Research Statement

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March 21, 2022

1 Research Summary

My research primarily concerns the sources of business cycles. I am particularly interested in isolating the consequences of people's beliefs about economic conditions for the frequency and size of economic booms and busts. In my work, I examine the degree to which changes in beliefs can be independent drivers of fluctuations, even when economic fundamentals have not changed; I study whether disagreement about economic conditions can lead small fundamental shocks to have large aggregate effects; and I ask whether anticipation of future economic improvements can lead an economy into perilous circumstances today.

A major theme of my work regards the mathematical representations that economists use in their theories. My work shows that, even after fixing the economic environment, choosing an appropriate representation of equilibrium is crucial for many important questions. For example, Chahrour and Jurado (2018) show that what the literature calls "news" models and what it calls "noise" models are actually two representations of a single idea: imperfect foresight about the future. While the literature has sought to determine which type of model is more consistent with data, our result says that no amount of data can distinguish between these two models. Instead, we argue a more interesting question is whether beliefs drive fluctuations that are not associated with past, present, or future economic fundamentals. This is a question that the data can answer, and for which a noise representation is ideally suited.

Similar to Chahrour and Jurado (2018), Chahrour and Jurado (2021b) focus on assumptions about representation, in this case on assumptions that have limited the scope of the empirical procedure known as "structural vector-autoregression." That literature has typically assumed that such methods can only be applied when the underlying structural economy has an "invertible" representation, that is, a representation in which economic shocks can be inferred from the current and past history of endogenous variables. In this paper, we argue that all that is really needed to use such methods is that the underlying economy has a "recoverable" representation, that is, a representation in which economic shocks can be inferred from the past, present, and *future* observations of endogenous variables. In Chahrour and Jurado (2021b) we therefore provide necessary and sufficient conditions for recoverability, and show they are satisfied far more generally than the conditions for invertibility. By relaxing the assumptions about representation, the class of methods that includes structural VAR can thus be applied more widely.

Chahrour, Cormun, De Leo, Guerron-Quintana, and Valchev (2021) applies these methods to perennial questions regarding exchange rate determination, and shows that (i) exchange are tightly linked to expectations regarding productivity; and (ii) standard models of risk premia cannot account for the comovements of the exchange rate with real variables or deviations from uncovered interest parity.

Chahrour and Ulbricht (2021) also centers around a representation result. We show that, by representing people's beliefs about economic conditions as the sum of the truth plus an information

error, researchers can sidestep several technical and conceptual challenges. Using our approach, it is possible to characterize the potential effects of information without ever committing to a particular account of what observations people learn from. We show how to use the result to quantify the importance of economic disagreements in the macroeconomy in ways that were previously not feasible. We use this result to draw more robust conclusions about the types of information that people in the economy use to make economic decisions.

Chahrour and Gaballo (2021) and Chahrour, Nimark, and Pitschner (2021) both provide simple micro-founded theories of how beliefs may drive fluctuations even when economic fundamentals do not move, in a manner that is consistent with the empirical findings in Chahrour and Ulbricht (2021), Chahrour and Jurado (2018) and Chahrour and Jurado (2021b). Chahrour and Gaballo (2021) examine the feedback effect that emerges when households interpret an initial price increase as a sign of improving economic prospects and increase their own consumption, thereby driving further price increases. We show that this learning process can lead very small initial perturbations in the economy to drive substantial fluctuations, and can deliver empirically realistic comovement of output, prices, and productivity. In contrast, Atolia and Chahrour (2020) focus on modeling how *firms* learn from the prices they see in intermediate goods markets, and finds that learning feedbacks are likely to be smaller for firm-level choices.

By contrast, the theory of Chahrour, Nimark, and Pitschner (2021) is based on time variation in the sectoral focus of news organizations. In our theory, news providers focus on events in specific sectors (e.g. the collapse of the auto sector in 2009), leaving people in all sectors with an incomplete view of the entire economy. Because of this time variation in the sectoral focus of news coverage, people actions depend in a time varying way on the productivity of other sectors, becoming extremely response to sectors that currently *in the news* and very little responsive to sectors that are not. The result is that aggregate outcomes in the economy can fluctuate in ways that appear unrelated to sectoral productivity: linear regressions of output on sector-by-sector productivity will display a large unexplained residual.

