

## Richmond Fed Regional Economics Workshop

Summary of Presented Research

**September 28, 2018**  
**Richmond, Virginia**

**9:00 a.m.**

### **Welcome and Introductions**

Andy Bauer, Senior Regional Economist,  
Federal Reserve Bank of Richmond

Kartik Athreya, Executive Vice President  
and Director of Research,  
Federal Reserve Bank of Richmond

**9:15 a.m.**

### **Erik Johnson**

Assistant Professor, University of Alabama  
*Valuing Curb Appeal: A Machine  
Learning Approach*

**10:00 a.m.**

### **Scott A. Wentland**

Research Economist,  
Bureau of Economic Analysis  
*Monetary Policy and the Housing Market:  
Evidence from National Microdata*

**11:00 a.m.**

### **Raymond Owens**

Senior Economist and Policy Advisor,  
Federal Reserve Bank of Richmond  
*Rethinking Detroit*

**1:00 p.m.**

### **Paul Carrillo**

Assistant Professor,  
George Washington University  
*House Price Markups and  
Mortgage Defaults*

**2:00 p.m.**

### **Luis E. Quintero**

Assistant Professor, John Hopkins University  
*A New Approach to Estimating Equilibrium  
Models for Metropolitan Housing Markets*

**2:45 p.m.**

### **Ferdinando Monte**

Assistant Professor, Georgetown University  
*The Geography of Consumption*

Since 2012, the Research Department at the Richmond Fed has been organizing a Regional Economics Workshop. The annual event gathers a number of researchers from different academic and research institutions within the Fifth District to present their ongoing work in the areas of urban and regional economics and state and local public finance.

Although information about local economic conditions plays only an indirect role in the conduct of monetary policy, regional economic research can help economists and policymakers better understand the effects of local, regional, and sectoral shocks on the aggregate economy. There is a growing line of research, supported by the increasing availability of granular and detailed data, that has focused on understanding how local and regional shocks propagate. Firms and sectors are interconnected across regions. When a negative or positive economic shock affects firms, and ultimately the cities and regions where they operate, these effects may accumulate and spread to other regions, producing macroeconomic consequences. In this way, research on regional economics can help policymakers better understand aggregate disturbances.

But why does this research focus on cities? In the United States, cities are major drivers of regional economic growth. Cities account for two-thirds of the population, and large cities (those with more than 150,000 inhabitants) generated approximately 85 percent of the country's GDP in 2010. Similar numbers are observed all around the world. This means understanding the drivers of city growth may help explain and identify some of the factors underlying national economic growth.

Moreover, research in urban and regional economics could shed light on what happens in the Richmond Fed's district. This contributes to the Bank's role in informing about key economic issues and engaging constituents in our communities. In the Fifth District, we not only have cities that have been growing very fast, but also some cities that undergo persistent decline and high poverty levels.

The workshop intends not only to promote the exchange of ideas, but also to facilitate the identification of common research topics for future collaboration. Our goal is to continue organizing this annual event and to continue expanding our relationships within the research community. The presence and participation of highly respected researchers have contributed to making this event a huge success.

Within this pamphlet, you'll find summaries of the work presented at the 2018 event.

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## Valuing Curb Appeal: A Machine Learning Approach

By Erik Johnson (University of Alabama) and Sriram Villupuram (University of Texas at Arlington)

A number of recent papers in urban economics are now using automated photo collection data to explore different aspects of cities. This approach has proved extremely useful when alternative sources of information are not available. The work by Johnson and Villupuram is part of this novel literature. Specifically, the paper uses image data from the Google Streetview API combined with machine learning algorithms to estimate the value of curb appeal, defined as the effect a property's external appearance has on its value.

Why does curb appeal matter? A house is characterized by a bundle of different attributes, and each component, including its curb appeal, determines the value of the house. The literature on hedonic pricing has devoted a lot of attention to the individual contribution of each attribute. However, up to the present, the curb appeal of a house has been pretty much ignored in the analysis because it has been difficult to assess. The goal of the paper is to measure and quantify this specific housing attribute and determine its importance in explaining housing values.

