "narrow banking" versus "free banking" in his work on the optimal quantity of money and paying interest on reserves.[2]

Lucas learned mathematical tools that had empowered Milton Friedman, adopted some of Friedman's prejudices, and worked on many of the same topics. He deepened and al-tered Friedman's findings. To help him do that, Lucas

* This article first appeared in the Journal of Political Economy, September 19, 2025.

[1] I have written other papers about how Lucas accomplished that. See Lucas and Sargent (1978), Lucas and Sargent (1981, pp.xi–xl), Manuelli and Sargent (1988), and Sargent (1981, 1982, 1996, 2015, 2022, 2024).

[2] Friedman emphasized that it matters how those interest payments are financed.

learned tools that Friedman either hadn't known about or had chosen not to use. These included dynamic programming and optimal control theory; Markov chains and optimal prediction theory; general competitive equilibria and separating hyperplanes (a.k.a. "welfare theorems"); stochastic discount fac-tors; Samuelson's overlapping generations model; the Cass-Koopmans optimal growth model; game theory; Chicago-Yale-Cowles Commission econometric methods for estimating systems of simultaneous linear difference equations that rest on sharp distinctions between structural statistical models, on the one hand, and the reduced forms models whose parameters are functions of the parameters of structural models, on the other hand; and the Phelps island model. To create the equilibrium Markov processes that we'll describe in section 5, Lucas used Markov decision problems (MDPs), the max-min separating hyperplane theorem,[3] and a communism of statistical models called the rational expectations hypothesis.[4] In using those tools to remake macroeconomics, Lucas followed rules.

> **Lucas learned mathematical tools that had empowered Milton Friedman, adopted some of Friedman's prejudices, and worked on many of the same topics. He deepened and al-tered Friedman's findings.**

3. Research Rules

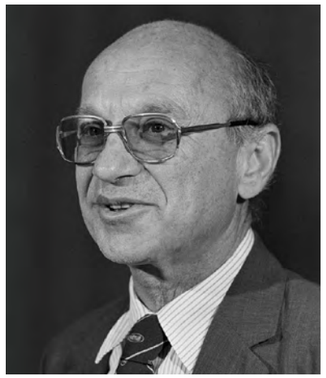
Lucas constrained himself (1) to preserve quantitative successes of earlier theories, (2) to construct equilibrium stochastic processes, and (3) to make a theory and an econometrics fit together. Other scientists and artists had used similar rules.

...the constraints that artists and theoretical physicists have to respect, how they make our craft difficult, and how they also make it possible... often the most important constraint on a new theory is not that it should survive this or that new experimental test, but that it should agree with the body of past observations, as crystallized in former theories. ... New theories..must not throw out all the successes of former theories. This sort of thing makes the work of the theorist far more conservative than is often thought. The wonderful thing is that the need to preserve successes of the past is not only a constraint, but also a guide.

Weinberg (2018, ch. 24)

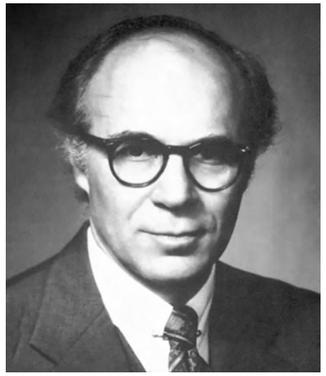
Lucas insisted on preserving past successes that included cross-country and historical evidence about inflation that quantity theory of money fit well; apparent money supply "non-neutralities"; Burns-Mitchell NBER reference cycle characterizations of business cycles; Friedman-Schwartz evidence pointing to monetary shocks as sources of business cycles; good fits to US business cycles of Klein-Goldberger and other Keynesian econometric models; and statistical evidence about stock prices and expectations theories of the term structure of interest rates.[5]

Lucas confined himself to building statistical models that contain artificial people who solve constrained optimization problems; binding those artificial people together with an equilibrium concept that enforces coherence; and to economize on free parameters by assum-ing that artificial agents share joint probability distributions with each other and with the model builder.[6]



Milton Friedman

American Economist, recipient of the Nobel Memorial Prize in Economic Sciences in 1976



Lawrence Robert Klein

American Economist, recipient of the Nobel Memorial Prize in Economic Sciences in 1980

[3] The max-min theorem implies the two fundamental theorems of welfare economics as well as related useful results in implementation theory.

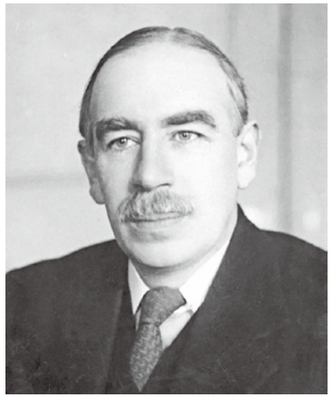
[4] As remarked in section 2, Milton Friedman either hadn't known these tools or hadn't used them in waysthat Lucas did.

[5] Aspects of rational expectations and optimal prediction theory were implicit in regression equations that Meiselman (1962) used to implement the expectations theory of the term structure of interest rates. Bob Lucas told me that the term structure was an ideal laboratory for rational expectations. When I first met him in his office at Carnegie Tech in November 1966, Bob was reading a preprint of Wallace (1967).

[6] They don't necessarily share information sets.

4. Two Revolutions

Lucas emphasized that, despite their differences, protagonists of the Keynesian and Rational Expectations Revolutions agreed about many important things.



John Maynard Keynes

English Economist and Philosopher

The Keynesian Revolution was, in the form in which it succeeded in the United States, a revolution in method.... if one does not view the revolution in this way, it is impossible to account for some of its most important features: the evolution of macroeconomics into a quantitative, scientific discipline, the development of explicit statistical descriptions of economic behavior, the increasing reliance of government officials on technical economic expertise, and the introduction of the use of mathematical control theory to manage an economy. It is the fact that Keynesian theory lent itself so readily to the formulation of explicit econometric models which accounts for the dominant scientific position it attained by the 1960s. As a consequence of this, there is no hope of understanding either the success of the Keynesian Revolution or its eventual failure at the purely verbal level at which Keynes himself wrote. It will be necessary to know something of the way macroeconometric models are constructed and the features they must have in order to"work"as aids in forecasting and policy evaluation.

(After Keynesian Macroeconomics,1978)

Keynesian and rational expectations revolutions shared objects of interest and purposes. A shared object of interest was a system of simultaneous stochastic difference equations.

... economic data are generated by systems of relations that are, in general, stochastic, dynamic, and simultaneous.... these very relations constitute eco-nomic theory and knowledge of them is needed for economic practice.... Hy-potheses about economic structure are also known as economic theories. They try to state relations that describe the behavior and environment of men and deter-mine the values taken at any time by economic variables such as prices, output, and consumption of various goods and services, and the prices and amounts of various assets. As there are several variables the economic structure must involve several simultaneous relations to determine them.

(Marschak, 1950)

A shared purpose was to identify parameters that are invariant to a set of historically unprecedented possible government policies.[7]

The economist's objectives are similar to those of an engineer but his data are like those of a meteorologist. The economist is often required to estimate the effects of a given (intended or expected) change in the "economic structure," i.e., in the very mechanism that produced his data. None of these changes can he produce beforehand, as in a laboratory experiment; and since some of the changes envisaged have never happened before, the economist often has to estimate the results of changes he has never observed... The economist can do this if his past observations suffice to estimate the relevant structural constants prevailing before the change. Having estimated the past structure the economist can estimate the effects of varying it. He can thus help to choose those variations of structure that would produce – from a given point of view – the most desirable results. That is, he can advise on policies (of a government or a firm).

Marschak (1950, p. 2)

Savers' and investors' expectations about the future were central in Keynesian models. To describe how private decision makers form forecasts of inflation, income, and factor prices, the most promising Keynesian econometric models constructed in the 1960s and early 1970s used versions of an "adaptive expectations" hypothesis of Friedman (1956) and Cagan (1956).

Jacob Marschak

American Economist, Professor at The University of California, Los Angeles

What is "wrong" with [adaptive expectations] is not [expressing] forecasts of fu-ture variables as distributed lags of current and lagged variables. The future must be forecast on the basis of the past, and it is surely acceptable to sim-plify things by modeling agents as using linear forecasting rules. (These points are obvious enough, but are so widely misunderstood as to warrant emphasis here.) The difficulty lies not in postulating forecasts which are linear functions of history but rather in introducing the coefficients in these linear functions as so many additional "free parameters," unrestricted by theory. That this practice is unnecessary, and in an important way fatal to the purposes of the empirical study of economic time series, is the message of [Muth (1961).

