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Brewing Bubbles: How Mortgage Practices Intensify Housing Booms

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Research Rap

INSIDE

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FIRST QUARTER 2014

Does the U.S. Trade More Widely Than It Appears? 1

Given the importance of international trade for economic growth, why in any given year do few U.S. firms export their wares, and why are most U.S. goods not traded with most countries? **Roc Armenter** presents some intriguing evidence suggesting the U.S. does export most of its products to most countries, just not very often.

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Does the U.S. Trade More Widely Than It Appears?

BY ROC ARMENTER

Trade matters. International commerce accounts for almost one-fifth of the U.S. economy's gross output. And by finding foreign markets for their goods, U.S. manufacturers provide jobs at home — even while competition from cheaper foreign goods may dampen domestic employment.

Indeed, it is not a stretch to say that economics as a separate discipline was born from the observations of David Ricardo and Adam Smith on trade. But trade matters beyond its impact on national income. It affects domestic workers and firms that face foreign competition, and as a result, it is a recurrent topic of public discussion.

We often hear stories about some developing country offering a product at half the price of a made-in-America equivalent and sending a domestic industry into disarray and its workers into unemployment. Or politicians debate the fairness and impact of China's trade policy on the U.S. economy. Indeed, China is the perfect example of a country "making the leap" through trade, catching up with the latest technology and being able to compete in global markets. And going further back in time, but much closer in space, the cotton trade was instrumental in the development of the U.S. economy in the 19th century.

Given trade's importance, it is perhaps surprising to learn that most of the products manufactured in the U.S. are actually not traded with the vast majority of countries over the course of a year.¹ For example, the U.S. exports several thousand distinct products to

Canada, spanning most of the nearly 9,000 product classifications provided by the U.S. Commerce Department. Yet, the U.S. sells just a few hundred to many other countries. Why would the U.S. sell a product in Germany and not in, say, Poland? Another interesting observation is that few U.S. firms actually engage in exporting. In 2005, less than a fifth of all U.S. manufacturing firms had any foreign sales. Given that the vast majority of manufactured goods can be traded at a relatively low transportation cost, why are so many U.S. firms failing to compete abroad? Are there insurmountable barriers to

¹ My discussion will focus on trade in manufactured goods. Of course, services are also traded internationally in the form of travel, royalties, license fees, and so forth. Although the U.S. actually exports more services than it imports, and thus enjoys a small surplus in this category, services remain a relatively small component of total trade compared with goods and raw materials.

trade, perhaps some of them man-made? Or is the U.S. manufacturing sector much less competitive abroad than we thought? In other words, what is behind these "missing" trade flows? Economists would like to understand the underlying barriers to trade to be able to answer all these questions.

Several researchers have made substantial progress by documenting strong links between trade and both market size and firm size. First, the U.S. is more likely to trade with larger, closer countries. Second, it tends to sell to these countries products that represent a larger share of its exports. Third, firms that export are also larger, in terms of both revenue and employment, and they appear to be more productive and capable of manufacturing a wide array of products.

These links between trade and size have led economists to posit theories of economies of scale in trade. Economists say that a production technology of a good exhibits economies of scale when the average production cost decreases as total production increases. The basic tenet in firm-level trade models is that firms must incur a large initial cost to begin selling their goods in a foreign market. For example, they may need to set up a distribution network or modify the product to meet the destination country's standards. But as the exporting firm sells more of the product to the importing country, these costs are offset by more sales revenue. Therefore, the bigger the firm, the bigger the production run, and the lower the cost of exporting per individual good sold. Economies of scale theories can explain why small firms, small countries, and low-demand products may not trade.



Roc Armenter is a vice president and economist at the Federal Reserve Bank of Philadelphia. The views expressed in this article are not necessarily those of the Federal Reserve. This article and other Philadelphia Fed reports and research are available at www.philadelphiafed.org/research-and-data/publications.

However, as we will see, economies of scale are not adequate to explain certain key aspects of actual international trade flows. For example, it is often the case that a product will be exported to one destination one year and not the next, and then shipped there again the year after that. It is also telling that many actual trade flows are very small in quantity or value, which casts some doubt on whether trade barriers are in fact all that formidable. To help explain these observations, I will instead advance the possibility that the U.S. does export most of its products to most countries — just not very often. It turns out that for many possible trade flows, we should not expect to see trade every year, but perhaps only once every few years. It thus becomes difficult to assert whether a missing trade flow in any one year is indeed a relevant observation. The distinction between missing and infrequent trade is important because the latter implies that the impediments to trade may be substantially smaller than previously thought.

A RICH, QUIRKY TROVE OF DATA

The U.S. collects and makes available detailed data for both imports and exports through the Census Bureau. At the monthly frequency, trade data provide information about each shipment, specifying its total dollar value, the country of origin (for imports) or destination (for exports), and detailed information about the product shipped. This trove has its origins in tariff and duty collection, which, luckily for trade economists, requires detailed data, as the rates typically vary with the type of product and country of origin or destination.

Currently, each product is classified according to the Harmonized System (HS) of unique 10-digit codes. The first two digits indicate the broadest category, known as a chapter (for

example, cereals, pharmaceutical products, or beverages); the next two digits provide a more detailed description and so on. For example, a beverage is first classified as water, juice, soda, beer, wine, and so on. Then if the beverage is, say, wine, it is further classified as fermented from grapes or another fruit, as sparkling or not, and finally as red or white.² These codes are valuable to trade economists, who often use the 10-digit description to indicate a distinct product. However, we do need to recognize that the classification system was not designed with academic research in mind. Sometimes even a 10-digit classification is covering up a substantial amount of heterogeneity. Take code HS6110110020, which covers the fairly broad category of women's wool sweaters. Meanwhile, other codes introduce quite irrelevant distinctions such as the size of the container. Sometimes products receive very close classifications because they share some physical or production attributes, yet we would never think of having one instead of the other. For example, vinegar is classified with wine as a beverage!

MISSING TRADE FLOWS

The data show that in any given year the U.S. trades a surprisingly narrow range of products with a limited set of destinations — trade being more common with large, nearby countries. To determine to what extent U.S. firms are absent from foreign markets, let us first construct a measure of all possible trade flows. To keep the discussion concise, we focus on U.S. exports in 2002.³ Take all the products the U.S. sold *somewhere* and all the countries

² The HS system is maintained by the World Customs Organization, with the first six-digit classification being common across countries. More detailed descriptions are often associated with tariff legislation. A complete guide to the HS system can be found at <http://www.usitc.gov/tata/hts/bychapter/index.htm>.

where the U.S. sold *something* in 2002. Combine both to construct all possible product-country pairs; that is, vinegar to Germany is one pair, vinegar to Guatemala another one; women's wool sweaters to Guatemala is yet another.

Which fraction of these possible trade flows did we actually observe in 2002? The surprising answer is very few — less than one-fifth of them! There are about 9,000 active product classifications. Looking at countries, we find that Canada received more than 8,000 different products from the U.S., but half of the countries received fewer than 700 products, and one-quarter of the countries received no more than 150 products.⁴

Looking at products, we find that half of the products were sold to only 35 or fewer countries, and a quarter of them reached 15 countries at most. Since there are questions about the HS classification being the right definition of a product, it is worth asking what happens if we use a broader classification. Table 1 reports the share of missing trade flows among all possible product-country pairs for different classification levels, from 10 digits (the most detailed description) to two digits (the broadest definition). The majority of possible trade flows remain unobserved even when product definitions are lumped together at the four-digit level, encompassing more than 1,000 distinct categories. Even if we distinguish only among broad chapters — there are only about 100 of them — more than one-third of all possible trade flows are missing. Similar results are obtained for imports.

³ This is unfortunately the latest data available at the firm level.

⁴ Shipments valued at less than \$2,000 do not need to be reported, so it is possible that the fraction of actual trade flows is larger. Available estimates of low-value shipments suggest that the difference in the total fraction is unlikely to be great.

TABLE 1**Missing Product-Country Trade Flows for Different Classifications**

Classification level	Number of traded products	Missing trade flows
10 digit	8,877	82%
6 digit	5,182	79%
4 digit	1,244	66%
2 digit	97	36%

Sources: Census Bureau and author's calculations.

Regarding which products are sold where, there is a clear pattern based on market size. For each destination country, it is possible to construct a measure of its market size, starting with the country's gross domestic product and adjusting it by the country's distance to the U.S. and by other variables known to increase trade costs. The resulting formula — known as the “gravity equation” in trade for its similarity to physics: closer and larger objects (or countries) exert a greater pull on (or trade more with) others — is excellent at predicting bilateral trade volumes.

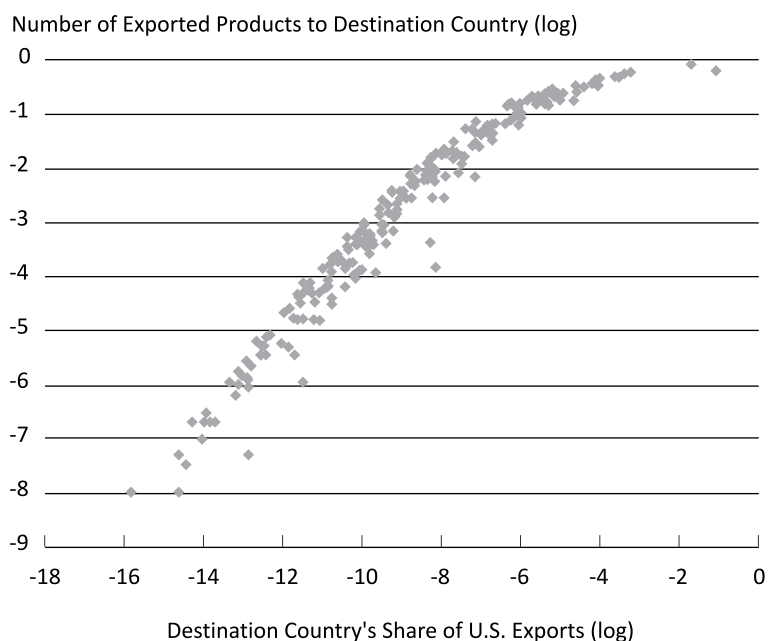
The data show clearly that the U.S. sells more products to and buys more products from larger, closer countries. Most possible trade flows with Canada and Mexico do indeed occur. Similarly, the U.S. engages in much trade with Germany and Japan, which are farther away but represent economic heavyweights.⁵ Figure 1 plots each destination country's market size against the number of products the U.S. sells there. Because the differences in market sizes across countries are very large, we need to use a log scale for the axes.⁶ Market size is captured as

the country's market share in total U.S. exports. The number of U.S. products sold clearly increases, becoming quite tight as market size increases. Note

of a third one, it will appear to be halfway between the two in a log scale but would instead show up much closer to the smaller country in a linear scale.

that the number of exported products increases rapidly at first but then slows down for destinations with very large market sizes. In these countries, most of the products are traded. Recall that by virtue of the classification system, no more than about 9,000 products can be sold to a given country.

Of course, different products also have different market sizes. It is perhaps not surprising to learn that automobiles make up a larger fraction of U.S. trade than turnips do. There are several techniques to identify variation in product-market size. A simple approximation is to use aggregate trade shares across products or, for example, the trade shares for Canadian exports. Using either measure, the data are clear: The U.S. is more likely to export products with large markets to more countries. Figure 2 brings this point home. It is a scatter plot as in Figure 1,

FIGURE 1**More Products Exported to Countries with Larger Markets**

Sources: Census Bureau and author's calculations.

⁵ Japan's GDP is about triple Canada's, and Germany's is about two times bigger.

⁶ A log scale measures relative rather than absolute differences. For example, if a country is twice as big as another country but half the size

on log axes. Now we plot the market size of the product against the number of countries to which the product is sold. Again, the relationship increases, though the trend is noisier than it is for countries.

FIRMS AND EXPORTS

Countries do not decide what to trade; firms and consumers do. So let us look at firms.⁷ Only 18 percent of U.S. manufacturing firms sold goods abroad in 2002, and the ones that did were consistently larger: Their total foreign and domestic sales were four to

⁷ Unfortunately, firm-level data are proprietary, but we can look at the big picture by combining the work of several economists as well as Commerce Department trade data from 2002. For a complete overview of exporters, see Alessandria and Choi (2010). A classic article in the literature is Bernard, Jensen, Redding, and Schott (2007). The facts that follow pertaining to firms and foreign sales are based on their analysis.

five times larger on average than those of firms that did not export. There are also systematic differences regarding employment, wages, and measures of firm performance such as labor productivity. Exporting firms employ more workers, pay higher wages, and have higher average output per worker-hour than nonexporting firms. In contrast, the differences across sectors were small. Less than 40 percent of the firms had foreign sales in the sectors for computers and electronic products and electrical equipment, appliances and components — the quintessential modern traded goods. The share of firms that exported was much lower in other sectors — as low as 5 percent in printing, publishing, and similar products, and 7 percent for furniture and fixtures.

So perhaps we are zeroing in on the reason the U.S. trades so few products to so few countries, yet where it

does trade it does so in large quantities: Most U.S. firms are either unable or unwilling to sell any amount abroad, but those that do are very large and competitive.

WHY IS THERE NOT MORE TRADE?

