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Economic Insights

Volume 10, Issue 2

Understanding Job Growth

Credit Scores and Rising Credit Card Delinquencies

Breaking Down the Latest Fight Against Inflation

Questions and Answers | Research Update | Data in Focus

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Economic Insights

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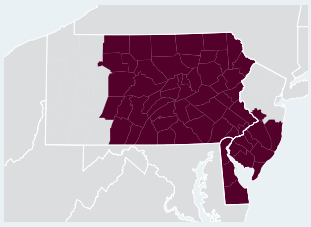

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Understanding Job Growth

We can better understand the health of the economy if we decompose job growth by economic sector.

Burcu Eyigungor
Senior Economic Advisor and Economist
FEDERAL RESERVE BANK OF PHILADELPHIA

The views expressed in this article are not necessarily those of the Federal Reserve Bank of Philadelphia or the Federal Reserve System.

Economists have long been interested in identifying underlying weaknesses in the economy and predicting recessions. The earlier they can assess weaknesses in the economy, the more effective the fiscal and monetary policies they can recommend. These policies, such as lower interest rates, can lessen or even avert a recession.

A common way to assess these weaknesses is by considering the overall unemployment rate. When it rises—and especially when inflation is also low—this may indicate a coming recession.[1]

However, not all sectors grow and shrink in tandem with the business cycle, so we can deepen our understanding of the economy by considering sectoral shifts in addition to the unemployment rate. This is why some economists focus on a few sectors—usually durable goods and housing—that lead the economic cycle. Notably, Edward Leamer, the late UCLA professor of economics and statistics, proposed that changes in housing starts are a good forward-looking indicator of the business cycle and must be incorporated into monetary policymaking.[2] However, durable goods and housing have seen a decline in their share of

economic output. By only focusing on these sectors, economists may miss the bigger picture.

To get a fuller understanding of underlying weaknesses in the economy—and thus produce a timelier assessment of the business cycle—I adopt a general view of *all* major sectors. Specifically, I categorize each sector as either procyclical or acyclical. I then show how procyclical and acyclical sectors change over the business cycle.

I also use this analysis to assess the economy as of the publication of this article. There are some conflicting signals about the current economy: Although GDP and employment have been growing fast, as of February 2025 a large share of employment growth is due to the expansion of acyclical sectors such as health care and government; procyclical sectors display low employment growth. This indicates a weaker economy than the headline employment numbers suggest.

Procyclical and Acyclical Sectors

Before we can define procyclical and acyclical sectors, we must define the business cycle. Throughout this article, I use the National Bureau of Economic Research's (NBER's) definitions of expansions and recessions. According to the NBER, a recession must lead to a significant decline in economic activity, be widespread across the economy, and last for more than a few months.

Now that we have defined the business cycle, we can see how each major economic sector correlates with that cycle. To define cyclicality, I focus on employment in each sector.[3] If a sector's employment growth is positively correlated with NBER-defined expansions, then the sector is strongly affected by macroeconomic conditions, so I categorize it as procyclical.[4] If the correlation is negative, I categorize the sector as acyclical. I categorize these sectors as "acyclical" rather than "countercyclical" because their correlation is only slightly negative. No sector is strongly *and* negatively correlated with expansions. I start my analysis with data from January 1987. This allows me to focus on recent recessions but still have a few years of data before the 1990 recession (Table 1).[5]

Procyclical sectors include well-known and widely analyzed ones like construction and manufacturing.[6] They also include many services, such as professional and business services, which has the highest correlation with NBER expansions. By considering all procyclical sectors, I incorporate the increasingly important services sectors into my analysis and get a more complete picture.

Although there are only three major acyclical sectors (utilities, government, and education and health services), they account for about one in three jobs. What's more, normal macroeconomic forces don't affect these sectors directly. Demand for schooling and medicine are not closely related to the business cycle,[7] and neither is government spending, which all three sectors rely on.[8] Importantly, these sectors are *acyclical*, not *countercyclical*, which means they do not have a clear-cut relationship with the business cycle.

There was an increasing trend in the share of acyclical sectors until the 1980s; this share has become more stable since then. Specifically, the share of employment in acyclical sectors quickly increased from 19 percent in the 1950s to 27 percent in the 1980s, but this increase slowed thereafter. For the period I focus on (that is, since 1987), the cyclicality is much more pronounced than the increase: The share has typically decreased during expansions and increased only around recessions (excluding the current post-COVID expansion). It is hard to disentangle the trend from the business cycle since 1987, because a long and persistent expansion pushes this share down.

When we chart the data, we see that acyclical sectors' increasing share of employment is a sign of weakness in the labor market (Figure 1). But this measure does not reveal how each sector's growth rate evolves around recessions. When we look at these rates as well as the shares, we see more clearly the lead and lag relationship between each sector and the business cycle. Notably, we do not see a slowdown in acyclical sectors' employment until well into a recession (Figure 2).[9] During the 2001 recession, the em-

TABLE 1

A Few Industries Continue to Grow Early in a Recession, Which Renders Their Correlation Negative

Correlation of major economic sectors and the business cycle, 1987–2024

	Correlation with Economic Expansion	Share of Employment in November 2024
Professional and Business Services	0.68	14.4
Manufacturing	0.64	8.1
Wholesale Trade	0.56	3.9
Construction	0.53	5.2
Retail Trade	0.47	9.8
Financial Activities	0.42	5.8
Transportation and Warehousing	0.34	4.2
Leisure and Hospitality	0.34	10.7
Information	0.24	1.9
Other Services	0.23	3.7
Mining	0.09	0.4
Government	-0.01	14.7
Education and Health Services	-0.08	16.8
Utilities	-0.10	0.4

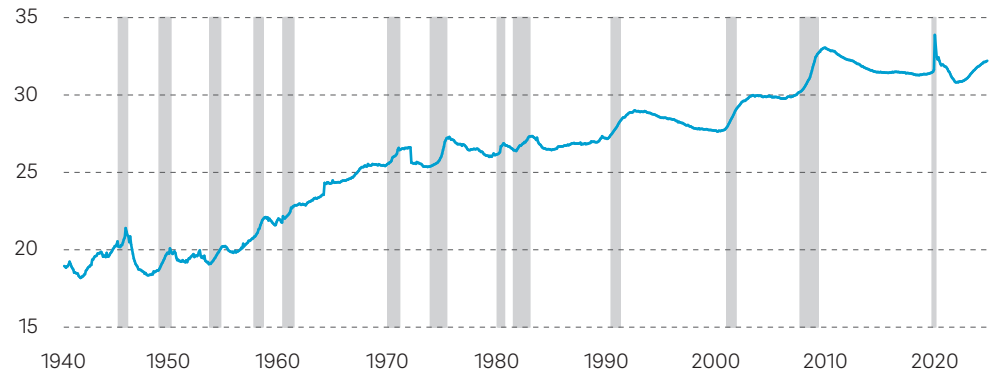
Data Source: Haver Analytics, Payroll Employment Industry Detail, North American Industry Classification System (NAICS), National Bureau of Economic Research (NBER), accessed on March 7, 2025

FIGURE 1

Acyclical Sectors' Share of Employment Increased Quickly from the 1950s to the 1980s

However, the rate of increase has slowed since the 1980s.

Share of acyclical sectors in employment, percent, 1940–2024



Data Source: Haver Analytics, Payroll Employment Industry Detail, accessed on March 7, 2025

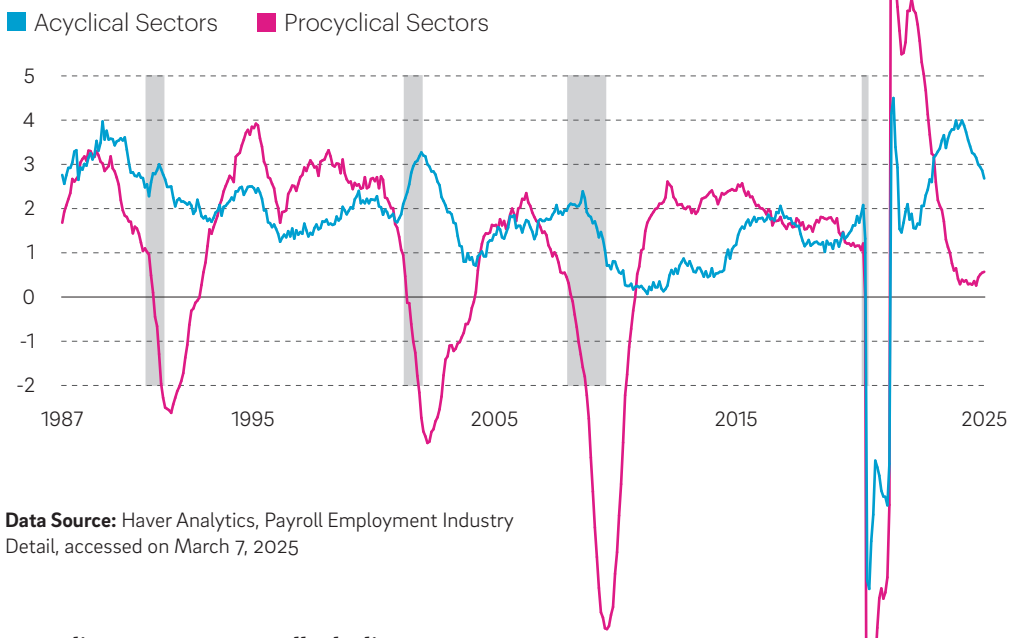
ployment growth rate for acyclical sectors continued to increase to 3.3 percent and started falling only after the official NBER recession had ended. Likewise, this rate continued to increase during the first eight months of the Great Recession, to 2.4 percent. Only thereafter did its growth rate reverse.

This high growth rate before and early in a recession might be due to opportunistic hiring in acyclical sectors as the labor market weakens. However, acyclical sectors' employment growth rate ultimately does decline, possibly because government expenditures take a hit from the recession with a lag. Many local government expenditures are decided in a yearly process for the following year. Many local governments also have balanced budget rules. As tax receipts fall during the recession, expenditures must eventually decline.[10]

FIGURE 2

The Growth Rate of Procyclical Sectors Falls Rapidly Before the Economy Is in a Full-Blown Recession

Employment growth rate, 12-month average, year over year, percent, 1987–2025



Data Source: Haver Analytics, Payroll Employment Industry Detail, accessed on March 7, 2025

To get a more accurate picture of the relative performance of acyclical sectors, we can compare their growth rate to the growth rate of procyclical sectors. I do that by calculating acyclical sectors' share of net employment growth among *all* growing sectors (Figure 3). Since 1987, around 70 percent of net jobs created during recessions (except for the COVID recession) were in acyclical sectors, which means that these sectors typically are the *only* sectors that grow during a recession.

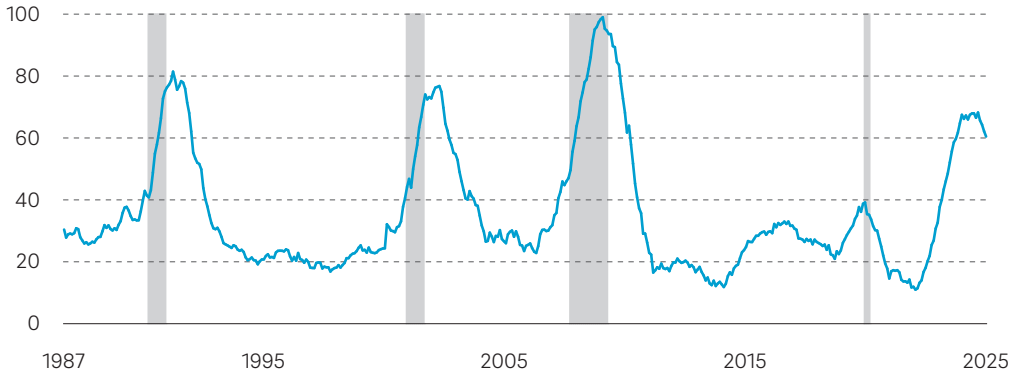
Because acyclical sectors do not respond as much to macroeconomic conditions, they should help stabilize the labor market. However, the unique behavior of acyclical sectors can also hide fundamental weaknesses in the labor market early in a downturn. If acyclical sectors continue to grow while procyclical sectors, which are more affected by aggregate conditions, are slowing down—possibly due to higher interest rates, deteriorating aggregate financial conditions, or supply or demand shortages—economists might miss the signs of the economy's underlying weaknesses, especially if they only focus on aggregate variables such as total employment growth.

