I am an applied macroeconomist. The focus of my research is examining positive and normative aspects of deep recessions. Specifically, my work examines (1) what policies are effective in deep recessions, (2) how economies behave at the zero lower bound on nominal interest rates, (3) the optimal inflation rate, and (4) the macroeconomic effects of remote work. In this work I combine a variety of approaches, including statistical analysis of micro and macro data, theoretical modeling, and computational methods. My research has been published or accepted in the *American Economic Review*, *Econometrica*, the *Journal of Political Economy*, the *Quarterly Journal of Economics*, the *Review of Economic Studies*, and the *American Economic Review: Insights* among others.

1 What policies are effective in deep recessions?

Through empirical and quantitative analysis, I aim to shed light on the mechanisms that drive economic recessions and inform policymakers about the most effective strategies to mitigate the impact of deep recessions. My work covers fiscal, monetary, and exchange rate policies; episodes such as the Great Depression, the Great Recession, and the Japanese lost decade(s); and a range of economic mechanisms such as the intertemporal shifting effect, the farm channel, the financial dampening effect, and secular labor reallocation.

1.1 Fiscal Policy and Macro Counterfactuals

In "**Micro MPCs and Macro Counterfactuals: the Case of the 2008 Rebates**" (Accepted at *QJE*, [16]), Jacob Orchard, Valerie Ramey, and I evaluate the effects of the 2008 rebate from a joint micro and macro perspective. Micro studies find that the marginal propensity to consume (MPC) out of the rebate was between 0.5-0.9 over three months, with the majority of spending on motor vehicles. Yet aggregate PCE or motor vehicle expenditure show no noticeable change over the rebate period, May-July 2008. In this paper, we calibrate a standard macro model with the estimated micro MPCs to construct counterfactual macroeconomic consumption paths in the absence of a rebate. The counterfactual paths imply that consumption expenditures would have plummeted in spring and summer 2008 and then mostly recovered in September 2008. We use narratives and forecasts to argue that these

paths are implausible.

To reconcile micro and macro evidence either the micro MPCs must be smaller than estimated, or there must be general equilibrium forces that dampen the micro MPCs. We first show that standard two-way fixed effect estimates of the micro MPCs are upward biased. When we correct for the biases, we estimate smaller micro MPCs using the CEX data than the previous literature. We then show that the relative price of motor vehicles increased in spring 2008, which standard models do not capture because they assume the relative supply curve is perfectly elastic. A realistic upward sloping relative supply curve both matches the relative price increase and predicts substantial crowding out in general equilibrium. This is because motor vehicle demand is relatively elastic and rebate spending is concentrated on motor vehicles. The combination of smaller micro MPCs and dampening general equilibrium forces implies general equilibrium consumption multipliers that are below 0.2.

Our work suggests that rebates are less effective at stimulating the economy than implied by previous micro evidence. More broadly it highlights the importance of demand and supply elasticities in determining the aggregate effectiveness of fiscal policy.

The 2008 rebate is a leading case of macroeconomics increasingly using applied micro methods to inform macro questions. However, there is no "applied micro free lunch" in that researchers must use a macro model to translate estimates obtained from household or subregional variation to a macro context. In "**Using Macro Counterfactuals to Assess Plausibility: An Illustration using the 2001 Rebate MPCs**" (*R&R EJ*, [15]), Jacob Orchard, Valerie Ramey, and I argue that researchers can take advantage of the confluence of micro estimates and macro models by constructing macro counterfactuals for historical periods and analyzing whether they are plausible. This plausibility test can be used to favor some estimates over others and helps determine which estimates and/or models deserve more scrutiny. And the attempt to reconcile the micro estimates and macro models with the behavior of aggregates is often illuminating. Macro counterfactuals are thus more broadly useful beyond our earlier work on the 2008 rebate, and indeed a natural progression of the credibility revolution for macroeconomics.

