I. Overview

While I view myself as an applied macroeconomist, I have worked on a broad array of topics which overlap with public finance, development, international economics, and econometrics. I believe this multidisciplinary approach has been fruitful in providing integrated treatments of different and yet related questions. In most of my work, I combine both macroeconomic and microeconomic data with rigorous theoretical and statistical analyses. This summary groups my research into five categories: *i*) monetary economics; *ii*) aggregate implications of informational frictions; *iii*) business cycles; *iv*) development, productivity and income differences; *v*) inequality. My research papers often fall into multiple categories and have been published (or been accepted for publication) in a variety of journals including *American Economic Review*, *Journal of Political Economy*, *Review of Economic Studies*, *Journal of European Economic Association*, *Journal of Monetary Economics*, *AEJ – Macroeconomics*, *AEJ – Economic Policy*, *Journal of Public Economics*, and others. Since I joined Berkeley in Fall 2007, 55 of my papers have been published or accepted for publication.

II. Monetary Economics

A. Monetary policy

A significant part of my research has been devoted to studying positive and normative aspects of monetary policy, which could be both a potent stabilization tool and a source of fluctuations. Specifically, I have been interested in how monetary policy should respond to developments in the economy to improve welfare as well as in the channels through which monetary policy can affect the economy.

"**Monetary Policy, Trend Inflation, and the Great Moderation: An Alternative Interpretation**" (*AER*, [13]) is motivated by a central debate in the monetary policy literature: did monetary policies associated with the appointment of Paul Volcker to be chairman of the Fed in 1979 play a role in the Great Moderation, the dramatic decline in U.S. macroeconomic volatility starting in the early 1980s? This paper argues that Volcker brought two key ingredients to policy that reduced macroeconomic volatility: *i*) a more aggressive response to inflation; *ii*) a reduction in the level of trend inflation (i.e., disinflation). In a nutshell, the paper shows that the aggressiveness of the response to inflation in interest rate rules has to steeply increase with the level of trend inflation if one wants to guarantee determinacy of rational expectations equilibrium in New Keynesian models. The paper shows that the Volcker disinflation and changes in the policy reaction function were quantitatively big enough to eliminate the possibility of self-fulfilling fluctuations in calibrated New Keynesian models. Thus, like Clarida, Gali and Gertler (2000, [12]), we conclude that fluctuations in the US economy in the 1970s were at least partly driven by changes in self-fulfilling expectations and that Volcker's changes to monetary policy eliminated this source of fluctuations. But unlike Clarida et al., we emphasize that a key component of the improvement in monetary policy was also the reduction in the level of inflation during the Volcker disinflation.

In light of the recent recession and short-term interest rates reaching zero, a number of prominent macroeconomists (Blanchard, Krugman, Summers and Mankiw among others) have proposed adopting higher inflation targets to reduce the possibility of such episodes in the future. There is a heated debate about whether such an increase in the inflation target is justified. Surprisingly, despite the importance of quantifying the optimal inflation rate for policy-makers, New Keynesian models of the business cycle have been strikingly ill-suited to address this question because of their near universal reliance on the assumption of zero steady-state inflation, particularly in welfare analysis. "**The Optimal Inflation Rate in New

Keynesian Models: Should Central Banks Raise their Inflation Targets in Light of the ZLB?"
(*REStud*, [24]) integrates both positive average inflation and the zero lower bound on interest rates (ZLB)
into New Keynesian models and derives measures of welfare in this setting. These extensions allow for
quantifying the costs of positive inflation targets, as well as one of their key benefits, namely reducing the
probability that monetary policymakers will be constrained by the ZLB. The key result from the paper is
that, at least in the context of New Keynesian models, it is very difficult to justify pushing the inflation
target much above 2%. We reach the same conclusion when we allow for long-lived periods of binding
ZLB (**"Infrequent but Long-Lived Zero-Bound Episodes and the Optimal Rate of Inflation"**, [32]).

Given limited scope to change short-term policy rates and apparent aversion to raising inflation targets,
central banks used large scale purchases of assets to move long-term interest rates. While these programs
appear to be successful in lower long-term interest rates, the mechanisms behind these programs are not
well understood. Specifically, the objective of "**Unbundling of Quantitative Easing: Taking a Cue from
Treasury Auctions**" ([57], joint with Walker Ray; reject and resubmit at the *AER*) was to understand how
QE worked as there are many potential channels. For example, QE could work because of the reasons
described above. But it could also work because QE signaled a poor state of the economy ("Delphic"
effects) or a commitment by the Fed to keep short term rates at very low levels for a long time. Because
there is only a handful of QE events and because QE happened in a particularly bad recession, it is hard to
disentangle these channels. Our solution was to examine the behavior of the treasury futures around
Treasury auctions. These auctions have a number of desirable properties. First, these auctions have a long
history with data going back to the early 1980s. So we can study the behavior of asset prices in
expansion/recession and many other regimes. Second, there is large variation in unanticipated demand
during auctions which gives us clean identification (because offered amounts are announced in advanced
and not adjusted during auctions, the only source of variation for prices is demand). Importantly,
institutional investors (pension funds, insurance companies, foreign central banks) are a key factor in
demand fluctuations. This is important because we can immediately rule out a number of explanations for
how QE worked (e.g., pension funds are unlikely to have superior knowledge about the state of the
economy). Third, the auctions are spread in time (e.g., an auction for 5-year bonds would be on Monday,
an auction for 10-year bonds would be on Tuesday and so on). As a result, we have precise identification
of when shocks to demand for a particular maturity happen. Fourth, there is a wealth of high-frequency
price data that allows us to focus on narrow windows around times when the Treasury announces auction
results and so we can rule out a number of confounding forces. Using this "laboratory", we first show that
these demand shocks do not generate dynamics that are predicted by other explanation for how QE could
work (e.g., a large demand shock for Treasuries does not move inflation expectations as measured by
inflation swaps) and yet these shocks generate highly persistent movements of yields. Then we document
that during the Great Recession and other times when financial markets were disrupted, demand shocks for
Treasuries with a given maturity where localized: that is, the largest reaction of yields happened at maturies
where demand shocks happened. In contrast, the estimated response to demand shocks in normal times
exhibits much less localization. This is precisely what is predicted by preferred habitat theories.
Furthermore, the responses estimated on variation at Treasury auctions can account for nearly all asset-
price reaction observed around QE announcements.

