Firm-Level Pay Policies
and the Labor Market

Bad Times, Bad Health

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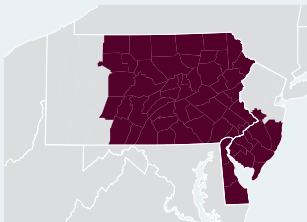
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Firm-Level Pay Policies and the Labor Market

Pay policies can have broad implications resulting in low, "rigid" wages and volatile unemployment.

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When we study the labor market, we need to think about larger firms. The bulk of U.S. private sector employment takes place in firms of 50 or more employees, making these firms important for overall labor market outcomes.

When we think about larger firms, we also need to think about firm-level policies. It is through these policies that a firm's leadership shapes how its firm operates. The policies are codified in within-firm rules governing decision-making as well as firm behavior.

In addition to directly influencing an individual firm, these policies indirectly influence the broader labor market, because that is where these firms interact with each other. Given the widespread use of such policies, it is worthwhile to go beyond the individual firm to consider such interactions and what they imply for wages and hiring.

Recently, researchers have argued that firm-level pay policies help explain why wages appear to be "rigid" (meaning that wages' response to the business cycle is limited) and why firms adjust wages only infrequently in response to changing econom-

ic conditions. Firm-level pay policies can also help explain why adjustments in employment and wages are asymmetric–specifically, why employment rises gradually when economic conditions improve but falls sharply as they deteriorate, and why wages are more likely to rise than fall.

The Concept and Related Evidence

A firm's pay policy–that is, how the firm plans to compensate its workers–is generally implemented via firm-level rules governing pay. Under such rules, coworkers in similar positions and with similar skills are treated similarly, and the rules indicate how the firm plans to pay these workers relative to similar workers at other firms. The rules are typically formalized in a salary structure, which involves a set of pay grades, each with a corresponding salary range for workers within that grade. The firm uses the salary structure to determine each worker's pay.

Industry surveys of human resources professionals offer a broad perspective on the prevalence of such structures. According to these surveys, as many as 85 percent of larger firms report using a formal salary structure to determine worker compensation.[1] The structure is important because it maps the firm leadership's views on worker compensation onto individual worker wages.

According to the surveys, the midpoint of each salary range typically targets a relevant "market wage," or the wage that workers in similar positions are generally paid in the labor market. The corresponding salary range then allows the firm to adjust the worker's pay for further differences in skill or performance. Large firms also often have different salary structures for different types of positions within the firm.

Salary structures are adjusted at regular intervals to reflect changing market conditions, but not on a continual basis. Most firms adjust their salary structures annually; some adjust theirs even less frequently. Understandably, evaluating changing market conditions across a range of different types of positions is not a small task. This means that wages tend to adjust to changing economic conditions with some lag.

Even though the survey evidence indicates that firm pay policies and related salary structures are widespread, evaluations of how they shape wages are hampered by the lack of sufficiently detailed information about job and worker characteristics in wage data.[2] To overcome these limitations, I turn to economic theory instead.

A Model with Firm-Level Pay Policies

Recently, I've used a theoretical model to consider the implications of firm-level pay policies for wages, hiring, and unemployment.[3] The model uses tools from modern macroeconomics to consider labor markets that, as a reflection of real-world labor markets, involve searches on the part of workers and firms. In both the model and the real-world labor market, when firms seek to hire, they post vacancies; unemployed workers search for the right vacancy; and firms and workers eventually match, starting an employment relationship. This approach enables the model to speak to how firm-level pay policies affect labor market characteristics economists care about, such as the extent of vacancy creation across firms, the rate at which unemployed workers find jobs, and market levels of employment and unemployment.

To capture firm-level pay policies, the model *constrains* each firm to pay similar workers within the firm the same salary but *allows* each firm to choose the level of this salary relative to its competitors. The model thus enables us to identify the implications of such constraints on firms and the labor market.

According to the model, firm-level pay policies lead to lower wages. To understand why, consider how firms set wages. In the model, firms face a situation in which their current and future wages influence their hiring today, because more workers apply for the firm's vacancies when these workers expect higher wages. More job applicants, in turn, leads to more hires at the firm. Due to this link between wages and hires, firms should find it profitable to offer attractive wages, even though that means having to pay workers more.

However, that same firm's existing workers are already engaged with work rather than actively searching for a new position, which makes them generally willing to continue working for somewhat less than it takes to attract a new worker.[4] When a firm decides on firm-level pay, it balances its desire to be attractive to job applicants with its desire to pay its existing workers no more than necessary. A firm-level pay policy thus makes offering attractive wages more costly for a firm and, as a result, we expect firms to pay lower wages.

Lower wages in turn make creating vacancies more profitable for firms, resulting in firms' creating more vacancies and ultimately also hiring more workers. This means that unemployed workers find jobs faster, and employment rises. However, taking both wages and employment into account, these shifts in labor market outcomes appear to favor firm profitability at the expense of workers. So, even though equal treatment with peers sounds desirable, these shifts in labor market outcomes can make such policies less desirable from the worker's perspective.

Rigid Wages and Volatile Unemployment

Changing economic conditions bring large shifts in unemployment. For example, during the Great Recession, unemployment increased from less than 5 percent in 2007 to as much as 10 percent in 2009. Economic downturns typically involve unemployment rising by about 40 percent of its long-run average level as the economy transitions from peak of expansion to bottom of trough.[5]

Unemployment causes economic distress for households, so why don't wages adjust to prevent a surge in unemployment during a recession? Economic theory implies that if wages were to fall sufficiently in a downturn, firms could continue to employ workers without a pronounced increase in unemployment. Instead, wages appear to exhibit a limited response to changing economic conditions, a phenomenon that has long puzzled economists.[6]

It turns out that firm-level pay policies also influence how much wages respond to changes in economic conditions, with implications for how much unemployment responds to those

changes. Such policies leave workers with a smaller share of the gains from economic activity, relative to their employers. This results in wages that are also less responsive to changes in economic conditions over the business cycle. Such policies thus offer one explanation for why wages are rigid: The wage increases seen in expansions and declines seen in contractions become smaller in the context of firm-level pay policies.

For firms, wage rigidity translates into greater cyclical variability in the profitability of hiring because wages do not fully adjust to changes in economic conditions.[7] As a result, the labor market becomes more volatile over the business cycle. When the labor market enters a contraction, vacancies decline more than they otherwise would. This makes it harder for the unemployed to find work, and unemployment rises more than in the absence of such policies. Correspondingly, expansions bring greater increases in vacancies and declines in unemployment than they would absent such policies. This aspect of firm-level pay policies allows us to make sense of the volatility observed in real-world labor markets.

For example, manufacturing is a setting in which formal salary structures are perhaps most straightforward to implement, due to individual worker output being easier to measure than in other settings. Manufacturing is also known as a very cyclically sensitive industry, with unemployment that clearly varies more over the business cycle than economywide unemployment.

Infrequent Wage Adjustment

It's not just that wage adjustments are limited in size: They are also infrequent. As noted above, survey evidence indicates that firms typically revise their salary structures on an annual basis, and sometimes even less frequently than that. Direct evidence confirms this pattern. For their 2021 *American Economic Review* article, Princeton University professor John Grigsby, University of Chicago professor Erik Hurst, and ADP Research Institute cohead Ahu Yildirmaz used wage data from a large, nationwide payroll processing firm and found that a substantial share–as much as 35 percent–of workers typically see no change in their wages from one year to the next. They calculated that, on average, wages change only once every 1.5 years. This frequency is consistent with evidence from other countries.[8]

Why would wages be adjusted so infrequently when doing so is costly for firms and workers? Firm-level pay policies can help us answer this question.

Given the commitment problem affecting wage setting, revising wages less frequently–say, annually rather than monthly–can increase a firm's profitability by preventing the firm from later departing from its originally preferred plan (which it knows it will want to do).

Of course, revising wages less frequently also limits the firm's ability to respond to changing economic conditions in a timely fashion, and the costs associated with a delayed response could outweigh its benefits. However, the research found that, despite these costs, it can be profitable for a firm to adopt a strategy of infrequent wage adjustment.

If all firms adopt infrequent wage adjustment, that undoes some of the effects of firm-level pay policies discussed above, raising the level of wages and making workers better off. In the context of firm-level pay policies, infrequent wage adjustment can thus be beneficial for workers.

Hiring Freezes and Asymmetric Labor Market Adjustment

Firm-level pay policies can also give rise to hiring freezes–that is, a firm's decision to pause hiring when economic conditions deteriorate, allowing the firm's workforce to shrink through attrition (rather than layoffs). A hiring freeze is another example of a firm-level policy.[9] In the model I used in my research, firm-level pay policies can trigger a hiring freeze if the level of employment in the labor market is high relative to prevailing economic conditions.

As discussed above, in the context of firm-level pay policies, hiring firms set wages that balance their desire to be attractive in hiring with their desire to pay existing workers no more than necessary. But attempting to hire becomes less profitable when employment is high because vacancies yield fewer hires when there are fewer workers searching for work–which makes firms want to reduce their hiring. What happens in the model is that, instead of all firms scaling down their hiring across the board, some firms withdraw from hiring altogether while others continue to hire. We thus see, in line with real-world labor markets, some firms freezing their hiring while others continue to hire.

The reason we see different firms responding differently is that withdrawing from hiring allows a firm to pay distinctly lower wages, causing some firms to prefer to withdraw–but as these firms withdraw, that also makes room for the remaining firms to profitably hire.[10]

When do we expect to see hiring freezes in particular? When the economy enters a contraction and the profitability of hiring falls across the board. In the model, the onset of hiring freezes in a contraction translates to a fluid drop in total vacancies in the labor market that makes it hard for the unemployed to find work, and unemployment rises. The U.S. labor market is characterized by a continual and substantial churn of workers from one job to another, and when hiring slows down, unemployment quickly rises.

Due to the hiring freezes, contractions play out quickly, whereas expansions involve a more muted increase in vacancies across firms. The more muted increase in vacancies leads to more gradual improvement in the conditions unemployed workers face in searching for work and a more gradual decline in unemployment.

