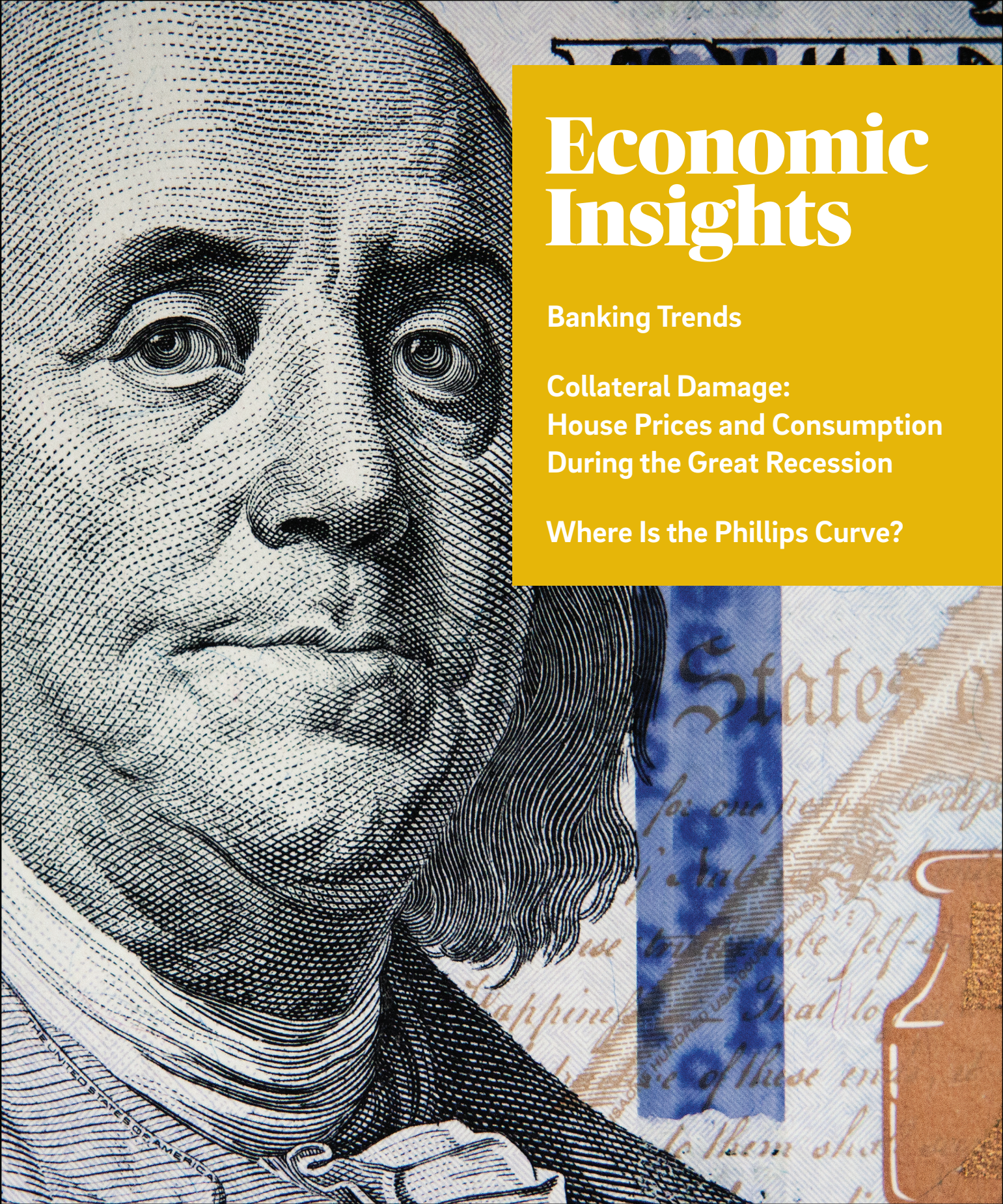




Economic Insights

Banking Trends

Collateral Damage:
House Prices and Consumption
During the Great Recession

Where Is the Phillips Curve?

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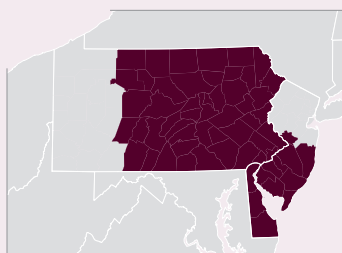
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Banking Trends: How Foreign Banks Changed After Dodd-Frank

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In 2007–2008, house prices and household consumption both cratered simultaneously. A coincidence? Likely not. **Ronel Elul** explores the connection between house prices and economic cycles.

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About the Cover

Philadelphia's most famous citizen, Benjamin Franklin, has graced the \$100 bill since the newly created Federal Reserve began issuing "Federal Reserve Notes" in 1914. This particular image is taken from H.B. Hall's engraving of Joseph-Siffred Duplessis's 1785 portrait of Franklin, which is currently on view at the National Portrait Gallery in Washington, D.C. In the background are details from the 2009 redesign of the \$100 bill, including a reproduction of the Declaration of Independence. Franklin served on the "Committee of Five" that drafted the Declaration and presented it to the Second Continental Congress, then meeting at the Pennsylvania State House, on July 4, 1776. The State House still stands today, just two blocks from the Federal Reserve Bank of Philadelphia, and is now known as Independence Hall.

Photo by Rich Wood.



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How Foreign Banks Changed After Dodd-Frank

The Great Recession and the Wall Street Reform and Consumer Protection Act of 2010 both affected how foreign banks operate in the U.S.

James DiSalvo is a banking structure specialist in the Research Department of the Federal Reserve Bank of Philadelphia. The views expressed in this article are not necessarily those of the Federal Reserve.

BY JAMES DISALVO

The Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010 substantially changed how foreign banking organizations (FBOs) operating in the United States are regulated. Previously, most of the regulation of an FBO fell on its primary regulator in its home country, and there were few restrictions on either the capital or organizational structure of its U.S. operations.¹

Dodd-Frank's new regulations changed that. Foreign banks above a certain size now have to organize their U.S. subsidiaries under a holding company subject to the same regulations as domestic bank holding companies (BHCs) and financial holding companies (FHCs). The new regulations also attempt to ensure that only banks that are regulated up to certain standards in their home countries can open or operate branches or agencies in the U.S. The higher regulatory costs and the differential regulation of subsidiaries and foreign branches could encourage FBOs to withdraw from U.S. markets or change the structure of their U.S. operations.

This paper examines how FBOs operate in the U.S., describes the regulatory changes due to Dodd-Frank, and provides some preliminary evidence about how FBOs have changed their operations following passage of the law. I find evidence that FBOs have shifted activities away from the U.S. market. But the changes have not been dramatic, and other factors like the European financial crisis probably played a significant role.

How Do FBOs Operate in the United States?

As of year-end 2018, 130 FBOs engaged in banking operations in the U.S., either by direct ownership of a state-chartered or federally chartered bank, or by establishing a branch or agency (Figure 1).

A directly owned chartered bank can be either acquired or formed de novo (i.e., as a startup operation), and it can engage in the same activities as other domestic banks. This directly owned chartered bank is run and regulated pretty much like

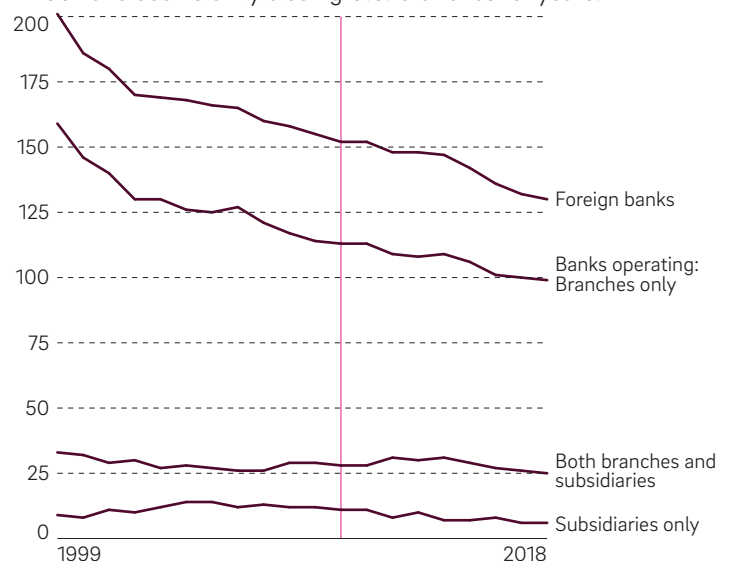
any other domestic bank, although a foreign-owned U.S. bank with domestic assets exceeding \$50 billion must be organized as a BHC and is therefore subject to regulation by the Federal Reserve. As of year-end 2018 there were 37 domestic banks owned by FBOs.

There's an important difference between FBO-owned domestic banks and other domestic banks: Even though an FBO's U.S. bank subsidiary may be relatively small, the FBO is almost always quite large and therefore might be considered important to the stability of either the global or the domestic financial system. Regulators might thus designate these FBOs as global systemically important financial institutions (G-SIFIs) or domestic systemically important financial institutions (D-SIFIs).² Of the 37 foreign-owned

FIGURE 1

Foreign Banks Operating in the U.S.

FBOs have been slowly closing U.S. branches for years.



Source: National Information Center.

U.S. banks mentioned above, 21 are owned by G-SIFIs or are themselves D-SIFIs.

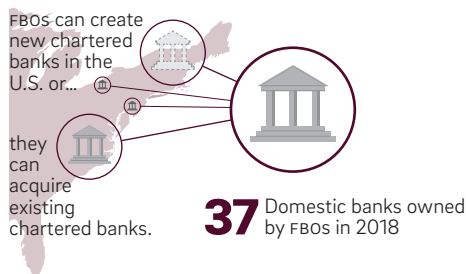
The other way to operate in the U.S. is through a branch or agency (Figure 2). Both branches and agencies are offices of the FBO that conduct business on behalf of the FBO outside its home country. One important part of their business is to provide banking services for client companies located in their home country but doing substantial business here. In addition, branches compete with U.S. banks to provide a wide range of banking services for companies not from their home country.

FIGURE 2

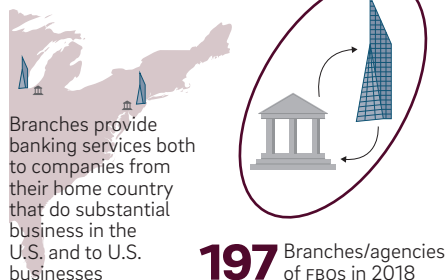
Two Models for FBOs in the U.S.

FBOs can operate subsidiaries or branches/agencies.

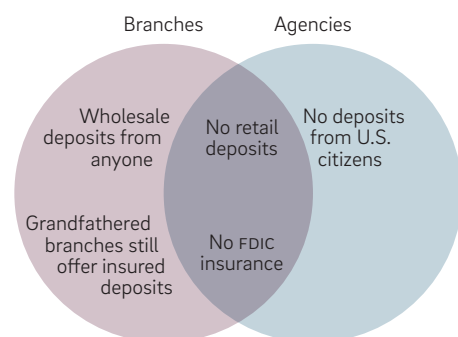
Bank Subsidiary Model



Branch/Agency Model



Differences Between Branches and Agencies



Source: National Information Center.