We illustrate this approach using micro estimates of the 2001 rebate. The counterfactual path implies that without the tax rebate nondurable consumption spending would have fallen dramatically in the late summer and fall of 2001. Using forecast-

ing regressions and other evidence, we argue that this counterfactual is implausible. When we investigate the source of the discrepancy, we find that the leading MPC estimates are not representative of the response of total consumption. Thus, similar to the 2008 rebate, the aggregate effect of the 2001 rebate appears to have been modest.

1.2 Monetary Policy and Durable Goods Demand

While rebates have become an increasingly popular stabilization tool, the first line of defense in recessions remains interest rate policy. The prevailing neo-Wicksellian view holds that the central bank's objective is to track the natural rate of interest (r^*), which itself is largely exogenous to monetary policy. Lower real interest rates encourage businesses to invest and consumers to spend, which bolsters aggregate demand. Implicit is that lower interest rates can create aggregate demand without future costs.

In "**Lumpy Durable Consumption Demand and the Limited Ammunition of Monetary Policy**" (*Econometrica*, [12]), Alisdair McKay and I instead argue that monetary policy faces an intertemporal trade-off when it stimulates aggregate demand. It is generally acknolwedged that an important component of the monetary transmission mechanism is to stimulate purchases of durable goods, which are particularly sensitive to interest rates. We capture this transmission mechanism in a fixed cost model of durable goods, which we estimate on micro data. We then verify that the model matches the aggregate response of nondurable and durable goods to monetary policy shocks. In our model, as a monetary stimulus increases the stock of durables today, there is less need to acquire durable goods in the future, all else equal. Monetary policy therefore raises aggregate demand today by borrowing demand from the future. Thus, monetary policy shifts demand rather than create, a mechanism we call "intertemporal shifting." To compensate for the weakness in aggregate demand going forward, the central bank must keep real interest rates low. That is, monetary policy stimulus has a side effect of reducing the real natural rate of interest (r^*) in subsequent periods.

The intertemporal shifting of demand is a propagation mechanism that makes changes in real interest rates very persistent: weakness in demand today must be compensated for with low real interest rates. But low interest rates today lower demand in the future, requiring future real interest rates to stay low as well. Based on

information through 2012Q4, our model predicts a path of interest rates that largely tracks the path that came to pass over the next seven years. The model predicts liftoff from the effective lower bound (ELB) in 2015Q4 and predicts low levels of interest rates in 2019Q4 just as in the data. The slow normalization of interest rates reflects a persistent decline in r^*. We isolate the contribution of intertemporal shifting to the path of r^* and show that it is quantitatively important to explaining the large drop and, especially, the slow normalization of r^* after the Great Recession.

A fixed cost model is a natural modeling approach to capture the lumpiness of durable adjustments in the micro-data. However, the nature of the adjustment costs we include in our model is also central to our main findings. The logic of our argument can actually be reversed in models with higher-order adjustment costs, a common formulation in which adjustment costs are increasing in the rate of change of investment. With higher-order adjustment costs, low interest rates today stimulate investment today, which lowers the marginal cost of investment in the future.

The fixed cost approach is also central to our resolution of the forward guidance puzzle. In the standard New Keynesian models as well medium-scale DSGE models forward guidance is as effective as contemporaneous interest rate cuts, a prediction that is generally regarded as implausible or at least puzzling. In "**Forward Guidance and Durable Goods Demand**" (*AER:I*, [13]) we show that in our fixed cost durable model the announcement of a real interest rate cut one year from now increases current output by only 41% as much as a contemporaneous real interest rate cut. Interest rate cuts further in the future are even less effective.

Forward guidance is less effective in our model because the demand for durables is particularly sensitive to the contemporaneous user cost of durables. Intuitively, the extensive margin decision is whether to adjust now or a little bit later. Optimality requires that a household at an adjustment threshold is indifferent between adjusting now versus waiting a short time (the smooth-pasting condition). Consider a household that wants to increase its durable position. Upgrading the durable position immediately brings a higher utility. But postponing the adjustment avoids paying the contemporaneous user cost on the addition to the durable stock. Because the choice of when to adjust is a short-term decision (now versus a short time later), the contemporaneous user cost plays a special role. We further show that the importance of the contemporaneous user cost to the extensive margin decision remains the same with long-term financing.