FIGURE 3

Except During COVID, Most Net Jobs Created During Recessions Are in Acyclical Sectors

This means acyclical sectors are typically the only sectors that grow in a recession.

Share of acyclical sectors in net employment growth among growing sectors, 12-month moving average as a percent, 1987–2024



Data Source: Haver Analytics, Payroll Employment Industry Detail, accessed on March 7, 2025

Note: There are months in which all sectors see a decline in job growth, but I smooth over those instances by focusing on the 12-month average.

FIGURE 4

In the Highest-Paying Sectors, Employment Is Shrinking

This could be a sign of AI's growing importance.

Employment in the four highest-paying sectors (financial activities, professional and business services, information, and utilities), 12-month average, year-over-year growth rate, percent, 1987–2025

Data Source: Haver Analytics, Payroll Employment Industry Detail, accessed on March 7, 2025

Even worse for economists hoping to predict a recession, acyclical sectors initially seem to grow *faster* as the rest of the labor market weakens.[11] Employment growth in procyclical sectors was in decline for 18 months before the 1990 recession, 11 months before the 2001 recession, and 21 months before the Great Recession (Figure 2). Meanwhile, before each of these recessions, growth in acyclical sectors was relatively strong or accelerating. This makes it even harder for economists to assess the weaknesses in the economy if they don't separate procyclical and acyclical sectors.

The Economy Today

To get a better picture of current economic conditions, I look at changes in acyclical and procyclical employment in two ways: as separate growth rates and as shares of all employment growth.

As of February 2025, the annual growth rate of employment in procyclical sectors was only 0.6 percent, despite a large increase in population due to a recent surge in immigration. Since 1987, employment growth in procyclical sectors has been this low only around recessions.[12] Overall, the sectors currently propping up the U.S. economy are acyclical–they are growing at a very robust 2.7 percent, although their growth rate is declining. Acyclical sectors' share of employment growth hints at substantial labor market weakness, too. According to this measure, 60 percent of employment growth was happening in acyclical sectors in February 2025, the last data point used in this article. Since 1987, this share has been this high only around recessions. In short, most of the recent employment growth has been in the acyclical government and government-adjacent sectors such as health care and education.

*See **AI and the Future of the Labor Market***

This weakness in procyclical sectors,

indicated by both their low employment growth rate and their small share in net employment growth, could be a sign of significant weakness in the underlying fundamentals of the economy, with the acyclical sectors temporarily compensating for this weakness. On the other hand, this time might be different. The COVID recession could have led to severe dislocations, especially in acyclical sectors such as health services and education. (For example, there have been reports of a shortage of nurses and teachers.) It could be that these sectors' growth is strong because they experienced more severe disruptions during the COVID recession. Another possibility is that, due to the rapid aging of the population, there is a boost in demand for acyclical sectors such as health care. According to these explanations, the relatively tepid growth in procyclical sectors is not a sign of weakness but instead is due to the exceptionally high demand in acyclical sectors.

Conclusion

In this article, I argue that the share of acyclical sectors among growing sectors might be another indicator of labor market health. A high share indicates that the sectors that are widely affected by macroeconomic conditions are stagnating. If the high share is accompanied by a rising unemployment rate, as is happening currently, this might be a sign that the underlying fundamentals of the economy are weaker than what the headline unemployment numbers suggest. However, none of this means that a focus strictly on this measure is sufficient. As noted above, there are reasons to suspect that the economy has fundamentally changed since 2020, which is why economists would be wise to combine this tool with the other tools in their arsenal. EI

AI and the Future of the Labor Market

One uncertainty facing the U.S. economy—and the world at large—is how artificial intelligence (AI) will affect the future labor market, and which sectors and occupations will be most affected. In their 2023 report for the International Monetary Fund, economist Carlo Pizzinelli and his coauthors predict that AI will mostly affect high-skill occupations such as professionals and managers. OpenAI technical staff member Tyna Eloundou and her coauthors likewise predict that higher-income jobs will potentially face greater exposure to large language model capabilities. Once-abundant computer science jobs already seem to be in decline.

To capture AI's possible impact on the labor market, I focus on the four highest-paying sectors: finance, professional and business services, information, and utilities. (Three of these industries also have the highest shares of employees with a bachelor's degree.) In these sectors, 12-month employment is shrinking—again, not something observed outside of recessions since 1987 (Figure 4). But it will take more time to see how much of this softening in demand is due to AI (that is, whether it will be persistent) and also what new jobs might be created due to AI.

NOTES

1 A popular tool that uses the unemployment rate is Sahm's rule, which predicts that if the three-month moving average of the unemployment rate goes up at least 0.5 percentage point in a year, the economy is already in a recession. This rule had been a perfect predictor of recessions until very recently. It was triggered in August 2024, but for now a recession seems to have been avoided.

2 Leamer (2007).

3 A sector's cyclicality can be measured using many different variables, including inputs, demand, and stock prices. In this article, I focus on each sector's employment.

4 For this article, I use the correlation with the business cycle to define cyclicality. The volatility of sectors is also important for their impact on the depth of the recession. Sectors that are more correlated with the cycle also typically respond more in recessions—that is, they are also more volatile.

5 I exclude the COVID recession because it was atypical.

6 In addition to Leamer, other researchers interested in the goods sectors' cyclicality include Morris Davis and Jonathan Heathcote, who focus on residential investment, and Susan Black and Tom Cusbert, who focus on the demand for durable goods.

7 There is even some countercyclicality in the demand for higher degrees. In their 1995 *Journal of Human Resources* article, economist Julian Betts and economic historian Laurel L. McFarland showed that enrollment at two-year public community colleges rose and fell along with the unemployment rate.

8 For example, the health care sector is partly funded by Medicaid and Medicare, and education is partly funded by Pell grants.

9 There is extra volatility in government employment due to the temporary hiring for the Census Survey every 10 years. To address this extra volatility, I smoothed government employment growth between March and September of Census years.

10 Annual state budgets are decided using projections on revenues and expenditures, and if there is a large shock like a recession, states can have budgetary shortfalls midyear. The Pew Charitable Trusts produces an in-depth review of how states address midyear budgetary shortfalls. Some states, such as Pennsylvania and Arizona, can simply carry the deficit forward to the next fiscal year. Some states, such as Illinois, can borrow short-term during the fiscal year. Some states can use their rainy-day funds or informal reserves. And others might need to make unplanned reductions in expenditures or increase taxes.

11 This might be due to compensation rigidities in sectors that involve government funding, which makes filling vacancies more difficult when labor demand in the rest of the economy is robust. For example, in her 2021 article for the Economic Policy Institute, labor economist Sylvia Allegretto calculated a pay penalty of 24 percent for teachers relative to similarly educated people in a robust labor market.

12 During recessions, employment growth collapses even more.

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Credit Scores and Rising Credit Card Delinquencies

COVID disrupted credit scores. Did that have something to do with the rise in card delinquencies?

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Most key indicators suggest good news for the postpandemic U.S. economy. GDP growth has been robust. So, too, has consumption growth. And unemployment rates remain near historic lows. But rising consumer delinquencies indicate that an increasing number of households are unable to meet their financial obligations.

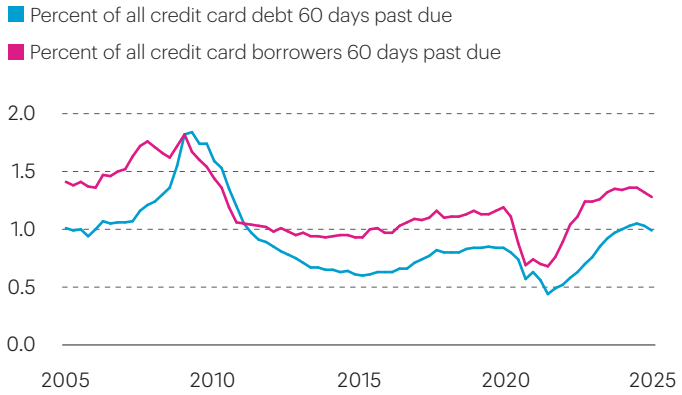
This is a reversal of the previous trend: Because people had fewer opportunities to spend money, and because many people benefited from government stimulus payments, card delinquency rates *fell* immediately after the pandemic. When card delinquency rates began to increase in the second half of 2021, it appeared that these rates were simply returning to their prepandemic level. However, the upward trend has continued, and delinquency rates are now at their highest levels since the Great Recession (Figure 1).[1]

If policymakers and lenders can understand *why* credit card delinquencies are on the rise, they will be in a better position to identify possible underlying weaknesses that aggregate statistics such as GDP and employment might miss. They will also be in a

FIGURE 1

Rising Consumer Delinquencies Suggests That More Households Are Unable to Meet Their Financial Obligations

Percent of all credit card debt (in dollars and in number of people) that is delinquent (60 or more days past due), seasonally adjusted, 2005–2024



Data Source: FRBNY Consumer Credit Panel/Equifax Data

Note: All people with card accounts 120+ days past due are omitted from the sample.

better position to address potential vulnerabilities in household balance sheets.

In this article, we evaluate one explanation for the rise in credit card delinquencies: pandemic-induced changes in borrower credit scores. Lenders use credit scores to distinguish between borrowers of higher and lower credit risk. The disruptions caused by the pandemic and its aftermath compressed the dispersion of credit scores. If this compression made it more difficult for lenders to rank borrowers by credit risk, that could explain the current rise in delinquencies. If it didn't, we can look more carefully at other explanations for the rise in delinquencies.

How Credit Scores Changed After the Pandemic

The pandemic and its aftermath affected credit scores through two channels. First, the lockdowns temporarily inhibited travel, dining out, retail spending, and other forms of consumption. Meanwhile, government stimulus payments temporarily boosted the income of many households. In addition, mortgage and student loan forbearance programs helped many households temporarily avoid having missed payments enter their credit records. As a result, the savings rate increased, the credit card utilization rate fell, and delinquency rates on credit cards and auto loans also fell. Because of these changes, the level of credit scores rose and the range of their distribution shrank (Figure 2).

The Level of Credit Scores

On average, credit scores have been slowly increasing since the Great Recession, but this upward drift in the level of credit scores rapidly accelerated after the pandemic. The median (50th percentile) credit score increased from 719 in the fourth quarter of 2019 to 731 two years later; it has remained at or above this level ever since. To put this 12-point increase in context, it took *five years* for the median credit score to increase this much before 2020.

Perhaps the rise in the level of credit scores played a role in the recent increase in delinquencies. In a recent article, senior economists Scott Fulford and Christa Gibbs of the Consumer Financial Protection Bureau argue that lenders insufficiently adjusted for the increase in the general level of scores and, as a result, originated new cards for applicants who normally might have looked too risky to get a card.[2]

To assess this argument, we need to understand how lenders reacted to the shift in scores. One extreme assumption is that the rapid upward shift in credit scores might have represented a pronounced and lasting change in the credit risk of borrowers. In this case, lenders should have reacted by increasing the credit supply to borrowers whose credit score rose. As a result, everyone further down the relative distribution of credit scores would qualify for more lending, too. But at the other extreme, lenders may have interpreted the rise in credit scores as a temporary aberration due to the transitory effects of the pandemic. In this case, lenders would have rescaled their lending standards in step with the rise in credit scores. All else being equal, new lending would occur at the same relative point in the credit score distribution.