There are currently 197 branches/agencies of FBOs in the U.S., mainly in New York, Los Angeles, and Miami.³

There are some important differences between branches and agencies. Neither can accept retail deposits, but, while a branch can accept wholesale deposits from anybody, an agency can't accept deposits from U.S. citizens.⁴ It is illegal for either a branch or an agency to have FDIC insurance, but some branches offer insured deposits because their deposits were insured before, and are thus grandfathered by, the Federal Deposit Insurance Corporation Improvement Act of 1991.

New Incentives Under Dodd-Frank

When Congress enacted the Dodd-Frank Act of 2010, it brought the regulation of FBOs more in line with the way domestic banks are regulated. One major change was that an FBO with a large presence in the U.S. must put all of its U.S. subsidiaries under a BHC or FHC. The BHC/FHC is then regulated as if it were a domestically owned institution. An FBO is not required to house its branches or agencies in the holding company, although the law does impose some new requirements on the foreign regulators of FBOs that operate branches in the U.S.

As a consequence of these and other changes, Dodd-Frank may have created incentives for FBOs to change how they operate in the U.S. First, Dodd-Frank imposed more stringent regulations, capital standards, and other regulatory costs on large banks, likely raising the cost of operating in the U.S. The higher costs may have induced FBOs to cut back on their overall U.S. operations. Furthermore, the lower regulatory costs for branches may have created incentives for FBOs to shift operations from subsidiaries to branches.

FBOs Since Dodd-Frank

Because of branch closings and consolidations, the number of FBOs operating in the U.S. has been declining for a while. However, this trend quickened after the financial crisis of 2007-2008, and

Dodd-Frank may have accelerated this trend. Since passage of Dodd-Frank in 2010, 26 firms have exited the U.S. entirely, and three more have converted their branches into representative offices.⁵ A plurality of these firms is from the euro zone.⁶ In addition, 18 firms cut back their U.S. operations, mainly by closing some but not all of their U.S. branches (Figure 3).

This is consistent with the view that FBOs cut their U.S. operations due to regulatory costs, but confounding factors make it very difficult to disentangle the influence of Dodd-Frank. A closer examination of exiting FBOs suggests that the European financial crisis was an important cause of exits. Seven (mostly European) banks failed and were either nationalized or closed, with the resultant closing of their foreign branches. Three other banks merged with or were acquired by banks that also have a presence in the U.S.⁷ Furthermore, the postcrisis period is not uniformly a story of FBOs leaving the U.S.: Twelve banks entered the U.S. market, and eight more expanded their presence.

The postcrisis period also witnessed slowing growth of FBO holdings in the U.S. From 1999 to 2008, real assets (of branches/agencies and bank subsidiaries) increased from \$1.8 trillion to \$3.4 trillion (in 2016 dollars), an annual growth rate of 7.33 percent (Figure 4). From 2008 to 2009 these assets shrank substantially. Thereafter, real assets grew from \$3.2 trillion to \$3.5 trillion, an annual growth rate of only 1.66 percent. FBO assets also declined as a percentage of total U.S. banking assets, from 22.4 percent to 19.4 percent (Figure 5). Most of this decline was due to a decrease in the assets of FBO branches/agencies. The slower growth of FBOs provides some evidence that they have responded to higher regulatory costs, but we do not find evidence that FBOs evaded the more stringent regulation of their U.S. subsidiaries by shifting activities to their branches.

In a more limited sample of large foreign banks, FBOs' U.S. holdings also decreased as a share of their worldwide operations (Figure 6). In aggregate, the share of FBOs' total assets that are in the U.S. declined modestly between 2011 and 2017, from 2.3 percent to 1.6 percent. Again, this was driven mostly by a decrease in branch/agency assets.

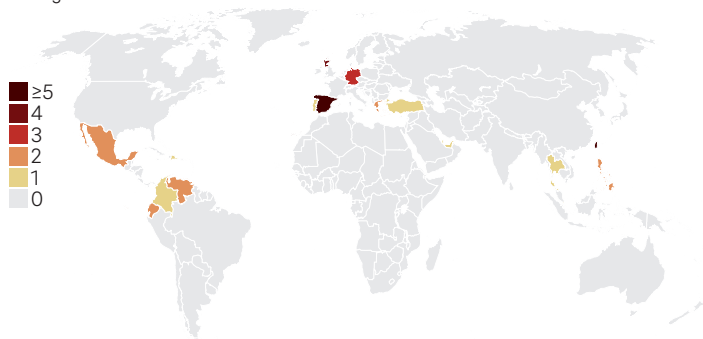
FIGURE 3

FBOs Exiting and Entering the U.S. Since Dodd–Frank

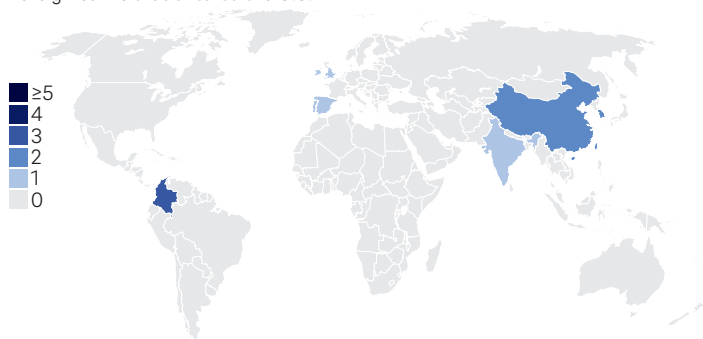
Many euro zone banks have left, while more Asian banks have moved in.

Branches and subsidiaries, 2010–2018

Foreign banks that **exited** the U.S.



Foreign banks that **entered** the U.S.



Source: National Information Center.

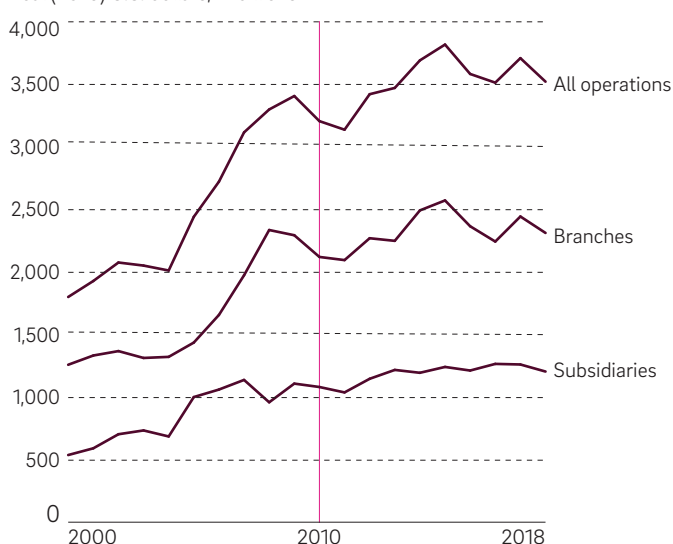
Note: All National Information Center data tables of FBOs operating in the U.S. are available for download from https://philadelphiafed.org/-/media/research-and-data/publications/economic-insights/2019/q3/ei2019q3_addendum.pdf.

FIGURE 4

Total FBO Assets in the U.S.

Growth slows during and after the Great Recession.

Real (2016) U.S. dollars, in billions



Source: FFIEC Call Reports, forms FFIEC002 (for branches), FFIEC031, FFIEC041, and FFIEC051 (for bank subsidiaries).

How Dodd–Frank Changed the Regulation of Foreign Banks

Branches

Dodd–Frank didn't change the operations or activities of branches, but it did force federal regulators to look closer at how their home countries regulate them. If an FBO is found to present a risk to the financial stability of the U.S.—i.e., is designated a global systemically important financial institution (G-SIFI) or a domestic systemically important financial institution (D-SIFI)—the Federal Reserve Board must take into account whether the FBO's home country has installed or made "demonstrable progress" toward installing a system of financial regulations to mitigate such risk when it reviews applications to open branches/agencies.¹³ Such a system is consistent with the Basel Accords and includes periodic examinations, standardized financial statements, and guidelines for capital adequacy and risk exposure.

The Federal Reserve can close a branch or agency of an FBO if its home country fails to adopt or make "demonstrable progress" toward adopting regulations that mitigate systemic risk.

Bank Subsidiaries

Home country regulators must meet the same guidelines that apply to branches. Additionally, there is a sliding scale based on an FBO's financial assets in the U.S. and worldwide. Banks with U.S. assets between \$10 billion and \$50 billion must pass home country stress tests on capital, form a risk committee for their U.S. operations, certify that they meet their home country's capital standards and that those are consistent with Basel, and run their own stress tests.

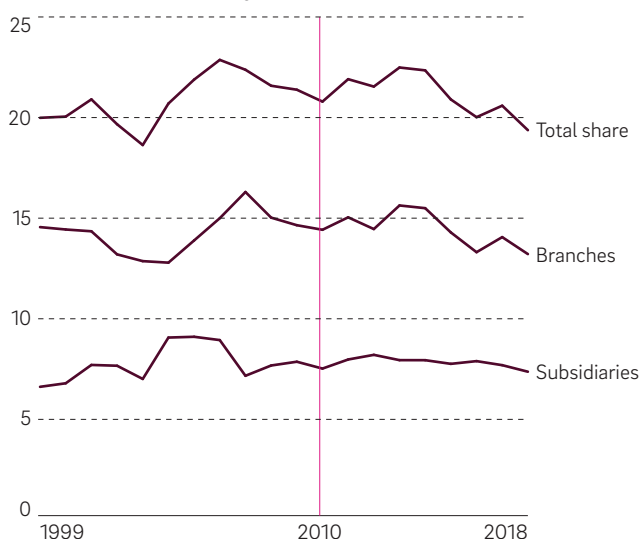
Additionally, if the bank has assets greater than \$50 billion worldwide, it has to run separate stress tests on U.S. operations.¹⁴

As of year-end 2018 this requirement for bank subsidiaries affected four banks. In addition to the above requirements, banks with greater than \$50 billion in U.S. assets must form a bank or financial holding company (BHC or FHC) and place all their U.S. holdings (not necessarily including branches/agencies) under it. The BHC/FHC must meet the same regulatory requirements as domestic BHCs and FHCs, including capital guidelines, leverage limits, liquidity requirements, and living wills. As of year-end 2018 these requirements affected 12 banks.