These correlated errors in peoples actions may look a bit like sunspots in some respects, but the theory puts tight restrictions on how output depends on the cross-section of changes in each sector. In the paper, we explore these restrictions and find evidence, for example, that measures of how unrepresentative current news reporting is can help to explain periods where people in the economy seem to be making large "unexplained" mistakes at the same time.

If mistaken beliefs can drive economic fluctuations, a natural presumption might be that more information should help the economy avoid undesirable outcomes. In fact, much of my research shows that more information can be detrimental to outcomes. In Chahrour and Gaballo (2021), for example, better information causes people to put too much "trust" in the price signals they see, leading people to over-react to economic developments in ways they would not have done if prices were less informative.

In Chahrour (2014), I focus on the problem of a public agency (like a central bank) who wishes to coordinate the actions of the public. In this context, I show that too much communication can lead to a form of *information overload* that actually prevents coordination, and worsens outcomes. In Akıncı and Chahrour (2018), we show that when households have more information about future economic fundamentals, good news about the future can lead them to make risky choices they might have otherwise avoided. In this environment, imperfect foresight about the future leads to the large fluctuations in debt associated with the boom-bust cycles seen in emerging economies.

A substantial portion of my research explores questions in international macroeconomics. In Chahrour and Stevens (2020), we re-examine facts about good-level prices that have been interpreted as evidence that international borders create strong market segmentation. In that paper, we show that a model of retailer search can match facts about both prices and quantities relying almost

entirely on market segmentation that occurs within countries, rather than across borders. Our results suggest that the evidence favoring strong border effects is less conclusive than previously believed.

Akıncı and Chahrour (2018) show that imperfect news about the future can help explain the pattern of increased borrowing in periods leading up to "Sudden Stop" events, in which consumption, investment, and output all fall, and the trade balance experiences a strong reversal. That paper estimates the importance of news about productivity in a non-linear model, and finds that roughly half of productivity changes are anticipated.

Finally, Chahrour and Valchev (2021) examine the sources and sustainability of the US dollar's special role in international trade, and explore the unique benefits that accrue to the US as a result. The paper is both theoretical and quantitative, showing that the broad availability of an asset (e.g. US Treasury bills) can be a major factor in the emergence of that country's currency as the dominant medium of exchange. The paper shows that the asset availability mechanism can deliver realistic long-run implications for US dollar dominance, net foreign asset positions, and home bias in portfolio holdings. In addition, we show that transitions from one currency to another in the model are qualitatively realistic with dynamics that begin slowly, then accelerate as one asset begins to dominate exchange.

A final theme of my research is the potentially important role that search frictions may play in a variety of contexts, including consumer, labor, and funding markets. This research highlights the importance that a good's (or asset's) *availability* may play in determining outcomes in the economy, as well the fact that relationships formed in search markets are long-term investments. These themes appear in Arseneau, Chahrour, Chugh, and Shapiro (2015), Chahrour, Chugh, and Potter (2021), Chahrour and Valchev (2021), and most recently in Basu, Candian, Chahrour, and Valchev (2021).

2 Extended Research Statement

In what follows, I explore in more detail several themes that recur in my work. These themes are (i) information-driven business cycles (ii) learning from prices (iii) when is more information better? (iv) international economics (v) customer markets and search frictions (vi) optimal fiscal and monetary policy. Non-numbered headings recall titles of the papers under discussion. I conclude with a brief discussion of the empirical strategies used throughout my work.

2.1 Belief-Driven Business Cycles

The strongest recurring theme in my research is the idea that business cycle fluctuations might be driven by economic optimism or pessimism that are, potentially, never born out by measurable changes in underlying economic fundamentals. Researchers have captured this general idea in several ways, including with models of news shocks, models of noise shocks, and models of sentiment. Though many macroeconomists find these mechanisms conceptually appealing, empirical evidence on their importance has been limited and that which exists has conveyed mixed messages about their importance.