First, the authors define different degrees or qualities

of curb appeal. For this purpose, the authors develop a rubric with four categories and rank the curb appeal of houses in each. Second, they collect publicly available images using the Google Streetview API and data on 274,629 residential home sales in Denver, Colorado, during the period from January 2008 to March 2018. They collected two images for each sale: a photo of the house's curb appeal and a photo showing the view from the house's front door. Third, the authors manually score a subset of photos according to the rubric and use this information to train the computer to predict the scores of other images. Finally, the authors estimate a hedonic price regression that includes all this information. In other words, they estimate the impact of different housing characteristics, including curb appeal, on housing prices.

Even though the work is still preliminary, the analysis suggests a few interesting results. First, the total curb appeal premium can be a minimum of 7 percent of a home's sale price. Second, the curb appeal of the home across from the property is a complement to the home's value. And third, the value of curb appeal varies greatly across neighborhoods.

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## Monetary Policy and the Housing Market

By Jeremy G. Moulton (University of North Carolina at Chapel Hill) and Scott A. Wentland (Bureau of Economic Analysis)

The paper by Moulton and Wentland examines the extent to which monetary policy affects housing markets in the very short run. There is substantial evidence that monetary policy announcements by the Federal Open Market Committee (FOMC) tend to have immediate effects on financial markets, particularly on prices of liquid assets. A large body of literature in financial economics has quantified the impact of the "new information" revealed by the FOMC using high-frequency financial data.

But how does the information revealed by the FOMC affect markets that are less liquid, such as residential housing? Their paper studies this question using microdata from Zillow's "ZTRAX" data set, which provides detailed national information on millions of daily individual housing transactions. Following a regression discontinuity design approach (RDD), the authors

examine the change in housing prices that can be attributed to FOMC announcements.

Their analysis offers three main results. First and foremost, they show that surprise interest rate cuts have sizeable and immediate effects on housing prices. In particular, the results show that a given unexpected rate cut increased home prices approximately 3 percent on average during the Greenspan Era (1996-2006). Second, the quantitative easing operations during the zero bound period had similar effects on housing prices as conventional changes in interest rates. Third, changes in housing prices show great variation across geographic areas. The paper shows evidence that surprise interest rate cuts had stronger effects in the "sand states" (Arizona, California, Florida, Nevada), which experienced a pronounced housing bubble prior to the recession.

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## Rethinking Detroit

By Raymond Owens III (Richmond Fed), Esteban Rossi-Hansberg (Princeton University), and Pierre-Daniel Sarte (Richmond Fed)

A number of U.S. cities have experienced large and prolonged declines in population, a process that has resulted in abandoned properties, deserted neighborhoods, and vacant land. The city of Detroit is one of the most salient examples of such phenomena. Over the years, the redevelopment of certain vacant areas in the city has been very challenging. But why has this been the case, especially since those areas are frequently found relatively close to the central employment center, land prices there are low, and their fundamentals seem to be fine?

The paper by Owens, Rossi-Hansberg, and Sarte studies this issue. The main idea of the paper is that revitalization efforts in some neighborhoods may be nonexistent due to the lack of coordination among developers and residents. To explore this mechanism further, they develop and quantify a spatial general equilibrium model that incorporates residential externalities, meaning that development by one party

may increase the payoff to development for another party. For example, the construction of homes may lead to the production of amenities (such as grocery stores) that draw additional residents and further development.

The authors use this quantitative framework to evaluate some of the policy alternatives that have been proposed to revitalize Detroit. Specifically, they focus on policies that rely on local government guarantees of residential investment. These guarantees establish that the city government would contract with local builders for the construction of a specific number of housing units in targeted neighborhoods. To be effective, the guarantees should be capable of attracting a sufficiently large number of households and should generate population density to make local amenities viable. It could happen that private sales absorb all residential units, in which case the policy would be costless to the local government.

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## House Price Markups and Mortgage Defaults

By Paul E. Carrillo (George Washington University), William M. Doerner (Federal Housing Finance Agency), and William D. Larson (Federal Housing Finance Agency)

The prices at which buyers and sellers of houses are willing to trade generally vary. Even houses that look identical are traded at different prices. Evidence shows that while some houses are sold at prices higher than their expected market price — that is, they have a positive markup — other transactions show a negative markup. But is there a connection between markups and mortgage performance? The paper by Carrillo, Doerner, and Larson explores this possibility.

The paper develops a simple conceptual framework that explains why markups may exist and then establishes a link between current markups, future equity value, and the likelihood of mortgage defaults. In the model, price markups and default rates have a negative relationship.

