FROM THE LAB

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2nd MEBDI Fall Conference on Big Data in Macroeconomics

Director's Message
Finn Kydland

In the *Growth, Development, and Structural Transformation* conference on September 30 – October 1, 2022, we explored the forces that drive economic growth and structural transformation at different stages of development. The research presented addressed open questions in the literature pertaining specifically to the roles that productivity growth, preferences, transport costs, and trade specialization play in determining economic growth and the rise of manufacturing in agrarian economies and of services in industrialized economies. The focus was on the determinants and implications of the reallocation of inputs and outputs among broad sectors along the development path. Understanding these mechanisms will help inform policymakers who are concerned with raising living standards. The academic organizers for this conference were Nick Pretnar, Postdoctoral Scholar at LAEF, and the late Berthold Herrendorf, former Professor of Economics at Arizona State University.

The Minnesota Economics Big Data Institute (MEBDI) held the *2nd MEBDI Fall Conference on Big Data in Macroeconomics*. This year, the conference took place on October 14th and 15th in Santa Barbara, in collaboration with the Laboratory for Aggregate Economics and Finance (LAEF). The conference aims to bring together senior and junior researchers who analyze big data through the lens of economic models to study a wide range of issues in macroeconomics, broadly defined. We welcomed papers that combine big data and models in novel ways on topics that include (but are not limited to): inequality in consumption, income, wealth, health, and others; labor markets, taxation, redistribution, household finance, macro finance, international macro, and any topic related to the post-pandemic economy. Theoretical papers on the economics of big data were also of ¬interest. Academic organizers: Fatih Guvenen, Loukas Karabarbounis, and Peter Rupert.

Growth, Development, and Structural Transformation

September 30–October 1, 2022

Tasso Adamopoulos – York University
Laurence Ales – Carnegie Mellon University
Sayahnika Basu – UC San Diego
Benjamin Bridgman – Bureau of Economic Analysis
Julieta Caunedo – University of Toronto
Georg Duernecker – University of Frankfurt
Domenico Ferraro – Arizona State University
Gary Hansen – UC Los Angeles
Finn Kydland – UC Santa Barbara
Danial Lashkari – Boston College
Yueyuan Ma – UC Santa Barbara

Rajnish Mehra – UC Santa Barbara
Marti Mestieri – Univeristat Pompeu Fabria
Oivind Nilsen – NHH Norwegian School of Economics
Latchezar Popov – Texas Tech University
Nick Pretnar – UC Santa Barbara
Ray Riezman – University of Iowa
Peter Rupert – UC Santa Barbara
Yongseok Shin – Washington University
Rish Singhania – University of Exeter
Akos Valentinyi – University of Manchester

New Evidence on Sectoral Labor Productivity: Implications for Industrialization and Development

Berthold Herrendorf, Richard Rogerson and **Ákos Valentinyi**

A common argument is that moving labor in developing countries into more productive sectors of the economy will help close the productivity gap with developed countries. But does evidence support the notion that moving labor from agriculture into manufacturing is the best way to close the productivity gap? The authors construct a new database of sectoral productivity levels in international prices and then measure productivity gaps at the sectoral level using the database. A participant told Valentinyi that he thought a story about a country, such as India, transitioning from agriculture to services would be useful for motivation. Valentinyi responded that the paper primarily provides measurement results, and that they do not take a stance on whether transitioning to manufacturing or services is better for aggregate productivity. Another participant asked whether productivity in this context is total factor productivity, and Valentinyi clarified that the paper measures labor productivity only.

The paper's novel dataset incorporates data from 12 sectors in 64 countries from 1990 to 2018. A participant pointed out that the size of the informal sector varies substantially by country and asked whether Valentinyi imputes value added from the informal sector. Valentinyi explained that some countries perform that imputation themselves, but that he and his coauthors did not attempt further imputation of informal sector value added beyond what the countries in the dataset provided.

Valentinyi presented two graphs, one for manufacturing and another for agriculture, each showing a positive linear relationship between the log of sectoral productivity in U.S. dollars and the log of sectoral productivity in 2005 international prices. A participant asked if Valentinyi was making the argument that there is no price-income relationship in these sectors in developing countries. Valentinyi responded that the goal was to show that the gap between international and American prices is unrelated to the level of development, not that the American price itself is unrelated to the level of development. Another participant asked how the dataset incorporates differences between countries that arise when several countries are involved in producing the same good, such as a television, but each country produces a different part of the final good.

Valentinyi responded that he strips out the distribution margins from the final consumption prices to obtain producer prices, which are used to construct production-side measures of productivity.

Next, Valentinyi provided evidence that while the productivity gap is smaller for manufacturing than for agriculture, manufacturing productivity is still lower than aggregate productivity. A participant asked how much of this result is a composition effect arising from the variation in productivity within the manufacturing sector. Vaneltinyi agreed that this effect is likely present and explained that he would need more detailed data on each sector within manufacturing to parse out the composition effect. Valentinyi and his coauthors conclude that there is little evidence that industrialization reduces aggregate productivity gaps. A participant asked how Valentinyi can reconcile this result with evidence in the literature that movement from agriculture to manufacturing increases productivity. Valentinyi responded that productivity has been backed out from model calibrations rather than directly measured in the existing literature, and that by directly measuring productivity this paper is able to provide a more accurate result.

How It's Made: A General Theory of the Labor Implications of Technological Change

Laurence Ales, Christophe Combemale, Erica R. H. Fuchs and Kate S. Whitefoot

New technologies enable firms to choose between employing a person or using a machine to complete a task. This paper develops a theory about when firms will choose automation, taking workers' skill levels and the nature of each task into account. The theory incorporates three key ingredients: step divisibility, a speed-complexity tradeoff, and fragmentation costs. A participant asked whether the theory only applies to manufacturing. Ales explained that while data is primarily available for manufacturing, the theory is more general and also applies to services. Another participant suggested that technology may increase the number of tasks that need to be completed rather than only affecting step divisibility, which is the way tasks are divided into smaller steps. Ales responded that in this model, the number of steps is assumed to remain unchanged unless the introduction of technology changes the product being produced.

Ales provided more detail on his model, starting with a characterization of the product, tasks required to create the product and steps involved in completing each task. A participant asked how the length of each step is measured, since Ales had not introduced time in the model. Ales explained that the length can be thought of as time, but he recommends thinking of it as a fraction of value added. Another audience member was curious about the role of outsourcing, which could be influenced by the availability of new technology. Ales responded that outsourcing could easily be incorporated into the model by changing the price of the outsourced step.

The model allows firms to choose between two operators to complete each step: a worker or a machine. The operator has an ability level, a degree of generality, and disutility from increasing the speed of work. Humans have a high ability to generalize and a high disutility of going faster, while machines have a low disutility of going faster and are more specialized. A participant asked whether the firm chooses the optimal level of production in this model. Ales explained that the level of production is given exogenously, and the question is how the firm should optimize the process of production, taking total output and the number of steps as given.

Ales introduced the "cone of automation", which predicts when firms will choose automation. Firms will hire low-wage workers for the simplest steps, highly-paid workers for the most complex steps, and machines for the steps in between. The proportion of moderately complex tasks done by machines increases with total production. A participant suggested that some firms may never find it cost-effective to hire a machine due to fragmentation costs. Ales explained that the reason hiring a machine would not be cost-effective is not the fragmentation cost of dividing a task into more steps, but rather the firm's total level of production. Ales provided data from the 1898 Hand and Machine Labor Study, as well as data on modern production of optoelectronics in California and Thailand. The cone of automation appears in both data sets, lending credibility to the presenter's theory.

The Structural Transformation of Innovation

Diego Comin, Danial Lashkari and **Martí Mestieri**

Over two centuries, the share of innovation that occurs in various sectors of the economy has shifted, with important implications for growth moving forward. Mestieri presented research documenting structural changes in innovation and total factor productivity across the agriculture, industry, and services sectors and providing a multisector growth model that endogenizes the direction of innovation. Using historical data, their model generates transition dynamics that replicate the joint evolution of sectoral shares and total factor productivity growth. The model predicts that total factor productivity growth will slow down in the future.

Mestieri used patent data to provide evidence of long-run change in the share of innovation in agriculture, manufacturing and services over time. A participant asked why patents were assigned to a sector based on the classification in the patent data, rather than the sector of the firm that filed the patent. Another participant raised a similar concern: the sector where the patent is used matters more than the sector that generates it. Mestieri responded that he did not have access to firm-level sector data and therefore relied on the classification given on the patent. He also explained that an alternative classification method, which uses natural language processing to compute similarities between the patent abstract and the description of the sector, produces a very similar pattern and assuages the concern that the patents are produced and used in different sectors. A third participant suggested including fixed asset tables for each sector and argued that innovation in the service industry would be better measured in trademarks rather than patents. Mestieri agreed that fixed asset tables should be included in the paper. The descriptive section of the talk concluded with evidence on structural change in total factor productivity, with the non-farming growth rate overtaking farming in recent decades and evidence of a decline over time in the share of research and development devoted to manufacturing.

Next, Mestieri introduced a theory designed to explain the structural changes in innovation observed in the data. A participant asked whether the theory explains levels or shares of innovation, and Mestieri clarified that he only explains the relative amount of innovation in each sector rather than the total. The model incorporates spillovers between sectors, captured in the data as the share of patents in each sector that cite patents from another sector. A participant asked whether knowledge from other sectors is fully captured by the citation. Mestieri explained that innovation drawing on another sector's knowledge without a patent is possible, but such innovations are likely marginal. If an innovation substantially improves production, the model assumes there will be a patent and a citation. The participant responded that there may be instances in which the service sector does not cite the manufacturing sector as a source of innovation. Mestieri agreed to think more about how to address that concern.

