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conference held May 2018

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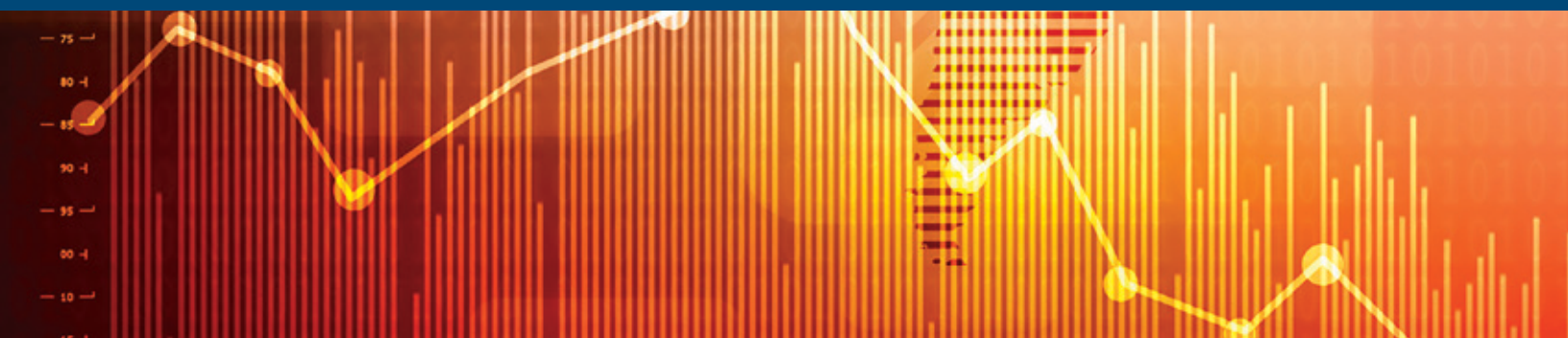
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Director's Message

Finn Kydland



"Women in Macroeconomics"—what a spectacular and timely conference that was. Twenty researchers from all over the world participated, by presenting their own research papers or serving as assigned discussants. I recall, at the Nobel events in Stockholm in 2004, one of the traditional meetings. It's an interview/discussion at the royal castle, conducted by a BBC journalist, of *all* of that year's Nobel Laureates sitting around a large table. As a consequence of the diverse fields, the interviewer asks rather general questions. One question was, why are there so few female laureates in the sciences and what can be done about it? Admittedly, the situation in economics is not much better than in physics, chemistry, and medicine. Our conference should be a source of great optimism in that regard. Of course, one has to remember that the Nobel tends to be awarded for research done many years, often decades, prior.

Personally, I was especially happy to have the attendees in Santa Barbara on the 17th of May (syttende mai), as they contributed greatly to the yearly social event at Tonya's and my house on that day: the celebration of Norway's National Holiday—Constitution Day. One could say their presence was especially appropriate as in the World Economic Forum's latest ranking of the best countries to be a woman, Norway is ranked number two (behind Iceland).

But rather than me going on and on about the conference, I'm sure you're more interested in hearing what the organizers themselves thought of how it went:

“ The conference was organized by Marina Azzimonti (Stony Brook University), Alessandra Fogli (Federal Reserve Bank of Minneapolis), and Veronica Guerrieri (University of Chicago, Booth School of Business). We wanted to bring together influential female macro-economists working in four key research areas: Macroeconomic Theory, Finance and Macroeconomics, International Macroeconomics, and Quantitative Macroeconomics. Our objective was to feature the high quality work of females in a field in which women are significantly under-represented. The conference provided participants a venue to strengthen their research, build their network, and receive mentoring, particularly to women at early stages of their careers. There was a lot of positive excitement! We had great presentations, insightful discussions, and lively interactions. We also had a discussion of the challenges faced by females in the profession and potential solutions to encourage participation.

We are thankful to LAEF for giving us the opportunity to gather such an incredible group of talented macro-economists! ”

The second conference summarized in this issue is the **XXIII Workshop on Dynamic Macroeconomics**, which took place in Vigo, Spain. The conference has taken place every year since 1995 in a castle just outside of Vigo (with the exception of the first time I personally participated, in 1996, when it took place in La Coruña). As the announcement says: "The aim of the Workshop is to offer young researchers interested in macroeconomic issues a forum for the presentation and discussion of research papers representing current advances in macroeconomics. Both theoretical and empirical papers are welcome." The Workshop represents a fantastic opportunity for advanced PhD students and an occasional first-year faculty member to present, for an hour, his or her main working paper in front of more than half a dozen "seasoned" professors (of which I'm considered one!) In practice, it means that most of the presentations are by young researchers who will be the future stars of the profession, especially in Europe. But also, typically, two or three of the 15 presenters come from U.S. universities, in this case from University of Minnesota and from UCSB.

For many years, the local organizer, from Universidade de

Vigo, has been Jaime Alonso-Carrera. This year, the remaining members of the scientific committee, in addition to Jaime and myself, were Tim Kehoe, University of Minnesota (always the Chair and the key initiative taker), Abraham Arpad, European University Institute, Juan Carlos Conesa, SUNY Stony Brook, Antonia Diaz, Carlos III in Madrid, Omar Licandro, University of Nottingham, Franck Portier, University College of London, and Victor Rios-Rull, University of Pennsylvania. The presenters will probably attest that their seminar in front of this group of professors will have been the most intense experience they've ever had!

Long-time readers of my Director's Message will know that, from time to time, I've reported on my participation in various panels of the Copenhagen Consensus Center, which specializes in ranking solutions to world problems. They've also branched out to prioritize problems of more limited regions, such as an individual nation (most recently Bangladesh), and last summer ranking solutions to the problems of a province of India, Andhra Pradesh. Obviously, this ranking has implications also for all of India. For more information:

www.copenhagenconsensus.com/andhra-pradesh-priorities

Finally, here is my annual list of notable international events in which I've participated over the past academic year:

Keynote Speeches and Public Lectures

July 7–9: Keynote, 24th Santa Colomba Conference, Siena, organized by Nobel Laureate Robert Mundell

Aug. 23–26: Lecture and panel discussion, Lindau Conference of Economics Nobel Laureates and hundreds of students from all over the world

Sep. 29–30: Keynote, Altius Conference, Oxford University

Oct. 29–30: Lecture and panel discussion; Nobel Prize Dialogue in Seoul: Future of Ageing

Oct. 31: Public Lecture, Yonsei University, Seoul

Nov. 15–16: Keynote, MISK Global Forum, Riyadh, Saudi Arabia

Mar. 11: Lecture and panel discussion, Nobel Prize Dialogue in Tokyo: Future of Food

Panels and Committees

Feb. 15: Oslo Business for Peace Award, selection-committee meeting, London

June 4–5: Premios Jaime I (prestigious Spanish prize), selection-committee meeting for Economics prize; Valencia

Mar. 12: Public Lecture, University of Tokyo

Mar. 22: Keynote, Mexican Association of Economists Annual Meeting, Mexico City

Apr. 20–22: Lectures in 3 locations in China, including at universities in Hangzhou and Hefei.

May 3: Keynote, INFONAVIT conference, Mexico City

May 8–9: Keynote and roundtable discussion, Conference on Science for Development, Quy Nhon, Vietnam

June 7–8: 50th Anniversary lecture, ConCiencia, University of Santiago, Santiago de Compostela, Spain

June 17–22: Panel meeting, Copenhagen Consensus Center, in Vijayawalla, India, to rank priorities of the province Andhra Pradesh



Women in Macroeconomics

May 17–18, 2018

Cristina Arellano – FRB of Minneapolis
Marina Azzimonti – Stony Brook University
Juliane Begenau – Stanford University
Corina Boar – Princeton University
Katarina Borovickova – New York University
Christine Braun – UC Santa Barbara
Mariacristina De Nardi – FRB of Chicago
Andrea Eisfeldt – UC Los Angeles Anderson School of Management
Doireann Fitzgerald – FRB of Minneapolis
Alessandra Fogli – FRB of Minneapolis
Stefania Garetto – Boston University
Veronica Guerrieri – University of Chicago Booth School of Business
Kinda Hachem – University of Chicago Booth School of Business
Ayse Imrohoroglu – University of Southern California

Sebnem Kalemli-Ozcan – University of Maryland College Park
Marek Kapicka – CERGE-EI
Finn Kydland – UC Santa Barbara
Jennifer La'O – University of Columbia
Ilse Lindenlaub – Yale University
Pricila Maziero – New York University Stern School of Business
Cecilia Parlatore – New York University Stern School of Business
Monika Piazzesi – Stanford University
Paulina Restrepo-Echavarria – FRB of St. Louis
Peter Rupert – UC Santa Barbara
Linda Tesar – University of Michigan
Carlos Zarazaga – FRB of Dallas

Multidimensional Sorting Under Random Search

Ilse Lindenlaub and Fabien Postel-Vinay



Structural labor economics literature investigates the inefficiencies that arise from the mismatch of heterogeneous workers to

heterogeneous jobs assuming these heterogeneities are unidimensional. This assumption is at odds with the fact that typical data sets describe workers and jobs in terms of multiple attributes. The main goal of the paper is to show what features of the data to sort and mismatch researchers miss by modeling the relevant heterogeneities as unidimensional.

