From the LAEF Lab

Laboratory for Aggregate Economics and Finance

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Guest Director's Message

Morris A. Davis
James A. Graaskamp Chair in Real Estate
Academic Director, James A. Graaskamp Center for Real Estate
Department of Real Estate and Urban Land Economics
Wisconsin School of Business, University of Wisconsin-Madison

Twice a year since 2009, the department of Real Estate at Wisconsin has organized a conference called "HULM" (Housing, Urban, Labor and Macro) with the Federal Reserve System. At the time we started the conference, there were few conferences focusing on housing. Our goal was to fill this void. When we designed HULM, we explicitly based its format on the LAEF model. The LAEF format is viewed by many as highly conducive to learning and research — 45 minute presentations with a 10 minute prepared discussion and commentary "as needed and at any time" from all participants throughout. The as-needed commentary is not only fun, but it keeps everyone alert and on the ready! (Director's comment: When the conference is really focused, and participants selected accordingly, we have found that the sessions are even livelier when we don't have a designated discussant.)

Last spring, I approached Finn and Peter about hosting a HULM-type conference in the summer as part of LAEF and they readily agreed. The HULM-LAEF team lined up an interesting mix of topics and speakers for the summer. We saw two top search papers on housing (Albrecht et al and Head et al); a structurally estimated urban model (Diamond); two papers on the relationship of information and house prices (Ferreira and Ehrlich) and a paper on housing demand and demographics (Green and Lee); two applied macro models, one studying household default (Martinez et al) and one studying firm default (Khan and Thomas); and one paper about the optimal destruction of information (which has applications to banking but also to securitization) by Monnet and Quintin. In addition, the discussants were top notch, the food was delicious, the weather was perfect, Carmen was awesome, and we finished in time to catch some kind of California-style "anything goes" parade just down the street. I left hoping we could do it again sometime!

As the diversity of the topics and people represented at the summer meeting exemplifies, HULM brings together economists who are pushing the frontier in all areas of real estate research. A highly valuable aspect of the event are the conversations and collaboration it fosters between academic researchers who study optimal policies in real estate and other markets and economists from the Federal Reserve and government agencies who directly participate in the implementation of those policies. The goal is to strike the right balance between research on questions of immediate policy relevance — what caused the recent financial crisis and how best to respond to it, among many others — and questions of longer-term, fundamental importance such as what drives migration patterns across cities or what frictions explain the microstructure of real estate markets, to name just a few typical topics HULM has featured over the years.

The next HULM meeting will take place at NYU Stern on February 28 and March 1st and paper submissions in all areas of real-estate-related research are welcomed. Email equintin@bus.wisc.edu if you have a paper you would like to present.

Laboratory for Aggregate Economics and Finance

Finn Kydland
Director

Peter Rupert
Associate Director

Carmen Earle
Business Manager

2112 North Hall
University of California,
Santa Barbara
Santa Barbara, CA 93106-9215
U.S.A.
Phone: (805) 893-2258
Fax: (805) 893-8830
Email: carmen@econ.ucsb.edu
www.laef.ucsb.edu

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*The next issue of **From the Lab** will feature the proceedings of the "4th Advances in Macro-Finance" and "Demography for Economists" conferences, co-sponsored respectively by the Tepper Business School at Carnegie Mellon University and the Stern School at New York University.*

Housing-Urban-Labor-Macro Conference

JUNE 21-22, 2013

VISITING CONFERENCE PARTICIPANTS

James Albrecht — *Georgetown University*
Morris Davis — *University of Wisconsin, Madison – GSB*
Rebecca Diamond — *Stanford University*
Gabriel Ehrlich — *Congressional Budget Office*
Fernando Ferreira — *University of Pennsylvania – Wharton*
Richard Green — *University of Southern California – Price and Marshall Schools*
Jesse Gregory — *University of Wisconsin, Madison*
Allen Head — *Queen's University*
Roozbeh Hosseini — *Arizona State University*
Aubhik Khan — *The Ohio State University*
Edward Kung — *University of California, Los Angeles*
Hyojung Lee — *University of Southern California – Price and Marshall School*
Leonardo Martinez — *Federal Reserve Bank of Richmond*
Timothy McQuade — *Harvard University*
Rachel Moore — *U.S. Congress Joint Committee on Taxation*
Munpyung O — *University of Nevada, Las Vegas*
Erwan Quintin — *University of Wisconsin, Madison – GSB*
Chris Redfearn — *University of Southern California – Price and Marshall Schools*
Julia K. Thomas — *The Ohio State University*
Susan Vroman — *Georgetown University*

University of Wisconsin Housing-Urban-Labor-Macro Conference, June 2013

Summaries of each of the presentations follow.
Note: speakers are highlighted in author listings.