Lucas and Sargent (1981, pp. xv–xvi)

The flaw "fatal to the purposes of the empirical study of economic time series" was that Keynesian statistical models weren't equilibrium Markov models, a class of models that now transcends much of applied dynamic economics.[8]

[7] Footnote 15 below describes Lucas's opinion about Christopher Sims'ss opinion about this "utopian" project.

[8] Lucas (1987, Sect. I) and Lucas and Sargent (1981, pp.xi–xl) described components and features of this equilibrium concept.

5. Equilibrium Markov Processes

In various papers, Lucas defined and formulated a class of statistical models suitable for analyzing the types of macroeconomic policy interventions that Marschak (1953) and his colleagues at the Cowles Commission had wanted to study.

Definition 5.1. *An equilibrium Markov process contains: (1) a collection of decision makers, (2) associated Markov decision problems (MDPs) defined over a common state space, and (3) budget and resource constraints that bind decision makers' MDP's together.*

In equilibrium Markov models, parameters of the dynamic demand and supply curves that Keynesian macroeconometric models wanted to be invariant to interventions are themselves functions of parameters that an historically unprecedented government policy intervention would alter. An equilibrium Markov model pins down functions that describe those de-pendencies. That makes it possible to analyze consequences of historically unprecedented policies.

Recent studies represent an equilibrium Markov model with a single "master equation." Bilal (2023) and Gu et al. (2024) show that carefully designed "deep neural networks" ap-proximate solutions of master equations for some interesting equilibrium Markov models well. They also show that it is more challenging to coax neural networks to approximate solutions of the master equations that must be supplemented with the auxiliary equations associated with other equilibrium Markov models. HANK models, models with non-redundant long term assets, and models with adjustment costs augment a master equation with auxiliary equations. See Gu et al. (2024).

> **In equilibrium Markov models, parameters of the dynamic demand and supply curves that Keynesian macroeconometric models wanted to be invariant to interventions are themselves functions of parameters that an historically unprecedented government policy intervention would alter. An equilibrium Markov model pins down functions that describe those de-pendencies.**

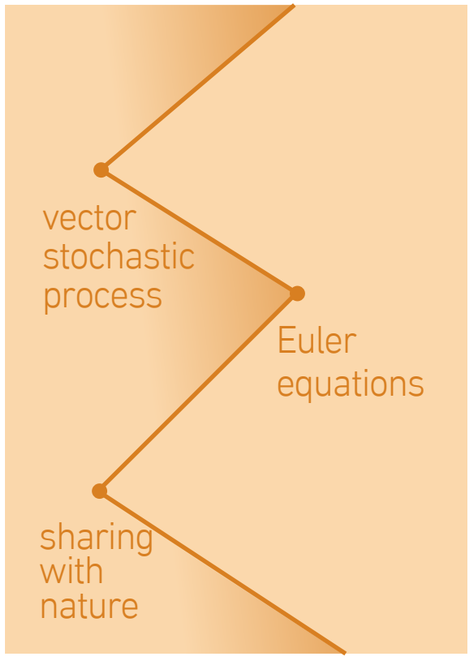
6. Rational Expectations

Equilibrium Markov processes use a rational expectations assumption to build in coherence and to economize on free parameters.

The term 'rational expectations', as Muth used it, refers to a consistency axiom for economic models, so it can be given precise meaning only in the context of specific models. I think this is why attempts to define rational expectations in a model-free way tend to come out either vacuous ('People do the best they can with the information they have') or silly ('People know the true structure of the world they live in').

Models of Business Cycles, 1987, p. 13.

A rational expectations assumption economizes on free parameters by making all decision makers inside a model share a vector stochastic process with each other and with the the-orist who built the model. Decision makers use that stochastic process to form conditional distributions that appear in Euler equations that restrict their decision rules. Rational expec-tations econometrics extends a communism of statistical models to include a "sharing with nature" that is an essential input into making maximum likelihood or generalized method of moments be good estimators.



7. Causality

Statements about causality are assertions that parameters of a statistical model are invariant with respect to a set of possible interventions.[9] Which parameters are invariant depends on the set of interventions. Because a model's author and the people inside it are concerned about different interventions, they want different sets of parameters to be invariant. An equilibrium Markov model reconciles those distinct ideas about about "causality," i.e, about parameters that are invariant.

A well posed Markov Decision Problem (MDP) includes a specification of vectors of states and decisions (a.k.a. controls), and a partition of a state space into controllable and uncontrollable subspaces. Each MDP contains its own theory of causes and effects. An MDP describes how decisions shape trajectories through a controllable subspace. It does so by fixing parameters in a controlled Markov transition equation that tells the decision maker how future payoffs are affected by alternative feasible choices of controls. The decision maker regards the controlled Markov transition law as "causal" in the sense that it is invariant across a set of admissible controls. An MDP also implies a joint probability density over sequences of states in an uncontrollable subspace and an associated theory of optimal prediction.[10]

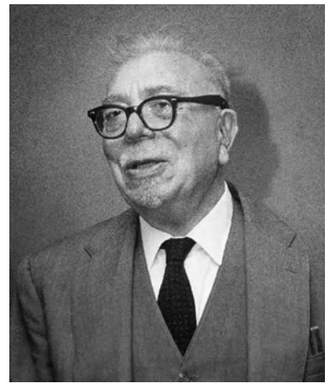
Thus, an equilibrium Markov process typically contains as many assumptions about causality – i.e., about invariance of parameters – as there are decision makers. These include the author of the model and the agents who live inside it.

Other meanings of causality

Economists use other senses of causality, including a concept of Wiener, Granger, and Sims that restricts a joint conditional distribution of a fixed stationary vector stochastic process. That concept differs from the control-theoretic senses of causality that apply to equilibrium Markov models.[11]

Yet another sense of cause refers to "causal inferences" like those drawn from R.A. Fisher's hypothesis tests of agricultural fertilizer treatments that assume fixed re-gressors in repeated samples. Inapplicability of Fisher's assumptions motivated Koopmans (1950), Hood and Koopmans (1953), Marschak (1950), and Hurwicz (1966) to invent an econometric theory applicable to systems of stochastic difference equations that are interre-lated in ways that government policy interventions alter.[12] Fisher's assumptions don't hold for the dynamic economic systems that Koopmans and his collaborators wanted to inter-pret and control. Recent "causal inferences" study much more limited "treatments" than the historically unprecedented policy interventions that Koopmans, Marschak, and Hurwicz wanted to understand.

> **Thus, an equilibrium Markov process typically contains as many assumptions about causality – i.e., about invariance of parameters – as there are decision makers. These include the author of the model and the agents who live inside it.**



Norbert Wiener

American Computer Scientist, Mathematician, and Philosopher

Christopher A. Sims

Christopher Albert Sims American Econometrician and Macroeconomist, recipient of the Nobel Memorial Prize in Economic Sciences in 2011

[9] My personal conversation with Leo Hurwicz after a 1975 Minneapolis Fed seminar at which Neil Wallace and I presented a preprint of Sargent and Wallace (1976) convinces me that my account here is compatible with Hurwicz (1966). Like Marschak (1953), Hurwicz wanted some parameters (states?) to be invariant under some hypothetical policy interventions, for example, parameters that describe agents' preferences, technologies, information sets, market structures, and timing protocols.

[10] To explain some implications of a rational expectations assumption, Lucas and Sargent (1981, pp.xi–xl) used the "certainty equivalence" property that linear quadratic MDP's possess to highlight the theory of optimal prediction that MDP's provide.

[11] Lucas and Sargent (1981, pp. 405-452) offer an example from Germany during the early 1920s in which inflation Granger caused money growth according to the joint probability distribution that emerged from an equilibrium Markov model. But that joint distribution was not invariant to monetary-fiscal policy interventions that altered the money growth process.

[12] See Marschak (1950), Koopmans (1950), Hood and Koopmans (1953).

8. Examples of Equilibrium Markov Processes

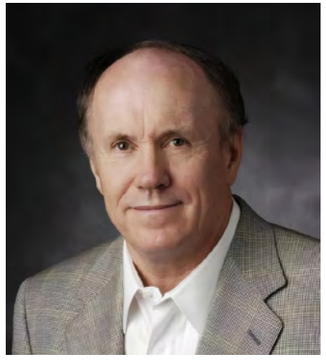
Equilibrium Markov processes pervade modern applied dynamic economics. They include representative agent recursive competitive equilibria with their "Big K, little k" distinctions; Markov perfect equilibria; Ramsey (a.k.a. Stackelberg) equilibria in which the state variables of a leader's problem include followers' continuation values; models of credible public policies like the ones studied by Stokey (1989, 1991); Atkeson and Lucas (1992) models of redistri-bution dynamics in which the state includes joint cross section distribution of continuation values and a Markov operator $T_{\#}$ that maps a cross section at t into a cross section at $t + 1$; Kantorovich optimal transportation models; Hopenhayn models of firm dynamics; mean field games in which states include cross section distributions of wealth or consumption or contin-uation values (these can be viewed as extensions of Lucas and Prescott (1971) "Big *K*-little *k*" models); as well as single-agent robust decision problems that include adversarial control and actor-critic systems.

