

Economic Insights

First Quarter 2022
Volume 7, Issue 1

Banking Trends

Meet the New Borrowers

The Costs and Benefits of
Fixing Downtown Freeways

Q&A

Research Update

Data in Focus



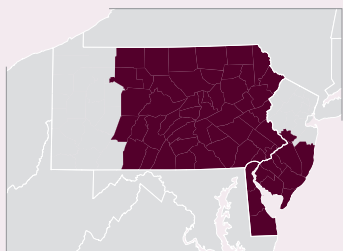
Economic Insights

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Economic Insights features nontechnical articles on monetary policy, banking, and national, regional, and international economics, all written for a wide audience.

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About the Cover

Philadelphia from the Art Museum

The cover photo of Philadelphia encompasses almost every stage of the city's development. In the midground, partially obscured by the statue, is Logan Square, one of the five squares city founder William Penn and his surveyor, Thomas Holme, included in their 1687 city plan. In the distance looms City Hall, a testament to the post-Civil War boom; it was the tallest building in the world upon its completion in 1894. In the near distance is Rudolf Siemering's 1897 Washington Monument. The monument and City Hall are connected by the Benjamin Franklin Parkway, the City's post-World War I attempt to tame the unruly, industrial metropolis with open vistas, museums, and classical architecture. Starting in the 1970s, a downtown building boom led to the construction of numerous skyscrapers, visible to the right. Few images so fully convey Philadelphia's complex and varied history, culture, and economy.

Photograph by Brendan Barry.

Q&A...

with Jeffrey Brinkman,
a senior economist here
at the Philadelphia Fed.



Jeffrey Brinkman

Senior economist Jeffrey Brinkman grew up outside Columbus, Ohio, the son of an engineer and a high school math teacher. He studied electrical engineering at The Ohio State University before switching to public policy and then economics, earning his doctorate from Carnegie Mellon University in 2011. For the past 11 years, he has researched and written about urban economics and the local consequences of policymaking for the Philadelphia Fed.

What led you to study engineering in college?

I was more interested in physics, but engineering seemed like a practical form of physics, with a job waiting at the end of college. But my first job after college, I wasn't doing research and design. I was in quality control. That environment was less interesting to me.

Is designing a model in economics similar to the kind of work you were hoping to do in engineering?

Yes. A lot of people don't realize that we do a lot of math and computational modelling in economics. When I got to grad school in economics, I just had to learn a new vocabulary. The actual work is very similar to engineering.

It sounds like what drew you to both engineering and economics was the opportunity to solve problems.

Yes. There's nothing better than writing down a mathematical model and trying to solve it on the computer. It's a very focused activity.

You've lived in Los Angeles, Pittsburgh, Detroit, and Philadelphia. How did living in these different cities shape your thinking about urban economics?

Before I moved to Los Angeles, I thought, if you want walkable neighborhoods, all you need is density. Well, Los Angeles is one of the densest cities in the country, and yet it's very auto dependent. There are other dimensions for cities besides density—things like, how the streets are laid out, whether the city was built in the 19th or 20th century. Cities built today tend to have less transit infrastructure because now we have cars. All these dimensions matter. A city isn't just your standard model with a central business district surrounded by residences.

Models are supposed to be applicable to different situations, but you're also pointing out that every city is unique. How do you reconcile your models with all these differences among cities?
Models should make our thinking more

concrete, so that we all know what we're talking about, but they should also allow us to measure differences. Like in our article about freeways. Our model helped us measure the size of the negative effects of freeways on central cities. As our models get more sophisticated, they capture that heterogeneity, but more sophistication means more complication and maybe less clarity of what they're trying to tell us. So, there's a tradeoff between "let's try to model everything" and "let's have a simpler model where I can get intuition about what's going on."

For your article, you applied cost-benefit analysis to the proposal to cap I-95 through central Philadelphia. Did local transportation authorities use cost-benefit analysis when designing these freeways in the first place?

They did, but it was all about, what are the transportation benefits of these highways? How do we get people into and out of the city? How do we move goods? They weren't considering these big negative effects on central cities. Even urban mayors at the time were like, this is going to revive the city, this is going to bring people into the city. But the exact opposite happened. The highways took people out of the city. They allowed people to live farther away, and because there are these big negative amenity effects for the neighborhoods nearby, that pushed people out of the city, too. People quickly realized that this was a problem. It led to protests everywhere.

It sounds like the public blowback was in part a response to the unquestioned assumptions of the planners in their modelling and cost-benefit analysis.

That's one of the things I enjoy. I love identifying unintended consequences. People have been yelling about this for years, but I think we're among the first economists to quantify these freeway disamenities. Learning how to look at the data is important. It's not just, "locations near freeways declined." It's, "locations in central cities near freeways declined." You have to get into the model and think about the economics of it to understand how to look at the data. ■



Banking Trends

Discrimination in Mortgage Markets

Automated underwriting may reduce but likely does not end discrimination against racial minorities.

Edison Yu

Economic Advisor
and Economist
FEDERAL RESERVE BANK
OF PHILADELPHIA

*The views expressed
in this article are not
necessarily those of
the Federal Reserve.*

Racial discrimination has haunted mortgage markets for decades, prompting legislation and public policy debates that continue to shape how all of us get our mortgages. A new technology may help reduce this discrimination.

Previous research into mortgage markets has shown evidence of a century's worth of racial discrimination, including redlining, unequal mortgage access, and differences in mortgage costs. Federal, state, and local governments have responded to this discrimination by enacting laws such as the federal Fair Housing Act of 1968.¹

These laws are not relics of a vanished era. Many banks were recently fined a large amount of money due to antidiscrimination lawsuits. For example, in 2019, Wells Fargo Bank wrote the City of Philadelphia a check for \$10 million to settle a lawsuit alleging that the bank engaged in discriminatory lending practices.²

Some analysts argue that algorithmic or automated underwriting (AU), which has become increasingly popular in mortgage markets,

renders lenders less likely to discriminate because it does not use race as an input and presumably bases loan decisions only on the applicant's financial data, limiting the discretionary judgement of human decisionmakers. If that's the case, then AU may help antidiscrimination efforts. This is why we need to study AU's impact on the mortgage lending business.

Researchers disagree as to how best to measure racial discrimination in the mortgage markets, so, before studying AU's impact on antidiscrimination efforts, I survey the history of the statistical methods used to identify racial discrimination. Although it may seem straightforward, identifying racial discrimination is challenging since researchers cannot observe all the information used by loan officers or borrowers. I then describe how, in a previously published working paper, my coauthors and I addressed this challenge by using high-frequency data. I conclude by exploring preliminary evidence on the effects of AU on racial discrimination in the mortgage markets.

The Mortgage Application Process

In the U.S., a mortgage application typically starts with a borrower contacting a potential lender to inquire about mortgage products. The borrower usually has an initial conversation with a loan officer, who is the front person within the lender organization responsible for communicating with the borrower. The loan officer can gauge the borrower's initial eligibility by using the borrower's basic financial information, such as the loan amount needed and credit scores, and guide the borrower to select a mortgage product. Once a mortgage product is selected, the borrower can submit a formal mortgage application.

Increasingly in recent years, borrowers have contacted potential lenders over the Internet.³ Borrowers search for potential mortgage products on mortgage-shopping platforms such as Zillow or with fintech lenders such as Quicken Loans.⁴ After the initial search, a borrower is contacted by the lender, usually by the lender's loan officer. Even at fintech lenders, human loan officers are involved in the application process.

The loan officer's involvement does not end with the initial contact. After a borrower submits a formal application, the loan officer ensures that the borrower has submitted all the necessary documentation, such as verification of income and employment, credit reports, and property appraisal reports. The officer also ensures the accuracy of the information in the application. Once the application is complete, the loan officer sends it to a loan underwriter, who makes the final credit decision based on the application and supporting documents. Although loan officers do not make final credit decisions, they influence the potential credit decision by nudging the borrower to provide timely and accurate documentation. Thus, a loan officer's racial bias can still affect the outcome of a mortgage application. For example, a loan officer might not inform a minority applicant of an incomplete application in a timely manner, leading to rejection of the application by the underwriter.

Many lenders increasingly rely on AU, which was used in about 56 percent of mortgage applications in 2019. An AU system processes an applicant's financial information and recommends whether to approve the loan. This recommendation is generated by a computer, not a human. These underwriting systems do not use race as an input and presumably base loan decisions only on the applicant's financial data. Antidiscrimination regulations allow lenders, when making loan decisions, to use variables directly related to credit history and risks, but they prohibit lenders from discriminating on the basis of race, religion, color, national origin, sex, familial status, or disability status.⁵

However, there are a few reasons why the final credit decision might still be biased. Algorithms may produce decisions that unintentionally correlate with impermissible variables (such as race and gender).⁶ Since the algorithms can be quite complicated, decision makers may not understand that the algorithms are making biased underwriting choices.⁷ In addition, a loan officer's bias may affect the timeliness and completeness of the information input into the AU system. Finally, lenders do not completely

rely on the AU-generated recommendation; a human underwriter still makes the final loan decision. AU decisions are only recommendations. So, the final loan decision may still be biased.

Identification of Racial Discrimination Using Observational Data

Social scientists have documented racial disparities in a wide range of areas, including in labor markets, credit markets, and the legal system. Because of the limitations of empirical tests, social scientists disagree as to whether or not these disparities are the result of discrimination by economic decision makers.

The two main types of tests used to identify racial discrimination are benchmarking tests and outcome tests. Benchmarking tests (also known as audit tests) use observational data in a straightforward way to test for discrimination. In the context of mortgage lending, if, after adjusting for credit risks, a minority group receives a lower average approval rate or higher interest rate for the same mortgage product, then the test has identified discrimination. Benchmarking tests are useful because they can be executed in real time.⁸ However, benchmarking tests are

vulnerable to omitted-variable bias. The omitted variables are the differences in group characteristics that the researcher does not observe but that can cause differences in evaluations. For example, minority applicants might have riskier financial profiles, and the approval rate gap seen in the data could reflect differences in credit risk rather than discrimination.

One common approach for solving this problem is to include additional variables as control variables in the analysis.

For example, one can look at the mortgage approval gap when comparing minority and majority applicants while controlling for financial variables such as income and credit risk. However, no researcher has data on all the variables observed by decision makers or borrowers. For example, researchers may not have the "soft" information that loan officers have from their interactions with borrowers. In antidiscrimination lawsuits where minority applicants charge that they received a higher interest rate or larger fees, an oft-used counterargument is that minority applicants do not shop around as much as majority applicants. That kind of data is not generally available to researchers, regulators, or even lenders. So, although it helps to include more control variables, they cannot eliminate the omitted-variable bias problem.

An alternative is to use an outcome test. Instead of comparing differences in how groups are evaluated, such as approval rates, outcome tests compare the subsequent performance of successful applicants through, for example, default rates.⁹ Suppose there is a cutoff of application quality, below which the application will be rejected. The applicant who just barely meets the cutoff is the marginal applicant. If there is discrimination, the minority group will face a higher threshold for inclusion, and the marginal minority applicant will thus have better ex post outcomes (for example, a lower default rate) than the marginal majority applicant.

AU may help anti-discrimination efforts. This is why we need to study AU's impact on the mortgage lending business.

Though intuitively appealing, outcome tests are notoriously difficult to implement. We rarely have data that enable us to identify the marginal applicant, so researchers usually use average quantities (such as the average default rate) instead. But the average difference in ex post outcomes can be a poor approximation of the difference in marginal outcomes. Since we observe only average performance, an observation that the default rate among African Americans is the same as among whites, for example, should not be interpreted as evidence of nondiscrimination.¹⁰ Studies using this approach are less likely to find evidence of discrimination.¹¹ Thus, implementing an outcome test is very challenging, and many papers in the literature have pointed out its limitations.¹² For that reason, I focus on benchmarking tests.

Evidence of Racial Discrimination in the Mortgage Markets

There is a long history of attempts to identify racial discrimination in the mortgage markets using observational data. Many of these papers try to solve the omitted-variable problem by including more control variables in the statistical analysis.