American patent data was used to estimate the model parameters, allowing Mestieri to characterize a constant growth path in which the difference in innovation growth rates between sectors asymptotically captures both technology push and demand pull. A participant asked how a general-purpose technology used in many sectors appears in the model. Mestieri explained that each innovation is assigned to a single sector, but spillovers to other sectors capture the generality of the new technology.

The Evolution of the Consumption Experience: Why the Services Share Has Risen

W.L. Bednar and **Nick Pretnar**

A household's decision of how to allocate expenditures between goods and services could depend on many factors, such as prices, wages, and off-market time used for consumption and home production. The authors hypothesize that as consumers become richer, the increased value of their time makes them more willing to purchase physical goods that minimize time spent on home production. The paper has three main findings: relative price variation is almost entirely responsible for the rise in the services share, goods used to be inferior in the past but are increasingly luxuries, and the results may be partially attributable to unmeasured relative quality improvements. A participant suggested that the characterization of goods as increasingly luxurious may change if Pretnar excluded technology, arguing that from the household's standpoint, the value of a computer does not necessarily increase as its processing power grows. Pretnar agreed to exclude technology and see if it changes the patterns he observes in the data.

Pretnar introduced a time-use ratio to capture the division of off-market time between using goods and using services. Multiple participants asked how cooking would be classified, as it requires goods but also produces a service for the household. Pretnar responded that cooking is classified as a good because it uses food and durables in the house, and that eating the meal is a consumption experience at home rather than a service. Another participant asked whether watching a movie at home is a good or a service. Pretnar explained that he defines the primary activity as watching the movie, a service, rather than using the television, a good. One audience member pointed out that households do not spend any time consuming some market-produced services, and therefore the model should be described as explaining structural change within the household sector rather than the economy as a whole. Pretnar agreed.

Households in the model divide their time between labor, using goods and using services. A participant asked Pretnar to explain the distinction between choosing how many goods to buy and how much time to spend using goods. Pretnar responded that the necessity of having time available to enjoy a good influences the decision of whether to buy it. Another participant asked if the utility from consuming a market service varies within the household, and Pretnar replied that his model includes a single household decision maker. Pretnar described his model as being so general that it can explain any story. A participant responded that a drawback of generality is that he cannot speak to phenomena such as the marketization of services. Pretnar responded that the model does allow households to decide whether to purchase a service from the market or produce it at home, and that market purchases and home production lead to different consumption experiences over which the household has a preference ordering.

Pretnar concluded with the finding that, accounting for consumption time, the structural transition in consumption from goods to services is not driven by consumer preferences and that quality improvements in goods, which out-pace quality improvements in services, have made goods more luxurious. A participant pointed out that the model does not include pieces of capital such as houses and boats that generate a flow of services and said that the model could be extended in future work to provide information about the markets for these pieces of capital.

Regional and Aggregate Implications of Transportation Costs and Tradability of Services

A. Keram Cosar, Sophie Osotimehin and **Latchezar Popov**

The feasibility and cost of separating the location of production from that of consumption are important questions for economic activity. Popov and his coauthors provide theoretical and quantitative answers to the question: What are the aggregate, sectoral, and regional effects of major technological advances and productivity improvements in shipping goods (transportation technologies) and transmitting data (communication technologies)? In their study, they digitized novel evidence on qualitative changes in the modal distribution of manufacturing freight and built a model in which transportation is modeled as an essential input in establishing spatial linkages between sectors.

Using their quantitative framework, they provide predictions on the aggregate and regional effects of potential future improvements in transportation and communication technologies. In addition, their simulation exercise shows that lower freight costs have counteracted and moderated structural change from agriculture and manufacturing into services. This assumes all else is held constant since the former sectors are more transportation intensive. The model also captures the population shift from northeastern U.S. regions toward the west of the country and suggests that documented long-run spatial changes in sectoral activity are primarily driven by forces other than transportation costs.

A participant raised a question of whether Uber is considered in the study, and Popov answered that it was not, even though Uber's revenue is in transportation and is an interesting special case. The same participant asked whether other countries are considered, and Popov answered that they have data only for the U.S. and speculated that other developed countries would look similar. Another participant asked a clarifying question about whether transportation in the study refers to just cargo transportation or includes passenger transportation. Popov responded that only cargo transportation is included. The presenter also received a question about whether government investment is counted as part of investments, and he answered that it is just a residual after government investment is left out. He mentioned that a part of it could be improvements in transportation infrastructure, the real technology to regulation, or publicly provided capital.

When Popov introduced the main model, a participant asked whether the composition of tradable and non-tradable goods changes over time when the transportation cost changes. The presenter answered that their classification of tradable versus non-tradable remains fixed. He clarified that it is services that will be non-tradable in the model. While talking about market clearing, the presenter received a question about whether the labor used to produce the transportation is only used in the origin. He answered yes and acknowledged that they have been thinking about the case that transportation floats over because the people who produce it move around, but it creates a lot of technical problems with closing the model.

While Popov was talking about the calibration of the model, a participant wondered whether the normalization is a statement about data or the model. The presenter answered that it is a statement about the model and referred to their other paper where they showed they can normalize the productivity to be one given lots of freedom in the input-output parameters in the production function. The other participant asked whether it would be possible to make the elasticity of substitution between intermediate commodities and the primary input labor commodity-specific, and Popov answered that there wouldn't be a huge technical problem with that, but that they then would have to figure out how to aggregate.

Spatial Integration and Agricultural Productivity: Quantifying the Impact of New Roads

Tasso Adamopoulos

Infrastructure projects in the developing world are touted as important to productivity gains. Adamopoulos presented a study about the effects of Ethiopia's 1996-2014 road expansion program on aggregate and local agricultural productivity and development outcomes. He combined a quantitative spatial framework with a novel district-level panel data set on agricultural production and transport costs. According to his research, the changes in transport costs implied by the expansion of the road network have had a sizable impact on productivity and the structure of the agricultural sector in Ethiopia. His model also delivers a U-shaped pattern of yield gains across districts with respect to transport cost changes. He attributes this pattern across districts to the extent of alignment of districts' changes in absolute and comparative advantage implied by the transport cost changes.

Adamopoulos began his presentation by showing pictures of roads and transportation in Ethiopia. A participant wondered whether his study considers the potential for exporting these agricultural products abroad. The presenter

answered that there are two types of goods: food consumed domestically and cash crops to be exported. Another participant wondered about Ethiopia's social and historical background. The presenter said Ethiopia has experiences with famine and is heterogeneous in terms of ethnic groups. He added that there was a change in the political regime in Ethiopia, which prompted infrastructure investments.

When the presenter introduced the road data and geo-coded transportation costs, he received a question about whether the markets in the data are the actual wholesale markets. He confirmed they are actual markets and said a government agency called Ethiopian grain trading enterprise reports prices from all the wholesale markets in Ethiopia. The presenter moved on to explaining the travel time, and a participant raised a question about the possibility of changing the means of transport when the new road is introduced. The presenter clarified that the only thing that changes in the calculation is the introduction of the new roads and the change in the market, not the means of transport.

When Adamopoulos explained a spatial model of agricultural productivity, a questioner asked whether genetically modified Golden rice is legal in general in Ethiopia since it could make a big difference.

Adamopoulos acknowledged that there was a tremendous increase in productivity not accountable to transportation directly, but said he would not address that in this study. Another questioner asked about the asymmetry in returns to scale between the production of food crops and cash crops. The presenter answered that they could have had decreasing returns in both, meaning all regions would be producing both goods. However, in the data, what we see is that there are a lot of regions that are completely specialized in producing only domestic food, with no region completely specialized in producing solely cash crops. His model allows this.

While the presenter explained the quantitative experiment studying the effects of reducing geographic transport costs across all districts from their actual 1996 levels to their actual 2014 levels, a participant suggested providing an idea of how much of the structural costs and benefits a country had, in terms of GDP. Adamopoulos explained that the focus here is on the agricultural side. This study focuses on the efficiency benefits there. He said her suggestion is a good point and would be helpful for countries deciding whether or not to implement a project.

Big Push in Distorted Economies

Francisco J. Buera, Hugo Hopenhayn, **Yongseok Shin**, and Nicholas Tracter

A large literature in macroeconomics has shown a large gap in technology levels across countries. This begs the question: Why do poor countries not adopt more productive technologies? One reason is that there could be barriers to technology adoption, such as distortions. However, empirically it has been verified that this explanation requires large distortions that might not hold in practice.

Another explanation focuses on complementarities and coordination failures behind the lack of adoption of more productive technologies by less developed countries. In a nutshell, technologies have complementarities, meaning that, in the presence of coordination failures, less-productive technologies could persist even if coordinated adoption of more productive technologies would be better. In this paper, the authors propose a framework integrating both explanations: complementarities help amplify distortions, even when coordination failures or multiple equilibria do not play a role. In this way, small distortions can have large effects (named a "big push" by the authors).

Idiosyncratic distortions have an impact more than three times larger than that of models without complementarities. The authors develop a static model in which there are two kinds of technology available to a firm: traditional and modern. Traditional technology is less productive and more labor-intensive, while modern is more productive and intermediate-good-intensive. The firm pays a cost of adoption for using a given technology in units of an adoption good. This cost of adoption

is key to the model. The literature on distortions has traditionally relied on the existence of multiple equilibria to explain how reasonable sizes of distortions can lead to the effects seen in reality. For that reason, members of the audience were worried that some of the assumptions in the model could be prompting the multiple equilibria. The presenter clarified that none of the elements in the model are necessary for multiplicity of equilibria, in the sense that they matter quantitatively but not conceptually.