There is a well-known fact that policy changes by the U.S. Federal Reserve are noticeably more gradual
than what one would expect given the Fed's real-time forecasts of macroeconomic conditions. Whether
this gradualism is due to policy smoothing or due to serially correlated policy shocks is important for
positive and normative analyses of monetary policy. Indeed, the way in which policymakers endogenously
respond to economic fluctuations plays a key role in determining the dynamic effect of shocks to the
economy. Understanding the historical contribution of endogenous policy reactions to economic
fluctuations therefore requires a careful characterization of the nature of policy decisions and the rate at

which policy changes occur. However, previous work has found it remarkably difficult to discriminate between these two theories of Fed's gradualism. "**Why are interest rate changes so persistent?**" (*AEJ— Macroeconomics*, [16]) documents new evidence using a variety of different methods—such as nested specifications, conditional policy responses to economic shocks, narrative reports, the predictability of interest rates by the staff of the Fed, and a search for omitted variables—which unambiguously supports the traditional ("policy smoothing") interpretation of policy-inertia.

Recent popular demonstrations such as the Occupy Wall Street movement have made it clear that the high levels of inequality in the United States remain a pressing concern for a large swath of the population. While such movements have primarily focused their ire on private financial institutions and their perceived contribution to inequality and the Great Recession, the Federal Reserve (Fed) has not remained immune to their criticism. The prevalence of "End the Fed" posters at these events surely reflects, at least in part, the influence of Ron Paul and Austrian economists who argue that the Fed has played a key role in driving up the relative income shares of the rich through expansionary monetary policies. However, while there is a variety of theories on how monetary policy can contribute to inequality, there is little (if any) evidence on how monetary policy can actually affect inequality. **"Innocent Bystanders? Monetary Policy and Inequality in the U.S."** (*JME*, [31]) uses the Survey of Consumer Expenditures to document that contractionary monetary policy actions systematically increase inequality in labor earnings, total income, consumption and total expenditures. Furthermore, monetary shocks can account for a significant component of the historical cyclical variation in income and consumption inequality. Using detailed micro-level data on income and consumption, this paper documents the different channels via which monetary policy shocks affect inequality, as well as how these channels depend on the nature of the change in monetary policy.

B.Pricing

Explaining non-neutrality of money has led macroeconomists to study a variety of frictions, such as nominal and real wage rigidities or information rigidities. But the most commonly emphasized potential source of monetary non-neutrality remains "sticky prices". In part, this likely reflects the ubiquitousness of sticky prices in daily life. However, measures of price stickiness appear to depend on the definition of what constitutes a "fixed" price because sales often interrupt fairly long intervals of otherwise stable prices. These intermittent periods of sales stirred a great controversy in macroeconomics. Specifically, one line of thought suggests that temporary sales are a form of price flexibility for firms who are unable to adjust their regular or "reference" prices. Thus, when firms want to lower prices, they do not have to change their "reference" prices. Instead, they introduce deeper and more frequent sales so that the effective price paid by consumers is lower than suggested by the regular price. In this scenario, the effective prices could be much more flexible and procyclical over the business cycle than regular prices and therefore Keynesian logic could be largely undermined. On the other hand, some argue that sales are largely irrelevant at business cycle frequencies.

Motivated by this debate, **"The Cyclicality of Sales, Regular and Effective Prices: Business Cycle and Policy Implications"** (AER, [23]) studies cyclical properties of sales using a very extensive data set assembled by Symphony IRI, a marketing and market research agency. This paper documents a string of striking facts. First, the frequency and size of sales fall when unemployment rises while regular prices, as predicted, moderately respond to changes in unemployment. Second, the share of goods bought on sale as well as the effective price falls. These findings are puzzling from the viewpoint of standard frameworks of price setting: how is it possible that sales move in the opposite direction than predicted by neoclassical theory, regular prices change little and yet the effective price decreases? One can reconcile these findings if consumers are allowed to switch from more expensive to less expensive stores when unemployment rises. In particular, even when individual prices are fixed, the mix of stores shifts towards stores with lower prices causing the effective price to fall. Furthermore, since price-sensitive consumers migrate to cheap stores, expensive stores

are less likely to use sales to attract bargain hunters (this would lead to transferring too much surplus to price insensitive consumers) and thus the frequency of sales can actually fall even as consumer incomes are declining. The paper presents extensive evidence to support this logic. However, while store switching can move sales in the direction opposite to what was predicted in previous work, store switching can also make prices paid by consumers more flexible than implied by posted prices. Indeed, this paper shows that effective prices paid by consumers are more responsive to unemployment than posted prices and thus the slope of the Phillips curve for effective prices may be much steeper than for posted prices.

In a related paper ("**Are Sticky Prices Costly? Evidence From The Stock Market**", AER, [52]), Michael Weber and I attempt to shed new light on why prices are inflexible in the first place. Indeed, a great deal of research focused on documenting price rigidities at the micro level. While the evidence is pointing to the short-run inflexibility of prices, it is much less clear that these rigidities at the micro level have serious implications for the behavior of macroeconomic aggregates. For example, one can construct counter-examples where price rigidity at the micro-level is consistent with total flexibility at the aggregate level. These counter-examples generated a heated debate in macroeconomics. The generic feature of these counter-examples is that firms can freely reset their prices but they choose not to because a range of prices is consistent with a given level of profits. In contrast, Keynesian models emphasize that there is a cost associated with nominal price adjustment. How to discriminate between the models was a huge challenge. This paper addresses the challenge by linking measures of price rigidities at the firm level (using confidential micro level data from the Bureau of Labor Statistics) to the behavior of stock returns in response to monetary policy shocks. The Keynesian theories predict that, in response to a monetary shock, stock returns should be more volatile for firms with stickier prices. The paper documents robust evidence that the behavior of stock returns is consistent with Keynesian models and inconsistent with alternative models. Thus, the paper provides crucial support for the tenets of modern macroeconomics.

In a series of papers, I move beyond conventional data sets on prices in brick-and-mortar stores and use price data from online markets. This is a relatively new but rapidly growing and increasingly important part of retail in the U.S.A, U.K. and many other developed and developing countries.[1] While e-commerce is young, its digital presence is a major force revolutionizing retail as we know it: according to Deloitte, the internet is projected to influence 64 percent of in-store retail sales by the end of 2015. To the extent that market valuation reflects prospects of companies, stock market participants believe that Amazon.com has a brighter future than Walmart (even though Amazon.com has only a quarter of Walmart's revenue) and that the future of retail is in online markets.

However, despite a significant and rapidly expanding share of e-commerce, the properties of online prices are still relatively understudied, even though these prices can shed new light on a number of key puzzles. Indeed, online markets have unique characteristics. For example, the physical cost of changing prices is negligible for internet stores, and therefore internet prices can fluctuate every instant (e.g., minute, day, week) in response to shifting demand and supply conditions. Searching for best online prices for very narrowly defined goods is particularly cheap and simple as consumers do not need to travel anywhere, buyers can establish the distribution of prices with just a few clicks, and pressure for price convergence is especially strong with ubiquitous price comparison websites (PCWs). More generally, the geographical location of

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[1] For example, the U.S. Census Bureau estimated that total e-commerce sales for 2013 were $263.3 billion, which is approximately 5.6 percent of total retail sales in the U.S. economy. Also online sales have grown much faster (10 or more percent) than sales of brick-and-mortar stores.

consumers and stores is largely irrelevant in e-commerce, and therefore administrative borders and similar frictions are likely to play a much more limited role.