News or Noise?

Chahrour and Jurado (2018) provide a new synthesis of the first two branches of this literature, which concern news shocks and noise shocks respectively. News shocks arise when agents *perfectly* observe a part of future economic fundamentals. By way of analogy, this is like learning today that in next week's big game your favorite team will certainly win the first half. You don't know whether

they will win the game, which is ultimately what you care about, because you are still unsure how the second half will turn out. Noise shocks arise when agents *imperfectly* observe the entire future fundamental. This is like your friend telling you that he thinks your team will win next week's game. He follows the sport more than you do, and is often right, but sometimes he gets it wrong.

The main point of this paper is that a person's forecasting problem always has both a news and a noise representation: From the perspective of an econometrician who observes economic fundamentals and people's beliefs (or consequences thereof), models of news and noise are observationally equivalent. This equivalence has several implications. First, what had appeared to be two distinct strands of literature is actually just one. By transforming authors' results from these different strands into the same type of representation, it becomes possible to compare results across the literatures in a coherent way. Second, the noise representation is ideal for answering the question, "To what degree do beliefs alone drive business cycles?" A noise representation is ideal for this purpose because it isolates all fluctuations in beliefs that are orthogonal to past, present and future fundamentals. Though this seems like an obvious question to ask these models, we could not find a existing empirical exercise that answers it.

The paper concludes with two empirical assessments of the importance of beliefs. In the first, we harmonize the representations of several models that have been estimated in both the news and noise literatures.[1] We then compare the importance of pure beliefs according to those authors' own estimates. We find that, even after accounting for the differences in representation, the authors' estimates imply very different things for the importance of beliefs. Our second exercise attempts to resolve this disagreement by controlling for differences in information, economic environment, and empirical strategies across the different models. We conclude that differences in economic environment (primarily) and information structure (to a lesser degree) can account for the different findings, while differences in empirical strategy and data choice are not important. Importantly, we find that the data strongly prefer environments that deliver a large contribution of independent fluctuations in beliefs.

Recoverability

Chahrour and Jurado (2021b) expands on an implication of Chahrour and Jurado (2018): if news and noise shocks are equivalent, then empirical strategies that are applicable for one of these representations should also be applicable for the other. Yet, the literature seems to have concluded that structural vector-autoregression (S-VAR) can be applied to news models, but not to noise models.[2] This conclusion is based on a presumption — nearly universal in the literature — that S-VAR and related methods require that underlying structural economies have an invertible representation. Instead, Chahrour and Jurado (2021b) argue that what is really important for implementing these methods is that the underlying structural model is recoverable, that is, that structural shocks can be inferred from past, present, and *future* observations of outcomes in the economy.

In Chahrour and Jurado (2021b), we provide necessary and sufficient conditions for both recoverability and invertibility, and show that the former conditions hold in far more cases than the latter.[3] Moreover, recoverability is easy to check in applications. In the paper, we argue that because structural models are often recoverable even if they are not invertible, semi-structural macroeconomic methods, including S-VAR, can applied be far more broadly than previously understood.

[1] The models are proposed and estimated by Schmitt-Grohé and Uribe (2012), Barsky and Sims (2012), and BHL2013.
[2] This claim appears often in the literature, and is especially explicit in Blanchard, L'Huillier, and Lorenzoni (2013).
[3] Formally, invertibility is sufficient for recoverability, but not necessary.

We conclude the paper with an exercise that demonstrates the usefulness of the approach. In this application, we use the structural assumption that noise shocks should be independent from past, present and future productivity to isolate the components of consumption that can be explained by productivity from those that cannot. According to our exercise, no more than 15% of business cycle fluctuations in consumption can be explained by productivity. In the paper, we remain agnostic about the degree to which economic beliefs explain the remaining 85% of fluctuations, but the results leave room for a large component of belief-driven fluctuations.