The authors study a continuous-time random search model with discounting populated by lived risk-neutral workers and firms whose productivity types are finite-dimensional. Workers can be matched to a job or be unemployed. They are assumed to search both on and off the job; and they might lose their job if matched. On the other side, firms are happy to hire any worker to the firm that generates positive surplus. Matching precludes further search on the job side. Utility is transferable. Wage contracts are determined as in the sequential auction model without worker bargaining power of Postel-Vinay and Robin (2002). The authors propose a notion of assortative matching in this environment. The notion is based on a first-order stochastic dominance

ordering of the marginal distributions of job attributes across workers with different skills. For instance, positive assortative matching in a cognitive dimension happens if workers with more cognitive skills are matched to a distribution of jobs whose cognitive contents dominates that of less cognitively skilled workers.

Their model produces three sets of results under two-dimensional heterogeneity and bilinear production technology. First, positive sorting occurs in a certain dimension if the complementarities in that dimension between skill and job types are greater than that of the other dimension. Second, more skilled workers do not sort into jobs with uniformly higher skill requirements. Instead, sorting is based on the skill requirement in which they are relatively strong. Third, sorting trade-offs mean that sorting generally cannot be positive between all skill and job dimensions.

The authors then make a test of the assumption of unidimensional heterogeneity types based on their theoretical insight. The premise of this test is that two workers with the same skill types working at a job that requires the same skill level should make identical mobility decisions. If two workers with identical measured skill and job types do not make the same mobility decisions, then the true data should not be unidimensional. The authors use simulation exercises to show that their test correctly reveals misspecification

of the unidimensional model when it is indeed multidimensional. They further elaborate on the problems with misspecification. They find that a misspecified unidimensional model is uninformative on true sorting patterns and proposes a first-best allocation that differs greatly from the true first-best allocation under multidimensional types causing significant welfare losses.

A member in the audience asked what type of application Lindenlaub had in mind to test the validity of one-dimensional assumption stating that depending on the application the approximation might be considered good or bad. Lindenlaub said her goal was to test the existence of an economy wide job ladder which featured prominently after the Great Recession. She said the literature pointed out that the economy wide job ladder measured as a ranking of firms by size or by wages has contracted. She added, "We want to explore how these conclusions change if we look into the data differently, looking for these heterogeneous job ladders. Do they all contract at the same rate in which case the one-dimensional assumption might not be a bad thing or do they contract differently? If they contract differently, what other consequences they have in terms of earning, losses, unemployment spell and duration for heterogeneous workers."

Optimal Monetary Policy in Production Networks with Nominal Rigidities

Jennifer La'O and Misaki Matsumura



Theory suggests that in an economy with nominal rigidities, monetary policy will have real effects by changing relative prices.

In a network model of production or an input-output economy, there is a series of relative prices. The paper addresses the question of what is the optimal monetary policy in this rich environment that includes not only a production network but nominal corrections. Existing literature focuses on multi-sector economies without studying optimal monetary policy. Particularly, a participant suggested looking into Pasten, Schoenle and Weber (2017) to motivate the paper. Alternatively, optimal monetary policy has been studied in only one or two sectors. In this setting, the canonical New Keynesian model, with a continuum of symmetric firms and one sector, suggests that price stability is optimal and the first best can be implemented.

The authors build a static multi-sector model with input-output linkages, where firms sell and buy intermediate goods. Each sector has a continuum of monopolistic firms that produce differentiated goods, which are later aggregated at the sectoral level using a CES technology. This implies that firms are price setters at the sectoral level but price takers across sectors. The only shocks in the model are those to sectoral productivity, such that the underlying economy is efficient. Nominal rigidities are added to the model, and the degree of rigidity in a sector is captured by the fraction of sticky firms within that sector that set nominal prices based on a noisy signal about

the realization of the productivity shocks before knowing the aggregate state. This may be thought of as an informational friction. On the contrary, the fraction of flexible firms set prices contingent on the aggregate state.

The government is modeled as follows: the fiscal authority sets sectoral taxes or subsidies on revenue via lump sum to eliminate the monopolistic markup. Monetary policy in this static setting is modeled as an authority controlling nominal wages. This strategy is somewhat different to how monetary policy is thought of in a New Keynesian static model where the authority controls money supply and thereby aggregate demand. A participant asked whether the dynamics between fiscal and monetary authority was of interest and whether it would matter if a Stackelberg leader game, or a simultaneous game was played between the two. Professor La'o replied that this might matter, but in this case a full commitment model with simultaneous plays is assumed. Another participant asked the reason why taxes are excluded from the supply side as to which Professor La'o answered that inefficiencies only come from the monopoly mark-up.

The solution to the model is found by using the primal approach, that is: the authors find the set of allocations that can be implemented as equilibria, and look for the one that is welfare maximizing. The policies that implement this optimum are then backed out. The main result is that unlike the canonical New Keynesian model; the first best cannot be achieved under sticky prices and multiple sectors. In the first best world all firms within a sector produce the same since they are ex-ante identical, but only differ in the amount of information they hold; yet production varies across sectors in response to different productivity shocks. However,

this cannot be attained because state-contingent tools that vary across sectors are needed. It is not enough to have a fiscal policy vary across sectors, and state-contingent monetary policy alone. A participant asked whether this result was a consequence of the heterogeneity in firms or the input-output structure, which Professor La'o replied that it is the multiple sector structure. Another inquired about whether the result would change if sticky firms within a sector received different signals, but someone stated it holds under different assumptions. What is important is the difference in information between sticky and flexible firms.

Given that the first best cannot be implemented, the authors are working on deriving and understanding the second best problem. Additional assumptions such as homothetic preferences, a production function and monetary policy log-linear in shocks need to be considered. However, results are not available yet. Professor Hachem, the commentator, suggested that before deriving the second best problem the authors think more carefully on the monetary policy instrument. She proposed two questions for the authors to think about. For instance, would an institution such as the Federal Reserve (FED) agree to set state-contingent nominal wages? An alternative is for banks to populate one sector and the monetary policy could affect that sector. How does this propagate into other sectors through the decision of banks? Finally, Professor Hachem stressed the importance of revisiting optimal policy in the context in which people are debating whether there should be GDP or inflation targeting. She concluded by asking whether GDP targets look more like the second best policy when production is networked?

Big Data in Finance and the Growth of Large Firms

Juliane Begenau, Maryam Farboodi and Laura Veldkamp



Juliane Begenau presents a model of big data, finance, and firm investment to investigate the observation that small firms are being

displaced by larger ones. She notes that the annual rate of new startups had decreased from 13% to less than 8% and that the percentage of employment at firms with less than 100 employees has fallen from 40% to 35%. A coinciding trend that has transformed the pricing of investment capital is big data. Big data reduces the risk of investment by providing more information, thus reducing the price of investment capital. Large firms generate more data and have more historic data, so they will benefit more from the use of big data, allowing large firms to grow larger. The paper uses a rational expectation model with noise in which investors choose how to allocate information across firms to determine its portfolio. This model differs from earlier models

by constraining the investor's data availability by the size of the firm.

The model is a repeated static model. Each period a firm first chooses entry and firm size. Then, investors choose how to allocate their data processing across varying assets. Next, the investors choose their portfolios of risky and riskless assets. Finally, asset payoffs and utility are realized. The following period, these steps are repeated with updated levels of accumulated capital and an ability to process big data that is increasing over time. In the model, small firms are equivalent to young firms and large firms are equivalent to old firms, which is consistent with the correlation between age and size in the data. The choice of how much data to process is limited by a data availability constraint that connects the size of the firm to the information capacity of the firm. The model shows that when investors process more data, their investment risk falls, which raises the average price.

The simulated model demonstrates how the growth of big data affects the growth of large and small firms and the magnitude of this effect. As firm size

and data change together, data initially dominates. The cost of capital for large firms falls as more processing power is reducing the risk of investing in large firms. As the small firm grows older, the data availability constraint loosens, and risk falls for the small firms and the cost of capital also falls. When the small firm outgrows its data availability constraint, the cost of capital for large and small firms converges.

Begenau concludes that growing computing power makes big data more valuable facilitating growth of large firms. This matches with the observation that large firms are growing faster now than in 1980. A conference participant questioned whether all large firms are getting larger. Data shows that firms are getting larger in services but not in manufacturing. Big data is allowing the financial market to make more informed choices about which firms to invest in. These investment choices influence the prices, cost of capital, and the investment decisions of these firms. The model presented is a first step in incorporating how big data choices may impact the real economy.

Payments, Credit and Asset Prices

Monika Piazzesi and Martin Schneider



Piazzesi presents a model of the determination of security prices and inflation in an economy with a layered payment system with trade in both

goods and securities. In the modern economy there are two layers to transactions. Nonbanks pay for goods and securities with inside money in the end user layer. These end user

payments send instructions to banks to generate interbank transactions in the bank layer. In both the bank and end user layers, money has a value from its liquidity, but has a leverage cost of creation. Piazzesi answers how monetary policy affects asset prices and goods prices and how asset markets and payment systems interact.

The model comprises three main characteristics, transactions occur in two layers, deposits have a convenience yield, and banks and governments face leverage costs. The

model determines price of securities and inflation in an economy that has a trade in both goods and securities. Because money is valued for its liquidity, but its creation requires costly leverage, the securities markets then matter for both the supply and the demand of inside money. The banks hold securities to back inside money, which is then used by other investors to pay for securities. Therefore, the securities prices, inflation, and policy transmission are determined by the details of the payment system. Real

value of a security is higher if held by a bank while the real value of a security is lower if held by investors who rely on inside money to trade it.

