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From the Lab Nov. 2023

Director's Message

Finn Kydland



2nd Annual Labor Markets and Macroeconomic Outcomes

This workshop was co-sponsored by Stony Brook University and took place at the Upham Hotel in Santa Barbara. This year's annual workshop had a dual track focus. First, we featured papers that focus on cyclical labor market outcomes. Second, several papers grappled with relationships between labor market outcomes and other household decisions, such as expenditure, savings, or home production. In making up the program, particular consideration was given to papers exploring any of the above topics using novel datasets and/or explicitly axiomatized micro-founded structural mechanisms. The conference organizers were Adam Blandin (Assistant Professor, Vanderbilt University), Ben Griffy (Assistant Professor, University at Albany), Nick Pretnar, (Postdoctoral Scholar, UCSB-LAEF), and David Wiczer (Associate Professor, Stony Brook University). Among the presenters for this conference were Nir Jaimovich, Dirk Krueger, and Victor Rios-Rull.

12th Advances in Macro-Finance Tepper-LAEF Conference at CMU

The Tepper School of Business at Carnegie Mellon University and the Laboratory for Aggregate Economics and Finance at the University of California, Santa Barbara, held the 12th conference on Advances in Macro-Finance, designed to bring together leading scholars doing research at the intersection of macroeconomics and finance. The conference consisted of selected papers plus a formal discussant for each paper. Both theoretical and empirical research were welcomed on topics including, but not limited to the impact of financial and investment frictions; labor markets; credit risk and corporate financing; models of risk premia; determinants of income and wealth inequality; household finance; and taxation.



2nd Annual Labor Markets and Macroeconomic Outcomes

April 14-15, 2023, Conference Participants

Alexander Bick – Arizona State University & FRB St. Louis
Javier Birchenall – UC Santa Barbara
Adam Blandin – Vanderbilt University
Martin Gervais – University of Georgia
Victoria Gregory – Federal Reserve Bank of St. Louis
Ben Griffy – University of Albany
Nir Jaimovich – UC San Diego
Karen Kopecky – Federal Reserve Bank of Atlanta
Dirk Krueger – University of Pennsylvania
Finn Kydland – UC Santa Barbara
Yueyuan Ma – UC Santa Barbara
Amanda Michaud – Federal Reserve Bank of Minneapolis

Carla Moreno – Loyola Marymount University
Nick Pretnar – UC Santa Barbara
Ray Riezman – University of Iowa
Jose-Victor Rios-Rull – University of Pennsylvania
Peter Rupert – UC Santa Barbara
Todd Schoellman – Federal Reserve Bank of Minneapolis
Kjetl Storesletten – University of Minnesota
Daniela Vidart – University of Connecticut
David Wiczer – Stony Brook University
Yang Xuan – Stony Brook
Kwanjai Yoo – Stony Brook



Baumol's Cost Disease and the Distributional Impact of Sectoral Shocks

Nitty Bergman, Itay Saporta-Eksten, and **Nir Jaimovich**

Productivity can change in various parts of the economy, with lasting effects for workers. Nir Jaimovich presented work asking how sectoral total factor productivity shocks affect welfare through a skill premium and the different consumption patterns between high- and low-skill workers.

Jaimovich and his coauthors use a multi-sector model that takes high-skilled and low-skilled labor inputs to produce different goods. The model allows workers to move freely between sectors and assumes that skill intensity needed varies across sectors. The model assumes competitive prices for goods and wages for both worker types. A Cobb-Douglas production function is used to simplify the analysis, as it maintains constant shares of high-skilled and low-skilled labor. The study then investigates how the skill premium changes due to sector-specific shocks and how these changes are related to preferences, wages, and each sector's share of high-skilled and low-skilled workers.

The authors use the Consumer Expenditure Survey to obtain expenditure shares by consumption category and income, as well as expenditure, income, and price elasticities. On the production side, measures of low and high-skilled workers by consumption category data are obtained from the Bureau of Labor Statistics. The study allows for the possibility that preferences might change over time.

The study finds that sector-specific shocks can alter the relative demand for high-skilled and low-skilled labor, leading to fluctuations in the skill premium. Accounting for these changes is crucial when assessing the impact of sector-specific supply shocks on the skill premium, consumption, and the overall economy. The presenter emphasized that the main driver of inequality is the skill premium effect, not the differences in consumption baskets, and showed that high-skilled individuals generally benefit

more from productivity shocks than low-skilled individuals.

The audience raised questions about capital and elastic labor supply. The presenter pointed out that there is no capital in this model and that they assume elastic labor supply. Although the researchers acknowledge the model's limitations, they highlight its value in offering a framework to analyze the effect of sectoral shocks. In the model, high-skilled workers receive different wages than low-skilled workers, an important factor when modeling consumption responses to different shocks. The researchers also emphasize that their framework is applicable not only to supply shocks but also to demand shocks and government redistribution across sectors.

Determining the elasticity of the skill premium in response to sector-specific shocks is vital for understanding how the economy and consumption patterns are influenced by productivity shocks. By examining the relationships between wages, consumption shares, and production functions, we can gain valuable insights into the economic dynamics and their effects on the skill premium.



Subjective Earnings Risk

Andrew Caplin, Eungik Lee, Søren Leth-Petersen, Johan Sæverud, and **Victoria Gregory**

Despite its importance, little is known about the accuracy of people's expectations about their future incomes, particularly in transitions. Victoria Gregory presented work measuring and modeling earnings risk using novel Danish survey data. The study tries to determine if earnings risk inferred from administrative data significantly differs from subjective expectations. To attempt this, Gregory and her co-authors designed a survey to measure expectations about job separation, time out of work, and the probability distribution of earnings a year ahead.

Regarding job transition probabilities, the authors found that people reported non-trivial amounts of time out of work after quitting, which raises the question of whether they are considering job-to-job transitions. Some respondents assigned a 100% probability of getting back to work within a month, which might indicate that they expect a swift transition. When it comes to eliciting probability distributions for earnings, they used the balls and bins method, which allowed respondents to visually represent their expectations, then simulated the empirical distributions by drawing from a mixture of uniform distributions. These results provide valuable insights into people's expectations and beliefs about their labor market outcomes, which can be used to inform economic models and policy decisions.