Sectoral Media Focus and Aggregate Fluctuations

The theory of Chahrour, Nimark, and Pitschner (2021) is based on time variation in the sectoral focus of news organizations. In our theory, news providers focus on events in specific sectors (e.g. the collapse of the auto sector in 2009), leaving people in all sectors with an incomplete view of the entire economy. Because of this time variation in the sectoral focus of news coverage, people actions depend in a time varying way on the productivity of other sectors, becoming extremely response to sectors that currently *in the news* and very little responsive to sectors that are not. The result is that aggregate outcome in the economy can fluctuate in ways that appear unrelated to sectoral productivity: linear regressions of output on sector-by-sector productivity will a large unexplained residual.

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Information-Driven Business Cycles: A Primal Approach

The above work focuses on cases where all people in the economy have the same information. When people in the economy face different local conditions and have different information about aggregate conditions, the potential emerges for what several authors have called "sentiment" fluctuations. The hallmark of a sentiment fluctuation in this spirit is that people in the economy make coordinated mistakes about their *idiosyncratic* economic prospects rather than about some aggregate variable.[4] Relative to models with a common information set, sentiments models open additional avenues for beliefs to fluctuate without corresponding changes in fundamentals. Because of this, they have a particular advantage in capturing observations, like that of Chahrour and Jurado (2021b), that economic outcomes are only very loosely tied to observable changes in aggregate fundamentals.

Chahrour and Ulbricht (2021) begins with a very general result regarding the representation of economies with incomplete information, which encompasses both aggregate noise models and models with dispersed information. In particular, equilibrium rational expectations in such models can always be written as (truth + error), where the truth is the expectation under full information and the error captures the mistake made by agents who have less than full information. Necessary and *sufficient* conditions for this to be the equilibrium of some information economy are that the error term in these expectations is orthogonal to anything observed by agents forming the expectation.

The theoretical result of Chahrour and Ulbricht (2021) generalizes the important results of Bergemann and Morris (2013) to dynamic and market-based economies. Using the (truth + error) representation, it is straightforward to characterize all of the possible patterns of information errors and, therefore, to compute bounds on the size and correlation of people's mistakes. Our approach

[4]This usage seems to originate with Angeletos and La'O (2013).

thus makes it easy to characterize how important sentiments can be in any dynamic economy, and using various assumptions about the minimal information that agents possess. In the paper, we perform several simple exercises to demonstrate how our result can be used to bound the potential importance or nature of information-driven business cycles with only partially specified models. For example, we show that when economic agents observe output but not productivity, then positive technology shocks must lead the output gap to become negative, an implication that is consistent with the data but challenges the presumptions of classical economics.

After presenting our main theoretical result, we apply our representation result to estimate a simple flexible price model under minimal assumptions about what people in the economy use in forming their expectations. Under the null that the model is correct, our estimation delivers a process for equilibrium information errors made by agents and allows us to explore ex post what sorts of information structures can capture the patterns we uncover. We find that a single (rational) shock to household expectations — a sentiment shock — can explain a large percentage of business cycle fluctuations. Meanwhile, slow learning can account for observed countercyclical labor effects of productivity shocks. Although the underlying theory and empirical strategy are very different, our results are consistent with the empirical findings described in my own work above and also with recent work by AngeletosAl2015,Anatomy2018.

Amplification and Business Fluctuations

Though they have many appealing properties, structural models of sentiments have generally been built by making strong assumptions about the exogenous signals observed by agents. Chahrour and Gaballo (2021) show that a model with learning from prices yields endogenous sentiment-like fluctuations along with additional implications that strengthen the case for an information-driven business cycle.

The paper demonstrates that the signal-to-action feedback effect — highlighted, for example, by Benhabib, Wang, and Wen (2015) — emerges when agents struggle to discern whether a change in the prices they see are driven by changes in their local conditions or by aggregate changes in productivity. In this context, a household's optimal response to a price change depends on the reason behind it. Yet, uninformed households cannot directly observe why prices are changing, and they attribute a part of every observed price change to local conditions. Because of this, a price increase driven by a fall in aggregate productivity is interpreted on every island as a positive local shock. This common mistake triggers an increase in demand for each island's local good. Higher total demand for final goods, however, leads to higher demand and higher prices for inputs in the economy, which are then reflected in yet higher final good prices.

