Research Statement
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My work seeks to advance two core research agendas. The first is to understand how the enormous heterogeneity observed at the micro level, and in particular the large disparities in income and wealth, impact the macro economy and macroeconomic policy. The second addresses one of the longest-standing questions in economics: "Why are some countries so much poorer than others?" More recently I have been more active in the former agenda but I hope to return to working in the latter agenda in the future. I have also done some more policy-focused work on the German economy outside these two main agendas.

1. Heterogeneity in Macroeconomics

One of the key developments in macroeconomics research over the last three decades has been the incorporation of explicit heterogeneity into models of the macroeconomy. As a result of taking micro data seriously, these theories study macroeconomic questions in terms of distributions of microeconomic variables like income or wealth rather than just aggregates. This approach is attractive for two reasons. First, empirically, it provides an integrated framework for making use of both micro and macro data. Second, conceptually, it provides a kind of "distributional macroeconomics" perspective, meaning an integrated perspective for analysing the distributional implications of macroeconomic trends, shocks or policies and the two-way interaction between distribution and the macroeconomy. My current research aims to contribute to this broader agenda.

I now summarize some of my research projects in this area, ranging from analysing the effects of policies like monetary policy or lockdown measures to tackle COVID-19 (Section 1.1) to studying potential drivers of rising income and wealth inequality like automation (Section 1.2) to the redistributive effects of asset-price changes (Section 1.3) to the development of new methods for thinking about heterogeneity in macroeconomics (Section 1.4).

1.1. HANK Models for Macroeconomic Policy Analysis

One of the main themes of my work has been the development of richer and more empirically realistic models for macroeconomic policy analysis. These Heterogeneous Agent New Keynesian (HANK) models combine features from the heterogeneous agent (HA) literature, namely heterogeneity and incomplete markets, and the New Keynesian (NK) literature, namely nominal rigidities. They open the door to studying distributional issues, business-cycle fluctuations, and stabilization policies, all within the same framework.

In **"Monetary Policy According to HANK" (Kaplan, Moll and Violante, AER 2018,)** we revisit the transmission mechanism from monetary policy to household consumption in such a model, calibrated to yield empirically realistic distributions of wealth and marginal propensities to consume. In standard Representative Agent New Keynesian (RANK) models, monetary transmission is based almost entirely on intertemporal substitution. In contrast, in our HANK model this channel is small. Monetary policy nevertheless has sizeable real effects because of indirect effects, in particular those

operating through a general equilibrium increase in labor demand and disposable incomes of high-MPC households. In **Alves, Kaplan, Moll and Violante (JEDC 2020)** we follow up this work by examining in more detail the relative importance of different HANK model elements (e.g. unequal incidence of aggregate income fluctuations across households or the distribution of profits) for amplification or dampening of the response of aggregate consumption to a monetary shock.

In **"Present Bias Amplifies the Household Balance-Sheet Channels of Macroeconomic Policy" (2020, R&R at QJE) with David Laibson and Peter Maxted**, we venture further into trying to understand the implications of the complex financial planning problems faced by real-world households, and of the psychological factors that influence them. To this end, we study the effect of monetary and fiscal policy in a heterogeneous-agent model where households have present-biased time preferences, a form of dynamic inconsistency that has received empirical support in both laboratory and field studies. The model features a liquid asset and illiquid home equity, which households can use as collateral for borrowing. Because present bias substantially increases households' marginal propensity to consume (MPC), present bias increases the impact of fiscal policy. Present bias also amplifies the effect of monetary policy but, at the same time, slows down the speed of monetary transmission. Interest rate cuts incentivize households to conduct cash-out refinances, which become targeted liquidity-injections to high-MPC households. But present bias with naive beliefs of the type we model also introduces a motivation for households to procrastinate on refinancing their mortgage. Intuitively, naive present bias implies that households will delay completing immediate-cost delayed-reward tasks such as mortgage refinancing, which involves lots of up-front paperwork. Naive households will continually delay refinancing, all the while (counterfactually) believing that the task will get done in the near future.

Heterogeneous agent models can, of course, also be used to study other policies besides regular monetary and fiscal policy. During the COVID-19 pandemic some of the most important policy questions were concerned with the appropriate policy responses to it and in particular the question to what extent different policies involve a trade-off between saving lives and preserving livelihoods. In **"The Great Lockdown and the Big Stimulus: Tracing the Pandemic Possibility Frontier for the U.S." (Kaplan, Moll and Violante, 2020)**, we contributed to this debate by quantifying this trade-off, focusing on the distributional effects of the pandemic and associated policy responses, across different types of workers and households. One of our main arguments is that the choice governments face when designing policy is not just between lives and livelihoods, as is often emphasized, but also over who should bear the burden of the economic costs.