That all of these are equilibrium Markov models extends Lucas's 1989 observation that

Complete market economies are all alike but each incomplete market economy is incomplete in its own individual way.

Robert E. Lucas, Jr. (1989)

"All alike" means that each economy belongs to a class of economies. A particular economy is determined by a commodity space, a price system, a list of decision makers together with their preferences and technologies, and a definition of equilibrium that applies to all members of the class of economies. One gets a new complete markets economy by specifying a new set of components.[13] You cannot get an incomplete markets economy simply by redesigning those standard components. But note that when they can be cast as equilibrium Markov models, incomplete markets economies can be constructed by appropriately defining their components. In that sense, they are alike too.



Edward Christian Prescott

American Economist, recipient of the Nobel Memorial Prize in Economics in 2004

9. Impulse Response Functions

An impulse response function records transient and enduring responses to statistical sur-prises. Every equilibrium Markov process implies a (non-linear) stochastic vector impulse response process. Lucas framed macroeconomic policy choices in a way that made him skep-tical of some applications of fixed impulse response functions. Many of the questions that impulse response functions answer didn't interest him.

... one cannot usefully think about economic policy - about the strategies of government, another 'player' in this game - in terms of current policy decisions only. Private agents necessarily have to make inferences about the way future fiscal and monetary policy will be conducted. If we discuss policy as though it involved only what government does today - that is, if we discuss policy in the terms that dominate current political discussion - then we are leaving the most important aspects of policy undiscussed and their consequences unanalyzed.

Modeling Business Cycles, 1987, pp. 102

For fixed impulse response functions, one can study dynamic responses of many variables to an innovation in one variable. This approach is taken in "event studies," for example, about central banks' "quantitative easings."[14] Because surprises can't be systematically chosen ex ante, fixed impulse response functions provide little help in designing improved policies. Nevertheless, they are salient features of Gallant and Tauchen (1996) auxiliary models for constructing moments for Generalized Methods of Moments estimators of free parameters of equilibrium Markov models whose likelihood functions cannot be written down.

A more ambitious application characterizes impulse response functions as functionals of (parameterized) government policy rules for a manifold of equilibrium Markov models. Such characterizations are essential inputs to evaluating outcomes under the historically unprecedented policies that a "utopian" Ramsey planner wants to understand.[15]

[13] Hansen and Sargent (2013) deploy this insight repeatedly. Lucas's remark illustrates Poincare's dictum that "Mathematics is the art of giving the same name to different things."

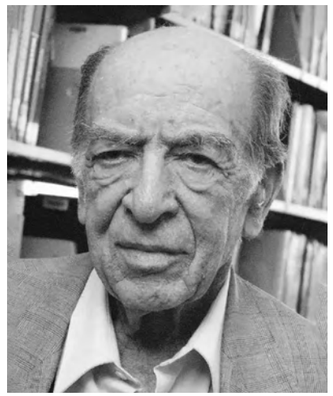
[14] Equilibrium Markov models displaying different responses to large and small shocks underly the modern interpretations of empirical evidence about sticky nominal prices described in section 14. Brunnermeier and Sannikov (2014) contains another example of hazards involved in neglecting nonlinearities in impulse responses functions.

[15] " Sims (1982) criticizes the 'rational expectations revolution' for 'destroying or discarding much that was valuable in the name of utopian ideology." (Lucas (1987, footnote 1, p. 8)) Section 4 of this paper indicates that Sims's characterization also applies to Koopmans' and Marschak's aspiration to use structural stochastic dynamic simultaneous equation models to analyze consequences of historically unprecedented policies. For Lucas's perspective on tensions between positive and normative economics, read all of Lucas (1987, footnote 1).

10. Rational Expectations Econometrics

Rational expectations econometrics requires solving two interconnected problems. A "directproblem" takes a vector of known parameters and computes an equilibrium Markov process. A solution of the direct problem lets you simulate the model, i.e., draw random samples from a joint probability distribution, thus generating artificial data sets. An "inverse problem" reverses knowns and unknowns. It takes an observed data set as known and infers unknown parameters.

Via a direct problem, an equilibrium Markov process induces a joint probability dis-tribution over sequences of prices, quantities, and information sets indexed by a vector of parameters, i.e., a likelihood function. That makes possible two varieties of rational expec-tations econometrics. An econometrician can pretend to be a frequentist and use maximum likelihood to infer parameters. An econometrician can instead pretend to be a Bayesian, put a prior over the parameter vector, merge prior and likelihood to form a joint distribution, and then use laws of inverse probability to approximate a posterior distribution for parameters.

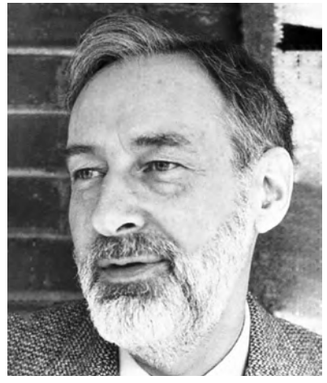


Leonid Hurwicz

Polish–American Economist and Mathematician, recipient of the Nobel Memorial Prize in Economic Sciences in 2007

As emphasized in section 4, the econometric parts of the rational expectations revolution owe much to the Koopmans-Marschak-Hurwicz Cowles Commission approach to macroe conometrics, sharing purposes and objects of interest. A shared purpose is to estimate structural parameters that are invariant to the proposed macroeconomic policy changes that the model is designed to study. Reduced form parameters aren't invariant with respect to the interventions that Keynesian and rational expectations macroeconometricians both wanted to study.[16] A shared object of interest is a system of simultaneous stochastic difference equations with reduced form parameters that are functions of deeper structural parameters that govern aspects of behavior that are invariant to a range of possible policy interventions. Pre and post rational expectations structural models also share R.A. Fisher's definition of parameter identification in terms of the Hessian of a log likelihood function evaluated at parameter values that maximize the log likelihood function.

Nevertheless, Lucas (1976) showed that a rational expectations equilibrium subverts many Cowles Commission (Koopmans (1950), Hood and Koopmans (1953)) exclusion re-strictions for parameter identification.[17] An equilibrium Markov process instead imposes extensive "cross-equation" restrictions across equilibrium decision rules and agent-specific conditional probability densities for agent-specific uncontrollable state variables. This tech-nical point about invariant parameters is the "revolution" part of rational expectations that helped make Lucas so unpopular at the Boston Fed conference at Martha's Vineyard in 1978 (see Solow (1978) and section 15 below).



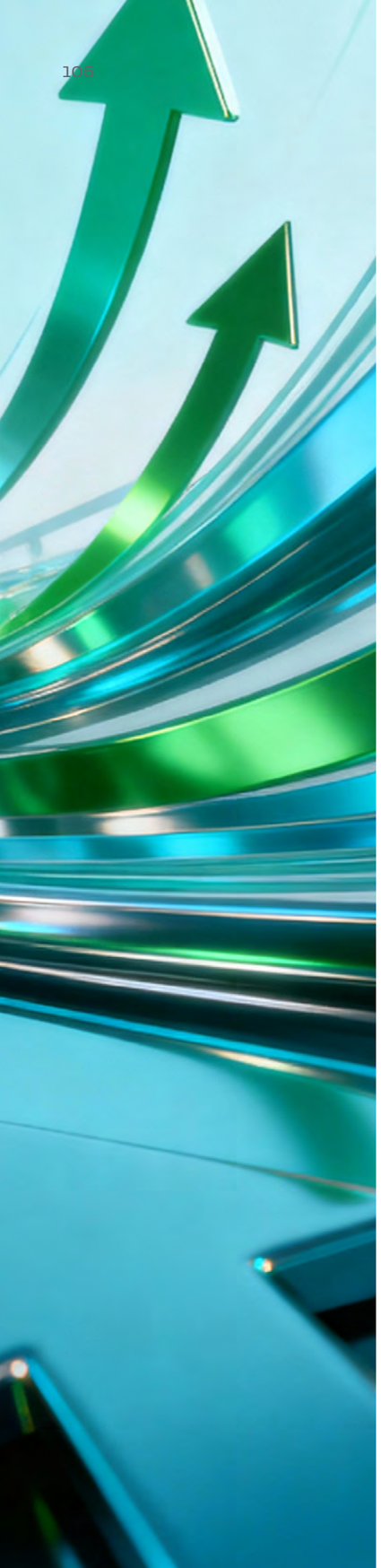
Tjalling Charles Koopmans

Dutch-American Mathematician and Economist, recipient of the Nobel Memorial Prize in Economic Sciences in 1975

"Rational expectations econometrics requires solving two interconnected problems. A "directproblem" takes a vector of known parameters and computes an equilibrium Markov process. A solution of the direct problem lets you simulate the model, i.e., draw random samples from a joint probability distribution, thus generating artificial data sets."