The model uses two aggregate bank balance sheet ratios to summarize the role of a layered payment system. The collateral ratio is equal to the risk-weighted assets divided by debt, which is the inverse of leverage. Banks choose this ratio to equate end users' liquidity benefit of additional inside money to the banks' cost of issuing more debt. The liquidity ratio equals reserves divided by inside money, which is the inverse of the money

multiplier. Banks choose this ratio to equate the liquidity benefit of extra reserves to the spread between the interest rate on short safe bonds and the reserve rate. In this model there are two main ways of intervening, interest rates and collateral mix. If the real interest rate is reduced the cost of reserves increases and so leverage increases. The interest on deposits decreases, decreasing the demand for deposits and increasing the demand for assets and therefore asset prices. Effects from changing the real interest rate are permanent. A conference participant asks about the

effect on inflation and asset prices. If more reserves are needed to back inside money, demand for bonds decreases leading to inflation in the short-run.

Piazzesi adds a two-layer transaction structure that is abstracted from in other models of monetary policy. The layered payment system leads to policy transmission depending on financial structure. Interest on reserves has a weaker effect if bank assets are more exposed to inflation. Asset trades are weaker if banks have effective liquidity management tools. Optimal policy trades off government costs and bank leverage costs.

OTC Intermediaries

Andrea Eisfeldt, Bernard Herskovic, Sriram Rajan and Emil Siriwardane



OTC networks typically take the form of a core-periphery network, where a core set of dealers trades with each other and with a

peripheral set of clients. In contrast, the clients on the periphery of the network are largely unconnected to each other and thus trade exclusively with dealers. The paper explores how this network structure impacts equilibrium pricing and allocations in the OTC market.

The authors build a network model of OTC trade and take the model to proprietary data on a credit default swap (CDS) transactions in the U.S. from 2010 to 2013. The quantitative core-periphery model uncovers surprising facts. The authors show that although transactions between customers and dealers occur at higher prices than inter-dealer transactions, customer-dealer prices are lower than what would be observed in a fully connected network or in a traditional Walrasian market. The reason is that

risk sharing is more limited in the core-periphery model, resulting in prices that are tilted to show the higher risk-bearing capacity of dealers. The network structure significantly amplifies the importance of financial institutions with large exposure to credit risk when they are highly interconnected dealers.

The authors show that core-periphery network frictions are the key determinant of the effects of a systemically important dealer's exit on credit risk pricing. In a complete network, or Walrasian setting, at calibrated values there is almost no effect from the exit of a systemically important dealer on credit risk pricing. By contrast, in the core-periphery network calibrated to credit default swap market data, the exit of a key dealer increases the dealer-market spreads by roughly 46 basis points on average. Moreover, if network frictions increase upon a dealer failing, the effect on spreads can double or triple. The reason why a dealer exiting has a much larger impact in a core-periphery structure is a result of the greater limits to risk sharing when not all counter-parties are connected,

and counter-parties are averse to concentrating trade in a single bilateral relationship. The takeaway from this analysis is that the most systemically important dealers are not only highly connected but provide a large amount of credit insurance to the market. It is the combination of being too-interconnected and having large positions in the CDS market that makes a dealer systemically important. This observation suggests that the regulatory focus should take into account total net exposures and not just institutions' interconnectedness.

One of the audience members asked the fraction of a single named transaction in the data. The author noted that this fraction is about half. The author also notes that by saying a customer is connected to a dealer she means that the customer had a trade with that dealer in a certain year. Another audience member wondered the basis of the core-periphery network structure assumption. The author showed that this assumption matches the data well. In terms of the relevance of dealer exiting, the author showed that in the data this happens quite frequently.

International Spillovers and Local Credit Cycles

Yusuf Soner Baskaya, Julian di Giovanni, **Sebnem Kalemli-Ozcan**, and Mehmet Fatih Ulu



Economists have suspected that capital inflows, rapid growths in domestic credits, and appreciating currencies in emerging markets result

from unusual monetary policies in developed countries. This paper provides causal evidence to this hypothesis through the interest rate channel. The authors show how heterogeneity across banks matters to reduce financing costs for domestic firms through this channel. Furthermore, the authors show that different responses of banks and firms to global shocks lead to aggregate credit growth in emerging markets.

Standard open-economy models have struggled with an identification problem regarding the effect of capital inflows to emerging markets. They cannot generate capital inflows to emerging markets caused by changes in global financial conditions under uncovered interest parity in the models. As a result, when econometricians observe aggregate data on capital flows and output, they cannot figure out where the changes come from between an aggregate

domestic demand shock and an external shock to world interest rate. The authors resolve this identification problem with rich sets of credit register data, bank-level data, and firm-level data in Turkey.

The authors modify uncovered interest parity equation by adding time-varying risk premium in their model. The authors have two layers of empirical strategies. The first one is to identify external credit supply shock. They run both IV regression and reduced-form regression of firm-bank-loan level borrowing and lending on VIX, a forward-looking volatility index, after controlling all fixed effects and macro fundamentals, expectations, and policy rate. Then, they find VIX is independent of Turkish fundamentals and highly correlated with capital inflows into Turkey. Second, they exploit heterogeneity both in international market access at a bank level and in the collateral-to-loan ratio of newly issued loans at a firm level. For this purpose, they use VIX as an instrument for the time-varying risk premium to find within-firm and within-firm-bank estimators.

The authors find that exogenous capital inflows lead to more credit and lower rates in emerging markets. The elasticity of domestic loan growth

regarding VIX is equal to -0.067 . In addition, the elasticity of the real interest rate regarding VIX is 0.017 . They find that lower rates and more credit come from large domestic banks with higher non-core liabilities, which exclude domestic deposits. The estimated coefficient on the interaction between VIX and the non-core dummy is 0.015 . Regarding financial constraints, the authors find the effect of the collateral-to-loan ratio on loan amount is 0.091 at the mean of VIX and this reduces to 0.074 when VIX is at the minimum level in the sample. This shows that low net worth firms do not over borrow because of financial constraints though they get lower rates when VIX decreases.

Several audience members asked whether governments in emerging markets get involved in financial markets when global risk and liquidity conditions change and if so, the authors controlled them in regressions. One was concerned if a time varying risk premium is constant for firms. Another audience member is curious whether Turkey is large enough to be a representative emerging market in the world. Finally, there were audience members to ask whether there might be another proxy for capital inflows and why the authors focus on VIX only.

How Exporters Grow

Doireann Fitzgerald, Stefanie Haller and Yaniv Yedid-Levi



The authors document the dynamics of exports quantities and prices when Irish firms enter new markets. They use both manufacturing

census and customs data to show that exporters do not attract consumers

using prices. Using a structural model, they confirm the relevance of two frictions in exporter dynamics, namely, the accumulation of a customer base and learning about idiosyncratic demand. Using their model, they found no evidence of the customer market hypothesis as a source of either countercyclical markups or the labor wedge. It seems that marketing and advertising are vital components of

these firms' investment.

In a first contribution, they use confidential Irish manufacturing and customs data to document the relationship between tenure and either price or quantity of exporting firms in 1996-2009. They observe export quantities and values for four 8-digit products for 5000 firms and 140 destination countries or so-called markets. Observations are defined

at the firm, product, market and year combination. They impute unit prices as values per unit of quantity. They assume that firms operate with the same marginal cost in all markets and face a log-linear demand in their price and competitors' prices. This assumption allows them to control for marginal costs using market fixed effects. Then, they regress quantity and prices on market fixed effects, product-firm fixed effects, the interaction of age and spell, and an indicator for whether the data is left- or right- censored (they do not observe if a firm exporting in 1996 (or 2009) exported before (after) that year). Due to unobserved heterogeneity in demand faced by firms, the relationship between tenure and residual prices or quantities may be biased. The authors argue that completed export spell length is a good proxy for unobserved heterogeneity. While residual prices do not vary with tenure, which is top coded at seven years, residual quantities slowly grow with tenure and are higher the more prolonged the spell. They find that exit hazard rates are lower for firms that are older in the destination market. These facts are replicated using Nielsen retail scanner data in a separate paper by one of the authors.

In a second contribution, they estimate a structural model to test two competing theories of an exporting firm's behavior. The advertising

hypothesis points out that firms attract and retain customers by spending on marketing and advertising whereas the customer market hypothesis suggests that firms attract new customers with low markups and exploit switching costs to raise markups later. Both theories predict that quantities grow with tenure, but the customer markets hypothesis says that prices should also grow.

In both versions of the model, firms face a stochastic sunk cost of entering a market and a stochastic fixed cost of participating in a given period. Since firms cannot fully anticipate demand, they fixed prices or quantities. In the advertising hypothesis, demand evolves according to advertising investment which is costly and irreversible. Firms then set prices as a markup over marginal cost. In the customer market hypothesis, demand evolves according to past sales. The optimal pricing rule, in this case, is a markup strategy in which the firms take into account the dynamic effects of keeping prices low to attract customers now, and then increasing them in the future given switching costs for the customers.

The authors use the simulated method of moments to estimate the model's parameters. They simulate the behavior of 50,000 entrant firms for 14 6-months periods to match two moments, e.g., the average exported quantity by tenure and spell, and the average exit probability by tenure.