FIGURE 5

Share of U.S. Banking Assets Held by FBOs

FBO assets decline as a percentage of total U.S. banking assets.
Percent of total U.S. banking assets, 1999–2018



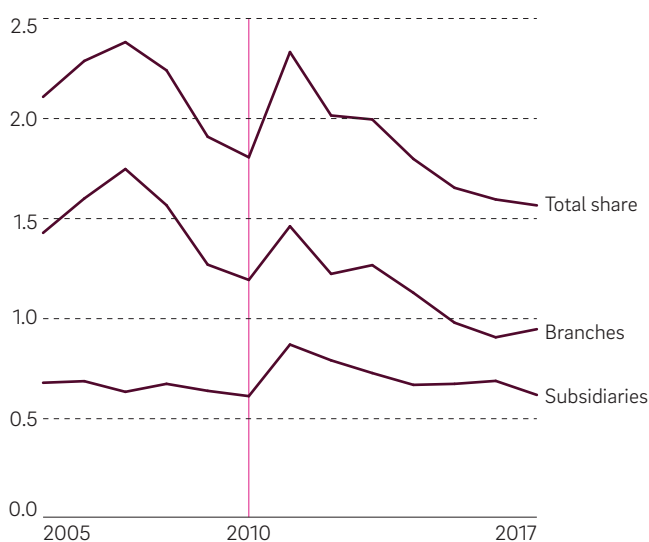
Source: FFIEC Call Reports, forms FFIEC002 (for branches), FFIEC031, FFIEC041, and FFIEC051 (for bank subsidiaries).

FIGURE 6

Share of FBO Assets in the U.S.

Aggregate FBO assets in U.S., as share of worldwide assets, have declined modestly.

Percent of total worldwide assets, 2005–2017



Source: S&P Global Market Intelligence (formerly SNL Securities) and FFIEC Call Reports, forms FFIEC002 (for branches), FFIEC031, FFIEC041, and FFIEC051 (for bank subsidiaries).

Note: Data on foreign banks' total assets were only available for some banks, and most of them from 2011 and after. The data presented here represent an average of about 90 banks per year. Data for previous years are for a substantially smaller number of institutions.

In addition to slowing the growth of their U.S. operations, the composition of FBO assets changed, particularly at branches. FBOs increased their cash holdings dramatically following the financial crisis (Figure 7), due mainly to a combination of regulations imposed under Dodd-Frank and changes in the Fed's conduct of monetary policy.⁸

During the crisis, the Fed began paying interest on funds placed in reserve accounts with Federal Reserve Banks to both domestic banks and foreign banks. Because most U.S. branches of FBOs are not allowed to take insured deposits, they get their funding by taking uninsured wholesale deposits and, thus, do not pay FDIC insurance. Furthermore, foreign branches are not covered by the capital requirements or liquidity requirements imposed on U.S. banks.⁹ This gave foreign banks an advantage in facilitating a regulatory arbitrage in which institutions not eligible for interest on reserves can effectively receive that interest, albeit at a cost. Since foreign branches can deposit funds in a reserve account with the Fed, it became profitable to borrow from institutions that could not receive interest on reserves—primarily federal home loan banks and other government sponsored enterprises—and to deposit these funds with the Fed. Indeed, foreign branches could do this more profitably than could U.S. banks because foreign branches face lower regulatory costs of borrowing to fund deposits at the Fed.

After the striking rise during the financial crisis and continuing through the European crisis, there is a modest reversal in cash holdings and an increase in commercial lending. With the recovery in Europe and the U.S., business loans have become relatively more attractive investments. Nonetheless, foreign branches continue to profit from regulatory arbitrage.

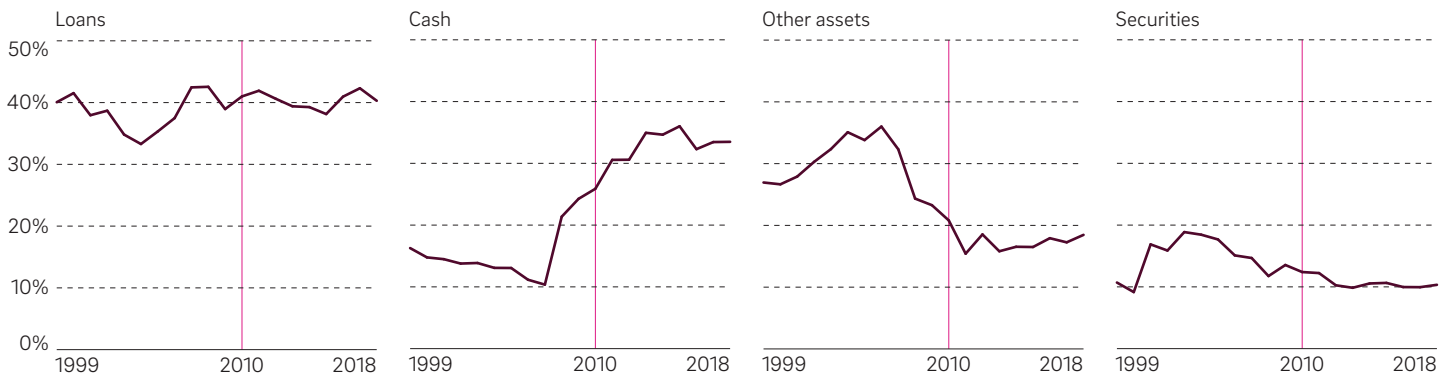
Further Regulations Proposed

The Federal Reserve and other regulators recently proposed additional regulations for large and complex U.S. intermediate subsidiaries of FBOs. In 2013 the regulators adopted liquidity coverage standards for the largest banks and BHCs, and in 2016 they adopted standards on stable sources of funding for the same organizations.¹⁰ The new proposal tightens those standards for some FBOs' U.S. subsidiaries that have over \$100 billion in assets, depending on their size and complexity.¹¹ It also adds additional capital requirements for the largest and/or most complex U.S. subsidiaries of FBOs.

FIGURE 7

Distribution of Assets in Branches

FBOs increased cash holdings dramatically following financial crisis.
Percent of total assets, 1999–2018



Source: FFIEC Call Reports, Form FFIEC002.

Note: "Other Assets" includes trading assets, Fed funds sold and repos, transactions with related parties, and all other assets.

The net effect of these new rules will likely be to raise the regulatory costs of the largest and most complex FBO operations in the U.S., but it will also lower such costs for other FBOs. As it's now written, these new rules would apply only to FBOs' holding companies and bank subsidiaries, not their branches and agencies. However, the regulators did ask for comments as to if and how the rule should be applied to branches and agencies of FBOs.¹²

Conclusion

Overall, although tighter postcrisis regulation of FBOs in the U.S. may have increased the cost of operating here, we have not observed dramatic changes in their operations. Consistent with predictions that the Dodd-Frank regulations would lead FBOs to reduce their presence in the U.S., FBOs have either exited or contracted their U.S. operations, mainly by closing branches. However, it appears that factors other than regulatory changes in the U.S. played a major role in those closures, and the evidence doesn't support predictions that foreign banks would shift operations from their subsidiaries to their branches. The branch closures have slowed the growth of FBO operations somewhat, and foreign banks' share of U.S. assets has declined. Foreign banks are also holding more cash postcrisis due to regulatory changes and changes in the way the Fed conducts monetary policy.

Of course, this evidence is purely descriptive, and preliminary to a formal attempt to disentangle the precise role of Dodd-Frank from a host of factors that may have affected FBOs' U.S. operations since the financial crisis. [\[4\]](#)

Notes

1 See Berlin (2015).

2 Systemically important financial institutions (SIFIs) are those of sufficient size, importance, and interconnectedness that their failure might cause another financial crisis. Domestic SIFIs are designated by the Federal Reserve Board and the Financial Stability Oversight Council (FSOC), which was established by Dodd-Frank. Further information on the FSOC and its activities can be found at <https://home.treasury.gov/policy-issues/financial-markets-financial-institutions-and-fiscal-service/fsoc>. There's no set definition, but global SIFIs are designated by the Financial Stability Board, which is hosted and funded by the Bank for International Settlements. Further information on the Financial Stability Board can be found at <http://www.fsb.org/>.

3 There is no limit on the number of branches/agencies an FBO can have, so several have multiple branches.

4 Retail deposits are deposits less than \$250,000, while wholesale deposits are equal to or greater than \$250,000 and therefore uninsured.

5 Representative offices are back-office facilities that can neither make loans nor accept deposits. These are counted as exits because the FBO no longer conducts banking in the U.S.

6 The breakdown is 12 European banks, eight Asian banks, four from South and Central America, two from Mexico, and three from Turkey and the Middle East.

7 Two of these mergers were of Spanish banks that merged with other banks as part of government rescues.

8 See Lester (2019).

9 A U.S. bank funded by insured deposits would have to pay fees for FDIC insurance as a percentage of the bank's assets. In addition, a U.S. bank would have to hold capital against the money deposited in the reserve account. Neither of these requirements applies to branches of FBOs.

10 See Regulation WW.

11 The Liquidity Coverage Ratio is the ratio of high-quality liquid assets (cash and assets that are easily convertible to cash) to projected net cash outflows for each 30-day period. The Net Stable Funding Ratio is calculated by weighting various liabilities for the numerator and various assets for the denominator.

12 For the full proposal, see the Board's website; for a summary, see Quarles (2019).

13 See Regulation K.

14 See Regulations K and YY.

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Regulation K, 12 CFR part 211.21(b), and (e), Federal Reserve Board.

Regulation WW, 12 CFR part 249, Federal Reserve Board.

Regulation YY, 12 CFR part 252, Federal Reserve Board.

Collateral Damage: House Prices and Consumption During the Great Recession

Did a decline in house prices cause the Great Recession? And if so, how? Credit constraints may be the key to answering those questions.

Ronel Elul is a senior economic advisor and economist at the Federal Reserve Bank of Philadelphia. The views expressed in this article are not necessarily those of the Federal Reserve.

BY RONEL ELUL

The U.S. economy experienced a severe financial crisis together with a housing bust in 2007-2008. The subsequent recession significantly affected the economy, which saw the deepest declines in consumption, investment, and employment since the Great Depression.

Can we pin the blame for this recession, and in particular the decline in household consumption, on the collapse in house prices? If we can understand whether—and how—a collapse in house prices triggers a decline in consumption, thus precipitating a recession, we can better formulate policies to prevent and mitigate future crises.

We focus on this link between housing and consumption because of housing's prominent role in the run-up to the Great Recession; because consumption represents by far the largest component of GDP, and the one that impacts the well-being of U.S. households most directly; and because housing itself makes up a large share of U.S. households' net worth.

In contrast to influential studies suggesting that a decline in house prices leads households to reduce their consumption because they feel poorer, we find that these wealth effects are modest. Instead, we identify an important role for the effect that house price declines have on making credit constraints more severe. In particular, we identify a novel channel of influence: Financially vulnerable households reduce their consumption because the decline in house prices leads to missed payments—which, in turn, reduce their access to credit. We call this the credit score channel.

Precrisis Studies

There appears to be a strong empirical link between house prices and consumption, particularly in the period following the Great Recession (Figure 1).