I have exploited this insight in a series of papers. In "**Price setting in online markets: Basic facts, international comparisons, and cross-border integration**" (AER, [54]), Oleksandr Talavera and I constructed a unique dataset of price quotes. Specifically, we gathered prices and other relevant information from a leading PCW for a duration of 5 years (more than 115,000 goods and nearly 20 million price quotes in the U.S. and Canada). This is a remarkable data effort similar to the Billion Prices Project (http://bpp.mit.edu/). Our data have a number of advantages relative to previous data sets. First, the time span (almost 5 years) is considerably longer than the time span usually available for researchers studying online prices (typically a year or less). This dimension is important when we study dynamic properties of prices, such as duration of price spells, speed of price convergence, and pass-through. Second, the coverage of goods is much broader than in previous analyses of online prices, which typically have focused on books and CDs. Third, we collected prices for identical goods in the U.S. and Canada so that comparison of prices is direct and simple. Thus, we can avoid a number of pitfalls associated with comparing price indexes or goods that are only broadly similar. Fourth, our data include information on important attributes such as the reputation of sellers and goods as revealed by ratings of sellers and products. We can use these attributes to explore the predictors of pass-through and speed of price adjustment for online prices. In contrast, previous research on basic properties of prices had only very limited (if any) information about characteristics of goods for which prices were available. Fifth, our data include many sellers—most stores in our sample sell goods only online and do not have conventional, brick-and-mortar retail outlets (e.g., Amazon.com)—rather than one retail chain; therefore, we can assess the relative importance of different sources of price variation. This multi-seller dimension is important because branches of a single seller are less likely to engage in competition between each other than with branches of different sellers. Sixth, the high frequency of our data allows us to time reactions of prices to other high frequency events such as changes in the exchange rate or natural experiments, thus making identification more clear-cut. Finally, our data are available to researchers.

Using this dataset, we report properties of various pricing moments (e.g., the frequency and size of price changes) in e-commerce and thus complement earlier studies (e.g., Nakamura and Steinsson, QJE 2008) that present the same information for regular, brick-and-mortar stores. In short, we find that online prices are more flexible that offline prices (e.g., price changes occur much more frequently in online stores (approx. once every 3 weeks or less) than in regular stores (once every 4-5 months or more)).

Once these basic facts are established, we study the sensitivity of online prices to fluctuations in the nominal exchange rate. Since adjustment of online prices is unlikely to have any physical costs, and with easy shipping the physical location of the seller is much less important, pass-through could be quick and nearly complete, while it can be slow and partial in the prices of regular stores because of the frictions associated with trade flows and mobility of buyers. We find that, on average, pass-through in online markets is incomplete but large and amounts to approximately 60-75 percent, which is greater than the 20-40 percent pass-through documented for regular markets. The speed of price adjustment to equilibrium levels is substantially faster in online markets (half-life is about 2-2.5 months) than in regular markets (half-life varies from 3 quarters to a few years).

There is significant heterogeneity in pass-through and the speed of price adjustment across goods in response to movements in the nominal exchange rate. Using the richness of our data, we show that for goods with certain characteristics, pass-through can be close to 100 percent. We also document that the size of pass-through and the speed of price adjustment are systematically associated with the degree of price stickiness,

turnover of sellers, returns to search, synchronization of price changes, reputation of sellers, and the degree of competition. These results help reconcile the heterogeneity of estimated pass-throughs and the speeds of adjustment across studies and provide new facts for theoretical models to match.

In short, while the law of one price is an appealing concept, the vast majority of previous research has emphasized various frictions that prevent the law from holding over relative long periods. For example, my earlier work (**"Border Effect or Country Effect? Seattle may not be so far from Vancouver after all"** [49], *AEJ—Macroeconomics*) identified and documented challenges in inferring the size of border effects from international price differentials. Online markets have unusual characteristics, such as low search costs, irrelevance of physical locations of buyers and sellers, and negligible physical costs of price changes; thus, studying price setting in online markets offers a unique opportunity to rule out the prominent frictions and explore whether the law of one price holds in this close-to-ideal setting. We document that, relative to prices in regular stores, prices in online markets are more flexible as well as exhibit stronger pass-through and faster convergence in response to movements of the nominal exchange rate. Multiple margins of adjustment (frequency of price changes, direction of price changes, size of price changes, exit of sellers) are active in the process of responding to nominal exchange rate shocks. To the extent future retail will shift to the internet, one can therefore expect that cross-country price differentials are going to be smaller and less persistent, bringing the law of one price closer to reality.

In follow-up work ("**Price Setting in Online Markets: Does IT Click?**", [68], forthcoming in *JEEA*; "**The Responses of Internet Retail Prices to Aggregate Shocks: A High-Frequency Approach**", [69], *Economics Letters*), Oleksandr, me and Slavik Sheremirov use data directly provided by a leading shopping platform to study a broad spectrum of pricing characteristics in online markets (e.g., dynamic pricing, synchronization of price changes, price dispersion). This is a genuinely unique dataset. Let me list just a few remarkable features. First, it gives a universe of goods sold online. Second, it gives a universe of online sellers. Third, the data cover two countries: USA and UK. Fourth, the dataset includes clicks which provide a measure of quantities. This latter feature is unprecedented as online scraping can yield price quotes but it cannot establish which prices are "active", i.e., transaction prices relevant for consumers.

Our main result is that, despite the power of the internet, online price setting is characterized by considerable frictions. By many metrics, such as the size and synchronization of price changes, price dispersion, or sensitivity to changes in economic conditions, the magnitude of these frictions should be similar to that in offline price setting. However, we also find significant quantitative differences: the frequency of price changes is higher online than offline. These results continue to hold when we compare the properties of online and offline prices for narrowly defined product categories, which ensures that the composition of goods is similar across markets. Jointly, these facts call for more research on the relative importance of menu, information, and search costs—and, more generally, on the price-setting mechanism in online markets.

I also have a series of papers ([10], [11]) studying price-setting in specific markets.

III. Aggregate Implications of Informational Frictions

How economic agents form their expectations has long been one of the most fundamental, and most debated, questions in macroeconomics. Indeed, the abandonment of adaptive expectations in favor of rational expectations was one of the defining features in the rebuilding of macroeconomics starting in the 1970s. Yet, even with the advent of rational expectations, research continued to emphasize the fact that, in forming their

expectations, agents typically face constraints. A series of my papers contributes to this area and helps to assess the theoretical and empirical importance of informational frictions for aggregate dynamics.