To make this argument, we integrate an expanded SIR model of virus spread into a macro model with realistic income and wealth inequality, as well as occupational and sectoral heterogeneity. Our starting point is that many of the individuals who are most financially exposed to the pandemic are also the most financially vulnerable. A key determinant of economic exposure is occupation. Socially facing workers who cannot work remotely (such as waiters and hairdressers), experienced especially large drops in earnings. In contrast, the earnings of workers in occupations that produce goods and services that do not require social interaction and have high flexibility to work from home (such as lawyers, academics, and finance professionals) have been left relatively unscathed. In our model, as in the data, the most exposed occupations also have the lowest liquid wealth to buffer such income

shortfalls. Our model therefore predicts that the welfare losses due to the pandemic are extremely unequal across the population but that there is scope for economic and health policies, with appropriate patterns of redistribution, to both contain the virus and mitigate its economic effects. We summarize our findings through a "distributional pandemic possibility frontier" (PPF), which shows the distribution of economic welfare costs associated with the different aggregate mortality rates arising under alternative containment and fiscal strategies. We also use our model to evaluate the CARES act, the large fiscal policy package implemented in the U.S. in the spring of 2020, and find that it was quite effective at alleviating economic hardship, in particular mitigating economic welfare losses by around 20% on average.

1.2. Theories of Rising Income and Wealth Inequality

Over the past forty years, economic growth in the United States has been unevenly distributed: income percentiles corresponding to the lower half of the distribution have stagnated while those at the top have sharply increased. Similar trends have occurred in many other advanced economies. A second theme of my recent work has been trying to understand these trends.

Since Pareto (1896), it has been well known that the upper tail of the income distribution follows a power law, or equivalently, that top inequality is "fractal," and the rise in top income inequality has coincided with a "fattening" of the right tail of the income distribution. That is, the "super rich" have pulled ahead *relative* to the rich. This rise in top inequality requires an understanding of the forces that have led to a fatter Pareto tail. In **"The Dynamics of Inequality" (Gabaix, Lasry, Lions and Moll, Econometrica 2016)** we show that the most widely used theories of the observed fat tails of these distributions, which build on a random growth mechanism, generate transition dynamics that are too slow relative to those observed in the data. We then suggest two parsimonious deviations from the canonical model that can explain such changes: "scale dependence" that may arise from changes in skill prices, and "type dependence," that is, the presence of some "high-growth types." While our work stops short of assessing concrete economic mechanisms put forth in the public debate – is the rise in top inequality due to: technical change, superstars, rent-seeking, globalization, and so on? – it provides some structure for economists trying to develop theories of fast changes in inequality. Economic mechanisms that can generate type- or scale-dependence (or both) are particularly promising, for example theories involving "superstar" phenomena.

One potential driver of rising income inequality that is often cited by pundits and policy makers alike is technical change, and in particular the automation of tasks performed by labor, and a large literature in macro and labor economics has studied how technology and automation affect the distribution of labor incomes. But not all income is labor income and capital income is an important income source, particularly at the top of the distribution where incomes have increased the most. Existing theories therefore paint an incomplete picture of technology's implications for overall income inequality. In **"Uneven Growth: Automation's Impact on Income and Wealth Inequality" (Moll, Rachel, Restrepo, Econometrica 2019)** we therefore develop a theory that links technology to the personal income and wealth distributions – and not just that of wages – and use it to study the distributional effects of automation.

Our main argument is that technology affects not only relative wages but also asset returns and this can have substantial distributional effects. This argument has two parts. First, automation directly contributes to income inequality by increasing returns to wealth and the concentration of capital ownership. Second, relative to theories in which returns are unaffected, automation is also more likely to lead to stagnant wages and therefore stagnant incomes at the bottom of the income distribution (even in the long run). The key for understanding both parts of the argument is that long-run capital supply in our model is upward-sloping. Automation increases the demand for capital relative to labor and, because supply is upward-sloping, this demand shift permanently increases returns to wealth. Importantly, this is in contrast to many workhorse theories of capital accumulation, in particular variants of the neoclassical growth model, in which long-run capital supply is perfectly elastic and therefore returns don't budge in response to demand shifts. Paraphrasing this logic: in workhorse theories, if AI technologies like ChatGPT increasingly outperforms labor, in the long-run this always benefits workers; in contrast in our theory, this benefits the owners of those technologies.

1.3 Redistributive effects of asset price changes

Over the last several decades, there has been a large increase in valuations across many asset classes. These rising valuations had important effects on the distribution of wealth (see e.g. Kuhn, Schularick and Steins, 2020, and Martínez-Toledano, 2020). This raises a number of interesting questions.