This literature can be traced back at least as far as the 1996 work of the former director of research at the Federal Reserve Bank of Boston, Alicia Munnell, and her coauthors. In that paper, the authors use the 1990 Home Mortgage Disclosure Act (HMDA) data, but they also use information from a survey that collects additional information from lending institutions operating in the Boston metropolitan statistical area.¹³ This additional information includes financial, employment, and property characteristics relevant to a lending decision but missing from the HMDA data. The survey sample covers all applications for conventional mortgage loans made by African American and Hispanic American applicants and a random sample of 3,300 applications made by white applicants. When using the HMDA data alone, the paper finds that the rejection rate of minority applicants is 18 percentage points higher than that of white applicants. When the researchers controlled for the additional information from the survey, the disparity between the rejection rates of minority and white applicants declined to just over 8 percentage points. These results show the importance of controlling for relevant variables absent from the HMDA data set. Still, the rejection rate gap remains large even after adding the controls. Many early papers in the literature show similar results.¹⁴

In a recent paper, University of California, Berkeley, law professor Robert Bartlett and his coauthors examine whether African Americans and Hispanic Americans pay higher mortgage interest rates than white Americans, and whether this pricing differential remains when the origination is automated. To address the omitted-variable problem, they merged 2009–2015 HMDA data with other data sets that include information about interest rates, the names of lenders, and loan performance. In addition, by using a sample of mortgages insured by a government-sponsored enterprise (GSE), they filter out the default and prepayment risks borne by the lenders. Thus, any disparity in the interest rates paid by minority and majority borrowers should reflect racial discrimination, not credit risk. They find that Hispanic American and African American borrowers collectively

pay an additional 7.9 and 3.6 basis points in interest rates for, respectively, purchase mortgages and refinance mortgages. They also find a 40 percent lower level of price discrimination if the lender is a fintech firm, which suggests that AU reduces but does not eliminate discrimination.

However, in their 2021 article, Federal Reserve economists Neil Bhutta and Aurel Hizmo account for more pricing variables, such as discount points and fees, and find no evidence that minorities pay more in mortgages. They supplement the 2014–2015 HMDA data with administrative data from the Federal Housing Administration (FHA) on all FHA-insured mortgages, and with information on points and fees from Optimal Blue, a leading provider of secondary marketing solutions and data services in the mortgage industry. They find a statistically significant gap in interest rates paid by race, but the gap is offset by differences in discount points. They argue that the differences in interest rates across racial groups found in the earlier papers are a result of African American borrowers choosing mortgage products with higher interest rates but lower points, potentially because minority borrowers may find it more difficult to put funds up front. This finding is restricted to FHA mortgages; whether the results generalize to other samples, such as the more GSE-dominated sample used by Robert Bartlett and his coauthors, remains unclear. Notably, lenders who provide FHA mortgage products tend to serve lower-income and minority communities and thus may be less biased.

In another recent paper, Penn State professor of real estate Brent Ambrose and his coauthors find that pricing disparities in mortgage contracts are influenced by whether the borrower and broker are of the same race. They used a novel data set that covers all mortgages approved and funded by New Century Financial Corporation, a now-defunct real estate investment trust, between 2003 and 2007. These loans are representative of the overall subprime market before the Great Recession. This data set comprises more than 300,000 mortgages originated by 124,736 individual brokers, and it contains a rich set of control variables. In addition, the data set includes the names of the brokers. When the authors used a surname-geocoding algorithm to infer each broker's race, they found that minorities pay more in fees than similarly qualified whites, but the premium paid by minorities depends on whether the broker shares their race. For example, African American borrowers who obtain a loan through a white mortgage broker pay 14 percent more than white borrowers who work with a white broker, but this premium is lowered to 6 percent when the broker is African American.

For a 2021 working paper, Neil Bhutta and his coauthors studied the impact of AU on racial discrimination using a newly available data set from HMDA. This 2018–2019 HMDA data set provides a longer list of variables—including credit scores, debt-to-income ratios, and AU recommendations—than did earlier HMDA data sets. When they focused on the sample of loans that utilized the AU system, they found that, by controlling for AU recommendations and using these new loan-level variables, the racial gap in mortgage denial rates fell to about 1–2 percentage points. They argue that the remaining gap might be explained by unobserved characteristics of the borrowers, which suggests a more limited role for racial discrimination in mortgages that use AU.

All of these researchers find that the racial gap in mortgage approval rates and costs is very large in the data, but some of this gap can be explained by factors such as credit risk. The question is whether the remaining racial gap is caused by racial bias or by insufficient control of omitted variables. Many of these papers attempt to reduce the problem of omitted variables by adding control variables to the analysis. However, it is difficult to know whether the additional variables eliminate the bias. In addition, these and other papers use samples across different data sets or cover different time periods. This makes it difficult to compare results.

Testing for Discrimination Using High-Frequency Data

In a recent research paper, my coauthors and I took a different approach to address the challenges of identifying racial discrimination.¹⁵ With some assumptions, this approach avoids the problem of omitted variables by employing high-frequency data. We used time variation in loan officers' loan approval decisions to draw

inferences about likely discriminatory behavior. We also used the entire HMDA data set from 1994 through 2019, which covers most mortgage applications in the U.S. during those 25 years, making our sample more comprehensive than samples used in earlier work. After discussing this new approach, I will show how we used this new approach to ascertain the impact of AU on discrimination.

First, we find that the volume of mortgage originations increases over the course of a calendar month (Figure 1).¹⁶ The number of loans originated on the last day of a month is almost twice as high as on the first day of the month. There is no similar pattern in application volume. This bunching pattern in originations is likely caused by loan officers' incentive to meet their month-end quota. Loan officers tend to receive a commission that equals a percentage of the total dollar amount they originate during the month. They can also receive a bonus for meeting their monthly origination target. Loan officers who fail to meet volume targets can be disciplined and risk getting fired. Our key insight is that this pressure to meet

month-end quotas makes it costlier for loan officers to discriminate at the end of a month.

At the same time, we observe that the mortgage approval gap between white and African American applicants shrinks over the course of the month (Figure 2). In the first seven days of a calendar month, the approval rate gap is close to 20 percent. The gap shrinks in the last days of the month and reaches the lowest point of around 10 percent on the last day of the month. When we control for many observable variables, the approval rate gap shrinks to almost zero on the last day of the month (Figure 3).

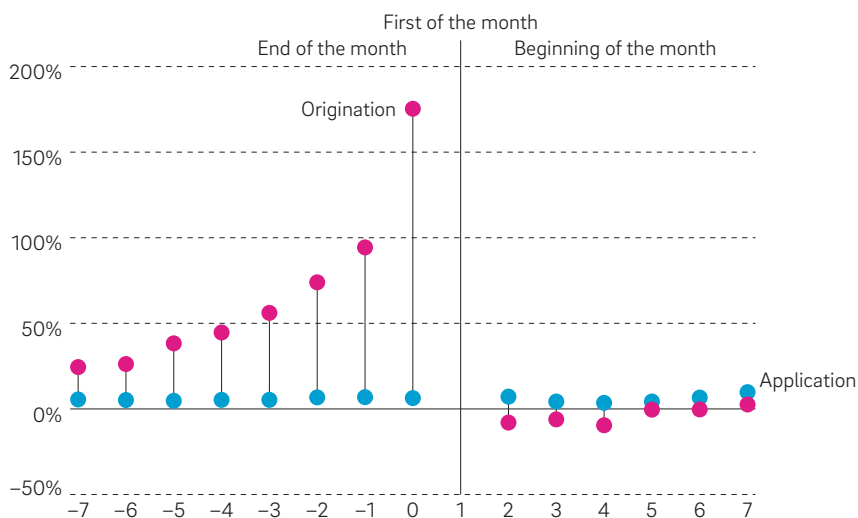
The higher-frequency daily data help us address the omitted-variable bias. In our paper, we discuss a number of potential omitted variable issues. The reduction in the approval gap within a month, as seen in Figure 3, might be attributed to an unobserved within-month movement of application quality rather than changes in discrimination. For example, the gap would be explained without reference to discrimination if the quality of African American applications is higher toward

FIGURE 1

Originations Surge as the Month Ends

Loan officers approve more applications toward the end of the month, most likely to meet their monthly quotas.

Daily loan applications and originations, as a percentage of loan applications and originations on the first day of the month, 1994–2019



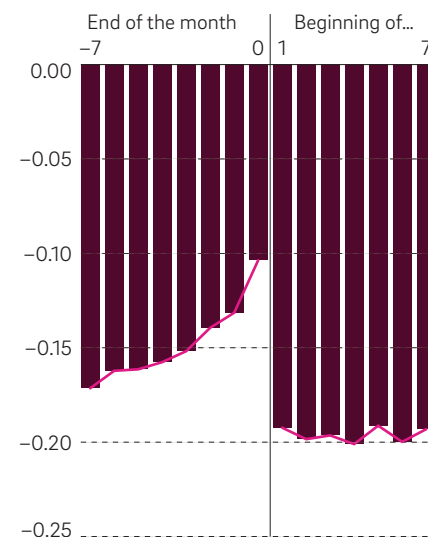
Source: Home Mortgage Disclosure Act (HMDA) data set, Board of Governors of the Federal Reserve System.

Note: The number 0 on the horizontal axis indicates the last day of a calendar month, the positive numbers indicate the first seven days of the month, and the negative numbers indicate the last days of the month.

FIGURE 2

The Approval Rate Gap Shrinks Toward the End of the Month

Approval rate for African American applicants minus rate for white applicants in the seven days preceding and succeeding the first of the month, 1994–2019



Source: Home Mortgage Disclosure Act (HMDA) data set, Board of Governors of the Federal Reserve System.

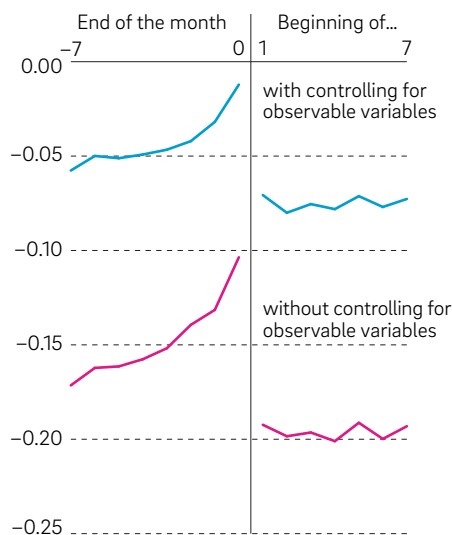
Note: This figure does not consider observable factors that might affect the approval decision.

the end of a month.¹⁷ But we do not see a within-month bunching pattern in application composition and observed applicant quality in the data. Minority borrowers do not seem more likely to submit applications toward the end of the month. Nor do we find evidence that omitted variables—including application quality—change within the month. For example, the share of applicants with an income lower than the county median is stable over the course of the month. This income test serves as a proxy for other potential differences between applicants. Furthermore, the ex post default rate gap doesn't vary over the course of the month. Our findings suggest that the shrinking approval rate gap is likely not caused by application- or applicant-related factors.¹⁸ Therefore, using the high-frequency data allows us to attribute the decline in discrimination to loan officers rushing to meet their monthly quotas.

FIGURE 3

The Approval Rate Gap Shrinks to Nearly Zero When We Control for Other Variables

Approval rate for African American applicants minus the rate for white applicants in the seven days preceding and succeeding the first of the month, controlling for several observable variables, 1994–2019



Source: Home Mortgage Disclosure Act (HMDA) data set, Board of Governors of the Federal Reserve System.

Note: Figure 3 plots the average approval rate residual gap from a regression of approval rates on loans and application characteristics from HMDA, such as loan amount, applicant income, and whether the loan was for purchase or refinance.

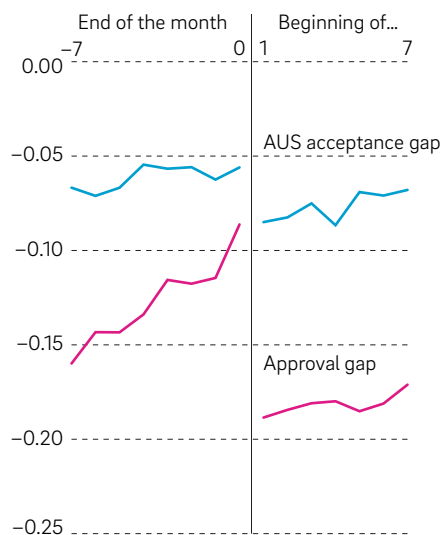
We find that the time-varying discrimination explains about 3.5–5 percentage points of the approval rate gap, which is about half of the unexplained approval rate gap of 7 percent after controlling for observable loan-level characteristics.

Our research also enables us to test the theory that AU reduces discrimination in the mortgage markets. We find that the gap in AU recommendations is nearly constant over the course of the month, which suggests less racial bias in AU decisions. Nonetheless, the approval rate gap of human-made decisions decreases for lenders that use an AU system (though not as much as for lenders that do not).¹⁹ This implies that there can still be racial bias when a human is making the approval decision, even after receiving an AU recommendation (Figure 4). Consistent with previous studies, our research shows that AU seems to reduce but does not eliminate the racial gap in approval rates

FIGURE 4

Even When Loan Officers Use AU, They Tend to Reject African American Applicants More Often Than AU Recommends

AU's approval rate gap between African American and white applicants versus the actual approval rate gap among lenders who use AU, 2018–2019



Source: Home Mortgage Disclosure Act (HMDA) data set, Board of Governors of the Federal Reserve System.

in the mortgage markets. One possible criticism of our methodology is that the within-month variation in the approval gap merely reflects differences in how long it takes to complete the origination process. For example, the shrinking approval rate gap can be a result of African American borrowers being more likely to settle their housing transactions (and hence mortgage applications) at the end of a month. But we find little evidence that racial differences in the time between application and origination vary within the month.