Prices moments are matched by construction. They preset the discount factor, the marginal cost, the entry cost and the relationship between entry and participating costs probabilities. The advertising model fits the data better than the customer markets model. For instance, the customer markets model requires an unrealistic price elasticity of demand to match the behavior of quantity and prices, which implies that markups are acyclic.

The discussant pointed out that Ireland has an above average population of multinational enterprises, i.e., 12% of firms in the sample are foreign-owned (vs. 1% in the US). These businesses are ordinary in sectors where global supply chains are essential. The assumption of constant marginal costs across markets may not hold given that these enterprises may use different technologies (costs) depending on the customer. The audience asked about the representativeness of Irish merchandise sectors given that it is a small country. Similarly, the advertising variable may have measurement error since many of these firms are owned by foreign corporations which may have invested in a customer base from another country. Additionally, the fact that size at entry and exit are similar suggests that sunk costs are not relevant and that the current specification is close to an exogenous exit rate.

Quantifying the Benefits of Labor Mobility in a Currency Union

Christopher L. House, Christian Proebsting and **Linda Tesar**



of Labor Mobility in a Currency

Unemployment rates vary more across countries of the euro area compared with states across the U.S. In "Quantifying

the Benefits of Labor Mobility in a Currency Union," the authors argue that labor mobility may play an important role in explaining these differences in unemployment patterns. The authors provide empirical evidence linking unemployment with net migration and develop a multi-region DSGE model with search frictions. Their counterfactual analysis suggests significant benefits to the euro area

had it observed levels of mobility as high as those across the U.S. during the recent financial crisis.

The authors first document several empirical facts that support a link between mobility and unemployment. They estimate internal migration rates in the U.S. to be 3.11% of the population versus 0.34% in the euro area. They show a higher dispersion

of unemployment rates across the euro area compared with the U.S., particularly in the wake of the recent financial crisis. In each monetary union, they estimate a negative association between the local unemployment rate and net migration for a given state (country). This association is much stronger in the U.S. The results are suggestive that mobility may play a role in explaining unemployment differences between the euro area and the U.S.

A multi-state (multi-country) DSGE model is developed that incorporates a search and matching framework and cross-state (country) labor mobility. The model is calibrated to the U.S. and Europe separately, adjusting the degree of labor mobility in each union to match observed migration in the data. Trade preference shocks are recovered that replicate observed local unemployment time series data. Given these shocks, counterfactual analysis for the euro area is performed. This analysis suggests the euro

area would have experienced lower aggregate unemployment and a reduction in the cross-country variation in unemployment rates had it experienced the levels of mobility estimated for the U.S. during the recent financial crisis. These results are unaffected by the assumed exchange rate regime. Welfare analysis and sensitivity tests were still in progress.

During the presentation, some participants expressed concern about the many differences between the U.S. and the euro area that make the two monetary unions incomparable. For instance, the U.S. serves not only as a monetary union but also as a fiscal union. Tesar responded that calibration to the U.S. was only used to recover parameters of the model, so these differences should not confound the results. A participant commented that employed in the model may be different from the unemployed in the model. For instance, employed individuals may be more mobile or more likely to file tax returns (which is

how the authors measured migration in the U.S.). This could perhaps make measurements of migration inconsistent between the U.S. and Europe.

The discussant for the presentation suggested that perhaps the nonemployment rate may offer a better measure of macroeconomic performance than the unemployment rate. This is true in the U.S. where flows from inactivity to employment are large. In addition, differences in how unemployment is classified across countries or perhaps unemployment insurance policies were partially responsible for observed dispersion in the unemployment rate. These concerns are less problematic if the nonemployment rate is used. Some exploratory empirical analysis by the discussant suggested that the U.S. has higher variation in nonemployment rates compared with the euro area, and that this may be an area for future analysis.

The Effects of Marriage-Related Taxes and Social Security Benefits

Margherita Borella, **Mariacristina De Nardi**, and Fang Yang



De Nardi looks at how marriage related policies affect the labor supply of both women and men, as well as, savings decisions. In the United States

taxes and old age Social Security benefits depend on marital status. De Nardi uses a life-cycle model of couples and singles using the Method of Simulated Moments to estimate the effects of eliminating marriage related provisions on labor supply and savings on the 1945 and 1955 birth cohorts. The results show that marriage related provisions reduce the labor participation of married women over the entire life cycle, the participation

of married men after the age of 55, and the saving of couples. Even though the 1955 cohort has a much higher labor market participation of married women, both the 1945 and 1955 cohorts see large effects.

De Nardi develops a life-cycle model with single and married people in which single people meet partners and married people have a chance of divorce. The working age population faces wage shocks, and the retired age population faces medical expenses and an exogenous probability of death. Individuals in couples face the risks of both partners. The number and ages of children depend on maternal age and marital status. There are both time costs and monetary costs of raising children. Households self insure by saving and by choosing

whether to work and how many hours to work. Wages are determined by accumulated human capital on the job.

The model is estimated using the Method of Simulated Moments and data from the Panel Study of Income Dynamics and from the Health and Retirement Study for the cohort born in 1941-1945. For the 1945 cohort, the current structure of joint income taxation and Social Security benefits provides strong disincentives to work for married women, single women who expect to marry, and married men older than 55. Using the estimated preference parameters from the 1945 cohort, the model is estimated for the 1951-1955 cohort which had a much higher participation of married women and for which policy may have very different effects. The model shows

similar effects on the 1955 cohort for participation, wages, earnings, and savings. The estimated model matches the life cycle profiles of labor market participation, hours worked, and savings for married and single people for both cohorts.

This paper is the first estimated structural model of couples and

singles that includes participation and hours decisions for both men and women in a framework with savings. The results suggest that marriage related policies significantly reduces the savings of couples and the labor force participation of women. The model shows that eliminating the current marriage related rules

increases participation at age 25 by over 20 percentage points for married women and by five percentage points for a single woman. These marriage based rules also decrease savings of married couples by \$40,000 at age 70 and wages for married women by about 10% because of the effect of experience on wages.

Household Saving, Financial Constraints, and the Current Account in China

Ayşe Imrohoroglu and Kai Zhao



As the world's largest emerging economy, China has experienced a large increase in current account balance since the early 2000s. On one

hand, the current account surplus rose from 3% to 9% between 2004 and 2008 as a result of an increasing saving rate and a relatively stable investment rate. On the other hand, the current account surplus declined dramatically after 2008 due to a rising investment rate and a flat saving rate.

Motivated by the facts above, Dr. Imrohoroglu considered a model that incorporates trends in not only saving but also investment, especially since 2008, to fully capture the behavior of the current account in China. In order to achieve this goal, this paper developed a dynamic general equilibrium model consisting of firms

that face borrowing constraints and altruistic households to show that changes in both investment and saving rates are important in shaping the time path of the current account in China.

The authors found that until 2008, the rise in the current account surplus was due to the one-child policy, as well as the tightening of financial constraint after the late 1990s. Based on their estimation, the one-child policy accounted for over half of the current account surplus in 2008. They argued that due to the one-child policy and insufficient insurance program offered by the government, the decline in family insurance played an important role in the increase in the household saving rate especially after 2000 as more and more families with only one child entered the economy. Consequently, this led to the increase in the national saving rate in the 2000s, which contributed to the rising current account surplus during the same period.

Moreover, the authors found that the changes in financial constraints facing the firms were able to generate the expansion in investment in China after 2008. In particular, the loosening of financial constraints facing the Chinese companies since 2008, likely due to the massive infrastructure plan launched by the Chinese government to stimulate its economy, substantially raises domestic investment and thus is responsible for the shift of the current account surplus after 2008.

One discussant raised the question about the role of government in the model. The presenter replied by explaining the difference in the mechanism of how government works in this paper. Instead of a lump-sum transfer of a budget surplus to private agents, the government will save the surplus for itself and invest back to the economy, which seems to characterize the saving behavior of the Chinese government more closely.





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Causes And Consequences Of Health Behavior Inequality

Vegard Nygaard

The author shows how income disparities in health behavior influence frailty, and their macroeconomic effects. The poor have higher rates of smoking, obesity, and heavy drinking which negatively impact longevity, labor earnings, and medical spending risk. He documents that frailty is higher for the poor and the older, and they associate frailty with lower employment and higher medical expenses. The author formulates and calibrates an overlapping generations model where health investments prevent frailty to deteriorate. Finally, the author suggests that lower consumption inequality, through higher tax progressivity or higher health insurance coverage, leads to higher average health in the population.

The author takes the frailty index from the medical literature, which measures health in a scale from zero (best health) to one (worst health). This index increases if a person has more disabilities or diseases, including morbidities (such as cancer or diabetes), difficulty performing activities of daily living (such as walking or eating) or instrumental activities of daily living (such as preparing meals or taking medications), and cognitive impairments.

Using the Medical Expenditure Panel Survey, the author documents that frailty increases with age and is higher among the poor than the rich. At age

40, an average person in the 75th percentile of the income distribution has approximately a frailty index of 0.05, while an average person in the 25th percentile has an index close to 0.1. Health deteriorates earlier in life for the poor than for the rich. For instance, at age 20, 40% of those in the 25th income percentile have a zero frailty index, while around 64% of those in the 75th percentile have a zero frailty index.