The authors measure the distance between the 10th and 90th percentiles of the earnings growth distribution in the administrative data. This range is used as a measure of variability in earnings growth. In the presented study, the interdecile range of the pooled survey data is found to be very close to the interdecile range of the administrative data. However, the typical interdecile range of the distributions reported by individual respondents in the survey is much lower. The study further shows that

the more heterogeneity there is in the mean expected income growth rates, the larger the divergence will be between the survey and administrative data.

A main finding of the survey is that subjective earnings risk is lower than what would be inferred from administrative data. Job transitions, both voluntary and involuntary, are important in understanding this discrepancy. The authors compare the beliefs inferred from a standard job search model with the beliefs measured in their survey. They find that the risk profiles around quits and layoffs in the model are higher and more heterogeneous than those in the survey. This suggests that the mechanisms in the model that lead to the right kinds of outcomes do not necessarily generate beliefs that match the data.

If researchers want to create a model that matches beliefs, they would need to modify the model in a different way. Potential future directions for this research include exploring whether the discrepancy between perceived risk and actual risk can explain why people hold so few financial assets, and examining how beliefs are formed and updated in response to income realizations.

The audience asked about the goal of the research, the credibility of the survey, the differences between subjective and administrative data, and whether the research could say anything about overconfidence. The presenter explained that their research is still ongoing, but they have found that subjective expectations generally exhibit lower risk than what is inferred from administrative data. They also plan to explore the relationship between perceived risk and saving behavior in the future.



Hours Worked and Lifetime Earnings Inequality

Adam Blandin, Richard Rogerson, and Alexander Bick

The drivers of inequality are hotly debated, and one factor that appears to play a role is the number of hours worked. Alexander Bick and his co-authors focus on the role of hours worked on lifetime inequality, along with other factors, such as human capital, education, skill premium, returns to experience, unemployment spells, and discrimination.

A major part of the research endeavor was dedicated to constructing long and balanced panel data on hours and earnings, in order to better investigate the relationship between hours worked and earnings. The researchers found a strong correlation between hours worked and earnings, with those who worked more hours tending to have higher lifetime earnings. This sparked a debate about whether the relationship was driven by preferences, frictions in the labor market, or a combination of both.

Some participants suggested that the relationship between hours worked and earnings could be explained by search frictions or heterogeneity in preferences for work and leisure. The presenters also highlighted the importance of accounting for hours worked when calibrating human capital models used in policy analysis. They argued that neglecting hours worked could lead to overestimating the importance of initial human capital and learning ability, which could in turn affect the conclusions drawn from policy experiments.

The speaker presented cross-sectional data on mean hours over the life cycle that showed hours worked increase slightly over time while young and have much higher variance on an annual basis. They find that variation in hours worked is largely driven by weeks worked, with little variation in hours per working week, and highlight the persistence of hours worked over time and the positive correlation between hours worked and earnings growth.

The model considers preferences over consumption and

leisure, investment in human capital, and heterogeneity in initial human capital and learning ability, as well as transitory heterogeneity. It shows that individuals with high learning ability will invest more in human capital and that those with high human capital face a trade-off between investing and producing. The model also suggests that the majority of investment in human capital occurs when individuals are young, as they want to reap the benefits for a longer period.

To compare two models that account for hours worked and investment in human capital, the researchers simulate giving everyone the mean age-specific hours profile and the age-specific ratio of investment to production, thereby shutting off all variation in hours worked. They find that 18% of the variance of lifetime earnings in the model with homogeneous preferences comes from variation in hours, whereas in the model with heterogeneous preferences this figure is around 40%. In comparing the roles of initial human capital, learning ability, and shocks to human capital over the life cycle, the authors find that the standard deviation of initial human capital and learning abilities is higher in the model with homogeneous preferences, as a lot of the variation is assigned to these parameters and to the persistent shocks. In terms of the correlation between initial human capital and preference for working, those who have high initial human capital are more likely to prefer working.

The presentation did not specifically address gender differences, but the presenter noted that they will soon be documenting these facts by gender. In a final exercise that included a tax rate change, the presenter commented that it would be interesting to know how the results would differ with the inclusion of gender. Throughout the presentation, various questions from the audience were raised, concerning the underlying

mechanisms behind the relationship between hours worked and earnings, potential alternative explanations, the implications of their findings for policy analysis, and the limitations of their research in addressing long-term trends and the bottom segment of the hours distribution

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Wealth, Wages, and Employment

Per Krusell, Jinfeng Loo, and Jose-Víctor Ríos-Rull

Although study of macroeconomics traditionally focuses on the joint dynamics of output, consumption, investment, interest rates, and employment, recent research has emphasized the importance of also including gross employment flows, which include transitions in and out of employment, unemployment, and outside the labor force. Jose-Víctor Ríos-Rull presented a new model that links vacancy posting with investment and considers an environment where the joint distribution of employment, wages, and wealth is determined, and where workers are risk-averse and only use self-insurance. Workers sometimes lose their jobs or quit, generating gross flows that are a form of employment and wage risk.

The model is useful for the study of business cycles and for policy analysis. It allows for a comprehensive examination of the response of risk, employment, wealth, and wages to policy changes. Additionally, it provides insights into the extent of wage rigidity.

The model was developed incrementally, starting with exogenous job destruction and worker quits, built on top of an existing growth model. This initial model exhibited little wage dispersion and low job creation during expansions. Endogenous quits were then added, which increased wage dispersion and kept workers longer in higher-paying jobs. On-the-job search, where workers receive outside job offers while still employed, was also introduced. Finally, the model included the outside labor force margin, where workers transition between unemployment and not actively searching for work.

The model assumes that jobs are created by firms, with a plant and a worker producing one unit of a good. Firms pay a flow cost to post a vacancy in the market, but cannot change the wage afterward. Plants and their capital are destroyed at a given rate, and workers quit

exogenously, leaving firms idle. Households differ only in wealth and wages, and there are no state-contingent claims or borrowing. Employed workers receive wages and save, while unemployed workers produce a basic good and search for jobs.

The key finding is that fully fixed and committed wages lead to counterfactual procyclical unemployment and massive on-the-job search. Allowing the wage of an already-formed job match to respond somewhat to aggregate shocks corrects this problem. Getting the right relative volatility of old and new wages and the amount of job-to-job moves and quits provides a way to measure wage rigidity. With partial wage rigidity, the model fares reasonably well with the data, although there are still areas for improvement.