[16] Similarly, impulse response functions aren't invariant to the interventions that a Ramsey planner con-templates.

[17] I wrote Sargent (2024) to describe the ramifications of Lucas (1976) for macroeconomics on the occasion of the 50th anniversary of Lucas's presentation of it at the inaugural Carnegie-Rochester conference in 1973.Sims (1980) and Sargent and Sims (1977) also questioned the plausibility of the Cowles Commission exclusion restrictions that Lucas (1976) criticized. Sims recommended not using quantitative macro models to analyze the alternative historically unprecedented monetary and fiscal policy rules that Marschak (1953) wanted to study.



11. Optimal Government Policies

To design an optimal policy, the Ramsey planner in Lucas and Stokey's (1983) model com-pares outcomes associated with joint distributions generated by alternative government de-cision rules. To compute those joint distributions, the Ramsey planner takes into account the cross-equation restrictions that describe how the government's plan influences the joint distributions.

To appreciate how thoroughly a Ramsey planner relies on a rational expectations as-sumption, it is enlightening to think about government policies in a setting that abandons a rational-expectations assumption, for example in a self-confirming equilibrium. In a self-confirming equilibrium, agents don't share a statistical model with nature. Each type of agent has its own manifold of statistical models, with each manifold being indexed by a distinct vector of parameters. Meanwhile, the data are generated by nature's statistical model, indexed by yet another vector of parameters. The parameters of each agent's model take values that among all models in that agent's manifold of models, best fit data generated by nature's model. Technically, this means that each agent's statistical model is an "information projection" from nature's model onto that agent's manifold of statistical models.[18]

Lucas (1986) explored consequences of replacing rational expectations with the assump-tion that decision makers form their beliefs about conditional distributions of future variables by recursively updating least squares estimates of parameters of an arbitrary and possibly misspecified statistical model. Under suitable conditions, a Law of Large Numbers makes parameter estimates and associated decision rules converge to become parts of a self-confirming equilibrium in which a decision maker's beliefs are statistically confirmed for events that oc-cur infinitely often within the equilibrium.[19] In a self-confirming equilibrium, an agent's statistical model is verified along an observed sample path generated by nature's model. Nevertheless it misrepresents outcomes that would occur along sample paths associated with historically unprecedented government policies. In a self-confirming equilibrium, misunderstandings about policies that haven't been tried lead to inferior government policies.[20] A government adopts inferior policies because its misspecified statistical model misleads it about off-equilibrium outcomes associated with historically unprecedented policies.[21] His-torical data contain no "treatments" that raise statistical misspecification alarm bells .

Self-confirming equilibria can be outcomes of models of learning that we shall discuss in section 12. Information projections and self-confirming equilibria will appear again when we discuss Lucas's preferences for simplicity in section 13.

[18] Csisz´ar and Matus (2003) and Nielsen (2018) describe information projections. Let $\{f_\theta(x)\}_{\theta\in\Theta}$ and $\{g_{\delta_o}(x)\}_{\delta\in\Delta}$ be two collections (manifolds) of probability distributions for outcomes $x \in X$. When model $g_{\delta_o}(x)$ governs the data, a population maximum likelihood estimator θ_o of parameter vector $\theta \in \Theta$ of misspecified statistical model $f_\theta(x)$ minimizes the Kullback-Leibler divergence

$$\mathrm{KL}(g_{\delta_o}, f_\theta) = \int \log\left(\frac{g_{\delta_o}(x)}{f_\theta(x)}\right) g_{\delta_o}(x)dx = -H(g_{\delta_o}) - E_{g_{\delta_o}} \log f_\theta(x),$$

where $H(g_{\delta_o}) = \int \log(\frac{1}{g_{\delta_o}(x)})\, g_{\delta_o}(x)\, dx$ is the Shannon information of nature's probability distribution $g_{\delta_o}(x)$ and E_{δ_o} denotes mathematical expectation under $g_{\delta_o}(x)$ The information projection of $g_{\delta_o}(x)$ onto $\{f_\theta(x)\}_{\theta\in\Theta}$ is distribution $f_\theta(x)$ in manifold $\{f_\theta(x)\}_{\theta\in\Theta}$ that maximum likelihood selects when nature's model g_{δ_o} generates the data, i.e., $\theta_o = \arg\max_{\theta\in\Theta} E g_{\delta_o} \log f_\theta(x)$. In some formulations, parameters δ_o of nature's model $g_{\delta_o}(x)$ are functions $\delta_o = \delta(\vec{\alpha}_o, \eta_o)$, where $\vec{\alpha}_o$ are maximum likelihood estimators of parameters of agents' models and η_o is another vector of parameters in nature's model. Dependence of δ_o on $\vec{\alpha}_o$ emerges because agents' statistical models influence their decision rules, which in turn influence an equilibrium joint distribution. See Esponda and Pouzo (2016) and Sargent (1999, ch. 6) for such formulations.

[19] A Law of Large Numbers brings the "infinitely often" qualification.

[20] Fudenberg and Levine (2009) relate self-confirming equilibria to Lucas (1976).

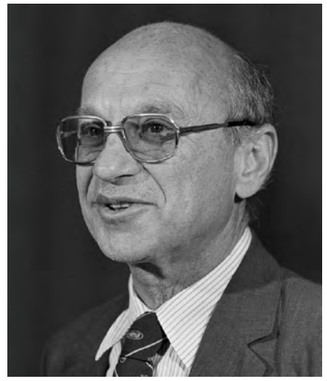
[21] Self-confirming equilibria appear in contending accounts of US inflation dynamics in the 1970s and 1980s discussed in Sargent (1999, 2008).

12. Equilibrium Computation and Learning

Using an equilibrium Markov model to do quantitative macroeconomic analysis requires computing an equilibrium for a vector of fixed parameter values. Solving the section 10 direct and inverse problems requires doing that, and the faster, the better.

I use "compute" as a synonym for "approximate." An equilibrium is associated with a fixed point of a mapping from perceived laws of motion to actual laws of motion. That fact brings connections between equilibrium computation algorithms and non rational expectations models in which agents inside a model learn about laws of motion and perhaps also price functions. Different models make different assumptions about who is learning and what they are learning. In some settings, the person learning is a model builder who is outside the model and who wants to compute a fixed point. In other settings, agents inside a model learn about transition equations that govern evolution of the uncontrollable states that they have misspecified.[22]

Techniques for analyzing convergence of models inhabited by least squares learners to a rational expectations equilibrium have contributed algorithms for approximating equilibrium Markov models. Connections between models of learning and methods for computing equilib-ria are intermediated through a mathematical tool called "stochastic approximation", early contributions to which were made by Milton Friedman (see Friedman and Savage (1947)) and his teacher Harold Hotelling (Hotelling (1941)). Sean Meyn (2022, ch. 5) links stochas-tic approximation to recent "machine learning" algorithms for approximating solutions of functional equations.



Milton Friedman

American Economist, recipient of the Nobel Memorial Prize in Economic Sciences in 1976

13. Approximating Models

Lucas agreed with Copernicus that

... a simple and beautiful theory that agrees well with observation is often closer to the truth than a complicated ugly theory that agrees better with observation.

Weinberg (2015, ch. 6)

That "a simple and beautiful theory that agrees well with observation is often closer to the truth than a complicated ugly theory that agrees better with observation" collides with rational expectations econometrics. Bayesian and frequentist statisticians know a manifold of parameterized joint probability distributions (i.e., likelihood functions); they just don't know parameter values.[23] Regarding an equilibrium Markov process (a.k.a. a likelihood function) as an approximation forces a model's author to think about statistical inference and decision making when equipped only with a misspecified statistical model. It also raises questions about how to evaluate approximating models.

Kydland and Prescott do not say much about which questions they hope their model could simulate accurately, or with what level of accuracy. ... Whether [Kydland and Prescott's] results are viewed as 'good' or 'bad' is a difficult ques-tion, as is the related question of which comparisons of theoretical to sample moments are most interesting.[24] One could obtain a formal sharpening of these questions by using the discipline of classical hypothesis testing... ... but the interesting question raised by the Kydland and Prescott model is surely not whether it can be accepted as 'true' when nested within some broader class of models. Of course the model is not 'true' : this much is evident from the axioms on which it is constructed. We know from the outset in an enterprise like this (I would say, in any effort in positive economics) that what will emerge - at best - is a workable approximation that is useful in answering a limited set of questions.