However, it is not obvious that changes in house prices should have a large effect on consumption. According to Milton Friedman's permanent-income hypothesis (1957), only changes

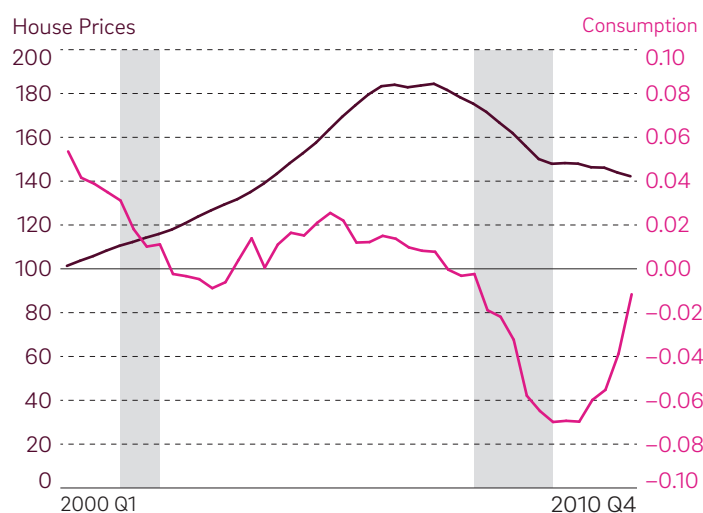
in wealth that households perceive as permanent should lead to large changes in household consumption. If households perceive a drop in house prices as temporary, it should not affect consumption. In addition, while housing—as an asset—is an important source of wealth, it is also consumed. That is, while a decrease in house prices may make some households poorer, it may also make housing more affordable (directly for home purchases but also indirectly through its effect on rents). More than one-third of U.S. households are renters, and renters are often financially vulnerable, young, or credit constrained. Any benefit they receive from declining house prices may be significant.

FIGURE 1

House Prices and Consumption

During the Great Recession, there appears to be a strong empirical link between house prices and consumption.

House prices: 2000–2010, January 2000=100, not seasonally adjusted;
Consumption: 2000–2010, personal consumption expenditures, Hamilton filter



Source: Case-Shiller National Home Price Index and U.S. Bureau of Economic Analysis.

Although the housing bust and Great Recession inspired economists to better understand the channels linking house prices and consumption, economists have actually been studying these channels for many years. In one of the first papers to identify a quantitative impact of changes in housing wealth on consumption, Bhatia (1987) used a time series of changes in housing wealth at the national level to explain changes in aggregate consumption. There are some limitations, however, to using aggregate data: Changes in housing wealth are correlated with other macroeconomic factors that might affect consumption; it is difficult to identify the channels through which such a link might occur; and different groups of consumers (for example, renters versus homeowners) might be impacted differently.

Later studies used disaggregated data and found differing effects. In one interesting study using microlevel data from the UK, Campbell and Cocco (2007) found substantial heterogeneity—for example, house price changes had a big effect on consumption among older homeowners, while those same changes had essentially no impact on young renters. They also showed that some of the measured impact of house prices on consumption may be due to the correlation between the health of the aggregate economy and house prices, rather than through the house prices themselves.

During the Great Recession, house prices experienced a large sustained drop, something that until then had been rare in most countries. In addition, the coincidence of the housing market collapse and the onset of the recession suggested an important connection between the two. Finally, the severity of the recession itself highlighted the importance of understanding its determinants.

Consumption During the Great Recession

In an influential study, Mian et al. (2013) articulate the connection between a drop in house prices and a decline in consumption in the context of the Great Recession. They show that zip codes in which the value of housing dropped the most between 2006 and 2009 are also those in which consumption fell the most. Actually, they use a proxy for consumption, auto sales. They also show that the impact of falling house prices was stronger when households in the zip code had higher loan-to-value ratios, i.e., when households borrowed a greater share of their housing value.

Mian et al. suggest several channels through which this link might operate. First, there's a wealth effect, in which declines in house prices make households poorer. If households are able to borrow freely, however, they should be better able to weather such wealth shocks, particularly if the shocks are temporary. But housing has also traditionally served as collateral for borrowing (for example, via home equity loans). For households that had already borrowed more against their house, this decline may aggravate credit constraints, making it more difficult or expensive for a household to borrow. In addition, the reduction in household consumption may also affect the local economy: If employers hire fewer workers, this aggravates the drop in consumption.¹ Finally, the health of the financial sector may also

drive consumption: If banks suffer losses on their residential loans, they may cut back on making auto loans or on other types of consumer lending.²

Mian et al.'s analysis hasn't gone unchallenged. Dupor et al. (2018) use county-level data to challenge their claim that declines in house prices were responsible for the dramatic decline in auto sales during the Great Recession. Dupor et al. argue that most of the decline in auto sales occurred at the national level and was relatively unaffected by local changes in house prices. They show that the decline in auto purchases can instead be explained in large part by households becoming more pessimistic about their future income prospects. They support this conclusion with a calibrated theoretical model. Individual-level data, as discussed below, can help clarify the extent to which house prices affect consumption, as well as identify those households that are most impacted, and the channels through which this occurs.

A reader of Mian et al.'s analysis might ask several questions. How important are these various channels? Can we quantify their contributions to the severity of the Great Recession? How exactly do they work? And who is most affected by them?

One way to answer these questions is by building a theoretical model that incorporates one or more of these channels and use available data to fit the parameters of the model. Berger et al. (2018) develop a model in which house price declines impact consumption by tightening credit constraints. In contrast, Kaplan et al. (forthcoming) construct a model that incorporates both wealth effects and credit constraints. They show that a decline in house prices does indeed contribute to a large decline in consumption, with the wealth effect playing the largest role (particularly for older households that expect to downsize in the near future). According to their model, credit constraints are relatively unimportant.

Measuring the Links: Individual-Level Data

Without individual-level data or a model, it's difficult to disentangle these different channels. For example, credit-constrained households might be hard hit by declining house prices, but they

See *Auto Sales as a Proxy for Consumption*. ➔

Auto Sales as a Proxy for Consumption

Although auto sales make up only about 10 percent of consumption, they have been widely studied because they account for a large share of the decline in consumption during recessions (and, conversely, the increase in recoveries). In addition, Aruoba, Kalemli-Özcan, and I use auto loan originations as a proxy for auto sales in our paper. Doing so allows us to use our credit bureau data to estimate the change in consumption for every consumer in our data set and relate that data to other information we have about them. It is true that some auto purchases are purely cash-financed, which our measure of auto loans would miss. But Johnson et al. (2014) have shown that the share of auto purchases purely financed with cash varies little over a business cycle, and so this does not have a significant impact on our analysis.

may just as well be less likely to own their homes. We have already discussed several papers that develop models to distinguish these; the approach that I take in my paper with Aruoba and Kalemli-Özcan is to use individual-level data.

In our paper we use anonymized credit bureau data linked with more detailed information on mortgages.³ Credit bureau data typically do not contain very detailed information on loan terms or consumer assets, but our data set links detailed information on the consumer's mortgages to their credit bureau record. This allows us, for example, to link the homeowner's loan-to-value ratio to the homeowner's other obligations. Our data set also contains a credit risk score, a summary measure of the consumer's risk of default similar to those used by many lenders when considering whether to extend credit, and the terms at which to do so.

To quantify the contribution of each channel, we compute the change in the relationship between house prices and our measure of consumption each time we add an explanatory variable associated with each channel. We begin by showing that, on average, a homeowner who experienced the average decline in house prices over the housing bust (roughly 20 percent) would have seen their likelihood of taking out an auto loan decline by roughly 10 percent.

We then add county unemployment rates, which are a measure of the impact of the recession on the local economy. We find that a homeowner whose county experienced the average increase in unemployment over this period would have seen their likelihood of taking out an auto loan decline by roughly 5 percent.⁴ In addition, adding unemployment reduces the direct impact of house prices by approximately one-sixth, demonstrating that some of the effect of house price declines occurs through local labor markets.

Next, we add a measure of the health of the banking system in the county in which the homeowner is located. This also has significant explanatory power for declines in auto loan originations, and, furthermore, adding this variable reduces the direct effect of house prices by another sixth, to approximately two-thirds of the effect's original value.

To what can we attribute the remaining

impact of house prices on auto loan originations? The two channels that remain are wealth effects and household credit constraints. But it is tricky to distinguish why a household whose house has declined in value has reduced its consumption. Is it because the household feels less wealthy, or because it can't borrow as much?

To disentangle these two effects, we use what we know about the characteristics of individuals in our data set. Individuals with good credit scores and plenty of home equity are unlikely to be constrained, even when house prices drop. Thus, the channel through which house prices affect them is a wealth effect. We find that these individuals are essentially unaffected by house price declines: Although they may become poorer, they can still borrow, so their consumption doesn't change much. We can conclude that the pure wealth effect is likely relatively modest.

In contrast, we show that for individuals with poor credit or large mortgages relative to the value of their house, the effect of house price declines is large. This reflects credit constraints: They are unable to

borrow as readily or as cheaply as they would have been able to, had the value of their house not dropped.

What is it about house prices that affects the ability of households to borrow? One possibility is that individuals borrow against their house in order to finance vehicle purchases, either directly or indirectly. For example, they may undertake a cash-out refinancing of their home or take out a home equity loan, to either buy a car outright or make a down payment on a new car. But others, such as McCully et al. (2019), have argued that this is not a large effect (and our analysis generally confirms this). We show that a new—hitherto unexplored—mechanism may be at work: a “credit score channel” (Figure 2).

We show that house price declines lead households—particularly less creditworthy ones and those with high loan-to-value ratios—to fall behind in their mortgage payments. One reason for this is that homeowners with little—or, even more so, negative—equity have less incentive to continue making their mortgage payments.⁵ This in turn hurts their creditworthiness

FIGURE 2

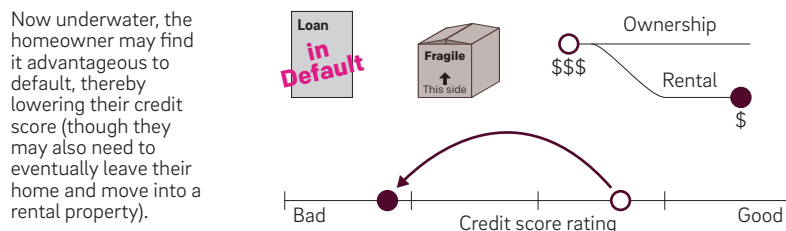
The Credit Score Channel

Thanks to its effect on credit scores, a decline in home values can lead to a decline in auto sales.

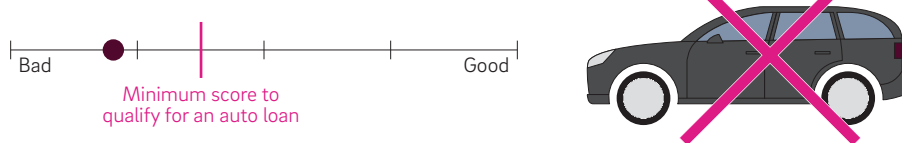
- 1 High loan-to-value homes can lead to...



- 2 Falling credit scores if homeowners default and...



- 3 That can make auto loans harder to obtain.



and makes it difficult to qualify for auto loans. Adding this new channel helps reduce the direct effect of house prices by one-quarter, to less than half its original value (Figure 3).

