FEDERAL RESERVE BANK OF KANSAS CITY

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Population Turnover and the Growth of Urban Areas

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Population Turnover and the Growth of Urban Areas

By Jason P. Brown and Colton Tousey

People in the United States are relocating nearly half as much they did in the early 1980s. Lower population turnover—the propensity of people to move into or out of a given location—may mean a decline in labor market adjustment across industries and occupations; when people move across regions for job-related reasons, they may help smooth out changes that hit certain labor markets harder than others. Population turnover may also lead to better matches between employer and employee, an important factor in the growth of urban areas.

Jason P. Brown and Colton Tousey examine the relationship between population turnover and overall population growth across urban areas of various sizes from 2000 to 2017. They find that larger urban areas tend to have higher population turnover and that higher initial levels of turnover are correlated with faster population growth over subsequent decades. Their findings, which are consistent with other studies showing economic activity increasingly concentrating in larger urban areas, suggest that areas with small populations and lower levels of labor market adjustment face greater economic challenges.

Mobile Banking Use and Consumer Readiness to Benefit from Faster Payments

By Fumiko Hayashi and Ying Lei Toh

The U.S. payments industry is currently implementing faster payments that will enable consumers and businesses to send and receive payments almost instantly at any time of day, any day of the year. Mobile banking in particular may allow consumers to realize the full benefits of faster payments. As a result, a consumer's use of mobile banking is a good indicator of their readiness to benefit from faster payments.

Fumiko Hayashi and Ying Lei Toh examine which consumer characteristics are associated with mobile banking use as well as what other factors may influence consumer readiness. They find that banked households that are younger, higher income, college-educated, employed, or that occasionally use alternative financial services are significantly more likely to have used mobile banking for transactions. Their results suggest three additional factors may influence consumer readiness to fully benefit from faster payments: the availability and cost of digital infrastructure, the availability of mobile banking and its transaction functions, and consumers' perceptions of and savviness with mobile banking and related technologies.

Corporate Leverage and Investment

By W. Blake Marsh, David Rodziewicz, and Karna Chelluri

The rise in corporate debt over the last decade has led to increased concerns about risks to financial stability and economic growth, as highly indebted firms are more likely to default in the event of an economic downturn. However, elevated corporate debt can influence a firm's decision-making even in the absence of financial stability risks. Debt service payments reduce net income that could otherwise finance future investment, and higher debt levels drive credit costs up as default risk rises, incentivizing firms to invest in riskier projects. In addition, some investors may be unwilling to finance new firm investments if they fear that any investment returns will accrue only to senior debt holders.

W. Blake Marsh, David Rodziewicz, and Karna Chelluri examine the relationship between high corporate leverage and future firm spending on structures, machinery, and equipment. They find that, on average, more leveraged firms across industries tend to have lower levels of investment activity in the future. This negative relationship between debt and investment is strongest for the most highly indebted firms and is evident in both economic downturns and expansions.

Reshuffling in Soybean Markets following Chinese Tariffs

By Cortney Cowley

In 2018, China significantly increased tariffs on imports of several agricultural commodities from the United States, including a 25 percentage point rise in the tariff on soybeans. China has been the primary foreign destination for U.S. soybeans over the past decade, accounting for a majority of U.S. soybean exports. A disruption in soybean markets could have broad implications for the U.S. agricultural sector, where soybeans have made up a majority of the growth in exports of bulk agricultural commodities and a growing share of crop production and farm revenues.

Cortney Cowley examines the initial market responses and potential long-term implications of Chinese tariffs amid other supply and demand disruptions. She finds that although some U.S. soybean exports reshuffled to other trading partners, total exports of soybeans declined 21 and 14 percent relative to the previous five-year average in 2018 and 2019, respectively, following the implementation of tariffs. Despite the signing of a "phase one" trade deal in January 2020, tariffs could, in the longer term, lead to expanded production in and exports from other countries, a further reshuffling of global soybean exports, and reduced competitiveness for U.S. soybeans in world markets.