1.3 Exchange Rates, Redistribution, and the Great Depression

Standard representative agent models implicitly assume that distributional effects of monetary policy are not important. Only recently has the Heterogeneous Agent New Keynesian (HANK) explored how the distributional consequences of monetary policy can be important in the aggregate.

In "**Recovery from the Great Depression: The Farm Channel in Spring 1933**" (*AER*, [7]), Joshua Hausman, Paul Rhode, and I provide empirical evidence that the distributional effects of monetary policy, more precisely exchange rate policy, are central to the recovery from the Great Depression. From its low point in March 1933, industrial production increased by 57% over the next four months. We argue that an important driver of this extraordinary recovery was the effect of devaluation on farm prices, incomes, and consumption (the "farm channel").

We show that crop prices rose rapidly in spring 1933, and that this increase was in part caused by devaluation. Using state and county-level data, we show that auto sales and income grew much more in farm areas of the country, particularly in those areas most burdened by farm mortgage debt. Finally, we gauge the aggregate effects of the farm channel through the lens of a heterogeneous agent model disciplined by our cross-sectional estimates. For plausible assumptions about farmers' relative marginal propensity to consume, the incidence of higher farm prices, and the aggregate multiplier, this redistribution to farmers accounted for 20-60% of spring 1933 growth. This farm channel thus provides an example of how the distributional consequences of macroeconomic policies can have large aggregate effects. Our analysis also implies that Roosevelt's controversial decision to take the U.S. economy of the Gold Standard was an important step in setting off the recovery from the Great Depression.

In "**Farm Product Prices, Redistribution, and the Early US Great Depression**" (*JEH* Lead Article, [9]) we argue that the farm channel was also quantitatively important in the onset of the Great Depression. The worldwide recession that began in summer 1929 quickly lowered the prices of farm products, particularly those of internationally traded crops. We show that in 1930 the spending of farmers fell relative to nonfarmers. This effect is concentrated in States most exposed to the decline in international crop prices. Using the same framework as in [7], we estimate that the farm channel accounted for 10-30% of the output decline in the first year of

the Depression.

1.4 Abenomics' Monetary Policy Arrow

Ben Bernanke, prior to being appointment Governor to the Federal Reserve, argued that Japan needed "Rooseveltian resolve" in order to escape its lost decade(s). In 2013, Shinzo Abe was elected Prime Minister of Japan and implemented a suite of policies, known as Abenomics, to end Japan's lost decade(s).

In "**Abenomics: Preliminary Analysis and Outlook**" (*BPEA*, [5]) and "**Overcoming the Lost Decades? Abenomics after Three Years**" (*BPEA*,[6]), Joshua Hausman and I evaluate the unconventional monetary policies that are part of Abenomics. We show that these policies had modest positive effects on output and inflation, and likely passed a cost-benefit test. We highlight two puzzles that account for why performance was not better: The response of net exports to the weak yen was small, and there is little evidence that expansionary monetary policy had large effects on consumption. We contrast our findings with [7] and suggest that the different distributional incidence of Abenomics may be important to explain why Abenomics may have been less successful at raising output and inflation than originally hoped for.

The paper "**Abenomics, the Housing Market, and Consumption**" (*Keizai Bunseki [The Economic Analysis]*, [8]) and the book chapter "**Abenomics, Monetary Policy, and Consumption**" (*The Political Economy of the Abe Government and Abenomics*, Ch. 6, [10]) further investigate the consumption response, or lack thereof, to Abenomics. We start by noting that slow aggregate consumption growth must reflect either (1) a combination of positive effects of monetary policy and negative effects of other shocks or (2) the lack of a positive effect of monetary policy on consumption. To distinguish between these possibilities, we test whether households consumption responses to Abenomics differ across characteristics that are important in the monetary transmission mechanism in other countries. In [8] we find no evidence that homeowners with mortgages increased consumption relative to homeowners without mortgages or relative to renters. We show that this reflects Japanese housing market institutions, which meant little pass-through of lower long-term interest rates to rates paid on the mortgages of existing homeowners. In [10] we further find little heterogeneity in the consumption response to Abenomics across household indebtedness, asset holdings, income, and age. This suggests that the overall effect

of monetary policy on consumption during Abenomics was small.