To see how lenders reacted to the shift in scores, we identified all borrowers who obtained a new credit card (whether it's their first card or an additional card) in any quarter and ranked them by their credit score in that quarter. We then compared the median credit score for these borrowers with the credit score of all borrowers; this gave us the new-card borrower's relative position. We repeated this exercise for each quarter starting in 2015 (Figure 3). Prior to the pandemic, the relative position of the median new-card borrower had been falling since 2016, from the 48.5th percentile to the 35.7th percentile. That trend was temporarily arrested from the third quarter of 2020 to the first quarter of 2021, likely because of tighter lending standards. Thereafter, the downward trend resumed. But since 2023, the relative position has increased, likely in response to rising delinquency rates. In the latest, fourth-quarter 2024 reading, it's at its highest level in eight years.

The shift in the relative credit score position of new-card borrowers is consistent with Fulford and Gibbs's argument that banks failed to consider the drift in credit scores when originating new cards after the pandemic.[3] Although Fulford and Gibbs also show that cards issued in 2021 and 2022 became delinquent more quickly than cards issued in the years prior to the pandemic, Boston Fed principal economist and policy advisor Joanna Stavins recently emphasized that this was a temporary episode, with delinquency rates on cards issued starting in 2023 being similar to rates on cards issued prior to 2020.[4]

The Compression of the Credit Score Distribution

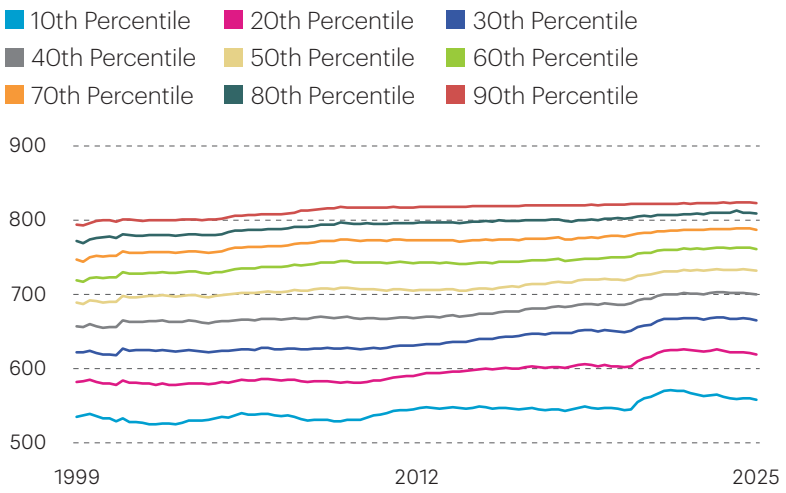
The pandemic lifted the credit scores of high-risk borrowers more than low-risk borrowers. In other words, as the level of credit scores rose, their distribution became compressed. The

FIGURE 2

The Pandemic and Its Aftermath Affected Credit Scores

The level of credit scores rose and their distribution shrank.

Change in credit score by decile, 1999–2025



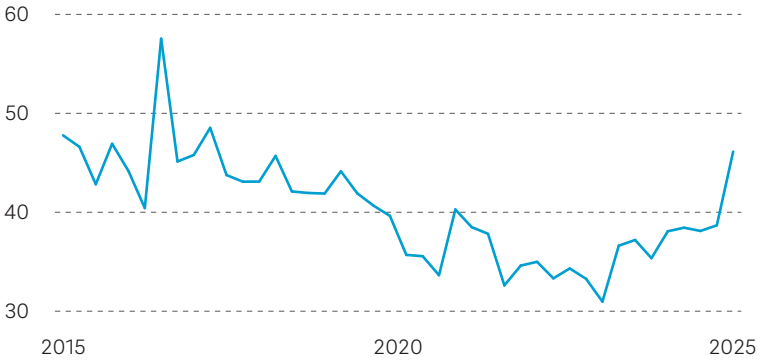
Data Source: FRBNY Consumer Credit Panel/Equifax Data

FIGURE 3

The Relative Position of the Median New-Card Borrower Has Been Rising Since 2023

As of the end of 2024, it was at its highest position in eight years.

Credit score ranking of median borrower who obtained a new credit card, 2014–2025



Data Source: FRBNY Consumer Credit Panel/Equifax Data

Note: Two percent of primary-sample credit card identification codes; risk score is lagged by one quarter.

difference between the 20th and 50th percentiles fell from 117 points in the fourth quarter of 2019 to 107 points a year and a half later (Figure 4). That's the smallest gap since 2000.

As credit scores became more compressed, far fewer borrowers fell below the traditional threshold used to distinguish riskier borrowers. For example, borrowers with a credit score below 660 are classified as nonprime by lenders, who generally charge them a higher interest rate and limit their access to credit. The fraction of borrowers with a nonprime score fell steadily in the decade after the Great Recession, from 38 to 32.7 percent—an average annual decrease of 0.53 percentage point.[5] In contrast, the fraction of borrowers classified as nonprime fell by 1.9 percentage points in 2020 alone and has remained roughly at this level ever since (Figure 5).

Credit scores allow lenders to categorize borrowers by risk of default. When the score distribution becomes compressed, the observable gap between more- and less-risky borrowers shrinks, which potentially makes them harder to distinguish. This may render credit scores less informative, and that can result in borrowers getting loans they cannot repay. We explore this idea in more detail in the next section.

Did Credit Scores Become Less Informative?

The primary purpose of a credit scoring system is to *rank* borrowers by their credit risk. A shift in the general level of credit scores does not necessarily represent a change in the ability of the score to perform this function. However, the same forces that increased the general level of credit scores could have also made it harder to rank borrowers. For example, a borrower who was close to missing a loan payment might have been able to avoid default thanks to the forced savings and stimulus payments. As a result, that borrower's credit score might be identical to the score of a borrower who was never at risk of default.

In addition, the pandemic made for an unusual economy. People employed in otherwise stable industries lost their jobs or were forced to work less. People changed employment to care for children when schools were closed. Trade disruptions altered relative price levels, driving up the cost of living for some households more than others. Credit scores, which are forecasts of default risk based on years of historical data, necessarily assume that the future will look like the past, and this was a false assumption during and immediately after the pandemic.

If credit scores became less informative because of unusual economic forces, lending might have been poorly targeted. This could partly account for the postpandemic increase in the level of credit defaults. To test this hypothesis, we measured the informativeness of credit scores with the widely used area under the curve (AUC) metric.[6] An AUC measure will vary between 0.5 (meaning that credit scores fail to distinguish between high- and low-credit-risk borrowers) and 1.0 (meaning that credit scores perfectly distinguish between borrowers). The closer the metric is to 1.0, the more informative the scores.

*See **Measuring the Informativeness of a Credit Score***

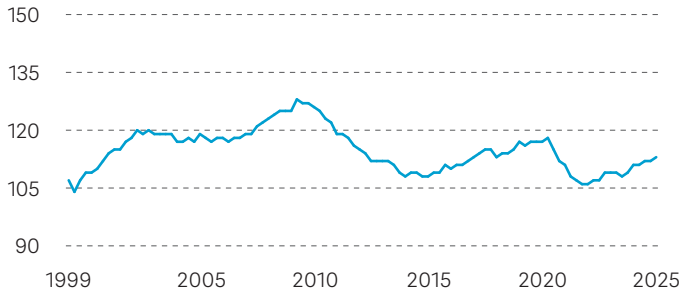
We began our analysis by identifying everyone in a quarter who has a credit card and is in good standing on all their cards. We recorded their credit score in that quarter and then related this to whether they had become delinquent on any of their credit cards one year later.[7] Using this data, we built our AUC measure. We repeated this exercise for every quarter starting with the first quarter of 2015 (Figure 6). The

FIGURE 4

The Pandemic Lifted the Credit Scores of High-Risk Borrowers More than Low-Risk Borrowers

The gap in 2020 was the smallest since 2000.

Difference between 20th percentile and 50th percentile of credit score distribution, 1999–2024

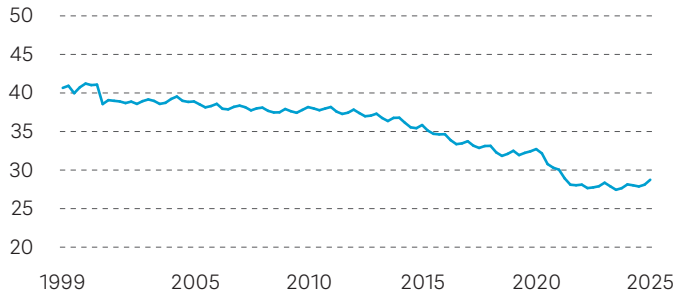


Data Source: FRBNY Consumer Credit Panel/Equifax Data

FIGURE 5

As Credit Scores Became More Compressed, Far Fewer Borrowers Fell Below the Traditional Threshold Used to Distinguish Riskier Borrowers

Percent of all borrowers with a nonprime credit score, 1999–2024



Data Source: FRBNY Consumer Credit Panel/Equifax Data

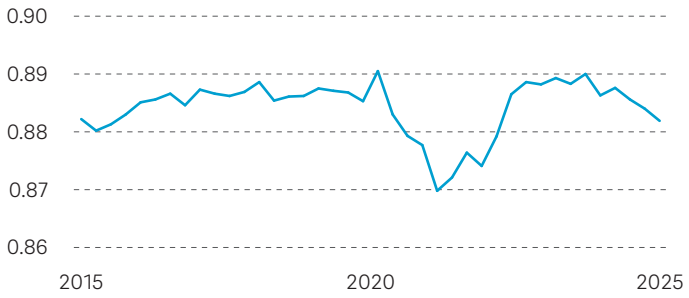
Note: Prime credit scores are ≥660; nonprime are <660.

FIGURE 6

Credit Scores Became Uninformative Only Briefly During the Pandemic

The quick recovery of score informativeness suggests that this is unlikely to explain the subsequent and extended increase in card delinquencies.

Area under the curve for all borrowers with a credit card, 2015–2024

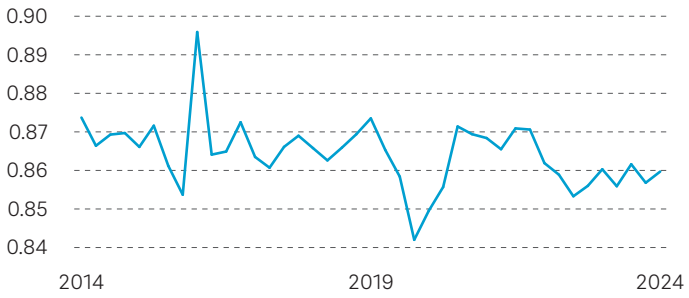


Data Source: Authors' calculations based on FRBNY Consumer Credit Panel/Equifax Data

FIGURE 7

The Reduction in Credit Score Informativeness for People Getting an Additional Card May Be Contributing to the Recent Increase in Delinquencies

Area under the curve (share of default, share of nondefault) for borrowers who had an increase in the number of credit cards, 2014–2024



Data Source: FRBNY Consumer Credit Panel/Equifax Data

informativeness of credit scores was fairly steady in the five years prior to the pandemic, with the AUC measure averaging 0.886. But in 2020 the informativeness of credit scores fell: The AUC measure averaged 0.873 in 2020, a decline of 1.3 percentage points.[8] As a result, lenders using these scores would have been less able to distinguish which borrowers were likely to default in 2021. In large lending portfolios, this could have led to the mispricing of loans and imprecise loan approval decisions.

However, this decline was short lived: The AUC of credit scores had returned to its prepandemic average by the second quarter of 2021 and remained at roughly that level until mid-2023. This temporary decline may be attributable to the increased uncertainty in the economy during the initial months of the pandemic, which made defaults harder to predict. Although the AUC measures for the second half of 2023 show a small decline in informativeness, this is likely unrelated to the pandemic and is too recent to be a leading explanation for the rise in card delinquencies that began in 2021. It is possible that the decline in rating informativeness during 2020 gave rise to less precisely targeted lending, but the quick recovery of score informativeness suggests that this is unlikely to explain most of the subsequent and extended increase in card delinquencies.

