

Research Digest

The Region often includes one or two articles about economists at the Minneapolis Fed and their current work. Research Digest is a new *Region* feature that provides shorter summaries of recent economic research papers.

In this issue, the Digest discusses work by Monika Piazzesi and Martin Schneider on several puzzles relating to housing, equity and bond markets, and by Cristina Arellano, Yan Bai and Jing Zhang on the impact of financial market development on the financing decisions and growth rates of companies.

Solving Asset Market Riddles

In three papers, Monika Piazzesi and Martin Schneider explore asset market puzzles with the help of heterogeneous and less-than-rational economic actors.



PHOTOGRAPH BY STEVE NIEDORF

Interrelationships among different asset types—stocks, bonds and real estate—remain something of a mystery to economists. How are their prices correlated? How do optimal allocations vary with expectations about inflation? What explains the dramatic shifts in portfolio holdings in the United States in recent decades? How do beliefs shape markets?

In a December 2007 *Region* article, “Masters of Illusion,” Fed economists Monika Piazzesi and Martin Schneider, now at Stanford University, explained their mutual interest in exploring the forces that drive these interrelated markets and in expanding asset price models to include real estate—a topic that demands greater scrutiny from economists given the current financial crisis.

“Housing as an asset, and the behavior of its price, is somehow not at the forefront of research in

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In “Inflation and the Price of Real Assets,” Piazzesi and Schneider seek to understand why the ratio of household wealth to GDP dropped by 25 percent during the 1970s and why price trends in stocks and housing led to a 20 percent portfolio shift from equities to real estate during that same decade.

finance and macro,” observed Schneider. But “most asset pricing models do not include housing.” Integrating real estate with other asset markets has therefore been a focus of much of their recent work. As Piazzesi has written elsewhere, “We want to understand the joint behavior of asset prices and quantities of the three major asset classes—bonds, houses and stocks.”

In a series of 2009 Minneapolis Fed staff reports, Piazzesi and Schneider delve into three curious aspects of these markets. The first paper explores household beliefs during the recent boom in U.S. housing markets. The second examines portfolio shifts from stocks into homes, and declines in household wealth relative to real GDP, during the 1970s, along with differing beliefs about inflation. The third seeks to understand the role of expectations and learning in explaining investor behavior in bond markets during the 1980s.

All three papers follow a similar path: They identify an asset market puzzle, statistically confirm the puzzle’s existence and then develop a model with some pattern of sub-

jective belief or “adaptive learning” that helps to explain the puzzle. With this method, the economists push the boundaries of representative agent/rational expectations theory by adding elements of heterogeneous and less-than-rational economic agents.

Momentum traders

In “Momentum Traders in the Housing Markets” (SR 422; also published in the *American Economic Review*, May 2009), the economists examine data from consumer surveys in the early-to-mid 2000s about housing price trends. They find that there was always a small cluster who believed it was a good time to buy a house and that the size of this “momentum” cluster strongly increased toward the end of the housing price boom.

More specifically, there seemed to be two phases in consumer attitudes about housing prices. From 2002 to 2003, a large fraction of those surveyed believed it was a good time to buy, peaking at 85.2 percent; their most important reason for this belief: “Credit conditions were favorable.”

An article on Piazzesi and Schneider’s work on money illusion appeared in the December 2007 *Region*.



During a second phase, 2004 to 2005, overall enthusiasm about home buying declined to about 60 percent and views about credit conditions also worsened. But the fraction of those who stated that “house prices are going up” or similar optimistic rationales for home buying more than doubled, from under 10 percent to over 20 percent. (The demographics of this momentum cluster, write the economists, don’t differ significantly from the population as a whole. On the other hand, housing price optimists are more optimistic than average about economic conditions in general.)

But how could such a small cluster of optimistic consumers (just 3 percent of the population) influence house prices, even though they don’t buy a large share of housing stock? Piazzesi and Schneider build what they call a “simple search model of a housing market” where, indeed, this happens. Three features are important for their result: (1) prices are set in a bilateral negotiation, so the price reflects the optimist’s valuation; (2) optimists account for a large

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share of transactions, so they drive the average transaction price; and (3) transaction costs are high enough to keep content homeowners from flooding the market, thereby keeping trading volume low.

Inflation and assets

In the second paper, “Inflation and the Price of Real Assets” (SR 423), Piazzesi and Schneider seek to understand why the ratio of household wealth to GDP dropped by 25 percent during the 1970s and why price trends in stocks and housing led to a 20 percent portfolio shift from equities to real estate during that same decade. Again, they start by documenting the puzzle, providing data on price and GDP ratio trends in housing, equity and net worth from 1952 to 2003.