One of these is: If a large fraction of the increase in wealth inequality is due to such valuation effects, should we care? Do those whose wealth increases due to rising asset prices also benefit in welfare terms? Or are such capital gains just "paper gains"? In a nutshell, do changes in asset valuations that increase wealth inequality also increase welfare inequality? In **"Asset-Price Redistribution" (Fagereng et al., 2023)** we think through this question systematically using a combination of theory and empirical work. We derive an intuitive sufficient statistics formula for the (money metric) welfare effect of a change in asset valuations, which depends on the present value of an individual's net asset sales: rising asset prices benefit prospective sellers and harm prospective buyers. Note that it is asset transactions (sales) that matter rather than asset holdings, i.e. rising asset prices benefit sellers not holders. To take an extreme example, if the only reason asset prices increase is falling interest rates and investors just live off their assets' cash flows and never sell these assets, nothing happens to their welfare. But in many other cases also welfare is affected. We estimate our money-metric welfare gains and losses using panel microdata covering the universe of financial transactions in Norway from 1994 to 2019. We find that rising asset valuations had large redistributive effects: they redistributed from the young towards the old and from the poor towards the wealthy. This work grew out of an NBER Macro Annual comment **(Moll, 2020)** in which I explored similar questions using a two-period toy model. **Fagereng et al. (2021)** provide related empirical evidence on saving behavior across the wealth distribution in Norway and emphasize the importance of asset-price changes.

In **"Putting the 'Finance' into 'Public Finance': A Theory of Capital Gains Taxation" (Aguiar, Moll and Scheuer, work in progress 2023)** we take the next logical step in this line of inquiry and study optimal taxation of wealth gains from rising asset prices. We find that the *source* of

capital gains matters critically for which type of tax can implement the optimal allocation. When a large chunk of capital gains is due to declining discount rates – like the finance literature argues is the case empirically – taxing wealth or unrealized capital gains is undesirable from a normative perspective. This is because such taxes can redistribute "in the wrong direction": they hit not only individuals who benefit in welfare terms (those who sell their assets) but also those whose welfare is unaffected or declines (those who do not sell or perhaps even buy). In the presence of valuation effects, the optimal tax system instead taxes capital gains on realization rather than accrual, but with some important differences from realization-based capital gains taxes typically used in practice.

1.4. Continuous-Time Methods for Macro Models with Distributions

A unifying thread in all of my research is that I try to develop better methods for thinking about heterogeneity in macroeconomics. This theme goes back to Moll (2014) and Buera and Moll (2015). **"Income and Wealth Distribution in Macroeconomics: A Continuous-Time Approach" (Achdou et al., ReStud 2020)** shows that, when recast in continuous time, incomplete-market models can be conveniently solved as systems of partial differential equations. This approach allows for both a tighter theoretical characterization and more efficient computations than traditional discrete-time methods. The model with two assets and kinked adjustment costs developed in Kaplan, Moll and Violante (2018) and the model of mortgage refinancing with present bias in Laibson, Maxted and Moll (2020) provide illustrations of the usefulness of these methods. Also see Bornstein (2020), McKay and Wieland (2020) and Guerrieri, Lorenzoni, and Prato (2020). In **"When Inequality Matters for Macro and Macro Matters for Inequality" (Ahn et al., NBER Macro Annual 2017)** we further extend this methodology to handle aggregate uncertainty and develop a computational toolbox for numerically solving such models.

2. Cross-Country Income Differences

One of the main conclusions of existing work is that the vast income differences between rich and poor countries cannot be fully explained by differences in observable factors of production, such as the size of a country's capital stock or the education of its labor force. Instead, we need to understand cross-country differences in aggregate productivity, broadly defined. My work pursues two lines of attack to understand the root causes of such productivity differences: capital misallocation from financial frictions (section 2.1) and differences in human capital accumulation or, more broadly, knowledge (section 2.2).

2.1 Financial market imperfections

Low aggregate productivity in poor countries may be due to an inefficient allocation of resources within these countries. In **"Productivity Losses from Financial Frictions: Can Self-Financing Undo Capital Misallocation" (Moll, AER 2018)** I examine how much resource misallocation arises due to poorly functioning credit markets in developing countries. To this end, I develop a highly tractable general equilibrium model in which heterogeneous producers face collateral constraints. I show that a key parameter determining the aggregate effects of financial frictions is the persistence of idiosyncratic productivity shocks hitting producers, with higher persistence leading to

smaller steady-state productivity losses but slower transition dynamics. This line of research is further developed in **Banerjee and Moll (AEJ Macro, 2010)**, **Townsend, Moll and Zhorin (PNAS, 2017)** and **Buera, Moll and Shin (RED, 2013).**