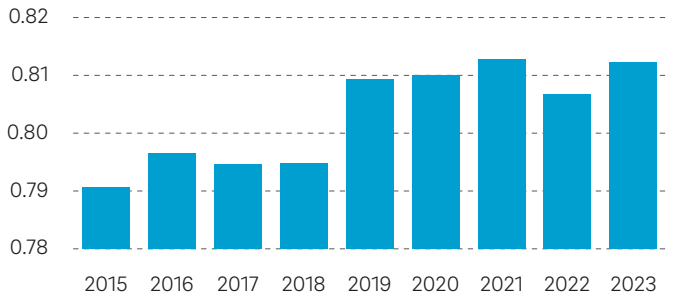
Thus far, we have focused on the informativeness of credit scores among *all* card holders. But if credit score imprecision played a role in subsequent delinquencies, the borrowers that matter most are those who received additional access to card lending. So, we repeated the analysis only for borrowers who increased their number of credit cards. Until 2022, the story is roughly the same as it is for all card holders (Figure 7). Among borrowers who received an additional credit card, the AUC in the five years prior to the pandemic held mostly steady around an average of 0.866. Although their AUC measure temporarily fell by roughly 2 percentage points in the fourth quarter of 2019, this was most likely due to the increased uncertainty that was to occur in 2020. By the second half of 2020, their AUC measure indicates that credit scores were as informative as they had been before the pandemic. However, the story changes in 2022. The

FIGURE 8

Informativeness of Credit Scores of New Credit Card Holders Did Not Worsen

Because the data are noisy due to the smaller sample size, we repeat the analysis using the annual average area under the curve. The results are the same.

Area under the curve (share default, share nondefault) for borrowers who went from having no cards to at least one card, annual average, 2015–2023

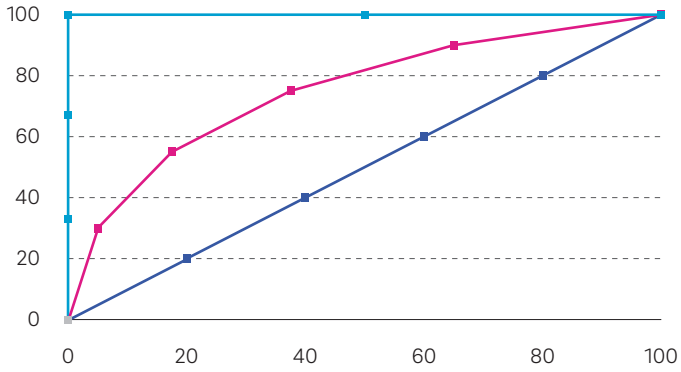


Data Source: FRBNY Consumer Credit Panel/Equifax Data

FIGURE 9

The Area Under the Curve Measure Can Tell Us the Informativeness of Credit Scores, but Only Imperfectly

Receiver operator characteristics curves (share of defaults admitted, share of nondefaults admitted) for each credit score scenario



Data Source: Authors' calculations

AUC measure declined again starting in the middle of 2022 and has since averaged roughly 1 percentage point below its prepandemic level. Even though this drop commenced after delinquencies started increasing, it may have partially contributed to the sustained increase in delinquencies.

To drill down on this account further, we conducted one final test of the hypothesis: We focused on borrowers who went from having no credit card in the previous quarter to one or more cards in the quarter being analyzed. This allowed us to limit our analysis to borrowers on the margin of credit card access.[9] For each quarter starting in 2015, we calculated the AUC measure for these borrowers based on whether they were delinquent on any card 12 months later. Because the data are unavoidably noisy due to the smaller sample size, we used the annual average of the AUC measure (Figure 8). In contrast to the credit scores for all card borrowers, there is no obvious decline in the AUC at the start of the pandemic, and in fact the AUC appears to have *risen* to a new, higher average level starting in 2019. Among this group, the average AUC from 2015 to 2018 was 0.799. Starting in 2019 the average AUC has been 0.814, with little annual variation. Based on this evidence, it does not appear that credit ratings became less capable of ranking first-time credit card borrowers in the years following the pandemic. Therefore, the data do not support the hypothesis that increased delinquencies among borrowers who were given their first card can be traced to a decline in credit score precision among this group.

Conclusion

The pandemic and its aftermath disrupted the distribution of credit scores, increasing their average level and compressing the distance between borrowers' scores. In this article, we evaluated whether this change in the distribution of credit scores also reduced their informativeness for predicting default and thereby potentially contributed to the recent rise in card delinquencies. We find limited support for this hypothesis. Among all borrowers with a credit card, there was a fall in the predictive power of credit scores during the pandemic, but this decline was temporary, and the informativeness of scores appears to have returned to its prepandemic level. There is some evidence of a decline in rating informativeness starting in mid-2022 for borrowers who received an additional credit card, which may have helped sustain the increase in delinquencies. However, there is no evidence of a decline in the informativeness of scores for people who received their first card, and this is the group that is likely to matter the most. In sum, the evidence suggests that a drop in the informativeness of credit scores may have played a role in the initial rise of card delinquencies but does not appear to be a leading explanation for the recent resurgence in card delinquencies.

By rejecting this one hypothesis, we can look more closely at other explanations for the rise in delinquencies. For example, rising prices have made it difficult for some households to meet daily expenses and repay obligations. Other borrowers may have overestimated how long the temporary stimulus program would last, leading them to become financially overcommitted when it ended. Still other borrowers may have used the stimulus program to forestall an inevitable delinquency. Identifying the relative importance of each of these alternatives is important if we are to guide policymaking going forward.

Measuring the Informativeness of a Credit Score

The informativeness of a credit score can be measured by its ability to distinguish between borrowers who are more or less likely to default on a loan. A widely used measure of the informativeness of a credit score is the area under the curve (AUC). The following example shows how this measure is built and demonstrates how it captures the ability of a score to distinguish between borrowers who will and will not default on a loan.

Consider a credit scoring system that categorizes borrowers into five categories of risk, ranging from A (lowest risk of default) to E (highest risk of default). Suppose also that there are 500 borrowers to be scored today, of which 200 will default and 300 will not default over the next year. The informativeness of the rating hinges on how well it sorts people by their propensity to default in the future.

We develop three scenarios for the informativeness of a credit scoring system by showing what fraction of people assigned each score will go on to default (Table 1). In Scenario 1, the score perfectly ranks borrowers by their credit risk: Nobody with a score of C or better defaults, whereas everyone with a score of D or worse does. By looking at the borrower's credit score, a lender will know with certainty whether they will default. In Scenario 2, the score allows lenders to sort people by their risk of default, but the ranking is imperfect—a lender has only a probabilistic guess of any borrower's propensity to default based on the score. Some people with the best score (A) will default; some people with the worst score (E) will not. In Scenario 3, the score is totally uninformative because it does not distinguish with any level of probability who will default: The probability that a borrower will default is identical at each score.

For each credit score, we use the AUC to measure two things:

The Share of Defaults Admitted at This Score. If a lender lent to everyone at this score or above, this is the fraction of all people they lend to (that is, at any score) who were going to default.

Share of Nondefaults Admitted at This Score. If a lender lent to everyone at this score or above, this is the fraction of all people they lend to (that is, at any score) who were not going to default. (To help the reader understand this concept, we calculated both shares for Scenario 2 [Table 2].)

Next, we use the two values at each credit score as the coordinates to build a curve that plots the Share of Nondefaults Admitted on the Y axis and the Share of Defaults Admitted on the X axis. This curve is known as the receiver operator characteristic (ROC). The area under this ROC curve is the AUC measure of the rating's informativeness (Figure 9). For the three scenarios in our example, these ROC curves are as follows:

The AUC for Scenario 1 is 1.0, which indicates that the credit score is perfectly informative. By contrast, the AUC for the totally uninformative score in Scenario 3 is 0.5, the lowest possible AUC. The imperfect credit score has an AUC of 0.75, intermediate between 1.0 and 0.5. More generally, the higher the AUC, the closer the credit score is to the perfectly informative scenario in which a lender knows with certainty the credit risk of any borrower based on their score. Conversely, the lower the AUC, the closer the score is to the perfectly uninformative scenario where it offers no additional information to distinguish borrowers with different propensities to default.

TABLE 1

Three Scenarios for the Informativeness of a Credit Scoring System

Each scenario shows what fraction of people assigned to each score will go on to default.

	Realized Default Rate at Credit Score for Each Scenario		
Credit Score	Scenario 1: Perfectly Informative	Scenario 2: Imperfectly Informative	Scenario 3: Uninformative
A	0/100	10/100	40/100
B	0/100	25/100	40/100
C	0/100	40/100	40/100
D	100/100	55/100	40/100
E	100/100	70/100	40/100

TABLE 2

How to Calculate Shares of Defaults and Nondefaults Admitted at Each Rating for Scenario 2

Credit Rating	Share of Defaults Admitted at This Rating	Share of Nondefaults Admitted at This Rating
A	10/200 = 0.05	90/300 = 0.3
B	(10+25)/200 = 0.175	(90+75)/300 = 0.55
C	(10+25+40)/200 = 0.375	(90+75+60)/300 = 0.75
D	(10+25+40+55)/200 = 0.65	(90+75+60+45)/300 = 0.9
E	(10+25+40+55+70)/200 = 1.00	(90+75+60+45+30)/300 = 1.00

Notes

1 This article utilizes data from the FRBNY Consumer Credit Panel/Equifax Data, an anonymized, nationally representative sample drawn from Equifax credit report data. The credit score used for this analysis is the Equifax Risk Score 3.0 (an Equifax-calculated credit score that ranges from 280 to 850, with a lower score indicating a higher risk of future delinquency).

2 They first made this argument in Fulford and Gibbs (2024).

3 See Fulford and Gibbs (2024).

4 See Stavins (2025).

5 This is largely a reflection of borrowers' credit histories recovering from the consumer delinquencies that characterized that recession.

6 For examples of the AUC in other research, see Albanesi and Vamossy (2024), Fulford and Nagypál (2020), and Berg et al. (2018).

7 Delinquency means any minimum payment is 60 or more days past due.

8 When the AUC falls by 1 percentage point, an additional one in every 100 borrowers is incorrectly ranked in terms of their credit risk.

9 In contrast, a borrower who goes from three to four cards already has substantial access to credit card lending. Receiving an additional card should not substantially increase their risk of default due to greater access.

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Breaking Down the Latest Fight Against Inflation

We apply a novel empirical approach to understand the role monetary policy played in post-COVID inflation.

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The views expressed in this article are not necessarily those of the Federal Reserve Bank of Philadelphia or the Federal Reserve System.

Like the central banks of other major advanced economies, the Federal Reserve has embraced systematic monetary policy, which means that its decisions are data dependent and this dependence follows a pattern understood by the public. For example, when economic output is above its natural level and inflation is above its intended target, the public understands that the Fed will likely increase the federal funds rate—which affects the rates banks charge for mortgages, car loans, credit cards, and other loan products—to rein in inflation.[1]

Economists and central bankers generally use monetary policy rules to summarize the conduct of systematic monetary policy.[2] Although these rules offer a useful benchmark, the Fed has never formally adopted one as a strict decision-making mechanism.[3] Instead, Fed policymakers set the federal funds rate by considering the bulk of economic data and assessing the balance of risks involved in achieving their objectives as mandated by Congress.[4] These deliberations take place at the Federal Open Market Committee (FOMC) meetings and culminate with the committee announcing its decision.

If the Fed doesn't strictly adhere to a specific monetary policy rule, how can we characterize the systematic behavior that underlies the decisions of the FOMC? And why is this characterization useful?