One shortcoming of the model is the perfect correlation between age and wealth at the time of starting a job, which seems counterfactual. To overcome this, the authors suggested some possible solutions. Also, unemployment volatility is too high, and the authors will explore how the model responds to a more detached workforce via the outside labor force margin. Job-to-job transition volatility can be replicated, although the amount of wage rigidity implied is yet to be determined.



Minimum Wage and Unemployment Insurance

Roozbeh Hosseini, Larry Warren, and **Martin Gervais**

The coronavirus pandemic and the government response to it has raised many questions about the consequences of the massive expansion of benefits. Martin Gervais presents work that examines the potential role of unemployment insurance in targeting wages, specifically in the context of reservation wages.

Gervais and his co-authors focus on the Coronavirus Aid, Relief, and Economic Security Act, or CARES act, which provided an extra \$600 a week of unemployment insurance, or UI, benefits. This amount is equivalent to a wage of \$15 an hour for a 40-hour work week, leading to the proposition that no one should accept a job for less than \$15 an hour, essentially setting a minimum wage at this level. Can unemployment insurance be used to target wages, and how are reservation wages affected by these benefits?

To address this question, the team of researchers first documented relevant facts using two primary sources of data: the Current Population Survey (CPS) rotation data and Benefit Accuracy Measurement (BAM) data. With the CPS rotation data, the researchers computed the wage premium of UI-eligible job finders, relative to UI-ineligible job finders. They found that this wage premium barely moved in 2020, but increased by about \$50 a week in 2021.

But there are problems associated with this approach, including sample size, selection, and the unique circumstances of 2020. Utilizing BAM data, the researchers identify a strong relationship between reservation wages and past wages, but not as strong a relationship between reservation wages and benefits. This finding suggests evidence of selection into the status of a UI claimant, especially in 2021. To further analyze the pass-through of UI benefits to wages, the researchers introduce a UI system in a directed search

model. This model considers factors such as the take-up margin, benefits financed by an earnings tax, on-the-job search, and the expiration of benefits. The key element in this model is the endogenous take-up of benefits.

The empirical evidence from the CPS Rotation Data shows that the wage premium of eligible versus non-eligible workers is positive, with a modest increase in the wage premium under extra benefits. This increased wage premium primarily comes from benefit collectors.

According to the model of these authors, the CARES Act and subsequent relief packages do not appear to have effectively influenced reservation wages in the long run. This suggests that policy interventions aimed at raising wages should focus on other mechanisms, such as direct adjustments to the minimum wage or targeted support for specific industries and populations. The study highlights the importance of understanding the complexities of the labor market and the various factors that influence both employers' wage-setting decisions and employees' reservation wages. The endogenous decision to file for UI benefits is just one example of these complexities.

To effectively design policies that promote higher wages and improved working conditions, policymakers must consider the intricate interactions between UI benefits, reservation wages, labor market conditions, and the broader economic environment. The research underscores the need for further investigation into the role of UI benefits in the labor market. Given the limitations of the data sources used in this study, future research could explore more granular data or alternative datasets to obtain a deeper understanding of the relationships between UI benefits, reservation wages, and employment outcomes.



Labor Market Anatomy of a Macroeconomic Crisis

*Kevin Donovan, Will Jianyu Lu, Joseph H. Pedkte, and **Todd Schoellman***

Despite our strong understanding how macroeconomic crises affect production, investment, consumption, and government debt, relatively little attention has been paid to how these crises affect individual workers. Todd Schoellman and his co-authors address this gap by investigating the welfare costs of crises for workers, theoretically and empirically.

The researchers develop two primary data sources. First, they create an aggregate dataset on unemployment and per capita GDP that covers 75 countries and 308 recessions. This dataset allows them to characterize recessions and macroeconomic crises across a wide range of countries and situations. Second, they use micro data from rotating panel labor force surveys, which include 38 countries, 71 million workers, and 111 recessions. This data allows researchers to explore how shocks propagate through the economy. In particular, the data can show which workers are most likely to lose their jobs and what happens to them after they do.

The study claims that the distribution of labor market outcomes is broader than previously estimated. Furthermore, it claims that labor market consequences of macroeconomic crises are more extensive and varied than earlier literature suggested, with stronger welfare implications. These crises tend to be associated with a small set of shocks, such as house price busts, financial crises, and the COVID pandemic. This relationship is descriptive rather than causal, and warrants further exploration into underlying mechanisms.

According to the authors, the anatomy of the shock is balanced across many dimensions, but falls most heavily on disadvantaged workers. The researchers trace the impacts of macroeconomic crises along various dimensions, such as sectors, separations versus job-finding, and worker characteristics. They find that

while the effects of crises are relatively balanced along these dimensions, they disproportionately impact young, low-skilled individuals. In light of these new findings, the study calls for a reassessment of the welfare costs of macroeconomic crises.

During the presentation, the audience raised several questions, including whether unemployment is a lagging indicator in other countries and questions about the duration and severity of recessions. Currently, the researchers are working on a quantitative evaluation of these findings, incorporating an Aiyagari-Bewley-Huggett model with unemployment and social insurance. By selecting specific countries for analysis, they aim to provide a more robust and nuanced understanding.



The Causal Factors Driving the Rise in U.S. Health Services Prices

*Maria Feldman and **Nick Pretnar***

In contrast to other countries, the United States has experienced high relative price increases in health services. In fact, since 1960, health service prices have risen at more than twice the pace of other prices. Nick Pretnar and his coauthor highlight two potential mechanisms underlying this phenomenon. The first is sector-specific change, including unbalanced sectoral productivity growth and rising market concentration in health services. The second is population aging, where older consumers demand ever-more health expenditure as they age in order to ensure survival.

The authors demonstrate that both the share of personal expenditure devoted to health services and the relative price of health care exhibit a clear upward trend over time. Pretnar confirmed that the same patterns held if health services were measured by share of GDP, in response to a question from the audience. A participant asked whether variation in quantities or prices drove changes in the health expenditure. Pretnar replied that quantity changes had direct effects, but fed back into prices in the general equilibrium.