For example, **"Endogenous information, menu costs and inflation persistence"** ([41]) develops a stylized model with state-dependent price adjustment and acquisition of information. In this model, there is a considerable nominal non-neutrality generated by a combination of costly price adjustment and acquisition of information. Intuitively, in economies with imperfect, dispersed information, macroeconomic variables not only clear markets but also aggregate information by aggregating private actions. Hence, menu costs not only directly make adjustment costly but, with endogenous public signals, they also lead to an information externality which creates incentives for firms to postpone their actions—including adjustment of prices—until more information is revealed by other firms. As a result, the adjustment of prices and the acquisition of information are sluggish in response to nominal shocks.

Despite a growing body of work studying the implications of possible departures from full information rational expectations (e.g., my work in [41]), the empirical evidence against this assumption underlying most modern macroeconomic models has been limited. In particular, while statistical evidence against the null is commonly uncovered, the economic significance of these rejections remains unclear. This observation motivated two papers: "**What can survey forecasts tell us about informational rigidities?**" (*JPE*, [15]) and "**Information Rigidity and the Expectations Formation Process: A Simple Framework and New Facts**" (*AER*, [18]). Starting from a variety of theoretical models in which agents face constraints on their ability to acquire or process information, these papers provide new empirical frameworks which allow us to characterize the statistical and economic significance of departures from the benchmark of full information models. These results also assess the nature and size of information rigidities facing different economic agents. The first paper [15] shows that the *conditional* response of the average forecast across agents to economic shocks, as well as the degree of disagreement across agents, can identify key characteristics of the expectations formation process. The second paper [18] develops another empirical test relating ex-post forecast errors to the revisions in agents' forecasts which can quantify the degree of information rigidities. In both papers, the implied degrees of information rigidities are economically large and consistent with significant macroeconomic effects. This justifies the burgeoning interest in imperfect information models and provides a set of stylized facts that models should be consistent with. In addition to documenting pervasive evidence of economically and statistically significant departures from full-information rational expectations for a broad spectrum of economic agents, these two papers can guide how best to model the expectations formation process (e.g., filtering models vs. sticky information models). For example, in the second paper [18], the data also point toward state-dependence in the expectations formation process: economic agents devote more resources to processing and acquiring information during recessions and after significant and visible events such as the 9/11 attacks.

One implication of information rigidities is that full-information rational expectations may be a poor proxy for what economic agents know and thus lead to a variety of "puzzles." For example, a number of studies report that the Phillips curve (which links nominal [inflation] and real [unemployment] sides of the economy) has been increasingly flat to the extent that the strong inflation-unemployment relationship observed in the data up to 1990s ceased to exist since 2000s. This observation became particularly important during the Great Recession when skyrocketing unemployment was expected to yield a massive deflation but instead inflation was stable at approximately two percent. As a result, some economist declared the Phillips curve dead which implies that central banks have little capacity to influence employment or output.

In "**Is The Phillips Curve Alive and Well After All? Inflation Expectations and the Missing Disinflation**" (*AEJ – Macroeconomic*, [19]), Olivier Coibion and I explore how departure from full information can influence the stability of the Phillips curve and can rationalize the behavior of inflation and unemployment during the Great Recession. We find that using survey-based measures of inflation expectations as an input into the Phillips curve dramatically improves stability and effectively eliminates the puzzling behavior of inflation and unemployment during the crises. We document that consumers expected much more inflation than is justified by full-information rational expectations so that deflationary pressures of heighted unemployment were offset by increased inflation expectations. We link these high inflation expectations to high gasoline prices during the period (despite the recession, commodity prices were high due to strong global demand). In other words, given informational constraints, consumers infer inflation from a limited set of macroeconomic variables that are highly correlated with inflation. Since gasoline prices and inflation moved in tandem in the past (this is much less so now) and gasoline prices are particularly salient, consumers concluded that inflation should be high in the future. This conjecture is consistent with macro- and microeconomic data (e.g., consumers who spend more on gasoline have inflation expectations more sensitive to changes in gasoline prices).

These results mean that inflation expectations are not as anchored as believed before and the lack of deflation was a lucky coincidence rather than an outcome of the central bank's policies. On a normative side, this paper points to a possibility of controlling inflation expectations to the extent a central bank can control proxy variables that consumers and business use to form inflation expectations. Using this insight and data from a survey of firm managers in Ukraine, Olivier Coibion and I find that central banks in countries where inflation expectations are closely tied to exchange rates (e.g., Ukraine) can have additional powers to anchor inflation expectations by limiting volatility of exchange rates ("**Inflation Expectations in Ukraine: A Long Path to Anchoring?**" *Visnyk of the National Bank of Ukraine*, [17]).

The degree of anchoring inflation expectations and mechanisms of expectations formation are further explored in "**Inflation Targeting Does Not Anchor Inflation Expectations: Evidence from Firms in New Zealand**" (*BPEA*, [1]) and "**How Do Firms Form Their Expectations? New Survey Evidence**" (*AER*, [29]). These two paper report results from a new survey of firm managers in New Zealand. We show that despite nearly twenty-five years under an inflation targeting regime in New Zealand, there is widespread dispersion in firms' beliefs about both past and future macroeconomic conditions, especially inflation, with average beliefs about recent and past inflation being much higher than those of professional forecasters. Much of the dispersion in beliefs can be explained by firms' incentives to collect and process information, i.e. rational inattention motives. Using experimental methods, we find that firms update their beliefs in a Bayesian manner when presented with new information about the economy. But few firms seem to think that inflation is most important to their business decisions and therefore they tend to devote few resources to collecting and processing information about inflation. Managers are unaware of the identities of central bankers as well as central banks' objectives, and are generally poorly informed about recent inflation dynamics. Their forecasts of future inflation reflect high levels of uncertainty and are extremely dispersed as well as volatile at both short and long-run horizons. Similar results can be found in the U.S. using currently available surveys. These findings imply that unconventional monetary policy tools such as forward guidance could be much less powerful than entailed by models with full-information rational expectations. Central bankers in low inflation countries such as New Zealand or the USA should be more aggressive in delivering their policies to economic agents.

In practice, economic agents are likely to have heterogeneous degrees of informational rigidity. Whether the interaction of heterogonous agents has aggregate implications is an important question. "**Strategic Interaction among Heterogeneous Price-Setters in an Estimated DSGE Model**" (*REStat*, [14]) builds

and estimates a model in which different firms may be subject to different kinds of frictions: some change their prices only infrequently (sticky price), some update their information infrequently (sticky information), some set their prices using simple rule-of-thumb, while some are subject to no frictions of any kind. Our estimates point squarely toward a hybrid model consisting almost exclusively of sticky price and sticky information firms, which provides further evidence on the importance of integrating nominal and informational rigidities into macroeconomic models. This paper helps to reconcile conflicting estimates in the previous literature as well as to guide policy making when agents are heterogeneous.