Modeling Business Cycles, 1987, p. 91

Rational expectations econometrics offers little guidance to a quantitative economist who acknowledges an unknown gap between his model and nature's.[25] Macroeconomists have responded to this difficulty in various ways. Calibrators who follow Kydland and Prescott (1982, 1996) rely heavily on the section 10 direct problem, but not on the inverse problem. Instead they condition on known parameters,

[22] See Lucas (1986) for an early analysis in which an agent inside a model is learning about the model. Bray and Kreps (1987) draw a distinction between models of learning "within" a rational expectations equilibrium and models of learning "about" a rational expectations equilibrium. There is a connection with Hansen's (2014) distinction between uncertainties "outside" and "inside" models.

[23] For them the information projection in footnote 18 is instead $\theta_o = \arg\max_{\theta\in\Theta} E\, f_{\theta_o} \log f_\theta(x)$, where $E\, f_{\theta_o}$ is the mathematical expectation under statistical model f_{θ_o}.

[24] Lucas (1987, p. 72) noted that Kydland and Prescott (1982) abandoned Solow's method of inferring the conditional variance and persistence of technological change by fitting an aggregate production function. To fit US business cycle fluctuations, they substantially increased Solow's calibration of the variability of technical change. Lucas (1987, Sec. VII) indicated that by neglecting monetary shocks as sources of cycles, Kydland and Prescott's procedure for setting technology change process parameters overstated their role in generating aggregate fluctuations.

[25] Bob told me that "anything is an approximation to anything else." A model can be wrong, i.e., an approximation, in an infinite number of ways. If you don't know what you're trying to approximate, you also don't have an approximation criterion.

adopt assumptions sufficient to make an equilibrium Markov model induce a stationary and ergodic process, and use associated laws of large numbers.[26] After importing some parameters from extraneous sources, they set other parameters to make their model's population moments match a selected list of sample moments. Before computing those moments, calibrators sometimes decide that their model is designed to be a better approximation to some frequencies than others, so they filter data to attenuate some frequencies and amplify others.[27] Sometimes they "filter" data by conditioning only on events that they had designed the model to explain, for example by excluding data during "sales" for a model in which firms set prices, as in Golosov and Lucas (2007).

Rather than ignoring particular frequencies or events, sometimes a calibrator discrimi-nates among variables, e.g., by focusing on quantities and ignoring prices in an equilibrium Markov model that supposedly determines both. To measure benefits from attenuating post WWII US business cycles, Lucas (1987, Sec. III) and Lucas (2003) used the value function for the Lucas (1978) asset pricing model. Asset prices are subgradients of that value func-tion.[28] An economist who regards Lucas (1978) as an adequate approximation to a joint quantity-price process would use both price and quantity information. But Hansen and Singleton (1982, 1983) had convinced Lucas that Lucas (1978) did not explain asset prices well. Hansen and Singleton had combined inverse problems for the Lucas (1978) model with US data on consumption and asset prices to construct specification test statistics that forced Lucas into unpleasant compromises.[29] Instead of using information about a coefficient of relative risk aversion carried by asset prices, he imported an extraneous estimate of that co-efficient together with estimates of the parameters of an exogenous aggregate consumption process and used them to quantify a value function that measures costs of business cycles.[30] To justify that calibration strategy, Lucas (2003) said that it is implausible to impute big

Lars Peter Hansen

American economist, recipient of the Nobel Memorial Prize in Economics in 2013

equity premia to a representative agent's high aversion to risk, and that sources of behavior other than risk aversion not included in his model would be required to explain the equity premium and other asset pricing facts that, from the perspective of the Lucas (1978) model, appear to be anomalies.

That led Hansen et al. (1999) and Tallarini (2000) to search for other sources of behavior that could preserve most of the quantity implications of Lucas (1978) that Lucas had relied on to measure costs of business cycles, while realigning asset prices closer to data. They discovered that adding concerns about model mispecification to a representative agent's aversion to risk improves fits to equity risk premia while leaving implications about quantities unaltered. Agents inside the equilibrium Markov model of Hansen et al. (2008) regard it as an approximation. Hansen et al. use robust control and filtering techniques to represent how those agents express concerns about statistical model specifications and also about appropriate priors to put on alternative statistical models.[31] Doing that requires a practical substitute for the rational expectations hypothesis that requires that a common, statistical model is shared by a model's authors, the decision makers inside the model, and nature. Is it possible to replace that "communism" assumption with one that does not increase the number of free parameters fatally? An approach described by Hansen (2014) assumes that a model builder presents to decision makers inside the model a statistical model of variables that those decision makers want to forecast in order to make good decisions.[32] The decision makers solve robust Markov decision problems to protect themselves from their concerns that the statistical model is misspecified. The agents inside the models of Hansen (2014) share their model builders' approximating models, but they distrust them. Their distrust contributes a market price of model uncertainty that helps to explain the asset pricing anomalies that made Lucas abandon some of his model's quantitative implications even as he relied on some of its other implications to measure costs of business cycles.

When people who share a common model respond to their specification doubts by solving robust Markov decision problems, ex post they can appear to have different statistical mod-els.[33] Although they share a common approximating model, each decision maker behaves "as if" he or she puts probability 1 on a "worst-case model." Because they have differ-ent purposes, "worst-case" models of different decision makers differ. This situation opens disciplined ways of modeling apparent belief heterogeneity.[34]

> **Hansen and Singleton had combined inverse problems for the Lucas (1978) model with US data on consumption and asset prices to construct specification test statistics that forced Lucas into unpleasant compromises.**

14. Lucas's Opinions

The following subsections recall how Lucas thought about nominal price rigidities; macro-labor; reconciling Phelps island and Arrow-Debreu models; and implementing Ramsey plans.

Price rigidities

... the term rigidity does not refer to some characteristic of nominal price or wage series by themselves, but rather to the behavior of these series relative to the way they would have been predicted to behave under a particular class of models.... The problem with price rigidities is that they seem to come and go. Sometimes monetary changes that 'ought' to be pure units effects seem to be just that; sometimes they seem to have large non neutral effects. ... the futility of theorizing by postulating that the behavior of agents is what it is without trying to locate the reasons for this behavior in preferences, technology, or the structure of the underlying game.

Modeling Business Cycles, 1987, pp. 89, 91

Turning first to models that don't "locate the reasons for this behavior in preferences, technology, or the structure of the underlying game," Calvo (1983) and Rotemberg (1982) constructed models that explain observed individual firms' price, quantity paths within set-tings in which monetary rules and shocks affect allocations.[35] To do that, they imposed socially improvable price-setting policies on firms, then proceeded to deduce monetary-fiscal policy functions that correct collateral damage from firms' price-setting policies. In contrast to Calvo-Rotemberg models, firms inside the models of Golosov-Lucas and Alvarez-Lippi choose how sticky to make prices. Impulse responses are non-linear and depend partly on shock volatilities.

Does a Golosov and Lucas (2007) or Alvarez-Lippi model look more like a Calvo-Rotemberg model or a flexible price model? "More like" in response to what? To small shocks? To big shocks? To changes in the monetary-fiscal policy functions that equilibrium Markov models are designed to study?

Answers are that Golosov-Lucas or Alvarez-Lippi models look more like Calvo-Rotemberg models for small shocks, more like flexible price model for large shocks, and more like flexible price model for change in systematic monetary-fiscal policies. Thus, in models in which firms choose stickiness:

... for small shocks the nature of the friction is irrelevant, that is, the propagation of the nominal shock is the same in state- and time-dependent models provided that the models are fit to the same steady-state moments. ... the inherent nonlinear nature of decision rules of SD models implies that for aggregate shocks above a minimum size, the economy displays full price flexibility. Thus, for SD models the impact effect of the shock depends on their size.

"Are State- and Time-Dependent Models Really Different?" Alvarez, Lippi, and Passadore, NBER Macro Annual, 2017, pp. 380- 381.

In the spirit of Stephen Weinberg's rules as guides for research, models in which firms choose stickiness preserve the following past successes:

- Cross-country and historical evidence about inflation that the quantity theory of money fit well
- Apparent money supply "non-neutralities"
- Friedman-Schwartz evidence that points to monetary shocks as sources of business cycles

Macro-labor

To study unemployment, Lucas preferred to use models with jobs .