In this model, when more firms adopt a technology, the marginal firm is faced with four different effects. The first one is detrimental to the firm: the price index falls (as a CES function, they fall proportionally because of the constant markup of CES), such that the firm makes less for each unit sold. The other three benefit the firm: demand for its output increases as a consequence of the price index going down; intermediate inputs become cheaper since final goods are their input of production, and those are now cheaper; and the adoption cost falls, since it is measured in terms of units of goods. When the three benefitting effects are stronger than the detrimental one, gains from adoption increase in the number of adopters. In other words, there is complementarity in adoption decisions. At this point, an audience member said that the choice of convenient forms like CES might be driving the directions of the price index and demand effects. He was worried that if one were to introduce oligopolistic competition, instead of the monopolistic competition assumed in the model, this could make prices of intermediate inputs actually go up.

There are a few reasons complementarity may be stronger: firms may not be very different from

one another as homogeneous firms help kill multiplicity; differentiated goods may be less substitutable; higher intermediate input intensity in the modern technology; and bigger share of goods in adoption costs.

Using this model, the authors proceed to do a quantitative exercise to quantify the role of coordination failures, distortions, adoption costs and differences in productivity between technologies across countries in the GDP gap between India and the U.S. For that, they parametrize the model to match U.S. and India establishment size distributions. They use publicly available data. They assume zero distortions in the U.S. However, idiosyncratic distortions are chosen such that Indian data is matched. Both countries are assumed to have access to the same level of technology. A member of the audience asked if these distortions are what makes these economies inefficient. However, as clarified by the presenter, even in the absence of distortions these economies are still not efficient given that there are other dynamics at play.

A key identification assumption is that both technologies are observed in equilibrium. A consequence of this to the model is the feature that firms cannot be larger than an endogenous maximum size when employing traditional technologies. Also, there is a gap of firm sizes between the maximum size of firms using the traditional technologies and the minimum size of firms using the modern technology. Of course, this discontinuity in firm size does not exist in the data, such that when calibrating the model, the authors have to force the data to match this analytical feature of the model. They claim this is not problematic since they focus on complementarities which do not really depend on the parametrization.

The calibration reveals that there

are multiple equilibria for the Indian economy, but not for the American one. Nevertheless, their parameterization assumes away coordination failures in the Indian case such that the data is best matched. Their model is able to account for

73% of the U.S.-India income gap, a better result than other models in the literature which lack intermediate inputs linkages and to which they compare themselves. Decomposing their results, the authors find that adoption costs and distortions

account for most of the difference in income, while different productivity of the traditional technology matters little in both cases.

Capital-Embodied Structural Change

Julieta Caunedo and Elisa Keller

Technical change is known to be one of the main engines of growth. However, technical change can come in many different forms and these may have distinct effects on macroeconomic phenomena. For instance, technical change can be capital-augmenting, such as robots that substitute away human workers, labor-augmenting, or even factor-neutral, when it is neither capital or labor saving. Technical change can also be disembodied when it is purely organizational, can be explored without investment in new equipment, and does not change the balance between labor and capital in the long-run. Alternatively, it can be embodied.

Despite the large literature on structural change, most of it has focused on sector-specific, factor-neutral technical change. This is in spite of the empirical importance of factor-augmenting technical change. In this project the authors study sector-specific factor-augmenting technical change embodied in capital. Capital-embodied technical change (CETC) requires one to invest in new equipment in order to benefit from it. An example of this kind of technical change is the creation of GMOs that allowed farmers to use more capital, such as pesticides. The question asked is: What is the role of CETC for structural change?

The paper starts by establishing

a minimal framework to highlight empirical evidence on the effects of CETC to structural change in the US. There are several equipment goods, each with their own technology level and which evolve according to idiosyncratic growth trends, thus incorporating CETC into the model.

The authors apply U.S. data between 1948-2020 aggregated to the agriculture, manufacturing and services sectors to this simplified framework. Prices of sectoral output, nominal investment and stocks by equipment and sector come from the Bureau of Economic Analysis; value added by sector comes from the National Income and Product Accounts; and quality-adjusted prices of equipment to consumption for 22 equipment categories and 3 software categories come from the literature. The authors do not include construction and real estate in the data. A member of the audience asked about the lack of data on capacity utilization. The presenter responded that this is accounted for in the model, to some extent, through the sectoral depreciation rates. She appreciated the suggestion and said she would add it to the to-do list.

There is a long-run trend of decrease in the price of investment relative to consumption. This trend is strongest in the services sector and weakest in the agricultural sector. In the raw data, there are decreasing and increasing trends for the relative prices of the agriculture and services sectors in relation to the manufacturing sector. However, given the simple

framework introduced previously, one can decompose CETC from other effects. The relations reveal that CETC is probably driving the trend in the relative price of agriculture to manufacturing. In the services sector, CETC had little effect in the change in relative prices to manufacturing until the mid 1980s, but after that it grew at a trend even greater than the one observed in the raw data. Hence, CETC should also be driving the trends of relative prices for services, though to a lesser extent than it is for agriculture. There are also non-trivial movements in the labor share within sectors in the data.

The next step is the introduction of a full capital-embodied structural change model. The model is inspired by Jones & Liu (2022). In the model, production requires performing a continuous set of activities. These activities can be performed with labor only, or with both labor and capital. There is a threshold for activities to be performed with capital depending on costs of hiring a worker or machine. Capital shares in the balanced growth path are constant in this model. The reason why they are constant in this economy is because the services from capital are increasing, but the price of capital is declining. A member of the audience asked if the depreciation rates in the user cost-of-capital equation were constant over time. The presenter was not sure about the answer, but said she can possibly adjust for it and said she would look into it. In the balanced growth path,

mechanization (the share of activities being performed with capital) is lower than CETC.

The author had not yet calibrated the whole model by the time of the presentation. Thus she showed a limiting case conveying which factor shares are assumed not to move. She stressed that it is important for the factor shares to move, so the results presented should be understood as a first approximation. This limiting case is similar to Acemoglu & Guerrieri (2008) with sector-specific CETC. The calibration targets relative prices, such

that total factor productivity is going to be residual.

Using the calibrated model, the authors do three counterfactual exercises to understand the exogenous driving forces for structural change. The exercises are meant to calculate the model predicted change in employment shares by sector between 1948 and 2020 for the American economy. The first exercise allows only factor neutral productivity growth by sector. The second one allows only for factor intensity. The third one allows for CETC. According to it,

CETC accounts for 74% and 33% of the movements out of agriculture and manufacturing, respectively, as well as 41% of the movement into services.

The presenter concludes by highlighting the next steps for the paper. One objective is to calibrate the model with time movement in labor shares. Another one is to build a time series for other countries. In particular, the authors are interested in the case of South Korea. Also, they want to run the accounting exercise in the cross-section of countries.

Capital-Skill Complementarity in Firms and in the Aggregate Economy

Giuseppe Berlingieri, Filippo Boeri, **Danial Lashkari**, and Jonathan Vogel

The capital-skill complementarity hypothesis states that capital and high skill labor are complementary, a consequence being that the decrease in the price of equipment has led to a rise in the skill premium, explaining part of the rise in inequality observed across the world in the past decades. But the hypothesis faces criticisms. It has been hard to identify aggregate capital-skill elasticities. And while global equipment prices have fallen everywhere, country-level evidence of its consequences on the skill premium is not particularly strong. For instance, the country studied in this paper, France, has a roughly constant skill premium despite facing falling equipment prices. A participant pointed out that different supplies of skills could be important in explaining this phenomena and how it differs from the U.S. case, but the presenter answered that what matters in the paper is the relative changes in supplies of skill: those should be similar between France and the U.S. Another participant pointed out that

this might not be the case and referred the author to a paper on the topic.

This paper proposes to tackle the two above critiques by applying a new model to French data. In the model, single product firms produce differentiated products under monopolistic competition within sectors and with arbitrary technologies. There are several kinds of inputs with aggregate inelastic supplies available, but the focus is on three of them: capital equipment, low-skill labor and high-skill labor.

The authors are interested in studying aggregate shocks to the supply of equipment that lower their firm-specific price. The authors start by assuming common factor prices to build intuition. The main result is that the aggregate elasticity of factor substitution, necessary for calculating the response of the skill premium to change in equipment prices, can be divided into three components: a within-firm complementarity between factor substitution; a cross-firm substitution; and a cross-sector substitution. Similar conclusions are reached with a model incorporating heterogeneous equipment prices by firms. In this model, equipment prices differ by firm through a firm-specific

price wedge, though the shadow price of equipment is the same for all firms. This model is the one taken to data, where the intersection of type of equipment and country of origin determines an equipment variety.

The model assumes a continuum of competitive monopolistic firms. The presenter explained, following a question, that this is done so that firms don't have to worry about implications of their pricing on competition. Another participant questioned if assuming oligopolistic competition would change the results, and if it could be introduced in the model. The author explained that this would make the model less tractable. Also, he highlighted that there is very little in the data that would allow him to discipline the factor inputs observed at the firm level and the products. In reality, there are multiple products, but the authors assume that consumers think about the bundle of products firms produce instead of the individual products.

Next, the authors take the model to French data. The authors employ several datasets in their estimation spanning from 1997 to 2007. The authors obtain composition adjusted wages and employment measures of skill groups. A limitation of this

study is that the sample of firms used to estimate and calibrate the model is highly selected since it only includes firms that are both importers and exporters. Finally, several other datasets are used to construct the instruments needed for identifying micro elasticities.