The authors build a model with endogenous population dynamics and two production sectors. There are overlapping generations, each characterized by representative agents. Health outcomes are an endogenous function of health spending, while survival probability each period is an endogenous function of health. Regarding firms, there is a perfectly competitive sector producing non-health consumption and investment and a monopolistically competitive health-services sector. Heterogeneity exists in sectoral total factor productivity and capital intensities. Health expenditure contributes to total health and survival rates via negative effects on non-accidental mortality rates.

A participant asked whether different aging, technology and health industry patterns seen in various countries could be studied. Pretnar answered that they were not focused on cross-country comparison. When answering two questions from the audience, the speaker clarified that they did not consider human capital and that health was not a state variable. One participant asked why flow utility was defined on non-health consumption only, rather than in health services and non-health consumption. Pretnar replied that, in their model, age was complementary to future consumption. One had to live to the next period to consume, so health spending impacted effective discounting via endogenous survival rates shown in the recursive optimization problem.

The authors calibrate the model to a transition path from 1960 to 2015. Counterfactual experiments are run by turning off various exogenous and endogenous growth mechanisms to assess what has driven up the relative price of health care. Results indicate that production-side factors, particularly market concentration and differences in productivity growth, appear almost entirely responsible for both rising health-services prices and health shares of spending. Population aging is not playing a central role.



The Impact of Pension Systems in Labor Markets with Informality

Carla Moreno

In Peru, about two-thirds of the working force is informal and 54% of adults over age 65 are not covered by any pension scheme. This dynamic extends to many parts of the world, as 60% of the world's total labor force is informal. The interaction of pensions and employment status may be important for distinct labor markets, which Carla Moreno studies in markets with informality.

In response to a question, the speaker defined informal labor as workers in employment arrangements that are not subject to national labor legislation, income taxation, social protection, or entitlement to certain employment benefits. A participant asked how its measured. The speaker replied that these workers who said in surveys that they were not contributing to the pension system. With a focus on the Peruvian context, Moreno studies whether the pension system design has an impact on workers' decisions about formality status and welfare, as well as implications of alternative pension system designs.

A participant asked whether farmers counted as informal labor. The speaker answered that she did not consider the agricultural sector in the analysis and that this group was not likely to transition between employment status. Hence, farmers were not a focus for her.

The author builds a heterogeneous agent life-cycle model with endogenous labor informality, where a worker's optimal choices are explicitly modeled over formal and informal sectors in each period and over different pension systems. In the model, there are three different sectors: formal worker, informal worker and informal self-employed. Mechanisms affecting a decision to be formal or informal include sectoral wage gap, earnings risk by sector, job opportunities in formal and informal sector, labor income taxes, and pension system features (e.g. contribution rate).

In working years, workers make a consumption-saving decision and an optimal sector decision in each period, with only formal workers contributing to a pension system. A participant asked what governed the dynamics in the model, and the speaker replied that the dynamics were mostly on informal workers. At the first formal job, a worker must choose a pension system between a public pay-as-you-go-style option and the individual account. Retirees receive a pension if available. The speaker said that returns were higher for the individual-account pension system and that agents could save outside the system, in response to two questions from the audience.

The model is calibrated to quarterly panel data of the Peruvian National Households Surveys from 2011 to 2018 and show that the current pension structure discourages formal working, despite a higher formal wage, due to the liquidity constraint imposed by mandatory contributions in the formal sector. Counterfactual analysis suggests that removing contributory pensions increases the labor formality rate and has a positive effect on the government budget, due to a higher tax base. This represents welfare gains of 3.8 percent. If the policymaker has to choose a contributory pension system, results indicate that, in an informal economy, a pay-as-you-go-only system is welfare-improving and may attract workers to take formal jobs, in comparison to offering only an individual-account system or simultaneously offering both.



How do Workers Learn? Theory and Evidence on the Roots of Lifecycle Human Capital Accumulation

Xiao Ma, Alejandro Nakab, and **Daniela Vidart**

Evidence shows that 71% of large firms with more than 100 workers provide both internal learning from colleagues and external training programs, according to Daniela Vidart and her co-authors. But how do different sources of worker learning interact and contribute to on-the-job skill acquisition over the life cycle? Using worker-level and firm-level data from Germany and the U.S., the authors examine this question and introduce a dual-source learning mechanism into a quantitative search framework to investigate the relative importance of internal and external learning in explaining human capital growth.

One participant raised a question about whether these trainings apply to all workers or only some of them. To address this, the speaker presented a statistical summary of the average number of training hours per worker across firms of different sizes. The current data did not directly indicate who uses these resources. Workers in larger firms receive almost twice as many training hours on average compared to those in smaller firms. This suggests that larger firms not only offer more diverse learning courses but also provide more opportunities for their workers to receive training.

The authors found that internal learning tends to decrease as worker experience increases, while external training shows an inverted U-shaped pattern over worker experience. These findings were consistent across both the German and U.S. data and were robust even after controlling for variables such as gender, education, and age. One participant raised a question about whether both internal and external learning sources generate direct knowledge, and the speaker said that this was a fair assumption. The speaker said that the literature has shown that external and internal learning may teach the same skills but differ in the way the teaching is experienced. Another participant mentioned that in the U.S., an important external

training source offered by firms is employer-reimbursed college expenditure, which is tax-free up to \$5,000 a year. The speaker clarified that the focus of their research was on-the-job training and did not include schooling, such as college courses.

The authors incorporated a dual learning mechanism in a standard search framework to examine the interactions between firms and workers in learning investments. They considered three types of learning in their model, including internal learning from colleagues, external learning from an external trainer, and learning-by-doing. This model equilibrium replicated the empirical findings on the two learning patterns and highlighted the importance of firm matching and coworker quality in human capital formation. One participant raised a question about whether the authors considered age-dependent learning techniques. The speaker clarified that they did not incorporate this consideration into their model. Another participant mentioned that the authors did not model active searching behavior by workers, but instead set it as an exogenous probability. The speaker responded that they followed the baseline model setting for this study, but acknowledged the need to consider workers' active search behavior in future studies.

In calibrating the model, the authors found that learning spillover effects and learning costs together explained almost half of the life-cycle wage growth from human capital accumulation. A participant asked if the authors considered how working from home during the COVID-19 pandemic affected external learning costs and the composition of internal and external learning patterns. The speaker responded that, due to data restrictions, they could not provide much information in their current study but acknowledged the importance of examining it in future research.