1.5 Policy Effectiveness under Secular Trends: Financial Dampening and Labor Reallocation

The potential for limited passthrough from monetary policy to real outcomes in deep recessions is a theme that reoccurs in "**Financial Dampening**" (*JMCB*,[21]) with Mu-Jeung Yang. We examine a different mechanism by which monetary policy may be less effective at raising output in times of financial retrenchment. In our model of bank capital structure and risk management, loan retrenchment combined with loan liquidation costs reduces the pass-through from monetary policy rate changes to loan supply (the "Bank Lending Channel"), which attenuates the effectiveness of monetary policy.

We test the prediction of the model on U.S. bank-level micro data. To isolate credit supply from credit demand shocks, we employ a spatial IV strategy, which we validate in our model. Specifically, we instrument local loan growth with loan growth at banks of the same bank holding company operating in a different geographic area. We estimate that retrenching banks increase loan supply substantially less in response to exogenous monetary policy rate reductions. We also show that areas more exposed to retrenching banks experience slower employment growth, suggesting that borrowers cannot easily substitute to expanding banks. Financial dampening thus provides a rationale for slow recoveries from financial crisis, and it suggests that central banks may want to cut interest rates more aggressively in times of financial distress.

Some economists have questioned the extent to which demand-side policy can be effective in deep recessions if frictions prevent unemployed workers from reallocating to industries with high labor demand. In "**Secular Labor Reallocation and Business Cycles**" (*JPE*, [1]) Gabriel Chodorow-Reich and I provide new evidence on the extent to which the need for reallocating labor contributes to the depth and persistence of recessions.

We propose a novel method to estimate how secular labor reallocation affects local labor markets and implement it using confidential administrative employment data. Specifically, we compare employment outcomes in local areas more exposed to national reallocation trends, while controlling for locally predicted growth implied

by these trends. Our estimates imply that the consequences of reallocation depend on the phase of the business cycle. More reallocation implies higher unemployment when the reallocation coincides with a recession, but roughly neutral effects when it occurs coincident with an expansion.

We show that a multi-area, multi-sector search-and-matching model featuring realistic frictions to sectoral mobility and downward wage rigidity can rationalize this result. In expansions, the wage constraint does not bind and relative wages adjust, causing little change in unemployment. In recessions, the downward wage constraint binds in contracting sectors causing large increases in unemployment. Overall, our results suggest that labor reallocation is an important determinant of the depths of recessions, but this does not imply that it is invariant to demand-side policies.

2 How do economies behave at the zero lower bound?

In some of the deepest recessions in history — the Great Depression, the Great Recession, and the Japanese lost decade(s) — monetary policy was constrained by the zero lower bound on nominal interest rates. Since such events are rare, there existed little empirical evidence on how the zero lower bound affects economic outcomes. A first set of my papers provides such empirical evidence ([20], [2], [17]).

This work is motivated by the standard new Keynesian model, which predicts that economies behave very differently at the zero lower bound than they do in normal times: completely wasteful government spending or forward-guidance are very stimulative, capital destruction or oil supply shocks are expansionary, and reducing pricing frictions exacerbates a recession. In this model aggregate demand is determined by intertemporal substitution. Lower expected real interest rates encourage consumers to pull forward consumption and vice-versa. Capital destruction, higher real oil prices, or higher government spending raise marginal costs, which raises expected inflation. In normal times the central bank raises nominal interest rates more than one-for-one with inflation, raising expected real interest rates, and inducing consumers to postpone consumption. But if the central bank does not respond, for example because it is constrained by the zero lower bound, then expected real interest rates decline causing an increase in consumption and output.