One possibility accounting for missing trade flows is that the U.S. is specializing in some products due to a comparative advantage, perhaps because of different factor endowments such as access to raw materials or a skilled workforce. This hypothesis runs afoul of the data: Most trade is intraindustry. For example, the U.S. sells cars to Germany, but Germany also sells cars to the U.S. Thus, neither can be said to specialize in cars. The relationship with size, especially at the firm level, is also puzzling. For the comparative advantage theory to hold, the source of the advantage would need to be systematically related to market size.

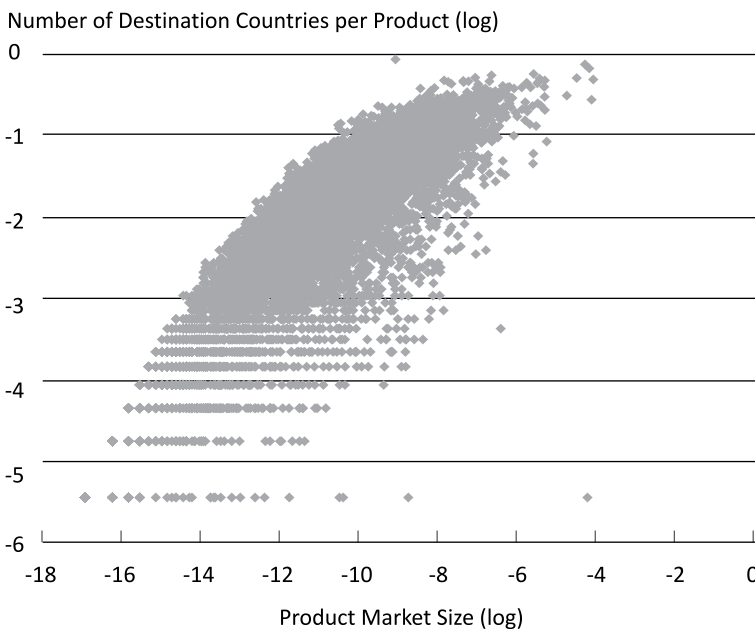
Trade economists instead currently favor a theory based on economies of scale in trade. The basic idea is that a firm faces a fixed cost, independent of actual sales, when accessing a foreign market. Unless the net revenues can cover the fixed expense, the firm would not sell in that particular market. Clearly, net revenues are tied to market size; thus, economies of scale can explain the relationship between missing trade and market size and why some trade flows go missing.⁸ Most of these models trace their lineage to Melitz (2003).

Economies of scale can also explain why some firms export and some don't. More productive firms are able to sell more and thus are more likely to be willing to incur the fixed cost. They will employ more workers and venture

⁸ Baldwin and Harrigan (2011) document how several models with economies of scale perform against the data, focusing on the facts reported in the previous section.

FIGURE 2

Products with Large Markets Exported to More Countries



Sources: Census Bureau and author's calculations.

into additional product lines. The same can be said about firms capable of producing better-quality or high-margin goods. See *The Relationship Between Size and Exporting* for a useful example.

Economies of scale in trade have some important implications in the event of a reduction in trade costs or tariffs. In particular, they predict that trade leads to an improvement in productivity industrywide, a very appealing prospect to trade economists, who have long suspected that liberalizing trade boosts efficiency. The mechanism is quite simple. As discussed before, more productive firms are more likely to be exporters. Now, a reduction in trade costs has two immediate effects. First, it increases the revenues of exporters as the cost of shipping their products to foreign markets decreases.

Second, it reduces the revenues of domestic firms that do not export as they face increased competition from foreign firms that do export.

In short, exporters expand, while nonexporters contract. Employment then shifts from the latter to the former. Since exporters are more productive, the average productivity of the industry and the economy increases. Although the increase in overall productivity represents a long-run gain for the economy, short-run costs may be significant. Smaller, less productive firms that sell only domestically may be driven out of business, leaving their workers unemployed, at least for a time. If these firms are concentrated geographically or economically, the reallocation of resource and workers to the more productive, exporting firms may be slow.

IS TRADE BROADER THAN IT SEEMS?

Economies of scale theories perform reasonably well in explaining why trade is more likely to involve large firms, high-demand products, and large, close destination countries. But as we will see, these theories run afoul of the data in some key respects. First, we see lots of small — actually, tiny — trade flows, adding up to no more than a couple of shipments in a given year. Barriers to trade thus cannot be particularly large, or otherwise these firms are losing money. Second, a lot of products and destinations appear and disappear year to year in the data, only to reappear years later, which we would not expect if economies of scale were the whole story. This infrequency seems to suggest that trade barriers are not only small but change often. These observations lead us to explore an alternative hypothesis: The U.S. does trade most products with most countries, just not very frequently. That is, a missing trade flow does not indicate that the U.S. never sells a particular product to a particular country; it just has not done so in the year being examined. What is so special, after all, about the time it takes the Earth to go around the sun? It may well be that no trade shipment enters the U.S. in the time it takes to read this article. We will be overreacting a lot if we conclude that we have stopped trading completely!

The distinction between infrequent and nonexistent trade flows is very important, for the latter are the backbone of the trade theories based on economies of scale. Infrequent sales cannot possibly bring home much net income. Their existence is thus compatible only with a very low fixed cost of accessing the foreign market. In other words, the barriers to trade, through the lens of a model with economies of scale that emphasizes fixed costs, would have to actually be small if there is infrequent trade.

The Relationship Between Size and Exporting

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ay U.S. firms must incur a cost of \$10 to gain access to a foreign market. Trinkets & U is a successful firm known for its uniquely useful trinkets. For each dollar's worth of trinkets sold, the firm makes a profit of 10 cents. Canada, a large country accessible by road and rail, is an attractive market. The firm knows it would sell \$200 worth of trinkets, making \$20 in profits. It will thus recoup the \$10 cost of exporting, and it gladly incurs it.

Now consider Andorra, a small, landlocked country across the Atlantic Ocean. The U.S. firm expects to sell no more than \$40 worth of trinkets there, which adds up to a paltry profit of \$4 — not enough to cover the expense of \$10 needed to access the Andorran market.

Returning to the U.S., we meet Gadgets Inc., a failing firm that produces quite useless gadgets. As a result, Gadgets will sell only \$120 worth of goods in Canada. To top it off, an inefficient production process shaves most of the profit down to only 5 cents per dollar. As a result, Gadgets Inc. does not sell in Canada, since it would net only \$6 in revenues, not enough to cover the fixed cost of \$10.

Note that if Gadgets Inc. would have managed to sell as much as Trinkets & U, even while making only 5 cents per dollar, it would have chosen to export to Canada. Similarly, if it had sold only \$120 but had a margin of 10 cents per dollar, it would have gone ahead and exported. The larger picture should be clear: Firms with low productivity and/or small margins are less likely to be exporters. These firms are also likely to be smaller, selling less and employing fewer workers.

Now, it is clearly untrue that all trade flows are infrequent; we could end up with no trade at all! In Armenter and Koren (forthcoming), we show how to develop a simple statistical model that uses the data on aggregate country and product trade flows to compute a probability that a shipment belongs to a particular product-country pair. The number of shipments exactly reflects the data, but each of them is randomly assigned to a product and a country category, akin to balls falling into bins at random. As simple as it sounds, the model is capable of predicting missing trade flows (that is, empty bins) and the size of the observed trade flows (how many balls do we expect to find in a nonempty bin?). A trade flow's relationship with the size of a firm or market is given by the probability that a trade flow in each category will occur, or, if you will, the size of the bin. For instance, Canada and autos have large bins and thus are very likely to catch many balls. Turnips and Andorra have very small bins, and thus it is very likely that they end up catching no balls at all. The framework does not elaborate on why Canada has more total trade than Andorra or autos sell better abroad than turnips; we just take these as given or approximate them through a gravity equation (for countries) and some model of product-specific trade costs (for products).

An example may be useful at this point. Assume that Canada's market size is 100 times larger than Andorra's. For the sake of simplicity, these two countries are the only trade partners the U.S. has, and we do not distinguish among products. The Canadian bin is 100 times larger than the Andorran bin. Total trade is 10 shipments per year. The difference in bin sizes implies there is a 99 percent chance a shipment goes to Canada, and only a 1 percent chance it goes to Andorra. The probability that more shipments end up going to Andorra in any year is vir-

tually negligible: Canada is expected to receive 9.9 shipments, while Andorra only a tenth of a shipment.

But shipments (or balls, for that matter) do not split! What does it

The distinction between infrequent and nonexistent trade flows is very important, for the latter are the backbone of the trade theories based on economies of scale.

mean for Andorra to be expected to have a tenth of a shipment? It simply says that a shipment to Andorra is expected to be observed about once every 10 years. In other words, the probability that we observe any shipment to Andorra in a given year is only 10 percent.

Given data limitations, it is not straightforward to sort out if a missing trade flow is actually nonexistent or just infrequent. There are, though, some observations that are distinct between the two hypotheses. If the number of shipments per product-country pair is zero, we cannot say much; that trade flow may be infrequent and we were just unlucky, or it may never happen. Now, things are different if the trade flow is observed. The infrequent trade hypothesis predicts we should see a very small number of shipments, possibly a single one. For, if a shipment is a rare event, two shipments are twice as rare! In contrast, the economies of scale hypothesis suggests that we should see a substantial number of shipments — enough for the firm to cover its fixed costs of accessing the market.

The data are clear on this aspect. Table 2 breaks down all the product-country pairs with positive trade for U.S. exports in 2005 according to the number of shipments that year. Among all pairs shipped that year, the most common number of shipments was one. The second most common was

two, and so on. Indeed, the number of shipments per trade flow conforms very well with what are called *count data*. This is usually associated with rare or infrequent events.⁹

What happens when we look beyond a single year's data? After all, if a trade flow is not observed in one year, why not look at two-year or five-year intervals? Indeed, as more years are combined, the number of missing trade flows decreases, albeit slowly. Table 3 shows the share of missing product-country trade flows when several years are combined.¹⁰ However, it would be quite unfair to dismiss the models

⁹ A classic example was the tally of deaths by horse kicks in the Prussian army, collected by Ladislaus von Bortkiewicz at the end of the 19th century. See Quine and Seneta (1987) for a discussion of the famous data and the associated law of small numbers.

TABLE 2

Shipments Across Traded Pairs

Number of shipments	Share of traded pairs
1	28.7%
2	12.8%
3	7.8%
4	5.4%
5	4.1%
6-9	9.9%
10 and above	31.4%

Sources: Census Bureau and author's calculations.

of economies of scale at this point; it could well be that, over the time examined, trade barriers decreased, thus explaining the increasing number of observed trade flows.

Another interesting observation surfaces when we extend our view beyond one year. When we consider two consecutive years, we can look for product-country pairs that appear anew in the second year as well as pairs that were dropped — that is, pairs that were observed in the first year but not the second. The data also speak loudly here: There was a lot of churning. That is, a lot of new trade flows cropped up, and a lot were dropped. Table 4 reports the new product-country pairs traded from year to year, as well as the pairs that stopped being traded, as a rate over traded pairs in the previous year. The second column repeats the calculation by weighting the pairs by their trade value. Every year close to one-quarter of the product-country pairs observed had not been traded the year before. And more than 20 percent of them were not traded the next year! In net terms, the total count of product-country pairs grew just over 2 percent, a full order of magnitude less than the gross changes.

¹⁰ Data are an average of the annual changes from 1990 to 2001 for U.S. imports. Import data over that period are somewhat more consistent regarding product classifications.

Now, this churning is a challenge to models with economies of scale but is to be expected in a model of infrequent trade. To be consistent with economies of scale models, the churning would imply a lot of year-to-year variation in trade barriers, but this seems unlikely. In the infrequent trade hypothesis, though, churning comes naturally. For example, all trade flows that are expected to be observed once every two years are bound to create churning.

Viewing “missing” trade flows as simply infrequent suggests we should not be looking at frictions or costs at the firm or product level. That is, the question should not be why firms do not trade or products are not traded with certain countries: We should instead ask why there are not more shipments. There are certainly some fixed costs per shipment — for example, whether a truck is full or half empty, a firm needs to pay the full wages of the driver. These fixed costs cannot be too large, since more than half of the shipments are valued at \$15,000 or less. And then some goods such as planes and satellites are so large that they are necessarily a single shipment. These goods tend to be durable, and we should not expect countries to purchase them frequently. For example, Andorra may buy a U.S. plane and not buy another until it is time to replace it several years later.

CONCLUSION


Trade is now a pervasive fixture of the modern world. Yet, economists are still explaining why there is not even more trade and, in particular, why so few products are shipped to and from most countries in a given year. Models with economies of scale are the leading theory of missing trade flows because of their ability to explain trade’s relationship with market size and the characteristics of firms that export. There are questions, though, whether the data on actual trade flows support some unique implications of these models. Of course, it takes a model to beat a model, and until recently there had been no viable alternative to theories featuring economies of scale. Recent work suggests that many missing trade flows are perhaps simply low-probability but not zero-probability events. 

TABLE 3

Missing Pairs over Multiple Years

Number of years	Share of missing trade flows
1	92.0%
2	90.3%
3	89.1%
5	86.6%

Sources: Census Bureau and author’s calculations.

TABLE 4

Entry and Exit, by Count and Value

	By count	By value
Newly traded pairs	24.6 %	1.1%
Disappearing pairs	22.4%	0.8%
Net difference	2.2%	0.3%

Sources: Census Bureau and author’s calculations.

How Much Larger Should We Expect Exporters to Be?