These patterns connect with the asymmetry seen in the U.S. labor market, in which both hiring and employment typically increase gradually in an economic expansion but decline quickly in a contraction. This asymmetry manifests itself in the evolution of the U.S. unemployment rate, with sharp increases followed by gradual declines (Figure 1).[11]

The model has predictions for wages as well, since firms

FIGURE 1

Employment and Hiring Typically Increase Gradually in Economic Expansions but Decline Quickly in Contractions

This asymmetry manifests itself in the evolution of U.S. unemployment, with gradual declines followed by sharp increases.

Monthly unemployment rate, percent, seasonally adjusted, 1975–2020
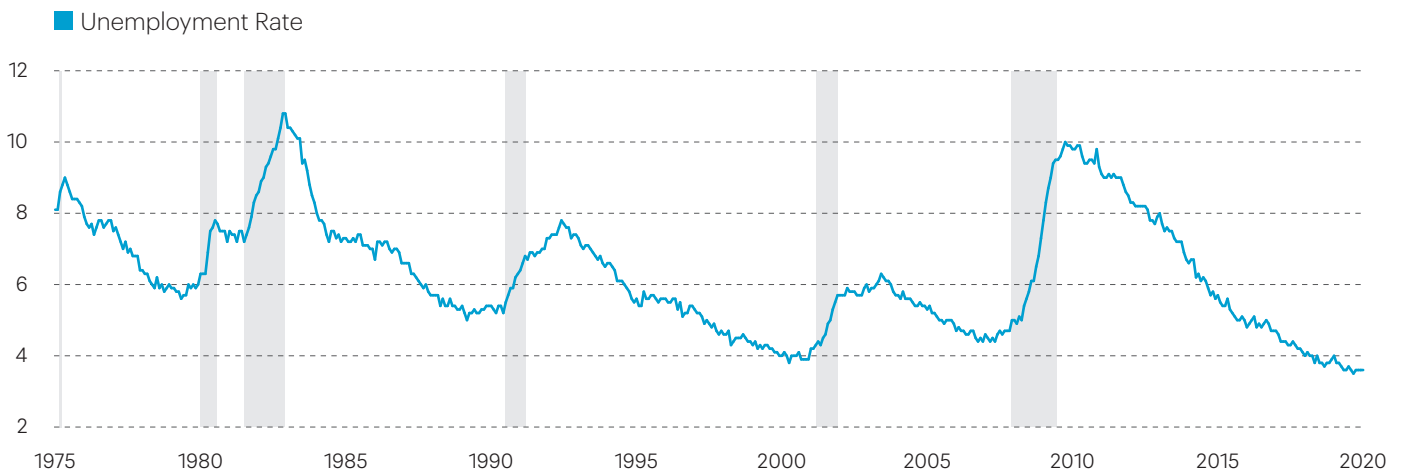
Data Source: U.S. Bureau of Labor Statistics, Unemployment Rate [UNRATE] via FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/UNRATE, December 16, 2024

Notes: The unemployment rate represents the number of unemployed as a percentage of the labor force. Labor force data are restricted to people 16 years and older who currently reside in one of the 50 states or the District of Columbia, who do not reside in institutions (for example, penal and mental facilities, homes for the aged), and who are not on active duty in the U.S. Armed Forces. Shaded areas indicate U.S. recessions as determined by the National Bureau of Economic Research (NBER).

make joint decisions about vacancy creation and wages. The asymmetry in vacancy creation–whereby contractions involve a burst of hiring freezes while expansions involve more gradual increases in vacancies–is associated with asymmetry in wage dynamics as well.

In the model, firms offer more attractive wages when they are seeking to hire more workers. In a contraction, some firms withdraw from hiring, leaving those firms that continue to hire *hiring relatively more workers than they would have absent the freezes*. This means that the hiring firms also *offer higher wages than they would absent the freezes*. For this reason, wages fall relatively less in a contraction than they increase in an expansion.

The model also features an increase in wage risk in a contraction, because workers employed at the freezing firms are paid less than workers at hiring firms. Downturns thus also involve an increased likelihood of especially low pay for the unlucky workers in freezing firms–as well as workers who lose their jobs remaining unemployed longer.

These predictions connect with empirical research highlighting the fact that wage dynamics feature asymmetry. Empirically, wages are more likely to rise than fall, a property referred to as "downward wage rigidity,"[12] in the spirit of the asymmetry in the model. Downturns have also been shown to involve elevated earnings risk, with an increased likelihood of especially low pay, both for workers who remain at the same firm and those who do not.[13]

Conclusion

Economic theory often abstracts from the role organizational constraints play in the real world. In the labor market context, the focus of many analyses has been, for example, on trying to find the best possible compensation package structure to incentivize a worker to work hard, which should then maximize firm profitability. While this may be the appropriate approach when thinking about a key player such as a CEO, most workers are not CEOs. Most workers in regular jobs are treated as one of many, and their pay is determined accordingly, within the confines of the constraints in place at their organization. In my research, I seek to think about the implications of such constraints on labor market outcomes, connecting them to well-known puzzles in the labor market. I view this work as a first stab in developing such organizational linkages within a macroeconomic model framework. More work remains to be done to develop related evidence as well as the theory. ▣

The Commitment Problem Affecting Wage Setting

When setting wages, firms face a commitment problem: A firm would like to plan to pay attractive wages in the future, but once the future arrives, it would like to depart from this plan and pay lower wages instead.

To understand why, consider a firm that is planning its current and future wages. Its desire to offer attractive wages today is tempered by the presence of its existing workers (if it has any), because the same high wages that attract job applicants make existing workers more expensive for the firm. The firm's wage plan thus involves lower wages today. But when the firm thinks about future wages, it understands that planning on low wages in the future will limit its ability to hire *at each point in time before that future date arrives*, because job applicants will be deterred by the low expected future wages. Due to this greater adverse effect of low future wages on hiring, the firm prefers to plan on higher wages for the future. In short, the firm would like to plan to pay higher wages in the future but pay less today.

But this logic implies that if the firm rethinks its wage plan once the future arrives, it would again prefer to pay lower wages at that point. These ingredients give rise to a commitment problem: The firm would prefer to depart from its original plan if given the opportunity to revise that plan later. In such circumstances, a firm might prefer to prevent itself from departing from its plan by fixing its wages for a longer period.

Notes

1 See, for example, WorldatWork Compensation Programs and Practices Survey (2022) and Bewley (1999).

2 For additional evidence supporting the prevalence of firm-level pay policies, Hazell et al. (2022) show that large firms often offer the same pay across locations, with 40–50 percent of wages being identical. Related evidence for firms hiring internationally is discussed by Hjort et al. (2022). For recent empirical papers that have sought to incorporate measures of a worker's position within a firm into analyses of labor market outcomes, see Bayer and Kuhn (2023) and Bagga (2024).

3 See Rudanko (2023, forthcoming).

4 Caldwell et al. (2025) discuss evidence that while searching workers generally apply to firms they perceive as paying higher wages, employed workers are often unwilling to search for a new job, or leave their existing one, despite possible gains in pay from doing so.

5 See Shimer (2005).

6 Of course, unemployment doesn't occur in a vacuum. The Federal Reserve has long employed systematic policy actions to preserve a maximum sustainable level of employment—and thus avoid increases in unemployment. This work, however, is complicated by the Fed's dual mandate, which requires that it also keep inflation in check.

7 Ultimately, the economic environment determines how much wages respond to changing conditions.

8 See Grigsby et al. (2021) and references therein. Lamo and Smets (2009) discuss evidence pertaining to Europe.

9 See, for example, Lambert (2020), Kelly (2023), and McGlauflin and Burleigh (2024).

10 The labor market becomes less congested when some firms withdraw from hiring, allowing the remaining firms to continue to profitably hire.

11 The asymmetry seen in the data stems in part from the burst of separations of existing employment relationships typically seen at the onset of a contraction; there is no corresponding burst of hires at the onset of an expansion. The theory highlights the role of the hiring margin instead.

12 See, for example, Grigsby et al. (2021) and references therein.

13 Storesletten et al. (2004) documented that recessions involve increased earnings risk, while subsequent research by Guvenen et al. (2014) highlight that recessions involve an increase in the likelihood of especially low earnings. Busch et al. (2022) argue that this is also true for wages. In the model, recessions involve an increased likelihood of especially low pay due to the possibility of hiring freezes, as well as unemployment spells becoming longer (as finding work becomes harder).

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Bad Times, Bad Health

Economic downturns might also drag down your health.

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When economic conditions worsen, the number of people in bad health increases (Figure 1). According to the U.S. Census Bureau's Current Population Survey (CPS), self-reported bad health rose by about 0.5 to 0.75 percentage point after each of the last three recessions.[1] This suggests that economic indicators such as the employment-to-population ratio do not capture the full toll of a recession. Downturns can affect our physical and mental health, too.

Economists have long argued that monetary policymakers face a tradeoff between inflation and unemployment. To encourage job creation, a central bank may need to loosen monetary policy–but in doing so, it risks contributing to inflationary pressure. On the other hand, by tightening monetary policy, a central bank may dampen inflation at the cost of people's jobs. For this (and other) policy decisions, it is important to know the full cost of economic fluctuations, which include the effects on population health.