The first step is to estimate the demand elasticity to firm revenue, as well as the technology-level production function elasticities. To estimate the former, the authors use firm-level export quantities and prices with five-year differences. A regression of changes in firm-level prices on firm revenue may suffer from endogeneity from other demand shifters covarying with prices (for instance, quality of products sold). Hence, import exposure to real exchange rate shocks across source countries is used as an instrument. In order to estimate technology-level production function elasticities, the authors run

two regressions with differences in changes of employment of factors as the dependent variable. Since the error term in these regressions depends on changes in firm-specific factor-augmenting productivities, and on changes in firm demand shifter and changes in the relevant sectoral price index, three instruments are employed to deal with endogeneity. The first one, used for equipment prices, is import exposure to bilateral transport cost shocks. The second one, used for revenues, is import exposure to origin supply shocks. Finally, the third one, used for wages, is local exposure to national sector-level labor demand shocks. As in the demand elasticity estimation, all differences are constructed using five-year periods. The reason for doing so, is that one might be worried (as was the case for an audience member) that these elasticities operate in distinct time horizons. Using long

differences, this worry is mitigated. Estimates for the micro elasticities are robust. In particular, low-skilled labor production function elasticity is larger than the analogous elasticity for high-skilled labor, such that the hypothesis that there is no capital skill complementarity can be rejected at the micro level.

Finally, the author aggregates results to the macro level with moderate aggregate capital-skill complementarities and estimates the responses to the observed heterogeneous firm-level shocks in equipment prices. The first shock leads to a three percent increase in the predicted skill premium, while the second one generates a six percent increase. Hence, though not seen in the raw data, this counterfactual exercise shows that the equipment prices shock faced by France should indeed have led to a rise in the skill premium.

Uneven Growth: A Supply Side Perspective

Javier Birchenall, Kang Cao and **Rish Singhania**

Increasing factor productivity and capital deepening drive economic development. Growth in real income typically comes in tandem with structural transformation - a contemporaneous shift in the allocation of resources between broad sectors of the economy as the sectors themselves become more productive. Aggregate growth in real output is determined by a combination of growth within sectors, potentially growing at different rates, as well as changes in the composition of output across sectors. Singhania presented work with co-authors using a supply-side model to decompose historical output growth between the two

channels of pure productivity growth and reallocation between sectors. They show that in the United States context, accounting for these two at-times countervailing forces of differentiated productivities and the distribution of resources is quantitatively important in terms of the drivers of output growth over the past century.

Population growth, capital deepening, and sectoral productivity growth combine to create growth in real gross domestic product as measured in national accounts. However, both productivity growth and factor utilization are not necessarily constant across sectors or within sectors over time. The authors refer to this distributional portion of aggregate growth as uneven growth: how a changing distribution of value added shares, productivity growth, and labor shares across sectors changes

aggregate output growth relative to an economy in which value added shares remain constant over time. The latter force is referred to as pure growth: an average of growth across economic sectors with weights proportional to output shares at a fixed point in time. A seminar participant questioned whether these forces should be thought of as being truly independent from each other, as growth may be directed by changing economic preferences over the composition of consumption over time. The authors noted the model was agnostic in terms of preferences, and that their estimation was instead decomposing the changes in output demanded under historical preferences.

The authors further decompose the uneven growth effect into two terms, eponymous effects attributed to Baumol and Denison. In their

context, the Baumol effect captures how the shifting distribution of sectoral value added changes each sectors' contribution to aggregate growth, while the Denison effect captures the contribution of the distribution of a growing labor force across sectors with different productivity levels, in terms of output per worker. On the Denison term and the changing distribution of labor across sectors, a participant questioned whether the model could account for the varying rate of reallocation of labor across sectors over time. The presenter noted that as changing labor shares are targeted moments, these transition paths are used to discipline the parameters of the model.

The authors use this accounting framework to estimate the sector-level substitutabilities of labor and capital for the postwar United States across 30 sectors and from the 1840s onward for the three sectors of manufacturing,

services, and agriculture. A participant noted this approach may be sensitive to the number of sectors included; the presenter agreed that in principle a finer measure of sectors may exhibit more volatile output values over time and with it drive parameters governing substitution, but noted this was not the case when comparing the two separate decomposition exercises for the United States. With parameter estimates in hand, the authors then use the model to back out sectoral productivity growth rates for both labor- and capital-augmenting technology growth for the postwar U.S.

The central counterfactual exercise is to examine the effects of fixing the capital-labor substitutability in all sectors to match its historical aggregate average of approximately unity. How much does dispersion in capital shares matter for measuring aggregate growth and what is missed in accounting

when it is ignored? The authors share the surprising result that although assuming a constant substitutability parameter across sectors overestimates the contribution of capital deepening to growth, it is almost exactly offset due to underestimating the effects of aggregate productivity change. The results suggest further that in a counterfactual postwar period with the absence of pure growth, the Baumol and Denison effects would have had net-positive effects on growth. The resilience of counterfactual growth to both a shift to a pure-growth counterfactual, as well as the removal of pure growth effects, entirely provides reason to question traditional narratives that portend a future decline in productivity due to sectoral stagnation and Baumol's cost or the failure of capital deepening.

Structural Transformation, Firm Dynamics and Labor Market Policies

Georg Duernecker

Employment protection and minimum wage policies are common, but evidence about their economic effects is often inconclusive. The presenter argues that adopting a sector perspective is necessary, as policies are not sector-neutral. Since strict employment protection depresses job creation in high-turnover sectors, it could also slow down structural transformation by preventing reallocation from manufacturing to services. In order to test this hypothesis, one could ask whether countries with stricter employment protection have a higher manufacturing share. The presenter shows, in a sample of 61 countries, a positive correlation of ten-year

averages from 1985-2019 between strictness of employment protection and industry employment share.

Before building the model, the author confirms empirically that services have more frequent labor adjustments than manufacturing. He also shows that part-time and flexible-hours employment in the services sector is much more common. Next, he explores whether job creation and separation rates are higher for the services sector. An audience member mentioned that firms can adjust their employment levels by not hiring and letting people voluntarily quit over time. The presenter suggested that the job destruction figure incorporates that by subtracting voluntary job separations. Establishment entry and exit is also shown to be higher in the services sector. The presenter then shows evidence on the growth of the services sector relative to manufacturing in the

U.S. in terms of employment, firm and establishment shares and employment per establishment.

The author proceeds to share a multi-sector model with firm dynamics and job turnover and calibrate it with U.S. data to answer how the effect of labor policies in the U.S. depends on the sectoral composition. The model is a mix of canonical multi-sector structural change models, a heterogeneous firms model without trade and with market power, and a model with uncertainty and learning about firm productivity. The model presented only includes one worker per firm and is preliminary. A future full version of the model will include a labor decision.

The model is set up in discrete time, with identical workers, firms producing differentiated consumption goods, and two sectors: manufacturing and services. Households finance firms'

entry costs and obtain a claim to profits. Households choose how much to consume in a three-stage optimization process. First, they choose how much to consume of each variety of manufactured goods and services separately. Second, they decide how much to consume of the manufactured and services aggregate goods formed of the optimal mix of varieties obtained earlier. Finally, they make intertemporal consumption decisions.

Firms have idiosyncratic levels of productivity that take two values: low and high productivity. Productivity is initially unknown for firms, but a firm observes a signal with a probability of it being high productivity. Firms remain productive for at most two periods. Based on the aforementioned signal, a firm decides either to stay and produce or exit the market. At the end of the first period, productivity is revealed to the firm, and low productivity firms leave the market. Total factor productivity, or TFP, is not sector-specific. In the full model, sector-specific TFP might be needed to get the result. A firm pays an entry cost in units of labor. There are no exit costs in the baseline case. Following a question by the audience, the presenter clarified that asset values are net of entry costs. Furthermore, some members of the audience were unclear if firm entry and exit was necessary to look at effects of employment protection. The presenter

clarified that in the current version of the model it is needed, since each firm only has one worker, meaning that establishment turnover is equal to worker turnover. He believes this feature should not be needed in the full version of the model.

This model is meant to account for the fact that the services sector requires more frequent labor adjustments than the manufacturing one. One participant highlighted that apart from the mechanisms described in the model, manufacturing firms can also sell for inventory, and this gives them an extra margin of adjustment. Another participant argued that manufacturing has more capital than services, which has implications since capital is less flexible than labor to adjustments. A quick discussion ensued. It was agreed that it is important for the author to think about these more fundamental technology differences between sectors.

The model gives four main results. The first one is a static market size effect: a positive relationship between the sector size and the rate of turnover. This happens since the zero-profit condition in the model implies that larger sectors will lose marginal firms with lower productivity. The second result states that since the threshold probability for a firm exiting between periods 0 and 1 is lower for the services sector, the average productivity of services is

lower, though more dispersed, than for manufacturing. The third result says that under some conditions TFP growth can promote sectoral reallocations toward the services sector. Finally, the fourth result speaks to the dynamic market size effect: a positive relationship between sector growth and worker turnover. This occurs because sector growth raises the profits of each variety producer within a sector. Hence, even low productivity firms choose to enter because they have an option value of serving a larger market tomorrow even if they are not that productive. This generates endogenously higher exit of firms in the next period, which is the same as higher worker turnover in this simple model. These results have implications for employment policies. Firing costs depress this option value of serving a larger sector. This reduces sectoral reallocation and increases productivity through the standard selection effect.

The presenter ended by mentioning his planned future steps. The first is to analytically characterize the effects of policy on the equilibrium. Then, he plans on developing the full model, in which firms have a life cycle of more than two periods and can hire multiple workers and a labor-leisure tradeoff exists.