"Optimal Development Policies with Financial Frictions" (Itskhoki and Moll, Econometrica 2015) asks whether financial market imperfections of this type imply that there is a role for governments in emerging countries to accelerate economic development by intervening in product and factor markets. We study optimal dynamic Ramsey policies in a growth model with financial frictions and find that the answer is "yes": optimal policy involves "pro-business" policies in early stages of development that speed up entrepreneurial wealth accumulation to overcome financial constraints; in later stages of development, optimal policy instead switches sign and takes a "pro-worker" stance. Our results provide an efficiency rationale, but also identify caveats, for many of the development policies actively pursued by dynamic emerging economies.

2.2 Human capital accumulation and knowledge diffusion

"Life-Cycle Wage Growth Across Countries" (Lagakos et al., JPE 2018a) documents that experience-wage profiles are on average twice as steep in rich countries as in poor countries. This fact is consistent with two key hypotheses: workers in poor countries may be accumulating less human capital over the life cycle or they may be facing more severe search frictions preventing them from climbing the job ladder. In **Lagakos et al. (JHC 2018b)** we document an analogous fact for new U.S. immigrants, lending further support to the human capital hypothesis. These facts improve our understanding of what causes the large observed cross-country income differences. Although a long tradition in growth and development economics considers human capital as a driver of cross-country income differences, most studies focus on human capital acquired through schooling and find that it plays a relatively small role. Our findings suggest that another type of human capital, that acquired over the lifecycle (e.g. through on-the-job learning), may be important nevertheless.

Productivity in poor countries is likely also shaped by knowledge diffusion, that is, the speed with which existing technologies spread both from rich to poor countries and within poor countries. **"Knowledge Growth and the Allocation of Time" (Lucas and Moll, JPE 2014)** develops this line of inquiry and builds a theory in which ideas are transmitted from one person to another, capturing the intuition that idea diffusion is akin to the spread of an infectious disease.

3. Work outside my two main research agendas

The Russian attack on Ukraine in February 2022 laid bare Germany's dependence on Russian energy imports and ignited a heated debate on the costs of a cut-off from Russian gas, with many pundits as well as industry and union representatives predicting a massive economic collapse. In **"What if? The Economic Effects for Germany of a Stop of Energy Imports from Russia" (Bachmann et al., 2022a)**, released less than two weeks after the Russian invasion, we contributed to this debate. Our answer at the time, based on some key statistics about the German economy, relevant empirical estimates and applied macroeconomic theory, was that an immediate emancipation from Russian energy was feasible and would entail "substantial but manageable" economic cost for the German

economy. Our analysis foresaw an output cost in the first year following such a cut-off in the range of 1-3% relative to a no-cut-off baseline scenario, in line with previous recessionary episodes that the country had successfully dealt with. Our key economic argument was that German firms and households would adapt to a cut-off of Russian gas supplies in ways that would ultimately reduce the economic impact. Producers would switch to other fuels or fuel suppliers and import products with high energy content while households would cut their gas demand by turning down their thermostats. Importantly, elasticities of substitution that are very low, but non-zero, translate into much smaller economic losses than in the case of literally zero substitutability (i.e., Leontief production). Substitution along the supply chain and across producers would mean that macro elasticities are larger than micro elasticities. "Cascading effects" along the supply chain would be muted as opposed to "destroying" the economy's entire industrial sector.

Fearing catastrophic economic consequences of an end to Russian gas, the German government decided to keep importing rather than sanctioning it. But the gas soon stopped flowing nevertheless because Russia weaponized and ultimately cut off gas supplies in the summer of 2022, in particular via the important Nord Stream 1 pipeline which was later destroyed by underwater explosions. Using the empirical evidence now at hand, **"The Power of Substitution: The Great German Gas Debate in Retrospect" (Moll, Schularick and Zachmann, BPEA 2023)** studies the adjustment of the German economy in the wake of the gas cut-off. We document two key margins of adjustment. First, Germany was able to replace substantial amounts of Russian gas with imports from third countries. Second, the German economy reduced gas consumption by about 20%, driven mostly by industry (26%) and households (17%). The economic costs of demand reduction were manageable with the economy as a whole only experiencing a technical mini-recession in the winter of 2022/23. Overall industrial production "de-coupled" from production in energy-intensive sectors (which did see large drops) and was hardly affected. We draw a number of key lessons from this important case study about the insurance offered by access to global markets and the power of substitution, specifically that supply shocks have drastically smaller costs when elasticities of substitution are very low but non-zero than when they are literally zero.

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