They associate frailty with weaker economic outcomes. First, higher frailty implies higher medical spending. In the age group 20-64, a person in the fifth quantile of frailty spends US\$13,300 which is eleven times the expenditure of a person in the first quantile. Second, they link higher frailty to a lower probability of working. For example, in the age group 20-64, 17% of those in the lowest quantile of frailty do not work compared to 60% in the highest quantile. Last, survival probability is higher for lower frailty.

The author provides a model to disentangle the relationship between health behavior and income inequality. Households derive utility from consumption and disutility from health behavior. The marginal utility of consumption increases with better health behavior, which, according to the author, helps match the positive correlation between income and health investment.

The state variables are frailty, age,

stochastic labor productivity, medical expense shocks. The probability of higher frailty increases as health effort is lower, or age increases. Frailty affects the life-cycle productivity, the medical spending distribution, and the survival probability. There is a government which provides universal health insurance; runs a minimum-consumption welfare program and finances spending through a progressive income tax. In an extended version, the model includes firms and health insurance (adding a new state variable), and the government offers social security and insurance for the elderly (Medicare) and the poor (Medicaid).

The audience asked how preference heterogeneity for unhealthy behaviors influences both individual and aggregate outcomes such as income and life expectancy, among other health and economic variables. Also, the audience commented that lifetime income should be connected with household health investment decisions instead of current income. The audience questioned how to add in the model the dynamic interaction between preventive and curative care. In outgoing work, the author plans to study how the population health distribution and, consumption inequality affects life expectancy, aggregate medical spending, government spending, and income.

Tenure Choice, Portfolio Structure and Long-Term Care – Optimal Risk Management in Retirement

Hans Fehr and Maurice Hofmann

The authors build a partial-equilibrium life-cycle model where long-term care risks drive housing equity by the elder which further encourages their stock market participation. Their model assumes real estate

to be a low-risk investment with a stochastic premium over the risk-free asset. They calibrate their model to German data and match the average homeownership rate and the stock market participation of renters. They

fail to match the life cycle profile of the model's more salient variables including the homeownership rate, the loan-to-value ratio, and the stock market participation of renters. In their counterfactual experiments, they show

that homeownership slightly reduces when the government covers adverse long-term care shocks.

The authors assume that households work from age 20 and exogenously retire at age 65. Households have a fixed labor supply but are uncertain about their future labor productivity. They derive utility from current consumption and housing services. They maximize expected discounted lifetime utility choosing their lifetime consumption and savings, portfolio holdings, whether to rent or live in own house (if they are homeowners) at any given period. They decide how to invest their wealth in real estate, bonds or stocks. They can take out mortgages against real estate, but face borrowing constraints (a maximum loan-to-value ratio). They face risky stock returns, adverse long-term care shocks and an uncertain lifespan (they may live up to 100 years). They start as renters at the beginning of their life and may choose to become homeowners afterward. They have a utility premium from living in owner-occupied real estate compared to renting but face transaction costs and minimum size requirements if they decide to move.

The authors model long-term care risk as a permanent shock, which induces periodically recurring costs. It reduces life expectancy and makes the utility premium for owner-occupied

real estate disappear. In their later experiments, they eliminate each of these features. The household can participate in the stock market, which is an absorbing state, only if it does not hold mortgages. The state variables are age, cash-on-hand, health, skill level, labor productivity, a stock market participation indicator and a renter indicator.

The paper's framework assumes exogenous stochastic processes for asset prices. For instance, the authors assume a stochastic risk premium for the return on housing holdings that is correlated with income shocks and is independent across time. Similarly, they assume that the relative price between the housing and non-housing consumption evolves stochastically and may be correlated with the interest rate shock. The only channel in which return to housing is correlated in time is through the correlation with the income process, which is assumed to have a correlated transitory shock. Their model does not incorporate the investment in new housing, i.e., assumed perfectly elastic.

At the current stage, the model does not replicate the homeownership rate of the average household in the wealth distribution, and the stock market participation rate. Notably, the model suggests a hump-shape homeownership rate, with a maximum

of 80% at age 65 for the average-wealth household, because the data shows that homeownership increases slowly from 50% to 60% in ages 35-65 and then stays reasonably stable until age 80. Similarly, the model displays increasing participation rates of both owners and renters (reaching 80% and 60% at age 70 respectively), since the data shows flat participation rates of around 40% for owners and 20% for renters throughout the life cycle. Similarly, the model does a poor job of matching the loan-to-value ratio throughout the life cycle.

The audience questioned the validity of the assumption that long-term care shocks make living in owned housing less desirable. The model ignores spousal and children decisions, i.e., shocks to income and expenditure related to family size. For example, the minimum housing requirements may change throughout the life cycle. The audience mentioned that renting markets are not competitive in Germany. The audience pointed out that the calibrated stock market variance is rather small and seems arbitrary (0.157). Likewise, stock market participation is limited to households without mortgages, which makes households mechanically hold stock when they own property.

Monetary Policy and Sentiment Driven Fluctuations

Jenny Chan

Chan analyzes monetary policy with Calvo sticky prices in a sentiment driven self-fulfilling economy à la Benhabib-Wang-Wen (2015). This economy has two types of rational expectations equilibria; one is sentiment driven, and the other is fundamental where beliefs do not matter for aggregates, which collapse to constants. The critical friction is that firms must set prices first based on an imperfect signal that is a function of both aggregate

and firm-level demands. With sticky prices, firms' price coordination in the sentiment equilibrium will be more difficult, which will generate less volatile sentiment driven fluctuations. Because of sentiment volatility, extreme inflation targeting a central bank will generate a more volatile output compared to a central bank that does not target inflation as actively.

Production takes place in two stages. Competitive final goods firms are

simple CES aggregators that transform intermediate goods, with no labor or any other factor involved. Intermediate goods firms use factors (capital and labor) and face nominal rigidities (e.g., sticky prices). They set prices under monopolistic competition given their noisy beliefs about demand. In equilibrium, they supply whatever quantity the demand requires at the given price. Nominal rigidities will generate non-neutralities.

Households maximize discounted lifetime utility subject to the budget constraint conditional on their beliefs. Households behave under monopolistic competition in labor markets, i.e., each household set its wage taking as given the labor demand schedule by the firms. Households form beliefs about aggregate output, labor supply schedule, and demand schedules for differentiated goods, contingent on shocks to idiosyncratic demand and technology. In an equilibrium, consumption will be the same for all households and so will the wage set. For each period, the optimal nominal wage chosen by households will be a markup over the marginal rate of substitution multiplied by the aggregate price level.

The timing is as follows. They realize households' beliefs about aggregate demand and idiosyncratic preference for goods. Firms receive a private signal of aggregate demand and idiosyncratic preference for their good. Firms set product prices and must commit to a production level based on their signal. Conditional on their beliefs, households supply labor and decide consumption for each good. Once the goods market opens, private information becomes

available to all agents. Intermediate goods prices adjust so that the goods market clears, and the aggregate price adjusts, so the real wage condition holds. In any rational expectations equilibria, aggregate demand beliefs equalize both aggregate consumption and aggregate output.

Since firms receive a noisy signal about aggregate demand and idiosyncratic preference for their products, the economy can have multiple equilibria and endogenous fluctuations in aggregate output. In particular, this economy features two categories of rational expectations equilibria. In one hand, a fundamental equilibrium exists where sentiments play no role. In this equilibrium, aggregate output and prices are non-stochastic. There is a stochastic equilibrium where sentiments matter and the volatility of beliefs about aggregate demand is endogenously determined and equal to the variance of aggregate output. The author log-linearizes the household's maximization condition of the household which pins down consumption and wages. Similarly, the author assumes that beliefs are independent and normally distributed.

The central bank sets the nominal

interest rate reacting to output and inflation (i.e., a Taylor rule). In a sentiment driven equilibrium, the central bank can suppress non-fundamental fluctuations with a sufficiently lax monetary policy. Even when the Taylor principle is satisfied, there is an indeterminacy of nominal variables. For standard parameter calibrations, the efficient allocation features no sentiment-driven fluctuations. The author points out that the disutility of labor (under constant relative risk aversion utility), aggregate and idiosyncratic productivity increase the desirability of non-fundamental fluctuations. Moreover, non-fundamental shocks affect the transmission of supply shock to aggregate output.

The audience was critical of the motivation for a sentiment driven equilibria. A participant suggested including a productivity shock or, a fundamental shock, to compare if the central bank can react to these shocks as sentiment fluctuations. They also wondered why the model requires Calvo rigidities for wage setting households. Likewise, they concerned that the model has two equilibria and that selecting among them was not straightforward.

Unconventional Monetary Policy in a Monetary Union

Johanna Krenz

Krenz assesses the use of monetary policy in a currency union. In particular, she focuses on whether monetary policy should be used to address country-specific disruptions, or union-wide disruptions. She uses a New Keynesian model with countries in a monetary union to assess optimal central bank policy responses to shocks. What she finds is that addressing country-specific shocks is not necessarily desirable, if the signal associated with shocks is particularly noisy.

Krenz constructs a model in which two countries belong to a monetary union and are subject to uncorrelated shocks. Each country is symmetric and populated by several types of agents: households, within which members may be workers or bankers; international intermediaries, who offer foreign bonds to domestic investors; banks, who channel savings from households to home and foreign producers; intermediate goods producers, who create a variety of goods needed for the final production

good; capital goods producers, who create goods for investment; and final goods producers, who take intermediate goods and produce a good for consumption. Monetary policy is approximated by a Taylor Rule, in which a central bank common to both countries reacts to deviations in output and inflation. The central bank also uses two "unconventional" tools of monetary policy: liquidity facilities, in which the central bank provides liquidity elastically to financial institutions; and private sector credit

purchases, in which the central bank purchases banking sector assets to stabilize the sector. In both cases, she allows the rules to respond to credit-spread, in which the difference between the financing cost for firms and the deposit rental rate has deviated from its target, and credit-growth, an indicator of a tightening financial market.