C

an the idea of infrequent trade also explain why some firms export and some do not? The answer is no. It takes only one product sold to one foreign market for a firm to qualify as an exporter. Thus, to assert that nonexporting firms are just infrequent exporters, we would need to say that trade, as a whole, is infrequent, which it is not. In Armenter and Koren (forthcoming), we show that the balls-and-bins model predicts that about three-quarters of the firms should be exporting — completely at odds with the data. Indeed, the model also gets wrong the relationship with size. Even though the model predicts close to four times more exporters than in the data, exporters are predicted to be even larger than the data show.

In Armenter and Koren (2010), we show that models with economies of scale also overpredict the size of exporters — by a lot. The reason is simple. It may appear that a four- or five-fold difference in size is large. But in the context of the distribution of firm size, it turns out to be very small. If larger firms are more likely to be exporters, they should be concentrated at the top of the firm-size distribution. Since about one-fifth of the firms export, the average firm in the top fifth of the firm size distribution should be a good approximation for exporters. Yet, the average top-quintile firm is more than 100 times larger than the average firm in the bottom four quintiles! That is, the theory overstates the size advantage of exporters by a factor of 25.

This suggests that productivity is not the only determinant of whether a firm exports. As a matter of fact, it is very likely not even the main determinant. Other determinants include the firm's location within the U.S., its ethnic or family links to the destination country, and the industry the firm belongs to.

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Location Dynamics: A Key Consideration for Urban Policy

BY JEFFREY BRINKMAN

The policies that cities adopt regarding such things as taxes, transportation infrastructure investment, zoning, schools, and police have important and often unpredictable effects on where businesses locate and individuals decide to live and work. In turn, these location decisions have real consequences for cities' general welfare and economic health. So to fully understand the long-term effects of their policies, cities must consider the complex ways by which firms, residents, and workers go about choosing where to locate.

Take, for example, London's decision in 2003 to implement a new plan to reduce congestion in the center of the city. At the time, development was booming and traffic congestion was becoming increasingly troublesome. Rather than try to increase capacity through construction of more highways and other automobile infrastructure, London introduced a congestion pricing policy. The idea of congestion pricing is simple and has wide support from economists and policy analysts. Because congestion has many negative social effects, including slower travel times, increased carbon emissions, and reduced local air quality, a tax on congestion can have net positive effects for society by encouraging people to travel by other modes or at different times.

London initially levied a charge of £5 on any car travelling into central London, with the price increas-

ing to £8 in 2005 and eventually to £10 (about \$15), where it stands now. There is some evidence that this policy has worked by initially reducing traffic volume by 27 percent and increasing vehicle speeds by 17 percent inside central London.¹ While London was one of the first major cities to implement congestion pricing, the idea has caught on with other European cities that are looking to the policy as both a source of revenue and a solution to ever-increasing traffic congestion.

However, the efficiency of congestion pricing is partially based on the assumption that the locations of people and businesses in a metropolitan area are fixed, an assumption that

¹ Jonathan Leape provides some analysis of the effects of congestion charges in London.

may be valid in the short term. However, in the long run, when faced with a new toll, people might not switch to transit. They might just choose to work or shop somewhere else, which could have negative economic consequences for the city.² This is one example of why location decisions are important in understanding the effects of urban policies.

THE COMPLEX INTERACTIONS OF LOCATION DECISIONS

The average person is familiar with the process of deciding where to live within a metro area. The decision, while sometimes difficult, seems fairly straightforward. People think about how much it costs to live in various neighborhoods and municipalities, how far they are from work and family, various amenities such as low crime rates and good schools, as well as access to services such as shopping or entertainment. They look at the city and its environs, weigh their options, and make a decision.

In an analogous way, businesses make decisions about where to locate in metro areas. They think about the cost and production advantages of various locations, certainly considering the cost of land and facilities, as well as access to customers or employees.

² In my working paper (2013), I present evidence suggesting that although congestion pricing does reduce traffic, the net effect on the economy is slightly negative. This outcome occurs because over the long run, congestion pricing reduces the concentration of businesses, which lowers productivity by reducing knowledge spillovers. Also see Gerald Carlino's 2001 *Business Review* article.



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These decision methods make perfect sense from an individual point of view. One individual's or firm's decision is unlikely to affect the overall characteristics of a large urban area. However, when we consider all of these people and businesses making decisions simultaneously or over the course of time, things get more complicated. For example, if the quality of a school depends on the educational level of the parents in the district or tax revenue drawn from the income of residents, then a question arises as to how high-quality school districts are formed in the first place and if they will continue at the same level of quality.

Another complication arises with the fact that business and residential decisions are connected. When a business moves, how does this affect where its customers or employees live? Conversely, when customers or potential employees move, how does this affect business location decisions? This simultaneous decision process complicates our understanding of the geographic distribution of population and employment in cities.

Finally, individual decisions may directly affect others in the form of an externality. In other words, one individual's or firm's actions may impose a cost on others or may deliver a benefit. The urban congestion described above creates a negative externality, since individual commuting decisions can cause congestion and slow everyone else down. Conversely, an example of a positive externality in urban areas is agglomeration. This is the idea that employment density has positive benefits for production, in that a firm's decision to locate near other firms leads to positive spillover effects. Externalities like these are of particular interest to economists and policymakers because they suggest that direct policy intervention has the potential to unambiguously improve efficiency in the economy.

HOW RESIDENTS SORT THEMSELVES INTO NEIGHBORHOODS

One important aspect of location decisions within cities revolves around how people self-sort into different local jurisdictions in a metro area for various reasons.³ This choice can be based on the innate characteristics of the various locations. For example, wealthy individuals will probably pay the most to live next to a beach. Or it might be the case that the characteristics of a neighborhood depend on the demographic composition of individuals living in that neighborhood. For example, the quality of the schools may depend on the education level of the parents living in that school district.

An early treatment of the role of sorting in cities was presented by Charles Tiebout in 1956. The key thrust of his paper is that, all else being equal, people will gravitate toward communities that provide the public services they desire. This is a powerful idea because it suggests that the existence of multiple local jurisdictions can possibly improve overall welfare by matching people with desired public amenities, not unlike the mechanism that drives the market for private goods.⁴

More recently, Dennis Epple, Thomas Romer, and Holger Sieg, among others, have more rigorously investigated the implications of sorting in cities and have also developed methods to test this implication empirically using observed sorting within cities. By considering that people have both different preferences for public services and different incomes, and recognizing that these two characteristics might be correlated, they are able to explain relative income and public service

³ For the purposes of this discussion, we are assuming that people are free to choose where to live. Of course, historically and currently, globally as well as in the United States, this right has often been denied.

provision across jurisdictions. They also show that people are sophisticated in their decision-making such as voting behavior, in the sense that residents recognize the effects of public service provision on their location choices.

BUSINESS LOCATION DECISIONS INVOLVE TRADEOFFS

Firms also make location decisions within cities. Ignoring for a moment the location of residents, who act as both customers and employees and thus are important in firms' decisions, firms still face tradeoffs in their location choices in urban areas. Firms must weigh the production advantages of a location versus the costs of a location, in particular, the land prices or rents.

The production advantages of a given location can be separated into two distinct types. The first type is the natural or innate production advantages of a location. This could include, for example, proximity to natural resources, desirable climate, or natural transportation hubs. The second type of production advantage arises from the concentration of firms and production. In its most general form, this is the idea that a firm's efficiency improves when it locates in close proximity to other firms. These are referred to as agglomeration economies or agglomeration externalities.

There is strong evidence that productivity rises in areas where employ-

⁴ It should be noted that providing all public services at a local level is not efficient. For example, when there are spillover effects, as is the case with public parks or law enforcement, where neighboring jurisdictions get benefits from the provision of services, or if there are returns to scale, as in transportation networks or public utilities, that require large fixed investment and network connectivity, the efficiency of fragmented jurisdictions comes into question. In other words, when public goods have certain characteristics, it is often more efficient for service provision or funding to happen at the regional, state, or national level.

ment is concentrated. The source of agglomeration economies has several explanations, including sharing of labor markets or inputs, or knowledge spillovers across firms resulting in improved technology.

Research on the source of agglomeration economies has been reviewed in previous *Business Review* articles by Jeffrey Lin and by Gerald Carlino. There is strong evidence of production advantages in dense areas in the form of high rents, wages, or more direct measures of productivity. However, one aspect of the research that both Carlino and Lin emphasize is the difficulty in identifying the different sources of production advantages. Lin suggests that an important consideration is the relative importance of natural advantage versus agglomeration effects, and he discusses methods for identifying these separately. Carlino makes the point that if people have different skills or educational levels, and these skills are correlated with location choice, then measured productivity in cities may be partially due to the sorting of high-productivity workers into cities, thus overstating the importance of agglomeration externalities.

Much of the research on firm location has focused on firm location decisions and agglomeration economies across metropolitan areas or on a citywide scale. However, there is strong evidence that the concentration of firms is important even at a neighborhood or district scale within urban areas, given that dense business districts are a prevalent feature of the urban landscape. Mohammad Arzaghi and Vernon Henderson, when looking at the advertising industry in New York, found that the production advantages of proximity to other firms declined rapidly across space even on a city-block scale. In their study, Stuart Rosenthal and William Strange also present evidence that the advantages of agglomeration externalities

decline significantly over a few miles.

In a joint paper, Daniele Coen-Pirani, Holger Sieg, and I study the dynamics of firm location in urban areas. By looking at location choices — including entry, exit, and relocation decisions of firms — in dense business districts versus sparse suburban locations, we are able to consider sorting effects simultaneously with the agglomeration productivity advantages. Using data from Pittsburgh, we find that more productive firms do, in fact, sort into dense business districts. However, they do so to take advantage

of agglomeration economies, which our estimates, based on select service industries, suggest can boost productivity by as much as 8 percent, implying that both sorting and productivity effects are important in urban areas. This productivity increase may seem large, but when one considers the high rents and wages that businesses pay in some neighborhoods relative to others, it is not surprising.

Table 1 shows some of the characteristics of firms in dense business districts versus more sparse locations in U.S. cities. Many of these business

TABLE 1

Establishment Characteristics Inside and Outside Dense Business Districts

Metro Area	Total Employment Outside Business Districts	Total Employment Inside Business Districts	Average Establishment Employment Outside Business Districts	Average Establishment Employment Inside Business Districts
Atlanta	1,115,398	229,002	15.79	29.25
Boston	1,728,075	531,349	15.66	39.01
Chicago	3,070,387	528,529	15.86	24.47
Columbus	705,534	63,278	18.69	23.73
Hartford	499,718	18,783	17.26	26.95
Houston	1,720,625	286,574	16.38	28.47
Jacksonville	491,959	24,315	15.24	25.38
Los Angeles	4,257,269	974,693	15.02	19.39
Philadelphia	1,921,626	196,428	15.91	27.66
Phoenix	1,551,921	64,793	18.31	27.78
Pittsburgh	822,013	157,009	14.58	40.04
Salt Lake City	440,239	53,086	15.22	21.08
San Antonio	655,740	26,572	17.21	20.49
Seattle	1,260,335	179,230	14.55	20.33
St. Louis	1,253,959	84,034	16.38	42.57
Washington, D.C.	1,930,848	303,770	15.42	21.68

Note: Business districts are defined as Zip codes with more than 10,000 workers per square mile. Sources: Data are drawn from the 2008 Zip code business patterns data. This table is taken from Brinkman, Coen-Pirani, and Sieg.

districts are the familiar downtown central business districts, although larger cities can have multiple dense business districts. For example, Los Angeles has 30 Zip codes spread throughout the metro area that meet the criteria of a dense business district. The evidence shows that establishments are larger in dense business districts.⁵ A familiar example might be banks, where larger banks are usually headquartered in downtowns of major metro areas, while smaller regional banks are often located in suburbs or smaller cities. Table 2 shows a more detailed comparison of establishments in the central business district of Pittsburgh versus the rest of the AL-

⁵ Establishments are single physical business locations, as opposed to firms, which may be composed of multiple establishments.

leggheny County for service industries.⁶ These data provide more insight into the production advantages of dense business districts as well as the sorting of firms. Establishments are not only larger in the central business district, but they are also older and have higher sales per employee. This evidence is robust across most industries.

INTERPLAY OF DECISIONS

Further complicating the spatial distribution of firms and workers in cities is the fact that their decisions are

⁶ Service industries here are defined by North American Industry Classification System (NAICS) codes 51-62, which correspond to fairly high-skill services such as finance, management, education, and health care. We focus on these industries because they are the most concentrated industries in dense business districts in cities. In addition, the relative importance of these industries has increased significantly over the past several decades.

mutually dependent. Firms must consider the location of customers as well as the location choices of employees. Likewise, workers want to be located close to their place of employment as well as to services. This makes the task of fully characterizing location in cities quite complicated.

First, let's consider the problem facing firms when residents act as customers, as in the retail sector. In this setup, we will think about cities' role in consumption. This problem was introduced in 1929 by Harold Hotelling, who proposed a theory on the location of firms with a fixed, uniform distribution of customers along a line. The basic idea is that multiple firms would strategically decide where to locate to capture the largest share of the market.⁷ The original framework proved to be neither rich enough nor rigorous enough to capture the real

TABLE 2

Pittsburgh Service Establishments: Central Business District vs. Rest of Allegheny County

Percentile	Inside Central Business District				Outside Central Business District			
	Age of Firms (years)	Number of Employees	Facility Size (sq. feet)	Annual Revenue/Employee	Age of Firms (years)	Number of Employees	Facility Size (sq. feet)	Annual Revenue/Employee
10th	2	2	1,432	\$47,481	2	1	1,565	\$40,000
25th	5	2	1,873	60,000	4	2	2,119	50,000
50th	13	3	2,499	70,000	10	2	2,474	64,000
75th	26	9	4,200	95,000	21	4	3,471	84,000
90th	42	28	8,470	140,000	34	11	5,276	116,077
95th	57	51	14,625	265,337	44	23	8,228	164,550
99th	108	288	53,563	890,257	76	99	22,841	495,803

Note: Business districts are defined as Zip codes with more than 10,000 employees per square mile.