Characterizing systematic policy requires an analytical framework. In empirical macroeconomics, one popular approach uses structural vector autoregressions (SVARs), a class of flexible econometric models first proposed by Nobel laurate Christopher Sims.[5] Building on Sims's work, Giorgio Primiceri of Northwestern University proposed that economists estimate the Fed's systematic behavior by using an SVAR of the U.S. economy that would account for changes in how the Fed responds to data and changes in other economic relationships.[6]

*See **Structural Vector Autoregressions***

Although appealing, Primiceri's proposed SVAR requires economists to impose restrictions regarding the functioning of the entire economy. In some cases, such as when the number of variables included in the SVAR increases, these restrictions are hard to justify using economic theory or institutional knowledge.[7] To address this concern, the authors of this article, along with Juan Rubio-Ramírez of Emory University and Daniel Waggoner of the Federal Reserve Bank of Atlanta, recently developed a methodology that relaxes this requirement. The distinctive feature of our approach is its ability to estimate systematic monetary policy using assumptions based on institutional knowledge about the Fed without needing to impose controversial restrictions on other aspects of the economy.

By characterizing systematic monetary policy with an SVAR, we can better understand FOMC decisions and conduct counterfactual experiments. In the counterfactual experiment we discuss later in this article, we assess how the economy would have evolved if the Fed had been more dovish or hawkish on inflation. (In the world of central banking, a hawk puts more weight on the inflation leg of the Fed dual mandate relative to a dove.)[8] This is especially important during episodes such as the postpandemic inflation surge—the first episode of high inflation since the Great Inflation of the 1970s.[9] During this surge, there was a debate about how much interest rates would have to increase to bring inflation back to its 2 percent target, and how much this would cost in terms of output. As noted by Federal Reserve Chair Jerome Powell, doing too little or too much could cause unnecessary harm to the economy.[10]

More specifically, by analyzing systematic monetary policy, we can answer three important questions: How did the Fed respond to the state of the economy during the most recent policy-tightening cycle?[11] How does this response compare with a more dovish or hawkish monetary policy response? And should the Fed have fought inflation earlier? In this article, we summarize our findings and discuss our results.

How Systematic Policy Interacts with the Economy

Before tackling the three questions posed above, let us illustrate how systematic monetary policy interacts with the economy. Understanding this interaction reveals why estimating systematic monetary policy is essential for our analysis. We do so with a conceptual aggregate demand and aggregate supply framework, which makes clear that, to understand how monetary policy interacts with the economy, we need to understand both demand channels and supply channels.[12]

The demand channels are summarized by an aggregate demand curve that describes a negative relationship between output and inflation. For instance, as inflation increases above the Fed's 2 percent inflation target, the public expects the Fed to increase interest rates. Higher real interest rates induce consumers to postpone some of their consumption plans and thus lead to lower demand for output today.

The supply channels are summarized by an aggregate supply curve that describes a positive relationship between output and inflation. For instance, as output increases above its natural level, firms in the economy must hire additional workers at higher wages or pay additional compensation to its current employees for them to work longer hours. This increase in labor costs raises production expenses, which leads to higher prices and inflation.

Systematic monetary policy directly affects the aggregate demand curve's slope, which captures the trade-off between inflation and output in the demand side of the economy. If the Fed were to put substantially more weight on inflation than on output, the public would expect the Fed to increase interest rates sharply in response to a given increase in inflation, inducing a large decline in the demand for goods and services. Thus, the aggregate demand curve flattens when the Fed prioritizes controlling inflation. For example, the public's demand for goods and services would noticeably fall in the face of an inflationary shock caused by an unexpected increase in oil prices due to a curtailment of oil production in the Middle East. In part, this would happen because the public would anticipate that the Fed would raise rates sharply in response to this inflationary shock.[13]

But if the Fed were to put substantially more weight on output than on inflation, the public would expect interest rates to rise moderately in response to a given increase in inflation. Hence, the public's demand for goods and services would fall by less than in the previous case in the face of the same inflationary shock. The aggregate demand curve steepens when the Fed prioritizes maintaining output at its natural level.

Although systematic monetary policy directly affects the aggregate demand curve, it has little influence on the aggregate supply curve. Instead, this curve's slope is mainly determined by other factors, such as how the economy produces its goods and services.[14]

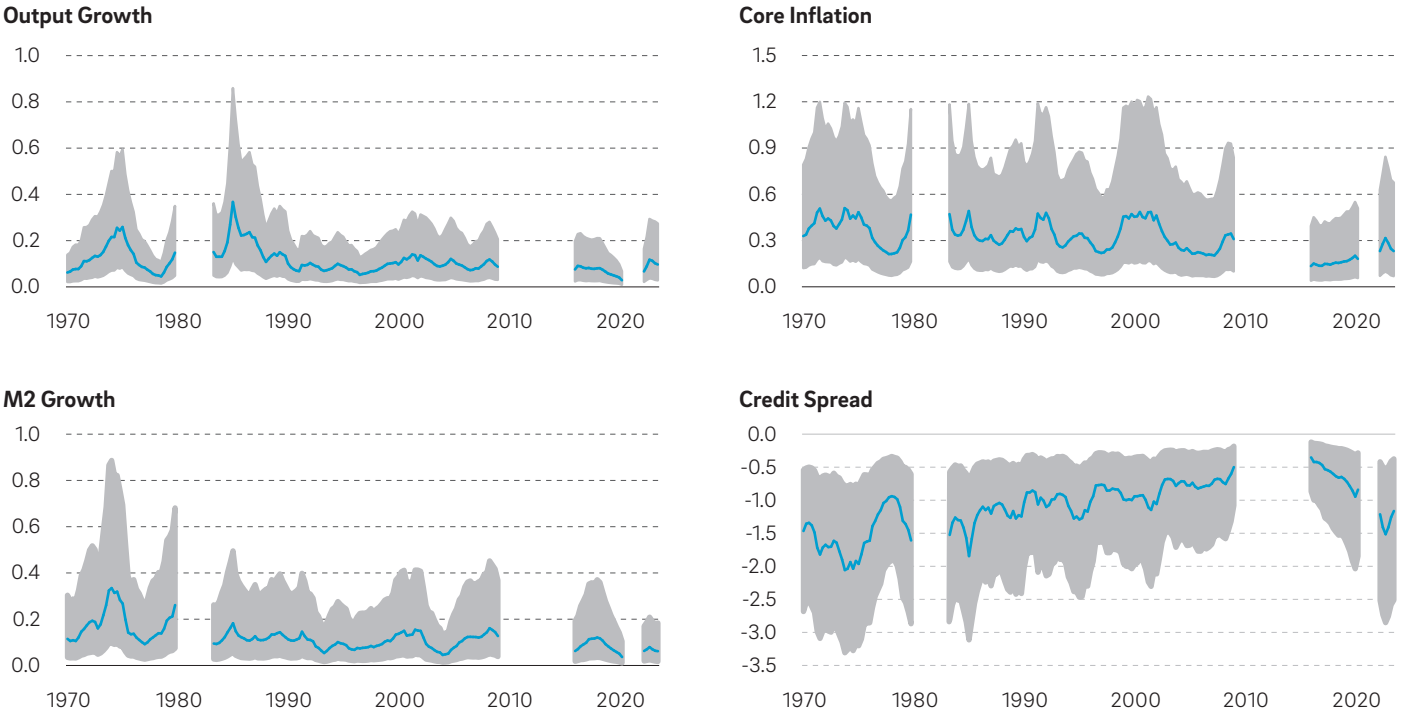
Inflation and output are determined by the intersection of the aggregate demand and aggregate supply curves. As the economy evolves, supply shocks (like our hypothetical spike in oil prices) and demand shocks (like an unexpected decline in consumer confidence) shift these curves, determining new values for inflation and output. If the central bank is primarily focused on maintaining low inflation (and thus the aggregate demand curve is flat, which means that inflation is unresponsive to output fluctuations), the shocks will lead to a larger fluctuation in output. If, however, the central bank is primarily focused on output (and thus the aggregate demand curve is steep, which means that output is unresponsive to inflation), the shocks will lead to a larger fluctuation in inflation.[15]

FIGURE 1

The Fed's Reaction Function Evolves Over Time

The Fed has changed how it sets the federal funds rate in response to movements in inflation, output, and financial market indicators.

Contemporaneous coefficients characterizing the Fed's systematic reaction function from 4Q1959 to 2Q2023



Data Source: Arias et al. (2025)

Note: Dark lines represent posterior medians; shaded regions represent the 68th percentile probability band. Blank spaces correspond to the periods in which the federal funds rate was not the Fed's main policy instrument (4q1979–4q1982) or was subject to the zero lower bound constraint (1q2009–3q2015 and 2q2020–4q2021).

Thus, systematic monetary policy is at the heart of the economy, and different monetary policy stances (that is, different views on how strongly to weight inflation and output in the dual mandate) will result in different economic outcomes. This is why we need to understand what the Fed did in terms of systematic policy, and what it could have done differently.

To be sure, conducting systematic monetary policy involves more than reacting to an increase in inflation as assumed in our illustrative conceptual aggregate demand and aggregate supply framework. In practice, the systematic behavior of central banks takes into account a large number of economic and financial indicators when deciding on the appropriate level of interest rates. Even then, systematic monetary policy does not always fully account for FOMC decision-making; sometimes policymakers' actions are better explained as deviations from their systematic behavior. These deviations are known as monetary policy shocks. Importantly, our analysis will also shed light on whether the actions of the Fed during the postpandemic inflation surge resulted from systematic policy or monetary policy shocks.

How to Measure Systematic Policy in Practice

Researchers have developed several methods for measuring the relationship between systematic policy and the economy. As highlighted above, our method's main advantage is that it estimates systematic monetary policy by leveraging assumptions rooted in institutional knowledge about Federal Reserve policy while maintaining an agnostic stance toward other, more complex aspects of the economy that are challenging to model—all in an environment that allows for structural change.

More specifically, we use time-varying monetary policy coefficients that capture the reaction of the Fed to output growth, inflation, and two financial market indicators: money growth and corporate credit spreads.[16] (The Fed reacts to more than output growth and inflation in part because timely measures of these variables are usually unavailable. So, the Fed also looks at financial market indicators such as money growth and corporate credit spreads to gauge the state of the economy in real time.)

In our SVAR, these policy coefficients characterize the Fed's systematic reaction function. This function quantifies precisely how much the Fed adjusts its main policy instrument (that is, the federal funds rate) in response to economic data, which provides a concrete representation of systematic monetary policy within our SVAR framework.[17] Even so, as mentioned above, the Fed does not always respond exactly as it has according to the

systematic reaction function. These deviations are captured in our SVAR by monetary policy shocks, as explained above.[18]

We can estimate the Fed's systematic reaction function by looking at its historical response to movements in inflation, output, and financial market indicators; we do so by fitting our SVAR to the data. When we estimate contemporaneous coefficients that characterize the Fed's systematic reaction function from the fourth quarter of 1959 through the second quarter of 2023, our key insight is that systematic monetary policy has changed (Figure 1). We illustrate this by highlighting four phenomena often discussed in academic and monetary policy circles.

*See **Monetary Policy Coefficients***

First, the Fed reacted more strongly to inflation in the early 1980s than during the subsequent Great Moderation, on average. Also, the federal funds rate reacted strongly to inflation during the first years of Chair Arthur Burns's tenure (1970–1978) and around the 2000s under Chair Alan Greenspan (1986–2006). Second, although many people think of Chair Paul Volcker's tenure (1979–1986) as exclusively focused on combating inflation, the Fed reacted strongly to output growth in 1983–1984. This suggests that the Fed viewed the high growth of real GDP in 1983–1984 as having the potential to overheat the economy, which would have hindered the progress made against inflation following Chair Volcker's appointment. Third, the political pressure President Richard Nixon exerted on the Fed during the early 1970s is reflected in the Fed gradually becoming more responsive to the credit spread determining borrowing costs of firms (rather than less responsive to inflation).[19] After the end of Nixon's presidency in 1974, the response to corporate credit spreads decreased in absolute terms before the Fed gradually became more responsive again after the Global Financial Crisis (2007–2008). Fourth, the stock of money's response to the growth rate has trended lower since the early 1980s, when policymakers expressed skepticism about using the quantity of money to guide policy.[20] These four changes in systematic monetary policy demonstrate why we need a flexible framework to capture the evolution of monetary policy.