Labor Share, Markups, and Input-Output Linkages: Evidence from the US National Accounts

Benjamin Bridgman and Berthold Herrendorf

The labor share of the U.S. economy has decreased over the years, becoming a major topic of interest with many explanations but no consensus on its cause. Bridgman and his coauthors try to develop an unifying framework to decompose and explain decreases in labor share, focusing on the post-War period. The authors develop a two-sector model, goods and services, because the labor share differs across these sectors. The model features input-output linkages that can amplify sector dynamics and two kinds of sectoral forces. The first affects sectoral output elasticity of labor (for example, capital deepening), while the second affects sectoral markup (for instance, changes in market structure leading to more monopoly power).

To separately identify the output elasticity of labor and the markup, the authors adopt the approach of Farhi and Gourio's 2018 work. In general, by using National Income and Product Accounts data one cannot identify user costs of capital. Hence, it is not possible to separate payments for capital and profits. However, by employing the approach developed by Farhi and Gourio, one can calculate user costs of capital at the sectoral level. This approach creates a measure of the user costs of capital that includes unobservable premia for risk and depends on financial data (price-earnings data) available since the 1950s.

The model has Epstein-Zin lifetime utility and a Cobb-Douglas aggregator for final output production, taking final goods and services as final inputs. Gross output of the different varieties of goods and services is Cobb-Douglas with constant returns and take capital, labor, and intermediate as inputs. The model incorporates disaster risk. Differently from that paper, disaster risk is measured at the sector level in this paper. Disaster risk enters the production of gross output as a labor-augmenting technical change that evolves following a random walk that is affected by a random shock representing rare disasters. After a disaster hits, there would be a transition in the standard model. However, in this model the authors introduce the same rare disaster risk in the capital accumulation dynamics in order to get capital converging instantaneously to the new equilibrium level. They do so in order to gain tractability. The rare disaster shock also serves as a capital-quality shock in this dynamic.

The authors proceed to calibrate the model using a U.S. economy without real estate and show evidence that the aggregate labor share with the real estate sector would not be considerably different. They take that to mean that real estate is not a main reason behind the decline in the labor share. Ignoring real estate in the calibration is advantageous as most of its values in the dataset are imputed and the sector has very large markups. The calibration is done statically for each one of three distinct periods: 1957-1973, 1984-2000 and 2001-2016. There is no calibration for the time of the Oil Shocks in the 1970s, since the model does not capture this period well. The authors assume balanced growth paths in each of these periods for the sake of tractability.

The presenter highlighted a few other points regarding the calibration: it allows markups to change; in line with the tractability they pursued in their modeling, calibration boils down to four moments; sectoral depreciation comes from the sectoral investment-capital ratio; and sectoral discount factors are estimated from sectoral price-earnings with user cost of capital.

The authors can use a combination of model parameters to look at structural change, capital deepening and outsourcing and derive results on the decomposition of changes in the aggregate labor share. By decomposing the decrease in the U.S. labor share into its different components, they show increases in sectoral markups amplified through input-output linkages as the main force. The decrease of output elasticities of labor was concentrated in the goods sector. Since this sector shrank over time, output elasticities of labor's contribution to the declining labor share was small.

The authors note that markups in both sectors roughly doubled. However, the levels of markups in these sectors are half of their aggregate sizes. The reason for that is double marginalization: sectoral markups are applied to the rental prices of capital and labor and to the purchase prices of intermediate inputs. Therefore, markups impact intermediate inputs both when their producers sell them and

when their users sell their output, implying that aggregate markups are considerably higher than sectoral ones. The authors stress you cannot get to this result without a "macro" approach (i.e. input-output linkages). A participant questioned what the results would be without double-marginalization. The authors have a calibrated model highlighting the differences, though it was not presented. The main takeaway from it is that sectoral markups are considerably higher and the markup in the goods sector exceeds the aggregate markup by a large amount.

A second decomposition, in which the channel of interest is shut down in order to estimate its individual impact, estimates the decrease in the labor share would have been 4.3, 2.7, and 0.8 percentage points larger in the absence of changes in sectoral markups, in the output elasticity of labor, and without outsourcing, and 2.8 percentage points larger in the absence of structural change. The presenter highlighted his interpretation of the importance of structural change in explaining the decline in labor shares.

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Spending and Job-Search Impacts of Expanded Unemployment Benefits: Evidence from Administrative Micro Data

Peter Ganong, Fiona Greig, Max Liebeskind, Pascal Noel, Daniel Sullivan and **Joe Vavra**

In April of 2020, the U.S. implemented the largest unemployment insurance benefits increase in history as a response to the pandemic. On top of usual benefits, $600 supplements were added from April to July 2021, and $300 supplements starting in January 2021. The total value of these supplements amounted to $470 billion. Using this variation, Vavra and his coauthors ask three questions about the effects of these supplements: Did they increase consumer spending? Did they discourage job finding? And what broader lessons can be learned about their impact that apply to non-pandemic macroeconomic scenarios?

To answer these questions, the authors use anonymized household-by-week bank account and credit card data from Chase, the largest U.S. bank in terms of number of branches, net income and total assets, through February 2021. In this dataset, it is possible to observe both labor income and unemployment benefits, as well as spending coming from Chase credit cards, cash, paper checks and electronic payments. The sample is representative in terms of pre-pandemic income and benefit levels and cross-state and cross-industry pandemic patterns.

Although the paper looks at the introduction of supplemental benefits in April 2020, their end, and then reintroduction of such benefits in January 2021, for the presentation the author decided to focus on the introduction of the first round of benefits. Hence, the focus of the talk was to compare workers who lost their jobs at the end of March but who had different unemployment insurance starting dates due to random state-processing delays.

The authors start by estimating the marginal propensity to consume (MPC) for the supplemental benefits as 0.43. Next, the presenter shows time series evidence on the effect of the supplemental benefits on the job finding rate. Job finding drops at the beginning of the pandemic. It increases after the first wave of supplemental benefits is phased out in July 2020. It falls again once new supplemental benefits are put in place in January 2021. The authors then go on to identify the causal effect of supplement benefits on job finding. Two strategies are used for this: high frequency interrupted time-series and dose-response difference in differences, the latter emphasized in the presentation.

The dose-response exercises allow the authors to look at the impact of supplemental benefits ending in July 2020 and being reintroduced in January 2021 on average exit rate to new jobs. As expected, the higher the supplemental benefits as a percentage of pre-pandemic benefits, the stronger the change in exit rate to a new job by a given worker once the supplemental benefits are discontinued. A few questions remain. Is the effect of ending the benefits the same as the overall effect of having them in place from April to July 2020? What is driving the magnitude of the effects? To explore these questions, the authors build a structural model.

The model is intentionally standard. The objective of the paper is to explain the dynamics within the current mainstream macro-labor framework, not to propose new channels. In a first calibration exercise using a pre-pandemic calibration, the predictions of the model do not match the data on spending and job-finding rates: the predictions for changes in the former are too small; for the latter they are too large. Calibration choices are then made to better match the data. Namely, job search costs are set higher, agents do not have perfect foresight on policy changes, and the discount factor of unemployed households is set to match the MPC of 0.43 obtained previously in the reduced-form estimation.

With this calibration at hand, the authors show that the counterfactual without supplemental benefits implies that job finding would be 5 percent higher, and spending 25 percent lower. The reason for the muted job effects in comparison to previous literature are that supplements are temporary and are implemented in a labor market with depressed job-finding rates, recall share of total exits is higher, and the per-week behavioral response to the supplements is lower. While the second and third forces were pandemic-specific, the first one, which explains about half of the reduced employment distortion, generalizes to recessions in general. The reason for the larger effect on spending might be that the benefits are perceived as more persistent than tax rebates, they target unemployed who have a temporarily low income, and the best fit calibration incorporates more impatient unemployed.

Pandemic Control in ECON-EPI Networks

Marina Azzimonti, **Alessandra Fogli**, Fabrizio Perri, and Mark Ponder

To evaluate policies designed to improve health and economic outcomes during a pandemic, Fogli and her coauthors develop what is known as an ECON-EPI network model. Relative to the standard epidemiological SIR set-up, their study explicitly models social contacts among individuals and allows for heterogeneity in their number and stability. In addition, they embed the network in a structural economic model, describing how contacts generate economic activity.

They calibrated it to the New York metro area during the 2020 COVID-19 crisis and showed three main results. First, the ECON-EPI network implies patterns of infections that better match the data compared to the standard SIR. The switching during the early phase of the pandemic from unstable to stable contacts is crucial for this result. Second, the model suggests the design of smart policies that reduce infections and boost economic activity. Third, the model shows that reopening sectors characterized by numerous and unstable contacts (such as large events or schools) too early leads to fast growth of infections.

Fogli began the talk by explaining the three components of the ECON-EPI Network. A participant questioned whether there could be economic interaction without human contact. Fogli answered that there would be heterogeneity—consider working from home—which will be accounted for in calibrating the model. When Fogli showed a figure of network layers of households and schools, a participant expressed concern about the process behind the model resulting from choice behavior and asked about the extent of endogeneity in this study's setup. Foglio answered that their study does not endogenize the behavior and choice but brings more heterogeneity by calibrating the model to the policy and observing drops in economic activity in different sectors. The presenter also clarified some questions about how interactions are connected and said they could keep track of all the networks connected via the workplace using the data.

After the presenter explained the establishment of labor demand in the model, a participant commented that the setting in this study is very close to being able to talk about the net surplus, which involves disease risk. He wondered whether the wages determined in the model would depend on this disease risk. Fogli answered that they have abstracted from differences in human capital among the workers in the two sectors and attributed all the differences in wages to differences in physical capital. The same participant organized how he understood the general exercise done in the paper. He understood that while the critical connections in the model are endogenously created, the authors are estimating equilibrium outcomes observed in pre- and post-pandemic.