Sources: Data come from the 2008 Dun and Bradstreet's Million Dollar Database and include only service industries (NAICS 51-62). This table is based on calculations by Brinkman, Coen-Pirani, and Sieg.

economy, but it paved the way for future work. For example, Timothy Bresnahan and Peter Reiss show the important tradeoff between customer access and competition in firm location decisions. This study looked across different cities, but the insight provided applies to location decisions within urban areas.

The retail location decision is further complicated by the fact that customers are free to move within cities as well. The models above assume that customer location is fixed, but in the long run, customers will move in order to be located close to retail or other services. Edward Glaeser, Jed Kolko, and Albert Saiz suggest that people are locating in cities increasingly for the culture, arts, retail, entertainment, and other amenities that cities provide. There might also be positive feedback in the sense that crowds of people attract more people, suggesting that there may be consumption externalities analogous to the production agglomeration externalities discussed above.

Another complication arises from the employer-employee relationship and its effect on firm and worker decisions. Here we are mostly concerned with cities' role in production and the costs associated with commuting to work. Early work by Edwin Mills and others analyzed where workers would live if all jobs were located at the center of a city. Later on, Masahisa Fujita and Hideaki Ogawa in 1982 and Robert Lucas and Esteban Rossi-Hansberg in 2002 developed models that freed firms and workers to locate anywhere within the city. These papers also consider the effect of ag-

⁷ Hotelling's model has mostly been applied as a metaphor for product differentiation, but in its literal sense, it is a useful framework in urban economics. The similarities are apparent given that location is a form of product differentiation and therefore leads to market power.

glomeration economies due to the density of firms. In that sense, these papers looked at the simultaneous location decisions of firms and workers in urban areas.

To understand how these simultaneous location decisions are made, it is important to understand all of the tradeoffs faced by both firms and

sumption is a vital determinant of city structure. In a current working paper, I look at the data from several cities to check the predictions of the theory described above and estimate the key determinants of city structure. Some of the important characteristics of location in cities are contained in Figure 1, which shows densities,

Firms must consider the tradeoff between the productivity of a location and the costs of being in that location, including rents and wages. Workers are concerned about the tradeoff between commuting times and costs on the one hand and the price of housing on the other.

workers in an urban economy. Firms must consider the tradeoff between the productivity of a location and the costs of being in that location, including rents and wages. For their part, workers are concerned about the tradeoff between commuting times and costs on the one hand and the price of housing on the other. In the presence of agglomeration economies, firms prefer to concentrate in dense areas, given that proximity to other firms increases productivity. However, this concentration leads to increased congestion, suggesting that workers would require higher wages to travel into these areas to offset their commuting costs. For the urban economy as a whole, the important consideration is whether the increased production is worth the extra costs of congestion.

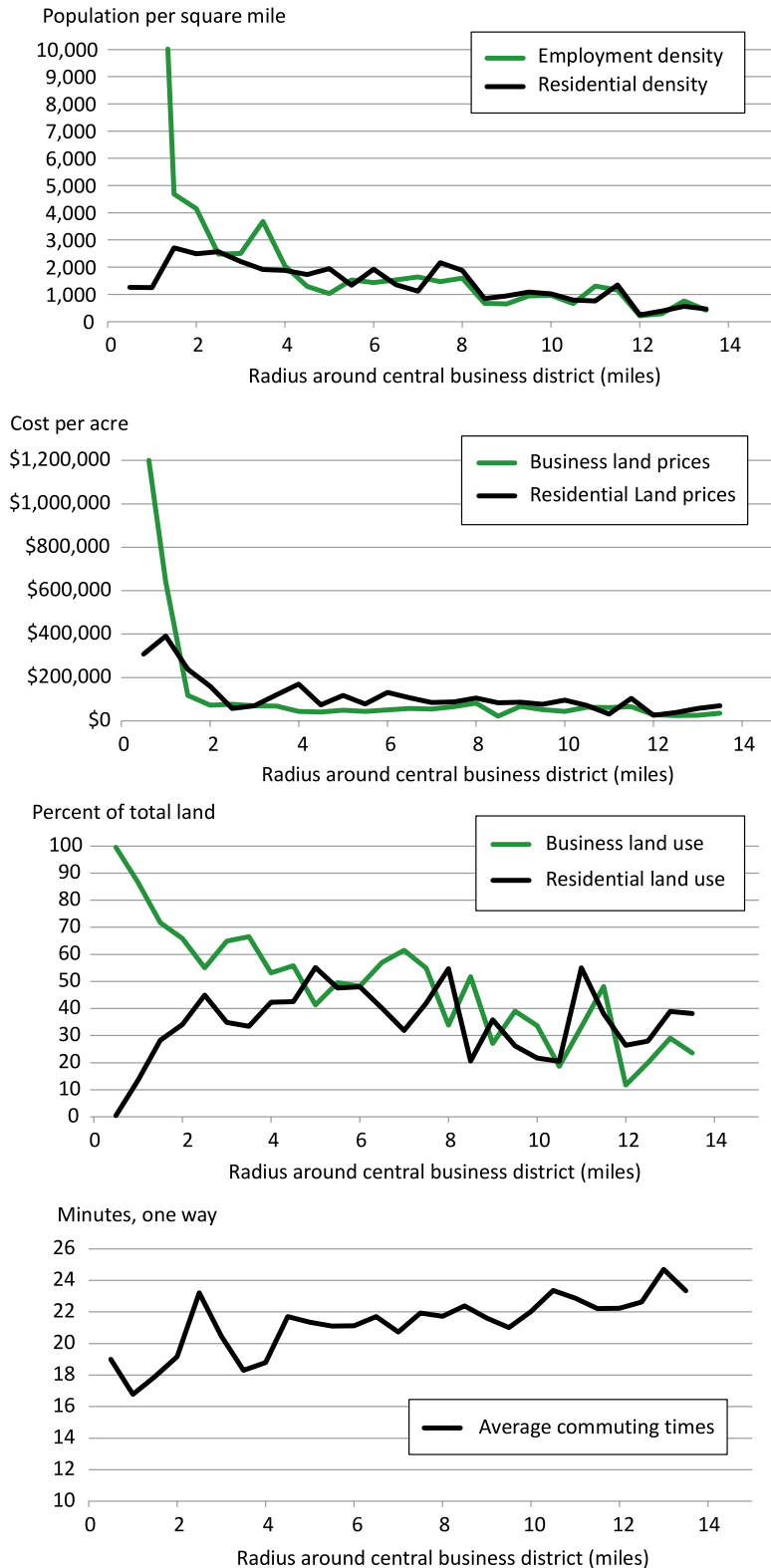
Ultimately, the final form of a metropolitan area, in terms of the spatial distribution of jobs and workers, will depend on the relative strength of agglomeration economies versus the cost of commuting into congested areas. Additionally, the relative value of land for production versus con-

land prices, land use, and commuting times for the area around the central business district of Columbus, OH. The features illustrated here are more or less common around business districts in cities and reflect the tension and tradeoffs that determine the structure of an entire city.

Indeed, as would be expected, employment density and residential density both decline as one moves away from business districts, although employment remains much more concentrated than residential population. This prevalence of dense business districts suggests that the strength of the agglomeration effects outweighs the cost of commuting and congestion. Otherwise, we would expect to see much more equally distributed employment across space. In addition, land prices decline away from dense business districts, while commercial use gives way to more residential use farther away from the business district. Finally, commuting times increase for residents away from business districts, consistent with the tradeoff faced by workers.

FIGURE 1


Tradeoffs in Location Decisions: Columbus, OH



Source: U.S. Census Bureau; Franklin County, OH, Auditor's Office. Data are for 2000.

CONCLUSION

Understanding all of these questions is important in the implementation of public policy in cities. Let's now return to the policy of congestion pricing implemented in London that was discussed earlier. At one level, congestion pricing seems to be a win-win proposition for policymakers. Consider that congestion is a negative externality, in the sense that one person's commuting decision places a cost on others. Then the idea behind congestion pricing is that by taxing congestion, people will make better commuting decisions, and this will improve efficiency. Given that congestion also has environmental consequences, and the fact that this policy is a potential source of revenue, it seems like a no-brainer.

However, once we consider business location decisions, the efficacy of this policy comes into question. The policy, by design, will make it more costly for people to travel into dense business districts, and workers will therefore require higher wages to do so. Paying these higher wages might not be worth it for businesses, and therefore, some businesses will leave the business district, reducing employment density. Given the strong evidence for agglomeration economies, or some proximity-related economies of scale, there will be some loss in production. Understood in this way, the efficiency of congestion pricing becomes ambiguous. This suggests that a better policy may be to reduce the costs associated with congestion rather than charge fees to discourage commuting into dense areas. 

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Brewing Bubbles: How Mortgage Practices Intensify Housing Booms

BY LEONARD NAKAMURA

The infamous housing bubble was composed of two parts: an unprecedented, decade-long surge in U.S. home prices that began in the mid-1990s, followed by an equally unprecedented fall in prices from 2007 to 2011. The bubble was a major factor in the financial crisis associated with the Great Recession. Similar housing booms and busts in the past have repeatedly led to severe financial crises in many parts of the world. Why these booms occur is not yet fully understood, but we have recently made some progress in our understanding. In particular, it appears that changes in mortgage lending practices can contribute to the strength of booms once they get started.

A feedback loop can occur when strong demand for homes creates rising home prices and those rising prices increase demand, rather than reducing it as we would normally expect higher prices to do. This paradox occurs because home price inflation tends to make it easier for more people of varying means to get mortgages, which by boosting demand in turn further increases home prices. The reverse also holds true — falling home prices generally make mortgages harder to obtain, further decreasing demand and worsening the downturn. These phenomena are called procyclical because they tend to intensify both the booms and the busts.

Studying these phenomena — and seeing whether we can moderate them — may help us learn how to promote

not only housing market stability but also general financial stability. While these procyclical movements are the normal workings of free financial markets, they may need to be constrained if we are to limit these cycles in the future.

ROLE OF PRICE EXPECTATIONS

Asset price movements are generally hard to predict, meaning that one year's price movements usually don't tell us anything useful about what will happen the next year. But home prices are an exception. If home prices go up more than normal this year, they are likely to do the same the following year.¹ Suppose we ask the question: In any given quarter, how much have real stock prices gone up in the past year?² In Figure 1, we can see the four-

quarter changes in stock prices quarter by quarter as reflected in the Standard & Poor's 500 stock index and in home prices measured by the Federal Housing Finance Agency house price index, both deflated by the personal consumption expenditure deflator. For example, we can see that stock prices rose 14 percent from the end of the second quarter of 2012 to the end of the second quarter of 2013. It is obvious that U.S. home price changes are much smoother than movements in U.S. stock prices, which are quite volatile. We also see that home price movements tend to be persistently positive for a few years, while the same is rarely true for stock price movements.

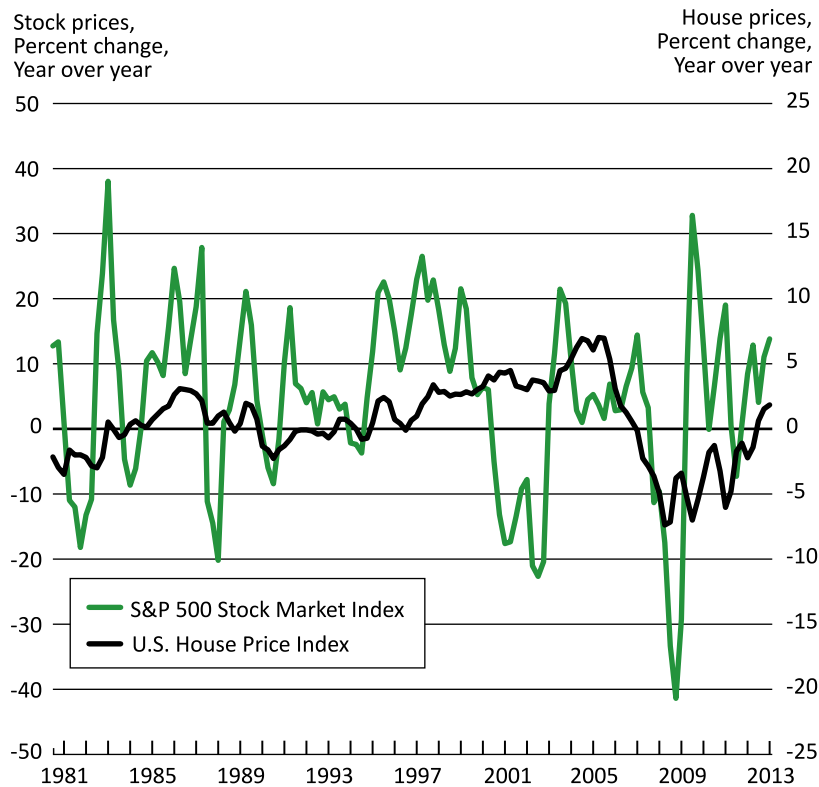
We can formalize this observation by asking what is the correlation between one year's real home price movement and the next year's. Over the past 30 years, if we take the rate of four-quarter change in the real U.S. home price for each quarter, we find that the following year's real home price percent change has a correlation of 69 percent. That is, a higher than average home price growth rate this year means that it is likely that next year there will also be a high growth rate.³ The same holds true, although with a somewhat lower correlation

¹ For a discussion of why asset price movements are generally hard to predict, see Burton Malkiel's 2007 book. For a prescient discussion of bubbles, see Robert Shiller's 2005 book.