Informational frictions are important not only for firms and consumers but also for policymakers who must make decision in real time when information is often incomplete. Some policy decisions could be at odds with what the public considers as justified. For example, in the mid-1990s, there was a widespread view that the U.S. economy was getting overheated and the Fed should raise interest rates to fight inflationary expectations. However, the Fed did not raise interest rates—which was perceived as a sign of unwarranted optimism about rising productivity—but inflation remained in check. How did the Fed succeed in sustaining rapid economic growth without fueling inflation and inflationary expectations? In retrospect, it is evident that the productive capacity of the economy increased. Yet as events unfolded, there was uncertainty about the expansion of the capacity of the economy and therefore about the sustainability of the Fed's policy. **"Monetary policy when potential output is uncertain: Understanding the growth gamble of the 1990s"** (*JME*, [50]) argues that if the central bank is committed to reverse policy errors it makes because of unwarranted optimism, inflation can remain in check even if the central bank keeps interest rates low because of this optimism. This paper presents theoretical and empirical evidence consistent with the view that recently the Fed has been willing to, at least partially, correct its mistakes, i.e., to respond to past departures from inflation targets. More generally, this paper shows that such a policy of correcting policy mistakes, which could be modeled as a form of price level targeting, could be advantageous when economic agents have differential information sets and thus disagree on what policy should be implemented.

Two recent papers ("**Inflation Expectations – A Policy Tool?**", [35], and "**The Formation of Expectations, Inflation and the Phillips Curve**", *JEL* [28]) provide synthesis analysis of how inflation expectations are formed and how policymakers can manage expectations to stabilize the economy.

Using these papers as a roadmap for my research program, I introduce a new approach to macroeconomics to better understand expectations. Specifically, for much of its history, data analysis in macroeconomics consisted of applying time series methods to aggregate variables over the short samples for which these data were available. Not surprisingly, few fundamental questions in macroeconomics were resolved through empirical analysis and disagreement within the profession was profound. The last decade or so has dramatically changed the role of empirical analysis in macroeconomics. The increasing availability of detailed and large micro-level data sets has allowed macroeconomists to identify striking new stylized facts in pricing, consumption and other areas. In addition, macroeconomists have increasingly turned to survey data of economic agents to measure their expectations. This literature has also helped generate new stylized facts about how different economic agents form their expectations. A third new development that has helped macroeconomics embrace empirical work as a way to progress is the increasing focus on identification. The fact that all aggregate variables are simultaneously determined has long made identification central to macroeconomic analysis, but available strategies, be they timing restrictions, narrative approaches, or structural restrictions appear to have had only limited sway on skeptics. Newly available data, however, has allowed for more convincing strategies from other fields of economics to be integrated into macroeconomics, e.g. high-frequency identification. The gold standard for identification, randomized control trials, is just now starting to make an appearance in macroeconomics.

My objective is to more systematically bring these three ingredients together: randomized treatments for identification combined with survey data and micro-level data to measure the effects of treatments on both beliefs and decisions. To the best of my knowledge, this approach has not yet been used in macroeconomics in a systematic fashion. But since most interesting economic decisions (consumption, hiring, pricing, investment, etc.) reflect expectations of the future, combining these three elements—a source of exogenous variation with individual-level data on both expectations and actions—promises to shed new light on the fundamental decisions underlying macroeconomic outcomes.

My completed (e.g., "**Inflation Expectations and Firm Decisions: New Causal Evidence**", *QJE* [30], "**Monetary policy communications and their effects on household inflation expectations**", [27], "**How Does Consumption Respond to News About Inflation? Field Evidence from a Randomized Control Trial**", [20], "**Do You Know That I Know That You Know...? Higher-Order Beliefs in Survey Data**", [34]) and ongoing projects (e.g., "**Expectations and Price Setting**", [36]) indicate the promise of this type of approach. Exogenous information treatments to firms and households, for example, translate into large changes in inflation expectations. These exogenous changes in inflation expectations, in turn, generate changes in prices, employment and investment on the part of firms, and changes in consumption on the part of households. Thus, we have decisive evidence for firms and households of a *causal* link running from inflation expectations to decisions. But a lot of questions remain unanswered: what are the specific mechanisms via which these expectations affect decisions, how do agents form their expectations about different variables jointly, what communications strategies can policy-makers use to shape the expectations of agents, and how these effects be mapped into structural models of decision-making and their underlying parameters?

IV. Business cycles

Understanding economic depressions has long been one of the central challenges in macroeconomics. Their massive costs as well as disagreement over their causes, propagation, and optimal policy responses are subject to continuous debate. The Great Recession rekindled this debate with a spark of urgency to come up with policies to alleviate the adverse effects of the downturn.

One key question in the current policy debate is the size of the fiscal multiplier. **"Measuring the Output Responses to Fiscal Policy"** (*AEJ – Economic Policy*, [3]) and **"Fiscal Multipliers in Recession and Expansion"** (NBER volume, [2]) are directly related to this question. These two papers develop new tools (smooth transition VARs, direct projections with state dependence) and use U.S. and international data to document that the size of the government spending multiplier is likely to be countercyclical; that is, unanticipated shocks to government spending raise output more in recessions than in expansions. Specifically, these two papers find that a dollar increase in government spending has a multiplier above one (typically in 1.5-2.5 range) in recessions and a much smaller multiplier (typically in 0-0.5 range) in expansions. This differential in output multipliers is robust to controlling for a variety of factors (e.g., anticipation effects in government spending).[2] In a related work ("**Output Spillovers from Fiscal Policy**", AEA P&P, [4]; "**Local Fiscal Multipliers and Fiscal Spillovers in the United States**", [8]), we find that government spending shocks could have large multipliers not only domestically but also spill into other countries (or counties when we examine within-US variation). In other words, a government spending shock in a country with abundant fiscal capacity ("Germany") can stimulate another economy with no such

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[2] In [5], we estimate multipliers for Japan which had a long history of ultra-low interest rates. In [8], we study whether the potency of fiscal policy varies with fiscal capacity.

capacity ("Greece"). This line of work suggests that fiscal activism may be justified during recessions as a tool to stimulate aggregate demand.

More generally, the effect of government spending shock has been difficult to identify because of fiscal foresight, that is, fiscal shocks are often known in advance but the timing when agents learn about the shock is difficult to establish. This challenge was particularly acute in the analysis of how government spending shocks influence exchange rates and other fast-moving, forward looking variables. Specifically, while theoretical models consistently predict that government spending shocks should lead to appreciation of the domestic currency, empirical studies have regularly found depreciation, which may be interpreted as leading to "beggar-thy-neighbor" effects. This counter-intuitive finding leads to development of models that can rationalize the behavior of the exchange rate via various frictions. In "**Effects of Fiscal Shocks in a Globalized World**" (*IMF ER*, [5]), Alan Auerbach and I tackle this challenge with high-frequency data on government spending. Specifically, we construct two daily series of government spending. The first series is payments to defense contractors reported in the daily statements of the U.S. Treasury. The second series is the announced volume of contracts awarded daily by the U.S. Department of Defense. Since one series measures actual outlays while the other provides a measure of future government spending, using these two series helps us to underscore the key role of fiscal foresight for timing shocks to government spending as well as responses to these shocks. We validate our daily military spending series by comparing them to standard government spending data available at lower frequencies and by relating them to major military developments. We document that the dollar immediately and strongly appreciates after announcements about future government spending. In contrast, actual payments lead to no discernible effect on the exchange rate. We examine responses of other variables at the daily frequency and explore how the response of the exchange rate to fiscal shocks varies over the business cycle as well as at the zero lower bound and in normal times.