When Fogli introduced the first results comparing the network versus standard SIR, one participant questioned whether school closures were included in the analysis. The presenter clarified that they are included, and the role of school closures is essential in explaining the flattening curve of infections. Another participant asked a related question about whether school closure is connected to human capital. Fogli answered essentially that it was not a question they focused on.

The presenter described the design of the smart mitigation and reopening scenarios, meant to reduce infection while increasing output. While talking about full reopening scenarios, including school reopening, the presenter received a question about whether children transmit the disease at the same rate as adults. She answered that they tried different things and re-parameterized the transmissibility of the disease to consider usage of masks. However, the main message, that the full reopening would have led to an enormous surge in infection, was not changed.

The Dual U.S. Labor Market Uncovered

Hie Joo Ahn, Bart Hobijn and **Aysegul Sahin**

The classification of individuals into employed, unemployed, and nonparticipants is very coarse. Underlying heterogeneity within these three broad categories is important for understanding many aspects of individual and aggregate labor market outcomes. Average stock-and-flow rates, commonly used to calibrate macroeconomic models of the labor market, do not reflect individual labor market experiences and outcomes.

Aysegul Sahin and her coauthors propose a new method using a Hidden Markov Model (HMM) to identify restrictions on transition probabilities between the different hidden states. They classify 10 million respondents in the Current Population Survey from 1980-2021 into three labor market segments. The first two segments correspond to the primary and secondary tiers in the core of the dual labor market theory. In addition, they identify a tertiary sector that is made up of those who are infrequently part of the labor force. Their analysis focuses on two features that distinguish the three market segments. The first is turnover rates: employment stability is higher in the primary tier than in the secondary and tertiary tiers; and nonparticipation in the tertiary market is more persistent than in the primary and secondary tiers. The second feature is the limited mobility of workers between the market segments.

Labor market frictions are irrelevant for primary sector workers, who comprise around 55 percent of the population. These workers are almost always employed, and they very rarely experience unemployment. Unlike workers in the secondary and tertiary tiers, they also seamlessly move from nonparticipation to employment. The secondary sector, which constitutes 14 percent of the population, exhibits high turnover and high unemployment and absorbs most of the short-run fluctuations in the labor market at both seasonal and business cycle frequencies. Workers in this sector are six times more likely to move between labor market states than those in the primary tier and are ten times more likely to be unemployed than their primary counterparts. The tertiary sector primarily includes workers who are loosely attached to the labor market and have a very low employment-to-population ratio. These workers mostly experience unemployment when they enter the labor force from nonparticipation but do not share the high job-loss rate of secondary workers.

The distinction between the three tiers in dual labor market theory helps to reconcile a set of seemingly unrelated observations on how different types of underlying heterogeneity within the three tiers are important for explaining several aspects of aggregate labor market outcomes. For example, distinguishing between long- and short-term employment is important for matching unemployment dynamics and explaining changes in the job tenure distribution. Heterogeneity among the unemployed is used to match the duration dependence of unemployment outflow rates, the costs of unemployment, the asymmetric dynamics of the unemployment rate of the business cycle, and the change in the quality of the pool of unemployed over the business cycle. Finally, different levels of labor-force attachment among nonparticipants are essential for fitting the joint occurrence of flows across the participation margin, while many persons report being always out of the labor force and not looking for work.

A participant asked what disciplines the number of latent states in the model. This question led to a lengthy discussion. The author said they started with three latent states in each segment and had some difficulties with matching unemployment in each sector. They tried some combinations and found that having four states in each sector worked well. The relationship between the number of sectors and the number of latent states in each sector is worth further investigation.

The Anatomy of Sorting – Evidence from Danish Data

Rasmus Lentz, Suphanit Piyapromdee and Jean-Marc Robin

Sorting can be measured by covariance or stochastic dominance if firm and worker types can be assigned cardinal labels. Wage sorting is an example. The presenter began with four channels, including job preferences, market segmentation, layoffs, and unemployed job finding, to examine the finite mixture model of wage and employment dynamics. Based on matched employer-employee data in Denmark spanning from 1989 to 2013, he presented several findings.

First, job preferences intensify with tenure and experience, and they are heterogeneous across worker wage types. Second, an increase in workers' age and tenure leads to a strengthened type-sorting. Third, all four channels take substantial effects on wage sorting, while the contribution of the layoff channel is minimal. Last, early-career workers experience wage sorting, which is mostly driven by market segmentation.

He highlighted the four channels as a novel contribution of his study. The sorting model characterizes both workers and firms by latent type, and time-varying factors are applied to workers only. Job mobility, which is a key feature of the model, represents random utility reflecting Gumbel-distributed value addition and random mobility costs that are drawn from a logit distribution. The study also sheds light on the importance of non-wage factors on preferences. He concluded that latent types are identified through both wages and mobility in the study, and preferences are revealed along with the rest of the mobility model.

A participant asked whether characteristics are fixed or not. He responded that they are basically fixed, but each worker type is driven by specific channels. Another participant wondered whether researchers would not be able to identify this because the arrival rate of offers does not depend on the previous firm. The presenter answered that in terms of an exclusion restriction, the random utility interpretation takes distributed shocks on top of values, resulting in the probability of picking an outside type.

The presenter received a question about the possibility of weakening effects of business cycles on the conditions. He answered that he does not use cycles yet, but will give it careful attention. Another participant asked the presenter to give an example of what preference intensity means. He said if the measure is zero, it indicates no sorting. A value of one indicates perfect sorting. He then mentioned that this study takes advantage of fine-grained worker-level data on weekly wages, and worker and employer IDs, as well as a set of worker characteristics like education, gender, and tenure.

The resulting mobility model shows, first, preference and layoff into unemployment exhibit a negative correlation. Second, an increase in worker wage type is associated with preference strength. Third, preference intensity increases as workers have more experience and tenure. The participant wondered whether the intensity may increase in a worker's wage type. The presenter agreed that the results can be mixed in terms of unemployment transition. But he said it is likely that job-finding contributes to sorting in the early stage, while sorting late is subject to the layoff channel, which is relatively insignificant to wage sorting.

Minimum Wages and Labor Markets in the Twin Cities

Loukas Karabarbounis, Jeremy Lise and Anusha Nath

What are the labor market effects of a minimum wage increase? It has been one of the most studied questions in labor economics. Loukas Karabarbounis and his coauthors answer this question by studying the effects of minimum wage policies that were recently enacted in the Twin Cities.

In 2017, Minneapolis introduced a minimum wage increase. Implemented in 2018, the policy corresponded to a 38% increase by 2020. A similar minimum wage policy was introduced in Saint Paul following the policy change in Minneapolis. The large increase in minimum wage and its interaction with the pandemic recession make the policy analysis in the Twin Cities particularly interesting.

To conduct the statistical analysis, the authors merge two datasets, Unemployment Insurance wage detail reports and Quarterly Census of Employment and Wages, into one large panel dataset that covers workers' hours and wages, the establishments at which they work, establishment location, industry and firm between 2001 and 2020. The data improves upon previous studies in three ways: hours worked enables them to study intensive margin of labor supply; more effective observations are gained from firms with multiple establishments; and the unit of analysis is a zip code, so that many common shocks can be absorbed in the cross-sectional analysis. The speaker clarified that the minimum wage increase was applied before tips in response to a question asked by a participant since workers in restaurants would experience the strongest policy effect.

The authors provide empirical evidence from both the time series and the cross-sectional dimensions. In the time series analysis, they apply a synthetic difference-in-difference method comparing Twin Cities with other U.S. cities. The synthetic control group shows similar high-frequency growth rate of jobs in the pre-treatment period, and the authors demonstrate their method is appropriate for addressing bias and establishing credible causality. Results show that for Minneapolis there are reasonable wage gains in most low-wage sectors, ranging from 4-13% by 2020.

In terms of employment losses, they find no employment changes in nearly all industries except for restaurants, for which they witness a considerably large decline in jobs, hours worked and earnings, ranging from -40% to -30%. One participant raised a question on how the effect of job declines can be related to changes in firm capital. The speaker said that they hoped to answer the question in the next stage since they have new data that would allow them to merge corporate income statements to firms studied in the paper.

Another participant raised a concern about pandemic and George Floyd protest-related shocks, by which cities were differentially affected. This question naturally led to the discussion on the cross-sectional analysis. Given that one can always challenge the time series results due to other potential shocks contemporaneous with minimum wage policy, the authors proceed to explore the cross-sectional variation across establishments exposed differentially to minimum wage within cities. In the econometric specification, they are able to take away the common effect of pandemic or civil unrest on all establishments within a sector, ZIP code, and time.

After controlling for typical establishment dynamics, results show that employment losses are roughly half as large as the time series estimates. The estimate of employment elasticity with respect to wage, i.e., labor demand elasticity, is roughly -1 at the establishment level. They rationalize their large employment elasticity estimates, compared to the previous literature, by both the large size of minimum wage change and the policy interaction with the pandemic recession.

Lastly, a model of establishment dynamics is developed to reconcile the difference in estimates from the time series and the cross sections. They argue the larger employment losses seen in the time series can be plausibly explained by firm entry cost or an aggregate shock contemporaneous with the minimum wage change, both of which could affect the time series but not the cross sections. To conclude, one can think of the true employment elasticity as being bounded between these two estimates.

Resource Curse or Blessing? Sovereign Risk in Resource-Rich Emerging Economies

Franz Hamann, Juan Camilo Mendez-Vizcaino, Enrique Mendoza and **Paulina Restrepo-Echavarria**

Why can't financial penalties on Russia halt the Russia-Ukraine war? The answer might be related to the oil and gas owned by the country. Motivated by the fact that the relationship between oil, default risk and macroeconomic outcomes was relatively unstudied, Paulina Restrepo-Echavarria and her coauthors document new findings on the relationship between sovereign risk and oil extraction, prices and reserves in oil-rich emerging countries. A sovereign default model with endogenous oil extraction is developed to rationalize the empirical regularities.