Directed Search in the Housing Market

by Jim Albrecht, Pieter A. Gautier, and Susan Vroman

It is a stylized fact in the U.S. housing market that houses are sold sometimes above, sometimes below, and sometimes at the asking prices. Following this observation, Albrecht, Gautier and Vroman construct a directed search model to answer the question of what role the asking prices play in the house-selling process. With most papers in the literature assuming random search, this paper contributes to the literature by using a directed search model in which sellers post asking prices and buyers direct their search in response to those prices. Further, the paper contributes to the literature on directed search by assuming only limited commitment to the asking price and allowing the asking price both to direct buyer search and signal seller type.

Vroman's presentation began with the case of homogenous sellers with identical houses and the same reservation value s as common knowledge. In a one-shot game, each seller posts an asking price, say a. After observing all posted prices, each competitive buyer chooses a seller to visit. Upon visiting a seller, the buyer realizes a match-specific value x from an i.i.d. random variable distribution across buyer-seller pairs without observing the number of other visitors. Then the buyer can choose to accept the asking price a, or to make a counteroffer. If no buyer accepts a, the seller has the option to accept or reject the highest counteroffer. If one or more buyers accepts a, an English auction among these buyers ensues with reserve asking price, and the seller has to transfer the house to the highest bidder. The payoff to the buyer is 0 if he doesn't buy a house and is x-p if he buys house at price p. Meanwhile, the payoff to the seller is his reservation value if he doesn't sell the house, and is p if he sells the house at price p. The authors prove that any distribution of asking prices between s and 1 constitutes an equilibrium and there are no equilibria in which any sellers post asking prices below their reservation values.

The authors then present a heterogenous-seller case, in which there are two types of sellers: a relaxed seller with high reservation value s, and a desperate seller with low reservation value 0. The type of sellers is private information and the asking prices work as the signal of each seller's type. Since this is a signaling game, the authors look for Perfect Bayesian Equilibria, in which buyer and seller strategies constitute a subgame-perfect equilibrium given buyer beliefs, and buyers update their beliefs from their priors using Bayes Law. The authors demonstrate the nonexistence of pooling-on-high equilibria, pooling-on-low equilibria, and hybrid equilibria and the existence of the separating equilibria, i.e. low-type sellers post low prices, high-type sellers post high prices, and buyers believe low prices signal low-type sellers with probability one and vice versa. Finally, the authors show the efficiency of the pricing mechanism.

During the discussion following Vroman's presentation, conference participants asked questions about the stationary setting of the game and wondered whether the result would change in a repeated-game model setup. Vroman said that the result would not change since the reservation value is endogenous, i.e. if the buyer waits for one more period, the seller's reservation value will change with time and therefore the equilibrium results will not be affected. Another participant asked why not use the Nash Bargaining mechanism during the bidding negotiation, and Vroman made it clear that Nash Bargaining would not work here due to the private information of the sellers' reservation value. Another participant asked about the possibility that the sellers themselves are uncertain about their own reservation value. Vroman admitted that the authors did not address that area in this paper but would be willing to see what would happen in future research.

The Determinants and Welfare Implications of U.S. Workers' Diverging Location Choices by Skill: 1980-2000

by Rebecca Diamond

During the decades of 1980-2000, high-skilled cities experienced an increase in wages, housing prices and the share of high-skilled workers. Meanwhile, cities with a larger proportion of low-skilled workers experienced the opposite effect. When contrasted with the increasing college wage gap, this "Great Divergence" has important implications for welfare comparisons between high and low-skilled workers: high rents and prices in the high-skilled cities could potentially offset the increase in wages of the high-skilled, leading to a reduction in well-being, the opposite of what the growing college wage gap would suggest. Similarly, low-skilled workers' wages could be magnified by relatively low rents and prices, yielding to the possibility that the college wage gap does not properly portray welfare dynamics during this time period.

Diamond calculates the college well-being gap between high-skilled and low-skilled workers using a structural spatial equilibrium model and United States census data. She finds that the college wage gap underestimates the well-being differences between these two types of workers. The net welfare effect of changes in the skill composition, rents, wages, and amenity prices of cities in the U.S. increased welfare inequality by 20 percent more than the college wage gap indicates.

The key difference between these two well-being measures is that welfare estimates from Diamond's model account for changes in wages and rents, as well as in city-specific amenity levels and prices. Since high-skilled workers prefer to live in cities with a high level of amenities, their location choices across time reveal that the higher costs of living in these cities is outweighed by the workers' desire to enjoy local commodities. Hence, the availability of amenities and higher wages dominates the offsetting effect of higher rents and prices, leading to a larger increase in well-being. Similarly, for low-skilled workers, the relatively low prices and rents do not compensate them for the lack of amenities and low wages.