In light of the recent banking crises, many economists went back to re-examine the experience of Scandinavian countries in the early 1990s to design policies for today. However, the nature of crises in these economies was heterogeneous and it is important to understand the fundamental forces behind these crises before one draws any generalizations. **"The Finnish Great Depression: From Russia with Love"** (*AER*, [67]) examines the sources and propagation of a deep economic downturn in Finland during this period. Using a standard, multi-sector, open-economy model, this paper argues that the main source of the depression in Finland, which was the largest contraction in Finland's history since the 1850s, was the collapse of Soviet-Finnish trade in 1991. In many ways, the collapse of the USSR provides a unique natural experiment for which one knows with precision the timing, nature and size of the exogenous shocks that hit the Finnish economy. Furthermore, unlike previous analyses of earlier depressions or downturns in developing economies, one has access to high quality economic data at different levels of aggregation and frequency which makes for an analysis rich in detail. Finally, this analysis of the Finnish Great Depression can also be useful for understanding the macroeconomic implications of large structural shocks affecting trade arrangements and the terms of trade in other countries, particularly in the case of the transition economies of Eastern Europe in the aftermath of the collapse of the Soviet Union. Indeed, the path of output in Finland and transition economies is remarkably similar. But Finland, as a western democracy with developed capital markets and institutions, faced none of the institutional adjustments experienced in transition economies. Thus, by studying the Finnish experience one can isolate the effects due solely to the shocks caused by the collapse of trade with the USSR from the other burdens of adjustment borne by transition economies. To the extent that these shocks, combined with standard macroeconomic reallocation costs and frictions, can account for the depressions in transition economies, the role of other factors such as institutional transformations may be smaller than previously thought. This work is also informative for understanding i) how business conditions in one country (e.g., U.S.) are transmitted to business conditions in this county's major trading partners (e.g., Canada and Mexico); ii) how change in sectoral composition of demand (e.g., the end of the Cold War) can lead to aggregate fluctuations.

In a related paper ("**The Cyclical Sensitivity in Estimates of Potential Output**", [25], forthcoming in *BPEA*, joint with Olivier Coibion and Mauricio Ulate), I examine measurement of long-run effects of recessions on output. In a nutshell, this paper argues that estimates of potential output produced by the CBO, Fed, IMF, OECD and other agencies are too pessimistic because these estimates are effectively moving averages of past growth rates of output and thus fail to differentiate between permanent and transitory shocks to output. As a result, if there is a large, persistent negative shock, CBO and other official agencies will report that productive capacity of the economy declines. The paper also proposes a technique that can help to discriminate permanent and transitory shocks. This paper has enormous policy implications. For example, the IMF uses potential output to compute structural fiscal deficits and our results suggest that the way the IMF computes potential output can lead to self-fulfilling fiscal austerity and macroeconomic contractions: a recession leads to a downward revision of potential output which leads to structural fiscal deficit which leads to fiscal austerity which reduces output which reduces potential output and so on. Relatedly, this paper predicts that the U.S. economy had considerable slack even in 2017 so that more stimulus (rather than tightening of monetary policy) may be required to bring actual output closer to the potential level. Consistent with this prediction, inflation has been remarkably stable despite very low levels of unemployment not only in the U.S. but globally ([26]).[3]

"The Response of Consumer Spending to Changes in Gasoline Prices" ([37]) is also a part of my agenda to better understand business cycles. This paper was also motivated by a key policy question. In 2014, policymakers, professional forecasters, consumers and businesses all wondered how the decline of oil prices from over $100 per barrel in mid-2014 to less than $50 per barrel in January 2015 would influence disposable incomes, employment, and inflation. A central component for understanding macroeconomic implications of this shock is consumers' spending from the considerable resources freed up by lower gasoline prices (the average saving was more than $1,000, or approximately 2 percent of total spending per household). While the question is classic in many ways, estimates of MPC out of savings from reduced gasoline prices are imprecise and scarce. Building on the dataset used by Dmitri for his job market paper, we construct high-frequency measures of spending on gasoline and on non-gasoline items for a panel of more than half a million U.S. consumers. We use cross-consumer variation in the intensity of spending on gasoline interacted with the large, exogenous, and permanent decline in gasoline prices to identify and estimate the partial equilibrium marginal propensity to consume (MPC) out of savings generated by reduced gasoline prices. Given the low elasticity of demand for gasoline and the nature of the oil price shock, one can think of this MPC as measuring the response of spending to a permanent, unanticipated income shock. Our baseline estimate of the MPC is approximately one. That is, consumers on average spend all of their gasoline savings on non-gasoline items.

We also show why previous studies tended to report lower and less precise estimates of MPC. For example, a policy report produced by the J.P. Morgan Chase Institute also uses "big data" to examine the response of consumers to the 2014 fall in gasoline prices and finds an average MPC of approximately 0.6. This report differs from our study in both its research design and its data. Most importantly, our data include a comprehensive view of spending, across many credit cards and banks. In contrast, the Chase report covers a vast number of consumers, but information on their spending is from Chase accounts only. If, for example, consumers use a non-Chase credit card or checking account, any spending on that account would be missed in the J.P. Morgan Chase Institute analysis, and measurement of household responses may therefore be incomplete. In this paper, we confirm this by showing that an analysis based on accounts in one financial institution leads to a significantly attenuated estimate of the response of spending to changes in gasoline prices.

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[3] Olivier Blanchard's review of the paper is available here.

I also have several papers (joint with Serena Ng) making methodological contributions to the estimation of business cycle models ([59], [38]) and the identification of structural shocks ([39], [55], [56]). For example, **"Estimators for Persistent and Possibly Non-Stationary Data with Classical Properties"** (*Econometric Theory*, [59]) and **"Estimation of DSGE Models When Data Are Persistent"** (*JME*, [38]) develop and apply a framework for estimating structural parameters when data are highly persistent and may (or may not) have a unit root. The key advantage of the proposed framework is that the researcher does not have to take a stand on whether a series has a unit root. He can obtain asymptotically the standard normal distribution of parameter estimates irrespective of whether the series has a unit root or not. Thus, this framework provides robust inference for highly persistent data which are so common in macroeconomics. **"Level and Volatility Factors in Macroeconomic Data"** (*JME*, [55]) proposes a computationally attractive method to identify first- and second-moment shocks and thus helps shed new light on whether volatility is an important source of macroeconomic fluctuations. "A Note on Variance Decomposition with Local Projections" (with Byoungchan Lee, [42], R&R at JBES) provides a framework for computation forecast error variance decompositions for a popular single-equation approach due to Jorda (2005, [70]).