What she finds is that each rule is more effective in different circumstances: the credit-spread

rule results in higher welfare when the central bank is responding to deviations from union-wide averages, while the credit-growth rule results in higher welfare if the central bank responds to country-specific shocks. As the integration between countries increases, i.e., hold more of the foreign country's assets, the reverse becomes true. Overall, she finds that the more correlated are the shocks to the countries financial systems, the more beneficial it is for the central bank to

use union-wide rules.

The decision rules of the social planner confused the audience. To the audience, the planner was changing preferences by changing the discount rate. Krenz showed that the discount rate was a fundamental, but that the planner could change the Euler Equation. There were also concerns about multiple equilibria, but Krenz responded that there was only one fundamental equilibrium.

Bargaining with Renegotiation in Models with On-the-Job Search

Axel Gottfries

Gottfries extends canonical models of job-to-job transitions to allow for wage renegotiation during employment. This extension allows turnover to depend on the wage, the solution of which was previously impossible. He shows that his model generates a unique equilibrium, and that the frequency of wage renegotiation has a large impact on job-to-job transitions. With this model, he assesses the size of minimum wage spillovers to the rest of the wages in the economy.

Gottfries builds a model in which workers search for employment both on and off the job. An unemployed worker receives a flow unemployment benefit, and job offers arrive at a Poisson rate. Employed workers are characterized by the productivity of their current employer and their current wage. They receive their current wage as a flow and receive

a new job offer at a Poisson rate. In addition, an opportunity to renegotiate their wage with their current employer arrives at a Poisson rate. When this occurs the firm and worker bargain over a new wage, given the productivity of the firm. For the firm, the trade-off of offering higher wages is that the worker is less likely to leave. This makes the frequency of renegotiation important in determining job-to-job transition rates.

With this model, Gottfries proves the existence of a unique equilibrium in which wages are turnover dependent. He then uses the model to assess the impact that a minimum wage law has on higher wages in two types of economies: one in which wages are renegotiated twice on average during a contract, and one in which wages are renegotiated 50 times on average during a contract. When firms can only

renegotiate infrequently, a minimum wage drives up wages in the rest of the economy by increasing the wage level necessary to prevent workers from moving to a new job. When firms can renegotiate frequently, the minimum wage only impacts low productivity firms, forcing them to increase their wages to prevent workers from leaving to other minimum wage firms.

Members of the audience were uncomfortable with the concept of renegotiations occurring at random, but Gottfries indicated that such an assumption was necessary to maintain a solution to the model. Another asked if contracts in the model were optimal. Gottfries indicated that a wage setting policy like back loading would be welfare improving, but that firms could not commit to such a contract.

Unionizing Non-Search Unemployment

Oskari Vähämaa

Vähämaa compares the outcomes for economies with a few large unions against the outcomes for economies with many small unions. Each environment has advantages: small unions increase the flexibility of firms

to respond to aggregate conditions, while large unions expose the union itself to more aggregate risk and aligns their incentives more closely to those of the firms. Ultimately, Vähämaa addresses the impact that unionization

has on a worker's incentives to search for a job.

To address this question, Vähämaa constructs a model in which there are many "locations" populated by workers. Each location operates a

production technology that takes the number of workers as its input and is subject to an idiosyncratic shock. Workers maximize collective utility as a family by consuming their labor income and allowing family members to take leisure by not searching for a job. Each period, workers choose whether to remain at their location, either by working or taking leisure, or searching for a job at a new location. Within a location, wages are determined competitively, and unemployed workers are paid a fixed benefit.

Within this environment, Vähämaa introduces unions, which can either be one large union or many small unions. He distinguishes between large and small unions by allowing large unions to set a common minimum wage at all locations, knowing that they can affect the aggregate state, while small unions exist at each location and decides the

number of workers allowed to work on each island, taking the aggregate state as given. When the large union is present, it either unilaterally sets a wage, or Nash Bargains with the firm over wages to be paid to all workers in the economy. When small unions are present, wages are still determined competitively.

To determine the level of leisure taken in this model economy, Vähämaa employs simulated method of moments to match employment patterns in the United States. Then, he compares the competitive economy with those populated by a single large union or many small unions. What he finds is that a large union, under either wage-setting regime, causes a substantial increase in non-search, or leisure, unemployment. The increase in non-search unemployment is smaller when wages are bargained.

In both cases, the standard deviation of wages in the economy decreases. Likewise, the economy populated with many small unions sees a large increase in non-search employment; but, the standard deviation of wages is higher as well. Comparing the two economies, Vähämaa finds that except in the monopoly case, a large union that bargains causes a smaller decline in output than many small unions, with large welfare gains for workers.

The audience wondered why a large union was able to set a minimum wage, but small unions were unable to. Vähämaa said that this was the dichotomy he chose between the two. Another questioned why the large union was not always optimal within the set-up of the model. Vähämaa indicated that the large union distorted the allocation of workers across locations to a larger degree than small unions.

Infrastructure Choice and Regional Growth: Evidence from the Division of Germany

Marta Santamaria

Santamaria explores the impact that transportation infrastructure has on regional economic growth. She focuses on the impact of deviations from optimal investment by the government. To do this, she uses a spatial model with a plausibly exogenous change in infrastructure investment: the reunification of Germany. Before reunification, differences in economic and political structure forced infrastructure investment to take place in locations that were not necessarily optimal for economic growth. After reunification, investment was unencumbered by these problems, allowing for optimal investment.

To estimate the benefits of optimal infrastructure investment, Santamaria constructs a quantitative spatial model of a country in which infrastructure is chosen by agents. In the model, there is a finite number of heterogeneous regions. Workers allocate themselves freely across

these regions by maximizing expected utility, which takes the form of CES preferences over the varieties of goods. Regions are heterogeneous regarding productivity, transportation costs, and choice of infrastructure investment. A government chooses infrastructure investment benevolently to maximize the welfare of workers subject to a budget constraint and taking the existing network as given. Investing in infrastructure in a particular region decreases the transportation costs associated with importing or exporting goods from that region.

She shows that optimal investment has 3 primary components: a direct effect on productivity, and general equilibrium effects on the allocation of labor and the market clearing wages. The model also predicts that a market in the center of the country, or highly productive market is more likely to receive investment. To estimate the gains of investment,

she calibrates the model to Germany prior to reunification. The underlying assumption is that transportation costs between East and West Germany were infinite before reunification and reflect geography after. As a placebo test, she shows that the model predicts highway placement very well prior to division, and that the model roughly replicates highway production during the division. She then uses the predicted investment as an instrument to estimate the effect that lack of investment had on population growth. She finds that a 1% increase in optimal highway investment implies between an 0.8% and a 1.18% increase in population growth.

The audience questioned the premise that trade was an important source of growth, but Santamaria stated that there is evidence in the data for such an assumption. The audience was also concerned that many projects in Germany were likely partially constructed at the time of division,

which could cause agents to optimally respond in a way that would not be predicted by the model. One noted that this was similar to a “time to build”

problem, which was not a feature of the model. Santamaria said these decisions were likely optimal *ex post*, and that she would consider allowing

them to re-optimize in the future. The problem she showed was that a dynamic problem was computationally challenging in this setting.

Sharing Risk to Avoid Tragedy: Theory and Application to Farming

Karol Mazur

Mazur describes how risk sharing can help economies achieve efficient levels of public good provision. He applies a model with these features to rural farmers and assesses the output gains resulting from insurance as well as the effectiveness of policies to achieve this outcome. Rural societies, despite being a substantial portion of the global population, suffer serious environmental problems and rarely have access to formal credit markets for insurance.

He models a farming society with two risk-averse agents. Each farmer has access to a production technology that uses labor and capital as inputs and is subject to an individual shock as well as a common aggregate shocks. Aggregate risk is a Markov process with a “good,” more productive state, and a “bad,” less productive state, the probabilities of which are determined by the collective investment of the farmers. Investment in capital serves

both to increase output and the productivity of labor and increase the likelihood of the good aggregate state. Mazur compares two benchmarks to show the theoretical predictions about risk and output from extreme cases: autarky, in which agents implement the fully competitive, non-cooperative solution; and the planner’s solution, in which the first-best is achieved. In the autarky case, each agent under-invests in capital because they free-ride off the other farmer’s investment. In the first-best case, an agent’s private benefit is suboptimal, but the gains from mitigating aggregate risk increase each’s overall welfare.

After showing each of these cases, Mazur explores three different contracting solutions: risk-sharing, in which agents insure the other’s consumption; co-operation over producing the public good (mitigating the aggregate risk); and a contract in which agents can optimize over both

risk sharing and providing the public good. Agents are limited in their ability to commit to these contracts but face a fraction of their consumption being destroyed should they deviate. He shows that the risk-sharing alone does not internalize the benefits of public good investment and achieves the same level of investment as the non-cooperative solution. However, contracting over the public good increases investment, and moves the allocation closer to the first-best. When both are included, the likelihood of breakdown is mitigated.