In addition, Diamond suggests that the increase of skill sorting into high- and low-skilled cities was caused by an increase of firms' high-skill labor demand in high-skilled cities. This resulted in a chain reaction that further increased the share of high-skilled workers in these cities: the inflow of high-skilled workers increased the local demand for housing and amenities, endogenously increasing their prices, and, in the case of amenities, their availability as well. This in turn attracted more high-skilled workers, further increasing the skill sorting. Low-skilled workers, on the other hand, moved out of these cities due to the price and rent increases, exacerbating the already polarized skill distribution, resulting in the equilibrium outcome we observe today.

A conference participant asked whether the underlying migration driver could be the initial distribution of skills in a city, instead of an increase in a firm's high-skill labor demand. If firms go where the high-skilled workers are, it is not firm demand, but rather the initial stock of high-skilled workers in a city that determines a city's migratory patterns. Diamond responded that using historical industry composition of cities in the U.S., the model could explain the observed demand shocks. Hence it was firms' demand, rather than the supply of high-skilled workers, that increased high-skilled migration inflows to the cities.

Another participant proposed a mechanism where parents of high-skilled workers invest in amenities for their children. In this case, it is intergenerational investment in amenities, not immigration, that drives the increase in amenity levels and rents. Diamond responded that by keeping the workers in their city of birth, she tested whether the model could explain the observed amenity and rent growth patterns. The result was that the model does poorly at explaining these patterns without letting workers choose their location of residence. This counterfactual experiment showed that the key mechanism at work is immigration to high-skilled cities, not parental intergenerational investment.

At the end of Diamond's presentation a question arose for future research. Is the United States in steady state with respect to migratory patterns? The model assumes an equilibrium outcome of course, but left steady state considerations to be explored later.

Credit Shocks and Aggregate Fluctuations in an Economy with Production Homogeneity

by Aubhik Khan and Julia K. Thomas

The recent great recession has reminded many economists that it is crucial to understand the connection between financial frictions and business cycle fluctuations. The literature looking into this dates back far before the recent recession – some notable papers include Bernanke and Gertler (1989), Bernanke, Gertler, and Gilchrist (1999), and Kiyotaki and Moore (1997). A key question in this literature is how a (potentially small) financial shock can produce a large and lasting recession. Khan and Thomas seek to answer this question by developing a macroeconomic model with firm heterogeneity in which there are frictions to capital reallocation, one financial and one real.

In the authors' model, firms face persistent shocks to both aggregate and individual productivity, similar in spirit to

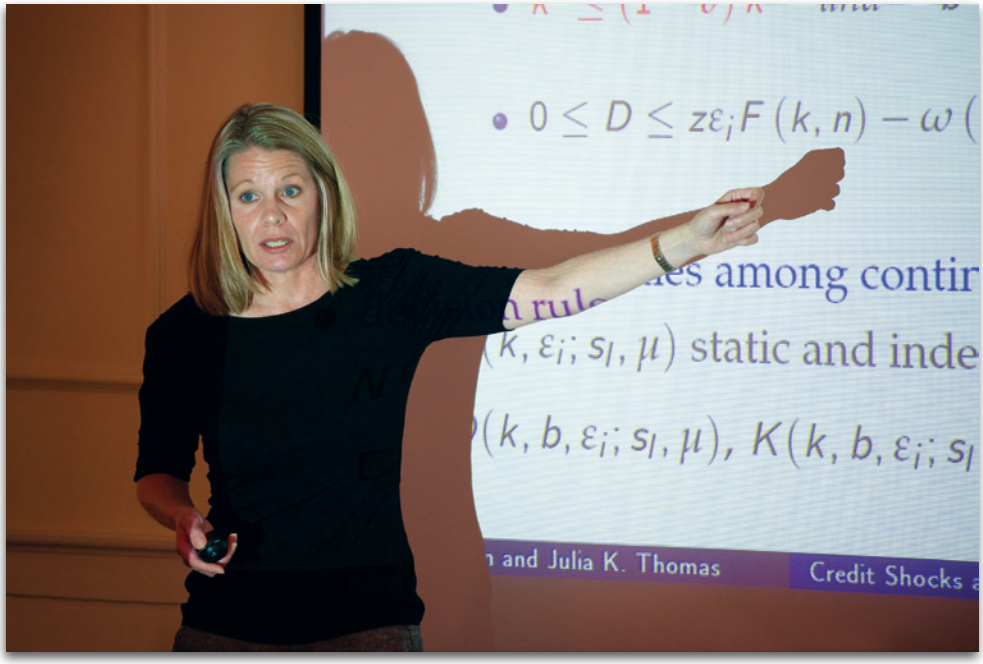
Krusell and Smith (1998), with firms facing the idiosyncratic shocks rather than households. In a frictionless world, complete capital markets would allow a reallocation of capital from less productive firms to more productive firms, but Khan and Thomas introduce two frictions that limit the reallocation of capital. The first of these frictions, which they call a financial friction, is that the size of investment loans is limited by collateralized borrowing constraints. A firm may seek to increase its capital following a "good" shock, but may not have adequate collateral to fund this purchase. The second friction, the real friction, is the partial irreversibility of investment. Since it is costly to disinvest, firms find it optimal to invest using a (S,s) rule. Given these frictions, productivity shocks lead to persistent disruptions to the efficient allocation of capital and thus a persistent reduction in aggregate total factor productivity.