We show that this feedback mechanism becomes stronger as the volatility of aggregate conditions shrinks, so that in the limit case, aggregate economic fundamentals never move but aggregate beliefs do, along with output, prices and hours. We augment this model with a predictable component in productivity – from Chahrour and Jurado (2018) this can be viewed as either news or as noise — and show the model delivers a rich mix of demand and supply driven fluctuations, and contemporaneous comovements in economic variables that are quite realistic. In short, the additional restrictions that come from modeling learning *from prices* are completely consistent with the data.

Good News is Bad News

Akıncı and Chahrour (2018) provide additional evidence of expectations-driven cycles, in particular around the periods known as "Sudden Stops" in developing economies. The paper argues that optimistic expectations can lead consumption and borrowing to rise at the same time, something

not possible, for example, with mean-reverting productivity shocks. Moreover, in economies with occasionally binding constraints, this optimism can push agents closer to the constraint, increasing the chance that it binds and a Sudden Stop crisis occurs.

We estimate the fully non-linear model, with an eye towards quantifying the empirical importance of news (alternatively noise) shocks in a panel of these economies. Our results indicate a robust finding that roughly one half of permanent productivity shocks are foreseen by agents in advance. We show that, among the data series we use in estimation, the empirical patterns of debt and the trade balance (including their comovements with other variables) provide the strongest identifying information for the importance of news: a model without a forecastable component in productivity cannot match, among other things, the volatility of debt-to-GDP ratios found in the data.

2.2 Learning from Prices

In seeking to understand the role of information in explaining the business, one theme that frequently emerges is the potential importance of what people learn from the prices they see.

Amplification and Business Fluctuations

Learning from prices is the central theme of Chahrour and Gaballo (2021) (also discussed above.) In this paper, households who are unsure about whether a price change results from an improvement in local conditions or a change in aggregate productivity will respond to aggregate changes as if they were, in part, improvements in local conditions. Hence, the price system can serve as a coordinating mechanism for actions and, therefore, for economic fluctuations that are larger than warranted by economic fundamentals alone. This learning mechanism can lead to an upward sloping aggregate demand curve, since high prices make agents expect good things in their own future and feel more wealthy. Upward sloping aggregate demand, in turn, delivers positive price quantity comovement and implies that technology shocks can be contractionary, both of which are consistent with the data.

Intersectoral Linkages

Atolia and Chahrour (2020), in turn, studies the importance of information transmitted by the prices firms see in their interactions with suppliers and customers. In that paper, we draw a tight connection between the prices those firms see and the input-output structure of the economy: firms with many different (types of) customers and suppliers will naturally acquire more information about what is happening elsewhere in the economy. Moreover, the pattern of interlinkages could lead information to pass through multiple links in the chain, as events affecting my supplier's supplier influence my supplier's actions and, therefore, are indirectly observable to me.

In that paper, we come to a striking conclusion: even though firms typically interact with a small portion of the overall economy, there are fairly general conditions in which firms behave *as if* they have full information in making their own investment choices. Hence, when firms see only directly-relevant market prices, incomplete information does not matter. We extend the result numerically, showing that even when the conditions for an exact irrelevance of information do not hold, the implications of incomplete information disappear for practical purposes once firms are allowed to see these prices.

2.3 Is More Information Always Better?

While economists have often assumed the more information is likely to improve economic outcomes, my work has highlighted several cases where the case for more information is decidedly less clear.

Public Communication and Information Acquisition

Chahrour (2014) focuses on information that is communicated by a public actor, such as a central bank. Central banks are well known for putting limitations on their public pronouncements and, despite several attempts to model this behavior, there is little consensus as to why banks perceive this to be in their interest.