Using comprehensive country-level data on oil, public debt, default episodes and credit ratings for the 1979-2016 period, the authors first present some well-known empirical facts for the 30 largest emerging market oil producers: they have high external sovereign debt-to-GDP ratios (29% on average); many have defaulted; and oil-price movements are associated with their business cycles.

Next came important new facts: the relationship between cycles in oil prices and economies differs across defaulters and non-defaulters; more surprisingly, country risk decreases with oil prices and production, but increases with oil reserves. They show country risk decreases by 0.05% when oil production increases by 1% in the short run, but that country risk increases by 0.16% when oil reserves increase by 1% in the long run from the dynamic fixed effects regression. One participant raised a point that some OPEC members have more power to set oil prices and may be less likely to default than others. The speaker claimed this had limited influence on their results or mechanisms, given that most countries studied are effectively price-takers, but that the question itself was worth further exploration.

On the theoretical side, they propose a model of sovereign default with optimal oil extraction and reserves decisions made by the government. The model setup is standard, as in Eaton and Gersovitz (1981), except for the newly introduced feedback mechanism by which default risk alters oil returns and oil returns influence debt and default risk. The default payoff becomes endogenous, which relies on the fact that choice of extraction alters reserves and consumption during exclusion. In addition, oil price shocks affect debt and spreads, and a trade-off exists between using the financial asset (debt) and using the real asset (oil) for consumption smoothing, depending on the relative yields of one versus the other.

Oil is a risky asset with real and financial returns that the sovereign internalizes – oil reserves affect bond prices. Default payoff is non-decreasing in oil reserves, and default incentives are stronger at lower oil prices under certain conditions. These theoretical findings are consistent with the conjecture that higher oil production or prices reduce country risk by increasing debt repayment capacity, but that larger reserves can increase country risk by making autarky more valuable and decreasing the need to access international financial markets. One participant asked about the oil discovery component, as it seemed to represent the resource as non-exhaustible. The speaker responded that one could tune the discovery parameter to zero, so their model was flexible in this regard.

In terms of the quantitative dimension, the calibrated model has a good fit of data moments. Besides, the model-generated data shows that country risk today is increasing in future oil reserves. They explore the role that endogenous extraction plays in replicating this main empirical result: in contrast to the model with constant extraction, the model with endogenous extraction can generate increases in oil reserves at the time of default because it is optimal to decrease extraction as present oil prices are lower than expected, saving oil for future sales. When re-entering the financial market shortly later, the sovereign starts to accumulate debt given the oil prices remain low, hence an increase in the interest rate. This mechanism successfully explains the positive relationship between oil reserves and sovereign risk observed in the data.

America's Missing Entreprenuers

Raj Chetty, John Van Reenen, Owen Zidar, and **Eric Zwick**

Entrepreneurship is essential for growth and technological progress. Understanding who becomes an entrepreneur and why is important for determining if talent is being optimally allocated. If individuals do not optimally sort into entrepreneurial roles, then identifying and removing distorting factors would increase productivity and innovation.

Eric Zwick and coauthors use tax records on firms linked to individuals to track all entrepreneurs in the U.S. longitudinally from 2000 to 2017. Specifically, they study the determinants of entrepreneurship in the U.S. in two steps: first, they conduct a descriptive analysis of the characteristics of star founders to identify potential gaps in the supply. Second, they examine several mechanisms for disparities in supply across groups: barriers to entry, such as liquidity constraints; labor market experience; and others.

A participant asked how the authors define an entrepreneur. Zwick explained, "we define an entrepreneur as a founding owner of a new firm who is actively involved in the firm's operation. To isolate active owner-managers from passive owners, we exclude owners who do not receive W-2 compensation or the equivalent in the case of partnerships. Our analysis excludes unincorporated sole-proprietorships to focus on employer businesses with the potential to become stars and superstars."

Zwick next presented the main findings of this preliminary work. There exist large persistent disparities in entrepreneurship rates by gender, race, and parental income. Entrepreneurs from under-represented groups do not have higher rates of return. Liquidity, experience, and exposure effects matter. All these results point toward a "pipeline problem." In fact, if under-represented groups (URGs) found firms at the same rate as high-income white men, there would be 5 times as many superstars. Furthermore, holding the number of superstars fixed, if founding rates were equalized there would be 3 times as many superstars from URGs.

Zwick elucidated several mechanisms that may be driving these results. First, returns to female entrepreneurs are on average half of those for men. Second, differences in levels of industry experience account for 47% of the gender gap in entrepreneurial entry. In fact, having a higher-share of female workers in an industry is more predictive of female entrepreneurship than the gap in returns between male and female entrepreneurs within the industry. Third, perhaps surprisingly, there is no evidence of heterogeneous liquidity effects for URGs. Fourth, childhood exposure to commuting zones with high entrepreneurship rates lead to greater rates of future entrepreneurship.

A participant asked, "when you say experience effects are important, what mechanisms do you have in mind?" Zwick responded, "We develop a novel measure of early labor market experience that leads to entrepreneurial entry. The idea underlying this measure is that some industries and occupations are more entrepreneurial than others, either due to technological or institutional differences. As a result, accumulating work experience in more entrepreneurial jobs early in one's career may enable subsequent entry at higher rates. Such experience might generate more entrepreneurial human capital in the form of ideas for new opportunities; networks of workers, customers, suppliers, and investors; and know-how in the industry."

The International Price of Remote Work

Agostina Brinatti, **Alberto Cavallo**, Javier Cravino and Andres Drenik

An increasing share of jobs can now be done remotely across borders. Information, communication, and technology-enabled service trade quadrupled since 2000, and now comprises 70% of all trade in services in the U.S. Furthermore, after Covid, companies are shifting to a more flexible work-from-anywhere model. In fact, according to a PWC survey, 28% of employers plan to allow remote work in another country.

Cavallo and his coauthors' paper looks at the question of how these remote wages are set. Specifically, they use new data from a globalized remote labor market to ask if wages are different across regions and countries, and whether remote wages are more sensitive to international competition and shocks.

The dataset was created from a web-based job platform that matches workers with employers from around the world. The work can be delivered online, which makes this platform a window into a globalized market for remote work. Furthermore, job-based web platforms are rapidly growing, tripling in size over the past decade, with $50 billion in revenues in 2020.

After describing the data, a participant asked whether working remotely means working from home or offshoring. For example, if a firm hires a company in another country to complete a job, will this be included as remote work? Cavallo explains that there are no firms in this setting. All we observe is whether a worker and an employer are in different locations, in which case it will be considered remote work. It is certainly worth considering how much this market is related to the more formal market where firms offshore work by hiring a third party.

The platform that Cavallo and coauthors study is the largest of its kind. It has millions of users, and 3 million jobs worth $1 billion are posted annually. The platform specializes in remote jobs, from web developers to accountants. These jobs are categorized into 12 broad and 91 narrow sectors. Workers are more spread out across the globe than employers, with 70% of workers being in non-OECD countries. Employers are primarily in developed countries, with 88% being in OECD countries, the majority of those being in the U.S.

A participant asks if Cavallo is working with posted wages or earned wages. Cavallo explains that he can observe both but uses posted wages because they are easier to access and there is not a meaningful difference between posted and earned wages, which indicates little negotiation in the hiring process. Another participant asked if it is possible for workers to lie about their location. Cavallo uses this opportunity to explain the payment process, and he says that lying is not very feasible because the platform uses information about users to ensure that they are working when and where they say they are.

Cavallo's first main finding is that wages vary with workers' locations, not employers' locations. Indeed, a third of the variation in wages is explained by differences in worker location. Second, remote wages are highly sensitive to foreign shocks. Dollar wages respond little to dollar exchange rates in the worker's country. Finally, wages respond strongly to foreign competitors' wages.

Empirical Measures of Income Risk

Tincho Almuzara, Manuel Arellano, Richard Blundell and **Stéphane Bonhomme**

It is crucial to have well-measured income risk. The nature of income risk shapes economic decisions, such as consumption, saving, and financial investments. Many policies aim at insuring households against income and other risks. The authors use a combination of microdata, such as employment history, education, and age, along with macro data, such as aggregate shocks, to measure the income risk in a more refined way. They find that there is vast heterogeneity in income risk and how it varies over the business cycle.

Most importantly, not only do shocks matter, but the processes of these shocks matter. One audience member raised an interesting question: in a micro-founded macro model, the aggregate shocks are unlikely to be independent of the micro-foundations. The author agreed with this comment and mentioned that because of the data they use, this is less of a problem in this paper.

The income process consists of three parts. The deterministic component is a function of individual characteristics, such as age and education. The persistent component is a nonlinear Markov process. The transitory component is independent over time, conditional on the aggregate shocks and individual-level characteristics. The total income risk in this paper is then defined as the predicted variance of the persistent component. The total income risk can be further decomposed into idiosyncratic shocks, aggregate shocks, and aggregate processes.

The business cycle factor is inferred from aggregate indicators, such as unemployment, output, hours worked, and investment. All variables are quarterly from 1960 to 2019 and are filtered, removing all variability above ten years. The estimation of the factor model is Bayesian, implemented using Gibbs sampling.

When hit by a macro shock, such as a recession, how income evolves depends on where they start from in the income distribution. Low-income people are more affected by the recession; however, they tend to recover more quickly. The high-income group is less affected by the recession and tends to recover slower. Similarly, low-income people initially benefit more from the expansion but revert more quickly to the mean.