We also explore the link between house price declines, refinancing, and consumption. We do find that house prices affect refinancing options: Homeowners with high loan-to-value ratios are especially hard hit when house prices fall. They are much less likely to refinance if house prices fall, and particularly less likely to undertake a cash-out refinancing. This is most likely because they now find it difficult to qualify for a refinancing and certainly do not have enough equity for a cash-out refinancing. However, we find that the effect of house prices, through refinancing, and then onto auto purchases, is relatively modest, reducing the remaining effect of house prices by 6 percent.⁶

Other recent work also takes a more micro perspective to examine the connection between house prices and consumption. Aladangady (2017) uses data from 1986–2008 (prior to the financial crisis) and finds that consumption responds strongly to house prices.⁷ He also finds substantial heterogeneity, much as we do. Three groups respond more than others: homeowners overall, who respond more than renters; homeowners with higher loan-to-value ratios; and households that are likely to be credit constrained along a number of dimensions. However (and unlike us) he finds an important role for cash-out refinancing. There are several important differences between his work and ours. First, he does not decompose the relative weight of each channel toward the total effect of house prices. In addition, he has much less detailed

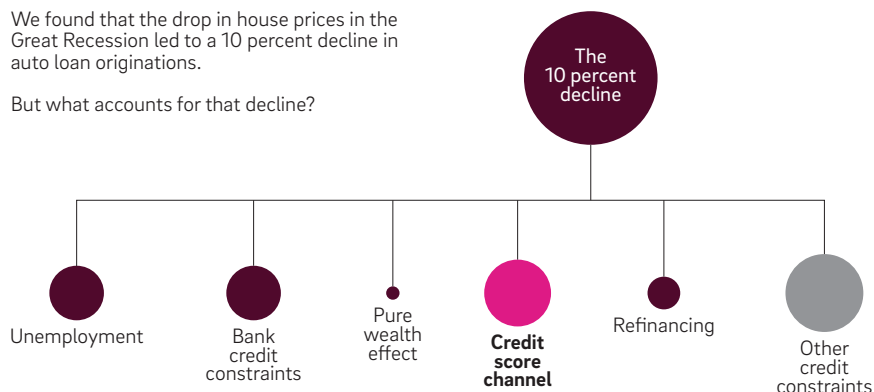
FIGURE 3

Falling Credit Scores Can Affect Consumption

The credit score channel is one of the biggest contributors to the 10 percent drop in consumption that results from house price declines.

We found that the drop in house prices in the Great Recession led to a 10 percent decline in auto loan originations.

But what accounts for that decline?



Source: Aruoba et al. (2019); some details from unpublished revision.

information on household creditworthiness, which does not allow him to break down the overall effect of credit constraints as richly as we do. Finally, given the span of his data, he is not able to weigh in directly on how house price declines affected the decline in consumption during the Great Recession. (This may also explain why he finds a significant effect for refinancing, as the period he considers was one of rising house prices.)

Conclusion

The decline in house prices made a substantial contribution to the severity of the Great Recession. The literature has outlined several channels through which this may have occurred. Our own work confirms this contribution and also allows us to quantify the importance of these channels. The most important channels are through household credit constraints,

banks' supply of credit to households, and the impact (direct or indirect) of house prices on the local economy. In contrast, there is little direct wealth effect. We also shed light on which individuals see their creditworthiness most severely impacted.

There are at least two policy implications of this work. First, consumers are particularly vulnerable when house prices decline. And second, two important channels through which this effect occurs may be mitigated through public policy: the health of the banking sector (which lends to consumers to allow them to weather these shocks) and mortgage defaults (which reduce future creditworthiness). By ensuring that the banking sector is appropriately capitalized, and through policies to mitigate the risk of mortgage default, we can help protect consumers and the economy as a whole. [\[E\]](#)

Notes

1 The decline in house prices may also affect the local economy by making it harder for small entrepreneurs to start new businesses. This link has been explored by Adelino et al. (2015), who show that an increase in house prices during the boom helped small businesses start up (for example, through their owners borrowing against the rise in the value of their own home).

2 Gilchrist et al. (2018) write that the causation may run in the other direction. They argue that a shock to the health of banks that operate in a particular area may have a negative impact on mortgage credit in that region. A decline in available mortgage credit may then affect the local economy in many different ways, including declines in house prices, retail sales, and employment.

3 Credit bureaus are private-sector firms that collect data on individuals' credit obligations and provide that information to current and prospective lenders. Recently, researchers have also used this data, in anonymized form. In our paper we use a match between Equifax Credit Risk Insight Servicing (credit bureau) and Black Knight McDash (mortgage) data. The credit score we use is the Equifax Risk Score. Please see our paper for further details.

4 A high local unemployment rate could reduce the likelihood of taking out an auto loan for two reasons: The high rate implies that the particular homeowners we consider in our sample are more likely to themselves be unemployed (and thus unable to purchase a car), and they may perceive that they are at a higher risk of being laid off in the future and thus scale back their consumption.

5 See Elul et al. (2010) for a study of the interaction between the influence of negative equity and liquidity constraints on mortgage default.

6 The effect is concentrated in those homeowners with high LTV, whose ability to refinance might indeed be expected to be the most affected by house price declines.

7 One attractive feature of his paper is that Aladangady uses census data, which has a much broader measure of consumption. His approach also allows him to better separate the direct effect of housing from the effects observed in the data simply because economic declines cause house price declines.

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Where Is the Phillips Curve?

A closer look at the Phillips curve helps us understand why our low unemployment rate hasn't led to a bigger rise in prices or wages.

Shigeru Fujita is an economic advisor and economist at the Federal Reserve Bank of Philadelphia. The views expressed in this article are not necessarily those of the Federal Reserve.

BY SHIGERU FUJITA

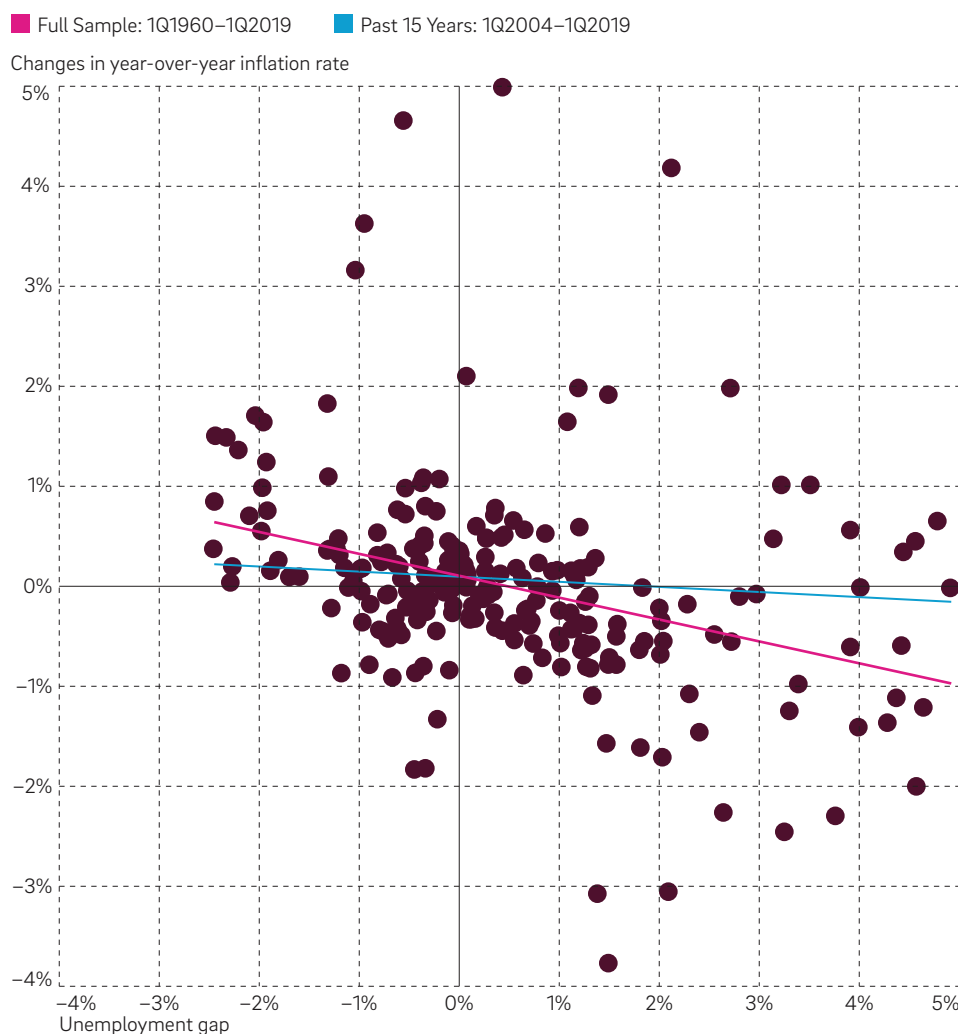
The Phillips curve is an old idea made newly urgent thanks to our long recovery from the Great Recession. In his 1958 study of the UK economy between 1861 and 1913, Alban William Phillips of the London School of Economics discovered that wages and unemployment move in opposite directions over time. The subsequent literature applied this idea to prices of goods and services. In the modern literature, the relationship between inflation and some measure of unused resources is often called the price Phillips curve or simply the Phillips curve; when wage growth is considered instead of inflation, it is called the wage Phillips curve.

The Phillips curve represents an empirical relationship between available but unused resources (resource slack) in the economy and either the inflation rate or wage growth. The best-known measure of resource slack is the jobless (or unemployment) rate. The Phillips curve postulates that higher unemployment is associated with lower inflation or wage growth, and that lower unemployment is associated with higher inflation or wage growth. Figure 1 plots a version of the Phillips curve using the data over the period 1960–2019. Each dot represents the combination of the inflation rate and the “unemployment gap” at each point in time. As explained below in more detail, the unemployment gap represents the deviation of the unemployment rate from its slow-moving trend. The red, or regression, line summarizes the average relationship between the two variables,

FIGURE 1

The Phillips Curve Relationship in the U.S.

As the labor market tightens, inflation typically rises—but not so much in recent years. Change in year-over-year inflation rate by unemployment gap, 1Q1960–1Q2019



Source: Bureau of Labor Statistics, Congressional Budget Office, Bureau of Economic Analysis.

and the slope of this line is indeed negative. The idea behind the Phillips curve is intuitive. A tight labor market, exemplified by a low unemployment rate, is associated with higher wages, and the higher labor cost pushes up inflation.

Recent years have seen a surge in research into the stability of the Phillips curve. The traditional Phillips curve assumes that the degree of the negative relationship, or its slope, is stable over time. For example, in Figure 1, the slope is 0.20, which means that a decline in the unemployment gap by 1 percentage point is on average associated with a 0.20 percentage point increase in the inflation rate. Although such an empirical relationship is never exact at each point in time, recent experience suggests that the relationship is not even close to constant. In particular, even though the unemployment rate has fallen substantially during the past several years, inflation has not measurably and consistently increased. This phenomenon represents a flattening of the Phillips curve and is shown by the blue line, which gives the relationship over the last 15 years. One can see that this line is much flatter than the red line, the one based on the entire sample.