The empirical section of the paper tests this hypothesis. Two alternative approaches are followed to measure markups. The first approach consists of taking the initial transaction price of a house, extrapolating the price forward using a housing price index, and calculating the

difference between the predicted price and the next observed price of the house. Obviously, this approach requires data on repeated sales. The second approach simply compares observed housing prices to appraised values. Most of the results of the paper are based on the first approach.

The paper estimates the impact of markups on various indicators of mortgage outcomes using a sample of 30-year fixed-rate loans from a large U.S. government-sponsored enterprise during the period 2005-07. In general, the authors find that markups are important determinants of mortgage delinquencies, defaults, prepayments, and credit losses conditional on default. The main result of the paper is that while positive markups of 20 percent lead to default rates larger than 8 percent, negative markups of 20 percent lead to default rates of approximately 5 percent. The authors conclude, based on these findings, that the economic effects of inadequately measuring collateral coverage may have important economic implications.

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## A New Approach to Estimating Equilibrium Models for Metropolitan Housing Markets

By Dennis Epple (Carnegie Mellon University and NBER), Luis Quintero (Johns Hopkins University), and Holger Sieg (University of Pennsylvania and NBER)

A large body of research in urban economics has focused on the estimation of hedonic price functions. Generally, this entails regressing housing prices or rents on housing attributes to uncover information about how each contributes to the overall value of the property.

The paper by Epple, Quintero, and Sieg develops a novel approach that they claim has several advantages over existing methodologies. First, it does not require assumptions about the determinants of housing quality. Second, the notion of housing quality includes both housing-specific and location-specific characteristics. Third, the approach can be easily implemented using only (at least in the simplest case) data on the distribution of housing values and household income at the city level. Fourth, this framework can be used to compare hedonic price functions and the distributions of housing quality across metropolitan areas. Fifth, it can be used to compare compensating variations across cities — in other words, how much residents would

need to be paid to be indifferent between two locations. The approach used is as follows. Suppose initially that households differ only in income, housing quality is not observed, and housing rents vary by housing quality. Using the local housing market equilibrium condition, it is possible to derive a relationship between housing values and income or, equivalently, between the city's income distribution and the city's distribution of rental values. For a given specification of the utility function and for given observed distributions of income and housing values, such a relationship can be used to determine how housing quality affects housing values.

The authors estimate that a New York resident would require \$5,700 on average to be equally well off in Chicago. They claim such estimates could be interpreted as indicators of agglomeration economies. The analysis is further extended to consider compensating variations for residents with different income levels.

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## The Geography of Consumption

By Sumit Agarwal (National University of Singapore), J. Bradford Jensen (Georgetown University), and Ferdinando Monte (Georgetown University)

Understanding the willingness of consumers to travel to buy goods and services is crucial to characterize local consumption patterns. This spatial behavior informs policymakers on a variety of local issues, including local taxes, local labor demand, and transportation infrastructure investment. The work by Agarwal, Jensen, and Monte is one of the first papers to provide a thorough description of local consumption markets.

First, the authors analyze the spatial distribution of transactions using data from 1.7 million credit card transactions by 70,000 U.S. consumers. In general, expenditure by consumers sharply declines at very short distances from their homes — that is, consumers are not very mobile. However, evidence also shows that the distance consumers are willing to travel to purchase goods varies by type of good and that consumers tend to buy more frequently from nearby stores. The authors suggest that a good's durability would partly explain the trade-off between distance and frequency of trips. For instance, consumers would be willing to make more frequent trips to buy less durable goods (such as perishable

foods), and, since traveling is costly, the distance between those stores and where they live should be short.

The second part of the paper develops a simple theoretical model that confirms the previous intuition. The model can be used to examine the effects of a local population increase resulting from a positive local shock. Firms in sectors with high storage costs would respond by hiring more workers per unit of land, as opposed to using more land farther away from consumers. The higher level of employment in those sectors will likely occur through a larger number of stores (since a higher store density reduces average distance traveled by consumers) rather than by more employees per store.

The paper offers evidence supporting the intuition from the model. When consumers spatially optimize their consumption behavior, local economic shocks have an impact on local employment, establishment density, and establishment size that varies by sectors that produce goods with different durability or storage costs.