However, uncovering the systematic relationship between economic activity and population health is more complicated

FIGURE 1

Following an Economic Downturn, the Fraction of People in Bad Health Increases

Percentage point change in employment and self-reported bad health among individuals 25 to 54 years old in each March following the three U.S. recessions since 2000 (after detrending)

■ Dot-com bust: Mar to Nov 2001 ■ Great Recession: Dec 2007 to Jun 2009 ■ COVID-19: Feb to Apr 2020
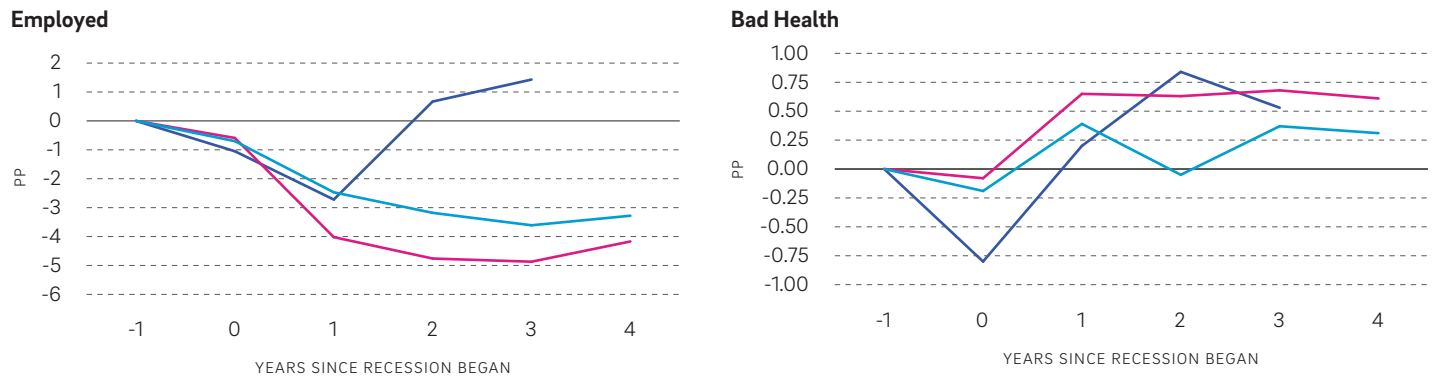
Employed

Bad Health

Data Source: U.S. Census Bureau and Bureau of Labor Statistics, obtained via IPUMS CPS, University of Minnesota, www.ipums.org

than it may seem. For example, in his influential paper–provocatively titled "Are Recessions Good for Your Health?"–University of Virginia professor of public policy and economics Christopher Ruhm presents evidence that mortality is *negatively* correlated with a state's unemployment rate. But while mortality is undeniably an important health outcome, it is not the only health indicator of interest, and not all causes of death are closely tied to an individual's health. (Think, for example, of traffic deaths.) Although unconditionally our measure of population health tends to move in line with mortality, we show that–over the business cycle–the two measures paint different pictures. Besides the difficulty of measuring health, factors missing from the data–such as innovations in medicine or changes in health policy–can also influence the relationship between population health and the business cycle. So, what can we learn from the data? Using the concept of a health production function as a guide, we analyze different possible links between population health and the business cycle. We argue that it is unlikely that changes in inputs or health behaviors fully account for the link between economic and health fluctuations. Instead, stress may explain this link.

The Correlation Between Population Health and the Business Cycle

To show that the relationship between population health and the business cycle is indeed systematic, we take a longer view than just the last three recessions.

Our oldest available survey of self-reported health began in the 1970s. When we plot survey measures of poor health and unemployment among the prime-aged in the survey, we see that increases in poor population health coincide with increases in unemployment (Figure 2). Although the relationship is noisy, with health exhibiting more jagged behavior than unemployment, there is a clear association between the two series. For

example, peaks in the unemployment rate tend to coincide with peaks in the fraction of people in bad health.[2]

But correlation is not causality. Other forces, such as innovations in medicine or changes to Medicaid, could explain the comovement of the unemployment rate and population health. That's why we adopt "local projections," a statistical technique that allows us to identify cause and effect. Specifically, we project outcomes of interest on a measure of surprise changes in aggregate demand due to a discretionary change in policy–that is, due to a shock to aggregate demand (Figure 3). This leaves us with the causal effect of these shocks on population health. By focusing on surprise discretionary changes, we rule out anything other than the change in aggregate demand–in this case, anything other than an unexpected discretionary change in policy.[3]

The fiscal policy shock we use is an unexpected change in the level of defense spending. The advantage of defense spending is that, unlike other forms of government spending, its surprise components are less likely to be a direct response to domestic conditions. This means it's unlikely that defense spending unexpectedly increases *because* unemployment is rising unexpectedly. Following the shock, whose impact we have scaled to an initial 1 percent increase in defense spending, demand remains elevated and gradually declines to zero after two and a half years (that is, after 10 quarters). The results are statistically different from zero for the first eight quarters. The increased demand is associated with a drop in the unemployment rate (for people 25 to 54 years old) by a little bit more than 0.05 percentage point. This response is significantly different from zero between 11 and 14 quarters after the initial shock. Average health in this population follows a similar pattern but is estimated more precisely. Bad health is statistically lower following the expansionary change in fiscal policy: Three to 15 quarters after a defense spending shock, the fraction of individuals reporting poor health decreased about 0.05 percentage point, which is slightly less than the peak decline in the unemployment rate.

FIGURE 2

Increases in Poor Population Health Coincide with Increases in Unemployment

Unemployment and bad health (percentage point deviation from trend) among individuals 25 to 54 years old, 4q1972–4q2018
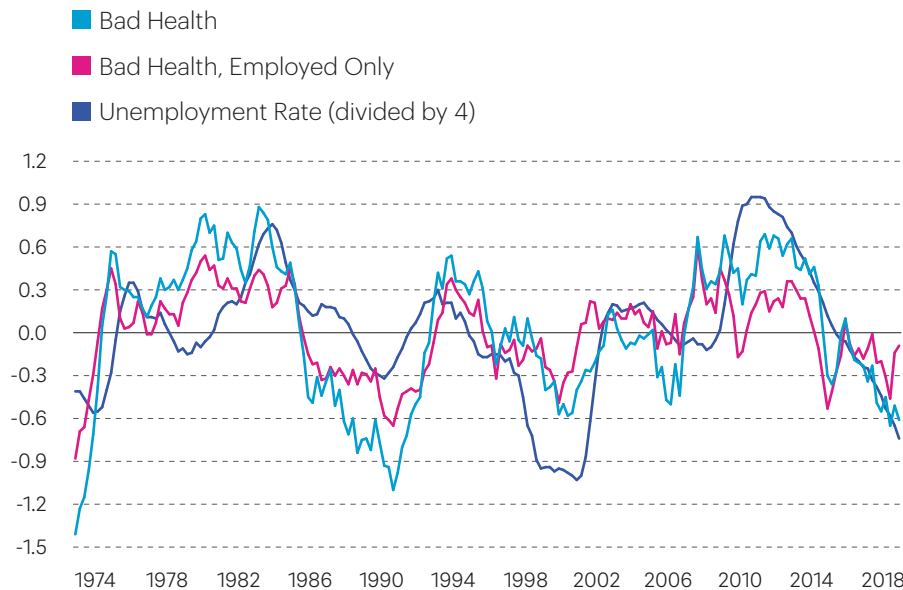
■ Bad Health

■ Bad Health, Employed Only

■ Unemployment Rate (divided by 4)

Data Source: National Center for Health Statistics, National Health Interview Survey, various years, obtained via IPUMS NHIS, University of Minnesota, www.ipums.org

Note: To smooth out noise and eliminate seasonal factors, we computed a four-quarter moving average prior to detrending.

We repeated this analysis for a contractionary monetary policy shock (Figure 4). Following the policy shock, interest rates increase persistently for at least a year by about 1 percentage point. The unemployment rate rises above its baseline value after about 10 quarters and continues to increase gradually to 0.3 percentage point after 16 quarters. Similarly, the fraction of prime-age individuals in bad health also rises; it becomes significantly positive roughly two years after the initial shock and then remains elevated. Its increase is about 0.15 percentage point of the underlying population.

In sum, once we strip out all other forces by focusing on economic fluctuations known to be caused by policy shocks to aggregate demand, population health worsens when the economy sours.

Does Measurement Matter?

Our measure of health is self-reported. Does that make it less reliable? For example, might an otherwise healthy person report being in bad health to lessen the possible stigma of being unemployed? Although our baseline measure of health is well established in the literature, we address this concern by considering alternative measures of health. Specifically, we consider several measures consistently available in the Centers for Disease Control and Prevention's National Health Interview Survey (NHIS), a nationally representative survey of the civilian noninstitutionalized population, from 1997 to 2018 (Figure 5).[4]

See *Is Self-reported Health a Good Measure of Health?* ↘

We find that the CPS and the NHIS report similar increases in bad health. We also find that alternative measures of health rise along with doctor visits. Specifically, an average of about 30 medical conditions–the so-called frailty index–rises by about 1.5

units, as does the reported inability to work. Although these measures are also self-reported, we think it less likely that survey respondents would misreport these other conditions.

What specific medical conditions rise? Of the 1.5 standard deviation increase, about 40 percent is due to depression. Depression has well-documented and severe negative economic effects for individuals as well as large aggregate costs.[5] An increase in certain nonpsychiatric medical conditions accounts for a similar share of the increase, with most of the remainder accounted for by functional limitations.

We can safely discount stigma as an explanation for our results: We observe similar cyclical increases in bad health among both the employed and the unemployed. Although the employed are, on average, less likely to report being in bad health, the relative fluctuation of *all* people 25 to 54 years old is similar to that of employed people 25 to 54 years old.

Worse Health and Lower Mortality–Contradictory Evidence, or Evidence of Disparity?

Our finding that self-reported and other measures of health deteriorate in recessions seems to contradict the research by Ruhm mentioned above. According to Ruhm, recessions are good for your health because they are associated with lower mortality.

Specifically, Ruhm finds that states with an above-average unemployment rate had a below-average mortality rate. Although there is some controversy about his finding, it was confirmed in 2020 by Northwestern University associate professor of education and social policy Hannes Schwandt and UCLA professor of economics Till von Wachter, at least for young adults in the immediate aftermath of the recession. However, Schwandt and von Wachter attribute the mortality decline to external causes such as a decline in accidents.[6]

One of this article's authors, along with Boston College professor of economics Pablo Guerron-Quintana and Hebrew University assistant professor of economics Alexey Khazanov, is using aggregate data to confirm this finding for U.S. business cycles.[7] (Their research uses the same

FIGURE 3

Following an Expansionary Defense Spending Shock, Population Health Improves

This is evidence that expansions improve population health.