Population Turnover and the Growth of Urban Areas

By Jason P. Brown and Colton Tousey

People in the United States are relocating nearly half as much as they did in the early 1980s. A decline in relocations may make some labor markets more vulnerable to sudden changes in macroeconomic conditions and in the industry composition of various regions of the country. When people move across regions for job-related reasons, they may help smooth out changes that hit certain labor markets harder than others. As a result, a decline in relocations may also indicate a decline in labor market adjustment across industries and occupations. For example, some areas of the Rust Belt hit hard by the decline in U.S. manufacturing were unable to compensate for the associated employment losses by reallocating displaced workers to other locations or regions. Over time, areas with less labor market adjustment may experience slower growth.

One way to measure labor market adjustment is through population turnover—the propensity of people to move into and out of a given location. Just as business turnover can fuel economic growth by allowing new firms to replace older and potentially less efficient firms, population turnover can bring new ideas into an area or spread existing ideas elsewhere. In addition, population turnover may lead to better

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matches between employer and employee, an important factor in the growth of urban areas.

In this article, we document the relationship between population turnover and overall population growth across urban areas of various sizes from 2000 to 2017. We find that larger urban areas tend to have higher population turnover. In addition, we find that higher initial levels of turnover are correlated with faster population growth over the subsequent decades. Persistent differences in both the level and composition of population turnover between urban areas are a proxy for differences in labor market adjustment and help explain faster population growth in larger urban areas. Our findings are consistent with previous studies showing economic activity increasingly concentrating in the country's larger urban areas (Glaeser 2011; Moretti 2012).

Section I documents differences in population turnover across small, medium, and large urban areas. Section II explores the relationship between population turnover and long-term population growth and discusses the potential implications for urban areas.

I. Domestic Migration and Population Turnover in the United States

Moves within the United States—hereafter, "domestic migration"—are often viewed as a crucial component of labor market adjustment. For example, several studies show that domestic migration helps smooth out macroeconomic shocks or structural changes to region-specific industries such as manufacturing and agriculture (Blanchard and Katz 1992; Partridge and Rickman 2006; Dennis and Iscan 2007; Partridge and others 2012).

However, domestic migration may play a smaller role in this adjustment now than in the past. Dao, Furceri, and Loungani (2017) find that net migration (moves in minus moves out) is less responsive to local demand shocks compared with previous decades. In addition, recent analyses of local labor market adjustment after China's entrance into the World Trade Organization generally find that large adverse shocks have small effects on local population or out migration (Autor, Dorn, and Hanson 2013; Autor and others 2014).

The potential diminished role of domestic migration in smoothing out labor market shocks may be a result of the overall decline in

domestic migration over the past several decades. Chart 1 shows the domestic migration rate from 1947 to 2017 using information collected by the U.S. Census Bureau and cosponsored by the Bureau of Labor Statistics. The migration rates are based on self-reported moves in the Current Population Survey's Annual Social and Economic Supplement (ASEC). In the mid-1980s, nearly 20 percent of people reported moving in the prior year. However, by 2017, the domestic migration rate had fallen by half to 9.8 percent.

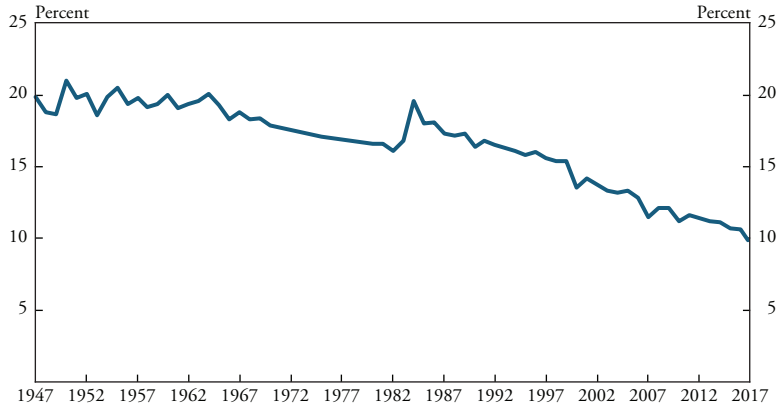
While other studies have documented these trends, few have offered explanations for them (Molloy, Smith, and Wozniak 2011; Molloy and Smith 2019; Frey 2019). Kaplan and Schulhofer-Wohl (2017) suggest the decline may be the result of less geographically differentiated compensation for occupations, combined with an increase in workers' awareness of that fact. Other common explanations include an aging population and the rise of dual-earner households, which may be less likely to move if both earners cannot secure employment in a destination. Dual-earner households may play an especially large role in domestic migration in large urban areas, where they are more likely to find better job matches. Consistent with this explanation, Molloy and Smith (2019) find that both in- and out-migration rates are higher on average in areas with stronger labor demand than in areas with weaker demand. However, to date, little research has examined domestic migration across urban areas of various size or how the overall trend in domestic migration may differ across urban areas.