² By *real* stock prices, we mean prices adjusted for inflation, that is, adjusted for changes in what the stock values can purchase. Throughout this article we will use the U.S. personal consumption expenditure deflator to adjust for inflation.



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FIGURE 1**U.S. House Prices Less Volatile Than Stock Prices**

Sources: Standard & Poor's, Federal Housing Finance Agency.
 Note: Quarterly data reflect inflation-adjusted four-quarter change.

of 51 percent, at the state level. By contrast, the correlation for real stock prices from one year to the next is close to zero: -4 percent. Why home prices display this correlation is an important open research question.

This greater predictability of home price movements, as we shall see, tends to feed on itself because of its connection to mortgages. We shall see that a number of practices associated with mortgage lending are procyclical —

³ For this calculation, we use data from the first quarter of 1980 to the second quarter of 2013. We take the growth rate of annual real house prices quarter by quarter and correlate it with the annual rate of real house prices four quarters later.

that is, they tend to reinforce housing booms and worsen the busts that follow.

Rising prices should discourage purchases because the purchase becomes more expensive. But paradoxically, rising home prices can also partially facilitate increased demand due to these procyclical aspects.

PROCYCLICALITY: MAKING BOOMS BIGGER

To illustrate this pattern, suppose home prices go up one year. Housing then becomes less affordable. That should dampen demand. But as we have seen, if home prices went up this year, they are likely to go up again next year. Potential homebuyers therefore may buy this year, fearing that prices

will be even higher next year. Put another way, the homebuyer hopes to gain from the expected post-purchase rise in price. That boost to demand in turn fuels a demand for credit — the homebuyer needs a mortgage, particularly if the home price is already high.⁴

But the fact that house prices are likely to go up next year also makes the mortgage lender more willing to supply credit. Even when the homebuyer will need to stretch to make the mortgage payments, the mortgage lender may be less concerned about the ability of the homebuyer to keep making the payments, because the collateral for the loan — the home itself — is likely to become more valuable and thus help prevent the lender from taking a loss. In a rising market, a homeowner unable to make the payments can sell the house and clear more than enough money to pay off the mortgage.

Thus, lending standards may become weaker, and those weaker standards may increase the number of potential homebuyers. Rising house prices thus help create even more demand, which may increase the tendency of the housing market to create bubbles. We will discuss below some recent empirical work that suggests that this force was at work in the years leading up to the bust, but first we will turn to another factor in mortgage making that can have a procyclical impact: The rapid pace of transactions during booms leads to more accurate and reliable home appraisals.

RISING PRICES, FAVORABLE APPRAISALS

Whenever money is loaned on collateral, the lender has two potential sources from which to obtain a return on the loan: repayment with inter-

⁴ See Ronel Elul's 2006 *Business Review* article.

est from the borrower or the proceeds from the sale of the collateral if the borrower defaults. For a collateralized loan, a key question is what the collateral will sell for. If the collateral is gold jewelry at a pawn shop, the gold content of the jewelry and the current market price of gold might determine the value of the collateral. For an auto loan, the sale price or the book value of a used car might determine the value of the collateral. While for some goods the resale value may be relatively transparent, determining the value of a particular home typically requires some due diligence. A home's location and individual characteristics such as its size and condition are key determinants of its value, and thus recent sale prices for comparable homes nearby are important evidence in determining the resale value of a particular home. For a home, the value of the collateral is thus determined by the sale price of the home and by sales of similar homes nearby. In the U.S., mortgage lenders use home appraisals to determine the value of the collateral.

A home appraisal is an estimate, made by a home appraiser, of the resale value of a home for which a potential homebuyer is seeking a mortgage. The appraiser bases the estimate partly on the prices of similar homes that have been recently sold in the same area. Using recent nearby sales helps protect the lender against lending too much to a homebuyer who has overpaid for a home, which could make it harder for the lender to recoup its loss in case of default.

When many nearby homes are being sold, as occurs during a housing boom, then the appraisal will be more accurate and the resale value more certain, as it is easier for the appraiser to find recently sold homes that closely resemble the home being appraised. This abundance of recent sales will make it less likely that the appraisal will be enough out of line with the

contract price to scuttle the deal, and more likely that the mortgage lender will approve the loan. On the other hand, when the boom comes to an end, typically the number of sales slows down. As demand slips, the dearth of buyers may force sellers to lower their prices. But if cutting the price would mean losing money on their homes,

homebuyers and to ensure that mortgages were highly likely to be repaid. Indeed, delinquencies and foreclosures on such mortgages were rare. For example, according to the Mortgage Bankers Association survey, during the housing boom years of 1998 to 2006, prime fixed-rate mortgages had a severe distress rate — defined as the

When sales become less frequent, appraisals become less accurate, making it more likely that the mortgage lender will deny the loan.

would-be sellers may instead pull their homes off the market or decide not to list them. When sales become less frequent, appraisals become less accurate, making it more likely that the mortgage lender will deny the loan. And if the sale falls through, then the next attempted sale in the neighborhood becomes more difficult, as it will have been even longer since a nearby house has been sold. Thus, appraisal accuracy facilitates a boom but worsens a slowdown.⁵

CHANGING CREDIT STANDARDS

The typical mortgage loan was, for many years, the prime loan, with a fixed rate of interest and a fixed monthly payment. The borrower typically was an owner-occupier who made a 20 percent down payment and had an excellent credit score, demonstrating a history of paying debts on time. The basic requirements of this prime mortgage loan were established during the Great Depression as part of the New Deal to restore access to credit to

share of mortgages that are more than 90 days delinquent or in foreclosure — of 0.6 percent, versus 3.7 percent during the bust years of 2008 to 2012.

As we now know only too well, mortgage standards became far more relaxed during the housing boom from 1995 to 2006. Subprime mortgage loans were made to borrowers who lacked strong credit scores, fueling sales in less well-off communities, and alternative mortgage products were offered to better-off borrowers who were stretching to buy into the more expensive communities. And the result was that far too many mortgages have been foreclosed on over the past few years.

But why did lenders make these riskier loans? In large part, of course, it was because they could charge these borrowers higher rates of interest and so could make more money on them. One narrative has it that mortgage lenders didn't care about credit quality because they were able to securitize mortgages — bundling loans of varying credit quality into single securities and selling them to unwitting investors.⁶ Another narrative is that securitization allowed institutions to earn money off instruments whose risk of default

⁵ See my 1993 article with William Lang for the underlying economic theory and the 2007 article by McKinley Blackburn and Todd Vermilyea for empirical evidence. Home appraisals are discussed more fully in my *Business Review* article from 2010.

⁶ See, for example, the 2009 article by Benjamin Keys and others.

was deemed likely only in rare circumstances. That is, the mortgage-backed securities would do badly only if the entire U.S. mortgage market failed, and otherwise would earn high profits.⁷ But these securitization narratives fail to explain why banks took large losses on their own mortgage portfolios, and indeed, why bank mortgage portfolios swelled so much during the run-up. In 1995, U.S. banks and thrifts held \$755 billion in residential real estate loans (in 2009 dollars), and in 2006 they held \$1.72 trillion worth, or more than double in real terms. And between 2007 and 2012, some \$181 billion of those loans were charged off, a loss rate of roughly 10 percent.

Rather, banks and thrifts held these mortgages because they saw that during this period losses were low because house prices were continuing to rise. That is, these types of loans had been profitable in the recent past, and lenders thought these loans were likely to continue to be profitable as long as prices kept rising, or at least didn't fall.

Creditworthiness. Our central thesis is that favorable home price expectations, generated by previous increases in home prices, may cause lenders to be less cautious about the creditworthiness of borrowers. The reason is simple: As the collateral becomes stronger, reliance on the borrower may weaken. And as lending standards weaken, the number of potential homeowners will likely expand as those whose credit standing had previously been too weak to qualify them for loans enter the market. As the number of potential owners increases, house prices may be bid even higher, extending the price boom and fulfilling the expectation of rising prices.

We expect then to see a correla-

⁷ See the 2009 article by Joshua Coval and others.

tion between rising house prices and falling credit standards. But which is the cause and which is the effect? Are rising house prices mainly feeding the drop in lending standards? Or is the drop in lending standards feeding the rise in home prices?

In my 2012 article with Jan Brueckner and Paul Calem, we argue that the rise in house prices has an important causal role in this process. The way we identify the direction of causation is to use the prior year's home inflation rate as a proxy for current expectations for the next year's home inflation rate. Specifically, our regressions look at whether the rate of home inflation four quarters ago predicted a decline in credit scores in the current period.⁸ Because the inflation occurred four quarters ago, it seems unlikely to have been caused by the current decline in credit standards.

We examine quarterly house price

Are rising house prices mainly feeding the drop in lending standards? Or is the drop in lending standards feeding the rise in home prices?

inflation data at the state level from 2001 to 2008. We then take state-by-state credit scores for those people who obtained new mortgages, dividing these new mortgagors into first-time homebuyers, repeat homebuyers (those who had a previous mortgage), investors (those with more than two mortgages), and refinancers. We measure credit scores using data from the Federal Reserve Bank of New York/Equifax Consumer Credit Panel database, and we use the state mean, the 25th percentile, and the 10th percentile

⁸ Credit scores are numerical measures of creditworthiness based on the borrower's history of timely repayment of debts. Lenders typically use credit scores as one element in their decisions to offer credit to a borrower.

of credit scores so that we examine a broad profile of credit scores.⁹ It is useful to examine the weaker credit scores as well as the mean to see whether the minimum credit score necessary for a mortgage is falling as well as the average credit score. For all four groups, and for all three measures, we find that past home inflation rates led to reductions in credit scores. Thus, the pool of borrowers whom lenders considered eligible for loans was widening in response to rising home prices.¹⁰

Alternative mortgage products.

As people pay higher and higher prices for homes, some borrowers may find it difficult to make their mortgage payments out of their current income. One way to make a house more affordable is to switch to an alternative "back-loaded" mortgage that has lower payments in the early years of the loan and higher payments later. U.S. borrowers with this type of mortgage pay

only the interest due for the first five or 10 years, compressing the timeframe for paying off the principal and making later payments higher.

The average 30-year fixed-rate mortgage had an interest rate of 6.1 percent from 2003 to 2006, whereas the average adjustable-rate mortgage had an interest rate of 5 percent. Thus, a \$200,000 mortgage might have had

⁹ The 25th percentile represents the highest credit score of the lowest quarter of new mortgage borrowers in the state that year; the 10th percentile represents the highest score of the lowest tenth of new mortgage borrowers.

¹⁰ Qualitatively similar results showing that house price inflation accompanies declines in credit standards can be found in 2012 articles by Giovanni Dell'Arricia and others and by William Goetzmann and others.

an interest payment of \$12,200 per year under a fixed-rate mortgage and \$10,000 under the adjustable-rate mortgage. On top of that, the mortgage borrower would pay an additional \$2,300 in the first year toward paying down principal, a process called amortization. Thus, for a standard 30-year fixed-rate mortgage, a borrower would be paying about \$14,500 per year. By contrast, with an interest-only adjustable-rate mortgage, the borrower might be able to pay \$3,000 or \$4,000 less annually, depending on the premium the borrower is charged for the interest-only feature. Borrowers who find themselves paying more for a home than they had hoped in a hot real estate market may be tempted to go for the interest-only mortgage to make the payments affordable, hoping that their earnings will rise, or that they can refinance, before the five- or 10-year grace period is up.

In my 2013 working paper with Brueckner and Calem, we show that expectations of increased home prices led to more widespread use of back-loaded mortgages, including interest-only adjustable rate mortgages (IO ARMs) and so-called option ARMs, which permitted *negative* amortization, allowing borrowers to pay even less for a few years.¹¹

When home prices turned downward, the rate of default and delinquency turned out to be very high. We show that default rates on these back-loaded mortgages were unusually high, even after accounting for factors such as unemployment rates, house price changes, and the like. This higher default rate is not surprising, in that these products catered to home purchasers who were stretching to be able to afford

their homes and thus would be most vulnerable to an economic downturn. Moreover, as we shall explore further below, some of those who took advantage of the low payment requirements of these loans were likely investors who had bought the homes only in the hopes of further price increases and who walked away from the mortgages when house prices fell.

Finally, we show that, unlike subprime mortgages, many of these back-loaded mortgages were retained on banks' balance sheets. And the default rates of these back-loaded mortgages were in most cases worse than those for securitized mortgages. Thus, for this class of mortgages, it does not appear that lenders sold off the worst mortgages. Rather, they ate their own

percent, scarcely different from 2000 or 2001, before these lower-quality mortgages had become prevalent. But by 2009, the rate had risen 7 percentage points to 9.2 percent. Moreover, notice that the distress rate of adjustable-rate prime mortgages had risen 16 percentage points, while that of fixed-rate prime mortgages had risen 4 percentage points. Severely distressed subprime mortgages overall had risen 23 percentage points.¹² Thus, it is evident that lowered credit standards, as reflected in the widespread use of adjustable-rate and subprime mortgages, were a preponderant factor in the extremely high distress rates of mortgages. This also suggests that requiring lenders to keep some of the mortgages they originate on their own books

It is evident that lowered credit standards were a preponderant factor in the extremely high distress rates of mortgages.

cooking. This behavior strongly suggests that lenders believed that these mortgages would be reasonably profitable, although this turned out not to be the case.