Conclusion

Researchers have long documented racial discrimination in the mortgage markets, and that literature is growing as AU prompts them to study its impact on antidiscrimination efforts in the mortgage-lending business. In this article, I summarize work by some earlier and more recent researchers who studied racial discrimination in the mortgage markets. Except for Bhutta and Hizmo's 2021 article, most papers find that there is at least some racial bias in the mortgage markets.

Papers in the literature attempt to reduce the problem of omitted variables largely by adding more control variables to the analysis. However, it is difficult to know whether the additional variables eliminate the bias. My research shows an approach that could solve the problem of omitted variables by using high-frequency data.

A 2021 working paper by Bhutta, Hizmo, and Federal Reserve economist Daniel Ringo, as well as my research using the high-frequency data approach, both show that AU seems to reduce but not eliminate the racial approval rate gap in the mortgage markets. Based on these findings, policymakers might want to encourage the use of AU to help reduce racial discrimination. However, data are available only for the last few years, so research in this area is still relatively new. Further research is needed to confirm our findings. 

Notes

1 Some analysts argue that such regulations are unnecessary and that market competitive pressures undermine the desire to discriminate. See, for example, Becker (1957).

2 See McCabe (2019).

3 See Buchak et al. (2018) and Fuster et al. (2019) for examples.

4 Fintech lenders use innovative technology designed to outperform traditional financial methods in the delivery of financial services.

5 According to the law, both “taste-based” and “statistical” discrimination are illegal. In economics, taste-based discrimination refers to discrimination as a result of prejudice, while statistical discrimination refers to decisions that unintentionally correlate with impermissible variables.

6 This would constitute statistical discrimination.

7 See Fuster et al. (forthcoming) for an example.

8 This is in contrast to results from experimental studies, which are more difficult to implement.

9 See Becker (1957).

10 Suppose that there are two, easily distinguishable types of white mortgage applicants: those who have a 1 percent chance of defaulting on a mortgage, and those who have a 50 percent chance. Similarly, assume that African American applicants have either a 5 percent or 50 percent chance of defaulting. If lenders are biased and approve white applicants who have a default rate of no more than 10 percent and African American applicants who have a default rate of no more than 5 percent, these decisions will generate observed ex post average default rates of 1 percent for white borrowers and 5 percent for African American borrowers. This is a case

when the ex post default rate is higher for the minority group while there is discrimination, contrary to what the outcome test would suggest if we observe decision thresholds for the marginal borrowers.

11 See, for example, Berkovec et al. (1998).

12 See Ayres (2002) and Canay et al. (2020) for examples.

13 HMDA data are among the earliest and most comprehensive mortgage application data sets in the U.S. One of Congress’s goals in enacting the HMDA in 1975 was to identify possible discriminatory lending patterns in the data collected. HMDA data are also used for Community Reinvestment Act bank exams.

14 See Ladd (1998) for a survey of the older literature.

15 See Giacoletti et al. (2021).

16 The figure shows the average loan origination number by calendar days of month. We can also restrict the end of the month to be immediately before the beginning of the month, but the results would look very similar.

17 Similarly, another example that can explain the time-varying approval rate gap is changing underwriting standards. But as shown later in this article, there is no evidence of changes in underwriting standards or application quality within a month.

18 Some regressions in our paper control for additional variables, such as credit scores and low-documentation status, by using a sample that merges HMDA and Black Knight McDash data. The results are similar.

19 The acceptance rate gap of AU shrinks by about 1–2 percentage points within-month, and the approval rate gap decreases by about 6–7 percentage points within-month.

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Meet the New Borrowers

Credit history is critical for credit access, and it's more than just a history of repayment.

Igor Livshits

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*The views expressed
in this article are not
necessarily those of
the Federal Reserve.*

Financially responsible households benefit from access to credit.¹ The ability to borrow against future income helps these households buy their homes, invest in their education, and maintain their preferred level of consumption despite the occasional shock to their income.²

Credit access is an important part of the conversation when it comes to social inequality and discrimination. When certain social groups can't access credit, it contributes to and perpetuates inequality in overall economic outcomes. For example, exclusion from (affordable) mortgages is a barrier to homeownership and geographic mobility, both of which in turn affect children's educational outcomes and social mobility. Consequently, any discrimination in access to credit can have a long-lasting detrimental effect on communities subject to such discrimination.

Access to credit can be determined in no small part by one's credit history, which is often summarized

by a credit score (such as the FICO score). These scores are easy to read and compare.³ For example, discrimination can simply be defined as different treatment of two individuals with identical credit scores. However, when investigating the presence of discrimination in the marketplace, it may not be enough to check whether individuals from different social groups are treated equally conditional on their credit score. Sometimes, underprivileged borrowers fail to achieve a good credit score in the first place because of their inability to build a credit history.⁴

The traditional view is that a credit history is a history of repayment. But new borrowers (who are the focus of this article) have had little time to establish such a record of paying on time. This brings us to our Catch-22: You need a credit history to get credit, and you need credit to build a credit history. This Catch-22 is particularly pronounced at the initial stage of the credit life cycle, which is the

subject of this article. And it is likely to be especially pronounced for individuals from an underprivileged background because these individuals cannot “piggyback” on their parents’ credit histories.

With that in mind, I will highlight an additional role of credit history. A credit history is also a record of borrowing, that is, of loan approvals. In this article, I examine the initial stage of the credit life cycle to better understand how inequality manifests itself in individuals’ gaining access to credit, and I examine how emerging borrowers overcome our Catch-22.

The Unscored and the Invisible

Until recently, there was little academic research into the early stages of the credit life cycle and the dynamics of access to credit among emerging borrowers. But that’s changing thanks in part to researchers gaining access to anonymized credit records data. By using such data in their 2017 article, economists Kenneth P. Brevoort and Michelle Kambara, both then at the Consumer Finance Protection Bureau (CFPB), answer some of my key questions. (Later in this article I refer to their findings alongside my own.)

In important related work that also uses anonymized credit records data, Brevoort, Kambara, and economist Philipp Grimm, who was also at the CFPB at the time, studied “credit invisibles” and “unscorable” individuals. “Credit invisibles” are individuals who have no record with one of the three major credit-reporting agencies.⁵ It is difficult to study those you cannot see. But we can compare the population in credit bureau files with the population in the U.S. Census to figure out who is missing from the former. Unlike the credit invisibles, people who are unscorable have a record with the credit-reporting agency, but their file is “too thin” to generate a reliable credit score. Brevoort, Grimm, and Kambara rightfully refer to these individuals as “unscored,” highlighting the conceptual possibility of assigning a score, especially if alternative data sources are permitted.

A key takeaway from Brevoort, Grimm, and Kambara’s 2016 article is that neighborhoods with a greater share of underprivileged individuals have a greater prevalence of credit invisibility. Perhaps most notably, these economists also find that minority consumers are less likely to be credit visible, even when researchers control for (relative) income. This supports the idea that solely controlling for credit scores is not sufficient for identifying unequal access to credit.

Shortcuts to Credit History

For new borrowers who lack a history of repayment, there are two shortcuts to acquiring credit and building a credit history: secured credit cards and “piggybacking.”

In his 2016 discussion paper, Philadelphia Fed economist Larry Santucci highlights the importance of secured credit cards as a gateway product and investigates how consumers graduate from secured to unsecured credit cards. Secured cards are a rather unusual credit product, because borrowers end up largely borrowing from themselves—a “lender” is secured by a cash deposit (or a locked savings account) that often matches the credit line on the card. Yet, since the card is reported to the credit bureaus, this product helps borrowers establish or repair a credit record. My findings confirm Santucci’s insight: The probability of having a secured card is 17 percent among new borrowers with credit cards, but less than a tenth of that for established borrowers.⁶

In their 2010 working paper, Brevoort, Federal Housing Administration economist Robert Avery, and Federal Reserve economist Glenn Canner point to another way for a new borrower to quickly establish a credit history: piggybacking, which refers to the practice of adding a new borrower to an existing (and established) credit card account, often that of a parent. This allows the new borrower to add the established card to their credit record. In their 2017 article, Brevoort and Kambara report that a quarter of new borrowers enter the credit market with someone’s help. (Fifteen percent enter with a joint account, and another 10 percent enter as authorized users—that is, they piggyback.) Importantly, if unsurprisingly, this number is smaller in poor neighborhoods. Although I cannot directly observe the prevalence of authorized users in the data, I can approximate their prevalence by seeing how often an old card—that is, a credit card more than nine months old—first appears on a borrower’s credit record.⁷ Surprisingly, piggybacking did not become more common following the implementation of the Credit Card Accountability Responsibility and Disclosure (CARD) Act of 2009, which made it harder for young people to get a credit card independently.

The New Borrowers

Like Brevoort and Kambara, I use anonymized credit bureau data to study new borrowers. However, the FRBNY Consumer Credit Panel/Equifax (CCP) data I use is distinct from the data set employed by Brevoort and Kambara.⁸ One peculiar aspect of the CCP data I use is that the sample expands unevenly over time (likely due to the household aspect of the data by design). As a result, I can’t safely define a new borrower as someone appearing in the data set for the first time. Instead, I define a new borrower as someone whose oldest credit trade (credit product) is no more than three months old.⁹ (The two data sets also categorize credit products slightly differently.)

New Borrowers

28

Average age of person

\$3,874

Average non-mortgage credit line

\$1,256

Average credit card limit

Established Borrowers

51

Average age of person

\$37,000

Average non-mortgage credit line

\$23,000

Average credit card limit

Source: Author’s calculations based on FRBNY Consumer Credit Panel/Equifax (CCP) data.

Note: New borrower is one whose oldest credit product is less than three months old.

Not surprisingly, new borrowers are much younger than established borrowers. The average new borrower is approximately 28 years old, while the average age of a person with a credit record is almost 51. And new borrowers' credit lines are a fraction of established borrowers' credit lines. The average nonmortgage credit limit of a new borrower is a mere \$3,874—just over a tenth the average nonmortgage credit limit of established borrowers. The average credit limit of a new borrower's credit cards is \$1,256, which is almost 18 times smaller than the average for established borrowers.

More surprisingly, new borrowers disproportionately live in poorer neighborhoods. This observation coexists with Brevoort, Grimm, and Kambara's observation that poorer neighborhoods have a greater share of credit invisibles. This could reflect either systematic differences in age composition across neighborhoods or a tendency of people who gain access to credit to move out of poorer neighborhoods (Figures 1 and 2).¹⁰

To determine whether households in disadvantaged neighborhoods struggle more to access credit, I compared the average age of new borrowers across neighborhoods. There is basis for concern: Individuals in disadvantaged neighborhoods gain credit visibility (and credit access) later in life than their counterparts in more privileged areas. When I conducted multivariate linear regressions of the average age of new borrowers on a set of neighborhood characteristics, I found that the regressions yielded positive and strongly statistically significant coefficients on the percentage of the neighborhood's population that belong to a racial minority, the percentage of the population that are noncitizens, and the percentage living below the poverty line; these coefficients get larger when the regression controls for the age composition of the neighborhood.¹¹ In other words, people in disadvantaged neighborhoods get credit access later in life than their peers in more privileged neighborhoods.