There are substantial interactions between the idiosyncratic shocks and macro shocks in an impulse response graph. Recession has a more significant negative effect on upward mobility among low-income groups.

Decomposing Passthrough: Labor Market Power, Technology and Adjustment Costs

Mons Chan, Sergio Salgado and **Ming Xu**

There is a long debate about empirical evidence on the relationship between firm-level productivity and workers' wages. While the link between productivity and wages depends on the economic environment, wages do not necessarily depend on idiosyncratic firm shocks. To investigate, the presenter explores the passthrough from total factor productivity (TFP) shocks to wages.

She develops a dynamic model of firms and wage setting, estimates firm-level productivity, and recovers distributions of marginal revenue product of labor (MRPL), markdowns, and passthrough elasticities. She uses firm-level data such as revenues, capital stock, and employment in Denmark, and extensive worker-level data on hourly wages and demographic characteristics with about 9 million observations. She takes the non-parametric approach proposed by Gandhi et al. (2020) to allow arbitrary substitution patterns between inputs.

The main advantage of this approach is that researchers do not need to observe nor specify adjustment costs or functional forms of labor supply. To estimate the passthrough, she employs log-linear approximation for average passthrough and second-degree polynomial approximation to capture the heterogeneous nature of the passthrough. The key results are that persistent shock elasticity ranges between 0.32 to 0.42, and a 1% increase in TFP is associated with a 2.11% increase in MRPL and a 1.73% decrease in markdowns. When she decomposes the passthrough effects, she determines key ingredients of passthrough as heterogeneous technology, labor market power, and adjustment costs.

A participant raised a concern: wage sorting would not be driven by competition. The presenter said that she showed the competition is consistent with production function estimation, and the study assumed a transitory shock affects worker's wages. She emphasized that the dynamic nature which integrates the persistence of shocks is one of the key features of this model. Another participant asked her to elaborate on several assumptions made in the model. She mentioned that the first key assumption is that a worker's wage is a single ability price multiplied by worker's time-varying ability, which represents the substitutability of labor conditional on ability. Second, firm-level capital is predetermined, and firms choose labor, material, and an endogenous part of capital, based on exogenous characteristics, price, and their previous choices. Third, workers are characterized by time-varying productivity, which is a function of innate ability, experience, and education. She then highlighted lessons from a firm's first order

condition for labor: wages in her model depend on market power, technology, and adjustment costs, and the passthrough is zero in the frictionless competitive labor markets.

The presenter then received a question about why the model is not conditional on both unobservables and TFP. She answered that the model needs to control for labor quality at the same time shocks that induce firms' input choices. One participant wondered that if markup changes, then its effect would have to show up in the model. The presenter agreed with his point and said that she cannot observe worker-level skills, so her production function incorporates ex-post transitory components.

A participant asked what wage variable is used in the model. She mentioned that wage does not come from data, ability price set at the firm level is an approximate measure of worker's wage, and all wage-relevant factors are linked together through this structural model. She was asked to share her thoughts on significant drivers of passthrough. She agreed that researchers need to account for wage setting, heterogeneous technology, and labor market power to discuss the dynamics of firm productivity. She again highlighted that there is a large passthrough of small positive shocks, but null effects in the case of small negative shocks, and the questioner said this is a very interesting point.

Simple Allocation Rules and Optimal Portfolio Choice Over the Lifecycle

Victor Duarte, **Julia Fonseca**, Aaron Goodman, Jonathan Parker

As more Americans became investors, demand for financial advice resulted mostly in simple rules. For example, allocate 2/3 of portfolio to stock, or gradually decrease equity share as one ages closer to retirement.

In fact, age-based approaches have taken over the marketplace of defined contribution pension plans, through a type of mutual fund known as target-date funds. But life factors other than age should matter for optimal portfolio choice over the life cycle, Fonseca argued, and we need a richer model that includes factors like labor income risk, home ownership, mortgage debt, health and mortality risks, pension income, family dynamics, taxes, and potentially other realistically important factors.

These many factors are likely to interact, as well, and the complexity of these interactions may be beyond the scope of simple advice. It might be better to consider a machine-learning approach to optimal decisions, Fonseca said. She and her co-author tested such an approach in a simulated environment to observe whether simple rules, such as simply lowering equity weighting with age, will be able to do anything close to a first-best that incorporates all of these complicated factors.

The authors used 21 state variables, 13 shocks, and highly non-linear policy functions. Deep reinforcement learning was used to solve for optimal investor behavior, using a simulated 100 million lives to train the software to create the optimal policy functions, but could suggest the welfare costs of following simpler policy functions, the simplest being fixed-proportion allocation over the life cycle.

A participant asked whether we will be able to interpret from these policy functions why these rules work better. Or in what way they work better. The participant said that this was usually one of the strengths of economists. Fonseca responded that, while lacking traditional interpretability of interactions, the flexibility of variable relationships is one of the strengths of the deep learning methods.

Ultimately, Fonseca claimed that the cost of following a simple rule like target-date funds results in a 2-3% consumption-equivalent loss relative to the complex and optimal rule. Participants commented that the underlying model's ability to predict how prices evolve relative to dividends introduces assumptions that may not fairly describe the empirical setting, and the findings about the effectiveness of various rules would be highly sensitive to these assumptions.

The model simulation incorporates family size, housing factors, assets and debts, income, progressive taxes, a pension, and 401k-style account. Assets include stocks, short-term bonds, long-term bonds, as well as housing and debts. A participant asked whether it was possible in the model to purchase additional homes as investment, and Fonsceca replied that, no, this was not a choice they included in their model. Their model does not include the possibility of divorce, but does include bequests. The economy can be in expansion or recession, and labor conditions will be a function of these economist conditions, as well as individual shocks. While several participants asked about the decisions that went into the realistic or non-realistic constraints in the modeling choices. The presenter generally responded that it was necessary to make certain modeling choices to keep the number of state variables and the extent of choices reasonable.

Fonseca described the methodology of direct policy optimization: not solving for value functions, as is traditionally done, but only policy functions using algorithms. While the method does not use theorems typically used to ensure the policy functions arrive at global optimums, the presenter argued that by varying starting points, they arrive at the correct global optimums.

A finding of the model is that their optimal policy gradually reduces equity allocation at a slower pace than target date funds, gradually reaching 60 percent (versus 40 percent in target date funds). While participants commented that this is likely to be sensitive to the simulated conditions, Fonseca closed by stating that substantial gains are possible by optimizing target-date funds to include more life factors.

Countercyclical Income Risk and Portfolio Choices: Evidence from Sweden

Sylvain Catherine, Paolo Sodini, and Yapei Zhang

Imagine a recession costing you both a job and a plunge in your portfolio. Naturally, we would expect some workers who are especially vulnerable to that outcome to have perhaps a different portfolio composition than someone who is less vulnerable to that outcome. Catherine, with co-authors, explores this phenomenon, suggesting that there is no empirical, reduced-form evidence yet that cyclical risks affect portfolio choices.

Catherine uses the term negative cyclical skewness to describe the condition of facing higher "left-tail" income risk when markets perform badly. The authors estimate cyclicality of variance and skewness for different groups of people, and show that households facing higher skewness are less likely to participate in markets, and those that do invest less.

However, Catherine is quick to point out, the fact that some workers invest less to contain their risks does not theoretically explain explain asset pricing puzzles, such as high equity risk premia, because the degree to which the cyclicality affects people is concentrated among lower wealth individuals who have dramatically smaller share of the total equity.

The authors use Swedish data on incomes from 1982-2015 and data on balance sheets from 1999-2007, which includes real estate. The model predicts that equity share decreases with three components of the human capital beta: covariance of income shocks with returns, countercyclical variance, and cyclical skewness, and that the hedging motive is larger for workers with higher human-capital-to-wealth ratios.

They sort the population by education level and industry and create groupings that they assume contain individuals with the same distribution of income risks. They measure the mean, variance, and skewness of the income shock distribution for each group. Participants raised many questions and seemed critical of the modeling exercise. For instance, some asked about whether factors like age and gender should matter, and the presenter noted that they chose not to emphasize these factors in their modeling decisions.

Several participants asked critical questions about the limitations of the model, to which the presenter expressed a viewpoint that he chose to focus on the choice variables that mattered in the real world, and that there was an open question as to whether the whether investors would see cyclicality as a meaningful, important factor on which to adjust their investment decisions, and how far up the wealth scale these adjustment decisions would go. Together these could determine whether these effects actually matter for asset prices in general.

Interestingly, the authors look at identical twins in different careers, with one whose career is in a setting with higher cyclical skewness. Human-capital-to-wealth ratios should matter, so the authors do look at age and show that life-cycle profile of equity share is increasing between the age of 40 and retirement.

For the top three deciles of owners, there is no effect in the optimal equity allocation from cyclical risks, and because these deciles control nearly all of the equity, little can be said about pricing puzzles given the unaffectedness of the well-off.

A participant commented that skewness is basically employment risk and that employment risk should intuitively vary with age – a 25-year-old and 50-year-old are fundamentally different. Catherine's results echo this observation. Ultimately the authors find cyclical skewness is a better predictor of equity allocation than other income risk measures.

FROM THE LAB

Laboratory for Aggregate Economics and Finance
University of California, Santa Barbara
Santa Barbara, CA 93106-9215 U.S.A.

ADDRESS SERVICE REQUESTED

LAEF

2112 North Hall
University of California, Santa Barbara
Santa Barbara, CA 93106–9215
U.S.A.
Phone: (805) 893-2258
Fax: (805) 893–8830
Email: Laurie.Preston@ucsb.edu
www.laef.ucsb.edu