The point of Chahrour (2014) is that, if banks desire to induce a *common understanding* in the private sector, then lower quantities and fewer instances of public communication may be desirable. This is so because, when fewer messages are transmitted, private sector agents are more likely to all hear the same message. But the paper goes further, demonstrating an additional reason to limit communication. For if private agents themselves value coordination, they will value a piece of information more if they believe others are likely to know that information as well. This complementarity in information acquisition also gives the potential for information overload: a central bank that communicates too much decreases the chances that a given message is received by all people, thereby reducing the incentive of each individual to "listen" to that information. In equilibrium, too much communication leads agents to acquire *less information*, so that people's understanding of economic conditions actually deteriorates if the central bank communicates too much.

Good News is Bad News

Although a very different context, Akıncı and Chahrour (2018) also present a case where more information has counteracting effects. On the one hand, when agents receive information about future productivity, they can take actions that improve their ability to smooth consumption. This is a benefit of foresight. On the other hand, good information about the future encourages agents to smooth consumption by borrowing from abroad. In models with strong pecuniary externalities (such as the leverage constraint we use in this paper) this borrowing entails a risk, with costs that are not fully internalized by the agent.

Amplification and Business Cycles

Finally, the learning from prices mechanism in Chahrour and Gaballo (2021) also entails ambiguous effects from improving information. In particular, we show that the price-to-action feedback mechanism in the paper get stronger as productivity becomes more predictable. Effectively, agents come to put more and more trust in their price signals, and therefore respond to them more strongly. This can lead to (inefficient) fluctuations in the limit of arbitrarily-small aggregate shocks.

2.4 International Topics

A substantial portion of my research addresses questions in international economics. The results in Akıncı and Chahrour (2018) have been discussed at length above. Chahrour and Stevens (2020) and Chahrour and Valchev (2021) address two other perennial questions in the field.

Border Effects

In Chahrour and Stevens (2020), we re-examine the evidence that international borders impose extremely strong segmentation of markets across countries. The insight of this paper is that analyses of the question based on price data alone face a tricky identification issue: prices could be very different across borders because producers in a given country are insulated from competitive forces arising in a neighboring country, or they could be different because markets are very segmented everywhere (including within countries) but country specific shocks give rise to price differentials.

We demonstrate this insight in a two-country/four-region model in which retailers search for the best wholesale price for their goods, but may be less likely to search in the neighboring country or in all neighboring regions, including other regions inside the home country. We show that in our model the type of identification problem described above is exact: it is possible to match our targets in good-level price data between the US and Canada without taking a stand on whether segmentation is primarily within countries or across international borders. We then show that the identification problem can be resolved by looking at within and across country trade flows. We combined price and quantity data and find that the bulk of market segmentation occurs within countries rather than at the border.

Trade Finance and the Durability of the Dollar

In Chahrour and Valchev (2021), we attempt to jointly model two of the main observations in international finance. (1) A large majority of international transactions — even those in which the US is not directly involved — are denominated and cleared in dollars. (2) US foreign liabilities (e.g. US Government Bonds) appear to pay much lower interest rates than qualitatively similar assets denominated in other currencies. We explain these two observations by modeling the importance of financing and collateral in international trade, combined with the incentive firms face to trade using matching collateral.

The key innovation in our model is the introduction of an asset availability channel: trading firms not only desire to coordinate their collateral choice with potential trading partners, they also desire to use an asset that is available as collateral in their own country. This mechanism gives rise to an additional complementarity between domestic households and trading firms and portfolio allocations become a coordination device for the currency choice of firms. This occurs because an asset that is widely available in all countries is superior at providing liquidity internationally and, therefore, earns a larger liquidity premium than other assets. Meanwhile, the presence of the an endogenous liquidity premium ensures that international demand for the asset remains strong.

We show that this mechanism gives rise several potential long run equilibria (steady-states) without implying that currency regions are indeterminate in any given period (a common implication in related models.) The model can thus be used to think about the sustainability of the currency regions, and derive predictions for what transitions between regions may look like.