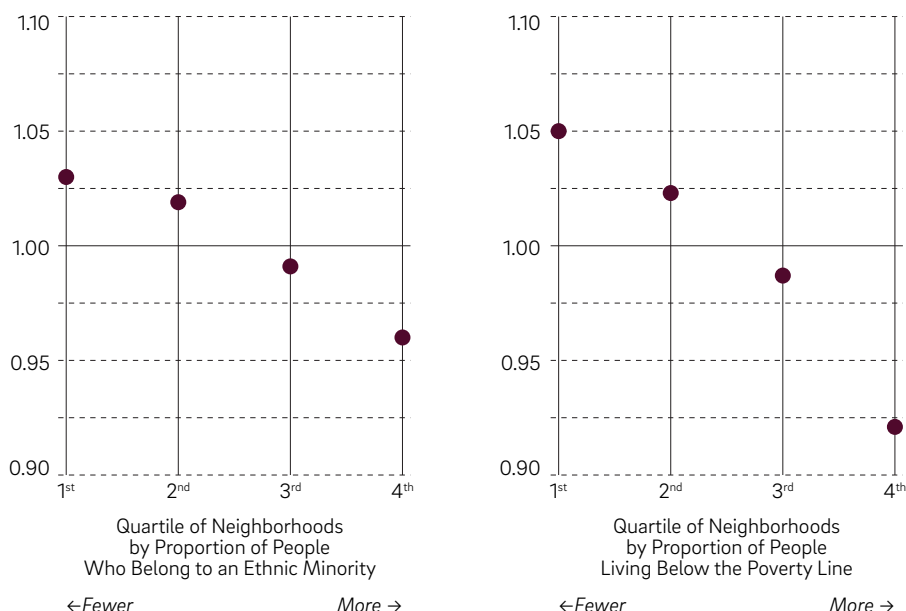
We can also analyze the credit products new borrowers use to enter the credit market. Again, Brevoort and Kambara have already looked into this.¹²

**See Credit Card:
The Gateway
Product.**

FIGURE 1

Credit Invisibles Disproportionately Live in Disadvantaged Neighborhoods

Share of credit invisibles in neighborhoods divided into quartiles, by ethnicity (left) and poverty (right), from lowest (1st quartile) to highest (4th quartile)



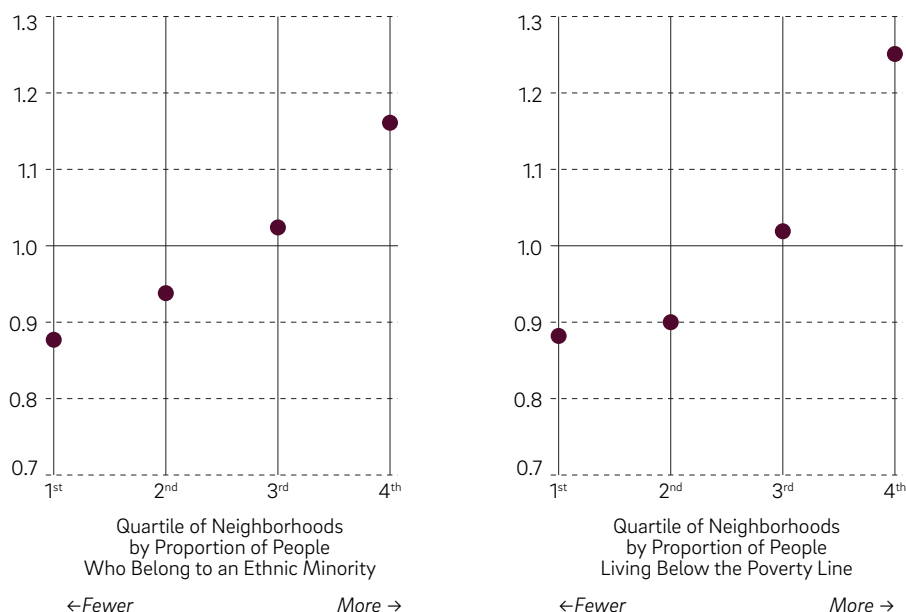
Source: Author's calculations based on FRBNY Consumer Credit Panel/Equifax (CCP) and U.S. Bureau of Census (Census) data. Ethnicity data are from Census.

Note: This figure depicts the ratio of each quartile's average of the statistic to the overall average of the statistic.

FIGURE 2

New Borrowers Disproportionately Live in Disadvantaged Neighborhoods

Share of new borrowers in neighborhoods divided into quartiles, by ethnicity (left) and poverty (right), from lowest (1st quartile) to highest (4th quartile)



Source: Author's calculations based on FRBNY Consumer Credit Panel/Equifax (CCP) and U.S. Bureau of Census (Census) data. Ethnicity data are from Census.

Note: This figure depicts the ratio of each quartile's average of the statistic to the overall average of the statistic.

I find that credit cards are even more important for initiating credit records than Brevoort and Kambara suggest (Figure 3), even though I omit piggybackers from my definition of new borrowers. Overall, credit cards account for about half of all credit market entries. Student loans, retail credit, and auto loans are the other important contributors. Not surprisingly, mortgages account for just a small fraction of new entries, since a typical first-time homebuyer has a well-established credit history.

Figure 3 further illustrates another important point: Credit market entry is very sensitive to aggregate economic conditions. An economic downturn (such as the Great Recession) leads to tighter lending standards that dramatically curtail the entry of new borrowers. A notable exception to that rule is student loans, which may boom in downturns as more people choose to pursue a formal education while labor markets slump.

I conclude with a few key observations regarding the evolution of credit access for new borrowers in the first year after entering the credit market. As already noted, their average initial credit limit is a fraction of that of established borrowers. But this average credit limit grows rapidly.¹³ The average (total) credit line of new borrowers' credit cards more than doubles in the first year.

The growth of credit access is particularly dramatic among borrowers who gain additional credit cards: Their aggregate credit line quadruples in the first year. This is unsurprising—more credit cards typically mean more available credit. What is surprising is that a significant share of this expansion of credit comes from an increase in the credit limit of their original credit card. In 2021, Arizona State University economist Natalia Kovrijnykh, Carnegie Mellon University economist Ariel Zetlin-Jones, and I documented this fact using a distinct (customized) anonymized data set from a different credit reporting agency. (We ran a regression analysis to confirm the statistical significance and robustness of this observation.) Notably, although the observation is robust among new borrowers, it is not statistically significant among established borrowers. These facts point to the importance of borrowing from multiple lenders, particularly for new borrowers.

New Borrowers and Borrowing from Multiple Lenders

My ongoing research with Kovrijnykh and Zetlin-Jones starts with the question: Why do new borrowers who obtain an additional card see a disproportionate increase in the credit line from their original lender? This goes against conventional wisdom, which states that the original lender should be concerned about debt dilution (where an additional loan decreases the value of pre-existing debt). The new loan increases the overall repayment burden of the borrower and should thus lead to a greater likelihood of default. Why then would the original lender extend the credit line even further?

This increase in aggregate credit is not driven solely by the demand channel (that is, by a borrower's request for more credit from all lenders, old and new). New borrowers who try but fail to get an additional loan do not see the large increase in the credit line of their original credit card.

It appears that incumbent lenders interpret the fact that a new borrower obtains additional credit as a positive signal

about the borrower's underlying risk (that is, the borrower's quality). This signal appears to be particularly important when it applies to a new borrower. Incumbent lenders respond positively to new credit when a borrower has a very short credit history, but this response is not evident when it comes to established borrowers. In other words, these signals from other lenders appear to be particularly valuable when a long history of repayment behavior is absent from a credit record.

Aggregating Information Across Lenders by Building Credit History

Because lenders seem to interpret other lenders' decisions about an individual borrower as informative, I focus on the signaling component of credit histories. Although repayments are an important component of credit histories, so too is the information-aggregation aspect of these records, particularly as it applies to emerging borrowers. Lenders appear to respond to the granting of credit to a new borrower before the borrower establishes any pattern of repayment. That's strong evidence in support of the information-aggregation mechanism.

For the theoretical portion of our research, we put forward a simple model that captures this information-aggregation mechanism (Figure 5). In the model, as in real life, lenders are heterogeneously informed—that is, they differ in what information they have about a borrower, or in how they interpret the information available to them. An example of differing access to information: My first credit card came from a lender that verified my enrollment as a university student—information not directly available to other lenders. An example of differing interpretations of information: the proprietary credit-scoring models employed by credit card lenders. However, our theoretical analysis does not distinguish between these two sources of information dispersion. We simply model multiple lenders receiving separate informative signals regarding a borrower's underlying risk type (that is, their likelihood of being able to repay loans of various sizes). Lenders in the model recognize the fact that their competitors receive additional information that is useful above and beyond the signal they received themselves. Consequently, lenders have a reason to read into their competitors' credit approval decisions, as these may reflect the competitors' information about the borrower.

In order to capture the mechanism described above, the model features borrowing over multiple stages. Early-stage loans are recorded in a publicly visible credit history. This credit history then affects the loan offers a borrower receives in the late stage of borrowing. Our theoretical analysis abstracts from learning from repayment: All of the loans are advanced before any repayment takes place. Yet borrowing over multiple stages permits the model to capture both credit-history building and debt dilution.

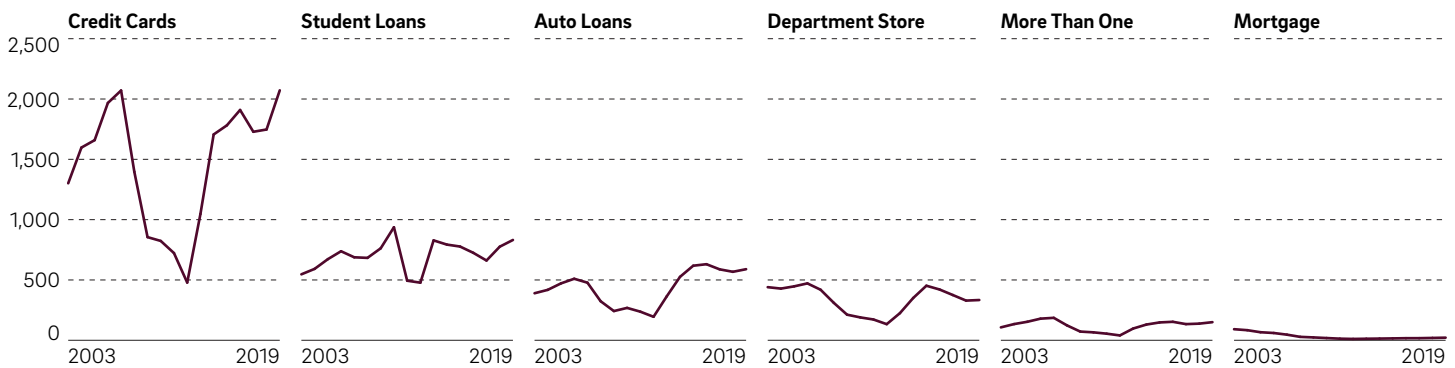
As intended, the model yields credit-history building. Specifically, only lenders with positive signals about a borrower offer a loan to that borrower at the early stage of borrowing. An early-stage loan thus informs other lenders of the positive signal the early lender has received. As a result, the dispersed information across lenders is aggregated in the late borrowing stage. That is, late-stage loan contracts reflect both the information (signal) of

FIGURE 3

Credit Cards Are the Dominant Form of Credit Market Entry

When it comes to initiating a credit record, credit cards are the most important product.

Estimated count of borrowers by first credit product, thousands, 2003–2019



Source: Author's calculations based on FRBNY Consumer Credit Panel/Equifax (CCP) data.

Credit Card: The Gateway Product

In their 2017 article, Brevoort and Kambara highlight the increasing importance of credit cards as the gateway product, but as they point out, this observation does not apply to borrowers under 25. They point to the restrictions imposed by the Credit CARD Act of 2009 as the likely explanation for this dichotomy. The Credit CARD Act explicitly restricts the marketing of credit cards to college students and individuals under 21. Unsurprisingly, the average age of a new borrower increased significantly following the act's implementation (Figure 4). In their 2021 working paper, Boston Fed economists Daniel Cooper and María José Luengo-Prado and University of Delaware economist Olga Gorbachev also document this fact. They argue that this restriction of credit has slowed the growth in overall consumption.

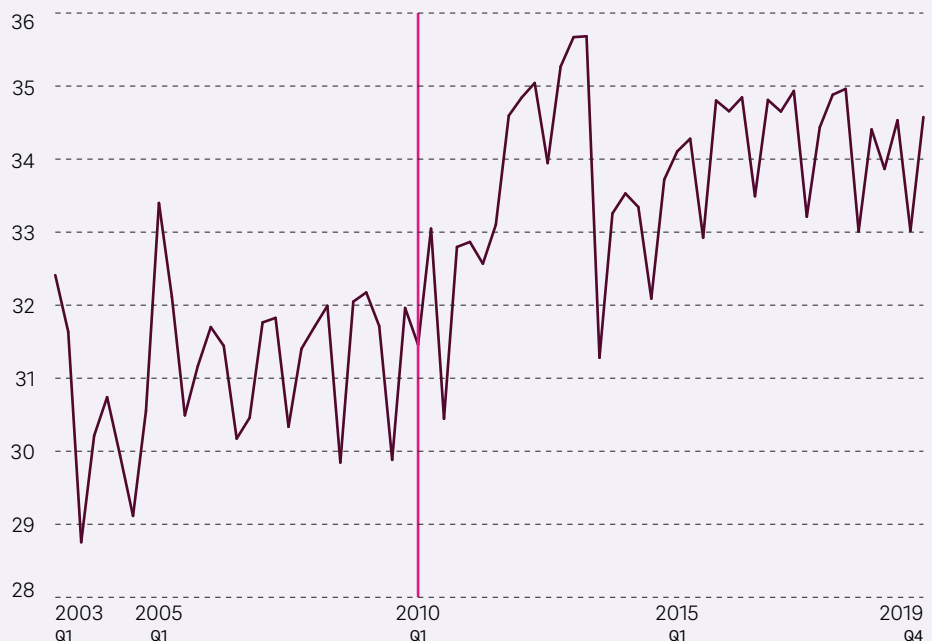
Figure 4 also illustrates the seasonality of credit market entry. The average age of entrants plunges in the third quarter of every year, just when the entry rate spikes (for both student loans and credit cards).¹⁵ In their 2013 discussion paper, the Philadelphia Fed's Keith Wardrip and Robert M. Hunt suggest that the composition of new borrower cohorts is also affected by the business cycle, as lending standards tend to tighten during recessions.

FIGURE 4

The Average Age of a New Credit Card Borrower Increased Significantly Following the Credit CARD Act of 2009

The act restricts the marketing of credit cards to college students and to borrowers under 21 years old.