What we mean, in ordinary usage, by 'unemployment' is exactly disruptions in, or difficulties in forming, employer-employee relationships. Simply hamstringing the auctioneer in a Walrasian framework that assigns no role at all to such a relationship is not going to give us the understanding we want. If we are serious about obtaining a theory of unemployment, we want a theory about unemployed people, not unemployed 'hours of labor services about people who look for jobs, hold them, lose them,

[26] Stokey et al. (1989) has been a source of such assumptions for generations of calibrators.

[27] Doing that alters information content of the theories and disrupts rational expectations cross-equation restrictions. By distinguishing "parameters of interest" and "nuisance" parameters, Hansen and Sargent (1993) and Sims (1993) convert that disruption into an advantage. They construct examples in which seasonal adjustment improves estimates of preference and technology parameters – the parameters of interest – while degrading "nuisance parameters" that describe evolution of information variables in agents' uncontrollable subspaces. Their analysis can be extended to other frequencies. Hansen and Singleton (1991) describe how a partitioned inverse formula obeyed by covariances requires taking nuisance parameters into account when inferring parameters of interest.

[28] See Hansen et al. (1999) and Alvarez and Jermann (2004).

[29] Lucas (1976) had advocated imposing the cross-equation and cross-frequency restrictions brought by an equilibrium Markov model. A model brought a package of quantitative implications, among which its author was not free to pick and choose.

[30] Kuh and Meyer (1957) assessed the pros and cons of importing parameters from extraneous sources.

[31] Hansen distinguished between concerns about model misspecification, which he called uncertainty, and doubts about a prior to put over alternative statistical models, which he called "ambiguity". Also see Hansen and Sargent (2022).

[32] Gallant and Tauchen (1996) call such a good-fitting model an "auxiliary model." It plays a different role in the analysis of Hansen et al. (2008), Hansen (2014) than it does in Gallant and Tauchen's simulation procedure for estimating parameters of a Markov decision model that can be simulated but whose likelihood function cannot be written down analytically.

[33] After I presented a joint paper with Lars Hansen about robustness at the Minneapolis Fed, Bob asked me "why should the people in our models be like us?" Muth (1961) had suggested putting agents inside a model on the same footing as the model builder and the econometrician who estimates it.

[34] Assuming a common approximating model provides "discipline" in the sense of economizing on free parameters. The heterogeneity of beliefs that emerges in such models is endogenous and constrained by a small number of parameters.

[35] People inside the sticky price models compared in this subsection set prices. In general equilibrium models in the Arrow-Debreu tradition, nobody inside the model chooses prices: they are set by someone outside the model, perhaps by a Walrasian auctioneer or by a robust algorithm (e.g. Scarf (1982)). In Lucas (1972), nominal prices are "sticky", but no one inside the model sets them.

people with all the attendant feelings that go along with these events. Walras's powerfully simple scenario, at least with the most obvious choice of 'commodity space', cannot give us this, with cleared markets or without them.

Modeling Business Cycles, 1987, p. 66.

To study aggregate prices, wages, interest rates, and employment, GDP and its compo-sition, Lucas preferred to use models without jobs. To explain these things, he said that modeling flows into and out of unemployment is a side show. Thus, Lucas asked

... whether modeling aggregative employment in a competitive way as in the Kydland and Prescott model (and hence lumping unemployment together with 'leisure' and all other non-work activities) is a serious strategic error in trying to account for business cycles.

Modeling Business Cycles, 1987, p. 66.

Lucas answered

I see no reason to believe that it is. If the hours people work - choose to work - are fluctuating it is because they are substituting into some other activity. For some purposes - designing an unemployment compensation scheme, for example - it will clearly be essential to break non-work hours into finer categories, including as one 'activity' unemployment. But such a finer breakdown need not substantially alter the problem Kydland and Prescott have tried to face by finding a param-eterization of preferences over goods and hours that is consistent with observed employment movements.

Many macroeconomists have agreed with Lucas that to understand aggregate employment, aggregate inflation, interest rates, and GDP and its composition, modeling flows into and out of unemployment is a side show. Lucas and Rapping (1969), Hansen (1985), Prescott (2002) and many real and monetary business cycle models include no employer-employee re-lationships interpretable as jobs. Neither did most pre-rational-expectations models that also assumed spot markets (e.g., "hiring halls") that continuously equate supplies and demands for labor.

Combining features of Phelps Islands and Arrow-Debreu models

A 20th century macro tradition that Paul Samuelson called a "neoclassical synthesis" recon-ciled macroeconomics with microeconomics by directing macro polices to attenuate business cycles and by directing microeconomic policies to redistribute and provide social insurance. Lucas adopted and modernized that synthesis by merging components of Arrow-Debreu and Phelps island models.

In a real general equilibrium model like Kydland and Prescott's, exchange occurs in centralized markets, so that goods are valued only if they are valued in use (consumption or production) by someone. To model a monetary economy, one thus needs to imagine that trading is decentralized in some way. My preference is to do this in a way that does minimal violence to the original, real theory that is being modified, so as not to discard altogether the theory's considerable ability to account for important real observations. ... By postulating an individual with specific preferences over cash and credit goods, and by being specific as well about the timing with which information gets revealed, we can derive all of classical monetary theory by just thinking through the margins on which an agent operates in this world of centralized/ decentralized markets. ... Everything that is valid in the traditional quantity theory of money can be extracted from these two marginal conditions, as can much that is new.

Models of Business Cycles, 1987, pp. 76, 78, 88

Lucas combined components of Arrow-Debreu and search-island models while insisting on preserving versions of complete markets Euler equations for consumption, labor supplies, and asset prices. Examples of combined models include Lucas and Prescott (1974) and Alvarez and Veracierto (1999, 2012) island search models as well as Lucas and Stokey (1987) cash-in-advance models. Each of those structures incorporates a version of Samuelson's neoclassical synthesis.[36]

Implementations

It is challenging to motivate governments to adhere to an optimal plan.[37] Here Lucas made important contributions. Examples include (1) Lucas and Stokey's (1983) implementation of a Ramsey plan by requiring governments to service carefully designed continuation debt maturity structures, and (2) Atkeson and Lucas's (1992) implementations of incentive com-patible social insurance arrangements that feature barriers to entry, contract exclusivities, and pecking orders among insurance contracts.

[36] By adding social insurance and redistribution to a central bank's mandate, some heterogeneous agent New Keynesian (HANK) models subvert Samuelson's neoclassical synthesis. Lucas criticized that aspect of HANK models when he discussed an early version of Bhandari et al. (2021) at a 2012 Minneapolis Fed conference. In that model, social insurance motives make Taylor rules become much more aggressive than they are in representative agent New Keynesian models.

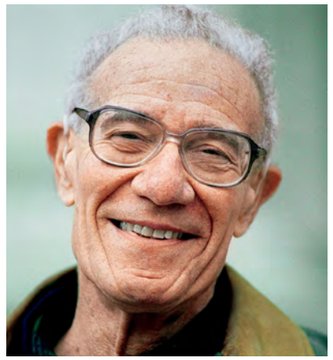
[37] This is the message of Kydland and Prescott (1977) and Calvo (1978).

15. Concluding Remarks

Although I celebrate them here, not everybody liked the equilibrium Markov processes that Lucas promoted. Summers (1991) did not. He asserted that "progress is unlikely as long as macroeconomists require the armor of a stochastic pseudo-world before doing battle with the real one." It puzzles me why some technically sophisticated economists also didn't like the way Lucas practiced macroeconomics.

Deep down I really wish I could believe that Lucas... is right, because the one thing I know how to do well is equilibrium economics. The trouble is I feel so embarrassed at saying things that I know are not true. It is plain as the nose on my face that the labor market and many markets for produced goods do not clear in any meaningful sense.

Solow (1978)



Robert Merton Solow

American Economist, recipient of the Nobel Memorial Prize in Economic Sciences in 1987

It is curious that Solow wrote those words partly in response to the following statements:

In recent years, the meaning of the term equilibrium has changed so dramatically that a theorist of the 1930s would not recognize it. An economy following a multivariate stochastic process is now routinely described as being in equilibrium, by which is meant nothing more than that at each point in time, postulates (a) [markets clear] and (b) [agents act in their self interest] are satisfied. This development, which stemmed mainly from work by Arrow (1964) and Debreu (1959), implies that simply to look at any economic time series and conclude that it is a disequilibrium phenomenon is a meaningless observation. Indeed, a more likely conjecture, on the basis of recent work by Sonnenschein (1973), is that the general hypothesis that a collection of time series describes an economy in competitive equilibrium is without content.