Changes in federal defense spending, the unemployment rate, and the fraction of people in bad health (the latter two for individuals 25 to 54 years old) following a one-time defense spending shock, 1974–2007
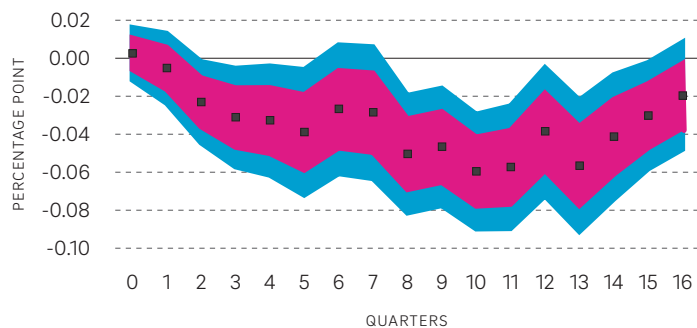
Defense Response
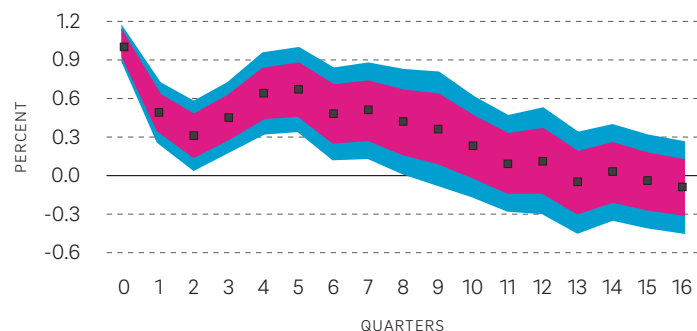
Unemployment Rate
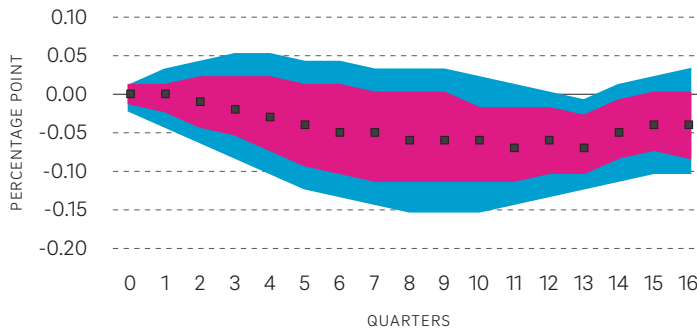
Bad Health

Data Sources: National Center for Health Statistics, National Health Interview Survey, various years, obtained via IPUMS NHIS, University of Minnesota, www.ipums.org; Bureau of Economic Analysis, obtained via FRED; Drautzburg (2020)

Note: Red band represents 1 standard error from the response estimated by our regression analysis; blue band represents 1.65 standard errors from the estimated response. The shock is normalized so that defense spending's initial increase is 1 percent.

statistical approach used in this article.) They show that, following a contractionary demand shock, the mortality of prime-age adults falls even as bad health rises. Unlike Schwandt and von Wachter's data, their data do not allow for a breakdown by cause of death. It is thus possible that the fall in mortality does not reflect underlying health but simply fewer deaths from accidents while working or commuting to work.[8] In that case, fewer deaths would be unrelated to better health as measured in this article.

Another explanation, however, is that population-level outcomes hide systematic differences between groups. Later in this article, we discuss research that shows that, when economic activity declines, fitness improves for some demographic groups but worsens for groups more closely attached to the labor market—that is, for those who are working or seeking work. Similarly, health outcomes may worsen for some and improve for others, manifesting as more individuals who report being in bad health while the death rate declines for other individuals.

How Health May Influence the Economy

None of the research discussed thus far suggests that a decline in population health harms the economy, which is another possible explanation for the correlation of health and the business cycle. Beyond case studies or pandemics, no data exist to test such a theory. But by disaggregating the national time series discussed above, we can learn much from the cross-sectional variation between states.

We broke down to the state level the national time series for the Great Recession that began in late 2007 (Figure 6). We then analyzed how population characteristics as of 2008 affected state employment outcomes after the recession. We find that states with worse initial health had lower employment rates in 2014 even when we condition on the state's employment level in 2008. Although this does not prove causation, it suggests that population health may influence labor market outcomes.

A Deeper Dive Into the Correlation Between Health and the Business Cycle

Economists analyze output as the result of a production function that transforms inputs—such as materials and hours worked—into output. Although such a production function accurately describes the production of concrete products—such as bread, electricity, and hip replacements—it is only a fictional accounting identity when applied to an abstract concept such as gross domestic product (GDP), the most commonly used measure of aggregate output. And yet this accounting identity helps us understand the determinants of output and productivity, the latter of which we can think of as a residual or unexplained "leftover" of the function. Similarly, the concept of a production function helps us understand the determinants of population health.

What would a health production function look like? In the canonical model developed by City University of New York emeritus professor Michael Grossman, current health depends on past health and current health investments, or inputs.[9] Inputs include preventive, curative, and rehabilitative health care services, but also health behaviors and conditions such as drug

abuse and addiction. The "product" of these inputs would be current health. More health investments, better health behavior, and fewer past adverse conditions would be associated with better health today. And just as productivity is a residual in the production of output, we may think of "residual health" as the part of current health left unexplained by past health conditions and current inputs and behaviors.

Past health conditions are a given, so when we observe a change in health today, the production function approach leaves us three possible explanations: (1) a change in health inputs, (2) a change in health behaviors, or (3) residual health. Here, we define health inputs as those consumed by individuals, such as health care goods and services, or emissions. Health behaviors are produced by individuals–think of life-style choices that impact health.[10]

Health Inputs

Could a decline in health inputs explain the decline in population health? Maybe some people can no longer afford to see a doctor during a recession. In the United States, more than half of individuals under age 65 access health insurance via their employer.[11] If they lose their job, they may lose health insurance and become unable to afford health services.

But this cannot be the sole cause of the correlation between population health and unemployment: Prime-age adults visited their doctors *more* frequently during the 2001 recession and the Great Recession from 2007 to 2009, yet more of them reported poor health (Figure 2). Moreover, individuals *with* and *without* health insurance reported a similar decline in health and a similar increase in doctor visits (Figure 7).

Not all health inputs are choices. Some are externalities, such as polluted air. And to the extent that economic activity is linked to pollution, there is a natural link to the business cycle. For example, one recent study found that a reduction in emissions improves population health for children.[12] However, to the extent that pollution and economic activity move in tandem, this channel cannot explain why bad health *rises* during a downturn. This suggests that, at best, a fall in health inputs explains only part of the rise in bad health during economic downturns.

Health Behaviors

Health behavior is a broad category that we do not fully capture in our data.[13] Using the NHIS data, we can measure two important health behaviors: exercise time and alcohol consumption. Neither the average amount of time prime-age adults spend exercising nor the fraction of prime-age adults who frequently have five or more drinks a day exhibits a systematic relationship with population health or employment. We found no relationship in the aggregate, nor when conditioning on health or employment status.

However, our degree of aggregation may mask individual differences. In one recent paper, researchers found that, when averaging age groups, there is no relationship between labor market conditions and fitness, but they also argue that the aggregate masks the fact that fitness improves for younger adults when the labor market is cooler. In contrast, it worsens for older

Following a Contractionary Monetary Policy Shock, Population Health Worsens

This is evidence that downturns worsen population health.

Changes in short-term interest rates, the unemployment rate, and the fraction of people in bad health (the latter two for individuals 25 to 54 years old) following a one-time monetary policy shock, 1974–2007

Federal Funds Rate
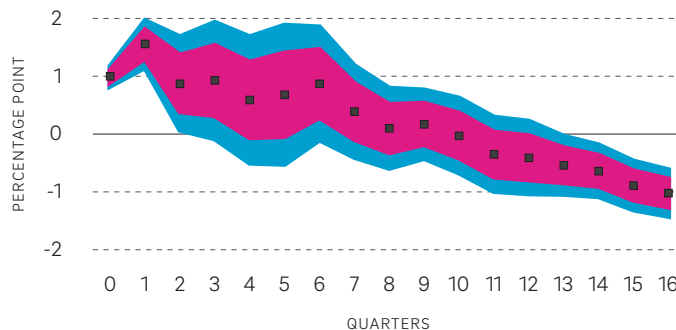
Unemployment Rate
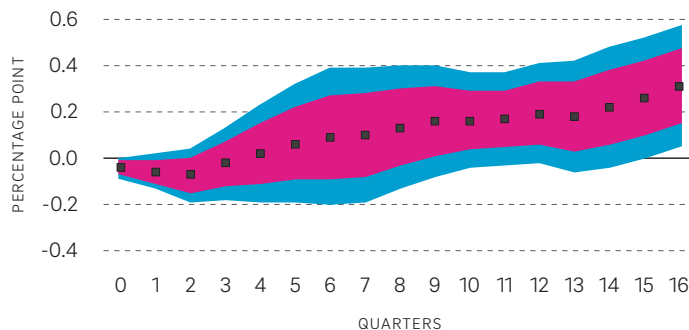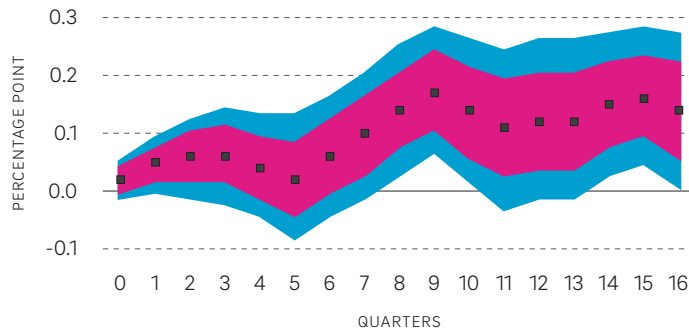
Bad Health

Data Sources: National Center for Health Statistics, National Health Interview Survey, various years, obtained via IPUMS NHIS, University of Minnesota, www.ipums.org; Board of Governors of the Federal Reserve System (U.S.) obtained via FRED; Wieland and Yang (2020)

Note: Red band represents 1 standard error from the response estimated by our regression analysis; blue band represents 1.65 standard errors from the estimated response. The shock is normalized so that the federal funds rate's initial increase is 1 percent.

FIGURE 5

Alternative Health Measures Paint the Same Picture

This validates our baseline measure.