To capture these overall trends, we consider a broader measure of domestic migration that accounts for population turnover—moves into plus moves out of a given area. The rate of population turnover in an urban area provides an ideal proxy for labor market adjustment.

One of the limitations of some of the prior research on domestic migration is the lack of geographical coverage in the ASEC data. To capture differences in population turnover across urban areas of various size, we use county-level tabulations of domestic migration based on income tax filings provided by the Internal Revenue Service (IRS) Statistics of Income (SOI). The SOI data capture the inflow and outflow of people from one county to another across the entire country and can be tabulated for both households and individuals. The number of returns filed approximates the number of households that migrated, while the

Chart 1

U.S. Domestic Migration Rate



Source: U.S. Census Bureau.

number of personal exemptions claimed approximates the number of individuals who migrated. We use the number of exemptions in our analysis, as it more closely approximates the total number of individuals who moved. Due to the way income tax returns are reported, the filing year actually includes information for the prior year. For this reason, we identify the year in our analysis as the year prior to filing—for example, we identify migration data for 2017 to 2018 as year 2017.

We use the IRS county-level data to group counties into urban areas known as Core-Based Statistical Areas (CBSAs).[1] The Census Bureau defines CBSAs as micropolitan or metropolitan depending on the population of urban areas within each county and neighboring counties. Using county-level population data allows us to show domestic migration between urban areas in the country. We label CBSAs as micropolitan (fewer than 220,000 people, such as Shawnee, OK), small urban (220,000 to <1 million people, such as Omaha-Council Bluffs, NE-IA), medium urban (1 to <4 million people, such as Kansas City, MO-KS), or large urban (4 million or more people, such as Chicago-Naperville-Elgin, IL-IN-WI).

Table 1 reports population summary statistics of the assigned groups measured in 2000. The majority of the urban areas in the sample are micropolitan, with populations ranging from 13,000 to 214,000. Although the Census Bureau has no official definition of rural areas, many of these micropolitan areas could be considered rural in nature.

Table 1

Population of Urban Areas in 2000

Urban area	Number	Population		
		Minimum	Median	Maximum
Micropolitan	734	12,949	54,637	213,967
Small urban	134	222,407	387,899	972,501
Medium urban	38	1,041,759	1,638,299	3,277,022
Large urban	11	4,135,875	4,740,056	18,356,204

Sources: U.S. Census Bureau and authors' calculations.

Table 2

Population Turnover Rates (Percent)

Urban area	2000	2017	Percent change
All urban areas (average)	8.13	7.51	–7.6
Micropolitan	5.82	5.23	–10.1
Small urban	7.53	6.79	–9.8
Medium and large urban	9.19	8.50	–7.5

Sources: IRS, U.S. Census Bureau, and authors' calculations.

When measuring population turnover, we exclude all moves within the same county or CBSA, as these moves are more likely to be housing-related than job-related (Frey 2019). This restriction means that our measures of population turnover are lower than if they were constructed based on all types of moves.

Even so, our measures show that the average population turnover rate in urban areas declined over the past two decades, though the decline was more pronounced for smaller versus larger urban areas. Table 2 reports population turnover rates measured in 2000 and 2017. In 2000, the average population turnover rate across urban areas was 8.1 percent, meaning that on average, 8.1 percent of the population moved into or out of an urban area. By 2017, the average population turnover rate across all urban areas had declined to 7.5 percent. Turnover rates were highest in larger urban areas in both 2000 and 2017 and lowest in micropolitan areas. In addition, micropolitan areas saw the greatest decline in population turnover from 2000 to 2017 (–10.1 percent).