The flattening of the Phillips curve carries important implications for monetary policy, but is the flattening real? And if so, why is it flattening? In this article, I review the recent literature on these issues and then discuss the implications for monetary policy, but first I define the Phillips curve more precisely.

What Is the Phillips Curve?

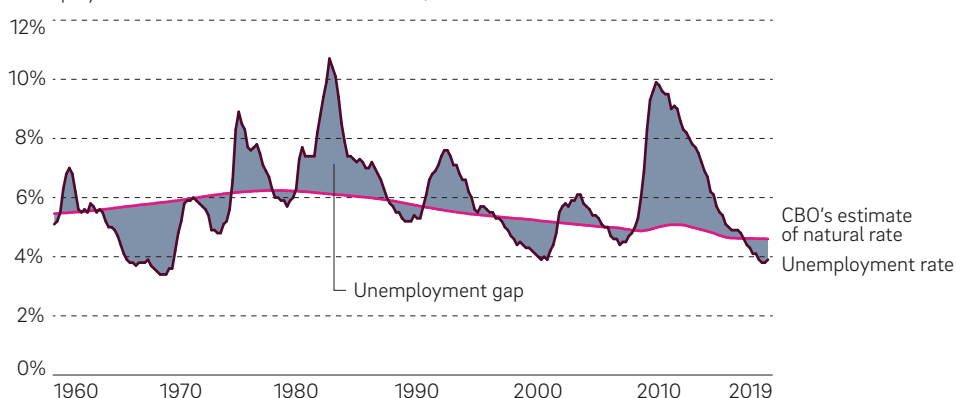
The Phillips curve relates price (or wage) inflation to the resource slack of the economy, capturing the intuitive idea that price or wage inflation should be inversely related to resource slack. The exact formulation of the Phillips curve, however, depends on how we measure inflation and resource slack.

For the purpose of estimating the Phillips curve, one well-known measure of the general price level of the economy is the core personal consumption expenditure (PCE) index. Many economists—including those at the Federal Reserve—use the rate of change in this index to measure inflation.¹

FIGURE 2

Natural Rate of Unemployment

Unemployment rate and estimate of natural rate, 1960–2019



Source: Bureau of Labor Statistics, Congressional Budget Office.

The best-known measure of resource slack is the unemployment rate, which the Census Bureau and the Bureau of Labor Statistics calculate as the share of jobless workers within the labor force. For the purpose of the Phillips curve, the literature typically considers the difference between the unemployment rate and the “natural” rate of unemployment. The literature calls this difference the unemployment gap. The actual unemployment rate increases or decreases depending on the cyclical conditions of the economy, and the natural rate is the hypothetical and unobserved level of the unemployment rate that would have prevailed in the absence of such cyclical variations.

Note that the natural rate of unemployment is not zero. Unemployment would not disappear even under stable economic conditions. For example, moving from one job to another takes time, and workers between jobs are counted as unemployed. One can view the natural rate as the trend unemployment rate, which changes only slowly over time, independent of cyclical conditions of the economy (Figure 2). How one measures the natural rate affects the gap and thus the Phillips curve itself, so the measurement of the natural rate is integral to the estimation of the Phillips curve.

Is the Phillips Curve Really Flattening?

A recent paper by Stock and Watson (2019) provides a useful summary of the Phillips curve estimation under various formulations.² In their baseline formulation, they construct the unemployment gap by taking the difference between the official unemployment rate and the natural rate of unemployment estimated by the Congressional Budget Office (CBO). They then look at the unemployment gap’s relationship with the core PCE inflation rate. They estimate the Phillips curve over three consecutive periods: 1960–1983, 1984–1999, and 2000–1Q2018 (Figure 3).

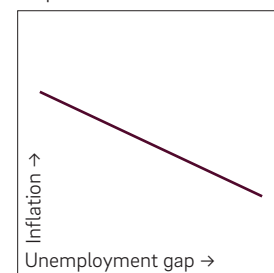
FIGURE 3

The 21st Century Phillips Curve Is Flatter

Change in year-over-year core PCE inflation rate and unemployment gap

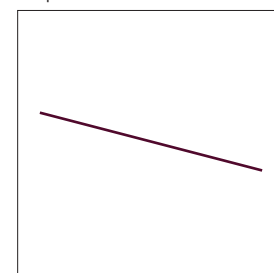
1960–1983

Slope: **−0.47**



1984–1999

Slope: **−0.26**



2000–2018

Slope: **−0.07**



Source: Stock and Watson (2019).

During the first two periods, the two variables are indeed strongly negatively related, with the slope coefficient of 0.47 and 0.28, respectively. However, for the last period, they estimate the slope coefficient to be only 0.03, which is not significantly different from zero. Statistically speaking, the small but negative slope cannot be distinguished from no change in inflation at all in response to the changes in the unemployment rate. The fact that the slope has decreased (in absolute value) over time represents the flattening of the Phillips curve.

But there are many different ways to specify the Phillips curve. Maybe the flattening is simply an artifact of some mismeasurement of the data, and using the correct data can uncover a Phillips curve relationship that is stable over time. In particular, the unemployment gap, as described above, may not appropriately reflect the size of labor market slack, because there is much uncertainty surrounding the measurement of the natural rate. Suppose that, for some reason, the natural rate is actually lower than the one estimated by the CBO, especially in recent years. If so, resource slack in the economy is actually larger than implied by the gap based on the CBO's natural rate, and therefore wage and price pressures are weaker than suggested by the CBO's measure.

Another possibility is that different types of jobless workers may pose different levels of wage pressure. For example, workers who are unemployed for a long period of time and workers who have just entered the pool might produce different levels of wage pressure. This is plausible if the "employability" of workers decreases as the duration of unemployment lengthens. In this case, longer average duration implies lower wage pressure, independent of the overall unemployment rate. Yet another possibility is that some workers who drop out of the labor force (and are not counted toward official unemployment) are actually available and willing to work. In this case, the official unemployment rate underestimates the extent of labor market slack.³

Stock and Watson estimate the Phillips curve using 10 measures of resource slack. Importantly, all 10 measures produce the flattening of the curve similar to the one based on the baseline specification. Thus, the weak responsiveness of inflation appears to be robust regardless of the measure of resource slack. Many other studies find similar results, even though these papers use different specifications and data.⁴

Stock and Watson also estimate the wage Phillips curve by replacing the core PCE inflation rate with the growth rate of average hourly earnings. They consider the same 10 measures of resource slack. Relative to the price Phillips curve, the wage Phillips curve appears to be more stable, but overall, they find a similar flattening of the wage Phillips curve in recent years.⁵

Is the Phillips Curve Nonlinear?

Even though the Phillips curve does appear to have flattened in recent years, a potential concern is that, as the labor market tightens, wage and inflation pressures suddenly surface. This possibility is particularly relevant in the recent situation. As of July 2019, the unemployment rate stood at 3.7 percent, the lowest level since the late 1960s, and even though inflationary pressure had not measurably surfaced yet, further declines

in the unemployment rate may finally unleash the underlying inflation pressure.

The standard formulation of the Phillips curve presumes that the inflation rate and resource slack are linearly related, so that the sensitivity of inflation is the same for any level of the unemployment gap, i.e., the slope of the Phillips curve is constant. The linear Phillips curve thus cannot capture the concern above.

Instead, one could specify a nonlinear Phillips curve where the responsiveness of inflation to the unemployment gap changes, depending on the level of the unemployment rate. Suppose that the natural rate of unemployment is currently at 4.5 percent. Consider, hypothetically, declines of 0.5 percentage point in the unemployment rate, one from 4.5 percent to 4 percent and the other from 3.5 percent to 3 percent. In the linear model these two changes are associated with the same amount of inflationary pressure, while in the nonlinear model the responsiveness of inflation is allowed to differ. One can then test statistically whether the latter case results in a larger inflation response.

Many studies in the literature entertain this idea, but there is no consensus about the presence of nonlinearity.⁶ The weak evidence, however, could simply be due to the fact that there are too few historical episodes where the unemployment rate fell substantially below the natural rate. Without more such episodes, we cannot test the hypothesis. Some economists get around this problem by using regional data.

Evidence from the Regional Data

The Phillips curve can be applied to regional data. That is, one can relate differences in resource slack to differences in inflation rates across different regions. One can further combine the cross-regional data with time-series changes in these variables within the same region. One major advantage of regional analysis over national-level time-series analysis is that it overcomes the small-sample problem discussed above: Even though there are only a few episodes in the national-level data in which the unemployment rate fell significantly below the natural rate, there are many more such episodes if one looks at historical data across different regions, allowing researchers to more accurately estimate the slope of the Phillips curve.

Hooper et al. (2019) present the distribution of the unemployment rate for the U.S. and for individual states between 1980 and 2017. There are very few national-level observations for an unemployment rate below 4 percent, while at the state-year level more than 15 percent of observations correspond to unemployment rates below 4 percent. Figure 4 presents similar pictures but in terms of unemployment gaps. The first panel plots the unemployment gap based on the national data over the period 1Q1959-1Q2019, while the second panel displays the state-level historical data over the period 1Q1976-1Q2019. There are only 18 observations (about 7 percent) below a -1.5 percent unemployment gap in the national-level data, whereas there are more than 1,100 observations (about 13 percent) below -1.5 percent in the state-level historical data.