My work suggests skepticism that these unusual predictions of the new Keynesian

model apply in practice. In "**Are Negative Supply Shocks Expansionary at the Zero Lower Bound?**" (*JPE* Lead Article, [20]) I look for events that raise current and future marginal costs, I check whether expected inflation rises as predicted and nominal interest rates do not, and I look for the predicted output rise.

I study the Great East Japan earthquake and global oil supply shocks in Japan when nominal interest rates are zero. I verify that these shocks raise expected inflation and lower expected real interest rates. However, I find that both shocks reduce output, contrary to theory. Indeed, I find that oil supply shocks are even more contractionary at the zero lower bound than in normal times. Specifications of the new Keynesian model that match these data also overturn the other unusual predictions of the model for the zero lower bound, such as large fiscal multipliers. These findings suggest that policy makers should be cautious in expecting large positive outcomes at the zero lower bound through the intertemporal substitution channel emphasized by new Keynesian models.

In "**Supply-Side Policies in the Depression: Evidence from France**" (*JMCB*, [2]) Jeremie Cohen-Setton, Joshua Hausman, and I perform a similar test in a different environment: France in the Great Depression. Elected in May 1936 and led by Léon Blum, the Popular Front government in France enacted a suite of supply-side policies: private sector wages were raised by 7-15 percent. Workers were granted 2 weeks of vacation without loss of pay. And perhaps most importantly, the work week was reduced from 48 to 40 hours, also without loss of pay. The size of these shocks, as well as their temporal isolation from demand-side policies, make France from 1936 to 1938 a useful setting for understanding the effects of supply-side policies in depressed economies.

Using aggregate data, we show that price increases and output declines coincided with the implementation of supply-side restrictions. We then exploit variation in the implementation date of the 40-hour law across industries to show that it lowered output and raised prices. Finally, we ask whether a standard new Keynesian model calibrated to match the cross-sectional data could still match the aggregate facts. We find that it predicts an implausible doubling of output. This paper, like my work more recent data, suggests that the new Keynesian model is a poor guide to the effects of supply-side policies in depressed economies.

In "**Fiscal Multipliers at the Zero Lower Bound: International Theory and Evidence**" ([17]) I examine to what extent fiscal stimulus crowds out net ex-

ports. A conventional view is that higher government spending crowds out net exports through a real exchange rate appreciation. By contrast, I show that a standard open economy new Keynesian model predicts that fiscal policy crowds in net exports at the zero lower bound, such that the fiscal multiplier is larger than in a closed economy. Intuitively, higher inflation from government spending reduces expected real interest rates, which depreciates the real exchange rate under uncovered interest rate parity (UIP). However, in the data I estimate that inflation surprises still cause an appreciation of the real exchange rate at the zero lower bound, contrary to the standard model's prediction. A new Keynesian with frictional UIP, calibrated to match these data, predicts that the open economy fiscal multiplier at the zero lower bound is smaller than the closed economy fiscal multiplier. This suggests that the conventional view still applies in practice.

Some existing work claims that standard new Keynesian models do not make unusual predictions when the zero lower bound is caused by a persistent shock to confidence: fiscal multipliers are small and negative supply shocks are contractionary. I examine and argue against these claims in the context of fiscal multipliers in two papers, "**State-dependence of the Zero Lower Bound Government Spending Multiplier**" ([18]) and "**Zero Lower Bound Government Spending Multipliers and Equilibrium Selection**" ([19]). But the results apply broadly to supply and demand shocks in these models.

In [18], I show that the size of the fiscal multiplier at constant, zero nominal interest rates is independent of what causes the zero lower bound. Existing work has found the opposite result because it simultaneously changed the persistence of the fiscal shock as well as the persistence of the zero lower bound. But it is the former change, not the latter, that changes the size of the fiscal multiplier.