To explain the dramatic trends in the 1970s, the economists build an asset market model in which households differ by age and wealth, and also where credit is nominal, meaning that inflation affects bond returns and the cost of borrowing. With this model, plus data on asset prices and holdings, as well as data on household inflation expectations, they develop a plausible explanation for both the drop in wealth and the shift toward housing.

The drop in household wealth relative to GDP, they show, was due to two unique events in the 1970s

that reduced the propensity to save: First, young baby boomers entered asset markets, immediately lowering average savings rates. Second, unexpected inflation eroded bond portfolios, lowering financial wealth and thereby reducing saving.

The shift from stocks to housing was due to three factors, with the Great Inflation of the 1970s as a key influence. First, higher inflation expectations led to lower predicted stock returns, so investors looked to housing instead. Second, disagreement about real interest rates (young households shifted their inflation expectations more quickly than old households) led to more borrowing and lending among households and an increase in collateral prices, namely, housing. And lastly, changes in inflation expectations made housing more attractive than stocks because of capital gains taxes on stocks and deductibility of mortgage interest. Taken together, these three factors (about 50 percent attributed to lower predicted stock returns and one quarter to each of the other causes) explain the asset portfolio shift.

Bonds and learning

The third paper, “Trend and Cycle in Bond Premia” (SR 424), examines another anomaly in asset markets. Sophisticated investors in the past 50 years “could have made a fortune,”

Piazzesi and Schneider write, by borrowing short-term funds and investing in long-term bonds whenever they observed a large spread between long- and short-term Treasury interest rates (right after recessions, for example) or whenever the overall level of the yield curve was high (especially during the early 1980s). But while publicly available interest rate data clearly reveal these statistical regularities, investors never exploited the profitable opportunities. Why not?

Most economists have hypothesized that investors’ assessment of risk (either perceiving that objective risk had increased or increasing their personal risk aversion) changed over time, leading them to shun the investment opportunity—however lucrative—as too risky. But another possibility is that investors simply didn’t recognize the pattern seen so clearly with the benefit of (massive databases and) hindsight.

Piazzesi and Schneider evaluate both explanations by first looking at survey data on interest rate and inflation forecasts and then building an asset pricing model that measures the explanatory power of both hypotheses. In their scrutiny of survey data, they find that “both candidate reasons for predictability patterns are important.”

Their model then seeks to

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incorporate both and measure their relative importance. To do so, the model accounts for “adaptive learning”—the idea that economic actors learn over time, reacting to past and current information to form expectations about the future. They find that this model “can help understand the movements in both components.”

Because adaptive learners react slowly to new information, argue the economists, they don’t change their interest rate forecasts quickly in response to sudden, sharp rate changes. Thus, adaptive learning “provides a reason for systematic differences between statistical forecasts and survey forecasts.”

Also, adaptive learning “gives rise to changes in perceived risk” and, given difficulties in the 1970s when high inflation wiped out much bond wealth, “adaptive learners viewed bonds as particularly unattractive around 1980,” demanding high risk premia.

The economists thus substantiate the idea that subjective beliefs, as measured through consumer surveys, can help explain what conventional asset price models have long viewed as puzzling.

—Douglas Clement



PHOTOGRAPH BY STEVE NIEDORF

Giving Credit Its Due

A multicountry analysis by Cristina Arellano, Yan Bai and Jing Zhang (not pictured) suggests that healthy credit markets are crucial to efficient operation of a nation’s firms—both large and small.

As the financial crisis took hold around the world last year, policymakers struggled to reestablish the smooth functioning of credit markets. And when the International Monetary Fund assesses a nation’s economic strength, it pays close attention to financial market development. But how exactly do healthy financial markets—those with plenty of liquidity and minimal frictions—facilitate the growth of firms? What happens to

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Their results suggest that when credit isn't easily available, firms operate at inefficiently small sizes; conversely, as financial markets develop, providing more ready access to capital, firms borrow more and operate more efficiently.

company financing decisions and growth rates when capital flow is restricted by poorly functioning credit markets?

In their July 2009 revision of staff report 392, "Firm Dynamics and Financial Development," Minneapolis Fed senior economist Cristina Arellano, visiting economist Yan Bai of Arizona State University and Jing Zhang of the University of Michigan explore the interplay of firm dynamics and financial markets, hoping to better understand the mechanisms that impede or encourage business growth. They do so by analyzing thousands of firms in a cross-section of countries whose financial markets vary in depth and sophistication. They then build a model economy where access to credit and risk of loan default are the mechanisms that might help explain variation in how firms finance their growth.

