

The conventional agenda in the asset pricing literature studies quantitative rational expectation models. This approach is particularly well suited for the study of recurring patterns, such as the comovement of price-dividend ratios on stocks with the business cycle or the seasonality in the housing market during a calendar year. (Volume and prices are above trend during the summer, while activity in housing markets slows down in the winter.) In rational expectation models, the expectations of agents reflect these recurring patterns and are consistent with the equilibrium dynamics of the model. The model is successful if the distributions of equilibrium prices and quantities are consistent with those in the data.

An advantage of this approach is that agents' expectations do not introduce free parameters. Rational expectations impose cross equation restrictions on agents' expectations and equilibrium dynamics that constrain these parameters to be the same. This approach imposes a welcome discipline on the model if there are no data on expectations. By design, the approach assumes that all agents have the same expectations. To study differences in expectations, a researcher has to specify the source of information that only some agents may receive, while others do not.

Recent years have witnessed a massive effort to collect expectational data. These new data enable researchers to be more agnostic about how agents arrive at their expectations. It is now possible to discipline expectations with direct observations on households and firms. More and more surveys that ask respondents about their expectations also ask them about their characteristics (e.g., household or firm age, income or sales) and choices (e.g., investments.) These data allow researchers to study the joint distribution of expectations, characteristics and choices. Now a model is successful if it can match the observed joint distribution in the data.

Freeing up expectations is especially appealing to study unique episodes that are associated with structural change. In these instances, it is often not clear how agents were forming expectations at the time. For example, what explains postwar house price booms? Two major boom-bust episodes stand out in the United States, because they coincide with booms in other countries (e.g., chapter 4.5 in Piazzesi and Schneider 2016). The first boom occurred during the late 1970s and early 1980s, while the second boom occurred in the early 2000s – both episodes had unique features. An important contributor to the first boom was the Great Inflation. How did households form expectations about future inflation during this unique event? Low interest rates during the second boom made it cheap for households to borrow and increased the value of houses, computed as the present value of a stream of future housing services. When house prices collapsed in 2007, interest rates came down further and remained close to zero. Did households during the boom foresee the low rates after the collapse? Did home buyers at the peak of the boom expect house prices to further appreciate or were they aware that house prices were about to decline? What did renters expect during these years? Again, surveys help us understand households' expectations and actions during this unique episode. It is difficult to think about these house price booms as recurring patterns.

Big Data Collection Efforts

Central banks have recently pioneered massive data collection efforts to improve the foundations of their economic models and ultimately their conduct of monetary policy. Many private companies, such as Vanguard, contribute to this effort because they want to better understand their clients. The surveys ask individual households or firms about their expectations for the future. Some surveys ask respondents to forecast aggregate variables: macroeconomic indicators

(e.g., inflation, GDP growth) or financial variables (e.g., stock returns, bond returns.) Other questions ask about individual-specific variables such as income. More and more, surveys ask the same respondents about their expectations *and* actual choices. For example, households are asked about their stock return forecasts and stock holdings. Other surveys ask firms about their current sales and sales forecasts.

Examples of such surveys include the European Community Household Panel by the European Central Bank and its member banks, which asks a panel of households about their income and living conditions. There are modules in the survey that ask about household expectations. Since 2011, the Bundesbank has been conducting the Panel of Household Finances, which asks households about their expectations and their choices. Since 2013, the Federal Reserve Bank of New York has the Survey of Consumer Expectations, and the Federal Reserve Board has the Survey of Household Economics and Decision Making. The Bank of Canada conducts the Canadian Survey of Consumer Expectations since 2015.

There has been considerable progress in how to frame the survey questions in a way so that people without formal training in statistics can express their perceived uncertainty about these forecasts. For example, Bachmann, Carstensen, Lautenbacher and Schneider (2020) study how to best frame survey questions to elicit views about uncertainty from firms. Many of the surveys involve academics directly in the design of their questions. For example, the Bundesbank solicited questions from academics for its Online Survey of Consumer Expectations 2019. The Ifo Business Tendency Survey allows researchers to include questions that are asked to businesses in Germany. The Atlanta Fed Survey of Business Uncertainty has been conducted since 2015 and also involves researchers in their survey. Companies like Vanguard allow researchers to ask questions to a subset of their investors.

How do survey expectations compare with rational expectations from conventional models?

The conventional agenda has worked hard to come up with models that are successful at generating investor expectations that are consistent with predictability regressions for asset returns. In the data, high ratios of asset valuations relative to fundamentals tend to be followed by low returns on the asset compared to the riskfree rate. For stocks and housing, regressions of excess returns over the next, say, five years on the current price-dividend or price-rent ratio have a negative slope coefficient which is statistically significant. For bonds, the regression is on the difference between the price on a long bond compared to a short bond. Expectations that capture this pattern describe investors who have *low return expectations in booms*. The reason why assets are highly valued despite this pessimistic outlook is that investors may be less risk averse in asset booms. Alternatively, investors may perceive less risk in booms.