In [19], I then examine why the persistence of the fiscal shock is such an important determinant of the fiscal multiplier at the zero lower bound. In particular, I examine why a small increase in the persistence can switch the multiplier from large positive to small or negative. I show that this discontinuity occurs because the solution method implicitly switches to a different type of equilibrium. When a consistent equilibrium selection criterion is used, then there is no such discontinuity, and the standard new Keynesian model predicts large and positive multipliers at constant, zero nominal interest rates.

3 The optimal rate of inflation

Many prominent macroeconomists have argued that the Federal Reserve should adopt a higher inflation target to reduce the likelihood of hitting the zero lower bound in the future. Despite the importance of quantifying the optimal inflation rate for policymakers, modern monetary models of the business cycle, namely the new Keynesian framework, have been strikingly ill-suited to address this question because of their near exclusive reliance on the assumption of zero steady-state inflation, particularly in welfare analysis.

In "**The Optimal Inflation Rate in New Keynesian Models: Should Central Banks Raise Their Inflation Targets in Light of the Zero Lower Bound?**" (*ReStud*, [3]) Olivier Coibion, Yuriy Gorodnichenko, and I explicitly incorporate positive steady-state inflation into new Keynesian models with an endogenously binging zero lower bound constraint. While hitting the zero lower bound is very costly in the model, our baseline finding is that the optimal rate of inflation is low, typically less than 2% a year, even when we allow for features that lower the costs or raise the benefits of positive steady-state inflation.

The key intuition for the result is that the benefits of higher inflation only accrue at the zero lower bound. As such the unconditional cost of the zero lower bound is typically small, so that even modest costs of trend inflation, which must be borne every period, will imply an optimal inflation rate below 2%. This explains why our results are robust to a variety of settings and suggests that our results are not particular to the new Keynesian model. We conclude that raising the inflation target is likely too blunt an instrument to efficiently reduce the severe costs of zero bound episodes.

In "**Infrequent but Long-Lived Zero-Bound Episodes and the Optimal Rate of Inflation**" (*Annual Review*, [4]) we reaffirm these findings when we calibrate the model to also match the fact that zero lower bound episodes are rare but long-lived.

4 Macroeconomic Effects of Remote Work

The Covid-19 pandemic has induced a rapid, large, and persistent shift towards working from home. By some measures, 30% of work hours since 2021 are now done from home compared to 5% before the pandemic. Such a large shift over a short period of time has the potential to have large macroeconomic effects.

In "**Housing Demand and Remote Work**" ([14]), John Mondragon and I show that the shift to remote work explains over one half of the record 23.8 percent national house price increase from 2019 to 2021. Using variation in remote work exposure across U.S. metropolitan areas we estimate that an additional percentage point of remote work causes a 0.98 percent increase in house prices after controlling for negative spillovers from migration. This finding reflects an aggregate increase in demand for home space: remote work causes a similar increase in residential rents, a decline in commercial rents, a greater increase in prices for larger homes, and a decline in household size among movers. The cross-sectional effect on house prices combined with the aggregate shift to remote work implies that remote work raised aggregate U.S. house prices by 16.0 percent. Using a model of remote work and location choice we argue that this estimate is a lower bound on the aggregate effect. Our results argue for a fundamentals-based explanation for the recent increases in housing costs over speculation or financial factors, and that the evolution of remote work is likely to have large effects on the future path of house prices and inflation.

In "**Measuring Work from Home in the Cross Section**" (*AEA P&P*, [11]), with Augustus Kmetz and John Mondragon, we analyze several measures of remote work in the cross-section of U.S. States and Core-based Statistical Areas (CBSAs) that have been used for causal inference or model calibration in the working-from-home literature. We show that While these measures differ in how comprehensively they measure WFH (e.g., they may or may not include hybrid work), we show that they are highly correlated in the cross-section. Therefore, these measures will yield similar causal effects once appropriately scaled by the average level of WFH. We conclude that, when choosing a particular measure, researchers should carefully consider the trade-off between how comprehensively WFH is measured and measurement error in the survey at the particular level of geographic aggregation.

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