Employment, measures of bad health, and doctor visits among individuals 25 to 54 years old, standard deviations from mean, by quarter, 1q1998–4q2018

Data Source: National Center for Health Statistics, National Health Interview Survey, various years, obtained via IPUMS NHIS, University of Minnesota, www.ipums.org

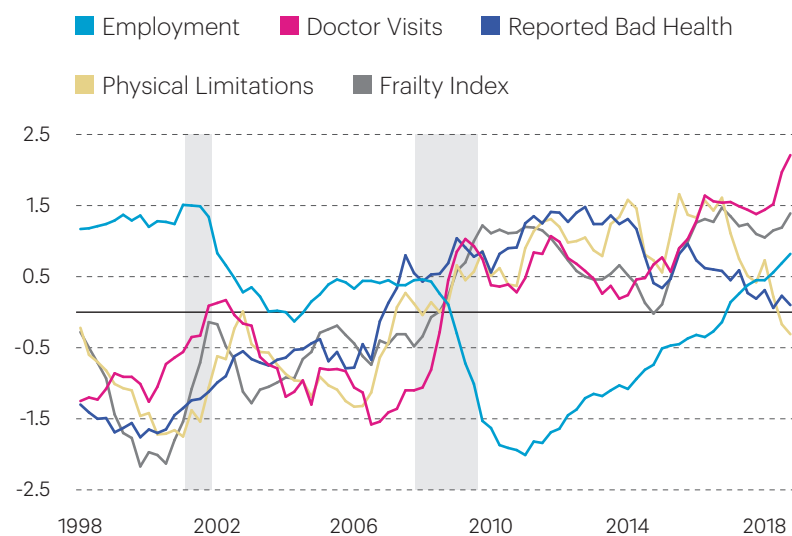**Note:** To smooth out noise and eliminate seasonal factors, we report a four-quarter moving average.

adults.[14]

Schwandt and von Wachter analyzed how a state's unemployment rate at the time of college graduation affected individuals later in life. Among those who graduated during a period of high unemployment, they found an increase in mortality due to liver disease and lung cancer in midlife. This is consistent with downturns being associated with a larger propensity to drink alcohol and smoke, which in turn leads to higher mortality 10 to 20 years after the downturn. This suggests that worse health behaviors may originate in downturns but might not affect health outcomes during the downturn, which would be required for worse health behaviors to explain the patterns we document.

Although economic conditions may affect health behaviors, the absence of a clear pattern in our aggregated data suggests that this is likely not the full story. Could other forces directly affect both population health and the labor market?

Residual Health

Residual health can be divided in two: Residual health that varies systematically with business cycle shocks–such as the demand shocks discussed above–is the health channel; we can think of the remaining residual health as a "health shock."

For our analysis of the link between business cycles and population health, we ignore health shocks. Although a fluctuation in population health could affect demand, the literature suggests that, catastrophic events such as pandemics aside, fluctuations induced by population health shocks are either too small or take too long to affect the business cycle.

We can also ignore individual health shocks, such as breaking a leg or becoming depressed. Although one person's health shock can affect their

finances, that won't impact population health.[15] From an aggregate ("macro") perspective, a health shock affects *population-level* health.

One source of such a shock is pharmaceutical innovation. However, pharmaceutical breakthroughs typically affect the labor supply over the course of decades, not from year to year, which is the time scale of the business cycle. For example, the introduction of opioid painkillers could explain about 40 percent of the decline in male labor force participation between 1999 and 2016 due to drug abuse.[16] And access to contraceptives increased young women's labor supply from 1970 to 1990.[17] But business cycles are a shorter-term phenomenon.

Other medical changes can act as a population health shock in the short term. However, these are hard to find and probably too small to have an aggregate effect. For example, the sudden withdrawal of a popular painkiller likely reduced the overall labor force participation rate by only 0.35 percentage point.[18] So, health shocks can be important for the economy but, with the notable exception of catastrophic events, they are unlikely to be a major driver of the typical business cycle.

This leaves us with a health channel. But what would that look like? One possibility is stress. For example, in 2009, Federal Reserve Bank of Chicago economist Daniel Sullivan and von Wachter estimated "a 50%-100% increase in the mortality hazard during the years immediately following job loss." They argue that their "results are consistent with these effects causing acute stress, which may substantially raise the mortality hazard in the short term."

In their 2012 article, Princeton University professor of economics Janet Currie and American University professor of health policy Erdal Tekin establish that local foreclosure rates were correlated with urgent, unscheduled hospital visits during the Great Recession. They suggest that stress due to financial distress may explain this link.[19] Similarly, UCLA professor of epidemiology Teresa Seeman and her coauthors found that, during the Great Recession, many people experienced an increase in blood pressure and fasting glucose levels. These two biomarkers are responsive to stressful conditions and associated with negative health effects such as heart disease.
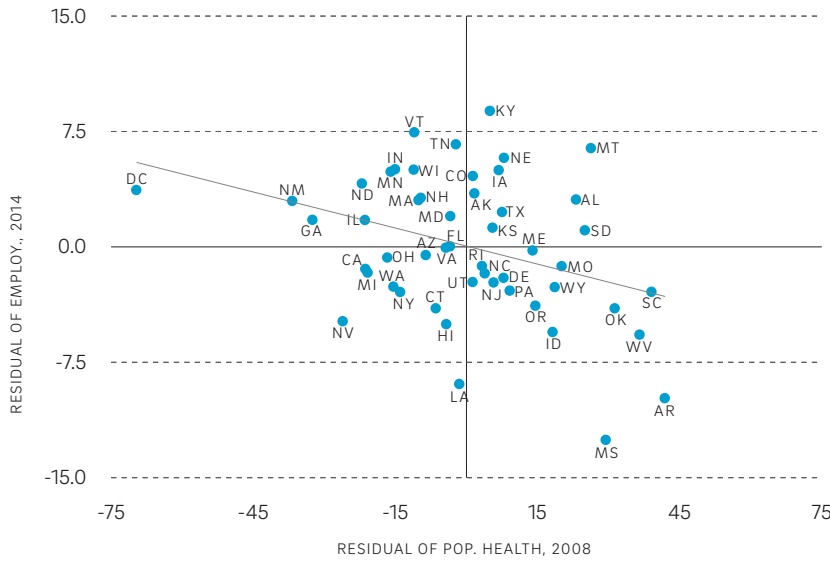
Stress resulting from an economic downturn is a plausible and concrete explanation for the causal link that our statistical approach has uncovered. It's probably not the only channel, but its well-documented presence during economic downturns backs our analysis.

FIGURE 6

Population Health May Influence Labor Market Outcomes

States with worse initial health had lower unemployment even when we condition on initial employment.

Population health in 2008 and employment in 2014 across U.S. states after subtracting the mean from each data point and accounting for 2008 employment; residual as percentage

Data Source: U.S. Census Bureau and Bureau of Labor Statistics, obtained via IPUMS CPS, University of Minnesota, www.ipums.org

Conclusion

More prime-age Americans report being in bad health during downturns than during expansions. Although causality may run both ways, we provide evidence that shocks to aggregate demand alter not only economic activity but also health. Health behaviors may contribute to these results, but downturn-induced stress is likely part of the health channel that links economic fluctuations to health fluctuations. Together, this suggests that economic downturns have effects beyond the economy as narrowly defined. They also affect population health.

The efforts of Drautzburg, Guerron-Quintana, and Khazanov, discussed above, to develop a structural equilibrium model that will quantify the importance of this mechanism should help policymakers incorporate this health channel in their decision-making. ☐

See **Stress: Health Channel or Health Outcome?** ↘

FIGURE 7

Lack of Health Insurance Can't Explain the Decrease in Population Health

Individuals with and without health insurance reported a similar decline in health and increase in doctor visits.

Employment, measures of bad health, and doctor visits among individuals 25 to 54 years old, standard deviations from mean, insured vs. uninsured, by quarter, 1q1998–4q2018

■ Employment   ■ Doctor Visits   ■ Reported Bad Health   ■ Physical Limitations   ■ Frailty Index

Data Source: National Center for Health Statistics, National Health Interview Survey, various years, obtained via IPUMS NHIS, University of Minnesota, www.ipums.org

Is Self-reported Health a Good Measure of Health?

Self-reported health status is a widely used measure in the economic literature. This measure is based on a single question that has been asked in a nearly identical way across several major surveys over a long period.[21] In contrast, many other health-related variables are frequently reworded or are recorded for only a handful of years.

Skeptics might argue that self-reported health is a poor measure of true underlying health. But true health is difficult to capture even with a variety of health-related questions, whereas self-reported health allows people to report on important aspects of their health that may be overlooked by typical survey questions. Despite the ambiguity of what exactly is being measured with self-reported health, its importance has been confirmed with many other more objective measures of health. Using data from the National Health Interview Survey (NHIS), we find that the risk of death in the two years after the survey is about 2.3 percent for those reporting bad health, while for those in good health this number is only 0.3 percent. Self-reported health has also been shown to contribute to or even outperform other more objective metrics in predicting mortality.[22]

Self-reported health is also highly correlated with other measures of health. For example, during the Great Recession, self-reported bad health rose along with other measures of poor health.

Some researchers have used a more concrete measure of health, the frailty index.[23] They construct this index by generating a score for each individual based on a variety of health conditions (such as diabetes and asthma); certain physical limitations (difficulty eating, walking); and certain risk factors (a high body mass index or a history of smoking tobacco products). The score is then normalized by the total number of factors considered. The frailty index and self-reported health have similar time series. This highlights the comprehensive nature of self-reported health: Respondents can factor in whichever aspects of their health they experience as debilitating.

However, health is complex and multifaceted. At the individual level, for example, someone in excellent general health can suffer from an acute illness. And mental and physical health need not move in tandem. At the population level, the divergence of self-reported health and mortality over the business cycle that we discuss also attests to the complexity of measuring health.

Stress: Health Channel or Health Outcome?

This article focuses on self-reported health as the main health outcome. In this article—as well as in much of the literature, such as in Grossman's canonical health model—health is summarized by a single number, but health is multifaceted, as the differences between mortality and self-reported health illustrate.

What would a richer model of health look like? We could think of health as a vector, or collection, of several health outcomes. Each of these health outcomes, in turn, is the result of a health production function whose inputs would include, among others, the past vector of health outcomes. Self-reported health could thus be like the frailty index, which we also discuss in this article, in that it can be conceptualized as a summary measure of these multidimensional health inputs.

In such a world, stress could thus be both an input and an outcome. For example, if economic distress causes mental or physiological stress today, this stress may then lead to a deterioration of other health outcomes. Stress would thus influence our health measure both directly and indirectly.

Notes

1 These numbers focus on so-called "prime-aged" individuals 25 to 54 years old. Results for the COVID-19 recession are sensitive to detrending, whereas results for the earlier recessions are not. We accessed the CPS data via IPUMS. See Flood et al. (2024).