Survey evidence challenges this view. A growing number of papers documents *high return expectations in booms*. For stocks, Greenwood and Shleifer (2014) provide evidence that investors predict high excess returns on stocks during booms. De la O and Myers (2019) show that high stock-dividend ratios are associated with high cash flow expectations in surveys, while expected returns do not change that much over time. In bond markets, Piazzesi, Salomao and Schneider (2018) document that forecast errors can account for a substantial component of cyclical movements in bond risk premia. During the postwar period, the Great Inflation is the one episode in which risk premia on long nominal bonds were high.

Similarly, for housing, Case and Shiller (2003) document that households who bought a house at the peak of the housing boom in 2003 were expecting double-digit appreciation rates for houses not only over the next year, but over the next decade. Piazzesi and Schneider (2009) document that there is only a small fraction of households (roughly 10 percent of all households) who believes

it is a good time to buy a house during the early phase of the housing boom (during the years 2000-2003). This fraction doubles during the years 2003-2006. Since there are few housing transactions overall – less than 10 percent of the housing stock turns over in any given year – a boom in house prices is easily supported by a small fraction of households who are optimistic. The Case-Shiller evidence suggests that these optimistic households select themselves into these few transactions and sustain high valuations.

The conventional wisdom is still dominant. Research that relies on survey answers has to argue that they provide direct evidence about expectations. A question is whether survey respondents are the right people to ask about their expectations – they may not be marginal investors. Some surveys address this issue by focusing on people who recently bought the asset, such as the Case-Shiller survey of recent home buyers. Another question is whether the survey respondents really understand the question they are being asked. There has been recent progress on this front by researchers who are involved in the survey design, as I already mentioned. Another important concern is whether survey answers reflect the career concerns of professional forecasters.² Finally, surveys may reflect risk neutral forecasts. Adam, Matveed and Nagel 2019 provide evidence against this argument for stocks. These concerns are important because they improve survey design and will lead to better survey evidence in the future.

Belief heterogeneity

Why do households have heterogeneous expectations? Some differences in beliefs can be explained with informational advantages by certain households. During the recent housing boom in Germany, for example, renters have higher (and more accurate) rent and house price expectations than owners (Kindermann, Blanc, Piazzesi and Schneider 2020). This pattern is consistent with the idea that housing is a unique asset, where non-owners (renters) may have more precise signals about housing dividends (in units of numeraire consumption) than owners of the asset who consume the housing dividend but may not know how much it is worth.

Will we be able to explain *all* the cross sectional variation in household expectations? The answer to this question will likely be no. The same observable characteristics (e.g., age, income and wealth) that have high R2s in explaining other choices that households make (e.g., housing tenure), have rather low R2s in explaining their expectations.

A more humble approach, which is still very interesting, is to admit that we do not know how households get to their expectations. Successful papers along these lines are Landvoigt (2017), Lenel (2018), and Giglio, Maggiori, Stroebel and Utkus (2019). Even with a more humble approach, we can describe clusters of people (e.g., Piazzesi and Schneider 2009) and study how these clusters evolve over time (e.g., Burnside, Eichenbaum and Rebelo 2016). These approaches may help us to make progress in our understanding of volume in asset markets, which is one of the most important open issues in finance.

How to use survey beliefs in models?

One way to use survey beliefs as an input into our models is work with a temporary equilibrium concept (for an introduction, see chapter 3.4 in Piazzesi and Schneider 2016). Suppose heterogeneous agents solve dynamic optimization problems given some expectations that may be functions of time t variables. The outcome of these optimization problems will be a demand system for

²An attractive feature of the Survey of Professional Forecasters conducted by the Philadelphia Federal Reserve is that survey respondents are anonymous which reduces the importance of career concerns. Bluechip survey respondents are not anonymous but are serving a wide range of clients who may be either long or short in fixed income assets, which also mitigates these concerns.

goods and assets at time t . The researcher can impose discipline on expectations with survey forecasts. This approach deals with unique episodes, which are reflected in the survey answers. A successful model then matches equilibrium prices and quantities. An example of such an approach is Landvoigt, Piazzesi and Schneider (2015) who study the role of credit conditions and expectations during the housing boom of the early 2000s. Another is Leombroni, Piazzesi, Rogers and Schneider (2020) who study the role of heterogeneous inflation expectations and inflation uncertainty for house prices and stock prices during the Great Inflation.

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