Exchange Rate Disconnect Redux

In Chahrour, Cormun, De Leo, Guerron-Quintana, and Valchev (2021), we apply the empirical methods of Chahrour and Jurado (2021b) to explore some longstanding puzzles regarding exchange rate determination. The goal of the paper is to provide a set of facts for researchers that help to constraint the set of plausible theories about exchange rates, while using as few ex ante theoretical assumptions as possible.

In the paper, we show that exchange rates are tightly connected to expected productivity at horizons of two years or longer. On the one hand, this finding contrasts with many empirical results

in the literature the suggest that exchange rate are "disconnected" from economic fundamentals. On the other hand, the finding help to explain why two have often appeared disconnected: the connection between fundamentals and exchange rates, though strong, is quite spread out over time and it is perturbed by expectational noise, which causes exchange rates to move in anticipation of productivity changes that are never realized.

2.5 Search Frictions and Customer Markets

Though much of my work has focused on the consequences of imperfect information, my work has frequently incorporated different types of search frictions.

Risky Business Cycles

In Basu, Candian, Chahrour, and Valchev (2021), we explore the potential importance of time variation in risk premia in generating business cycle comovements. Though the literature has conjectured that such fluctuations should be tightly connected, both the data and theory posed some significant challenges in making the connection clear.

From an empirical perspective, though the asset pricing literature has long recognized that risky asset returns are predictable over longer horizons, short term fluctuations in stock prices sometimes seem to imply that the business cycle and stock markets are largely disconnected. Our empirical approach in this paper uses a VAR to extract a five year *expected* excess stock return and then identifies a shock that explains the largest possible portion of those fluctuations. We then show that the same shock that drives longer-run fluctuations in expected stock returns also drives business cycle fluctuations in the data, including comovement in all the main macro aggregates. One notable exception to the comovement of variables in the VAR, however, is part-time employment which seems to rise substantially during contractions caused by our risk premium shock.

Motivated by this evidence, we propose a model that can match the empirical patterns discussed above in response to exogenous changes in risk aversion. The key problem from the theoretical perspective is generating comovement of all variables: increases in risk aversion encourage agents to engage in precautionary savings and thus tend to push consumption and investment in opposite directions. The resolution we offer is to observe that, in an economy with many savings possible savings vehicles, precautionary motives will also switch savings among the investment types. In our model, we assume that labor relationships can be long-lived (full-time workers) or short lived (part-time workers). In this case, an increase in risk premia pushes firms away from employing more risky full-time workers, towards investing in physical capital and part-time workers. This reallocations allows the model to match the increase in part-time workers in periods of high equity premia, but it also allows the model to generate comovement of the main macroeconomic aggregates because the reallocation to less productive workers (and capital, which has no instantaneous marginal product) decreases output in the economy overall, generating a real version of the Paradox of Thrift.

Anticipated Productivity and the Labor Market

In CCP2016 we present a standard macroeconomic model that has a classic Mortensen and Pissarides (1994) search and matching labor market. The innovation in the paper is that we remain agnostic about process for wage determination employed by agents in the economy. Using standard macro and labor market times series, as well as several candidate wage series, we then estimate a reduced-form process for wages embedded in the otherwise fully structural model.

Our semi-structural approach allows us to identify the process for wages that is most consistent with both data and the surrounding economic structure. Our key finding is that wages respond

quickly to neutral technology shocks, but not enough to fully offset the increased hiring incentive created by technology improvements. As a result, technology shocks drive a very large portion of labor market fluctuations in the estimated economy. The estimated wage process is quite different from both Nash bargaining — in which wages fully adjust on impacts — and from the standard version of sticky wages — which imply gradual hump-shaped adjustment to shocks.

Optimal Fiscal and Monetary Policy in Customer Markets

Search frictions are also a natural way to model the phenomenon of long-lived producer-customer relationships within otherwise standard macroeconomic models, and in Arseneau, Chahrour, Chugh, and Shapiro (2015) we estimate such a model using advertising data. The estimated search model implies large congestion externalities in customer markets, which can be partially offset with appropriate fiscal policy.