Lucas and Sargent (1978, p. 304)

Equilibrium Markov processes acquire content only by looking at more data or by impos-ing more restrictions on prices and quantities than Sonnenschein (1973) had.[38] For over 35 years, Stokey et al. (1989) has been our handbook for constructing stationary and ergodic equilibrium Markov processes amenable to econometric implementations. It tells us how to economize on free parameters and how to expand data sets to make an equilibrium Markov process become econometrically restrictive.

Before being too hard on Solow (1978), we should remember how Lucas (1987, Sec. III), Lucas (2003) tempered his initial enthusiasm about rational expectations econometrics after likelihood ratio and Chi-square specification test statistics computed by Hansen and Single-ton (1982, 1983) rejected some of his favorite equilibrium Markov models. Those adverse findings pushed Lucas into the wilderness of calibration. Informal Kydland and Prescott (1982, 1996) techniques that Lucas came to favor resembled the informal parameter selec-tion methods that Solow preferred.

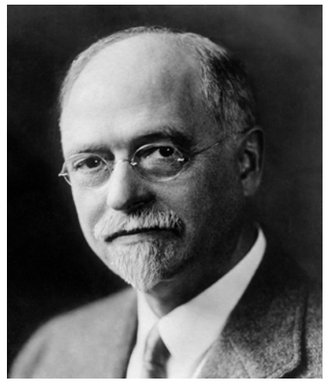
[38] Brown and Matzkin (1996), Chiappori et al. (2004), Kübler and Polemarchakis (2024) and others re-sponded to Sonnenschein (1973) by describing data sets and specifications of primitives of general equilibrium models that restrict data on prices, quantities, and endowments.

> "Progress is unlikely as long as macroeconomists require the armor of a stochastic pseudo-world before doing battle with the real one." It puzzles me why some technically sophisticated economists also didn't like the way Lucas practiced macroeconomics.

Despite Lucas's misgivings, the coherence between economic theory and econometric practice that rational expectations brought into macroconomics remains attractive today. Rational expectations econometrics flourishes within the Central Banks and Treasuries at which the critique in Lucas (1976) was aimed. Herbst and Schorfheide (2016) and Dynare manuals are Bibles at many central bank research departments. New applications of deep neural nets to solving master equations extend the types of models and data sets for which rational expectations econometrics is practical.[39] By treating parameters as additional state variables, Friedl et al. (2023) approximate a manifold of master equations and compute a "look-up table" that represents a manifold of equilibrium Markov processes indexed by a parameter vector. This is what Lucas (1976) and Lucas (1987, Sect. I) wanted quantitative macroeconomists to present to government policy makers. Recent advances like these make it possible to practice rational expectations econometrics today with much better than we could in the 1970s.

Kreps and Porteus (1978, 1979), Lucas and Stokey (1984), Epstein and Zin (1991), Gul and Pesendorfer (2001, 2004) broadened the range of behaviors that Markov decision prob-lems can incorporate. These can be cast as what Bertsekas (2022) calls "abstract dynamic programs" that connect conditions for existence of solutions of Bellman equations and the stability of controlled Markov processes. Abstract dynamic programs extend our Stokey et al. (1989) toolkit.[40]

Section 2 described how Milton Friedman had influenced Lucas's choices about topics to study in mathematics, statistics, and economics. Backward induction led me to describe Milton Friedman's technical tools and the questions that he studied. I could also have written about how Irving Fisher influenced Milton Friedman's tools and questions. That would have strengthened my message about how their mathematical



Irving Fisher
American Economist

tools constrained and empowered both Friedman and Lucas.[41] Lucas got farther than Friedman partly because he knew more mathematics and more probability theory. Lucas confronted more constraints and had better guides.

[39] "A Markov process that solves a master equation coupled with some auxiliary equations" is a synonym for "an equilibrium Markov model".

[40] Sargent and Stachurski (2024, ch. 9) provides an elementary account confined to finite state and action spaces.

[41] Lucas spent many hours mastering ideas that Friedman and other great economists of the generation before him had used productively. A macro growth theorist might describe this as the "imitation" phase of Lucas's growth process. What Lucas learned in that phase constrained and empowered his achievements during the subsequent "innovation" phase that we celebrate here.

References

Alvarez, Fernando and Urban J Jermann. 2004. Using asset prices to measure the cost of business cycles. Journal of Political economy 112 (6):1223–1256.

Alvarez, Fernando and Marcelo Veracierto. 1999. Labor-market policies in an equilibrium search model. NBER macroeconomics annual 14:265–304.

2012. Fixed-term employment contracts in an equilibrium search model. Journal of Economic Theory 147 (5):1725–1753.

Atkeson, Andrew and Robert E Lucas. 1992. On efficient distribution with private informa tion. The Review of Economic Studies 59 (3):427–453.

Bertsekas, Dimitri. 2022. Abstract dynamic programming. Athena Scientific.

Bhandari, Anmol, David Evans, Mikhail Golosov, and Thomas J Sargent. 2021. Inequality, Business Cycles, and Monetary-Fiscal Policy. Econometrica 89 (6):2559–2599.

Bilal, Adrien. 2023. Solving heterogeneous agent models with the master equation. National Bureau of Economic Research.

Bray, Margaret and David M Kreps. 1987. Rational learning and rational expectations. In Arrow and the ascent of modern economic theory, edited by George Feiwell, 597–625. Springer.

Brown, Donald J and Rosa L Matzkin. 1996. Testable restrictions on the equilibrium mani fold. Econometrica: Journal of the Econometric Society 1249–1262.

Brunnermeier, Markus K and Yuliy Sannikov. 2014. A macroeconomic model with a financial sector. American Economic Review 104 (2):379–421.

Cagan, Philip. 1956. The Monetary Dynamics of Hyperinflation. In Studies in the Quantity Theory of Money, edited by Milton Friedman, 25–117. Chicago: University of Chicago Press.

Calvo, Guillermo A. 1978. On the Time Consistency of Optimal Policy in a Monetary Economy. Econometrica 46 (6):1411–1428.

1983. Staggered prices in a utility-maximizing framework. Journal of monetary Economics 12 (3):383–398.

Chiappori, P-A, Ivar Ekeland, Felix K¨ubler, and Herakles M Polemarchakis. 2004. Testable implications of general equilibrium theory: a differentiable approach. Journal of Mathe matical Economics 40 (1-2):105–119.

Csisz´ar, Imre and Frantisek Matus. 2003. Information projections revisited. IEEE Transac tions on Information Theory 49 (6):1474–1490.

Epstein, Larry G and Stanley E Zin. 1991. Substitution, risk aversion, and the temporal behavior of consumption and asset returns: An empirical analysis. Journal of political Economy 99 (2):263–286.

Esponda, Ignacio and Demian Pouzo. 2016. Berk–Nash equilibrium: A framework for mod eling agents with misspecified models. Econometrica 84 (3):1093–1130.

Friedl, Aleksandra, Felix K¨ubler, Simon Scheidegger, and Takafumi Usui. 2023. Deep un certainty quantification: with an application to integrated assessment models. Tech. rep., Working Paper University of Lausanne.

Friedman, M. 1956. A Theory of the Consumption Function. Princeton University Press.

Friedman, Milton and L.J. Savage. 1947. Planning Experiments Seeking Maxima. In Se lected Techniques of Statistical Analysis for Scientific and Industrial Research, and Pro duction and Management Engineering, edited by Millard W. Hartay Churchill Eisenhart and W. Allen Wallis, 363–372. New York and London: McGraw-Hill.

Fudenberg, Drew and David K Levine. 2009. Self-confirming equilibrium and the Lucas critique. Journal of Economic Theory 144 (6):2354–2371.

Gallant, A Ronald and George Tauchen. 1996. Which moments to match? Econometric theory 12 (4):657–681.

Golosov, Mikhail and Robert E Lucas. 2007. Menu costs and Phillips curves. Journal of Political Economy 115 (2):171–199.

Gu, Zhouzhou, Mathieu Lauriere, Sebastian Merkel, and Jonathan Payne. 2024. Global Solutions to Master Equations for Continuous Time Heterogeneous Agent Macroeconomic Models. Princeton University.

Gul, Faruk and Wolfgang Pesendorfer. 2001. Temptation and self-control. Econometrica 69 (6):1403–1435.

2004. Self-control and the theory of consumption. Econometrica 72 (1):119–158.

Hansen, Gary D. 1985. Indivisible labor and the business cycle. Journal of monetary Eco nomics 16 (3):309–327.

Hansen, Lars Peter. 2014. Nobel lecture: Uncertainty outside and inside economic models. Journal of Political Economy 122 (5):945–987.

Hansen, Lars Peter and Thomas J. Sargent. 1993. Seasonality and approximation errors in rational expectations models. Journal of Econometrics 55 (1-2):21–55.