To solve the model, the authors simplify their problem by segmenting all firms into two mutually exclusive groups. These two groups are distinguished by having a zero or non-zero probability of entering a state in which the firms' borrowing constraint would bind. The unconstrained firms behave as standard Modigliani-Miller firms – they are indifferent between retained earnings and dividends, thus capital choices are independent of their financial position. The constrained firms are more difficult to deal with because their decisions depend on their financial position. These firms can become unconstrained if they acquire sufficient wealth. By segmenting firms in this simple way, the model can be made more computationally tractable

Kahn and Thomas calibrate their model using microeconomic investment and financial data. Their calibrated model generates a distribution of firms over productivity, debt, and capital that endogenously determines aggregate output and total factor productivity. Their model is able to reproduce the gradual decline in GDP and decline in measured TFP seen in the recent recession, but fails to generate the unusually slow recovery in investment and employment. They argue that time-varying distortions in the labor market are likely to have been instrumental in explaining the prolonged recovery, as proposed by Ohanian (2010), and since their model does not incorporate any of these distortions, the model is not expected to deliver the slow recovery.

Participants at the conference discussed a number of issues pertaining to this model. First of all, firms have a fixed level of equity in the model, do not have access to state contingent equity, and can only acquire one-period debt. The authors are currently working on related work where they allow firms to enter more complicated debt contracts. There was also some discussion about the importance of the calibrated capital-to-output ratio. The authors used a calibrated value of 2.39 and had capital and labor factor shares adding up to roughly 0.9. If Kahn and Thomas were to choose a number further from one, their capital reallocation frictions would have more kick. Lastly, there was some discussion about how to incorporate labor market distortions into the model. There has been a rising labor wedge in the recovery, which points to a large role for these types of distortions, and including this feature in the model would be essential to getting the full picture of what occurred during the great recession.

Citation: Ohanian, L. E. (2010) "*The Economic Crisis from a Neoclassical Perspective*," Journal of Economic Perspectives 24 (4), 45-66.



Julia K. Thomas, The Ohio State University

The Role of Contagion in the Last American Housing Cycle

by Anthony DeFusco, Wenjie Ding, Fernando Ferreira and Joseph Gyourko

The DeFusco, Ding, Ferreira, and Gyourko paper evaluates the role of contagion in the timing and magnitude of the residential booms of 99 MSAs (Metropolitan Statistical Areas) during the last U.S. housing cycle. The authors present evidence that contagion played an important part in the rise of housing prices during the last housing boom. The authors establish that the initial increase in prices started in highly concentrated areas in California and New England, which spread towards central California in the first case, and towards the northeast in the latter. Furthermore, as price growth spread from these MSAs to neighboring markets, one-fourth to one-third of the average change in prices at the start of a boom was caused by changes in prices in the closest neighboring MSA.

During his presentation, Ferreira described three facts about the average effects of contagion. First, these effects arise only from the very closest geographical neighbor, and do not vary by the distance to that neighbor. Second, the estimates are robust to the measure of closeness between MSAs, whether it is by geographical distance or migration flows between MSAs. Lastly, these average effects are heterogeneous among MSAs, and contagion is much greater when transmitted from a larger to a smaller market. The effects have a larger impact on markets where the supply of housing is elastic.

Ferreira further explained that the cause of the last U.S. housing boom can be traced down to the initial booms of large, inelastically-supplied MSAs. The price growth in these MSAs can be explained by increases in the household income of mortgage applicants. However, aside from that single fundamental factor, the authors did not find that changes in other fundamentals, such as local incomes, migration flows, and lending behaviors, affected the magnitude of the contagion effect. This observation suggests that other non-fundamental factors, like irrational exuberance or misperceptions, might be the cause of contagion.