Although formalized in different ways, search frictions are also the source of wholesalers' pricing power in Chahrour and Stevens (2020) and are central to the asset availability mechanism in Chahrour and Valchev (2021).

2.6 Fiscal and Monetary Policy

My research has also frequently addressed questions regarding the efficacy and optimal conduct of fiscal and monetary policy.

Debate on the Size of the Tax Multiplier

ChahrourSGU2012 use a DSGE model as a controlled environment to help understand disagreement across the S-VAR and narrative approaches to identifying the effects of tax shocks. By applying the two approaches to data generated by a known DSGE model, we can determine whether the different conclusions arise from the differences in the transmission assumed by the methods. We find that, in fact, both methods uncover the effects of tax shocks quite well, though the more restricted S-VAR approach has smaller standard errors. Hence, the different conclusions are a consequence either of the two approaches identifying fundamentally different shocks or, possibly, a result of the large standard errors of the second approach.

Optimal Capital Taxation and Consumer Uncertainty

Both ChahrourSvec2014 and ACCF2015 (discussed above) consider optimal policy prescriptions in environments with non-standard features. In ChahrourSvec2014, consumers doubt the probability model for exogenous shocks hitting the economy and evaluate outcomes according to a min-max (robust control) objective. In such a context, we show the government both (i) seeks to reduce the distortion of beliefs by smoothing welfare across states and (ii) exploits the disconnect between consumers' subjective beliefs and the truth to lower the cost of providing fiscal insurance. Both of these forces call for a smoother profile for the labor tax rate, and higher volatility of taxes on private assets.

Sales and Price Spikes

Finally, Chahrour (2011) has contributed to the literature examining good-level price stickiness, a key input to macroeconomic studies of monetary policy. In the paper, I argue for a notion of temporary prices (a.k.a. "sales") that incorporates short lived price increases and decreases, and

show that using a "sales filter" that properly accounts for price spikes, along with some more subtle timing issues, changes our understanding of the persistence of regular price series.

2.7 Empirical Strategies and Results

Though my research has focused largely on theoretical mechanisms — information-based accounts of the business cycle in particular — more than half of my papers include substantial empirical exercises, ranging from minimally-restrictive semi-structural methods to calibration to likelihood-based estimation of DSGE models.

Several of these exercises have merged structural and non-structural components. In CCP2016, we incorporate a non-structural wage setting relationship within an otherwise structural DSGE model. The representation of information errors in Chahrour and Ulbricht (2021) is similar to the wedge accounting approach of Chari, Kehoe, and McGrattan (2007), allowing us to test *ex post* whether the wedges are consistent with a structural interpretation as an information error. Both ChahrourSGU2012 and Chahrour and Jurado (2021b) seek to identify conditions on structural models under which semi-structural approaches can give accurate answers.

Several of my empirical exercises have made use of moment-based estimation strategies, including Chahrour and Ulbricht (2021) and Akıncı and Chahrour (2018). The later paper employs a simulated method of moments approach to estimate a fully non-linear economy with an occasionally binding collateral constraint. An advantage of the moment-based approach is that it can provide simple narratives regarding what aspects of the data provide crucial identifying information regarding the parameters or shocks of interest. In Akıncı and Chahrour (2018), for example, it is clearly the comovement patterns of debt and the trade balance that are crucial for identifying the share of productivity shocks that are anticipated.

Despite the variety of environments and empirical strategies employed in the work described throughout this note, my findings have largely been supportive of the idea that people's beliefs could play an important independent role in driving economic fluctuations. Because beliefs are notoriously difficult to measure, *proving* that this mechanism plays a central role in fluctuations is likely to remain a challenge going forward. Nevertheless, the results in Chahrour and Ulbricht (2021), Chahrour and Jurado (2018), Chahrour and Jurado (2021b) and Chahrour and Gaballo (2021) all offer promising new avenues for testing this important hypothesis. I look forward to exploring several of these avenues in the future.

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