Both empirical analysis and the theoretical model confirm that well-functioning credit markets are critical determinants of firm financing patterns and growth rates. "In less financially developed countries," write Arellano, Bai and Zhang,

"small firms grow faster and use less debt financing than large firms." Their results suggest that when credit isn't easily available, firms operate at inefficiently small sizes; conversely, as financial markets develop, providing more ready access to capital, firms borrow more and operate more efficiently.

Cross-country facts

The economists begin with an exploration of empirical reality, developing a comprehensive record of firm-level data from 22 European nations in 2004 and 2005. For firms, the major data points are **size** (book value of total assets), **leverage** (total liabilities over total assets) and **growth** (net real growth in sales from 2004 to 2005). For financial market development, the economists use two statistics for each of the 22 countries: a ratio of **private credit to gross domestic product** (higher ratios indicating better financial market development) and percentage of **adults included in credit registries** in 2005 (higher coverage showing better financial markets since lenders can more easily

obtain borrower information).

The economists find wide variation among countries. Denmark has a credit-to-GDP ratio of 147 percent (indicating negative equity), while Romania's ratio is just 11 percent. Credit coverage is 100 percent in Sweden but under 2 percent in Russia.

Differences in firm characteristics are also wide. The average (mean) Dutch firm has assets worth nearly 14 million euros, while the average Estonian company has a market value of less than 600,000 euros. Mean leverage is 0.92 in the Netherlands but just 0.42 in Estonia; the average growth rate is five times higher in Estonia than in the Netherlands (54 percent versus 11 percent).

Markets and firms

What do the data show regarding associations between financial market development and firm dynamics? The economists find that while on average, across all countries, small firms use more debt financing than large firms—that is, average small firm leverage ratios are higher—that doesn't tend to be true of countries with relatively *undeveloped* financial markets. In those nations, the data reveal, small firms often use *less* debt financing—their leverage ratios are lower. This seems to make sense:

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Capital is less available in countries with undeveloped financial markets, and as credit costs and default risk rise, small firms tend to face more severe restrictions on loan contracts than large firms.

Less intuitively, the data reveal that small firms grow more quickly than large firms in nations with less-sophisticated financial markets. This, suggest the economists, is because small-firm growth is constrained by the high cost of credit in poor financial markets, so firms tend to operate at an inefficient scale; but when economies enjoy positive shocks, many small firms react by rapidly growing to more efficient size. Large firms, less credit-constrained, are likely to already be operating at an efficient scale.

In sum, they find that “small firms use less debt financing and grow disproportionately faster than large firms in countries with worse credit bureau coverage and lower ratios of private credit to GDP.”

Testing theory through a model

While their empirical analysis provides a solid picture of firm dynamics and financial markets, the theoretical basis is still unconfirmed. So the economists build a mathematical model to test their idea that patterns of firm growth and financing are

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affected by credit costs, which are higher in underdeveloped financial markets. By comparing this model's predictions with actual data, the economists can gauge whether the access to credit that well-functioning financial markets provide truly plays a role in firm debt and growth dynamics.

After developing a general model, the economists calibrate it to resemble England and Bulgaria—again, economies with developed and underdeveloped financial markets, respectively. The test of theory is whether a calibrated model tying firm dynamics to financial markets can reproduce actual data for each country.

For Bulgaria, the results are almost dead-on. The data show a mean asset level of 51 thousand euros for Bulgarian firms; the model generates 52. The data show 0.53 sales growth from 2004 to 2005; the model also generates 0.53. Leverage ratios are 0.65 in the data

and 0.60 from the model. The relationship between firm size and leverage ratio is also closely matched by the economists' model, running from 0.45 for the small firms to 0.71 for the largest in the data, and from 0.47 to 0.68 in the model. Growth rates in the data run from 0.73 to 0.39; the model generates 0.77 to 0.40. The data-model fit couldn't be much tighter.

The results are also good—but not quite as close—for the United Kingdom. While the match is nearly perfect for the mean asset, growth and leverage figures, the size-leverage and size-growth relationships are not as exact. “The fit is tighter for Bulgaria than for the UK,” they observe.

But overall, the model-data fits are remarkably close for both countries, supporting the theory that financial markets have a strong bearing on firm dynamics. Even after a further test to control for the importance of productivity differences in the two countries, the economists conclude: “The differential growth and leverage ratios across firms and economies are mostly driven by financial factors.”

—Douglas Clement