During the presentation, a conference participant mentioned that California, the area where most of the initial booms occurred, was recovering from a recessionary experience when its housing boom started. The participant wondered whether the boom in these markets was just part of an economic recovery rather than an episode of contagion. Ferreira argued that the data does not provide evidence in favor of that hypothesis. He explained that there were no differences, in terms of price levels or price growth rates, between California MSAs and those in the rest of the sample before the California booms started.

Another participant asked how the authors' estimates compared with those found in the literature. Ferreira pointed out that their estimates are much lower than those found in the contagion literature. He explained that the difference could be attributed to better data. The wealth of information used in their estimation allowed them to address several issues of upward biases that plague the contagion literature, hence providing more credible and conservative estimates.

At the end of the presentation, a participant pointed out that the presence of second home buyers and investors could explain the price correlations among neighboring MSAs. He posited that if homebuyers are affected by an income shock in their "home" MSAs and they purchase property in neighboring MSAs, this shock could explain the price correlations across MSAs. Ferreira answered that second home buyers and investors could not explain contagion across neighboring MSAs. He and his co-authors have data on second home purchases, and can match them to owners' area of residence. Using that information, they estimated the effect of these purchases on the price growth in neighboring metropolitan areas, and found that it had no effect on timing or magnitude of booms.

Age, Demographics, and the Demand for Housing, Revisited

by Richard Green and Hyojung Lee

The relationship between demographics and house prices has been intriguing to economists both because housing, as a complex good, has to meet a variety of a household's needs, and because much remains to be understood about the consequences of the baby boomers liquidating their housing. The earliest concern about the demographic effect on house prices was sparked by a paper by Mankiw and Weil (1989) in which real house prices were predicted to fall by 3 percent per year between 1987 and 2007 in response to the aging of the baby boomers. In practice, however, real house prices experienced an average growth of 3.5 percent per year from 1987 to 2007 and a dramatic crash after 2007. To explore the impact of demographic changes on the house prices, Green and Lee revisited the research question of the impacts of demographic factors, especially age distribution and other socioeconomic characteristics, on the willingness-to-pay of households for a constant-quality house during the Baby Boom and Bust. The authors apply a hedonic pricing model to study the relationship between the households' demographics and house prices. According to the hedonic pricing theory, the authors express house prices as a function of a bundle of housing characteristics so they obtain the corresponding implicit prices of housing characteristics. Based on these findings, the authors derive the implicit

marginal demand price of each housing characteristic determined by households' demographics.

The data for the paper are from the 2006-2010 American Community Survey 5-Year Public Use Microdata Sample. House price is specified as the flow of housing services consumed each census year, i.e. annual inflation-adjusted gross rent for renters and user cost of housing capital for owners. The authors incorporate house age; number of bedrooms and other rooms; whether houses are urban, rural, condominium, or mobile home; home ownership; and region as housing characteristics. Households' demographics are represented using the number of household members in a five-year age group; the householder's marital status, ethnicity; gender; the educational attainment of the households' highest earner; and non-housing household income and age-income interactive terms. The result shows that the implicit prices of housing characteristics are relatively constant over time during the Baby Boom and Bust. Further, holding other variables constant, the pure effect of age on housing demand remains positive until one is 85 years old. The authors' regression shows that demographic changes might not reduce future housing demand, but tend to increase housing demand in the near future. At the end, the authors draw policy implications from the regression results that the impact of aging and retirement of baby boomers on the housing market would be limited, and that it is the price elasticity of supply that matters.

During the discussion, one conference participant asked whether the hedonic pricing model could be applied if there is a fixed moving cost for households, and if so, whether the coefficients could be interpreted as shadow prices. Lee answered that if people can choose at each future time period exactly what kind of house they want, then shadow prices can be figured out, but that is rarely true in real life.

Another conference participant asked why the authors did not include the mortgage rate into the households' characteristics. Lee admitted that they did not include this variable due to the difficulty in estimating the cost of capital, but would make efforts to incorporate this into the continuing work on the paper.

Search, Liquidity and the Dynamics of House Prices and Construction

by Allen Head, Huw Lloyd-Ellis and Amy Hongfei Sun

The literature looking at the dynamics of housing prices has demonstrated that price changes exhibit positive serial correlation with long-run mean reversion. This pricing behavior is inconsistent with a Lucas asset pricing model where housing prices should immediately reflect future expected dividend value and would therefore not demonstrate this persistence. The goal of the Head-Lloyd-Ellis-Sun paper is to explain this high frequency positive serial correlation through a mechanism based on search and the liquidity of housing.