II. Population Turnover and Long-Term Growth

A greater decline in population turnover among less populated areas mirrors a previous finding that these areas have also experienced

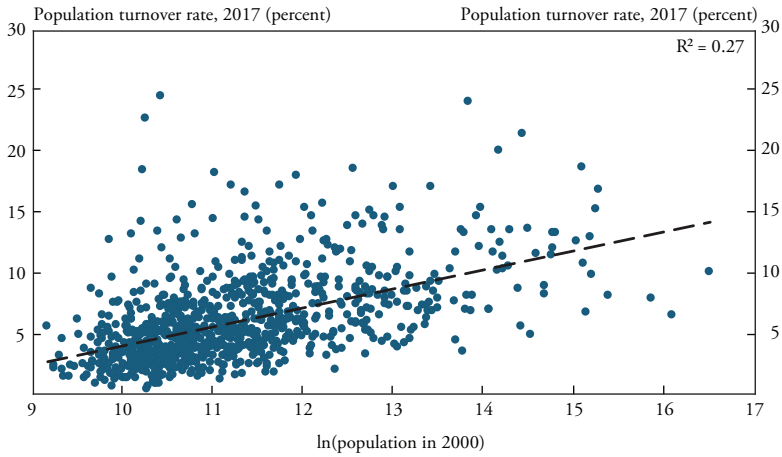
larger declines in business turnover (Brown 2018). Economic theory suggests that business turnover can fuel economic growth by allowing new firms to replace older and potentially less efficient firms. The same may be true for population turnover to the extent that it allows for better matches between employers and employees in the labor market. Indeed, previous research has documented a positive correlation between business turnover and the population growth of urban areas (Hathaway and Litan 2014). Together, declining business and population turnover may suggest that smaller urban areas have become less dynamic.

To examine this possibility, we explore the relationship between the initial population size of urban areas and population turnover as well as the relationship between initial population turnover and subsequent population growth. Chart 2 shows the relationship between urban area population (natural log) in 2000 and population turnover in 2017. The black dashed line slopes upward, indicating that the general relationship between initial population and population turnover in subsequent years is positive. In other words, urban areas with a larger population in 2000 tended to have higher population turnover in 2017.

Given the general differences in population turnover by urban area size noted in the previous section, the relationship between initial population and population turnover may also vary with urban area size. To account for these potential variances, Chart 3 plots initial population and population turnover by urban area size group for micropolitan areas (blue dots), small urban areas (green dots), and medium and large urban areas (orange dots). The steeper dashed regression line for micropolitan areas indicates that these areas have driven the overall positive correlation between population and population turnover. The less steep—but still upward-sloping—dashed regression line for small urban areas indicates that the correlation between initial population and population turnover is much weaker for these areas. Finally, the flat regression line for medium and large urban areas indicates that the correlation between initial population and population turnover in these areas is not discernable from zero. Together, Charts 2 and 3 illustrate that although areas with larger populations tend to have higher population turnover, the strength of this correlation decreases as the population of urban areas increases.

Chart 2

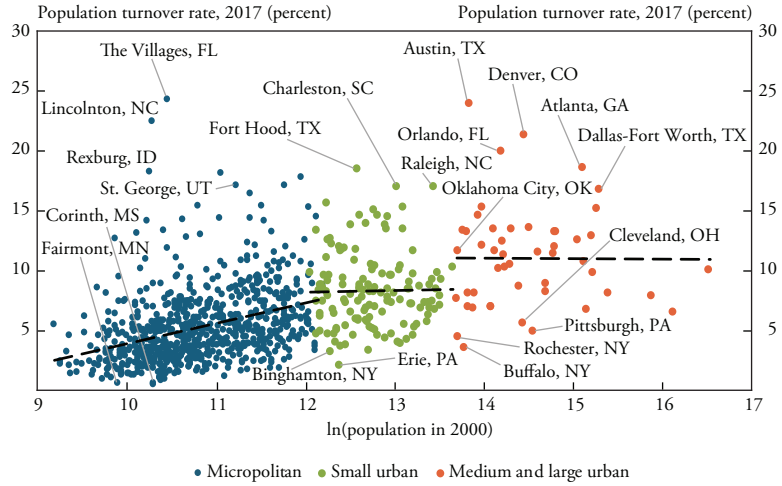
Initial Population and Population Turnover



Sources: IRS, U.S. Census Bureau, and authors' calculations.

Chart 3

Initial Population and Population Turnover by Urban Area Size



Note: CBSAs are labeled with the names of their primary cities.
Sources: IRS, U.S. Census Bureau, and authors' calculations.