2 Formally, the correlation between the two series is 0.6.

3 To compute this projection, we used ordinary least squares regression, building on work by Oscar Jorda and by José Luis Montiel Olea and Mikkel Plagborg-Møller. Jorda introduced the key idea in 2005, and Montiel Olea and Plagborg-Møller made an important contribution in 2021. Our aggregate demand surprises are measures of surprise changes in monetary and fiscal policy. These results are taken from ongoing work by Thorsten Drautzburg, Pablo Guerron-Quintana, and Alexey Khazanov. Readers can find additional details about this implementation in their paper.

4 We accessed the data via IPUMS. See Blewett et al. (2024).

5 See Abramson et al. (2024).

6 Importantly, they find midlife increases in mortality for those graduating in a recession. These increases later in life are persistent, larger than the initial declines, and disease-related.

7 See Drautzburg et al. (2024).

8 The Bureau of Labor Statistics reports that there were about 5,300 fatal work injuries in 2023. "Transportation incidents" are the most common cause of work fatalities, with 37 percent of the total. Overall, however, work fatalities account for a small fraction of U.S. deaths. If we apply the same 37 percent share to the roughly 5,500 work fatalities in 2022 (and if workers were largely 20 to 69 years old), then work fatalities caused by transportation incidents accounted for only about 6 percent of overall motor vehicle deaths (as measured by the Insurance Institute for Highway Safety) in 2022. As a fraction of all unintentional injuries in this age group, the share was lower still.

9 See Grossman (2000).

10 This distinction is not always sharp. For example, obtaining health care services can be time-intensive for individuals. And working with a physical therapist would count as a health input, whereas working out with a personal trainer would be considered a health behavior. However, for the data available to us, the distinction is unproblematic.

11 See Scott (2023).

12 See Simeonova et al. (2021).

13 Aspects of health behavior that we do not cover here include, for example, overwork, diet, and sleep.

14 See Papps et al. (2023), who used data on the run times of a weekly running event in the United Kingdom from 2004 to 2020.

15 For more on how an individual's health shock can affect their finances, see Hosseini et al. (2021).

16 See Krueger (2017).

17 See Bailey (2006).

18 See Garthwaite (2012).

19 The authors suggest stress as a "potential mechanism." They explain that "stress is thought to affect health both by depressing the immune system and through the direct action of 'stress hormones' on factors such as blood pressure and cardiovascular health.... Stress can also have harmful consequences through psychological responses such as depression" (p. 66). Foreclosures may also impact health behaviors indirectly by lowering wealth, but the authors show that their findings still hold when they focus on the "most serious acute conditions," such as heart attacks and kidney failure, whose treatment is not a choice. See Currie and Tekin (2012).

20 See, for example, Capatina (2015) and Halliday et al. (2021).

21 Respondents are asked: "Would you say that [person's] health in general is excellent, very good, good, fair, or poor?"

22 See Halliday et al. (2021).

23 See, for example, Hosseini et al. (2021), Searle et al. (2008), and Yang and Lee (2010).

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Banking Trends

Where Depositors Fear to Tread

When depositors flee banks, does that spell the end of lending?

Edison Yu

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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.

Silicon Valley Bank (SVB), a midsize U.S. bank, collapsed and was closed by regulators on March 10, 2023. It was the third-largest bank failure in U.S. history and the largest since the 2007–2008 Global Financial Crisis. SVB had a lot of uninsured deposits, and its failure quickly spread fear about the financial health of other banks–particularly other midsize banks. Indeed, in the immediate aftermath of SVB's collapse, depositors withdrew a large amount of deposits from the U.S. banking system (Figure 1).

Since deposits are one of the largest funding sources for banks, the events that followed SVB's collapse raised an important question for policymakers: Would this large deposit outflow affect banks' ability to lend and thus fund projects? The answer depends on whether banks need deposits to finance loans.

There are two broad theories regarding how banks obtain funding for lending. To help distinguish between the two, I call them the deposit view and the lending view. According to the deposit view, banks create liquidity by turning otherwise illiquid liabilities, such as deposits, into loans that borrowers can use to

FIGURE 1

About $300 Billion of Deposits Left the U.S. Banking System in the Three Weeks After SVB Failed

Deposits of all U.S. commercial banks, billions of U.S. dollars, weekly, seasonally adjusted, 2022–2024

■ Deposits, All Commercial Banks

Data Source: Board of Governors of the Federal Reserve System (U.S.), Deposits, All Commercial Banks [DP-SACBW027SBOG], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/DPSACBW027SBOG, December 3, 2024

fund their investments. Based on this view, lending would fall with a large outflow of deposits from a bank.

According to the lending view, however, banks don't need deposits to lend. Instead, demand deposits are created when banks extend credit, so banks actually *create* deposits and liquidity through lending.[1] This process is limited not by the amount of cash deposits available but rather by loan demand, capital constraints, and regulations such as reserve and liquidity requirements. Based on this view, deposits fell because banks were faced with either a decreased demand for loans or a tightening of other constraints, such as capital or reserve requirements. Lending activity does not necessarily decline after depositors withdraw funds from the banking system.

Although economists have found evidence to support both the deposit view and the lending view, understanding which mechanism is dominant can help determine if–and how strongly–policymakers should respond when they observe large deposit outflows.[2] Unfortunately, empirically disentangling the two and identifying which margin is constraining banks' lending is challenging. Specifically, policymakers have struggled to determine whether bank lending is constrained by a decline in cash deposits or by lower loan demand and capital constraints. This article will review evidence of each of these constraints.

Which Comes First: Deposits or Loans?

The two views discussed above support different ideas about how banks obtain funds to lend. In the deposit view, banks collect deposits from savers, keeping a fraction as reserves and lending out the rest. (This is known as a fractional reserve banking system.) Thus, deposits are a prerequisite for a bank's ability to lend. We can explain this with a simple bank balance sheet. Suppose that there is only one bank in the economy and one person with $100 cash. Instead of stashing this cash in their house, this person deposits it at the bank. After the initial cash deposit, the bank has $100 in assets in the form of cash and $100 in liabilities in the form of deposits (Figure 2, top). Suppose now that the bank loans a borrower a fraction of those cash deposits–say, $80–and keeps the rest in reserve for regulatory requirements or depositor withdrawals. Now the bank's balance sheet shows $20 in cash and $80 in loans on the asset side (Figure 2, bottom). Thus, the bank has done something the depositor could not have done if

they had stashed their cash in their house instead: It has increased liquidity by turning deposits into loans, which enables additional transactions. The loan is the amount of liquidity created through the banking system.

In this scenario, the supply of deposits is the primary determinant of bank lending: Liquidity creation is made possible by the initial deposit, and lending is limited by either a lack of deposits or too high a reserve requirement. Any decline in deposits would directly limit new lending.

In the lending view, a bank can lend without an initial cash deposit. But how is that possible? When a bank makes a loan to a consumer or a firm, it typically creates a checking account for the borrower's use. Going back to our earlier example, if a borrower gets a $100 loan from a bank, that bank will create a promissory note (a claim) and issue the borrower a checking account with $100. From the bank's point of view, it has an additional $100 in assets in the form of loans and an additional $100 in liabilities in the form of demand deposits. In other words, the bank has created a deposit by making a loan (Figure 3). As New York University professors of economics Lawrence S. Ritter and William L. Silber put it in their money and banking textbook, *Principles of Money, Banking, and Financial Markets*, "Demand deposits come into being when banks extend credit–that is, when they make loans or buy securities."

As we can see from this example, lending is not necessarily constrained by the amount of cash deposits available because, according to the lending view, banks *create* deposits through lending. Bank lending may instead be constrained by other factors. For example, the bank needs to meet capital or other regulatory requirements, and the quantity of loans issued is constrained by loan demand, which is not unlimited.

Policy Implications

The optimal policy response to a crisis like the SVB failure would differ under the two views discussed above. In the deposit view, since having available deposits is directly related to a bank's ability to lend, policymakers need to replenish the lost deposits with a substitute source of

FIGURE 2

A Bank Can Create Liquidity by Turning Deposits Into Loans

An $80 loan is created out of a $100 deposit.
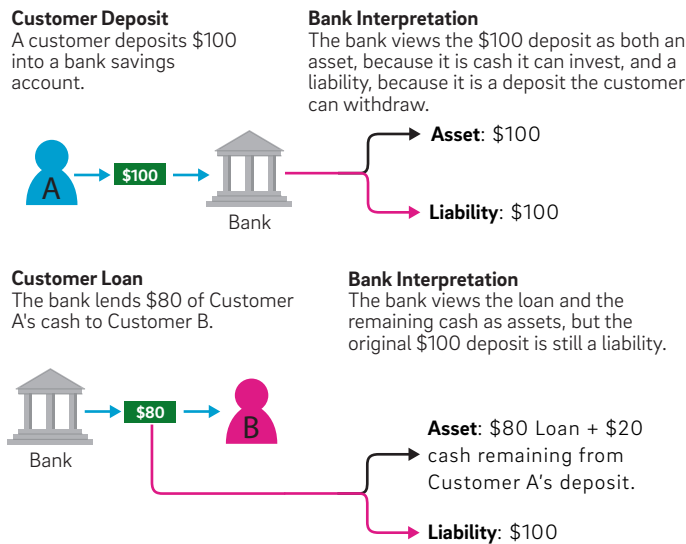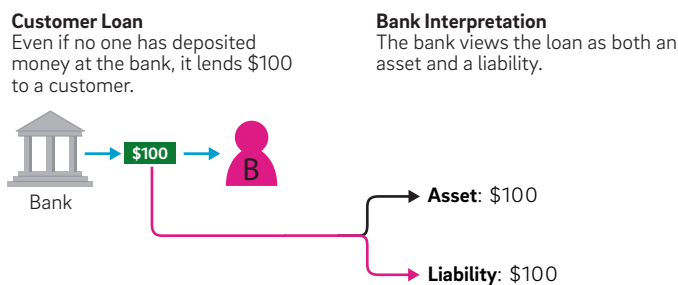An example balance sheet, according to the deposit view

Customer Deposit
A customer deposits $100 into a bank savings account.

Bank Interpretation
The bank views the $100 deposit as both an asset, because it is cash it can invest, and a liability, because it is a deposit the customer can withdraw.

A → $100 → Bank

Asset: $100

Liability: $100

Customer Loan
The bank lends $80 of Customer A's cash to Customer B.

Bank Interpretation
The bank views the loan and the remaining cash as assets, but the original $100 deposit is still a liability.

Bank → $80 → B

Asset: $80 Loan + $20 cash remaining from Customer A's deposit.