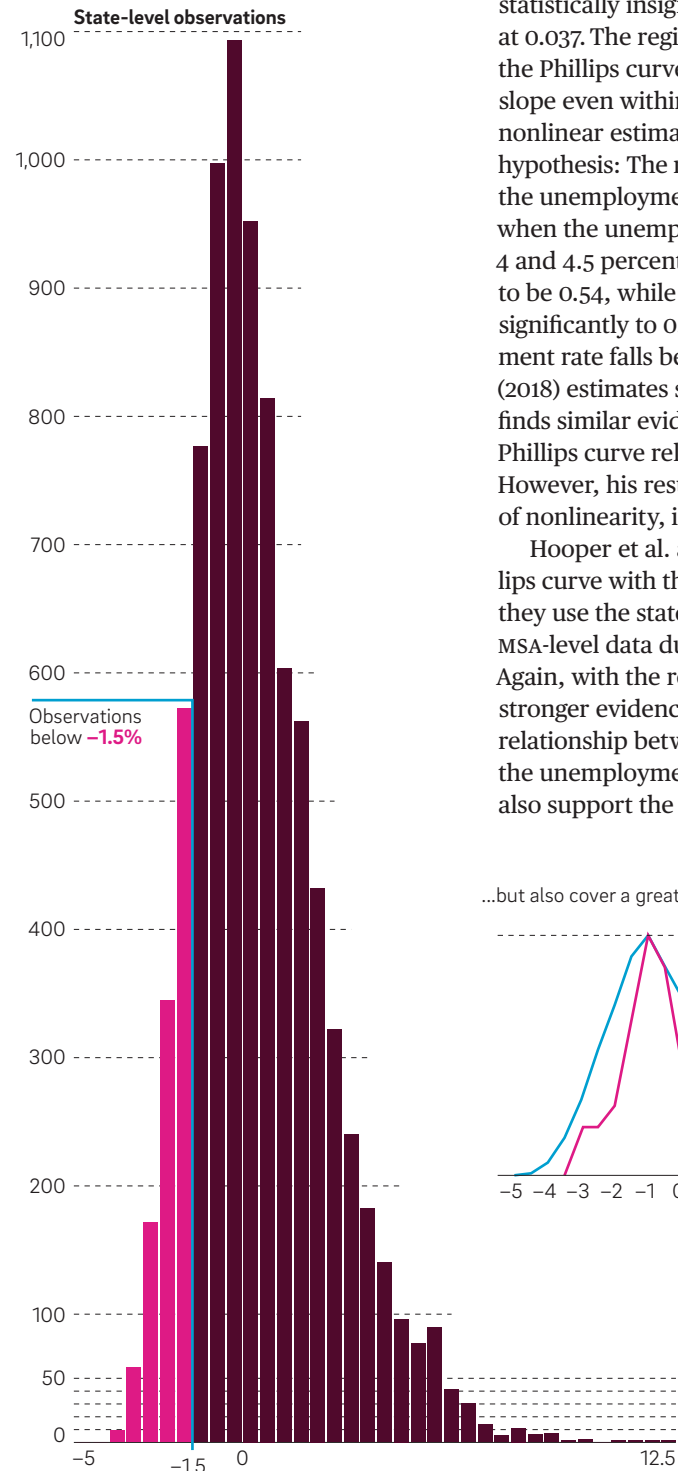
Hooper et al. estimate the Phillips curve using the data across metropolitan statistical areas (MSAs) over the period 1990-2017. These authors estimate the traditional linear model as well as

FIGURE 4

Distributions of Unemployment Gaps: National-level Data versus State-level Data

For each percent unemployment gap, number of national observations, 1Q1959–1Q2019, and state observations, 1Q1976–1Q2019

The number of state-level observations not only dwarf the number of U.S.-level observations...



Note: Bars represent half-percent increments.

two nonlinear models where the inflation response depends on the level of the unemployment rate.⁷ According to their linear model, the Phillips curve slope is 0.44 and highly statistically significant. Importantly, these authors also estimate a similar model using the national-level data over roughly the same sample period and find a much smaller and statistically insignificant slope coefficient at 0.037. The regional analysis uncovers the Phillips curve with a clear negative slope even within linear models. Their nonlinear estimations also confirm the hypothesis: The negative slope steepens as the unemployment rate falls. Specifically, when the unemployment rate is between 4 and 4.5 percent the slope is estimated to be 0.54, while the slope steepens significantly to 0.95 when the unemployment rate falls below 4 percent. Murphy (2018) estimates similar models and finds similar evidence as far as the linear Phillips curve relationship is concerned. However, his results show that the degree of nonlinearity, if any, is small.⁸

Hooper et al. also study the wage Phillips curve with the regional data, although they use the state-level data instead of the MSA-level data due to data unavailability. Again, with the regional data, they find stronger evidence for the negative relationship between wage growth and the unemployment rate. Their results also support the presence of nonlinearity

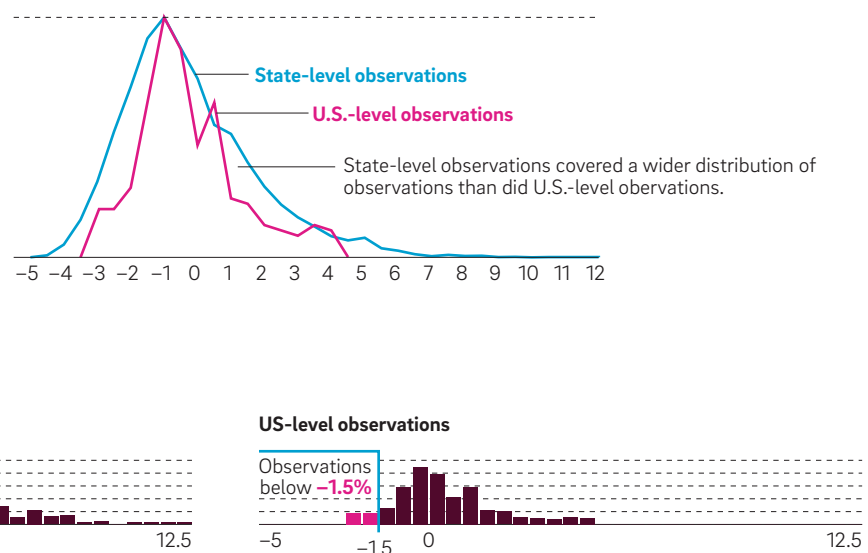
in the wage Phillips curve. Leduc et al. (2019), however, cast doubt on the presence of nonlinearity in their estimation of the wage Phillips curve. In contrast with other studies, Leduc et al. isolate movements of unemployment rates that are driven only by changes in labor demand and then examine how those demand-driven movements influence wage growth.⁹

Overall, although there is some disagreement in the literature on the presence of nonlinear effects of resource slack on wage and inflation pressures, the regional data generally reveal stronger Phillips curve relationships. This general finding suggests that, as the local labor market tightens, the inflationary pressure might be building up at the regional level, even when inflation has yet to surface at the national level. Thus, the regional-level Phillips curve analysis can be a useful tool to detect early signs of inflation.

Endogenous Monetary Policy

The literature points out another important advantage of the regional-level analysis over the aggregate time-series analysis: The regional Phillips curve analysis is much less susceptible to the bias in the estimated slope that arises due to endogeneity of monetary policy. Monetary policy attempts to stabilize inflation in response to various economic forces that drive unemployment up or

...but also cover a greater distribution of outcomes.



Source: Bureau of Labor Statistics, Congressional Budget Office.

down. Therefore, monetary policy is also endogenous, that is, part of the national economy. And to the extent that the Federal Reserve's monetary policy has been successful in stabilizing inflation, one may not actually observe the Phillips curve in the aggregate time-series data, even when such negative relationships actually exist. This is a logical explanation of why the Phillips curve can disappear at the national level even when the relationship exists at the local level. Fitzgerald and Nicolini (2014) point out this possibility, and McLeay and Tenreyro (2019) explore the idea further by using a New Keynesian dynamic stochastic general equilibrium (DSGE) model. Using this model as a laboratory, McLeay and Tenreyro run the experiments on how the observed Phillips curve relationships change under different monetary policy rules. They show that a disappearing Phillips curve relationship is a natural consequence of successful monetary policy.¹⁰

The national-level data are likely to be contaminated by the endogeneity of monetary policy, but the regional data are much less prone to this endogeneity, because cross-regional differences in unemployment rates and inflation are unaffected by monetary policy. The reemergence of the Phillips curve in the regional data supports this argument.

Mismeasurement of Inflation

As discussed above, many researchers have considered alternative measures of economic slack in estimating the Phillips curve. Their results are similar even when they use different measures. But the weakening Phillips curve relationship (at the national level) may stem from the measurement of inflation. Stock and Watson explore this idea.

Price measurement is challenging for a number of reasons. First, the market price of a particular good or service may be unavailable. For example, it is not possible to obtain the market price of a particular health care service. A more extreme example is services provided by churches and, more generally, by some nonprofit organizations, which are not even priced. But they are part of our consumption basket and thus should be (and indeed are) part of the overall PCE price index.¹¹

The second challenge concerns the quality adjustment of new goods. In calculating the price index, the basket of goods and services must be updated as new products are introduced into the market, replacing their older versions. New products tend to be priced higher, but the higher prices could be simply due to quality improvements. The price changes due to quality improvements should be removed from the observed price changes. But estimating the portion of the price change due to quality improvement is a daunting task. There are many other challenges in price measurement.¹²

Note that these challenges have always been present, but the problems might have become more severe in recent years, obscuring the aggregate-level Phillips curve relationship. To explore this idea, Stock and Watson divide the PCE price index into 17 subcategories of goods and services that differ in the degree of difficulty in measuring their prices. They then examine the Phillips curve relationship for each category separately. They find that Phillips curve slopes differ significantly between these categories. The slopes tend to be higher in services whose prices are determined in local markets and are relatively well measured, such as rent, recreational services, and food services. By aggregating those 17 subcategories weighted based on their cyclical

sensitivities, these authors construct an alternative to the PCE inflation rate, which they call the cyclically sensitive inflation (CSI) index. They show that the CSI-based Phillips curve is alive and well, even in recent years when the traditional Phillips curve appears to be dormant.

A general implication of Stock and Watson's exercise is that there are some categories of goods and services for which the Phillips curve relationship is clearly visible. They put more weight on these cyclically sensitive goods and services when constructing the overall price index, which allows them to "recover" the Phillips curve. But the authors do not get into the details of what exactly has caused inflation to be less sensitive to resource slack. Moreover, given that monetary policy is concerned with overall price stability—not the stability of a subset of the price index—it is not clear why and how Stock and Watson's findings should be utilized in monetary policy.

Summary and Implications for Monetary Policy

Aggregate data suggest that inflation has become less sensitive to resource slack. However, regional-level analysis reveals that the two measures remain strongly negatively related, although the evidence on nonlinearity is mixed. So one may

FIGURE 5

Inflation Rate Stuck Below 2 Percent

Year-over-year core PCE inflation rate, January 2008 to June 2019



Source: Bureau of Economic Analysis.

conclude that the Phillips curve relationship itself is still alive. Moreover, endogenous monetary policy supports the idea that successful monetary policy in recent years is actually the reason for the flattening of the national-level Phillips curve.

The flattening of the Phillips curve, if indeed it resulted from successful monetary policy, is excellent news for policymakers. There are, however, a few reasons to be cautious about this rosy conclusion. First, in all but a handful of months over the last 10 years, the core inflation rate has been below the Fed's target level of 2 percent (Figure 5). Similarly, even though inflation expectations have been stable overall, some measures of inflation expectations—in particular, the one based on inflation-indexed bonds—have been consistently below the 2 percent target in recent years. Over the same period, the U.S. labor market has consistently been improving. Some policymakers have raised a concern that inflation expectations are drifting away from the target.¹³ This observation casts some doubt on the assumption that monetary policy successfully controls inflation expectations and actual inflation.

Second, the environment surrounding American workers seems to be undergoing various structural changes, including an expansion of the gig economy, workplace automation via advances in artificial intelligence and robotics, and increasing employer concentration. These structural changes might be weakening worker bargaining power, thus suppressing wage growth.¹⁴ It is not surprising, it is even natural, then, that the wage Phillips curve is flattening.¹⁵ The price Phillips curve would not be immune to these structural changes, either. The changes in the wage-unemployment relationship would influence the inflation-unemployment relationship. Furthermore, the structural changes (or their underlying causes) might directly affect the pricing margin (i.e., the difference between the product price and the input cost) independently of the degree of labor market slack.