The authors begin by estimating a structural vector auto-regression (VAR) using data from 106 MSAs to attempt to establish some facts about local housing markets that the model will try to explain. The VAR shows that prices, sales, construction, and population growth have a higher autocorrelation than per capita income growth, but are all strongly correlated with income growth. The model also shows that prices and sales growth are more volatile than per capita income and that population growth is more volatile than construction growth but less persistent. Lastly, the VAR shows that prices and sales growth are negatively correlated.

To explain these facts, the authors construct a standard Diamond-Mortensen-Pissarides-type model, but modified to explain housing market phenomena. The key mechanism in the authors' model that explains the slow adjustment of housing prices occurs through market tightness in the matching function. Following an income shock that temporarily raises a city's relative per capita income, the entry rate of people increases sharply and stays above trend for many periods. These people need housing so the market becomes tighter over time as more buyers enter. The time-varying market tightness changes the liquidity of housing, and prices change to reflect this change in liquidity. Since buyers entering the housing market increase the market tightness, this reduces the time it takes to sell a home and slowly raises prices. The price increase then leads to increased construction which results in a decrease in the market tightness since sellers enter. Ultimately, tightness and housing prices will both return to trend.

Several issues were discussed by conference participants during Head's presentation. The first was the choice of having an exogenous exit rate of home owners and renters from the city. This exit rate is important because it determines the future number of sellers in the city which changes trends in market tightness and hence home prices. Head said that he and his co-authors have been able to endogenize this flow rate and it does not change their results much. Another issue that came up was the choice of linear utility. This greatly simplifies the problem since with non-linear utility match histories would matter and would determine the distribution of wealth. Lastly, Head explained that the AR(2) process for the income shock is crucial to all of the dynamics in prices. With a temporary i.i.d. shock, most of the dynamics would be different and the model would not qualitatively describe the data.

Past and Present UCSB Macroeconomics Graduate Students Attended The Conferencce

Rational Opacity

by Cyril Monnet and Erwan Quintin

Corporations have a tendency to withhold news about the quality of the long-term assets they hold. This behavior is described by economists as opacity. Traditional arguments attribute this tendency to keep secrets to agency problems between managers and stakeholders, or more simply, to the inherent fluidity/complexity of corporate holdings. The Monnet-Quintin paper proposes a different theory by describing an environment where it is optimal for the stakeholders of long-term investment projects to incentivize managers to withhold information. Thus the corporations described in this paper are rationally opaque.

The detailed argument is developed in a simple model of liquidity. Agents can invest in a productive long-term project but face the risk that they may need to consume at an interim stage, before the project matures. When they need to liquidate their investment early, they can either scrap the project or, instead, sell it to more patient agents. The paper adds two aspects from the canonical Diamond and Dybvig framework: First, the long-term project is risky and its probability of success is drawn at the interim stage. Second, when they make the original investment, agents can choose to make that interim information public, or they can opt instead to receive only a coarse signal of the project's quality. In terms of timing, early investors choose the design of the information technology at date 0. Next, they decide whether to invest in the long-term project or to store their endowment. At the start of date 1, late investors appear and all consumption types are revealed. The message then becomes available to all. Walrasian markets open, projects trade and/or are scrapped. Early consumers consume while late consumers wait until the returns to their investment are realized and consume the proceeds.

After establishing the existence and uniqueness of the equilibrium, the authors proceed to characterize the information design decisions of early investors. First they consider a simple case in which agents only have to choose between revealing everything and revealing nothing. The result is that agents who face a greater refinancing risk rationally choose to withhold information about the quality of the project, while the rest of the agents will choose

to reveal full information. Then the authors consider the case in which agents can design the message function in any way they wish. Because the only point of establishing more revealing information design is to induce a better scrapping decision when early investors are not constrained to sell, it follows that the only message function needed is the scrapping threshold. The paper continues to prove that investors who face a relatively low risk of early consumption will choose a higher scrapping threshold. And inversely, investors facing a high early consumption risk will prefer a lower scrapping threshold and possibly no information at all. Overall, the higher the early consumption risk, the more opaque information the early investors will reveal. In terms of efficiency, the total expected output is strictly below what would prevail under full information. So the equilibrium allocation under rational information design is Pareto inefficient.