Two other papers in this area investigate how business cycles affect retirement choice (**"Macroeconomic Determinants of Retirement Timing"**, [62]) and why recovery of employment from recessions has been sluggish since the 1990s (**"Amerisclerosis? The Puzzle of Rising U.S. Unemployment Persistence"**, [21]).

V. Development, Productivity and Income Differences

One of the central questions in economics is why firms and countries have large and persistent differences in productivity. Despite decades of research, this question continues to puzzle the profession as productivity differences, in the words of Moses Abramovitz, are still a measure of our ignorance. This is even more so for understanding innovation which is widely perceived as the key conduit of economic growth and productivity enhancements. In a series of papers, I contributed to the literature studying differences in productivity and innovation at the micro- and macroeconomic levels.

"Are Oligarchs Productive? Theory and Evidence" (*J. of Comp. Econ.*, [58], Montias Prize) examines how the allocation of property rights affected the productivity of Ukrainian firms and documents that oligarchs could have been sufficiently powerful to overcome disorganization in transition economies and restore production chains thus raising productivity of firms which they owned in these chains. **"Globalization and Innovation in Emerging Markets"** (*AEJ—Macroeconomics*, [64]) uses a large cross-country survey to document that globalization puts increased pressure on domestic firms to innovate (see also [63]). **"Financial constraints and innovation: Why poor countries don't catch up"** (*JEEA*, [53]) uses the same survey to investigate how financial constraints prevent firms from innovating and catching up to the technological frontier (see also [61]). **"Using Firm Optimization to Evaluate and Estimate Productivity and Returns to Scale"** ([40]) provides a methodological contribution to measuring productivity differences across firms, develops a new estimator for production/revenue functions, and critically reviews existing estimators of returns to scale and productivity. **"Using the Survey of Plant Capacity to Measure Capital Utilization"** ([51]) constructs new aggregate and industry-level series of capital utilization for the U.S.

In a more macroeconomic perspective, **"Culture, Institutions and the Wealth of Nations"** (*REStat*, [46]) and related work ([43], [44]) studies how culture affects innovation, productivity and income differences. While the idea that culture is a central ingredient of economic development goes back at least to "The Protestant Ethic and the Spirit of Capitalism" by Max Weber, the effects of culture on economic outcomes are still understudied. In [46], the focus is on one cultural dimension: individualism vs. collectivism, which is

considered by cross-cultural psychologists to be the main dimension of cultural variation and has been extensively used since pioneering studies by Geert Hofstede (other cultural dimensions are explored in [44]). In short, individualism emphasizes personal freedom and achievement. Individualist culture therefore awards social status to personal accomplishments such as important discoveries, innovations or great artistic achievements. In contrast, collectivism makes collective action easier in the sense that individuals internalize group interests to a greater degree. However, it also encourages conformity and discourages individuals from standing out. Using neutral and non-neutral genetic markers as instrumental variables, [46] documents that higher individualism causes more intensive innovation, higher productivity and incomes. Quantitatively these effects are large even after controlling for a wide variety of confounding factors. Furthermore, this paper documents that culture could be a source of differences in institutional arrangements across countries and thus culture may be a fundamental force behind the speed of development.

Gerard Roland and I continued this research agenda in a series of follow-up papers. For example, in **"Culture, Institutions, and Democratization"** ([45]), we attempt to shed new light on democratization process, perhaps one of the most important developments in recent history.[4] The dominant theory of democratization in social sciences, modernization theory, holds that, as the level of economic development in a country increases, it will tend to become democratic (Lipset, 1959). A key question is whether China, the biggest country in the world with miraculous growth over the last four decades, will evolve towards democracy. Strikingly, although culture is often considered a bedrock of many social and economic processes, the role of culture in democratization has been largely ignored until now. This paper presents a model integrating culture in democratization processes. The gist of our theory is that countries with more individualist cultures are more likely to make a transition to democracy (a collectivist culture tends to stick to a "good" non-predatory autocracy, which will not be the case with an individualistic culture). Predictions of the model have strong, robust support in the data, controlling for existing determinants identified in the literature. If this theory is correct, as countries with collectivist cultures develop economically, they will not necessarily evolve towards democracy or might do so more slowly or possibly only under the effect of an exceptional crisis, which is in stark contrast with modernization theories.

In further exploration of the economics effects of cultural attributes such individualism, we (jointly with Bohdan Kuharskyy) investigate how cultural distance can influence firms' decisions to source their production across countries ("Culture and Global Sourcing", [60]). While practitioners long appreciated the issue of cultural distance, academic research was largely silent on the matter. After characterizing the optimal allocation of decision rights across firms in the presence of cultural differences, we predict that the incentive of a firm to integrate its input supply is decreasing in the cultural distance between the headquarters and suppliers. Combining data from the U.S. Census Bureau's Related Party Trade and the Bureau van Dijk with various measures for cultural distance, we find empirical evidence strongly supportive of this prediction.

The importance of linkages for economic development is further studied in **"Linkages and Economic Development"** ([9]), which is joint with Dominick Bartelme. While specialization is a powerful source of productivity gains, how production networks at the industry level are related to aggregate productivity in the data is an open question. After constructing a database of input-output tables covering a broad spectrum of countries and times, develop a theoretical framework to derive an econometric specification, and document a strong and robust relationship between the strength of industry linkages and aggregate productivity, which is quantitatively consistent with a basic multi-sector model where "wedges"/

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[4] According to Freedom House (1999), there was not a single liberal democracy with universal suffrage in the world in 1900. By 2000, 120 of the world's 192 nations were liberal democracies.

"distortions" are sources of inefficiency. Our estimates imply that the TFP gains from eliminating these distortions are modest but significant, averaging roughly 10% for middle and low income countries.

VI. Inequality

This line of research uses micro-level data sets to provide foundations for macroeconomic analyses of inequality. The focus in much of this research was on transition economies which experienced dramatic increases in inequality since early 1990s ([31] uses U.S. data to study inequality). However, sources of the rising disparity in income and consumption in these countries have been relatively understudied. The objective in this research was to document levels and dynamics inequality as well as shed some light on sources of inequality as well as effects of policy on inequality.