Until the IRS Do Us Part: (Optimal) Taxation of Families

Hans A. Holter, Serhiy Stepanchuk, **Dirk Krueger**

Labor markets in Scandinavia offer a paradox for economists. Scandinavian countries have high and progressive taxes and among the highest labor force participation rates, employment rates, and incomes per capita. Female employment is especially strong. Having observed that Scandinavian countries tax married couples individually, Dirk Krueger and his coauthors attempt to quantify the impact of the interaction of tax progressivity and separate taxation of couples on the labor participation of married and single individuals, tax revenues and welfare.

The authors argue that the combination of higher tax progressivity and reform towards individual taxation might increase participation of married individuals, especially women, by delivering a lower average tax rate for the secondary earner and a negative household wealth effect due to higher average tax rate on the primary, often male, earner. In addition, this combination potentially increases tax revenues and overall welfare.

A participant asked whether taxes affected selection into marriage. The speaker answered that marriage was invariant to the tax system in their modeling assumption and that considering this margin might alter the results. Another participant asked about the types of taxes considered. The speaker replied that they focused on labor income taxes, but also incorporated consumption and capital income taxes.

The authors estimate a tax function that parametrizes tax progressivity and the degree to which married couples are taxed jointly, for single and married households in 17 OECD countries from 2001 to 2019. In a set of country-level panel regressions, they empirically document a strong positive interaction between tax progressivity and "tax separateness," when predicting the employment rates of married individuals. Higher progressivity increases

the effect of shifting from joint to individual taxation on employment. A participant raised concerns over a potential confound: government spending on such things as child-related transfers. The speaker said that these should have been controlled for by the country and country-time fixed effects.

The authors build a quantitative overlapping generations model with couples and singles, endogenous labor supply, asset accumulation and household heterogeneity. The labor supply decisions of both spouses cover a standard intensive margin, as well as an operative extensive margin with disutility (a cost) and accumulation of experience if participating. The benchmark fiscal policy is tax progressivity. A participant asked whether the rate schedule of separate taxation was common between groups. The speaker replied that under separate taxation, the tax rate on married men or women was different from that of singles, but the tax progressivity did not differ between married men and women. He added that optimal taxation might change if one were to allow different degrees of tax progressivity for women and men that are married.

The authors match selected aggregate, fiscal and cross-sectional moments to calibrate their model to United States data from 2010-2019. The model successfully replicates the empirical patterns. Going from joint to separate taxation increases the employment rate of married women by 17% and 34% under current and two-times-current U.S. progressivity, respectively. Combining a relatively progressive tax system with individual taxation generates more revenue than at present, while improving welfare across cohorts.



From Trend to Cycle: The Changing Careers of Married Women and Business Cycle Risk

Kathrin Elleroth and **Amanda Michaud**

The proportion of married women that are employed has risen remarkably over several decades, now accounting for 20% of aggregate hours. Meanwhile, married women have had about half the hours volatility as other groups, reducing aggregate hours volatility by 12%. Motivated by these facts, Amanda Michaud and her coauthor study how the rise in married women's employment has impacted the U.S. business cycle dynamics. By providing a unified theory of trends and cyclical dynamics, the authors show how some factors driving the trend increase cyclical volatility and others reduce it.

A participant asked why they focused on married women. The speaker answered that single men and single women behaved similarly, but married women's behavior was distinct from every other group. Another participant raised a question on whether selection into marriage for highly educated women drives up employment. The speaker expressed doubt about this explanation and stressed that the employment patterns emerged long ago.

Married women's lower cyclical volatility is mostly driven by their counter-cyclical attachment or procyclical labor force exits. Many of them are on the margin of labor supply during normal times, but are less likely to leave the labor force during recessions. Regarding the trend, married women's labor force attachment has drastically increased over time relative to other groups. A participant asked whether cohabiting couples were considered. The speaker clarified that they only studied women in a formal and legal marriage.

To replicate the lower cyclicality of women's employment, the authors construct a partial equilibrium life-cycle model of women's careers and business cycles. The model incorporates a unitary household consisting of a husband

and a wife. Recessions are periods of low job-finding or high job-loss probabilities, and lower wages. Married men face an exogenous income process while married women make labor supply choices. Among married women, the employed choose hours worked and can quit, and the unemployed choose search intensity. The model includes *ex-ante* heterogeneity in the life-cycle fixed cost of work and in the permanent productivity of a wife and a husband. In addition to the market income and asset income, home production of the wife provides resources to the household's budget, a key to preventing high employment fluctuations. In the model, women are less likely to exit when marginal utility of consumption rises due to lower husband or asset income; when fixed cost of work is low or wage at work relative to home productivity is high; and when returns to experience are high or precautionary motives are strong to keep a job in case the husband loses his in the future. Hence during recessions, insurance motives and job hoarding lead to pro-cyclical exits.

Results from the calibration exercise are consistent with the model implications. Married women are more likely to stay in the labor force during recessions or when the husband is unemployed. The less attached "life-cycle" type of women contributes to less decline in hours and employment during recessions. A participant suggested that introducing technological progress in home production or changes in social norms might be valuable for future work.



Serial Entrepreneurship in China

*Loren Brandt, Ruochen Dai, Gueorgui Kambourov, Xiaobo Zhang, and
Kjetil Storesletten*

Because of its widely accepted position as a driver of economic growth, entrepreneurship is the subject of a large research literature, in particular on what factors encourage or discourage it. Serial entrepreneurship, when entrepreneurs start more than one firm, has drawn less attention. Kjetil Storesletten and his co-authors study serial entrepreneurship in China, where firm entry is responsible for much of productivity growth and where a large share of firms are started by serial entrepreneurs.

A participant asked whether serial entrepreneurship, or SE, included those who tried but failed to create more than one firm. Storesletten replied that those cases were not studied. In response to another question from the audience, the speaker clarified that those who started but did not run the additional firms were still considered an example of SE. This naturally led to a discussion of the definition: (1) an entrepreneur is an individual investor with the largest share at the time of firm establishment or acquisition; a serial entrepreneur is an individual who is or was the entrepreneur of more than one firm. One participant asked how they could know the individual share of firms for those not publicly traded. The speaker replied that their data set was rich with ownership information, drawing from the Business Registry of China and firm inspection data. SE is quantitatively important and plays a more important role over time in the data. The average registered capital is around double for serial than for non-serial entrepreneurs, and 83% establish their second firm concurrently with the first firm.