Given these caveats, there is no guarantee that monetary policy that has successfully stabilized inflation in the past will be similarly successful in the future. Monetary policy needs to be adjusted to the changing environment.

In regard to the research efforts on the Phillips curve, existing studies tend to focus on empirical relationships without clear theoretical underpinnings. Such theoretical frameworks would help identify the true underlying relationship between labor market slack and inflation (or wage growth) and thus provide a basis for sound monetary policy. 

Notes

- 1** The PCE price index gives the average price level of individual goods and services, based on the representative expenditure shares of goods and services. The core measure excludes gasoline and food prices from the underlying basket. The consumer price index (CPI) is an alternative measure.
- 2** One needs to estimate the slope of the Phillips curve via some econometric technique, allowing for some noise affecting the observed data. If the underlying true relationship is strong enough, one should be able to recover the true value of the slope once enough data points are accumulated.
- 3** Individuals exit the labor market for many different reasons. For example, some voluntarily retire or focus on raising their kids. But some might be discouraged by an unsuccessful job search. One could count this latter group as part of the labor market slack. See, for example, Kashkari (2017) for this view.
- 4** See Dotsey et al. (2018) and Hooper et al. (2019).
- 5** Hooper et al. (2019) and Leduc and Wilson (2017) present similar findings.
- 6** See, for example, Ball and Mazumder (2011), Nalewaik (2016), Albuquerque and Baumann (2017), Murphy (2018), and Gagnon and Collins (2019).
- 7** These authors use unemployment rates instead of the unemployment gap. This specification is equivalent to assuming that natural rates are constant over the period. For inflation, the PCE index is not available at the MSA level and thus these authors instead use the consumer price index (CPI). As in the national-level analysis, they focus on core inflation rates excluding food and energy.
- 8** To be more precise, Murphy focuses on testing for the presence of a particular form of nonlinearity, and Hooper et al.'s specification seems less restrictive in capturing the underlying nonlinear effects. The differences in the exact specifications might explain the differences in the results.
- 9** Isolating demand-driven movements in unemployment rates is appropriate, given the policymakers' interest in whether stimulative monetary policy leads to a sharp and sudden rise in wage growth.
- 10** In the academic literature, the behavior of the central bank is often described by a simple mathematical formula, the "monetary policy rule." A typical rule assumes that the central bank sets the interest rate to minimize variations in inflation and output. One can also consider different rules. What McLeay and Tenreiro show is that, under the rule that replicates the recent actual behavior of the Federal Reserve, the Phillips curve tends to disappear at the national level.

11 Prices of these services are estimated from the costs of providing the services. In principle, to the extent that those costs are tied to wages of the service providers, the same Phillips curve idea applies to these services as well.

12 See Stock and Watson (2019) and references therein.

13 See Bullard (2017), for example.

14 See Krueger (2018) and references therein. It is also widely recognized in the academic literature that labor's share of national income has fallen significantly over the last two decades. See for example Bergholt et al. (2019). This decline is likely related to these structural changes.

15 Note that, as discussed above, Leduc et al. (2019) find a flattening wage Phillips curve even in their regional-level analysis.

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Research Update

These papers by Philadelphia Fed economists, analysts, and visiting scholars represent preliminary research that is being circulated for discussion purposes.

The views expressed in these papers are solely those of the authors and should not be interpreted as reflecting the views of the Federal Reserve Bank of Philadelphia or Federal Reserve System.

Financial Characteristics of Cost of Funds Indexed Loans

Two recent articles by Hancock and Passmore (2016) and Passmore and von Hafften (2017) make several suggestions for improving the home mortgage contract to make homeownership more achievable for creditworthy borrowers. Though the proposals in the two papers differ in some aspects, one common feature is an adjustable rate indexed to a cost of funds (COF) measure. Such indices are based on the interest expense as a fraction of liability balance for one or a group of depository institutions. One of these, the 11th District Cost of Funds (COF) Index, was in wide use in the 1980s and 1990s, but use has fallen off since then. COF indices have the advantage that they are less volatile than market-based indices such as the one-year U.S. Treasury rate, so that borrowers are not exposed to rapid increases in payments in a rising rate environment. We analyze COF-indexed adjustable-rate mortgages (ARMs) from the point of view of the lender. First we develop a methodology for constructing a liability portfolio that closely tracks the specific COF index proposed by Hancock and Passmore and Passmore and von Hafften. We then explore the financial characteristics of this liability portfolio. We show that the liability portfolio, and by implication the

mortgages it would fund, share a characteristic of fixed-rate mortgages: Values can vary significantly from par if rates change. This creates two problems for lenders: Pricing of COF-indexed ARMs is difficult because it depends not only on current interest rates but also on interest rates when principal is repaid, either through amortization or prepayment. Second, deviations from par make mortgage prepayment options valuable, so that lenders offering the product must manage option risk as well as interest rate risk. We conclude that while mortgages using a COF index have clear benefits for borrowers, they also are more difficult for lenders to price accurately. Further, once they are in lenders' portfolios, they increase the complexity of interest rate risk management. While these issues do not imply that COF indices cannot be part of innovative new mortgage designs, understanding their financial characteristics may contribute to the search for a better mortgage

Working Paper 19-25. Patrick Greenfield, Federal Reserve Bank of San Francisco; Arden Hall, Federal Reserve Bank of Philadelphia Supervision, Regulation, and Credit Department.

Should Central Banks Issue Digital Currency?

We study how the introduction of a central bank-issued digital currency affects interest rates, the level of economic activity, and welfare in an environment where both central bank money and private bank deposits are used in exchange. Banks in our model are financially constrained, and the liquidity premium on bank deposits affects the level of aggregate investment. We study the optimal design of a digital currency in this setting, including whether it should pay interest and how widely it should circulate. We highlight an important policy tradeoff: While a digital currency tends to promote efficiency in exchange, it can also crowd out bank deposits, raise banks' funding costs, and decrease investment. Despite these effects, introducing a central bank digital currency often raises welfare.

Working Paper 19-26. Todd Keister, Rutgers University and Federal Reserve Bank of Philadelphia Visiting Scholar; Daniel Sanches, Federal Reserve Bank of Philadelphia Research Department.

Pre-event Trends in the Panel Event-Study Design

We consider a linear panel event-study design in which unobserved confounds may be related both to the outcome and to the policy variable of interest. We provide sufficient conditions to identify the causal effect of the policy by exploiting covariates related to the policy only through the confounds. Our model implies a set of moment equations that are linear in parameters. The effect of the policy can be estimated by 2SLS, and causal inference is valid even when endogeneity leads to pre-event trends ("pre-trends") in the outcome. Alternative approaches perform poorly in our simulations.

Working Paper 19-27. Simon Freyaldenhoven, Federal Reserve Bank of Philadelphia; Christian Hansen, University of Chicago; Jesse M. Shapiro, Brown University and NBER.

Do Minimum Wage Increases Benefit Intended Households? Evidence from the Performance of Residential Leases

Prior studies debating the effects of changes to the minimum wage concentrate on impacts on household income and spending or employment. We extend this debate by examining the impact of changes to the minimum wage on expenses associated with shelter, a previously unexplored area. Increases in state minimum wages significantly reduce the incidence of renters defaulting on their lease contracts by 1.29 percentage points over three months, relative to similar renters who did not experience an increase in the minimum wage. This represents 25.7 percent fewer defaults posttreatment in treated states. To put this into perspective, a 1 percent increase in minimum wage translates into a 2.6 percent decrease in rental default. This evidence is consistent with wage increases having an immediate impact on relaxing renter budget constraints. However, this effect slowly decreases over time as landlords react to wage increases by increasing rents. Our analysis is based on a unique data set that tracks household rental payments.

Working Paper 19-28. Sumit Agarwal, National University of Singapore; Brent W. Ambrose, The Pennsylvania State University and Federal Reserve Bank of Philadelphia Consumer Finance Institute Visiting Scholar; Moussa Diop, University of Wisconsin–Madison and Federal Reserve Bank of Philadelphia Consumer Finance Institute Visiting Scholar.

The Effects of Gentrification on the Well-Being and Opportunity of Original Resident Adults and Children

We use new longitudinal census microdata to provide the first causal evidence of how gentrification affects a broad set of outcomes for original resident adults and children. Gentrification modestly increases out-migration, though movers are not made observably worse off and neighborhood change is driven primarily by changes to in-migration. At the same time, many original resident adults stay and benefit from declining poverty exposure and rising house values. Children benefit from increased exposure to higher-opportunity neighborhoods, and some are more likely to attend and complete college. Our results suggest that accommodative policies, such as increasing the supply of housing in high-demand urban areas, could increase the opportunity benefits we find, reduce out-migration pressure, and promote long-term affordability.

Working Paper 19-30. Quentin Brummet, NORC at the University of Chicago; Davin Reed, Federal Reserve Bank of Philadelphia Community Development and Regional Outreach.

Freeway Revolts!

Freeway revolts were widespread protests across the U.S. following early urban interstate construction in the mid-1950s. We present theory and evidence from panel data on neighborhoods and travel behavior to show that diminished quality of life from freeway disamenities inspired the revolts, affected the allocation of freeways within cities, and changed city structure. First, actual freeway construction diverged from initial plans in the wake of the growing freeway revolts and subsequent policy responses, especially in central neighborhoods. Second, freeways caused slower growth in population, income, and land values in central areas but faster growth in outlying areas. These patterns suggest that in central areas, freeway disamenity effects exceeded small access benefits. Third, in a quantitative general equilibrium spatial model, the aggregate benefits from burying or capping freeways are large and concentrated downtown. This result suggests that targeted mitigation policies could improve welfare and helps explain why opposition to freeways is often observed in central neighborhoods. Disamenities from freeways, versus their commuting benefits, likely played a significant role in the decentralization of U.S. cities.

Working Paper 19-29. Jeffrey Brinkman, Federal Reserve Bank of Philadelphia Research Department; Jeffrey Lin, Federal Reserve Bank of Philadelphia Research Department.

History Remembered: Optimal Sovereign Default on Domestic and External Debt

Infrequent but turbulent overt sovereign defaults on domestic creditors are a “forgotten history” in macroeconomics. We propose a heterogeneous-agents model in which the government chooses optimal debt and default on domestic and foreign creditors by balancing distributional incentives versus the social value of debt for self-insurance, liquidity, and risk-sharing. A rich feedback mechanism links debt issuance, the distribution of debt holdings, the default decision, and risk premia. Calibrated to euro zone data, the model is consistent with key long-run and debt-crisis statistics. Defaults are rare (1.2 percent frequency) and preceded by surging debt and spreads. Debt sells at the risk-free price most of the time, but the government’s lack of commitment reduces sustainable debt sharply.

Working Paper 19-31. Pablo D’Erasmus, Federal Reserve Bank of Philadelphia Research Department; Enrique G. Mendoza, University of Pennsylvania, NBER, PIER Federal Reserve Bank of Philadelphia Visiting Scholar.

Forthcoming

How Low (or High) Can
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