Quintin discussed a few issues associated with the optimal information design. First, all the results established in the previous section go through unaffected when information is private rather than public because market prices reveal all private information in this environment. Second, empirical literature shows that opacity, as proxied by the variance in the rating of banks, seems to increase during periods where secondary markets are illiquid or under stress. This evidence can be explained by the model in the sense that the potential losses associated with secondary markets become smaller and the need to withhold information diminishes when the secondary markets are deeper. Liquidity-minded stakeholders will choose to withhold bad news when and only when they expect secondary market prices to be affected by the depth of those markets. Specifically, the model shows that the effect of secondary market depth on the optimal information policy is U-shaped. Third, Quintin considers the impact of transparency regulations. Since early investors are worse off in expected terms under full information, getting early investors to support transparency regulation would require imposing taxes on late investors. Otherwise, if early investors have a high risk of early consumption, constraining early investors to provide full information will cause them to opt for storage, thus causing a decline in investing activity.

A conference participant posed a question about the depth of the secondary market, which, in the paper, is public information and deterministic to early investors. The participant argued that in reality the depth may vary and can be affected by policy. Quintin agreed with the comment and proposed one possible extension to the authors' framework. He believes a dynamic model in which the depth of the secondary market is random can resolve the issue.

Price and Time to Sale Dynamics in the Housing Market: the Role of Incomplete Information

by Gabriel Ehrlich

Two stylized facts describe the market for existing homes: there is a strong positive correlation between sales prices and sales volumes, and a negative correlation between sales prices and the average time houses take to sell. This pattern is illustrated by monthly data for the United States from January 2000 to December 2010. The correlation coefficient between prices and sales volumes during this period was 0.80, while the correlation coefficient between prices and months' supply was -0.19. Both correlations are statistically significant at the five percent level.

The author offers a stylized model to explain these patterns using three key assumptions: first, sellers have incomplete information regarding conditions in the housing market; second, sellers face idiosyncratic variation in the offers they receive; and third, misalignment between sellers' and realtors' incentives prevents realtors from conveying their knowledge of market conditions to sellers efficiently. The first assumption seems natural given most households' infrequent participation in the housing market. For the second, idiosyncratic variation in the offers a seller receives may arise from differences in the match quality between the potential buyer and the house, variations in buyers' eagerness to transact quickly, or other factors. For the last assumption, recent work by Levitt and Syverson (2002, 2008) has shown that because realtors' typical compensation structure leads to misalignment between realtors' and sellers' incentives, realtors may not be able to convey their knowledge of market conditions to sellers efficiently.

Ehrlich proceeded to discuss his model, with and without the consideration of realtors, in a two-period scenario. The seller receives one exogenous price offer every period, and can accept or reject the offer in the first period, but has to accept it in the second period. The offers are the sum of an 'aggregate demand' component, which is constant across periods, and an idiosyncratic component, which is distributed i.i.d. across periods. In the case without realtors, the sellers can only observe the overall price and have the knowledge of the distribution of the two components, thus sellers have to infer the expected offer in the next period in order to decide whether to accept or reject the offer in the first period. The result is that when the seller follows the optimal policy, the expected time to sale in the model with no realtor is weakly decreasing in the state of aggregate demand, while the expected sales price is strictly increasing in aggregate demand.

In the case with realtors, Ehrlich assumes the realtor can observe aggregate housing demand directly, and must

be employed by the seller to sell the house. The realtor can only communicate with the seller by advising him on whether to accept or reject an offer after it has been received, and the realtor will receive a fraction of the sales price in return. The equilibrium strategy for realtors is to report their own preference truthfully. For sellers, the best response is to always reject the first offer when the realtor recommends it, but to sometimes reject the offer when the realtor recommends 'accept'. Moreover, in equilibrium, the expected time to sale is weakly decreasing in the state of aggregate demand, while the expected sales price is strictly increasing in aggregate demand.

A key prediction of the model is that the correlations between prices, time on market, and sales volumes are driven by seller confusion over the true state of the housing market. To test this prediction, the author constructs a measure of homeowner perceptions of housing values using data from the American Community Survey. This measure is then compared with several housing market price indices to construct a measure of homeowner misperceptions of housing values at the state and MSA levels. Finally, the author runs a regression of sales volumes over the misperceptions index to test whether homeowner misperceptions of the state of the housing market influence sales levels. In the baseline specification, a 1.0 percent increase in homeowner perceptions of prices relative to market prices reduces sales volumes 1.2 percent.

The paper concludes by exploring the determinants of homeowner misperceptions about the housing market. The cautious assessment is that while the variability and persistence of house prices seem reliably and intuitively related to house price misperceptions, it remains difficult to assess what other aspects of the housing market determine house price misperceptions.

A conference participant posed a question about the sensitivity of the model to the persistence assumption of the 'aggregate demand' component. He suggested that if this component follows an AR(1) process, then the stylized facts could be simply explained by the forecasting ability of sellers. Ehrlich agreed that different assumptions could generate similar results of the model, while here the persistence is needed to fit the data.