To rationalize the observed SE behavior, the authors develop a simple two-period model emphasizing the role of equity, ability, and distortions. In the model, risk-neutral entrepreneurs can start one firm each period. The total factor productivity of a potential new firm is stochastic, and the productivity of the second

firm is correlated with that of the first. A firm has decreasing-returns-to-scale production and faces a collateral constraint so that its capital cannot exceed a certain fraction of its equity. Consequently, entrepreneurs may be constrained or unconstrained when making the optimal capital and debt decisions; hence a role for financial frictions.

Observations in the data on the relationship between capital, equity and total factor productivity, or TFP, are consistent with model implications. In the first period, an entrepreneur with equity observes TFP for a potential firm and then decides to operate the firm if and only if TFP exceeds an optimal threshold. In the second period, an entrepreneur who operates a firm in the first period can choose whether to start a new firm. A participant asked whether operating new and old firms concurrently depended on the decreasing-returns-to-scale production. The speaker confirmed that it did and that the entrepreneur would simply operate the most productive firm if production had constant returns to scale.

There are two channels explaining why some entrepreneurs are serial: productivity-persistence and distortions. First, TFP is persistent across firms started by the same entrepreneur, so it is optimal for high-productivity entrepreneurs to enter again. Second, some individuals have an advantage in terms of market access, and therefore favored individuals end up starting many firms. In the model, favored entrepreneurs can borrow without limit at a lower interest rate. Then if productivity persistence is low and some entrepreneurs are sufficiently favored, TFP for SE firms can be lower than non-SE firms due to negative selection. Regression results from the inspection data suggest that productivity-persistence dominates.



12th Advances in Macro-Finance Tepper-LAEF

April 21, 2023, Conference Participants

Ana Babus – Washington University

Saki Bigio – UC Los Angeles

Francesco D'Acunto – Georgetown University

Tetiana Davydiuk - Carnegie Mellon University

Thomas Ernst – University of Maryland

Xing Huang - Washington University

Maziar M. Kazemi – Arizona State University

Lars-Alexander Kuehn – Carnegie Mellon University

Finn Kydland – UC Santa Barbara

Dan Li – Federal Reserve Bank of Governors

Stephan Luck – Federal Reserve Bank of New York

Sarah Papich – UC Santa Barbara

Nick Pretnar – UC Santa Barbara

Liyan Shi – Carnegie Mellon University

Mathieu Taschereau-Dumouchel – Cornell University

Jessie Wang - Federal Reserve Bank of Governors

Colin Ward – University of Minnesota

Ariel Zetlin-Jones - Carnegie Mellon University

Miao Ben Zhang – UCS Marshall



Payment for Order Flow and Asset Choice

Thomas Ernst, Chester Spatt, Xing Huang

As ordinary people increasingly explore equity options, there are many important and unanswered questions about whether the options market is an appropriate environment for retail investors. In this paper, Ernst and Spatt study the relationship between market microstructure, payment for order flow (PFOF) and broker incentives. They find that PFOF is higher in options than in equity, creating an incentive for brokers to steer clients toward trading options. This conflict of interest is particularly damaging to unsophisticated retail investors, for whom option trading can be wealth damaging. Ernst and Spatt argue that this issue would be best addressed by altering the market structure to reduce the disparity in PFOF between the two types of trades.

Ernst began by characterizing the market microstructure. In equity markets, market makers tend to break even on exchange trades and profit from retail investors, who are less informed and rarely buy right before a price increases or sell right before a drop. To attract retail trades, market makers provide sub-penny price improvements on each trade that add up to at least \$20 million per month. Options markets are less beneficial for retail investors. Options trades have to be cleared through exchanges, where established firms serve as designated market makers with special trading privileges.

Designated market maker assignments rarely change and limit competition, leading to higher prices. A participant asked how a company becomes a designated market maker. Ernst explained that the exchange chooses, and that the designated market maker for the same stock can vary across exchanges. Another participant asked whether differences in profitability lead platforms such as Robinhood promote options trading to inexperienced

investors. Ernst responded that he would need a data sharing agreement with Robinhood to learn the answer. A third participant asked how margin requirements work on Robinhood. Ernst replied that while he does not know the full set of rules, he knows that Robinhood sells options an hour before they expire. He agreed that he should think more about the role of margin requirements in retail trades.

The paper uses two tests to assess the effects of combining PFOF with designated market makers. First, the authors restrict their sample to stocks with a single designated market maker and find that PFOF is associated with 25% wider effective spreads and 50% wider quoted spreads. Second, they use an order size regression discontinuity design in which they compare outcomes for trades just above and just below the 500-share cutoff, up to which a designated market maker can internalize shares. They find that the trades just below the cutoff have much larger realized spreads, which is consistent with the result from their first test.

The discussant, Xing Huang, pointed out a potential challenge to identification in the regression discontinuity design: while regression discontinuity assumes that trades above and below the cutoff are placed randomly, the two types of trades may have different characteristics. Huang suggested running placebo analysis for trades routed to exchanges where the wholesaler is not the designated market maker to make the regression discontinuity more convincing. She also challenged the paper's assumption that retail orders should be seen as random noise. While retail traders tend to be uninformed, evidence suggests that Robinhood investors follow systematic patterns and that retail investors' choices should be seen as systematic noise rather than random noise.



The Anatomy of Financial Innovation

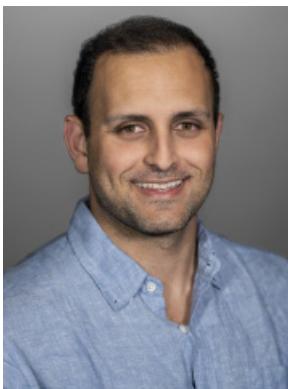
Ana Babus, Matias Marzani, Sara Moreira, and *Dan Li*

Financial innovation has expanded the set of financial products that firms can use to raise external funds from about 150 in 1985 to nearly 800 in 2014. Adoption of these new financial products is heterogeneous across firms, and usage of a higher variety of financial products is typically associated with growth. The main research question for this paper is whether and how innovation in financial products affects a firm's ability to raise funds. To study the allocation of products across firms, the authors build a model in which firms in specific sectors decide to issue financial products. They then use a model-based variance decomposition to tease out the role of financial innovation. The main findings are that differential adoption of products across firms explains most of the variation in the amounts of funds raised and that firms that adopt relatively new and specialized products are more successful in raising funds.