Deconstructing the Latest Tightening Cycle

Time-varying coefficients summarize historical trends in the Fed's behavior. But to assess the role played by systematic policy in a particular episode, such as during the post-COVID inflation surge, economists typically rely on historical decompositions that divide the observed values of economically meaningful variables (such as the federal funds rate, inflation, and output growth) into predictable and unpredictable parts (Figure 2).

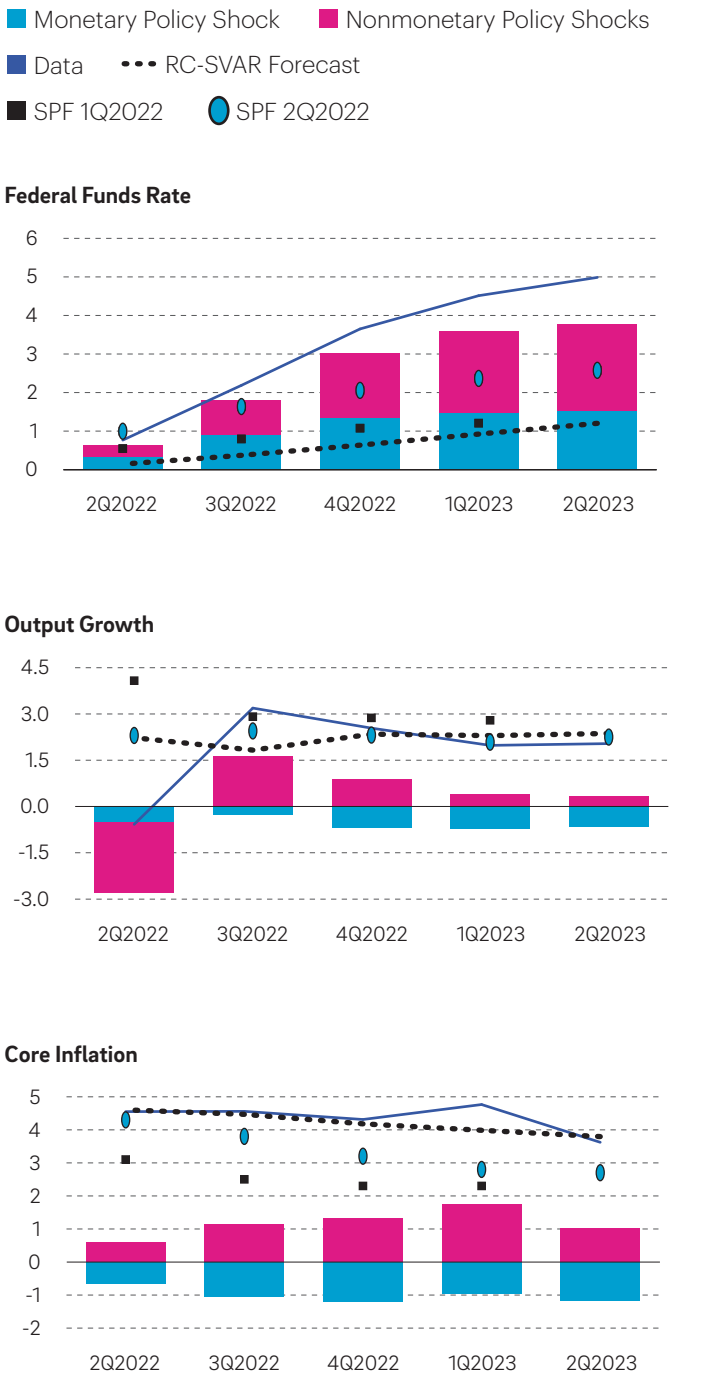
The predictable part is our SVAR's best forecast of how the economy will evolve. For our period of interest, this prediction broadly aligns with the predictions of professional forecasters as measured by the Survey of Professional Forecasters.[21] The unpredictable part is the difference between the realized data and the SVAR's predictions. Our SVAR attributes any difference between the data and the predicted values to either monetary policy shocks or nonmonetary policy shocks. The former are Fed actions that deviate from the reaction function; the latter

FIGURE 2

How Did the Fed Respond to the State of the Economy During the Most Recent Policy-Tightening Cycle?

The bulk of the unexpected increase in the federal funds rate was driven by a combination of demand and supply shocks that were more inflationary than anticipated.

The difference between the realized data (federal funds rate, inflation, and output growth) and the SVAR's predictions; monetary and nonmonetary policy shocks (i.e., the combination of demand and supply shocks) that explain that difference, according to the SVAR; percent for federal funds rate, percent log-difference annualized for output growth and core inflation; 2Q2022–2Q2023



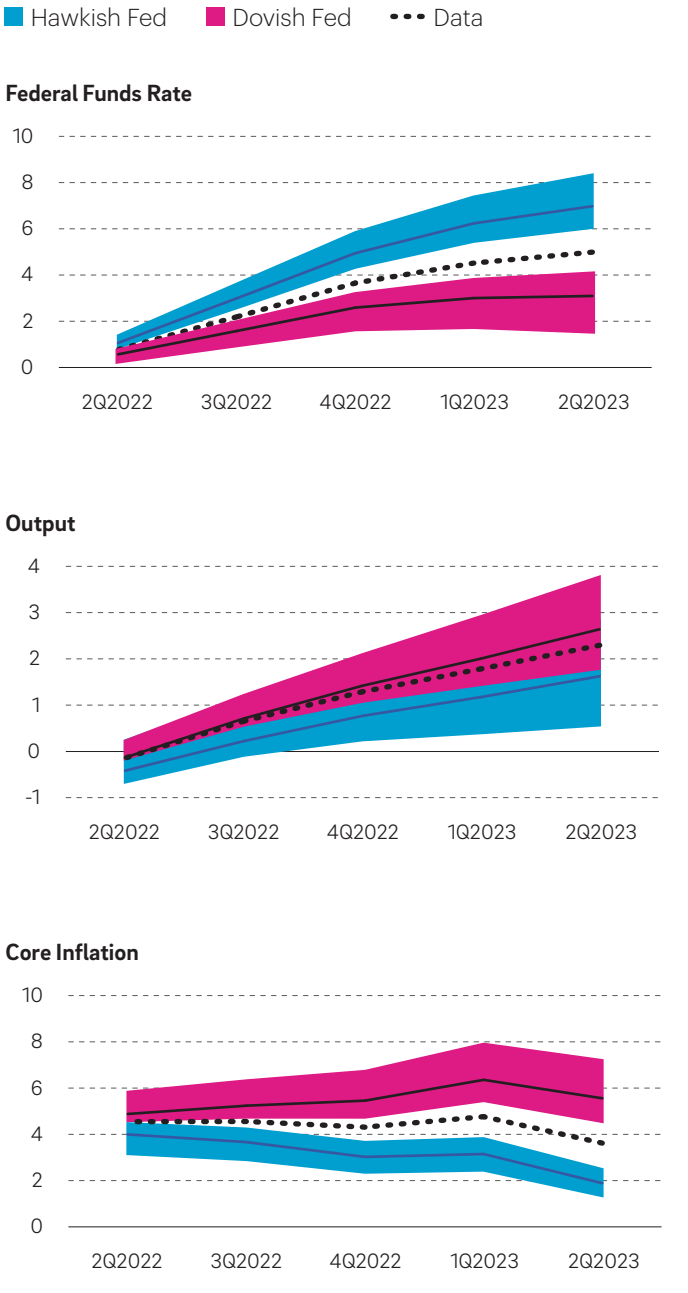
Data Source: Arias et al. (2025)

FIGURE 3

How Does the Fed's Response to the State of the Economy in 2022–2023 Compare with a More Dovish or Hawkish Monetary Policy Response?

A hawkish Fed would have returned inflation to target with negligible lost output.

The difference between the realized data (federal funds rate, inflation, and output) and the SVAR's predictions; actual and hawkish and dovish counterfactuals, according to the SVAR; percent for federal funds rate, percent log-change for output, percent log-difference annualized for core inflation; 2Q2022-2Q2023



Data Source: Arias et al. (2025)

Note: Lines represent posterior medians; shaded regions represent 68th percentile probability bands.

are a combination of demand and supply shocks that shift the economy's aggregate demand and supply relations.

Systematic policy is the critical factor underlying the deconstruction into predictable and unpredictable parts. When coefficients are large, an unpredictable change in the federal funds rate is mainly the result of nonmonetary policy shocks–that is, the Fed is responding to unanticipated changes to supply or demand in pursuit of its dual mandate of full employment and price stability. But if coefficients are small, an unpredictable change in the federal funds rate must be mainly the result of a monetary policy shock–that is, the Fed has changed rates for some reason beyond its systematic reaction function. In addition, systematic policy influences how quickly the economy achieves a status consistent with the Fed's mandate. For instance, a large inflation coefficient means that the Fed is squarely focused on inflation and will quickly aim to neutralize the inflationary effects of any shock by raising rates, whereas a large output growth coefficient means that the Fed will quickly seek to neutralize an adverse demand shock (such as a decline in consumer confidence) by lowering rates.

By deconstructing the path followed by economic variables into predictable and unpredictable parts, we make sense of the evolution of interest rates, output growth, and inflation we observe in the data. We begin the deconstruction in the first quarter of 2022 because the Fed began the latest tightening cycle near the end of that quarter, on March 16. In the first quarter of 2022, a forecaster using our SVAR would have predicted a gradual increase in the federal funds rate, (roughly) on-trend output growth, and persistently high inflation. But by the second quarter of 2023, the federal funds rate averaged 5 percent–nearly 4 percentage points higher than what the SVAR had predicted.

There are two explanations for why the Fed increased interest rates beyond what the SVAR would have predicted. The Fed could have reacted to new information that affected the reaction function, such as unexpected demand and supply shocks that caused the economy to run hotter than could have been anticipated by our SVAR in the first quarter of 2022. In this case, we would attribute the unpredictable part of the historical decomposition to nonmonetary policy shocks. However, the Fed could have reacted to new information outside its typical reaction function. For example, the Fed could have increased rates beyond the prescription of the reaction function to make up for previous deviations from the rule, or it could have taken account of a development or risk not explicitly included in our rule. In this case, we would attribute the unpredictable part of the historical decomposition to monetary policy shocks.

In our analysis, we find that 60 percent of the unexpected increase in interest rates between the first quarter of 2022 and the second quarter of 2023 was due to nonmonetary policy shocks that caused the economy to run hotter than previously anticipated, and the Fed had to increase rates to address this new development. The remaining 40 percent of the unpredictable increase was due to monetary policy shocks and can be interpreted as either the Fed making up for previous deviations from the rule or the Fed accounting for a development or risk not explicitly included in our rule, such as the risk of an inflationary spiral. The latter was a chief concern during the latest tightening

cycle. As Chair Powell said in December 2022, "The worst pain would come from a failure to raise rates high enough and from us allowing inflation to become entrenched in the economy." If that were to happen, he added, "the ultimate cost of getting [inflation] out of the economy would be very high in terms of employment, meaning very high unemployment for extended periods of time, the kind of thing that had to happen when inflation really got out of control and the Fed didn't respond aggressively enough or soon enough ... 50 years ago."[22]

Counterfactual Experiment

Historical decompositions help us understand how the economy and monetary policy have evolved, but our SVAR also helps us determine how output and inflation would have evolved if the Fed had departed from our estimated reaction function.[23] To this end, we replay history since the second quarter of 2022 using a counterfactual reaction function in which the Fed's response to inflation is twice as large as in our estimates. Because this counterfactual captures a more aggressively anti-inflationary stance, we call it the hawkish counterfactual. We then replay history using a counterfactual reaction function in which the response to inflation is half as large as in our estimates. This counterfactual is designed to capture a less aggressive fight against inflation, so we call it the dovish counterfactual.

According to our estimates, the dovish counterfactual would have caused a modest gain in output at the cost of inflation running persistently above 5 percent (Figure 3). In contrast, under the hawkish counterfactual, inflation would have returned to the 2 percent target at a negligible cost in terms of output. Ultimately, the cost in terms of output is determined by the slope of the aggregate supply curve, which measures the supply side trade-off between output and inflation. Our results are consistent with a steepening of this curve, which suggests that during the post-COVID inflation surge, policymakers faced a less adverse trade-off than they had faced in the 1970s.[24]

Was the Fed Behind the Curve?