Several urban areas deviate from the general relationship between initial population and population turnover. For example, the top-left corner of Chart 3 contains areas with relatively smaller populations in 2000 but high population turnover in 2017. One reason for the unusually high population turnover in these areas may be that they have features that make them more attractive places to live (McGranahan, Wojan, and Lambert 2011; Rappaport 2018). For example, many of these areas (The Villages, FL; Lincolnton, NC; Rexburg, ID) are adjacent to larger urban areas, have high natural amenities, or have warmer winters. Conversely, the bottom-left corner of Chart 3 contains areas of similar size but with low population turnover. One reason for the unusually low turnover in these areas may be that they are more dependent on manufacturing, such as Fairmont, MN, and Corinth, MS. These areas may be less attractive to movers because of the long-term decline in some portions of U.S. manufacturing. This pattern of lower turnover in historically manufacturing-heavy urban areas persists across progressively larger urban areas. For example, population turnover was well below the regression line in Erie, PA; Pittsburgh, PA; Buffalo, NY; and Rochester, NY, all of which are in the Rust Belt.

On the other end of spectrum, population turnover was well above the regression line in the large urban areas of Austin, TX, and Denver, CO. These areas in particular are likely to have benefitted from the knowledge economy, in which innovative firms and innovative workers increasingly cluster in larger urban areas with high amenities (Moretti 2012).

A natural question is whether differences in turnover rates across urban areas are due more to differences in inflows versus outflows of people. One way to gauge the quantitative importance of inflows and outflows in generating the observed differences in turnover rates is to look at the correlation between inflows and outflows. In unreported results, we find that the correlation is very strong, ranging from 0.95 for micropolitan areas up to 0.98 for large urban areas. This strong correlation suggests that across the size distribution of urban areas, locations with high inflow rates also have high outflow rates, and areas with low inflow rates also have low outflow rates. Thus, population turnover rates are a useful measure of labor market adjustment even without distinguishing between inflows and outflows.

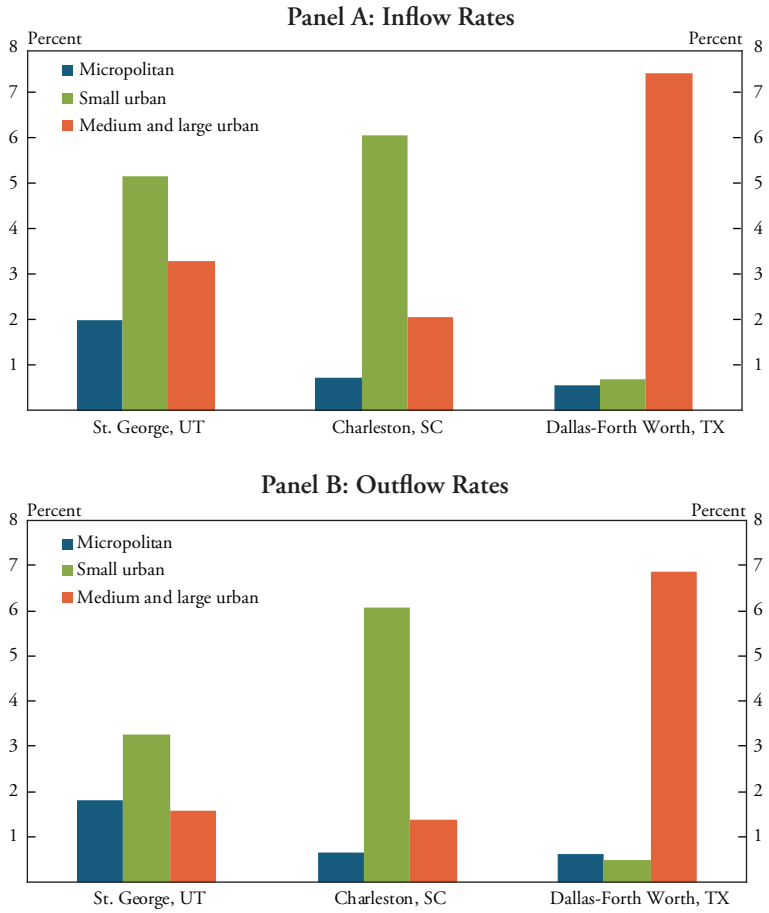
Nevertheless, decomposing turnover rates into inflows and outflows may be useful to the extent that the origins and destinations of these flows differ in meaningful ways. Population turnover rates alone cannot reveal, for example, whether residents of small urban areas are primarily moving to larger urban areas; only a detailed decomposition of inflow rates by origin area size would capture this information. Decomposing both inflow and outflow rates in this way may provide additional insight into the future of the labor market in different urban areas. Previous research has highlighted the higher average productivity of workers in larger urban areas (Glaeser and Saiz 2004; Henderson 2007). Workers take the knowledge and capabilities that influenced their productivity when they move. As a result, an urban area that is primarily losing residents to larger areas and gaining residents from smaller areas may subsequently see less productive matches between employers and employees.