We can see in Table 1 that from 2003 to 2006, mortgages of lower credit quality — subprime and alt-A — ballooned from 10 percent of all mortgages originated to 39 percent. We can also see that from 2004 to 2006, IO ARMs and option ARMs similarly ballooned from 8 percent to 25 percent of all mortgages originated. These adjustable-rate mortgages were sometimes subprime and alt-A, and sometimes prime.

The outcomes can be seen in Table 2, which depicts severely distressed mortgages — those in foreclosure or with payments three months or more overdue. In 2006, when these mortgages were being made, the overall rate of severely distressed mortgages was 2.2

rather than sell them into the securitization market — so lenders bear more of the risk of their lending decisions — may not be sufficient to prevent risky mortgage lending in a boom. Limiting the use of alternative mortgages may also need to be considered.

Finally, these risky mortgages have now effectively disappeared from the mortgage market. They expanded demand during the boom, but now they are rarer than in 2000, well before the worst of the house price boom. This has contracted the potential demand for homes, contributing to the steepness of the decline in home prices.

Flippers. Buy low; sell high. That is the basic hope of any investor, in any market. Normally, invest-

¹¹ Similar results are found in the 2012 article by Michael LaCour-Little and Jing Yang. For a complementary point of view on back-loaded mortgages, see the 2012 working paper by Gadi Barlevy and Jonas Fisher.

¹² In this survey, respondents are asked to classify mortgages into prime and subprime; it is generally believed that alt-A mortgages are primarily classified as subprime.

TABLE 1
First Lien Mortgage Originations During Housing Boom

	Mortgages by Major Type						IO ARMs*	Option ARMs*
	Total, in billions of dollars	Subprime	Alt-A	Agency prime	Government	Jumbo		
2003	\$3,725	\$310	\$85	\$2,460	\$220	\$650	NA	NA
2004	2,590	540	190	1,210	135	515	55	145
2005	2,755	625	380	1,090	90	570	418	238
2006	2,550	600	400	990	80	480	387	255
2007	2,081	191	275	1,151	116	348	295	111
2008	1,384	23	42	928	293	98	76	8
2009	1,759	4	6	1,201	451	97	8	0
2010	1,581	4	4	1,092	377	104	9	0
2011	1,420	4	4	948	294	170	0	0
2012	1,861	4	4	1,270	380	203	0	0
	Percent of total							
2003	100%	8%	2%	66%	6%	17%	NA	NA
2004	100	21	7	47	5	20	2	6
2005	100	23	14	40	3	21	15	9
2006	100	23	16	39	3	19	15	10
2007	100	9	13	55	6	17	14	5
2008	100	2	3	67	21	7	5	1
2009	100	0	0	68	26	6	0	0
2010	100	0	0	69	24	7	1	0
2011	100	0	0	67	21	12	0	0
2012	100	0	0	68	20	11	0	0

Source: Inside Mortgage Finance, 2013.

Notes:

Subprime: For borrowers with low credit scores.

Alt-A: For those who fail to qualify for prime mortgages but have high credit scores.

Agency prime: Originated, guaranteed, and securitized by the government-sponsored enterprises Fannie Mae and Freddie Mac.

Government: Guaranteed by the Federal Housing Administration or Department of Veteran Affairs.

Jumbo: Too large to be securitized by Fannie Mae or Freddie Mac.

IO ARMs: Interest-only adjustable rate.

Option ARMs: Adjustable rates plus the option of minimum payments that do not cover even the interest owed.

*Figures for IO and option ARMs are also included within the results listed for subprime, alt-A, agency prime, and jumbo mortgages.

tors hope to identify assets that are for sale for less than they are intrinsically worth, buy them, and then sell them as other buyers come to see their intrinsic worth. For example, during the housing bust, many homes came

to be sold at very low prices, and real estate groups invested in these homes, hoping to rent them for a time and later sell them at higher prices. These professional investors help to stabilize markets, particularly in times of crisis.

These investors often do not require mortgages and instead pay cash. They can be identified in large part because they buy properties that are cheap relative to the rest of the home market. They will frequently buy from so-

TABLE 2**Percent of Mortgages That Became Severely Distressed**

	All Mortgages	All Prime	Prime Fixed Rate	Prime Adjustable Rate	All Subprime	Subprime Fixed Rate	Subprime Adjustable Rate	FHA	VA
1998	1.8	0.9	0.7	1.5	5.7	5.3	5.8	3.8	3.2
1999	1.8	0.7	0.5	1.1	7.6	7.4	7.8	3.5	2.9
2000	1.8	0.6	0.5	1.1	8.9	9.3	8.7	3.5	2.5
2001	2.3	0.8	0.7	1.4	11.9	12.7	11.0	4.4	2.9
2002	2.3	0.8	0.7	1.3	11.4	11.7	10.6	5.2	3.2
2003	2.1	0.9	0.7	1.2	8.3	8.1	8.2	5.7	3.4
2004	2.0	0.8	0.7	0.8	6.5	7.4	5.8	5.5	3.1
2005	2.0	0.8	0.8	0.8	6.3	6.2	5.9	5.9	2.8
2006	2.2	0.8	0.7	1.4	7.7	6.0	9.0	5.5	2.5
2007	3.5	1.6	1.0	4.0	14.1	8.1	20.1	5.7	2.7
2008	6.1	3.6	2.1	9.9	22.4	13.1	33.0	6.5	3.9
2009	9.2	6.7	4.7	17.3	29.2	20.9	41.2	8.9	5.1
2010	8.3	6.0	4.4	16.5	26.2	19.8	37.4	8.1	4.6
2011	7.5	5.2	4.0	13.5	23.8	18.8	33.8	8.6	4.6
2012	6.6	4.3	3.4	10.5	21.3	17.6	30.1	8.3	4.3
Average 1998-2006	2.0	0.8	0.6	1.2	8.2	8.2	8.1	4.8	2.9
Average 2008-2012*	7.5	5.1	3.7	13.5	24.6	18.0	35.1	8.1	4.5

Source: Mortgage Bankers Association, via Haver Analytics.

Note: Severely distressed mortgages are those 90 days or more past due or in foreclosure.

*Averages were calculated without factoring in 2007, largely a transition year between boom and bust.

called motivated sellers, such as homeowners who have to move because they have taken jobs beyond commuting distance from their current homes or from a bank that has foreclosed on a property.

However, because home price increases tend to be predictable, unsophisticated home investors may also come in who believe that home prices will continue to rise. If you live in a hot real estate market in a home worth, say, \$200,000, and suddenly you find that comparable homes nearby are worth \$300,000, you may think to yourself that your home has earned

more money than you did by working. Since you now have \$100,000 in unexpected home equity, you may decide to borrow against it to buy an additional house or two, planning to make some minor improvements and sell them in a year or two. If home prices are rising rapidly enough, you can make a profit even if you bought houses that were not especially intrinsically cheap. Of course, you will borrow as much as you can to limit your cash outlay, to stretch your home equity. If home prices fall, you may quickly walk away from the homes, mortgages and all.

This type of investment is particu-

larly pernicious to the housing market because the homes often remain unoccupied, since the buyer is not a professional real estate investor and has no easy way to rent them out. These types of purchases exaggerate the apparent demand for homes, and thus the market appears to have a more unequal balance between supply and demand, which also tends to prolong the boom and drive prices higher.

A 2011 working paper by Andrew Haughwout and his coauthors at the New York Fed showed that this type of investor became surprisingly prevalent in the later years of the housing

boom. They estimate that in the states hit hardest by the bubble — Arizona, California, Florida, and Nevada — as much as 20 percent of all home purchases were made by borrowers who already had two or more mortgaged homes. Patrick Bayer and others, in a careful study of investors in Los Angeles County during the housing boom, are able to show that there were two types of investors — those who bought houses relatively cheaply and those who bought houses more or less at the market rate. The latter tended to come into the market as house price inflation increased, earned rates of return no different from others in the market, and were statistically associated with price instability in their markets.

BOOMS, BUSTS, AND CRISES

We have seen in recent years repeated financial crises associated with housing booms and busts in the United States, Europe, and Asia. Carmen Reinhart and Kenneth Rogoff (2009) present evidence that the most intractable recessions have been associated with financial crises related to housing booms and busts. They note that the five worst financial crises post-World War II and before the latest world crisis — Spain in 1977, Norway in 1987, Finland and Sweden in 1991, and Japan in 1992 — all coincided with very large housing booms and busts.

They point out that a “massive run-up in housing prices usually precedes a financial crisis” (p. 217). This perspective suggests that reducing housing booms and busts might well reduce the magnitude of ensuing financial crises and recessions.


Indeed, around the world, regulators have stepped up efforts to contain housing booms. In a July 2013 article in the *Wall Street Journal*, David Wessel and Alex Frangos examine efforts in South Korea, Israel, and Canada to use housing regulations to slow housing booms. For example, the South Korean government and central bank have required homebuyers in certain neighborhoods to come up with down payments as high as 50 percent and limited the ratio of mortgage payments to income. To discourage investors, they have imposed high taxes on sales by people who own more than one home. In Canada, government-insured mortgage loans have to be paid off in 25 years instead of 30, raising the required monthly payment. Those efforts have succeeded, at least as of this writing, in slowing home price booms. But in Israel, Wessel and Frangos report, despite higher down payment requirements, home prices continue to rise at double-digit rates.

At the same time, we should recognize that government regulation may be part of the problem as well. The U.S. government has a long history of

support for homeownership, and ironically, this support may have contributed to problems in the housing market. See Wenli Li and Fang Yang's 2010 article for a discussion of government support for homeownership.

FINANCIAL STABILITY AND PROCYCLICALITY

A key question, then, for financial stability is whether we can tone down housing booms and busts by moderating the procyclical impact of appraisals, credit standards, and alternative mortgage instruments. Our research has not yet reached the stage of showing us how to optimally moderate housing booms and busts. But we have identified some mechanisms that appear to make boom and bust cycles greater and therefore more dangerous to financial stability. They may point the way toward strategies for moderating these cycles. Indeed, as we have seen, regulators and central banks around the world are already taking steps in hopes of moderating these cycles.

Preserving financial stability may require a tradeoff between allowing the mortgage market to adapt freely to changes in demand and ensuring a stable housing market through greater regulation of mortgages and appraisals. But precisely where that balance lies is beyond our current understanding and deserves further study. 

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New Perspectives on Consumer Behavior in Credit and Payments Markets

BY MITCHELL BERLIN

A

t the Federal Reserve Bank of Philadelphia's latest conference on consumer credit and payments, researchers presented the results of the following seven studies on topics including household financial decision-making, the effects of regulation on credit card markets, and the effect on individuals of interactions between credit and labor markets.¹

STICKING TO YOUR PLAN: HYPERBOLIC DISCOUNTING AND CREDIT CARD DEBT PAYDOWN

Theresa Kuchler, of New York University's Stern School of Business, reported on an empirical study of individuals' success in carrying out plans to reduce their credit card balances. Broadly, Kuchler had two objectives. Her first objective was to find evidence for *present-biased* behavior, in which consumers make plans to reduce future borrowing but systematically deviate from their plans by acting impatiently in the future. Her second objective was to determine the extent to which individuals are sophisticated about their own behavior, in the sense that they understand that they act in a present-

biased way and make borrowing decisions that reflect this understanding.

Kuchler developed a simple model of consumer borrowing behavior that could be used to make predictions about how different types of consumers would behave. She tested her predictions using a remarkably detailed data set from an online financial management service. Individuals use this service to make plans to reduce their credit card balances, although the service doesn't impose penalties if they fail to meet those plans. Individuals provide demographic information — for example, age, income, and education — as well as information about their paycheck receipts and detailed information about their credit card use, bank account behavior, and expenditures. Moderating concerns that the people using a financial planning service are not representative of the broader population, Kuchler explained that according to observable demographic measures, the sample is reasonably similar to the general population.

¹ The seventh biennial conference on consumer credit was hosted jointly on October 3-4, 2013, by the Philadelphia Fed's Payment Cards Center and Research Department. The papers presented may be found at <http://www.philadelphiafed.org/research-and-data/events/2013/consumer-credit-and-payments/agenda.cfm>.

In the first part of the study, Kuchler sought to measure present bias. Specifically, she measured present bias by the sensitivity of an individual's discretionary expenditures — restaurant and entertainment expenditures — to the receipt of a paycheck. Intuitively, a larger expenditure on discretionary items as soon as a paycheck arrives is consistent with impatient behavior, especially when this expenditure conflicts with a prior plan to use the income to reduce credit card balances. She finds that many consumers' discretionary expenditures are very sensitive to the receipt of a paycheck, a finding consistent with present bias. (Kuchler explained that such behavior was also consistent with other explanations, a matter she addressed later.)