Average age of new borrowers whose first credit product is a credit card, 2003–2020



Source: Author's calculations based on FRBNY Consumer Credit Panel/Equifax (CCP) data.

Note: A new credit card borrower is one whose oldest credit card and oldest credit trade are at most two months old.

the late lender and the signal of the early lender. We thus have an environment in which the “best” new borrowers build a credit history by taking on (rather than repaying) an early-stage loan. Doing so facilitates information aggregation across lenders—that is, it convinces late-stage lenders of their creditworthiness.

But there are costs associated with building a credit history. One such cost is having to pay inflated interest rates at the early stage of borrowing. This is a result of cross-subsidization, as the (best) borrowers who are building their credit histories are pooled with riskier borrowers who are taking advantage of an interest rate that does not fully reflect their true risk of default. Another possible cost of credit-history building is overborrowing—that is, ending up with a larger-than-optimal loan. Borrowing over multiple stages (and from multiple lenders) gives rise to debt dilution, which is familiar from both corporate and international finance literature, though it is rarely emphasized in consumer

credit literature. In our theoretical environment, borrowers’ inability to commit not to overborrow, combined with the debt dilution motive at a late stage, may result in the best borrowers taking on inefficiently large loans.¹⁴

Yet, despite the costs associated with building a credit history, the best borrowers still find it worthwhile to take early loans in order to facilitate information aggregation across lenders. That is, they still use the early loan to signal to their later lenders the favorable signal of the early lenders. The alternative to building a credit history in this way is either a smaller overall loan or one at a less-favorable interest rate.

Our model highlights the importance (and the favorable side) of borrowing from multiple lenders. This is in contrast to how this is normally viewed in the literature: as simply debt dilution.

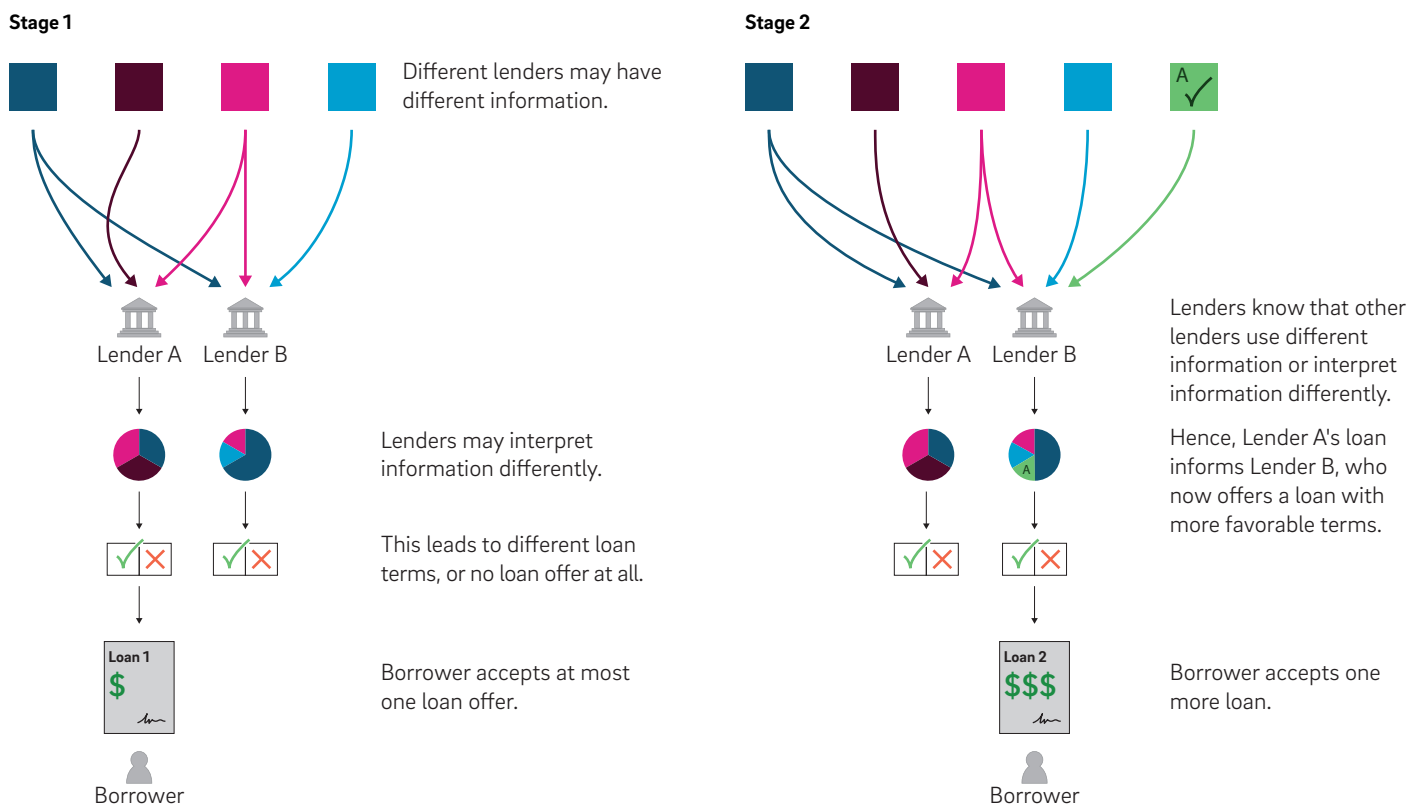
This theory also has a surprising implication: More dilution is better. In the late stage, the early lender would rather

see a larger top-up loan than a smaller top-up loan. (A top-up loan is a loan added to a preexisting loan.) In the model, this loan comes from a later lender. And that later lender has an additional piece of information (signal) about the borrower, beyond what was available to the early lender. As a result, the size of the top-up loan is informative. Although a larger loan to a given type of borrower is bad news for lenders (because it increases the probability of default in the repayment period), a counteracting force dominates in our model: Only the best borrowers get a large top-up loan, while borrowers with smaller top-up loans have less-favorable signals. This selection effect dominates the dilution effect explained above.

Strikingly, we find that this model prediction is borne out in the data. Delinquency rates are indeed lower among new borrowers with larger top-up loans than among new borrowers with smaller top-up loans. Notably, this observation does not apply to established borrowers,

FIGURE 5

A Simple Model of the Information-Aggregation Mechanism



which suggests that the informational content (or rather, spillover) of a lending relationship is less important for that group.

Conclusion

To analyze and address issues related to (unequal) access to credit, we need to understand how new borrowers gain and expand their access to credit, and how policies and external circumstances affect their ability to do so. My research highlights the importance of aggregating dispersed information regarding borrowers' creditworthiness and the role played by credit history in that aggregation.

These insights should complement the recent findings of researchers who document that lenders can benefit from alternative data (ranging from noncredit bill payment to social media behavior) in loan underwriting decisions. For example, in their 2020 article, Frankfurt School of Finance & Management economists Tobias Berg and Ana Gombović, Humboldt University (Berlin) economist Valentin Burg, and Duke University economist Manju Puri point out that the digital footprint of an online shopper can be as informative about their future default rate as the information contained in their credit records.

But information improvements may not be a “free lunch.” The same information that convinces lenders that a subset of borrowers is creditworthy likely leads them to reject other potential new borrowers. 

Notes

1 The pricing of loans may be just as important as their availability. Thus, “access to credit” really means “access to affordable credit.”

2 On the other hand, there are concerns about excessive indebtedness. These concerns motivated some of the restrictions in the Credit CARD Act, which explicitly limit the marketing of credit to young (new) customers, thus limiting their access to credit. In this article, I focus on the positive (in every sense of the word) aspects of credit access, including positive analysis of the effects of the Credit CARD Act. Normative concerns, as well as the specific behavioral biases that lead to financial mistakes, are the subject of my 2020 *Economic Insights* article.

3 Theoretical analysis conducted by Kovrijnykh, Livshits, and Zetlin-Jones (2019) highlights an important distinction between building one's credit history and improving one's credit score. Borrowers with the most favorable income prospects build their credit history in order to convince lenders to grant them large (and riskier) loans. Thus, these “best” borrowers end up with a higher probability of default (and a lower credit score) than borrowers without a credit history, who do not qualify for the riskiest loans.

4 Both this distinction and the critical importance of the credit history are highlighted in a new article by Stanford University economist Laura Blattner and University of Chicago economist Scott Nelson.

5 Although mainstream lenders, as a rule, report their loans (and their repayment) to credit bureaus, some fringe lenders do not. Payday loans, for example, are typically not reflected in the credit records that we consider here. This explains why a nontrivial fraction of credit records begin with a record of a collection, even though the loan that led to that collection was not itself in the credit record.

6 The data set used is the FRBNY Consumer Credit Panel/Equifax data (CCP).

7 I do not observe whether an account is jointly opened with another borrower. This is another way to facilitate credit market entry, as pointed out by Brevoort and Kambara (2017).

8 I use data from the first quarter of 2019 for my regression analysis, whereas for the summary statistics I aggregate a full year's worth of data (ending in that quarter) because the characteristics of new borrowers have pronounced seasonal fluctuations.

9 In contrast to Brevoort and Kambara (2017), I exclude from the definition of "new borrowers" consumers whose first entry with a credit bureau is when they are in collections. My definition also excludes borrowers who enter the credit market by piggybacking on older cards.

10 These statistics are computed based on representation in the CCP compared with the adult populations of census tracts reported in the American Community Survey (ACS). These levels of credit visibility are implausibly high across the board (likely due to the household aspect of the data by design), but our focus is the comparison across different clusters of neighborhoods. These comparisons are robust to various ways of addressing bias in the levels of visibility.

11 The table of regression results is available from the author upon request: igor.livshits@phil.frb.org.

12 Our findings differ slightly, most likely due to our different definitions of new borrowers, our different data sets, our different time periods, or a combination thereof.

13 Another aspect in which new borrowers differ from established ones is their riskiness — that is, the probability that they will fail to pay their debts in a timely manner. When new borrowers first appear in the data set, their delinquency rate is very low, but that is largely mechanical—they haven't had debts long enough to miss many payments. Within a couple of years, the delinquency rate of a cohort of new borrowers overtakes that of established borrowers. That means lenders may have good reason to be reluctant to advance credit to individuals without an established credit history.

14 See Eyigungor (2013) for an excellent discussion of debt dilution.

15 Because the entry rate is seasonally volatile, I plot Figure 4 at the annual frequency.

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Photo: Brendan Barry

The Costs and Benefits of Fixing Downtown Freeways

Urban freeways spurred our suburban boom.
Can burying them do the same for the urban core?

Freeways are conspicuous features of urban landscapes.¹ Highway construction represented a massive infrastructure investment in the 20th century, and it improved access, commuting, and trade. Nonetheless, it has long been recognized that there were negative effects for nearby neighborhoods, particularly in central cities. Today, many cities are mitigating some of the negative effects of freeways through expensive measures to cap or bury sections of freeway. Do these projects justify the costs? Could future infrastructure investments benefit from consideration of neighborhood disamenities? In this article, we summarize evidence

of freeways' effects on quality of life and discuss the potential benefits of real-world policy interventions in Philadelphia.

Construction of the Interstate Highway System

Discussion of a national system of interstate highways, which had been gaining momentum since the 1930s, culminated with the signing of the Federal-Aid Highway Act of 1956 by President Eisenhower. This act authorized the construction of 41,000 miles of freeways over a 10-year period. To gain popular support for the highway system, Eisenhower emphasized

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The views expressed in this article are not necessarily those of the Federal Reserve.

its advantages for national defense. However, the economic benefits were the primary motivation for supporters of the plan, and boosters of freeway construction touted the reduced transportation costs associated with freeways.² Mayors of major cities broadly supported construction, believing that new freeways would reduce congestion and improve the local economy.

Economic development was an important rationale for freeway construction, and while there are clear benefits for a region, the effects of freeways can be either positive or negative for an individual neighborhood. The new interstate system improved commerce and trade by connecting major cities and reducing travel times,³ but as University of Toronto economist Nathaniel Baum-Snow shows, freeways also accelerated suburbanization and exacerbated the population decline in central cities. This population decline near downtowns was partially driven by reduced transportation costs that improved access and made suburban areas relatively more attractive. Freeways further worsened the decline by reducing the quality of life in central neighborhoods. As freeway construction began rapidly in the late 1950s, residents came to recognize these negative effects, and protests against construction appeared in most large U.S. cities.

Amenities for Some, Disamenities for Others

The construction of freeways brought broad changes to urban areas, but the costs and benefits of the freeways were not the same for all neighborhoods. When a freeway is built through a city, access to regional amenities such as job centers improves in neighborhoods near the freeway due to reduced travel times. This is particularly true for outlying areas located a long distance from the jobs and services that are often concentrated in central cities. Therefore, when freeways were constructed, neighborhoods in suburbs far from the central business district grew rapidly.