Another participant focused on the regression measure of homeowner perceptions of housing values. He was worried about the assumption that the shadow values of housing characteristics remain constant over time in the regression. Ehrlich responded that he could try another specification with interaction, but it would make the proper interpretation of the year-effect become an issue.

Mortgage Defaults and Prudential Regulations in a Standard Incomplete Market Model

by Juan C. Hatchondo, Leonardo Martinez and Juan Sanchez

Mortgage defaults are widely seen as costly, which has led to both academic and policy discussions about the reduction of default rates. Hatchondo, Martinez and Sanchez first propose an extension of a standard incomplete market (SIM) model that accounts for the observed behavior of mortgage borrowing and default in the United States. In particular, they follow closely the model studied by Kaplan and Violante (2010), but introduce housing, house price risk, and mortgages. Specifically, agents must own or rent a house and renting incurs a constant cost in the model. The log of housing price follows an AR(1) process, and mortgages are modeled as long-term loans. Mortgages can be refinanced or defaulted in any period and are collateralized by a house. There are no restrictions on the initial down payment other than the requirement that it be non-negative. Interest rates are set endogenously and depend on the default probability. In terms of timing, in each period the agent observes the realization of his earning and house price shocks at first, and then makes his housing and borrowing decisions based on his current home ownership status.

There are several assumptions in the framework of this paper that account for the results. First, the agents may freely choose their debt level; second, home equity is affected by shocks to house prices that do not affect the services the agent obtains from the house, so house price shocks affect both the agent's wealth and the price of housing services; third, the agent borrows using flexible long-term debt contracts. In addition, each period the agents are allowed to refinance by prepaying their mortgage and asking for a new mortgage, which implies that even though debtors cannot hold financial assets in the data, they can choose to adjust their saving level by adjusting their home equity. This makes it possible to study how changes in the mortgage contracts available to the agent may affect homeowners who may want to refinance in the future.

The model was calibrated to study the effects of introducing minimum down payment requirements and allowing lenders to garnish defaulters' income. There are four targeted moments: home ownership rate, median non-housing savings-to-income ratio, mean price-to-income ratio, and mean down-payment, and the first three are approximated well in the benchmark calibration. The calibration also generates an endogenous distribution of down payments and an increasing life-cycle profile of home ownership, which match well to the ones observed in the data. When down payment requirement increases, there is a steady decrease of default rate as well as home ownership rate. In terms of

welfare, down payment requirement benefits home owners, a majority of the population. This is because down payment requirements make it more difficult for renters to buy a house, since they are forced to save more before buying it. The cost of defaulting on a mortgage and then losing the house is higher. A higher default cost decreases the default probability, and thus reduces the cost of borrowing and allows home owners to refinance their mortgage at a lower rate. Income garnishment of defaulters' income would also reduce the mortgage default rate. In terms of welfare, since an increase in income garnishment does not have a significant negative effect on the agents' ability to self-insure but does have a significant positive effect on their ability to borrow, welfare increases for most agents with the level of garnishment in the economy.

The paper also assesses the agents' ability to self-insure against the housing price and income shocks by calculating insurance coefficients. For tractability, the paper assumes that debtors cannot hold financial assets. Thus, debtors can adjust their savings only by changing their home equity. However, this simplifying assumption does not impair debtors' ability to self-insure against adverse shocks. The response of consumption to income shocks implied by the model in this paper is comparable with the response implied by a SIM model without housing in which the agent saves using financial assets. In the benchmark model, most of the consumption inequality is explained by earning shocks instead of by housing price shocks.

A conference participant asked about the shape of the interest rate curve generated by the benchmark calibration. Specifically, he was wondering what caused the sharp increase in the interest rate when LTV ratio reaches 80 percent. Martinez responded that the authors believe it was because the targeted mean down payment was around 20 percent. Thus, the 80 percent LTV ratio is a dead level for the mortgage interest rate which will rapidly increase when this LTV ratio threshold is reached.

Another participant questioned the claim that the changes in home ownership rate across experiments were small. He argued that home ownership rate changes very slowly according to historical data, so a 2 percent percent to 3 percent change in the model is quite significant. Martinez agreed with the comments and suggested that according to the model one should stop increasing the minimum down payment rate at 15 percent in order to maintain a stable home ownership rate.

Reference: Kaplan, G. and Violante, G. L. (2010). `*How Much Consumption Insurance Beyond Self-Insurance*?' AEJ Macroeconomics, volume 2, 53-87.

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