Kuchler argued that present-biased individuals might, nonetheless, be fully rational and aware of their behavior (thus being *sophisticated*). Alternatively, they might be *naïve*, and simply not understand that in the future they are likely to act in a way that frustrates their current plans. Her model offers predictions about how a present-biased but sophisticated individual would behave differently from one who was also present-biased but naïve. Specifically, the model predicts that very impatient but sophisticated individuals will typically pay down less of their debt than those who are also sophisticated but less impatient. Intuitively, a sophisticated, impatient individual reasons that, "I know in the future I am going to consume more than my current plan for future consumption. Therefore, I can achieve a smoother consumption path if I consume more today, which



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will, in turn, reduce future consumption.” Naïve individuals don’t reason this way because they don’t understand that they will act in a way that frustrates their plans for the future. Accordingly, the level of impatience will not affect the extent to which they pay down their debt.

Kuchler’s empirical results confirmed her strategy for identifying individual degrees of impatience and also her distinction between sophisticated and naïve individuals. She found that all individuals reduced their credit card balances less than they had planned but that sophisticated individuals were more successful. She also found that the extent to which sophisticated individuals paid down their debt was related to their level of impatience, while for naïve individuals it was not, as her theory predicted.

She concluded by considering alternative explanations for her empirical results, notably credit constraints or habits-driven behavior. She argued that other plausible models of borrowing behavior are either inconsistent with her results or else have no predictions about behavior regarding debt repayment.

FINANCIAL CONSTRAINTS AND CONSUMERS’ RESPONSE TO EXPECTED CASH FLOWS: DIRECT EVIDENCE FROM FILING TAX RETURNS

Brian Baugh from the Ohio State University presented the results of a study conducted with Itzhak Ben-David and Hoonsuk Park on household consumption behavior in response to filing tax returns and receiving tax refunds. Using a proprietary data set from a financial institution that included data on individuals’ credit card usage, as well as information about tax filings, the authors examined the role of credit constraints on consumption behavior. Broadly, the authors found strong evidence of credit constrained behavior,

as households that received refunds increased their consumption only modestly at the filing date but increased consumption by a significantly larger amount when the refund was actually received. Furthermore, household consumption was not affected by the size of the prior year’s refund, even though previous refunds were good predictors of current refunds.

All individuals reduced their credit card balances less than they had planned, but sophisticated individuals were more successful.

The authors had anonymized data from a financial institution on the credit and debit card use of 500,000 individuals from July 2010 to December 2012. Ultimately, the sample size was reduced to about 15,000 individuals primarily because the authors required information on the date on which tax returns were filed. Baugh argued that the actual filing provided a good estimate of the household’s expected refund. The authors assumed that the filing date was reasonably well measured by the date on which the individual paid a fee to a tax preparation service such as TurboTax or H&R Block.

The authors’ main findings were that households increased consumption only moderately at the time of filing, but they increased consumption significantly more when the refund was actually received. Specifically, they found that households that received refunds increased consumption by approximately 3 percent at the time of filing, while they increased their consumption by two to four times that amount when the refund was received, depending on the precise empirical specification. Focusing on low-income households alone, the percentage increase in consumption at the filing date was smaller

and the percentage increase when the refund was received was larger. The authors found similar effects for the probability of shopping following these dates. They found no significant effect on consumption by households that did not receive a refund.

Restricting their sample to those for whom they had two successive tax filings, the authors then examined

whether households used the information on past tax refunds to form expectations about future tax refunds. The authors argue that the prior year’s refund is a good (albeit imperfect) predictor of the current year’s refund. Accordingly, they divided the population into households with positive surprises — that is, their refund was larger than the preceding year’s refund — and negative surprises. They found that both those with positive and negative surprises increased consumption when they received the refund. The authors concluded that people’s consumption was unaffected by the prior year’s refund, even though it is a very good predictor. Baugh suggested that this finding raised some doubts about economic models in which households form rational expectations about future consumption.

ARE YOUNG BORROWERS BAD BORROWERS? EVIDENCE FROM THE CREDIT CARD ACT OF 2009

Andra Ghent of Arizona State University presented the results of her study conducted along with Peter Debaut and Marianna Kudlyak on the relative default behavior of young borrowers. One of the goals of the CARD

Act of 2009 was to limit the marketing of credit cards to individuals younger than 21 years old, premised on the view that young borrowers were more likely to get into financial difficulties. While the authors found that the act was largely successful in restricting credit card access for young individuals, they also found evidence that young borrowers were significantly less likely to default than older individuals. Ghent argued that their results called into question the fundamental premise of those sections of the act restricting credit card access — that is, that young borrowers were poorly equipped to manage their credit card borrowings compared with older borrowers.

First, the authors use the Federal Reserve Bank of New York's Consumer Credit Panel/Equifax to evaluate whether the CARD Act had the desired effect.² They found that after implementation of this law, individuals under 21 (i) were 8 percentage points less likely to have a card, (ii) had fewer cards, conditional upon having a card at all, and (iii) were 3 percentage points more likely to have a cosigned card. The authors concluded that the act had successfully restricted access to credit cards by the young.

Then the authors examined whether young borrowers actually were delinquent more often than older borrowers. While young borrowers were more likely to suffer minor delinquencies (less than 90 days), the authors found that young people were actually significantly less likely than older borrowers to be more than 90 days delinquent. Instead, serious delinquencies followed an inverse U-shaped pattern over a borrower's lifetime, increasing until age 40-44, at which point a borrower was 12 percentage points more likely to be seriously delinquent than a 19-year-old.

² All data from this data set are anonymized. The researchers have no access to personally identifiable information about individuals.

Ghent noted that lower delinquency rates for young borrowers suggested that the young were not less creditworthy. But to evaluate the effect of the restrictions in the act, we must take into account that prior to the imposition of the new law, young borrowers *chose* whether to acquire credit — that is, there was a selection effect. In principle, this selection effect might go either of two ways. While the borrowers below the age of 21 who acquired credit cards prior to the act might have been less capable of managing their finances than more experienced borrowers, they might also have been more prudent or forward-looking than the typical borrower. The authors use the passage of the act as a laboratory to identify the selection effect.

Specifically, the authors identified two groups of borrowers. Those in Group 1 got their first credit card at age 21 after the act was passed. Those in Group 2 got their first card at age 21 before the act was passed; that is, they

While young borrowers were more likely to suffer minor delinquencies (less than 90 days), the authors found that young people were actually significantly less likely than older borrowers to be more than 90 days delinquent.

could have legally acquired a card before age 21 but had not. The differences in behavior of these two groups help identify the selection effect. While not all members of Group 1 would necessarily have qualified to receive a card, presumably some would have qualified and would have chosen to acquire a card had they been permitted to do so.

The authors found that individuals from Group 2 were significantly more likely to experience serious delinquencies than those in Group 1, both in the years immediately after they ac-

quired their cards and also later in life. In addition, Group 1 members were more likely to have a mortgage at age 22 or 23 than were members of Group 2. The authors interpreted these findings as evidence that individuals who entered the credit market early before the passage of the act were likely to have been relatively good credit risks and that these borrowers were trying to establish a good credit history, perhaps to qualify for homeownership. Thus, the authors found no evidence that by limiting access to young borrowers, the act was protecting borrowers who were less prudent or less capable of managing debt than others.

FINANCIAL EDUCATION AND THE DEBT BEHAVIOR OF THE YOUNG

Meta Brown of the Federal Reserve Bank of New York presented the results of her study with Wilbert van der Klaauw, Jaya Wen, and Basit Zafar on the effects of education and the

borrowing behavior of young individuals. Specifically, the authors examined the effects of taking courses in mathematics, financial literacy, and economics on credit market outcomes. Their study exploited the fact that states vary widely in their high school course requirements in these three areas and that a large number of states had introduced new requirements during the sample period, 1998-2012. Brown argued that the authors found that required courses in these three areas had statistically and economi-

cally significant effects on the borrowing behavior of individuals in their twenties. Mathematics and financial education courses appeared to promote more savvy borrowing behavior, although Brown cautioned against drawing welfare conclusions from the empirical results.

The authors created a data set that compiled state-by-state changes in required courses in high school from 1998 through 2012. The data set included whether a state had increased required math courses by one year, whether a state had imposed a new requirement that students take at least one financial literacy course, and whether the state had imposed a new requirement that students take at least one economics course. Using the FRBNY Consumer Credit Panel/Equifax data, the authors followed the borrowing behavior of individuals born in or after 1984 — who were thus likely to have attended high school during the sample period.³ They collected a number of measures of credit market behavior for these individuals at age 22 to 28, including whether they had credit reports, their Equifax risk scores, various measures of delinquency, whether they had entered bankruptcy, and their debt balances, including mortgages, credit card balances, auto loans, and student loans. The authors also collected data on unemployment rates and income in each individual's Zip code to control for economic conditions. In addition, the authors included various measures of educational quality for each state, such as per capita educational expenditures.

The authors found that educational requirements had significant effects on borrowing behavior. Brown argued that focusing on behavior subsequent

to the introduction of a new educational requirement strengthened the view that differences in behavior were causally related to the educational requirement. Qualitatively, the effects of more required math courses and a required financial literacy course had similar effects along most dimensions, with the notable difference that only the financial literacy requirement increased the likelihood that an individual would have a credit report. Brown suggested that having a credit report might be an indicator of an individual's understanding the value of building a credit history. Both math and financial literacy requirements were associated with higher credit scores, lower balances, and, for the most part, fewer adverse credit outcomes. One notable difference is that math requirements were associated with a higher probability of bankruptcy. Brown suggested that this might be an indicator of greater financial savvy, rather than a measure of imprudent behavior, as some prior studies have found that households tend to forgo the option to enter bankruptcy even when it would appear to be economically rational.

These effects were economically significant as well. For example, an additional year of math was associated with a decline in auto loan and credit card balances of \$890. Similarly, the introduction of the financial literacy requirement was associated with a decline in auto loan and credit card balances of \$580.

Brown explained that the effects of the economics course requirement were quite different. The economics requirement was not associated with a higher probability of having a credit score, but it was associated with higher average debt balances, as well as a greater prevalence of repayment problems. Brown suggested that an economics course might demystify debt usage without promoting greater financial savvy.

HOUSE PRICES, COLLATERAL, AND SELF-EMPLOYMENT

Manuel Adelino of Duke University discussed the results of his study with Antionette Schoar and Felipe Severino on the effects of higher house prices during 2002-07 on the growth of very small businesses. Adelino explained that there are numerous channels through which higher house prices might affect small-business growth. The authors sought evidence for the collateral effect, in which higher house prices ease credit constraints by permitting small-business owners to post their houses as collateral for bank loans. Adelino argued that the authors had indeed found compelling evidence for this collateral channel, despite formidable empirical challenges.

The main challenge was to disentangle the collateral channel from demand-driven effects, in which stronger demand promotes both small-business growth and higher house prices. The authors' primary identifying assumption was that while higher demand should affect both larger and smaller firms, the collateral channel should operate only for small firms. Since borrowing needs for larger firms are likely to be much larger than the value of a house, higher house prices were unlikely to have an appreciable effect on larger firms' ability to borrow. Using county-level data from the Census Bureau that identifies the number of employees at each establishment, the authors found that higher house prices were significantly associated with higher employment growth at the smallest enterprises (one to four employees) and that this positive effect declined monotonically with firm size, consistent with growth at the small enterprises being driven by the collateral channel.

The authors proceeded to use detailed data about firm characteristics from a number of other sources, both to lend greater plausibility to their claim for the collateral channel

³ All data from this data set are anonymized. The researchers have no access to personally identifiable information about individuals.

and, particularly, to rule out demand-driven effects. Adelino argued that even for very small firms, house values were unlikely to be an important determinant of the ability to borrow if the firms' capital needs were large. The authors used the Census Bureau's Survey of Business Owners Public Use Microdata Sample, which surveys small firms about capital outlays at their startup, among other firm characteristics. Consistent with the authors' hypothesis, the positive effect of higher house prices was much stronger for those firms with lower capital needs. They examined whether their results were driven by firms in the nontradable goods sector — arguably those firms most likely to be affected by local demand — or by firms engaged in construction — those firms most likely to be directly affected by a local housing boom. They found that the positive relationship between house prices and employment growth was not driven by these types of firms. The authors also found that their results held for firms in industries that ship their goods long distances, again addressing the concern that employment growth might be affected by local demand.

Finally, the authors performed a back-of-the-envelope calculation to estimate the economic importance of the collateral channel. Adelino estimated that the collateral channel can account for 15 percent to 25 percent of the increase in employment growth due to higher house prices during the sample period, compared with approximately 40 percent that can be assigned to the effect of higher home prices on household demand.

UNEMPLOYMENT INSURANCE AND CONSUMER CREDIT

Brian Meltzer of Northwestern University reported on the results of a study with Joanne Hsu and David Matsa that measured the effects of unemployment insurance (UI) on

both household delinquency and the supply of credit. Meltzer argued that while other studies have examined the various effects of unemployment insurance — for example, the effect on labor search or on households' ability to smooth consumption — the authors' study was the first to examine whether more generous unemployment insurance might affect credit market outcomes. Broadly, the authors found

The authors found that unemployment was less likely to lead to mortgage delinquency and foreclosure in those states where unemployment insurance was more generous.

evidence that more generous unemployment insurance was associated with statistically and economically significant reductions in household delinquency and increases in access to credit. The authors' approach was to exploit the variation across states and over time in the generosity of unemployment benefits as a means to identify the causal effects of UI on credit markets. They used a number of different data sets, covering the sample period 1992-2011.