However, freeways also negatively affect the quality of life for nearby neighborhoods. These disamenities include noise, pollution, and barrier effects, whereby a newly constructed freeway limits access to amenities and services located on the other side of the freeway. For neighborhoods that do not benefit significantly from improved regional access, these negative effects can lead to neighborhood decline. For example, locations near central business districts already have access to jobs and other regional amenities and thus do not gain much from freeways. In these neighborhoods, the negative effects of freeways dominate, and the net result is population loss.

In a recent working paper, we provide evidence that freeways reduced the quality of life in nearby neighborhoods by looking at long-run changes in population and other variables. What we find is as expected: Suburban neighborhoods near freeways grew rapidly after freeways were constructed, while central neighborhoods near freeways declined. Using fine geographic data covering 1950 to 2010, we studied long-run changes in neighborhoods before and after the interstate highway system was built (Figure 1). We find that in the group of central-city neighborhoods closest to freeways, population declined by 32 percent, while in the group of central neighborhoods more than 2 miles from freeways, population actually grew by 56 percent.

Much of the negative effect on local amenities from freeways is due to barrier effects. Freeways often block local streets and limit the passthrough of cars and pedestrians. When a freeway cuts off a neighborhood from nearby amenities, the neighborhood becomes less desirable, and people relocate to other neighborhoods. Using data from historic travel surveys before and after freeways were constructed, we find that people were less likely to travel to the other side of a freeway locally, and if they did, the travel time was longer. In other words, although freeways improve overall regional access, they reduce access to nearby neighborhood amenities.⁴ This research suggests that construction of the interstate highway system incurred significant external costs, and policymakers should consider these costs when assessing the value of urban freeway projects.

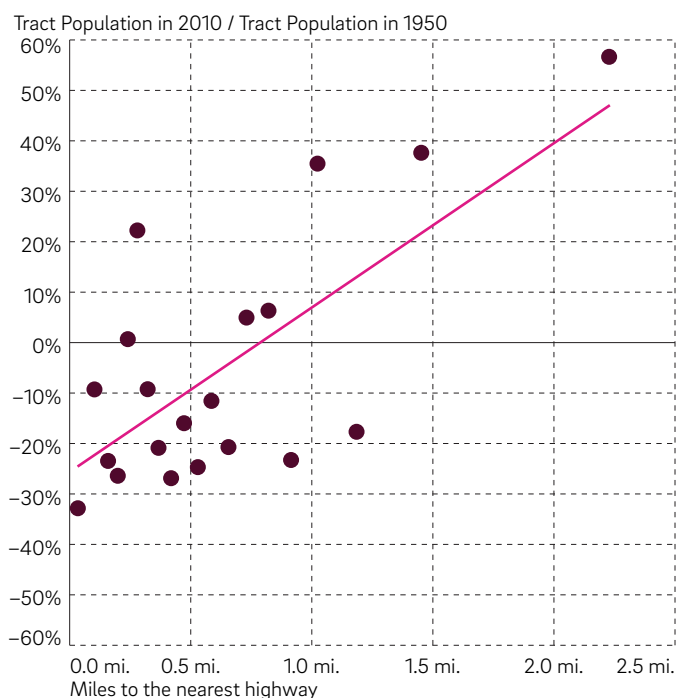
Quantifying Neighborhood Amenities

When measuring the effects of freeways, it is often hard to disentangle negative quality-of-life effects from the benefits accrued thanks to greater access to jobs and other regional resources. One way to identify quality-of-life amenities is to use proximity to a city's central business district as a proxy for job access before construction of the highway. But cities are more complex than suggested by that simple proxy. For example, cities often exhibit multiple job centers. For this reason, we prefer measures of job access that help us study cities with real-world geographies.

FIGURE 1

In Central Neighborhoods, Population Declines Are Greatest in Census Tracts Nearest to Freeways

Average population change, 1950–2010, in bins of neighborhoods within 2.5 miles of the city center, plotted against the distance to the closest freeway, for a sample of 2,312 neighborhoods in 64 metro areas in the U.S.



Sources: Brinkman and Lin (2019); U.S. Census Bureau.

An emerging literature in urban economics uses the spatial distribution of jobs, residences, land prices, and wages to separately quantify the value of locations for production (productivity) and the value of locations for consumption (residential amenities). The value of a residential location can arise from a variety of characteristics, including good schools, entertainment options, and natural amenities such as ocean views. Likewise, locations vary in their value for production due to natural advantages such as proximity to natural resources, or proximity to customers, suppliers, or employees. Finally, these locations are all connected, given that people consider the time and expense of traveling to work when choosing where to live. In addition, firms consider access to a pool of employees when considering where to locate. Since people can usually choose where to live and where to work, the spatial distributions of population and employment in cities provide evidence of the value of locations for different activities.

Employment and residences are distributed very differently within urban areas. This suggests that locations vary in their value for production versus residential uses. We find that there is an extremely high density of jobs in the central business district of Philadelphia, with employment densities exceeding 200,000 jobs per square mile for several census tracts (Figure 2, top panel). Jobs are highly concentrated in the central business district even though land prices there are extremely high. It is common for per-acre land prices in American cities to be at least 10 times higher in the central business district than in suburbs just 10 miles away.⁵ The concentration of jobs and the willingness to pay such high prices is clear evidence that business districts provide advantages for the production of goods and services. Researchers have shown that these efficiencies can arise from access to a pool of employees, input sharing, and information spillovers (that is, information about one thing generating information about seemingly unrelated things).⁶

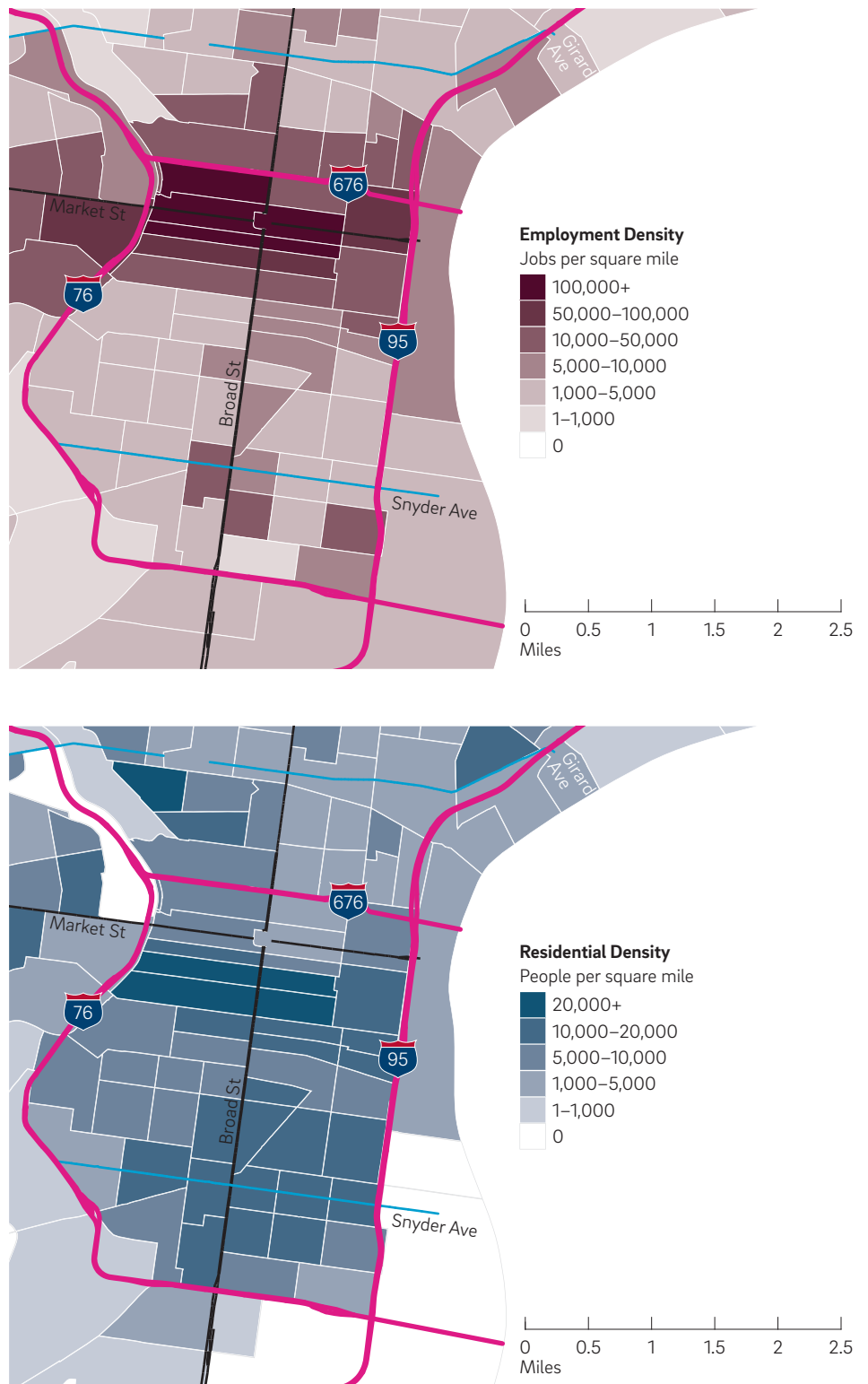
However, although residences are not as spatially concentrated as jobs, there are still big differences in density across space (Figure 2, bottom panel). For example, the neighborhoods directly south of the

FIGURE 2

Many People Highly Value Living Near Jobs

Jobs are very dense in the central business district, and many residents live near those jobs.

Employment density (top panel) and employed residential population density (bottom panel) for census tracts in central Philadelphia on the same scale, 2000.



Sources: Brinkman and Lin (2019); American Association of State Highway and Transportation Census Transportation Planning Products (CTPP) program; U.S. Census Bureau.

central business district exhibit residential population densities as high as 25,000 employed workers per square mile. Again, given that these locations are also very expensive, it is clear that people particularly value living in these locations. Less obvious is whether they derive this value from proximity to jobs or from residential amenities.

Recently, some economists have developed quantitative models to disentangle how much people value different characteristics of a location, including access to jobs and residential amenities.⁷ By using the observed spatial distribution of jobs and workers, and also by incorporating information on rents, wages, and travel times between locations, these economists can identify the mechanisms that guide the spatial layout of cities and the colocation patterns of firms and workers in cities. In particular, their models separate the value of job access from the quality-of-life benefits of neighborhoods. These models also allow for the analysis of real-world policies. For example, Philadelphia Fed economist Christopher Severen uses one such model to study the effects of subway construction in Los Angeles. By using such a model for our working paper, we find that the quality-of-life effects of freeways play an important role in decentralization and significantly affect overall welfare.

Mitigating Freeway Disamenities

Many cities have implemented or considered projects to mitigate disamenity effects by burying or capping freeways through city centers. The goal of these projects is to reconnect streets and neighborhoods, reduce noise, and reclaim land for other urban uses. These projects continue to move forward despite high construction costs. Costs vary depending on project details but can range from \$300 million to \$700 million per mile of freeway. Freeway construction costs have increased drastically since construction of the interstate system.⁸ Therefore, it is important to know whether the benefits of these projects are worth the costs.

In Philadelphia, several projects have partially capped small parts of freeways. Parts of I-676 through Center City were partially capped to create small parks near the Benjamin Franklin Parkway, the scenic, tree-lined boulevard connecting City Hall with the Philadelphia Museum of Art. The costs were modest given that the freeway was already below grade, and construction was done as part of a project to reconstruct existing bridges crossing the freeway. Another project would extend an already existing cap over I-95, which closely follows the Delaware River through the city, to better connect the city to the riverfront. The new project covers only an additional one-tenth of a mile of freeway but involves development of a large urban park. Despite this improvement, large sections of the Philadelphia waterfront will remain cut off by I-95. When the freeway was first built, much of the waterfront was a declining industrial zone. Planners saw this zone as the logical route for the new north/south interstate through Philadelphia. However, 60 years later, the Philadelphia waterfront remains underutilized, and I-95 is the obvious obstacle preventing redevelopment.

We estimate the benefits of a more ambitious project that would reconnect a much larger portion of central Philadelphia to the Delaware River waterfront (Figure 3). Using quantitative

methods developed in urban economics, we simulate the effects of burying a section of I-95 from Snyder Avenue to Girard Avenue. This roughly 4.5-mile stretch of freeway starts in South Philly and traverses the riverfront neighborhoods of Pennsport, Queen Village, Society Hill, Old City, Northern Liberties, and Fishtown. The proximity of these neighborhoods to the central business district and their high population density suggest that this might be an ideal setting for such an intervention.

We conduct the analysis using data on the location of population and employment, as well as data on commuting travel times between locations. We input these data into a quantitative model to estimate the amenities and productivities of different neighborhoods. Intuitively, amenities are estimated through the model by comparing neighborhoods in terms of job access and population density. If a neighborhood has superior job access but low population density, this is evidence of fewer amenities. For Philadelphia, we find that neighborhood amenity values are roughly 11 percent lower immediately next to a freeway compared to locations far away. In addition, these effects decline but persist out to at least a mile from a freeway. In other words, people would be willing to pay roughly 11 percent of their income to avoid living directly next to a freeway, holding everything else constant (including access to jobs). In analysis conducted for a recent working paper, we find an even larger effect of 17 percent in Chicago. These estimates suggest that negative quality-of-life effects from freeways are quantitatively important.