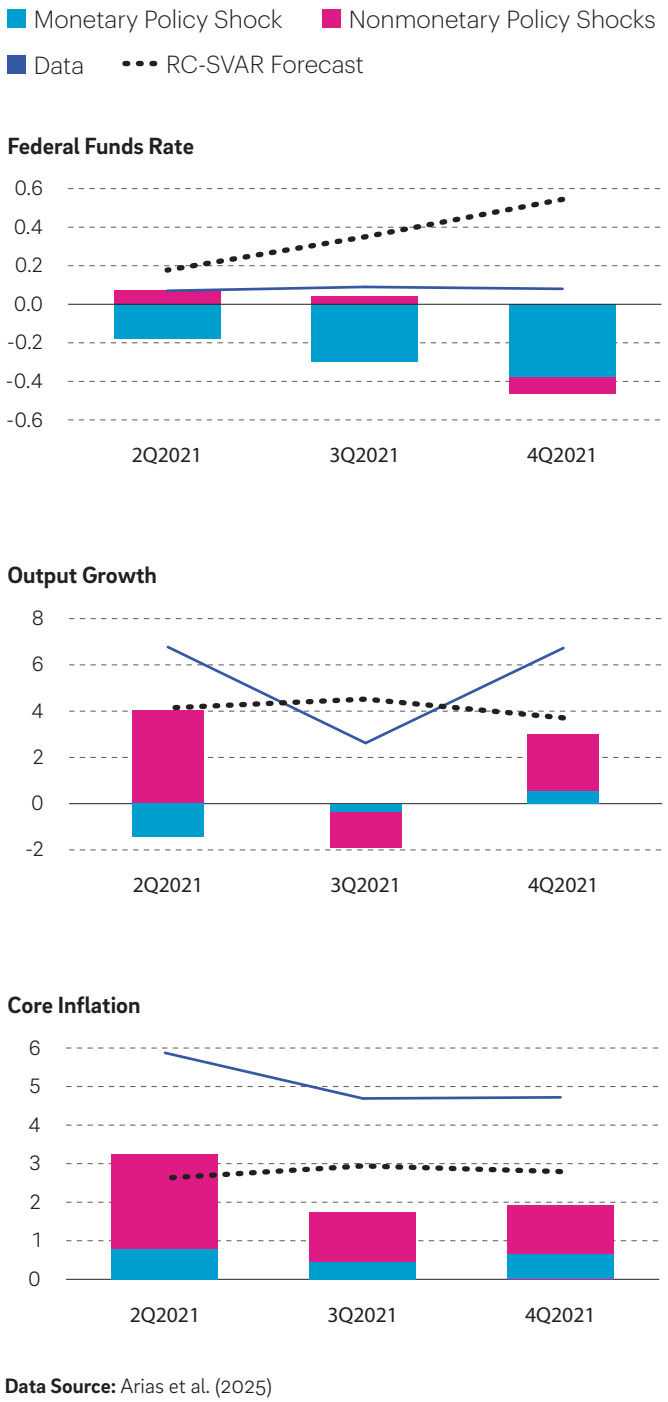
The tightening cycle we deconstructed began on March 16, 2022, when the Fed decided to increase interest rates from the 0-to-1/4 target range to the 1/4-to-1/2 range. But several economic commentators were already calling for interest rate hikes by then, which suggests that the Fed delayed the onset of the tightening cycle beyond what would have been prescribed based on its past behavior.[25]

We address this concern by resetting the clock to the first quarter of 2021, when President Joe Biden signed into law the American Rescue Plan (ARP)—one factor that motivated calls for an earlier increase in the federal funds rate. When we reset the clock, our SVAR agrees with the critics: The Fed would have increased interest rates in 2021 had it followed its historical behavior. However, our SVAR also indicates that the Fed's delay in raising interest rates was not a major contributor to inflation during the early stages of the post-COVID inflation surge (Figure 4).

FIGURE 4

The Fed Would Have Increased Rates in 2021 Had It Followed Its Historical Behavior

The difference between the realized data (federal funds rate, inflation, and output growth) and the SVAR's predictions; monetary and nonmonetary policy shocks that explain that difference, according to the SVAR; percent for federal funds rate, percent log-difference annualized for output growth and core inflation; 1Q2021–2Q2023



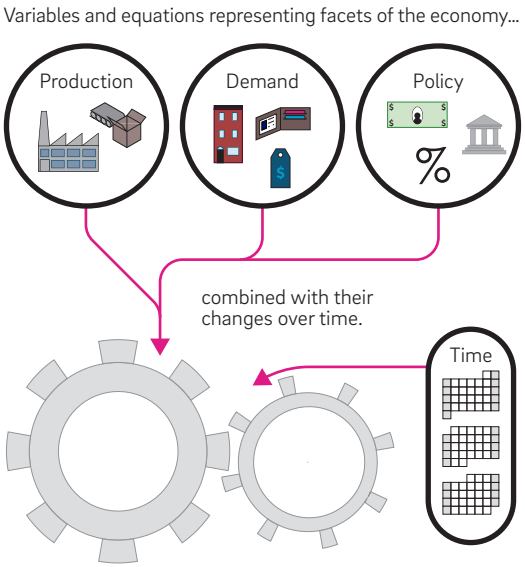
Data Source: Arias et al. (2025)

FIGURE 5

An Econometric Model Characterizing the Joint Behavior of Economic Variables

An SVAR comprises equations representing different parts of the economy. The economic relations described by these equations can evolve, as made clear by the pandemic.

SVARs Explained



Conclusion

In this article we discuss the importance and challenges of measuring systematic monetary policy, and we demonstrate how it can be used to break down the latest inflation fight. Our approach has the advantage of fitting the data at times when the economy is subject to structural changes, such as what we witnessed during the latest pandemic. As with any economic model, our SVAR provides only an approximation of the complex, real-world economy. Nonetheless, it empowers us to better understand the Fed's actions.

Structural Vector Autoregressions

A structural vector autoregression (SVAR) is an econometric model that characterizes the joint behavior of economic variables (Figure 5). An SVAR comprises equations that represent different parts of the economy. Some of these equations describe the production side of the economy, others the demand side, and others the behavior of policymakers. The economic relations described by these equations evolve over time, as made clear by the COVID pandemic. Other changes are subtle but also important. For example, systematic monetary policy has evolved since the Fed was created in 1913. In this context, SVARs that incorporate these structural changes offer a compelling framework for economic analysis.

Monetary Policy Coefficients

A monetary policy coefficient is a number that specifies how much a policy instrument, such as the federal funds rate (r), changes in response to a change in another variable, such as inflation (π), other things being constant. For example, in the policy rule $r = 1.5\pi$, the coefficient is "1.5," so, all else being equal, a percentage point increase in inflation leads to a 1.5 percentage point increase in the federal funds rate.

A *time-varying* monetary policy coefficient changes over time. For example, if the coefficient in the previous example is time-varying, it could be 1.5 during a particular period and 3 in another. How might this happen? In one hypothetical case, a newly appointed Federal Reserve Chair is more hawkish on inflation than their predecessor. If the new Chair immediately persuades the FOMC to change the policy rule, the coefficient will quickly change from 1.5 to 3; if it takes longer for the Chair to persuade the FOMC, this change will take longer and perhaps happen in stages.[26]

Notes

1 The natural level of output is the maximum amount of output an economy can achieve without generating inflationary pressure. The inflation target of the Federal Reserve is 2 percent over the longer run as measured by the annual change in the price index for personal consumption expenditures. See Board of Governors (2024).

2 The most famous rule, known as the Taylor rule, prescribes setting the federal funds rate according to a specific function of inflation and the output gap (that is, the difference between realized output and its natural level or trend). See Taylor (1993) and Taylor (1999).

3 See for example Box 6 in the February 2025 Monetary Policy Report to Congress, https://www.federalreserve.gov/publications/files/20250207_mprfullreport.pdf.

4 See Board of Governors (2024).

5 See Sims and Zha (2006).

6 An example of the former is a change in the composition of the FOMC that leads to a change in the Fed's systematic policy, such as putting more weight on inflation than

on output, or vice versa. An example of the latter is what we experienced during the pandemic.

7 Intuitively, as the number of variables in the SVAR grows, the structural relationships among them become more complex than in SVARs with fewer variables. See the comments and discussion section of Leeper et al. (1996) for a debate about this issue.

8 See Board of Governors (2021) for a discussion of the Fed's dual mandate.

9 The Great Inflation was a period of high inflation in the United States that started in the mid-1960s and began to dissipate in the early 1980s.

10 See Powell (2023).

11 The Fed began the latest tightening cycle on March 16, 2022, when it raised the target range for the federal funds rate to 1/4 to 1/2 percent. The last interest rate hike of the cycle occurred on July 26, 2023, when the Fed raised the target range to 5-1/4 to 5-1/2 percent.

12 The aggregate demand and aggregate supply framework we use here is a simplified version of the one featured in Chapter 15 of Mankiw (2018).

13 An unexpected increase in oil prices can also cause a decrease in the public's demand for goods and services due to an income effect driven by a decline in the real value of income.

14 In more advanced dynamic stochastic general equilibrium models, there are channels through which systematic monetary policy can affect the supply-side conditions of the economy. See, for example, Coibion and Gorodnichenko (2011).

15 In less stylized models than the one we use, this trade-off also emerges in response to demand shocks, such as an unexpected decline in consumer confidence. See Erceg et al. (1998).

16 Our measure of money growth is based on the growth rate of the M2 monetary aggregate, which consists of M1 (that is, currency, demand deposits at commercial banks, and other liquid deposits) plus saving deposits, time deposits in amounts of less than $100,000, and balances in retail money market funds. See https://fred.stlouisfed.org/series/M2SL for details.

17 We choose the policy instrument (that is, the federal funds rate) and the data that enter the Fed's systematic reaction function (that is, output growth, inflation, money growth, and corporate credit spreads) based on theoretical and practical considerations.

18 The FOMC might be responding systematically to variables outside the SVAR, in which case our SVAR would be misspecified. To ease this concern, we show in our forthcoming *Review of Economic Studies* paper that our characterization of systematic policy implies monetary policy shocks that align well with the narrative approach of University of California, Berkeley, economists Christina and David Romer, who argue that there was a contractionary monetary policy shock in the summer or early fall of 2022.

19 See Drechsel (2024) for evidence of President Nixon's political pressure on Chair Burns.

20 The skepticism originated in the unstable relationships between various monetary aggregates and other economic variables such as output growth. For example, at the January 1980 FOMC meeting Chair Volcker said, "I would remind you that nothing that has happened—or that I've observed recently—makes the money/[gross national product] relationship any clearer or more stable than before. Having gone through all these redefinition problems, one recognizes how arbitrary some of this is. It depends on how you define [money]." See also Bernanke (2006).

21 The Survey of Professional Forecasters (SPF) is the oldest quarterly survey of macroeconomic forecasts provided by academics, forecasting firms, and banks and other financial institutions in the United States. We adopt the SPF projections for the three-month Treasury bill rate as our projections for the federal funds rate. See Research Department, Federal Reserve Bank of Philadelphia, Survey of Professional Forecasters, https://www.philadelphiafed.org/surveys-and-data/real-time-data-research/survey-of-professional-forecasters.

22 See Powell (2022).

23 In our main counterfactuals the public is not necessarily aware of a change in policy. Even though this is a plausible assumption in the context of our framework, some may wonder whether the public would have acted differently had it known about the policy change. The latter is known as Lucas's critique after Lucas (1976). To address this issue, our forthcoming *Review of Economic Studies* paper presents an alternative set of counterfactuals, inspired by McKay and Wolf (2023), that do not run afoul of this critique; our conclusions remain unchanged.