The authors use the New Issues Database from the Securities Data Company, which provides data on public and private security issuance from 1985 to 2014. For each financial product in the data set, the authors use text analysis to measure its novelty on a scale from zero to one, based on Investopedia article descriptions. In their model, the economy consists of large firms with sector-specific productivity and investors with mean-variance preferences over securities. A participant asked whether investors who are employed in a sector would avoid investing in the same sector to minimize risk. Babus responded that, for tractability, investors in the model are only segmented by their preferences over financial products and not by employment. Financial products represent distinct technologies that allow a firm to convert its cash flows into a set of cash flows for investors. In equilibrium, no issuer has an incentive to exit one financial product and use another product instead.

By implementing variance decomposition, the authors quantify the contribution of the components implied by their model to the dispersion of growth proceeds across sectors. They find that the average quality of financial products accounts for about 60% of the variation across sectors in the growth rates of proceeds. New financial products tend to be sector-specific and contribute to differences in average quality across sectors, with 50% of new financial products used in only a single sector and only 2% used in at least 20 sectors. Differential adoption of new products explains most of the observed variation in the amount of external funds raised, showing that financial innovation is an important determinant of a firm's success. A participant asked whether the complexity of a new financial product plays a role in determining its usefulness to a firm. Babus explained that the model in its current form does not speak to complexity, but that she may be able to incorporate it into a planned follow-up project linking firm characteristics with novelty.

Dan Li, the discussant, encouraged Babus to dig more deeply into the data. For example, she recommended differentiating between equities and bonds, which cater to different types of investors with different levels of sophistication. Furthermore, Li suggested exploring the tails of the distribution of the novelty measure to determine the role of highly innovative products. She pointed out a business cycle pattern in the novelty measure, which may show increased adoption of new financial products after a financial crisis.



Process Intangibles and Agency Conflicts

Hui Chen, Ali Kakhbod, Maziar M. Kazemi, Hao Xing, and **Colin Ward**

A process intangible is a method or product that makes production more efficient. The availability of a new process intangible only helps a firm if workers implement it. This paper studies whether the composition of intangibles affects payments to human capital. The relationship between wages and process intangibles includes a direct effect, in which firms must pay higher wages because more intensive processes raise the benefits of shirking, as well as an indirect effect in which the relationship strengthens as the intensity of the process increases. Process intensity is defined as the ratio of process-focused intangibles to total intangibles.

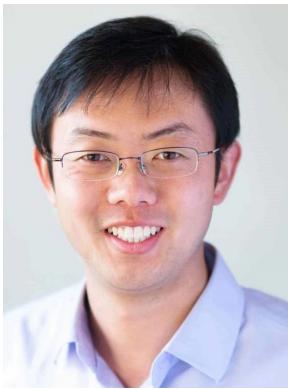
A participant questioned the decision to distinguish between process and product intangibles, pointing out that marketing teams combine marketing techniques, which are process intangibles, with product intangibles such as brand names. Kazemi responded that the distinction arises from the management literature, and agreed that certain elements of marketing and organization are included in process innovation.

Kazemi began by presenting three stylized facts. First, higher process intensity is associated with higher compensation. Second, more physical investment strengthens this link. Third, higher process intensity is associated with a 10% decrease in sales per unit of capital. Next, Kazemi presented a model in which a firm produces output using physical capital and product intangibles. The model's main innovation is in the evolution of physical capital. In addition to the standard growth from investment and reduction from depreciation, this model allows the effect of investment on capital growth to depend on process intangibles and workers' effort. A participant asked whether intangible capital evolves in the same way as physical capital. Kazemi explained that intangible capital in this model simply grows through

investment and shrinks through depreciation, as in a standard capital growth model. The model has testable implications, including a positive relationship between manager compensation and process intensity.

To determine process intensity empirically, the authors use data on patent process claims from Bena and Simintzi (2019), as well as Burning Glass Technologies data, which provides lists of skills associated with each vacancy in the universe of online job postings. With this data, the authors find that a one standard deviation increase in process intensity is associated with a 7.6% increase in total compensation, an 8.4% increase in deferred compensation, and a wage increase of 3-4% relative to the industry average. These findings are consistent with the testable implications of the model. A participant suggested that products may be more protected by patents than processes, and that the explanation for higher wages could be a firm's desire to avoid losing a worker who will bring an innovative process to another firm. Kazemi responded that this explanation is unlikely, as firms actually file more patents for processes than for products.

The discussant, Colin Ward, pointed out that this paper's assumption that capital complementarity is between zero and one is at odds with a finding in Eisfeldt et al. (2022) that capital complementarity is negative. He also commented that the regression analysis is currently not well integrated with the model, and questioned whether the model is necessary for the paper. Kazemi agreed that more should be done to connect the model with the empirical analysis.



The Cost of Regulatory Compliance in the United States

Francesco Trebbi, Miao Ben Zhang, and Jessie Wang

The costs of regulation are undoubtedly large but are difficult to measure, creating a challenge for policy evaluation. This paper quantifies firms' regulatory compliance costs from 2002 to 2014 in terms of the labor spending devoted to adhering to government rules. After quantification, the authors study the returns to scale in regulatory compliance to determine whether the regulatory system favors large firms. They find that regulatory costs account for an average of 1.34-3.33% of a firm's total wage bill, totaling between \$79 billion and \$239 billion for all American firms in 2014. Regulatory compliance costs increase until a firm's size reaches 500 employees, and then decrease.

Zhang introduced the conceptual framework, in which firms hire workers for production and regulatory compliance. The probability of an inspection is based on enforcement stringency, and firms pay a fine upon inspection if their level of regulatory compliance falls below the required threshold. Each firm's RegIndex is defined as the percentage of its labor spending that is devoted to regulatory compliance. A participant asked why the amount of spending on compliance was in the denominator of the formula for the fine. Zhang explained that the formula was a mathematical convenience that allows him to solve for the optimal level of spending on compliance. While the true fine does not follow that exact formula, the formula provides the right intuition that the fine increases as spending on compliance shrinks towards zero.