Next, we use these estimates of disamenities and quantitative modeling techniques to analyze the effect of burying I-95 in central Philadelphia. We simulate a counterfactual economy where the transportation benefits of the freeway remain but the negative effects to nearby neighborhoods would be fully mitigated. The improvement to nearby neighborhoods would be accomplished by reconnecting streets, reducing noise and pollution, and reclaiming land for other uses. We do not consider removing the freeway altogether, given that this would require calculating changes in travel patterns throughout the region. This is harder to simulate, but techniques have been developed to account for the effect of changes in transport networks on travel. Removal of the freeway would likely have muted benefits relative to the mitigation experiment we present here.

The first result of the experiment is that population near the freeway increases drastically, with population densities of employed individuals in neighborhoods near the freeway increasing by as much as 2,840 people per square mile after the intervention. Overall, for neighborhoods within one mile of the freeway project, population increases by 7 percent in this scenario. Land prices in these same neighborhoods increase by 2.4 percent.

With this simulation, we can roughly estimate the benefits of such a project. The simulation provides an estimate of the overall increase in welfare for the entire regional population. This benefit is derived from the improved amenities in neighborhoods near the freeway project, and it accounts for general equilibrium effects that lead to changes in population and employment throughout the city. Overall, we find that this project alone leads to the quality-of-life equivalent of a 0.05 percent increase in income, or roughly \$245 million every year for the entire Philadelphia metropolitan area. Using a discount rate of 7 percent,

this suggests the total lifetime value for the project is around \$3.5 billion.⁹ This notable result shows that the benefits of these projects are on the same order of magnitude as the costs. Projects of this sort often cost around \$500 million per mile, so the total cost of this project is around \$2.25 billion. Based on these rough estimates, this particular project would pass a cost-benefit test.

A project like this could be funded using general tax revenue from the city, state, or federal government. However, the benefits of the project would accrue mostly to the surrounding neighborhoods. New York University professor of finance Arpit Gupta and his coauthors find that the Second Avenue subway in New York created value for nearby property owners in excess of the construction costs. Improvements in local amenities are capitalized into higher property prices. This suggests

that a targeted tax or assessment could be used to finance improvements such as the one proposed here.¹⁰

There is significant uncertainty surrounding these estimates. These results are conservative estimates of quality-of-life benefits. The results change depending on the assumptions, modeling choices, and setting. In particular, estimates of parameters that describe how people value neighborhood amenities vary in the existing literature yet have significant effects on welfare calculations. If we use values at the high end of existing estimates, the benefits of mitigation can increase by 100 percent, whereas low-parameter estimates can reduce the benefits by about 30 percent. Additional work and more development of quantitative modeling would improve the precision of these estimates. Nonetheless, negative quality-of-life effects are quantitatively important, and targeted

projects like the ones being proposed or implemented in cities all over the U.S. may provide important benefits for central cities.

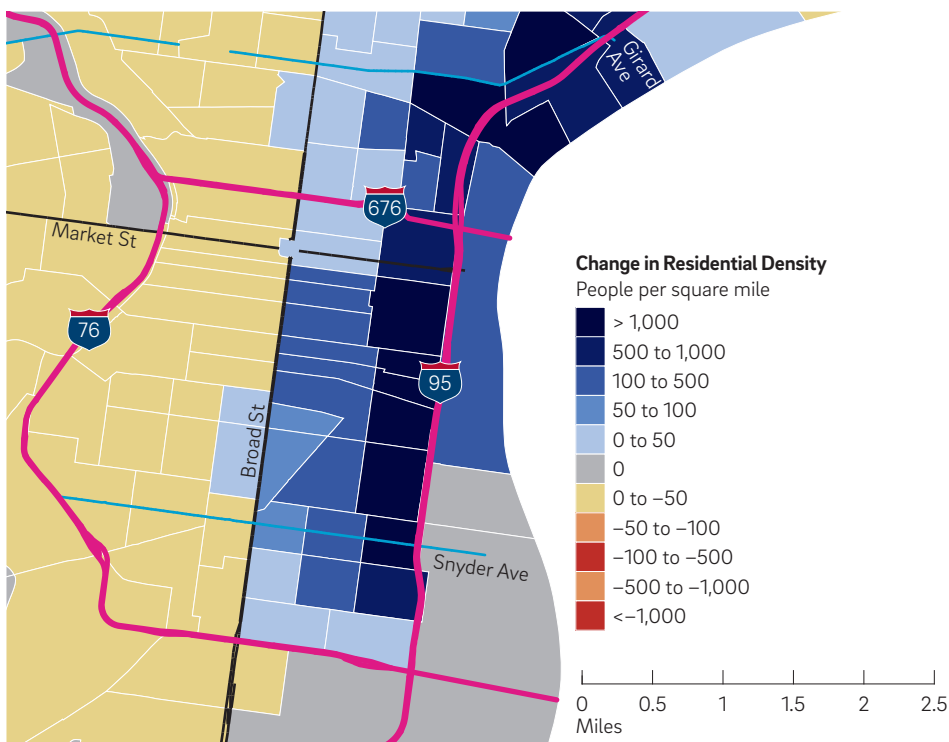
Conclusion

Economic development was an important rationale for freeway construction, but not everyone benefited from the new freeways. That's because freeways bring amenities to some neighborhoods by increasing access but disamenities to others by reducing the quality of life. Using techniques developed in recent economic research, we can quantify neighborhood amenities and thus the costs and benefits of freeway construction for individual neighborhoods and for an entire metro area. Many cities, including Philadelphia, could benefit from mitigation of freeway disamenities by covering or capping central city highways. 

FIGURE 3

Burying a Portion of I-95 in Philadelphia Would Likely Lead to a Population Boom in Neighboring Census Tracts

Change in employed residential population density for census tracts in central Philadelphia if negative neighborhood effects were mitigated for I-95.



Source: Authors' calculations; U.S. Census Bureau.

Notes

- 1** "Freeway" generally refers to a limited-access highway built for high-speed automobile travel. We use the terms "freeway" and "highway" interchangeably to refer to these types of limited-access roads.
- 2** See Weingroff (1996) for an extensive history of highway building in the U.S.
- 3** See Duranton, Morrow, and Turner (2014).
- 4** Highways reduce the quality of life through other margins, too—for example, noise or pollution. Given the extensive literature estimating these effects, we don't attempt to quantify them. But the spatial scale of barrier effects seems to exceed the spatial scale of noise or pollution effects by a large degree.
- 5** Haughwout et al. (2008) find that average land prices in Manhattan can be hundreds of times higher per square foot than in suburban locations just 30 miles away.
- 6** For more on this topic, see Carlino (2011).
- 7** See, for example, Ahlfeldt et al. (2015).
- 8** See Brooks and Liscow (2019).
- 9** A discount rate is used to calculate the present value of a project that will have benefits in the future. The federal Office of Management and Budget recommends using a discount rate of 7 percent for public infrastructure investments, although state transportation departments often use lower values, which increases the estimated benefits of a project.
- 10** Gupta, Van Nieuwerburgh, and Kontokosta (2022) study value capture and the potential of targeted property taxes.

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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.

Dynamic Pricing of Credit Cards and the Effects of Regulation

We construct a two-period model of revolving credit with asymmetric information and adverse selection. In the second period, lenders exploit an informational advantage with respect to their own customers. Those rents stimulate competition for customers in the first period. The informational advantage the current lender enjoys relative to its competitors determines interest rates, credit supply, and switching behavior. We evaluate the consequences of limiting the repricing of existing balances as implemented by recent legislation. Such restrictions increase deadweight losses and reduce ex-ante consumer surplus. The model suggests novel approaches to identify empirically the effects of this law. We find the pattern of changes to interest rates and balance transfer activity before and after the CARD Act are consistent with the testable implications of the model.

WP 21-38. Suting Hong, Shanghai Tech University; Robert M. Hunt, Federal Reserve Bank of Philadelphia Consumer Finance Institute; Konstantinos Serfes, Drexel University and Federal Reserve Bank of Philadelphia Consumer Finance Institute Visiting Scholar.

Individual and Local Effects of Unemployment on Mortgage Defaults

Using survey data from the Panel Study of Income Dynamics, we document descriptively that unemployment has a relatively large effect on individual mortgage default rates: The average default rate for the employed is 2.4 percent; whereas for the unemployed, it is 8.5 percent. Once several other characteristics are controlled for, the unemployed have default rates that are 4 percentage points larger than those of the employed; and when endogeneity is additionally accounted for, the unemployment effect on default rates declines to 3 percentage points. Moreover, we find that more granular metrics for unemployment entail lower comparable effects of unemployment on default rates. That is, the comparable effect of individual unemployment on mortgage defaults is rather lower than the effect of state or county unemployment rates. This finding suggests that local metrics of unemployment, rather than attenuating possibly large individual unemployment effects on defaults, indeed contain more information than the aggregation of these individual effects.

WP 21-39. Silvio Rendon, Federal Reserve Bank of Philadelphia Supervision, Regulation, and Credit Department; Kevin Bazer, Federal Reserve Bank of Philadelphia Supervision, Regulation, and Credit Department.

Corporate Disclosure: Facts or Opinions?

A large body of literature documents the link between textual communication (e.g., news articles, earnings calls) and firm fundamentals, either through predefined "sentiment" dictionaries or through machine learning approaches. Surprisingly, little is known about why textual communication matters. In this paper, we take a step in that direction by developing a new methodology to automatically classify statements into objective ("facts") and subjective ("opinions") and apply it to transcripts of earnings calls. The large-scale estimation suggests several novel results: (1) Facts and opinions are both prominent parts of corporate disclosure, taking up roughly equal parts, (2) higher prevalence of opinions is associated with investor disagreement, (3) anomaly returns are realized around the disclosure of opinions rather than facts, and (4) facts have a much stronger correlation with contemporaneous financial performance, but facts and opinions have an equally strong association with financial results for the next quarter.

WP 21-40. Shimon Kogan, IDC Herzliya and the University of Pennsylvania; Vitaly Meursault, Federal Reserve Bank of Philadelphia Research Department.

Financial Consequences of Severe Identity Theft in the U.S.

We examine how a negative shock from severe identity theft affects consumer credit market behavior in the United States. We show that the immediate effects of severe identity theft on credit files are typically negative, small, and transitory. After those immediate effects fade, identity theft victims experience persistent increases in credit scores and declines in reported delinquencies, with a significant proportion of affected consumers transitioning from subprime-to-prime credit scores. Those consumers take advantage of their improved creditworthiness to obtain additional credit, including auto loans and mortgages. Despite having larger balances, these individuals default on their loans less than they did prior to the identity theft incident.

WP 21-41. Nathan Blascak, Federal Reserve Bank of Philadelphia Consumer Finance Institute; Julia Cheney, Federal Reserve Bank of Philadelphia Consumer Finance Institute; Robert Hunt, Federal Reserve Bank of Philadelphia Consumer Finance Institute; Vyacheslav Mikhed, Federal Reserve Bank of Philadelphia Consumer Finance Institute; Dubravka Ritter, Federal Reserve Bank of Philadelphia Consumer Finance Institute; Michael Vogan, Ally Bank.

Consumer Credit with Over-Optimistic Borrowers

Do cognitive biases call for regulation to limit the use of credit? We incorporate over-optimistic and rational borrowers into an incomplete markets model with consumer bankruptcy. Over-optimists face worse income risk but incorrectly believe they are rational. Thus, both types behave identically. Lenders price loans forming beliefs—type scores—about borrower types. This gives rise to a tractable theory of type scoring. As lenders cannot screen types, borrowers are partially pooled. Over-optimists face cross-subsidized interest rates but make financial mistakes: borrowing too much and defaulting too late. The induced welfare losses outweigh gains from cross-subsidization. We calibrate the model to the U.S. and quantitatively evaluate policies to address these frictions: financial literacy education, reducing default cost, increasing borrowing costs, and debt limits. While some policies lower debt and filings, only financial literacy education eliminates over-borrowing and improves welfare. Score-dependent borrowing limits can reduce financial mistakes but lower welfare.

WP 21-42. Florian Exler, University of Vienna; Igor Livshits, Federal Reserve Bank of Philadelphia Research Department; James MacGee, Bank of Canada; Michèle Tertilt, University of Mannheim.