Members of the audience took issue with the ability of agents in the model to insure against aggregate risk. Mazur said the agents are building an analogue to “public precautionary savings.” It also concerned the audience about the use of a separate objective function for the planner, to which Mazur indicated he assumed the planner to be a benevolent third party.

Financial Intermediation and Occupation Choice

Jiajia Gu

Gu explores the causes of a negative relationship between GDP per worker and business ownership among economies around the globe. In developing economies, more individuals own businesses than in developed economies. She breaks down this empirical relationship into two classifications of business ownership: own account workers, who work for themselves; and employers, who employ other laborers. What she finds is a strong negative relationship between GDP

per worker and own account workers, but no relationship or a slightly positive relationship between GDP per worker and employers. Given that low-income countries face substantial financial frictions, she constructs a model that incorporates a choice of occupation (worker, self-employed, or employer), and financial frictions, to determine the degree to which financial intermediation determines the breakdown of employment.

In the model, workers are risk-averse and characterized by their assets and

current ability level. Each period, an agent faces a probability of dying, in which case they distribute their wealth to the next generation. A surviving agent has a probability each period of drawing a new ability level. Gu models financial intermediation by assuming that a fraction of wealth is lost each period, creating a wedge between the return to savings and the cost of borrowing. During each period, an agent can be in one of 3 employment states: working for an employer, working for themselves, or employing

other workers. Both own-account workers and employers use a Cobb-Douglas production technology and borrow capital to finance production, but an own-account worker is assumed to employ only themselves, while an employer is allowed to hire additional workers competitively. Production in both cases is augmented by the ability of the owner. An agent chooses between each of these three employment states at the beginning of each period.

Using a static version of the model, Gu shows that low-ability agents choose to become workers, while medium ability agents become own-

account workers, and high ability agents become employers. She shows that when there are no financial imperfections present, the distribution of wealth has no impact on the entrepreneurship choice: an agent can borrow the optimal amount of capital. However, as intermediation efficiency falls, the cutoffs for both transitioning from worker to own-account worker and from own-account worker to employer fall. However, the corresponding increase in the rental rate of capital drives low-wealth workers away from becoming either employers or own-account workers. The result is that for low-wealth economies, the overall

effect on the sizes of these occupations is ambiguous. By calibrating the dynamic model, she finds a negative relationship between own-account employment and output, and a slight positive relationship between employer share and output.

The audience took issue with the differences in savings technology between different occupations. Gu said such a feature was true in the data. It concerned others in the audience about using a static model in a paper about financial frictions. Gu stated that the static model is used to explain key concepts, and that the main model is dynamic.

How does Consumption Respond to a Transitory Income Shock? Reconciling Natural Experiments and Semi-Structural Estimations

Jeanne Commault

Commault addresses an important question in the literature on consumption and savings: how individual consumption responds to a transitory income shock. Canonical theories postulate that transitory income shocks should have little or no effect on consumption as individuals consume out of their permanent income. However, the data is inconclusive: natural experiments suggest a large response from idiosyncratic income shocks, while structural approaches based on theoretical underpinnings suggest little or no response. Commault reconciles these two approaches by allowing for a flexible, transitory shock structure. She allows us to correlate consumption growth with past income shocks. With this framework, she develops and estimates a robust estimator, finding a significant response of consumption to transitory shocks.

To motivate her approach, Commault introduces a standard life-cycle consumption model. Notably, she imposes convex preferences and a borrowing constraint, which increases the consumption risk associated with transitory income shocks. Using this

model, she derives an Euler Equation and shows that log consumption growth can be decomposed into four components: impatience, which is a comparison between the interest rates and the individual's discount rate; demographics; the current innovation, or transitory shocks; and a precautionary motive that accounts for expectations over future transitory shocks. She shows that as wealth increases, the size of this precautionary component declines, and the response to transitory shocks declines. The innovation she introduces is noting that previous transitory shocks may impact an individual's savings today, meaning that there is a covariance between current consumption and previous income shocks.

To estimate the response of consumption to transitory shocks, she sets up a system of equations that describe income and consumption growth in a reduced-form way. In a simple example, she shows that neglecting the covariance between consumption and transitory income shocks can induce a downward-biased estimate of the elasticity of

consumption regarding income. In her general model, she allows a rich covariance structure and uses the Panel Study of Income Dynamics, which allows for consumption data using the Consumer Expenditure Survey. She shows that neglecting the serial dependence causes a substantial downward bias, and that including covariance between present consumption and past income shocks increases the estimated elasticity by roughly an order of magnitude. She further shows that the results are robust to a variety of shocks and consumption classifications.

The audience questioned the source of the difference between this project and previous related work. She noted that the primary difference is that previous work assumed certainty equivalence in consumption, which limited their response to risk. This makes wealth important in her paper, but not in previous work. Another was concerned about identification and asked what happened when she performed Monte Carlo simulations on the model. She indicated that she recovered the correct empirical analogues.

Why Do Countries Experience Housing Booms? Spain vs. Germany

Laurentiu Guinea Voinea

This paper investigates the contribution of news shocks on relative prices of investment in the business cycles. First, the author identifies the so-called news shocks of residential investment innovations that best explain future variation in residential price for the Spanish and German economies using structural vector auto-regressions (SVARs). He then proposes a two-sector model with home production to interpret the propagation mechanisms described in the SVAR. The decomposed effects show that in Spain news shocks on relative prices of housing stimulate investment in residential structures while in Germany the news enhances investment in equipment and structures. He suggests that the news shocks' contribution to aggregate fluctuations is relatively more important in Spain than in Germany.

In a first part, the author documents the Spanish and German residential and non-residential investment sectors using standardized data from the European Union's KLEMS 2017 release. The relative prices of structures investment in both economies share a decreasing trend from 1970 to the late nineties. After President Aznar's housing liberalization in Spain in the late nineties, the price of the Spanish structures investment recovered the 13% drop of the previous 20 years in less than a decade and then fell abruptly in the years after the crisis reaching its 2000s level. It contrasts with a decreasing trend in Germany in the early 2000s and a subsequent recovery that continues until now. At the same time, the GDP share of non-residential structures capital doubled in Spain in 1970-2010, while it decreased for Germany by around 20%.

Residential investment prices were relatively more volatile in Spain than Germany in the last forty-five years. The relative price of residential

investment to durable consumption goods increased 45% and 15% in 1970-1980 in Spain and Germany, respectively. By the end of 1990, the price had increased by 35% for Spain and 20% for Germany compared to 1970. In the 2000s, the Spanish price augmented 40% until it crashed following the 2007 crisis. Meanwhile, the residential price of investment diminished to a lesser extent in Germany and did so earlier than Spain to recover in the post-crisis years to its pre-2000 relative level.

The author then uses SVARs to extract news shocks about future investment decisions from observed movements of the relative price of residential investment for annual data in 1970-2015. Identification of the news shock comes orthogonal innovations to the relative price of residential investment that best explains future variation in the residential price. The SVAR includes the logs of total output, consumption, hours worked, the relative price of investment, aggregate investment and its three subcomponents residential investment, business structures investment and equipment investment. The author claims the results are robust to using many different lags, despite a low number of degrees of freedom due to a short time series (46 periods), the presence of many variables (eight) and two lags. He uses Bayesian estimation with 2500 realizations to improve the estimation.

He argues that the estimated news shocks create a boom in output, consumption, investment and hours in both economies. The author finds that, for Spain, news shocks to relative prices of residential investment explain 59% of output's variance, 65% of the aggregate investment, and 80% of the residential investment. In contrast, for Germany, there are the news shocks to relative prices of business structures and equipment that explain

a higher fraction of the variance of output, consumption, and investment in business structures and equipment than the news shocks on residential investment. The Spanish impulse response function (IRF) features more persistent hump-shaped dynamics than the German IRF. The news shock for Germany explains a higher variation for the equipment investment than the Spanish one. The author compares the estimated news shocks to the Spanish business cycles and then remarks an overlap between business cycles and news shocks.

He proposes a model with non-time separable preferences in consumption and hours worked, home production, investment-specific technological change, and news shocks to the relative price of the residential investment. Non-time separability in preferences introduces a weak short-run wealth effect on the labor supply to generate comovement of the real variables in response to the news shock. There is a resulting comovement between output, consumption, investment and hours worked at the aggregate and sectoral levels. The author then compares the model's IRF to the SVAR's. The model fails to explain the higher consumption in Germany.

The audience questioned the use of annual data for these specific countries. In particular, available quarterly series can help extend the analysis and confirm its robustness. Besides, it is not clear that what the author interprets as news shocks in the relative price of the investment is in reality what he claims. Similarly, the author does not argue why Germany is a suitable counterfactual for Spain regarding the housing liberalization of the late 1990s. Likewise, the so-called news shocks appeared to pick up coincidentally the comovement of business cycles in these two countries.

Heterogeneous Effects of Housing Credit Policy

Myroslav Pidkuyko

Pidkuyko studies the impact of exogenous changes in US federal housing agencies mortgage holdings on household-level income and expenditures from the Consumer Expenditure Survey (CEX) and the Survey of Consumer Finances (SCF). The author argues that using narrative measures as an instrument for agencies' purchases achieves identification of such impact. He concludes that following an increase in agency purchases, households with mortgages increase their spending, while outright homeowners and renters do not change their expenditures.