The paper uses data from the Occupational Employment and Wage Statistics survey from 2002 to 2014, as well as the O*NET database on the tasks required for each occupation. The authors measure the regulation-relatedness of each task, aggregate tasks to the occupation level, and then aggregate occupations to

obtain an establishment-level measure of labor spending on regulation-related tasks. They validate their measure by showing that they find a decrease in spending on regulation when the oil and gas industry was deregulated in 2005 and then an increase when it was re-regulated in 2010, relative to a synthetic control. The authors use shift-share instruments to separate the effects of enforcement from regulatory requirements themselves, and find that as firm size increases, responsiveness to regulations increases even though enforcement does not vary by firm size. A participant asked whether Zhang could provide any empirical examples of the optimal level of regulation. Zhang responded that determining the optimum would require measuring the benefits of regulation as well as the costs, which is beyond the scope of the paper.

The discussant, Jessie Wang, pointed out that three key measures of regulatory compliance costs are not included in RegIndex: capital costs, the one-time cost of learning new regulations, and costs paid to third-party providers for compliance services. If these other factors were taken into account, she argued that the relationship between firm size and regulatory cost would be a more linear negative relationship rather than an inverted U. She also suggested relating spending on regulatory compliance to firm outcomes, ranging from growth to public image, to determine whether spending on compliance can benefit a firm.



The Debt-Inflation Channel of the German Hyperinflation

*Markus Brunnermeier, Sergio Correia, Stephan Luck, Emil Verner, Tom Zimmermann, and **Francesco D'Acunto***

While economic theory dictates that unexpected inflation has real effects by redistributing wealth to net nominal debtors, empirical evidence of this phenomenon is rare. This paper uses the German inflation of 1919–1923 to study how an unexpected episode of rapid inflation transmits to the real economy through the debt-inflation channel. The authors find that in the aggregate, leverage decreased by 50%, the interest expense share fell by 60% and bankruptcies declined by 70%. Firm-level evidence on the debt-inflation channel shows redistribution, in which high-leverage firms experienced a decline in their interest expenses and increased employment by 17%. A participant asked how much debt was denominated in foreign currencies during this period, and Luck responded that almost all debt was denominated in the domestic currency.

Luck described the likely sources of inflation, including reparations in the aftermath of World War I, large deficits, and a lack of political will to raise taxes and cut spending. Despite high inflation, the German economy continued to experience strong growth in terms of real GDP per capita until the end of 1922. A participant questioned how GDP growth could be so high in the period that led to the rise of Hitler. Luck pointed out that the rise of Hitler began after 1922, and explained that despite the costs of high inflation, people were doing well in the sense that unemployment was very low.

The authors use newly digitized firm-level data that includes balance sheets and income statements for about 700 firms per year. Their analysis shows that high-leverage firms experienced higher stock returns and hired more people throughout the period of inflation, with the strongest effects on firms with high levels of long-term debt. A participant asked why employment was so high when wages quickly lost their value. Luck

responded that many Germans were living on fixed incomes from real estate during this period and had to sell the real estate due to the stickiness of rental prices, creating many hand-to-mouth workers who needed labor income to survive. Another participant asked whether mergers and acquisitions distorted their results, as large firms increased their employment by buying smaller ones. Luck explained that while mergers and acquisitions did occur during this period, they were not common enough to mechanically drive the employment results. In terms of external validity, Luck explained that the results suggest financial frictions should be taken into account in modern macroeconomic theories of inflation.

The discussant, Francesco D'Acunto, questioned whether the results are driven by the lower value of debt or the relative value of real assets, which increases during inflation. He suggested an errors-in-variables specification to account for how other financial characteristics are normalized by total assets, which are measured with error. In terms of welfare implications, D'Acunto would like to see more discussion of effects on the household sector: while financially constrained firms performed well during the inflationary period, many corporate bonds were held by households that experienced a drop in net worth. D'Acunto was also curious about the paper's external validity, asking whether the debt-inflation channel is inactive under less extreme modern conditions or just harder to detect.



A Theory of Payments-Chain Crises

Saki Bigio and **Mathieu Taschereau-Dumouchel**

Payment chain crises can arise due to payment delays, in which each firm cannot pay its suppliers until it receives payments from customers. This paper's goal is to formally model delays in payments by embedding sequences of chained orders and payment networks in a business cycle model. An externality arises as a delay by one firm damages other firms' total factor productivity. While economies with low or moderate debt converge to an efficient steady state in this setting, high levels of debt can become permanent by generating hysteresis in an inefficient steady state.

Each agent in the model can act as both a buyer and a seller. Within each discrete period, time is continuous on an interval from zero to one. Some agents have cash to pay for their orders to start being produced right away, while others must wait to receive a payment before they can place an order. With chained orders, one firm may have to wait for several other firms to be paid before it receives a payment and is able to place an order itself. When the firm has to wait, less of its order is completed before the period ends. Therefore chained orders and payment delays reduce total factor productivity. In all cases, agents wait for a fraction of production to be completed before they make a payment so they can check the quality of the product. Each order requires one worker, regardless of order size, and average output per worker in the limit is less than one. An audience member suggested a counterfactual analysis of the effect of a payment chain crisis on total factor productivity, and Bigio agreed that this analysis would be a useful addition to the paper.

The model uses a dynamic framework with two types of long-lived agents: a natural borrower with no wealth that provides labor and a natural saver with wealth but no labor. Savers can pay cash for their orders, while

borrowers may need to use more chained orders depending on their debt level. The main mechanism is that a higher debt level leads to more chained orders, lowering total factor productivity and creating more debt. This cycle can generate a permanent recession with strong hysteresis. A participant asked how including financial intermediaries would change the model. Bigio explained that an intermediary could relax the debt constraint, accelerating total factor productivity for all agents. Another participant asked whether financial intermediaries would be Pareto improving. Bigio responded that the model suggests a tax should be used so that agents internalize the effect of delays, but that intermediaries would not be necessary if plenty of cash and credit were available in the economy and their potential effects in terms of Pareto improvement are unclear.

The discussant, Mathieu Taschereau-Dumouchel, focused on suggesting future work on this topic. On the theory side, he recommended using a richer network structure to determine the effects of payment chains in an economy with centrally important nodes and links that are not random. He also suggested incorporating data into future work, including micro evidence that firms with chained orders are at a disadvantage and macro evidence that payment crises matter and are strongly correlated with GDP.



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