Liability: $100

FIGURE 3

But According to the Lending View, Banks Create Deposits by Extending Credit

A hundred dollars of liquidity is created without any initial deposit required.
An example balance sheet, according to the lending view

Customer Loan
Even if no one has deposited money at the bank, it lends $100 to a customer.

Bank Interpretation
The bank views the loan as both an asset and a liability.

Bank → $100 → B

Asset: $100

Liability: $100

funding in the banking system. This source can be other liquid assets such as cash or bank reserves. Indeed, policymakers have implemented measures to do just that. For example, two days after SVB's failure, the Federal Reserve established the Bank Term Funding Program (BTFP) to provide emergency liquidity to U.S. depository institutions. In particular, the BTFP allows banks to exchange less-liquid assets such as U.S. Treasuries for cash at their full-face amount, regardless of the current market value. And regardless of the BTFP, banks can borrow from the Fed through the discount window, which is a permanent facility that lends cash to banks, often for just a few days or weeks.

However, based on the lending view, the deposit flight is not necessarily a problem for bank lending. Instead, if policymakers are concerned about the banking crisis negatively affecting loan

demand, they can increase loan demand through deficit spending. Alternatively, policymakers can loosen capital requirements or other regulatory constraints.

This section presents a sharp contrast between the two views on what potentially constrains bank lending. In reality, the deposit and lending channels are at work at the same time. The empirical question concerns the direction of causality: Do deposits lead to lending, or the reverse? In the next section, I look at recent research that tries to disentangle these channels empirically.

Empirical Evidence in the Literature

Trying to distinguish between the two channels empirically is challenging because decisions made by a bank typically affect both cash deposits and lending. For example, a bank's advertising campaign can increase both its deposits and its lending. Thus, cash deposits at and lending by a bank usually move together. This makes finding the direction of causality difficult.

To address this problem, researchers have identified exogenous shocks that help them isolate causality. An exogenous shock is an event that occurs outside a bank's decision-making process and acts like a natural experiment that isolates a bank's true response to an event.

For their 2016 *Journal of Finance* article, Wharton School assistant professor of finance Erik Gilje, University of Virginia professor of business administration Elena Loutskina, and Boston College professor of finance Philip E. Strahan used windfalls from oil and gas shale discoveries in the United States as just such a natural experiment. Because of the oil and gas "fracking" boom, local landowners suddenly received mineral royalty payments, leading to an arguably exogenous increase in deposits at banks with branches in shale-boom counties. Their paper identifies 327 banks that received deposit windfalls in different years between 2003 and 2010 as new discoveries were made.

In response to this inflow of deposits, they find, banks with a branch presence in a shale-boom county increased mortgage lending in areas *not* experiencing the boom. In other words, landowners in areas experiencing the fracking boom deposited their newfound wealth in banks, and those deposits traveled through the bank branch network to become loans in areas not experiencing the boom. The result is likely causal for two reasons. First, those other regions were not directly affected by the fracking boom, which alleviates the concern that loan demand drove up lending. In addition, banks with a greater need for funds to support loan growth did not establish new branches in counties experiencing a shale boom.

In her 2022 *Journal of Financial and Quantitative Analysis* article, Notre Dame University assistant professor of finance Jun Yang used the exogenous shock of the influx of international students to U.S. universities from 2000 through 2018 to study the relationship between banks' deposit-taking and lending activities. The article first documents that the number of foreign Chinese students at U.S. universities increased more than sevenfold, from about 60,000 to almost 370,000, from 2000 through 2018. The influx of Chinese students serves as a positive shock to local deposits. The shock is not uniform across all banks, because

some banks have brand names that are better recognized in those students' home country, the People's Republic of China, and this name recognition is plausibly exogenous to a local economy. The paper finds that banks that are more likely to be recognized by Chinese students experienced a higher deposit inflow and expanded their credit supply locally compared with similar banks in the same county. One feature of Chinese students is that, although they contribute to local deposits and consumption, they are mostly excluded from the credit market due to their limited credit histories in the United States. Therefore, she argues, the expansion of credit is driven by the deposit channel.

Overall, both papers find that an exogenous inflow of deposits into banks led to an increase in lending. This supports the deposit view that the direction of causality is from deposits to lending.

However, for our recent *Journal of Financial Stability* article, Washington University professor of finance Anjan Thakor and I looked for situations in which bank cash deposits fell while loan demand rose. We used natural disasters as natural experiments. We found that, immediately after a natural disaster, people withdrew more cash from banks. According to the deposit view, this should have led to a decrease in lending. However, we find that the opposite occurred: Loan demand *increased* for reconstruction and emergency borrowing. Banks funded their loans by creating deposits; this met the demand for loans associated with natural disasters. This means that banks increased lending even when cash deposit balances were falling. This evidence supports the lending view of liquidity creation. Consistent with this view, we also find that banks with more capital created the most liquidity.

A 2017 *Journal of Financial Economics* article by University of New South Wales associate professor of banking and finance Kristle Romero Cortés and Boston College professor of finance Philip Strahan also uses natural disasters as loan demand shocks for banks. They find that banks that operate in multiple local markets shift capital to areas affected by natural disasters from areas that are less affected. They use property damage from natural disasters as a proxy for loan demand. They find that credit in unaffected but connected markets declines by a little less than 50 cents per dollar of additional lending in areas affected by a natural disaster. The article provides evidence that banks can reallocate deposits within their banking network to meet loan demand shocks.

Conclusion

Banks play an important role in liquidity creation, but there is no consensus on the exact mechanism by which liquidity is created through the banking system. This has policy implications when there are large deposit outflows from the banking system, as in the aftermath of SVB's failure. This article illustrates two potential mechanisms and presents recent empirical evidence. So far, there is no consensus in the literature on how lending was impacted by SVB's failure. It's likely that both mechanisms are at work in the real world. Further research is needed before we can resolve this debate. ⊟

Notes

1 Elements of this view date back to Wicksell (1906), Schumpeter (1912), and Keynes (1930).

2 See Brunnermeier and Pedersen (2009), Berger and Bouwman (2009), and Donaldson et al. (2021) for more references.

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Yang, Jun. "Deposit-Lending Synergies: Evidence from Chinese Students at U.S. Universities," *Journal of Financial and Quantitative Analysis*, 57:5 (2022), pp. 1960–1986, https://doi.org/10.1017/S0022109021000429.

Research Update

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

Flood Underinsurance

Using data on expected flood damage and National Flood Insurance Program policies, we estimate annual flood risk protection gaps and underinsurance among single-family residences in the contiguous United States. Annually, 70 percent ($17.1 billion) of total flood losses would be uninsured. Underinsurance, defined as protection gaps among properties with positive flood risk and incentives to purchase full flood insurance coverage, totals $15.7 billion annually. Eighty percent of at-risk households are underinsured, and average underinsurance is $7,208 per year. Underinsurance persists both inside and outside the Federal Emergency Management Agency's special flood hazard areas, suggesting frictions in the provision of risk information and regulatory compliance. Seventy percent of uninsured households would benefit from purchasing flood insurance, even as prevailing prices rise. Household beliefs about climate risks are strongly correlated with underinsurance.

WP-24-23. Natee Amornsiripanitch, Federal Reserve Bank of Philadelphia Supervision, Regulation, and Credit Department; Siddhartha Biswas, Federal Reserve Bank of Philadelphia Supervision, Regulation, and Credit Department; John Orellana-Li, Federal Reserve Bank of Philadelphia Supervision, Regulation, and Credit Department; David Zink, Federal Reserve Bank of San Francisco

Climate Shocks in the Anthropocene Era: Should Net Domestic Product Reflect Climate Disasters?

The asset costs of natural disasters in the United States grew rapidly from 1980 to 2023, with the trend rising 4.9 percent annually in real terms to $90 billion in 2023. Much of this trend in costs is likely due to climate change, and as a loss of assets implies a faster depreciation of real assets. We argue that the expected depreciation from these events should be included in consumption of fixed capital (CFC), leading to lower levels and slightly lower growth rates for net domestic product (NDP) and Net Domestic Investment. We use Poisson pseudo-maximum-likelihood regressions to estimate this expectation and generate our experimental measure of costs. An alternative calculation of CFC and NDP might directly include the time series of costs incurred rather than the far smoother expectation; this was the procedure adopted before 2009 and resulted in abrupt changes in NDP.

WP-25-01. Leonard Nakamura, Emeritus Economist, Federal Reserve Bank of Philadelphia, Economic Statistics Centre of Excellence; Brian Sliker, Bureau of Economic Analysis

Who Remains Unbanked in the United States and Why?

This paper conducts a detailed exploration of the factors associated with unbanked status among U.S. households and how these relationships evolved between 2015 and 2019. Biennial FDIC household survey data on bank account ownership and household characteristics, combined with state-level variables, are examined with application of both fixed effects and multilevel modeling. The analysis finds that even as rising incomes drove a decline in the unbanked percentage of the population over this period, income remained the most significant differentiator, with strong associations with race and ethnicity also persisting. Unbanked status became more concentrated among single individuals and disabled individuals and less concentrated among younger households over this period, and less strongly related to unemployment spells. New factors identified by the analysis include lack of digital access and noncitizen immigrant status, both associated with significantly higher likelihood of being unbanked. Identified state-level relationships include an association between financial literacy measures and percent unbanked. Overall, the findings suggest that continuation of recent efforts by policymakers to bridge the digital divide in rural and urban areas and to enhance financial literacy could help expand financial inclusion. Another key takeaway is that unknown structural factors still pose a challenge to explaining who is unbanked, especially regarding gaps by race and ethnicity, underscoring a need to capture more granular data on the unbanked.

WP-25-02. Paul Calem, Bank Policy Institute; Chris Henderson, Federal Reserve Bank of Philadelphia; Jenna Wang, Federal Reserve Bank of Philadelphia

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

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

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

How Wealth and Age Interact to Affect Entrepreneurship

Using wealth windfalls from lottery winnings and matched employer-employee tax files, we compare the effect of additional wealth on the entrepreneurial activity of older and younger individuals. We find that additional wealth leads older winners (aged 55 and older) to reduce business ownership and scale. In contrast, additional wealth leads younger winners to increase business ownership and performance. We also show that extra lottery wealth reduces the wage labor supply of both younger and older individuals. Thus, while younger lottery winners reduce wage labor to increase entrepreneurship, older lottery winners reduce both wage labor and entrepreneurship to retire.