2013. Recursive Linear Models of Dynamic Economics. Princeton, New Jersey: Princeton University Press.

2022. Risk, ambiguity, and misspecification: Decision theory, robust control, and statistics. Journal of Applied Econometrics.

Hansen, Lars Peter and Kenneth J Singleton. 1982. Generalized instrumental variables estimation of nonlinear rational expectations models. Econometrica 1269–1286.

1983. Stochastic consumption, risk aversion, and the temporal behavior of asset returns. Journal of political economy 91 (2):249–265.

1991. Computing semi-parametric efficiency bounds for linear time series models. Nonparametric and Semiparametric Methods in Econometrics and Statistics 387–412.

Hansen, Lars Peter, Thomas J Sargent, and Thomas D Tallarini Jr. 1999. Robust permanent income and pricing. The Review of Economic Studies 66 (4):873–907.

Hansen, Lars Peter, John C Heaton, and Nan Li. 2008. Consumption strikes back? Measuring long-run risk. Journal of Political economy 116 (2):260–302.

Herbst, Edward P and Frank Schorfheide. 2016. Bayesian estimation of DSGE models. Princeton University Press.

Hood, William C and T C Koopmans. 1953. Studies in econometric method. Wiley.

Hotelling, Harold. 1941. The Experimental Determination of the Maximum of a Function. Annals of Mathematical Statistics 12:20–45.

Hurwicz, Leonid. 1966. On the structural form of interdependent systems. In Studies in Logic and the Foundations of Mathematics, vol. 44, 232–239. Elsevier.

Koopmans, Tjalling C. 1950. Statistical inference in dynamic economic models. New York: Wiley.

Kreps, David M and Evan L Porteus. 1978. Temporal resolution of uncertainty and dynamic choice theory. Econometrica: journal of the Econometric Society 185–200.

1979. Dynamic choice theory and dynamic programming. Econometrica: Journal of the Econometric Society 91–100.

Kuh, Edwin and John R Meyer. 1957. How extraneous are extraneous estimates? The Review of economics and Statistics 39 (4):380–393.

Kydland, Finn E. and Edward C. Prescott. 1977. Rules Rather than Discretion: The Incon sistency of Optimal Plans. Journal of Political Economy 106 (5):867–896.

Kydland, Finn E and Edward C Prescott. 1982. Time to build and aggregate fluctuations. Econometrica 1345–1370.

1996. The computational experiment: An econometric tool. Journal of economic perspectives 10 (1):69–85.

K¨ubler, F. and H. Polemarchakis. 2024. Identification in general equilibrium. Journal of Mathematical Economics 113:103017.

Lucas, Robert E Jr. 1972. Expectations and the Neutrality of Money. Journal of economic theory 4 (2):103–124.

1976. Econometric policy evaluation: A critique. Carnegie-Rochester Conference Series on Public Policy 1 (1):19–46.

1978. Asset prices in an exchange economy. Econometrica 1429–1445.

1986. Adaptive behavior and economic theory. Journal of Business S401–S426.

1987. Models of business cycles, vol. 26. Oxford Blackwell.

2003. Macroeconomic Priorities. American Economic Review 93 (1):1–14.

Lucas, Robert E Jr. and Edward C Prescott. 1971. Investment under uncertainty. Econo metrica: Journal of the Econometric Society 659–681.

1974. Equilibriumsearch and unemployment. Journal of Economic Theory 7 (2):188 209.

Lucas, Robert E Jr. and Leonard A Rapping. 1969. Real wages, employment, and inflation. Journal of political economy 77 (5):721–754.

Lucas, Robert E Jr. and Thomas J Sargent. 1978. After Keynesian Economics. In After the Phillips Curve: Persistence of High Inflation and High Unemployment, 47–72. Boston, MA: Federal Reserve Bank of Boston. Proceedings of a Conference Held at Edgartown, Massachusetts, June 1978.

1981. Rational expectations and econometric practice. Minneapolis, Minnesota: University of Minnesota Press.

Lucas, Robert E Jr. and Nancy L Stokey. 1983. Optimal Fiscal and Monetary Policy in an Economy without Capital. Journal of monetary Economics 12 (3):55–93.

1984. Optimal growth with many consumers. Journal of Economic Theory 32 (1):139–171.

1987. Money and Interest in a Cash-in-Advance Economy. Econometrica 55 (3):491 513.

Manuelli, Rodolfo and Thomas J Sargent. 1988. Models of business cycles: A review essay. Journal of Monetary Economics 22 (3):523–542.

Marschak, Jacob. 1950. Statistical inference in economics: an introduction. In Statistical inference in dynamic economic models, vol. 10 of Cowles Commission for Research in Economics, edited by T C Koopmans, 1–50. New York: John Wiley & Sons, Inc.

1953. Economic Measurement for Policy and Prediction. In Studies in econometric method, edited by William C Hood and T C Koopmans, 1–26. Wiley.

Meiselman, David. 1962. The Term Structure of Interest Rates. Englewood Cliffs, N. J.: Prentice-Hall.

Meyn, Sean. 2022. Control systems and reinforcement learning. Cambridge University Press.

Muth, John F. 1960. Optimal properties of exponentially weighted forecasts. Journal of the american statistical association 55 (290):299–306.

1961. Rational expectations and the theory of price movements. Econometrica: Journal of the Econometric Society 315–335.

Nielsen, Frank. 2018. What is an information projection. Notices of the AMS 65 (3):321–324.

Prescott, Edward C. 2002. Prosperity and depression. American Economic Review 92 (2):1 15.

Rotemberg, Julio J. 1982. Sticky prices in the United States. Journal of political economy 90 (6):1187–1211.

Sargent, Thomas J. 1981. Interpreting economic time series. Journal of Political Economy 89 (2):213–248.

1982. Beyond demand and supply curves in macroeconomics. The American Economic Review 72 (2):382–389.

1996. Expectations and the nonneutrality of Lucas. Journal of Monetary Economics 37 (3):535–548.

1999. The conquest of American inflation. Princeton University Press.

2008. Evolution and intelligent design. American Economic Review 98 (1):5–37.

2015. Robert E. Lucas Jr.'s Collected Papers on Monetary Theory. Journal of Economic Literature 53 (1):43–64.

2022. Learning from Lucas. Journal of Economic Methodology 29 (1):17–29.

2024. Critique and consequence. Journal of Monetary Economics 141:2–13.

Sargent, Thomas J and Christopher A Sims. 1977. Business cycle modeling without pretend ing to have too much a priori economic theory. In New methods in business cycle research, vol. 1, 145–168. Federal Reserve Bank of Minneapolis.

Sargent, Thomas J. and John Stachurski. 2024. Dynamic Programming, Vol I. Cambridge, England: Cambridge University Press.

Sargent, Thomas J and Neil Wallace. 1976. Rational expectations and the theory of economic policy. Journal of Monetary economics 2 (2):169–183.

Scarf, Herbert E. 1982. The computation of equilibrium prices: an exposition. Handbook of mathematical economics 2:1007–1061.

Sims, Christopher A. 1980. Macroeconomics and reality. Econometrica 1–48.

1982. Policy analysis with econometric models. Brookings papers on economic activity 1982 (1):107–164.

1993. Rational expectations modeling with seasonally adjusted data. Journal of Econometrics 55 (1-2):9–19.

Solow, Robert M. 1978. Summary and Evaluation. In After the Phillips Curve: Persistence of High Inflation and High Unemployment, 203–209. Boston, MA: Federal Reserve Bank of Boston. Proceedings of a Conference Held at Edgartown, Massachusetts, June 1978.

Sonnenschein, Hugo. 1973. Do Walras' identity and continuity characterize the class of community excess demand functions? Journal of economic theory 6 (4):345–354.

Stokey, Nancy L. 1989. Reputation and time consistency. The American Economic Review 134–139.

1991. Credible public policy. Journal of Economic Dynamics and Control 15 (4):627 656.

Stokey, Nancy L, Robert E Lucas, and Edward C Prescott. 1989. Recursive Methods in Economic Dynamics. Harvard University Press.

Summers, Lawrence H. 1991. The Scientific Illusion in Empirical Macroeconomics. Scandi navian Journal of Economics 93 (2):129–48.

Tallarini, Thomas D. 2000. Risk-sensitive real business cycles. Journal of Monetary Eco nomics 45 (3):507–532.

Wallace, Neil. 1967. The term structure of interest rates and the maturity composition of the federal debt. The Journal of Finance 22 (2):301–312.

Weinberg, Steven. 2015. To explain the world: The discovery of modern science. Penguin UK.

2018. Third Thoughts. Harvard University Press.