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Research Statement

My research is in quantitative macroeconomics and centers around the interaction between aggregate technological progress and household inequality at the micro level. In the first branch of my work, I explore the consequences of technological change for inequality, in particular focusing on automation adoption and rising earnings risk. The second branch of my research analyzes the origins of technological progress and documents long-run trends across countries. I approach these topics by developing and embedding theoretical mechanisms into quantitative heterogeneous agent frameworks, which I discipline using large-scale microdata. Through my research, I have already started to build a network of co-authors.

Automation and unions. In my job market paper, **"Technological Change and Unions: An Intergenerational Conflict with Aggregate Impact"**, I study the role of unions in shaping the evolution of employment and wages of workers during technological transitions, focusing in particular on workers exposed to automation technologies. I show that unions, and labor adjustment frictions more broadly, are important to understanding how the adverse impact of technology adoption is distributed across generations, and how fast overall employment in exposed occupations declines along the transition.

Linking microdata on U.S. workers from several sources, I exploit variation across local labor markets to document the effect of unionization on workers in routine-manual jobs, who have been particularly exposed to automation technologies since 1980. First, unionization is associated with a greater fall in employment and wages for young workers entering the labor market, consistent with insider-outsider dynamics. As a result, the routine-manual workforce becomes relatively older in more unionized labor markets, an effect that persists throughout the transition. Second, unions accelerate the decline in overall routine-manual employment, measured as greater employment decline in high-unionzed labor markets early in the transition and a subsequent slow catch-up in less unionized labor markets after 2000.

I develop a quantitative dynamic equilibrium model of endogenous technological change and unionization which demonstrates that union-imposed firing costs combined with gradual technology adoption over time can jointly rationalize the documented distributional and aggregate effects of unions. Firing costs incentivize firms to replace their workforce through reduced hiring rather than costly layoffs when adopting automation. Moreover, when firms anticipate more automation to come, they further shrink their workforce preemptively today in order to avoid firing costs in the future which gives rise to the documented accelerated employment decline in routine occupations in high-unionized labor markets. The model combines three building blocks that make it a suitable quantitative framework to measure the intergenerational transfer of the welfare cost of automation from incumbent routine cohorts to young, incoming workers which unions generate: 1) two occupations, with endogenous technology adoption in the routine occupations; 2) overlapping generations of workers with occupational choice; and 3) incumbent routine workers are represented by a labor union that endogenously sets wage premia. The degree of unionization is parameterized by the level of exogenous firing costs, which determine the union's ability to impose wage premia by reducing firms' elasticity of labor demand. The two-sector setup with occupational choice endogenizes the supply of labor. This allows the model to decompose the documented overall employment decline in routine occupations into a downward shift in demand driven by technology adoption and an endogenous supply response driven by incoming workers switching to non-routine occupations to avoid the automation impact.

I calibrate the model to local labor markets in the U.S. in 1980 and study the responses of a high-unionized and a low-unionized labor market to an unexpected fall in automation prices that matches the price path of capital goods in the U.S. since 1980. Unions protect incumbent routine workers by lowering their layoff risk and wage decline, which reduces the welfare cost of automation to these workers along the transition by up to 4% of permanent consumption. The cost is shifted to incoming cohorts, increasing the welfare cost of automation to incoming routine workers by up to 2% of permanent consumption in high-unionized labor markets due to falling routine entry wages and hiring. While older, incumbent workers are stuck in a declining sector, having made their occupational choice without anticipating automation, incoming workers can endogenously respond to automation by entering non-routine occupations, which limits the welfare impact on them. The impact of high unionization spills over into non-routine occupations as the accelerated reallocation of labor suppresses wages there.

Technological progress in the modern health sector and life expectancy. What caused the increase in life expectancy since 1800 and rapid growth of a modern health sector during the 20th century? In work with Krueger and Ludwig, **"The Medical Expansion, Life-Expectancy, and Endogenous Directed Change"**, we study the joint dynamics of income growth, the modern health sector, and the increase in life expectancy over the last two centuries. We document the evolution of life expectancy over the last two centuries and the emergence of the modern health sector in the 20th century in the U.S. We then provide a quantitative theory to jointly explain the documented facts. The theory is built on the insight that the demand for health increases over time as individuals become richer and older, which in turn sparks a reallocation of resources towards the production and innovation of health goods. Households are initially too poor to demand health goods, and life expectancy is stagnant. As income grows, fueled by technological progress, households start consuming basic health goods, life expectancy starts to rise, and directed technological progress eventually, with a delay of 100 years, leads to the emergence of a modern health sector. We find that rising household demand for health accounts for one-third of the observed increase in the relative price of health goods, while two-thirds are accounted for falling input prices in the modern health sector relative to the final goods sector, driven by technological progress. Moreover, modern health goods have accounted for roughly 30% of the increase in life expectancy at age 20 since 1940, which translates into 3.3 additional expected years of life.

Long-run interest rates. Real interest rates provide an important channel through which long-run trends in economies affect inequality, by shaping savings and investment decisions as well as monetary policy. What accounts for the secular decline in long-run rates since the 1980s across countries? In **"Global Natural Rates in the Long Run: Postwar Macro Trends and the Market-Implied r* in 10 Advanced Economies"** (with Davis, Fuenzalida, Mills, and Taylor), we estimate paths for the natural rate of interest across 10 advanced economies for the postwar period, covering more countries and decades than previous studies. We first document that estimates of natural rates and risk premia differ between macro and finance frameworks. To resolve this conflict, we build a unified macro-finance framework that jointly disciplines estimates of the natural rate and risk premia with higher-frequency financial information from the yield curve and lower-frequency secular inflation and growth trends as in macro models. To estimate the model, we construct a new database of zero-coupon yield curves for 10 countries for the postwar era. We find that slowing growth and demographic trends account for 2/3 of the long-run decline in natural rates across countries, and show that global components are important for unexpected bond returns, while the local components are important for natural rates.

Rising earnings risk. How much does rising risk in labor earnings matter for wealth inequality and welfare? In **"Dynamics of the Wealth Distribution in the Presence of Higher-Order Earnings Risk"**, I answer this question by introducing higher-order earnings risk consistent with recent empirical findings into a benchmark heterogeneous-agent model. I show that higher-order earnings dynamics in the form of left-skewness and excess kurtosis strengthen the precautionary savings motive, leading to greater consumption inequality and lower wealth inequality. The earnings dynamics are partially passed through to the consumption of poor households who are willing to pay up to 1.7% of permanent consumption to avoid higher-order earnings risk. Methodologically, I develop a new General Polynomial Chaos Expansion approach, a global solution method to solve for the aggregate dynamics of this class of models, and demonstrate that it increases efficiency relative to previous methods. I extend the baseline method to allow for time-varying base distributions, which is particularly useful in economic settings in which the cross-sectional household distribution at times moves far away from the ergodic distribution. I then apply the extension by introducing time-varying earnings risk into the benchmark model.

Going forward. Building on my job market paper, I am in the process of obtaining firm-level data, allowing me to directly observe the impact of adjustment frictions on adoption and employment decisions by firms. Moreover, I am working on the policy implications of the positive findings in my job market paper, based on the insight that policy aimed at alleviating the automation impact on workers needs to be conditioned on the local labor market setting. In follow-up work to **"The Medical Expansion, Life-Expectancy, and Endogenous Directed Change"**, my co-authors and I plan to evaluate the long-run consequences of health care reforms, such as abolishing the Affordable Care Act and reforms to the copay level of health insurance contracts.