WP-25-03. Philippe d'Astous, HEC Montréal; Vyacheslav Mikhed, Federal Reserve Bank of Philadelphia Consumer Finance Institute; Sahil Raina, Alberta School of Business; Barry Scholnick, Alberta School of Business and Federal Reserve Bank of Philadelphia Consumer Finance Institute Visiting Scholar

Measuring Fairness in the U.S. Mortgage Market

Black Americans are both substantially more likely to have their mortgage application rejected and substantially more likely to default on their mortgages than White Americans. We take these stark inequalities as a starting point to ask the question: How fair or unfair is the U.S. mortgage market? We show that the answer to this question crucially depends on the definition of fairness. We consider six competing and widely used definitions of fairness and find that they lead to markedly different conclusions. We then combine these six definitions into a series of stylized facts that offer a more comprehensive view of fairness in this market. To facilitate further exploration, an interactive Online Appendix allows the user to examine our fairness measurements further across both time and space.

WP-25-04. Hadi Elzayn, Stanford University; Simon Freyaldenhoven, Federal Reserve Bank of Philadelphia; Ryan Kobler, Federal Reserve Bank of Philadelphia; Minchul Shin, Federal Reserve Bank of Philadelphia

Constructing Applicants from Loan-Level Data: A Case Study of Mortgage Applications

We develop a clustering-based algorithm to detect loan applicants who submit multiple applications ("cross-applicants") in a loan-level data set without personal identifiers. A key innovation of our approach is a novel evaluation method that does not require labeled training data, allowing us to optimize the tuning parameters of our machine learning algorithm. By applying this methodology to Home Mortgage Disclosure Act data, we create a unique data set that consolidates mortgage applications to the individual applicant level across the United States. Our preferred specification identifies cross-applicants with 93 percent precision.

WP-25-05. Hadi Elzayn, Stanford University; Simon Freyaldenhoven, Federal Reserve Bank of Philadelphia; Minchul Shin, Federal Reserve Bank of Philadelphia

Who Provides Credit in Times of Crisis? Evidence from the Auto Loan Market

We examine the contribution of different lending channels to the auto loan market in times of crisis. Specifically, we explore lending from traditional banks, credit unions, and finance companies (nonbanks) over the past two decades, with an emphasis on the Great Recession and the COVID-19 pandemic. We find that banks provided weak support during the pandemic, thus losing market share and continuing the trend that emerged following the Great Recession. Nonbank market share during this period grew most significantly for subprime borrowers and in counties with stronger bank dependence. Survey evidence suggests that a tightening in banks' lending standards may have contributed to this trend. These findings contrast with the experience during the Great Recession, when banks contributed the most resilient credit to the auto loan market. Our paper highlights nonbanks' increasing role in the auto loan market in times of crisis, particularly for the subprime segment.

WP-25-06. José Canals-Cerdá, Federal Reserve Bank of Philadelphia Supervision, Regulation, and Credit Department; Brian Jonghwan Lee, Federal Reserve Bank of Philadelphia Consumer Finance Institute and Emory University

The Value of Piped Water and Sewers: Evidence from 19th Century Chicago

We estimate the impact of piped water and sewers on property values in late 19th century Chicago. The cost of sewer construction depends sensitively on imperceptible variation in elevation, and such variation delays water and sewer service to part of the city. This delay provides quasi-random variation for causal estimates. We extrapolate ATE estimates from our natural experiment to the area treated with water and sewer service during 1874–1880 using a new estimator. Water and sewer access increases property values by a factor of about 2.8. This suggests that benefits are large relative to the value of averted mortality, many other infrastructure projects, and construction costs.

WP-25-07. Michael Coury, University at Buffalo, The State University of New York; Toru Kitagawa, Brown University; Allison Shertzer, Federal Reserve Bank of Philadelphia; Matthew A. Turner, Brown University

How Resilient Is Mortgage Credit Supply? Evidence from the COVID-19 Pandemic

We study the resilience of U.S. mortgage credit supply during the COVID-19 pandemic—the most significant shock since the financial crisis—and draw out broader lessons about the functioning of this important market. While mortgage lending boomed in 2020 and 2021, we find that a sharp increase in intermediation markups limited the pass-through of low rates to households. We link this increase in markups to capacity constraints amplified by pandemic-related operational and labor market frictions. We also present new evidence that capacity constraints in the mortgage market are national in scope and have not yet been significantly mitigated by recent technological change. Nonbank lenders, often thought to be fragile, gained market share from banks but remain reliant on securitization. We also find evidence that government credit guarantees support the flow of credit to risky borrowers but are not always sufficient, and that quantitative easing particularly boosts credit supply for the specific types of loans being purchased.

WP-21-20R. Andreas Fuster, École Polytechnique Fédérale de Lausanne; Aurel Hizmo, independent; Lauren Lambie-Hanson, Federal Reserve Bank of Philadelphia Consumer Finance Institute; James Vickery, Federal Reserve Bank of Philadelphia; Paul Willen, Federal Reserve Bank of Boston and NBER

Sequential Search for Corporate Bonds

Customers in over-the-counter (OTC) markets must find a counterparty to trade. Little is known about this process, however, because existing data consist of transaction records, which reveal only the outcome of a search. Using data from a trading platform for corporate bonds, we unpack the search process. We analyze how long it takes customers to trade and how dealers' offers evolve across repeated inquiries. We estimate that it takes two to three days to complete a transaction after an unsuccessful attempt, with substantial variation across trade and customer characteristics. Our analysis offers insights into the sources of trading delays in OTC markets.

WP-25-08. Mahyar Kargar, University of Illinois at Urbana-Champaign; Benjamin Lester, Federal Reserve Bank of Philadelphia; Sébastien Plante, University of Wisconsin–Madison; Pierre-Olivier Weill, UCLA, NBER, CEPR, and Federal Reserve Bank of Philadelphia Research Department Visiting Scholar

Coverage Neglect in Homeowner's Insurance

Most homeowners do not have enough insurance coverage to rebuild their house after a total loss. Using contract-level data from 24 homeowners insurance companies in Colorado, we show wide differences in average underinsurance across insurers that persist conditional on policyholder characteristics. Underinsurance matters for disaster recovery. Across households that lost homes to a major wildfire, each 10 percentage point increase in underinsurance reduces the likelihood of filing a rebuilding permit within a year of the fire by 4 percentage point. To understand why consumers purchase underinsured policies, we build a discrete choice insurance demand model. The results suggest that policyholders treat insurers that write less coverage as if they set lower premiums, forgoing options to get more coverage at the same premium from other insurers—a pattern we call coverage neglect. Our findings suggest that coverage limits are either not salient to consumers or difficult to estimate without the input of insurance agents. Under a counterfactual without coverage neglect, consumer surplus increases by $290 per year, or 10 percent of annual premiums, on average.

WP-25-09. J. Anthony Cookson, University of Colorado Boulder; Emily A. Gallagher, University of Colorado Boulder and Federal Reserve Bank of Philadelphia Consumer Finance Institute Visiting Scholar; Philip Mulder, University of Wisconsin Madison

Mortgage-Backed Securities

This paper reviews the mortgage-backed securities (MBS) market, with a particular emphasis on agency residential MBS in the United States. We discuss the institutional environment, security design, MBS risks and asset pricing, and the economic effects of mortgage securitization. We also assemble descriptive statistics about market size, growth, security characteristics, prepayment, and trading activity. Throughout, we highlight insights from the expanding body of academic research on the MBS market and mortgage securitization.

WP-25-10. Andreas Fuster, EPFL, Swiss Finance Institute, and CEPR; David Lucca, Jane Street; James Vickery; Federal Reserve Bank of Philadelphia
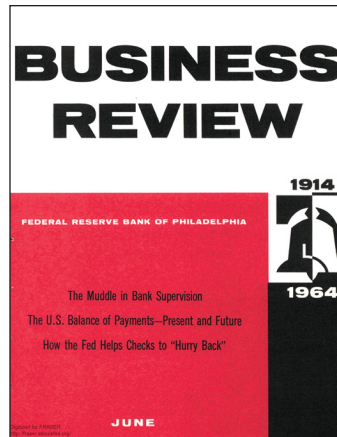
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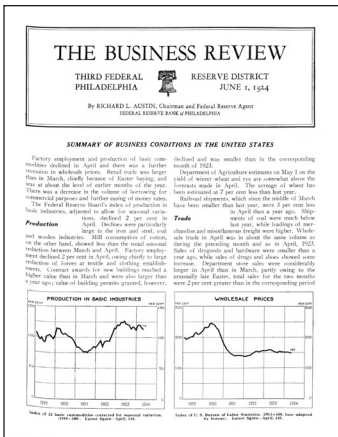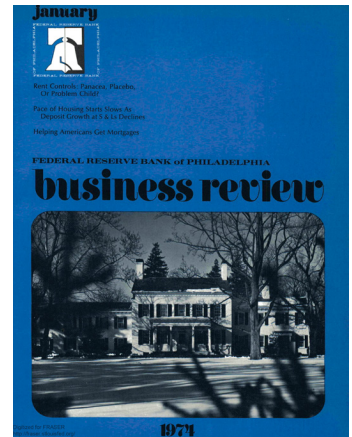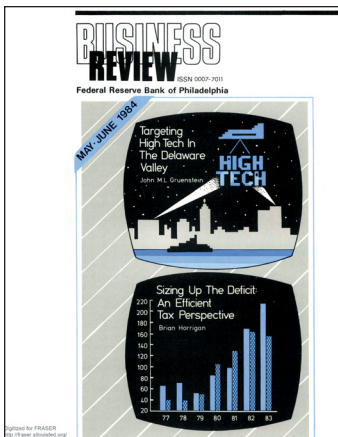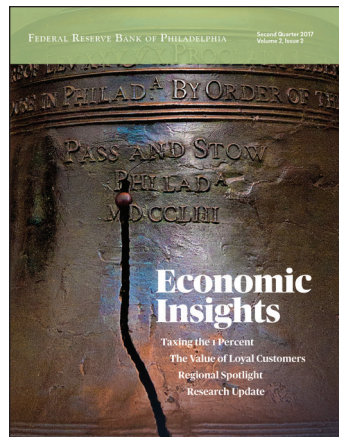
1920s

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