For example, **"Returns to Schooling in Russia and Ukraine: A Semiparametric Approach to Cross-Country Comparative Analysis"** (*J. of Comp. Econ.*, [47]) compares returns to schooling—a significant source of inequality—between Russia and Ukraine. This comparison is interesting because inequality was much less pronounced in Ukraine than in Russia in the late 1990s and early 2000s although the initial conditions were similar for these two countries. The paper decomposes the cross-country differences into differences in prices, unobservables, and labor force composition at all points of the earnings distribution. This paper documents that the price effect is the dominant reason for the higher returns to schooling in Russia. A related work **"Inequality and Volatility Moderation in Russia: Evidence from Micro-Level Panel Data on Consumption and Income"** (*RED*, [66]) provides an integrated analysis of consumption and income inequality as well as labor market outcomes and public policy in Russia since early 1990s until present.

In the process of working on [47], it became clear that public sector employees in Ukraine receive 24-32% less wages than their private sector counterparts conditional on observable demographic and job characteristics, with the gap being particularly large at the top of the wage distribution. Yet, the levels of consumption and asset holdings are similar for public and private sector employees. **"Public Sector Pay and Corruption: Measuring Bribery from Micro Data"** (*JPubE*, [48]) documents these facts and attributes the differential in consumption-income levels to non-reported compensation (bribes) in the public sector. Using a compensating differential framework, this paper identifies the size of bribes and develops an aggregate measure of bribery.

Building on the framework in [48], **"Myth and Reality of Flat Tax Reform: Micro Estimates of Tax Evasion Response and Welfare Effects in Russia"** (*JPE*, [65], National Prize in Applied Economics, Russia, http://econprize.ru/) examines the effects of Russia's 2001 flat rate income tax reform on consumption, income, and tax evasion. Using difference-in-difference and regression-discontinuity-type approaches, this paper find that large and significant changes in tax evasion following the flat tax reform are associated with changes in voluntary compliance. At the same time, the productivity response of taxpayers to the flat tax reform is small relative to the tax evasion response. This result is particularly important because dramatic increases in tax revenues in Russia after the reform were often attributed to a supply side response. This paper dispels this myth and establishes that increased tax revenues were generated by enhanced tax compliance. Finally, this paper develops a novel framework to assess the deadweight loss from personal income taxes in the presence of tax evasion based on the consumption response to tax changes.

I also explore how rising inequality in the U.S. could have contributed to the depth of the recent recession. A popular theory of how these two are related posits that as inequality increases, high-income households

are able to consume relatively more than low-income households. If low-income households experience a disutility from not consuming equivalent amounts as high-income households, they might try to maintain a higher level of consumption, potentially funded by debt. Along similar lines Rajan ([72]) argues that as inequality rose, credit was made increasingly available to lower-income groups to support their consumption levels in the face of stagnant incomes. While this argument suggests inequality increased the supply of credit, the political demand for this expansion in credit supply was arguably driven by disutility from the dispersion in consumption between the rich and the poor. **"Does Greater Inequality Lead to More Household Borrowing? New Evidence from Household Data"** (with Olivier Coibion, Marianna Kudlyak, and John Mondragon; [33]; R&R in *JEEA*) takes this and other theories to the data. We combine household data on debt during 2001-2012, regional variation in inequality, and a novel imputation procedure to show that low-income households in high-inequality regions accumulated less debt relative to income than similar households in lower-inequality regions, which is opposite to the predictions of the "catching up with Joneses" theory. We propose a simple model to rationalize these findings that hinges on lenders using a household's relative position in the local income distribution to infer the underlying quality of applicants. Specifically, higher inequality allows lenders to more easily discern borrower quality and so channel relatively more credit toward higher-income applicants. That is, relatively more credit is allocated to low-income applicants when local inequality is low rather than high, since higher levels of inequality imply that applicant incomes are stronger signals of credit-worthiness. As a result, high-income borrowers are able to borrow at lower rates or more easily as inequality increases. This information theory has robust support in the data. These results highlight a novel channel through which changes in inequality can have significant and differential economic effects on household leverage.

In another paper ("Consumption inequality and the frequency of spending", joint with Olivier Coibion and Dmitri Koustas, [22]), I explore the dynamics of inequality in the U.S. Specifically, income inequality has been rising sharply since the 1980s, raising concerns among economists, policymakers, and the general public. However, whether consumption inequality has gone up in similar fashion, which is arguably more relevant for welfare, remains the subject of heated debate. Understanding what has happened to consumption inequality can also be informative about the forces underlying the rise in income inequality. We conjectured that the frequency of consumption measurement can matter.

Consider households' purchases of paper towels. If households purchase them weekly and use them daily, it will not matter whether we observe their expenditures over a two-week period (as in the Diary survey of the Consumer Expenditure Survey (CEX)) or over a quarter (as in the Interview survey of the CEX), since each time horizon is long enough to capture purchases. But now suppose that households begin to stock up on paper towels once a month but continue to use the same amount daily. If we measure expenditures only over a two-week period, some households would report large expenditures on paper towels (because they stocked up for the month over that period) while others would report no expenditures (because they were still consuming from their stock of paper towels). So, when expenditures are measured over a short period, inequality would appear to have gone up even though the underlying consumption of paper towels by households remains the same. But measuring expenditures over a quarter would yield the same (and correct) conclusion as it did when households were not stocking up – inequality in consumption and expenditures is unchanged.

Consistent with this intuition, we document that the frequency of shopping has indeed systematically declined over time. Using data from the CEX Diary Survey, we find that the fraction of days in which households engage in any shopping for non-durable goods has been falling over time, so that households concentrate their shopping into fewer days of the week. Using even more detailed information on household expenditures (albeit over a shorter period) from Nielsen HomeScan data, we again document a decline in the number of days in which households do their shopping. Hence, part of the greater increase in inequality

as measured by the CEX Diary Survey may indeed be coming from a changing frequency of shopping by households. Several additional pieces of evidence, based on micro data, support this conjecture. For example, using the American Time Use Survey, we document a strong decline in the average amount of time spent shopping by US households, driven entirely by the extensive margin. Households do fewer trips per day and are less likely to go to any store on any given day, but spend the same amount of time at a store once they do go. These are precisely the expected patterns as households buy larger amounts of the same goods while at the store and therefore need to go to the store less often. Thus, the ability to stock up appears to be a critical component of these differences in trends.

We argue in the paper that a big part of these dynamics can be rationalized by the rise of club stores such as Sam's Club, Costco, and BJ's. which, by design, sell larger quantities of goods to households at lower unit prices. As these stores have expanded throughout the country since the 1980s, it has become easier for households to stock up in ways that were not feasible in the past, consistent with the decreased frequency of shopping that we observe. Furthermore, there is considerable geographic variation in the ease with which households can access one of these retailers, enabling us to quantify the contribution of this mechanism (we constructed a database of openings and closings of club stores). According to our estimates, the increased prevalence of club/warehouse stores since the early 1980s can account for approximately 40% of the rise in measured inequality in expenditures.

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