Assessment Frequency and Equity of the Real Property Tax: Latest Evidence from Philadelphia

Philadelphia's Actual Value Initiative, adopted in 2013, creates a unique opportunity for us to test whether reassessments at short intervals to true market value and taxing by such values improve equity. Based on a difference-in-differences framework using parcel-level data matched with transactions in Philadelphia and 15 comparable cities, this study finds positive evidence on equity outcomes from more regular revaluations. The quality of assessment, as measured by the coefficient of dispersion, improves substantially after 2014, although the extent of improvement varies across communities. Vertical equity, measured by price-related differential, also improved, although it was still above the standard threshold. Cross-city comparisons confirm Philadelphia's improvement in quality and equity of assessments after adopting the initiative. These results highlight the importance of regular reassessment in places where property values increase quickly, and they shed light on the disparate impacts of reassessment across income, property value, race, and gentrification status. The paper makes the case that the property tax, if designed well, can be an equitable tax instrument.

WP 21-43. Yilin Hou, Maxwell School, Syracuse University; Lei Ding, Federal Reserve Bank of Philadelphia Community Development and Regional Outreach; David J. Schwegman, School of Public Affairs, American University; Alaina G. Barca, Federal Reserve Bank of Philadelphia Community Development and Regional Outreach.

Visualization, Identification, and Estimation in the Linear Panel Event-Study Design

Linear panel models, and the “event-study plots” that often accompany them, are popular tools for learning about policy effects. We discuss the construction of event-study plots and suggest ways to make them more informative. We examine the economic content of different possible identifying assumptions. We explore the performance of the corresponding estimators in simulations, highlighting that a given estimator can perform well or poorly depending on the economic environment. An accompanying Stata package, `xtevent`, facilitates adoption of our suggestions.

WP 21-44. Simon Freyaldenhoven, Federal Reserve Bank of Philadelphia Research Department; Christian Hansen, University of Chicago and Visiting Scholar, Federal Reserve Bank of Philadelphia Research Department; Jorge Pérez Pérez, Banco de México; Jesse M. Shapiro, Brown University, NBER, and Visiting Scholar, Federal Reserve Bank of Philadelphia Research Department.

Democratic Political Economy of Financial Regulation

This paper offers a simple theory of inefficiently lax financial regulation arising as an outcome of a democratic political process. Lax financial regulation encourages some banks to issue risky residential mortgages. In the event of an adverse aggregate housing shock, these banks fail. When banks do not fully internalize the losses from such failure (due to limited liability), they offer mortgages at less than actuarially fair interest rates. This opens the door to homeownership for young, low-net-worth individuals. In turn, the additional demand from these new homebuyers drives up house prices. This leads to a non-trivial distribution of gains and losses from lax regulation among households. On the one hand, renters and individuals with large nonhousing wealth suffer from the fragility of the banking system. On the other hand, some young, low-net-worth households are able to get a mortgage and buy a house, and current (old) homeowners benefit from the increase in the price of their houses. When these latter two groups, who benefit from the lax regulation, constitute a majority of the voting population, then regulatory failure can be an outcome of the democratic political process.

WP 22-01. Igor Livshits, Federal Reserve Bank of Philadelphia Research Department; Youngmin Park, Bank of Canada.

Concentration in Mortgage Markets: GSE Exposure and Risk-Taking in Uncertain Times

When home prices threaten to decline, large mortgage investors can benefit from fostering new lending that boosts demand. We ask whether this benefit contributed to the growth in acquisitions of risky mortgages by the government-sponsored enterprises (GSEs) in the first half of 2007. We find that it helps explain the variation of this growth across regions. The growth predicted by this benefit is on top of the acquisition growth caused by the exit of private-label securitizers. We conclude that the GSEs actively targeted their acquisitions to counter home-price declines.

WP 20-04 Revised. Ronel Elul, Federal Reserve Bank of Philadelphia Research Department; Deeksha Gupta, Carnegie Mellon University and Visiting Scholar, Federal Reserve Bank of Philadelphia Research Department; David Musto, University of Pennsylvania and Visiting Scholar, Federal Reserve Bank of Philadelphia Research Department.

Inequality in the Time of COVID-19: Evidence from Mortgage Delinquency and Forbearance

Using novel data, we show that during the COVID-19 pandemic minority and lower-income borrowers experienced significantly more financial distress. We quantify how much the pandemic has exacerbated inequalities with a difference-in-differences analysis. We then show that forbearance programs mitigated inequalities as minority and lower-income borrowers took up forbearances at higher rates, reducing their delinquency rates more than White and higher-income borrowers in 2020. Finally, we show that minority and lower-income borrowers are more likely to fall into delinquency and default after exiting forbearance and that fast-tracking FHA modifications with 40-year terms could best help these borrowers obtain longer-term debt relief.

WP 21-09 Revised. Xudong An, Federal Reserve Bank of Philadelphia Supervision, Regulation, and Credit Department; Larry Cordell, Federal Reserve Bank of Philadelphia Supervision, Regulation, and Credit Department; Liang Geng, Federal Reserve Bank of Philadelphia Supervision, Regulation, and Credit Department; Keyoung Lee, Federal Reserve Bank of Philadelphia Supervision, Regulation, and Credit Department.

Why Are Residential Property Tax Rates Regressive?

Among single-family homes that enjoy the same set of property tax-funded amenities and pay the same statutory property tax rate, owners of inexpensive houses pay almost 50 percent higher effective tax rates than owners of expensive houses. This pattern appears throughout the U.S. and is caused by systematic assessment regressivity— inexpensive houses are overassessed relative to expensive houses. I use an instrumental variable approach to show that a large portion of this pattern can be attributed to measurement error in sale prices. Sixty percent of the remaining regressivity can be explained by tax assessors' flawed valuation methods that ignore variation in priced house and neighborhood characteristics and 40 percent by infrequent reappraisal. A simple valuation method can alleviate assessment regressivity and increase poor homeowners' net worth by more than 10 percent.

WP 22-02. Natee Amornsiripanitch, Federal Reserve Bank of Philadelphia Supervision, Regulation, and Credit Department.

Bond Insurance and Public Sector Employment

This paper uses a unique data set of local governments' bond issuance, expenditure, and employment to study the impact of the monoline insurance industry's demise on local governments' operations. To show causality, I use an instrumental variable approach that exploits persistent insurance relationships and the cross-sectional variation in insurers' exposure to high-quality residential mortgage-backed securities. Governments associated with ailing insurers issued less debt, cut expenditures, and hired fewer workers. These effects are persistent. Partial equilibrium calculations show that affected governments' aggregate expenditures and employment levels in 2017 would have been 6 percent to 10 percent higher if bond insurance had remained available.

WP 22-03. Natee Amornsiripanitch, Federal Reserve Bank of Philadelphia Supervision, Regulation, and Credit Department.

The Great Migration and Educational Opportunity

This paper studies the impact of the First Great Migration on children. We use the complete-count 1940 Census to estimate selection-corrected place effects on education for children of Black migrants. On average, Black children gained 0.8 years of schooling (12 percent) by moving from the South to the North. Many counties that had the strongest positive impacts on children during the 1940s offer relatively poor opportunities for Black youth today. Opportunities for Black children were greater in places with more schooling investment, stronger labor market opportunities for Black adults, more social capital, and less crime.

WP 22-04. Cavit Baran, Northwestern University; Eric Chyn, NBER and Dartmouth College; Bryan A. Stuart, Federal Reserve Bank of Philadelphia Research Department.

Net Income Measurement, Investor Inattention, and Firm Decisions

When investors have limited attention, does the way in which net income is measured matter for firm value and firms' resource allocation decisions? This paper uses the Accounting Standards Update (ASU) 2016-01, which requires public firms to incorporate changes in unrealized gains and losses (UGL) on equity securities into net income, to answer this question. We build a model with risk-averse investors who can be attentive or inattentive and managers who choose how much to invest in financial assets to maximize firms' stock prices. The model predicts that, with inattentive investors, stock prices react more to changes in UGL from equity securities under the new regime and, under certain conditions, investors assign larger price discounts. Managers respond to such discounts by cutting financial asset holdings. We use insurance company data to test these predictions. Prices of stocks with low analyst coverage react more to changes in UGL from equity securities, highlighting the role of investor inattention. Using a difference-in-differences approach, we find that by 2020, publicly traded insurance companies cut investments in public stocks by \$23 billion.

WP 22-05. Natee Amornsiripanitch, Federal Reserve Bank of Philadelphia Supervision, Regulation, and Credit Department; Zeqiong Huang, Yale School of Management; David Kwon, Yale School of Management; Jinjie Lin, Yale School of Management.

Data in Focus

ATSIX

The Philadelphia Fed collects, analyzes, and shares useful data about the Third District and beyond. Here's one example.

The Federal Open Market Committee (FOMC) responded to the Great Recession of 2007-2009 with unprecedented measures, cutting interest rates to low levels and buying financial assets. But some wondered at the time, might those measures induce higher inflation? The public's expectations for higher inflation can be self-fulfilling, so, if Americans believe that these measures will induce higher inflation, higher inflation might just occur, and that in turn can alter the effectiveness of the FOMC's target interest rates.

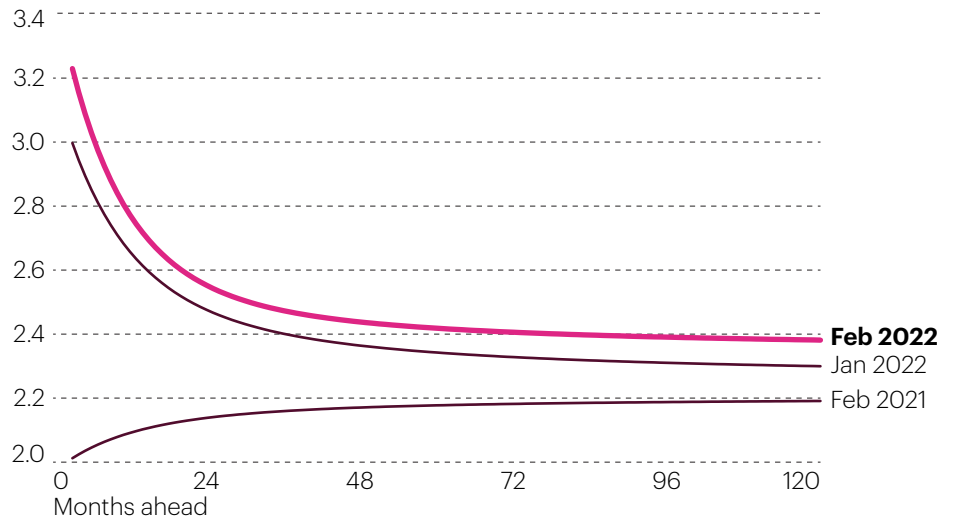
Generally, the best way to gauge inflation expectations is by surveying economists and consumers, but those surveys typically ask respondents to give their inflation expectations for specific dates in the future. What policymakers need is a continuous curve of inflation expectations, not just expectations for specific future dates.

That's why Philadelphia Fed visiting scholar S. Borağan Aruoba of the University of Maryland developed the Aruoba Term Structure of Inflation Expectations (ATSIX), a smooth, continuous curve of inflation expectations three to 120 months ahead.¹ Aruoba's model optimally combines the Philadelphia Fed's Survey of Professional Forecasters² with two surveys published by Wolters Kluwer Law & Business. Aruoba found that his model's inflation expectations "track realized inflation quite well, and in terms of forecast accuracy, they are at par with or superior to some popular alternatives."³

With the FOMC once again taking extraordinary measures (this time to counter a devastating economic shock resulting from the COVID-19 pandemic), now is a good time to revisit ATSIX and see what it tells us about expectations for future inflation. 

ATSIX: Term Structure of Inflation Expectations

Average Annualised Expected CPI Inflation, percentage points



Source: Research Department, Federal Reserve Bank of Philadelphia.

Notes

¹ The ATSIX methodology was developed from research initially funded by the Federal Reserve Bank of Minneapolis.

² <https://www.philadelphiafed.org/surveys-and-data/real-time-data-research/survey-of-professional-forecasters>

³ S. Borağan Aruoba, "Term Structures of Inflation Expectations and Real Interest Rates," Philadelphia Federal Reserve Working Paper 16-09/R (2016).

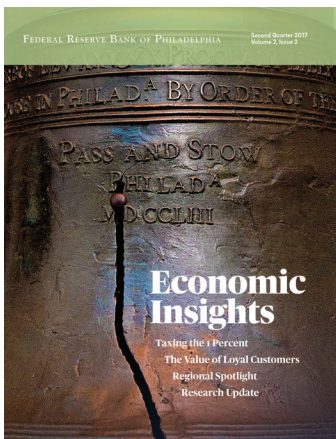
Learn More

Online: <https://www.philadelphiafed.org/surveys-and-data/real-time-data-research/atsix>

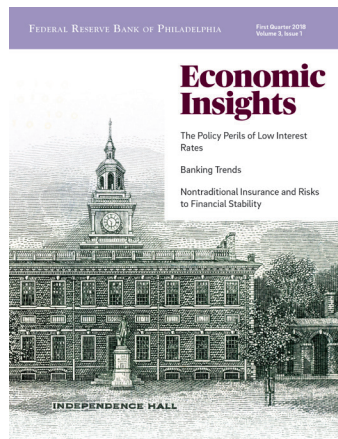
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