24 We document the steepening of the Phillips curve in Online Appendix V of Arias et al. (2025).

25 Among the economists calling for early monetary policy action were former International Monetary Fund chief economist Olivier Blanchard and former U.S. Secretary of the Treasury Lawrence Summers. See Blanchard (2021) and Summers (2021a, 2021b).

26 See Bordo and Istrefi (2023) for an analysis of how the composition of the FOMC committee in terms of hawks or doves can affect monetary policy decisions.

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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.

Measuring Climate Transition Risk at the Regional Level with an Application to Community Banks

We develop a measure of climate transition risk for regional economies in the United States, based on the mix of firms that produce emissions in each region. To quantify transition risks, we consider the introduction of an emissions tax levied on companies emitting greenhouse gases and estimate changes in the market values of industries due to a carbon tax using Merton's (1974) model. We find that transition risks are highly concentrated in a few sectors and counties with heavy exposures to transition-sensitive sectors. The size and geographic concentration of the tax effects depend significantly on assumptions about the elasticity of demand for inputs in the production chain. When applying county-level estimates for transition risks to banks' deposit footprint, we find mild to moderate transition risks for community banks as a whole, although transition risks are high for a few banks.

WP 25-11. Mitchell Berlin, Federal Reserve Bank of Philadelphia Emeritus Economist; Sung Je Byun,Federal Reserve Bank of Dallas; Pablo D'Erasmo, Federal Reserve Bank of Philadelphia; Edison Yu, Federal Reserve Bank of Philadelphia

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 as well as regional house price and credit changes. The growth predicted by this benefit is on top of the acquisition growth caused by the exit of private-label securitizers. Our results are consistent with the GSEs actively targeting their acquisitions to counter home-price declines.

WP 25-12. Ronel Elul, Federal Reserve Bank of Philadelphia; Deeksha Gupta, Johns Hopkins 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

The Effect of the Great Recession on Student Loan Borrowing and Repayment

We study the long-term effect of the Great Recession on federal student loan borrowing and repayment. Using detailed longitudinal data on federal student loan borrowers, we compare labor markets that faced varying degrees of unemployment severity during the economic downturn. On average, a 1 percentage point increase in Great Recession unemployment rates caused a 7 percent rise in total outstanding debt and 6 percent rise in defaulted borrowers. Across institutional sectors, the Great Recession accounted on average for 19–32 percent of the total increase in undergraduate student debt and 10–25 percent of the total increase in defaults. Borrowers who were students at the onset of the recession saw the largest effects on accrued debt, due to delayed graduation and lengthened enrollment spells.

WP 25-13. Michel Grosz, Federal Trade Commission; Tomás Monarrez, Federal Reserve Bank of Philadelphia Consumer Finance Institute

On the Testability of the Anchor-Words Assumption in Topic Models

Topic models are a simple and popular tool for the statistical analysis of textual data. Their identification and estimation are typically enabled by assuming the existence of anchor words—that is, words that are exclusive to specific topics. In this paper we show that the existence of anchor words is statistically testable: There exists a hypothesis test with correct size that has nontrivial power. This means that the anchor-words assumption cannot be viewed simply as a convenient normalization. Central to our results is a simple characterization of when a column-stochastic matrix with known nonnegative rank admits a separable factorization. We test for the existence of anchor words in two different data sets derived from monetary policy discussions in the Federal Reserve and reject the null hypothesis that anchor words exist in one of them.

WP 25-14. Simon Freyaldenhoven, Federal Reserve Bank of Philadelphia; Shikun Ke, Yale School of Management; Dingyi Li, Cornell University; José Luis Montiel Olea, Cornell University

Monetary Policy with Inelastic Asset Markets

I develop a New Keynesian model to study the transmission of both conventional and unconventional monetary policy through financial markets. The model's two key features are (i) heterogeneous financial intermediaries with downward-sloping asset demand curves, and (ii) households that face frictions in reallocating their savings across intermediaries. The central bank directly controls the risk-free rate, whereas the risk premium is determined by the distribution of intermediaries' wealth and the central bank's purchases of risky assets. Interest rate hikes reduce long-term risky asset values, redistributing wealth away from risk-tolerant intermediaries and increasing the risk premium. Central bank asset purchases can initially stimulate investment by reducing the risk premium, but asset prices may undershoot when those purchases are unwound. Optimal policy simultaneously uses both interest rate cuts and asset purchases to stabilize asset prices during downturns.

WP 25-15. Joseph Abadi, Federal Reserve Bank of Philadelphia

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 failures (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 nontrivial 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 middle-wealth 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. We find empirical support for this mechanism in the voting patterns in U.S. Congress, where members from districts with higher homeownership rates or lower income inequality (larger middle class) tended to vote for lax mortgage regulation prior to the Great Financial Crisis.

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

The Bronx Is Burning: Urban Disinvestment Effects of the Fair Access to Insurance Requirements

We study the unintended effects of Fair Access to Insurance Requirements (FAIR) plans developed by 26 states in the 1960s to address insurance redlining in urban neighborhoods. FAIR plans' problematic features included prohibitions on considering environmental hazards in underwriting, mandatory insurer participation that diluted underwriting incentives, and payouts exceeding market values in declining areas. Using a triple-difference design comparing pre-/post-FAIR periods, neighborhoods with/without likely FAIR access, and participating/nonparticipating states, we find that FAIR inadvertently led to significant housing disinvestment and accelerated declines in neighborhood population and income, with simultaneous increases in the Black population share.

WP 25-16. Ingrid Gould Ellen, New York University; Daniel A. Hartley, Federal Reserve Bank of Chicago; Jeffrey Lin, Federal Reserve Bank of Philadelphia; Wei You, Peking University

Token-Based Platform Governance

We develop a model to compare the governance of traditional shareholder-owned platforms to that of platforms that issue tokens. The owners of a traditional platform have incentives to implement policies that extract rents from users. If the platform's owners can commit to future policies, they can implement a more efficient outcome by issuing a token that offers claims on the platform's services. Such a token alleviates conflicts of interest between the platform's owners and its users, mitigating inefficiencies: A policy that benefits users increases the value of tokens and therefore the platform's seignorage revenue. If the platform's owners cannot commit to policies ex ante, however, they can achieve the same outcome by issuing a token that bundles claims on the platform's services with an ownership share (i.e., cash flow claims and voting rights).

WP 25-17. Joseph Abadi, Federal Reserve Bank of Philadelphia; Markus Brunnermeier Princeton University

Interchange Fees in Payment Networks: Implications for Prices, Profits, and Welfare

In a two-sided model of the payment card market, we introduce a specific form of elastic demand (constant elasticity), merchant market power, ad valorem fees, and cash as an alternative. We derive the "credit card tax," consisting of an endogenously determined interchange fee and any rewards paid. We characterize how this tax influences prices, profits, and welfare. We also examine how these relationships vary under different assumptions about the elasticity of demand, merchant market power, and differentiation between cash and credit. Under the assumptions of our model, by endogenizing the credit card tax, we show that capping interchange fees benefits all consumers by lowering these taxes, even if rewards decrease.

WP 25-18. 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; Yin Zhang, Drexel University

A Gibbs Sampler for Efficient Bayesian Inference in Sign-Identified SVARs

We develop a new algorithm for inference based on structural vector autoregressions (SVARs) identified with sign restrictions. The key insight of our algorithm is to break apart from the accept–reject tradition associated with sign-identified SVARs. We show that embedding an elliptical slice sampling within a Gibbs sampler approach can deliver dramatic gains in speed and turn previously infeasible applications into feasible ones. We provide a tractable example to illustrate the power of the elliptical slice sampling applied to sign-identified SVARs. We demonstrate the usefulness of our algorithm by applying it to a well-known small-SVAR model of the oil market featuring a tight identified set as well as to a large SVAR model with more than 100 sign restrictions.

WP 25-19. Jonas E. Arias, Federal Reserve Bank of Philadelphia; Juan Rubio-Ramírez, Emory University, Federal Reserve Bank of Atlanta, and Visiting Scholar, Federal Reserve Bank of Philadelphia Research Department; Minchul Shin, Federal Reserve Bank of Philadelphia

Identification Through Sparsity in Factor Models: The ℓ_1-Rotation Criterion

Linear factor models are generally not identified. We provide sufficient conditions for identification: Under a sparsity assumption, we can estimate the individual loading vectors using a novel rotation criterion that minimizes the ℓ_1-norm of the loading matrix. This enables economic interpretation of the factors. Existing rotation criteria (e.g., Varimax, Kaiser 1958) are theoretically unjustified and perform worse in our simulations. We illustrate our method in two economic applications.

WP 20-25R. Simon Freyaldenhoven, Federal Reserve Bank of Philadelphia

International Currency Dominance

We present a micro-founded monetary model of the world economy to study international currency competition. Our model features both "unipolar" equilibria, with a single dominant international currency, and "multipolar" equilibria, in which multiple currencies circulate internationally. Governments can compete to internationalize their currencies by offering attractive interest rates on their sovereign debt. A large economy has a natural advantage in ensuring its currency becomes dominant, but if it lacks the fiscal capacity to absorb the global demand for liquid assets, the multipolar equilibrium emerges.

WP 25-20. Joseph Abadi, Federal Reserve Bank of Philadelphia; Jesús Fernández-Villaverde, University of Pennsylvania, NBER, CEPR, and Visiting Scholar, Federal Reserve Bank of Philadelphia Research Department; Daniel Sanches, Federal Reserve Bank of Philadelphia

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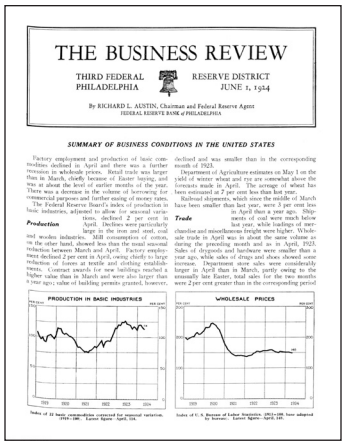

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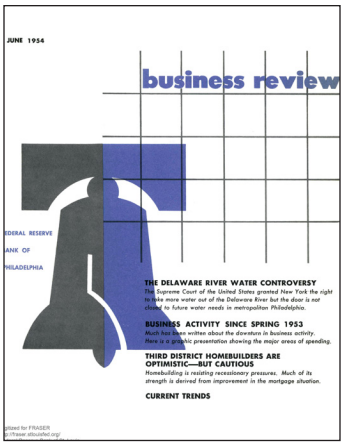

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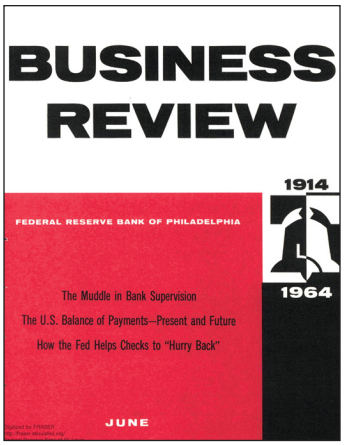

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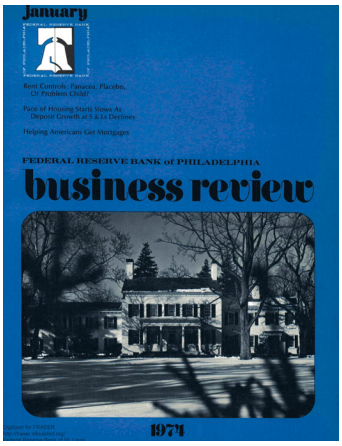
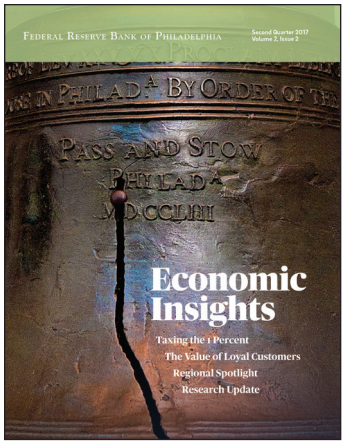


1970s

1980s



2010s

2020

2023