The main results were striking. In particular, the authors found that unemployment was less likely to lead to mortgage delinquency and foreclosure in those states where unemployment insurance was more generous. The economic effects were large. For example, a \$1,000 increase in a state's maximum unemployment benefit was associated with a 5 percent decline in delinquency (compared with the sample mean) for unemployed households in that state. Furthermore a \$1,000 increase was associated with a 12 percent decline (compared with the sample mean) in foreclosures for unemployed households. The authors found similar effects when they examined the

cross-state differences in household delinquency and foreclosure associated with differences in extended unemployment benefits put in place during the Great Recession.

Meltzer and his coauthors hypothesized that suppliers of credit would be more prone to offer credit on attractive terms in those states where household income was stabilized through higher unemployment insurance. Consis-

tent with their hypothesis, the authors found evidence of lower mortgage spreads in those states with higher maximum unemployment insurance benefits. In addition, the authors examined cross-state variation in home equity line of credit (HELOC) offers using data from Mintel Comperemedia, a data provider that tracks credit card offers reported by their sample of households. The Mintel data set contains demographic information about participating households, which permitted the authors to identify supply effects with more precision. During the sample period 2000-11, the authors found that unemployed homeowners in those states with more generous unemployment benefits were more likely to receive a HELOC offer. In addition, they found that all households in such states were more likely to receive credit card offers and that the offers were on more generous terms, while the effects were strongest for low-income households. Specifically, they found that for every \$1,000 of additional maximum UI benefits, low-income households were offered \$900 in additional credit and that interest rates were 50 basis points lower.

BANK PROFITABILITY AND DEBIT CARD INTERCHANGE REGULATION: BANK RESPONSES TO THE DURBIN AMENDMENT

Mark Manuszak of the Federal Reserve Board presented his joint research with Benjamin Kay and Cindy Vojtech into the effects of the Durbin Amendment of the Dodd-Frank Act on bank profitability. Among other provisions, the Durbin Amendment, codified in Regulation II, included ceilings on interchange fees for debit card transactions for all banks with assets exceeding \$10 billion. Manuszak cited industry participants who predicted that banks would respond to the price ceiling by raising deposit account fees or by cutting costs in other parts of their operations. Broadly, the authors found evidence that banks did raise deposit account fees, although not enough to offset the decline in fees due to price ceilings, but they found no evidence of changes in operations to reduce costs.

The authors' identification strategy was to exploit the exemption from the interchange fee ceiling for banking organizations with assets of less than \$10 billion, plausibly an exogenous source of variation. Manuszak argued that balance sheet differences between banks above and below the \$10 billion cutoff after the imposition of Regulation II can be ascribed to the imposi-

tion of price ceilings.


Using data collected quarterly by banking regulators to examine progressively broader revenue categories, the authors found that interchange fee income — the narrowest category, which includes both credit card and debit card interchange income — declined approximately 36 percent in response to the price ceiling.⁴ Thus, banks did not successfully make up for their loss of interchange income on debit cards by increasing interchange income on credit cards (which were not subjected to price ceilings under the new regulation). A broader category, other noninterest income, fell by nearly 20 percent, suggesting that other sources of noninterest income did not rise enough to offset the fee ceiling.

The broadest category they considered, total noninterest income, was not affected significantly by the ceiling. Manuszak explained that one of the components of total noninterest income, deposit fees, increased by 4 percent to 8 percent. This offset 13 percent to 25 percent of the lost interchange income. The authors viewed this increase as evidence of market power, with banks raising the price of a bundled product in response

⁴ Specifically, the authors use data collected about bank holding companies, the so-called Y-9R.

to a price ceiling on another product in the bundle.

Using the Federal Deposit Insurance Corporation's Summary of Deposit data set, the authors found no evidence that Regulation II led to branch closings. Nor did they find any evidence from Call Report data of other adjustments in operations to cut costs in response to the lost revenue from the ceilings; instead, the authors found evidence of higher expenses, perhaps an indication of higher quality, according to the authors.

Finally, the authors examined in more detail their assumption that the \$10 billion cutoff was actually exogenous. Informally, Manuszak argued that while many provisions of the Dodd-Frank Act included revenue cutoffs — including some with the \$10 billion cutoff — these provisions were imposed at many different times. Using the actual date on which Regulation II was imposed as the event date for the present study significantly reduced the likelihood that other provisions were muddying their findings. Formally, the authors tested for the possibility that banks near the \$10 billion cutoff might have strategically limited asset growth or reduced total assets to fall below the threshold. Supporting their assumption that the \$10 billion threshold was exogenous, they found no evidence for such behavior. 



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Assessing DSGE Model Nonlinearities

The authors develop a new class of nonlinear time-series models to identify nonlinearities in the data and to evaluate nonlinear DSGE models. U.S. output growth and the federal funds rate display nonlinear conditional mean dynamics, while inflation and nominal wage growth feature conditional heteroskedasticity. They estimate a DSGE model with asymmetric wage/price adjustment costs and use predictive checks to assess its ability to account for nonlinearities. While it is able to match the nonlinear inflation and wage dynamics, thanks to the estimated downward wage/price rigidities, these do not spill over to output growth or the interest rate.

Working Paper 13-47. S. Borağan Aruoba, University of Maryland, Federal Reserve Bank of Philadelphia Visiting Scholar; Luigi Bocola, University of Pennsylvania; Frank Schorfheide, University of Pennsylvania, National Bureau of Economic Research, Federal Reserve Bank of Philadelphia Visiting Scholar.

Natural Amenities, Neighborhood Dynamics, and Persistence in the Spatial Distribution of Income

The authors present theory and evidence highlighting the role of natural amenities in neighborhood dynamics, suburbanization, and variation across cities in the persistence of the spatial distribution of income. The authors' model generates three predictions that they confirm using a novel database of consistent-boundary neighborhoods in U.S. metropolitan

areas, 1880-2010, and spatial data for natural features such as coastlines and hills. First, persistent natural amenities anchor neighborhoods to high incomes over time. Second, downtown neighborhoods in coastal cities were less susceptible to the suburbanization of income in the mid-20th century. Third, naturally heterogeneous cities exhibit spatial distributions of income that are dynamically persistent.

Working Paper 13-48. Sanghoon Lee, University of British Columbia; Jeffrey Lin, Federal Reserve Bank of Philadelphia.

Competition, Syndication, and Entry in the Venture Capital Market

There are two ways for a venture capital (VC) firm to enter a new market: initiate a new deal or form a syndicate with an incumbent. Both types of entry are extensively observed in the data. In this paper, the author examines (i) the causes of syndication between entrant and incumbent VC firms, (ii) the impact of entry on VC contract terms and survival rates of VC-backed start-up companies, and (iii) the effect of syndication between entrant and incumbent VC firms on the competition in the VC market and the outcomes of incumbent-backed ventures. By developing a theoretical model featuring endogenous matching and coalition formation in the VC market, the author shows that an incumbent VC firm may strategically form syndicates with entrants to maintain its bargaining power. Furthermore, an incumbent VC firm is less likely to syndicate with entrants as the incumbent's expertise increases. The author finds that entry increases the likeli-

hood of survival for incumbent-backed start-up companies while syndication between entrants and incumbents dampens the competitive effect of entry. Using a data set of VC-backed investments in the U.S. between the years 1990 and 2006, the author finds empirical evidence that is consistent with the theoretical predictions. The estimation results remain robust after she controls for the endogeneity of entry and syndication.

Working Paper 13-49. Suting Hong, Federal Reserve Bank of Philadelphia.

A Tale of Two Commitments: Equilibrium Default and Temptation

The author constructs the life-cycle model with equilibrium default and preferences featuring temptation and self-control. The model provides quantitatively similar answers to positive questions such as the causes of the observed rise in debt and bankruptcies and macroeconomic implications of the 2005 bankruptcy reform, as the standard model without temptation. However, the temptation model provides contrasting welfare implications, because of overborrowing when the borrowing constraint is relaxed. Specifically, the 2005 bankruptcy reform has an overall negative welfare effect, according to the temptation model, while the effect is positive in the no-temptation model. As for the optimal default punishment, welfare of the agents without temptation is maximized when defaulting results in severe punishment, which provides a strong commitment to repaying and thus a lower default premium. On the other hand, welfare of agents with temptation is maximized when weak punishment leads to a tight borrowing constraint, which provides a commitment against overborrowing.

Working Paper 14-1. Makoto Nakajima, Federal Reserve Bank of Philadelphia.

The Perils of Nominal Targets

A monetary authority can be committed to pursuing an inflation, price-level, or nominal output target yet systematically fail to achieve the specified goal. Constrained by the zero lower bound on the policy rate, the monetary authority is unable to implement its objectives when private-sector expectations stray from the target in the first place. Low-inflation expectations become self-fulfilling, resulting in an additional Markov equilibrium in which both nominal and real variables are typically below target. Introducing a stabilization goal for long-term nominal rates anchors private-sector expectations on a unique Markov equilibrium without fully compromising the policy responses to shocks.

Working Paper 14-2/R. Roc Armenter, Federal Reserve Bank of Philadelphia.

Recall and Unemployment

Using data from the Survey of Income and Program Participation (SIPP) covering 1990-2011, the authors document that a surprisingly large number of workers return to their previous employer after a jobless spell and experience more favorable labor market outcomes than job switchers. Over 40% of all workers separating into unemployment regain employment at their previous employer; over a fifth of them are permanently separated workers who did not have any expectation of recall, unlike those on temporary layoff. Recalls are associated with much shorter unemployment duration and better wage changes. Negative duration dependence of unemployment nearly disappears once recalls are excluded. The authors also find that the probability of finding a new job is more procyclical and volatile than the probability of a recall. Incorporating this fact into an empirical matching function significantly alters its estimated elasticity and the time-series behavior of matching efficiency, especially during the Great Recession. The authors develop a canonical search-and-matching model with a recall option where new matches are mediated by a matching function, while recalls are free and triggered by both aggregate and job-specific shocks. The recall option is lost when the unemployed worker accepts a new job. A quantitative version of the model captures well the authors' cross-sectional and cyclical facts through selection of recalled matches.

Working Paper 14-3. Shigeru Fujita, Federal Reserve Bank of Philadelphia; Giuseppe Moscarini, Yale University, National Bureau of Economic Research.

Shrinkage Estimation of High-Dimensional Factor Models with Structural Instabilities

In high-dimensional factor models, both the factor loadings and the number of factors may change over time. This paper proposes a shrinkage estimator that detects and disentangles these instabilities. The new method simultaneously and consistently estimates the number of pre- and post-break factors, which liberates researchers from sequential testing and achieves uniform control of the family-wise model selection errors over an increasing number of variables. The shrinkage estimator only requires the calculation of principal components and the solution of a convex optimization problem, which makes its computation efficient and accurate. The finite sample performance of the new method is investigated in Monte Carlo simulations. In an empirical application, the authors study the change in factor loadings and emergence of new factors during the Great Recession.

Working Paper 14-4. Xu Cheng, University of Pennsylvania; Zhipeng Liao, University of California, Los Angeles; Frank Schorfheide, University of Pennsylvania, National Bureau of Economic Research, Federal Reserve Bank of Philadelphia Visiting Scholar.



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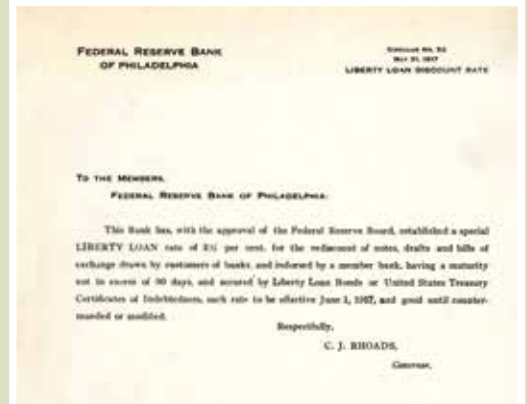
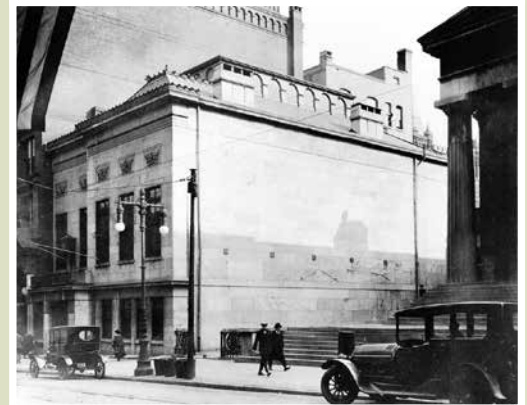
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On December 23, 1913, President Woodrow Wilson signed the Federal Reserve Act, establishing the Federal Reserve System as the U.S. central bank. Its mission is to conduct the nation's monetary policy; supervise and regulate banks; maintain the stability of the financial system; and provide financial services to depository institutions, the U.S. government, and foreign official institutions. The Federal Reserve Board opened for business on August 10, 1914, and on November 16, 1914, the 12 regional Reserve Banks were open for business.

Congress designed the Fed with a decentralized structure. The Federal Reserve Bank of Philadelphia — serving eastern Pennsylvania, southern New Jersey, and Delaware — is one of 12 regional Reserve Banks that, together with the seven-member Board of Governors in Washington, D.C., make up the Federal Reserve System. The Board, appointed by the President of the United States and confirmed by the Senate, represents the public sector, while the Reserve Banks and the local citizens on their boards of directors represent the private sector.

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