The U.S. mortgage market is the largest capital market in the world. It is the dominant source of credit for American households. For instance, at the end of 2017Q3, total household mortgage debt was \$8.7 trillion. In comparison, auto, credit card and student loan debt combined were equal to \$2.3 trillion. There is heavy government involvement in this market through government-sponsored enterprises (GSEs) popular known as Fannie Mae and Freddie Mac. They held almost 20% of all mortgage debt in 2004's peak. Pidkuyko investigates whether the government's involvement

in the mortgage markets through these agencies impact households' spending during their life cycle.

The author uses the narrative measure constructed by Fieldhouse and Mertens (2017) to overcome confounding of mortgage purchases by GSEs with the business cycle. In the first step, he uses data of net purchases, mortgage holdings, and commitments from archives of Federal Reserve Bulletin and the narrative measure. In the second step, he estimates the impulse response of households' consumption to news shocks about the future purchasing activity of these agencies. He merges quarterly data for 4000-5000 households using income and expenditure (CEX) and mortgage portfolio composition (SCF) for 1980-2007.

In his empirical specification, he estimates impulse responses of shocks to agency mortgage purchases to a household's consumption and disposable income. To attain identification, he uses the narrative measure as an instrument of net agency purchases in a local projections IV regression. He then regresses households' income or

consumption on the instrumented agency purchases commitments made over the next following two quarters, and control variables including lagged PCE inflation, the housing price index, total mortgage debt, the log level of real mortgage originations, housing starts, and lags of several interest rate variables.

For those households in the CEX survey, the author finds that aggregate income increases by 0.01 basis points a year after the shock, while aggregate expenditure increases 0.05 basis points 6 quarters after the shock. He constructs 10-year pseudo-cohorts based on the year of birth of the household's head using 1989 as a benchmark for both surveys. He divides households into groups according to mortgage tenure (renters, mortgagors, and homeowners), mortgage maturity (less or more than a threshold of 18 years), use of a home equity line of credit (HELOC), and if the household belongs to the bottom half of the pre-tax income distribution. He finds that only households with mortgages increase their expenditure to an additional 1% increase in net purchases by federal housing agencies, while renters and owners do not react.

Borrowing Constraints, Search, and Life-Cycle Inequality

Benjamin Griffy

Griffy constructs a quantitative general equilibrium life-cycle model with search and matching frictions in the labor market and risk-averse households that accumulate human capital, and face borrowing constraints. He estimates the model using indirect inference. Using the calibrated model, Griffy explores how differences in wealth, human capital, and learning ability at labor market entry influence the life cycle. He

finds that low wealth causes workers to search for low-paying jobs and slow human capital accumulation to mitigate borrowing constraints. Differences in learning ability at entry to the labor market changes the return to human capital accumulation and earnings growth and has the most substantial change in life-cycle consumption.

Households are initially endowed with wealth, human capital and learning

ability. They can be either employed or unemployed, and search for jobs in both employment states. When workers are employed, they can devote time to either human capital accumulation or production. Investing in human capital is risky due to potential depreciation over time, uncertain returns and its lack of tradability. When they face unemployment, their human capital depreciates and they might not receive unemployment insurance. Workers

face a trade-off between the risks of not finding a job quickly versus accepting a low pay job. Risk-neutral non-vacant firms produce using human capital and separate either exogenously or endogenously (workers search on the job). Vacant firms pay a fixed cost to post profitable vacancies and match subject to market tightness. Free entry of firms pins down the value of a vacancy. A block recursive equilibrium for such an economy is a set of value functions, associated policy and market tightness functions that satisfy the workers' maximization problem, the free entry condition in all labor submarkets, and the aggregate law of motion is consistent with the policy functions.

The author uses indirect inference to estimate structural parameters using the matching between selected reduced-form empirical moments and those from simulated data. In particular, he minimizes a weighted average of differences between regression

coefficients from actual and simulated data. The moments to match are the effect of wealth on job search behavior, the regression coefficients of initial wealth quintile on earnings, and the marginal distributions of pre-labor market wealth, earnings at first job, and average and variance of earnings growth rates. The key targets are the borrowing constraint and search behavior. Griffy uses state-month variation from the Survey of Income and Program Participation to estimate the elasticity of re-employment wages to unemployment insurance benefits, across different net liquidity wealth quintiles.

He finds that the application strategy and the human capital accumulation channels are essential mechanisms of life cycle earnings growth. In his main counterfactual experiment, he shifts the baseline wealth distribution by one standard deviation and quantifies the change in consumption, earnings, human capital, and the piece-rate.

However, the effects of such an experiment are not linear. He finds that an increase of one standard deviation in initial wealth causes a considerable increase in the learning-time policy rule. The magnitude of this effect is lower if the shock involves a decrease of one standard deviation in initial wealth. He provides evidence that an increase in one standard deviation in initial wealth and learning ability causes 23.9% and 24.7% more consumption, respectively. In contrast, a one standard deviation increase in the human capital only increases consumption by 9.7%.

The audience question segmentation of the labor market by wealth. They asked about how to introduce different patience levels in the model. The speaker said heterogeneous discount rates could capture different levels of patience. It concerned the audience that some graphical results of the annual earnings during the life cycle were due to over-smoothing.

Optimal Pensions in Segmented Financial Markets

Giacomo Caracciolo

Caracciolo studies the optimal size of social security in the presence of limited asset market participation and heterogeneous returns to wealth. He develops an overlapping generations model with two generations, which work when they are young and retire at a specific age. Households have differential initial wealth levels, a bequest motive, face longevity risk and heterogeneous labor efficiency paths over the lifetime. Using the calibrated model, he analyzes the welfare and distributional consequences of typical systemic and parametric pension reforms. Pensions can be socially optimal, depending on the size of the financial friction, and their return relative to the low-yield storing technology. The optimal size of social security crucially depends on how many households are close to the financial restriction threshold. The type of pension scheme

affects the stationary distribution of wealth and consumption.

Households enter the economy at age 25, work until 65 and reach a maximum age of 100. They face age-dependent survival probabilities and inelastically supply one unit of labor during their working years. Their utility comes from consumption and bequests. Households have heterogeneous initial wealth endogenously determined by bequests, initial labor efficiency and its evolution in their lifetime. However, optimal consumption smoothing is not possible due to the financial friction. Specifically, a minimum capital investment requirement selects agents into those who have access to the higher market return and those who do not. Pensions allow agents to partially overcome the financial friction, i.e., to access either the return to capital or

the return of the economy depending on the specific pension arrangement—either a fully funded system (FF) or a pay-as-you-go system (PAYG). A representative firm produces output using a Cobb-Douglas technology with constant returns to scale and hires labor and capital in perfectly competitive factor markets.

In his calibration, the target parameters are the capital share, the discount rate, the relative risk-aversion coefficient, the depreciation rate, the utility's parameters for bequests, the storage technology return, the total factor productivity, and the rate of technological progress. In particular, he wants to calibrate the elasticities in consumption such that the utility from consumption displays higher curvature than the one obtained from bequests, following previous literature, which implies increasing savings rates

to wealth. Caracciolo uses, in the calibration, the increasing dispersion and a typical hump-shaped profile of the labor earnings as households grow. In doing so, he computes the labor earnings profiles by ranges of 10 years of age from the Panel Survey of Income Dynamics following Heathcote, Perri & Violante (2010). Likewise, the author uses the age-dependent survival probabilities using the 2014 US Actuarial Life Table from the US Social Security Administration. He assumes no population growth of the newborn which implies that both fertility and mortality rates are constant across time in the stationary state.

Using the calibrated model, the author assesses, in the absence of social security, how different levels of the minimum investment requirement affects the stationary equilibrium distribution. When the minimum investment requirement increases (given that it is in a relatively high level), a higher proportion of the low-skilled households is excluded from the capital market. Consequently, the amount of capital supplied to firms falls and so do wages and output. It implies an increase to the return of capital and a reduction

in the average return to savings. Further increases in the minimum investment requirements generate higher a wealth Gini coefficient.

In the policy experiments, the author assumes that the social planner chooses an optimal tax rate, which pins down the size of social security, to maximize a utilitarian social welfare function. In a PAYG scheme, a positive tax rate will crowd out private savings and make the minimum investment threshold harder to reach and, thus, reducing the lifetime utility of wealthier households. The author concludes that this specific form of social security promotes risk sharing both across households belonging to different income groups and across different generations. On the other hand, in a fully funded system, he argues that households insure against demographic risk and benefit from the high market return by pooling resources together. The mechanism implies a reduction in the disposable labor income during working age and a crowding out of private savings

The author seeks to extend the model in five ways. First, he wants to introduce effort to model the

dispersion in heterogeneous returns to wealth. He still lacks an interesting experiment to run like an aging shock or transitional dynamics. Third, the basic model takes capital as a risk-free asset. Fourth, in an extended version of the model, initial wealth can correlate with the labor income path to generate a more realistic wealth distribution. Fifth, the basic model lacks households that choose their labor supply.

The audience questioned why individuals could not set up mutual funds, which implies a convexification of the interest rates and the intertemporal budget set. They asked what happens if, instead of having one wealth restriction to invest in higher return assets, there are multiple investment possibilities for different wealth brackets. Additionally, they wondered if the introduction of depreciation in capital or savings modifies the primary results of the model. Similarly, the survival probability does not depend on the wealth profile, the labor income path, or other household-specific characteristics. Finally, they asked about the equilibrium's dynamic efficiency given the presence of two interest rates.

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