To explore whether inflows and outflows to urban areas indeed differ by origin or destination size, we compare select urban areas with similar population turnover rates in 2017 but different initial populations in 2000. Specifically, we compare the urban areas of St. George, UT (population 75,396); Charleston, SC (population 456,261); and Dallas-Fort Worth, TX (population 4,431,182). The population turnover rates for all three urban areas are similar in 2017, ranging from 16.6 to 17.0 percent. However, the composition of the turnover—that is, the inflows and outflows broken down by origin or destination size—is very different.

Panels A and B of Chart 4 decompose turnover into the inflow and outflow rates of these three urban areas by origin or destination size. The composition of the inflow rate for Dallas-Fort Worth is substantially different from the St. George and Charleston urban areas. The orange bar in Panel A shows that Dallas-Fort Worth's overall inflow rate is primarily driven by people moving from other medium and large urban areas. In contrast, the inflow rates in St. George and Charleston are primarily driven by people moving from small urban areas. The composition of outflow rates follows a similar pattern (Panel B). Dallas-Fort Worth's overall outflow rate is primarily driven by people moving to other medium and large urban areas, while the outflow rates in St. George and Charleston are primarily driven by people moving to

Chart 4

Inflow and Outflow Rates of Select Urban Areas



Sources: IRS, U.S. Census Bureau, and authors' calculations.

small urban areas. This comparison illustrates that places like Dallas-Fort Worth, which have higher contributions of inflows and outflows from medium and large urban areas, likely experience different labor market adjustments. Much of the service sector is increasingly based on knowledge, idea exchange, and agglomeration; shifting the economic base in such a way highly favors larger urban areas (Henderson 2007; Moretti 2012).

The composition of population turnover implicitly captures differences in the knowledge and experience of people as they move from one

area to another. To the extent that moves are job-related, any persistent differences in the composition or level of population turnover across urban areas may have long-term implications for growth in those areas. To explore this possibility, we calculate the correlation between an urban area's population turnover in 2000 and subsequent population growth from 2000 through 2017. The upward-sloping dashed regression line in Chart 5 shows that an urban area's initial population turnover rate is positively correlated with subsequent population growth. In other words, urban areas with higher population turnover rates in 2000 tended to have greater population growth over the next 17 years.[2]

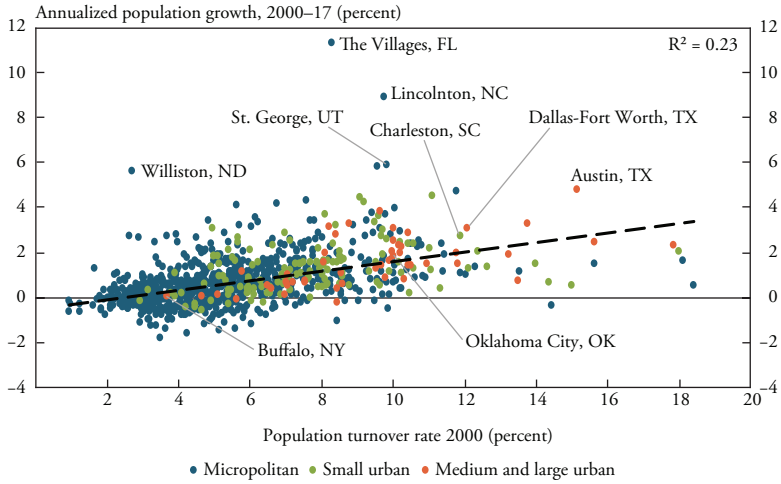
As with the correlation between initial population and population turnover, some urban areas are outliers. For example, the micropolitan area of Williston, ND, has higher population growth than might be expected given its lower initial population turnover rate. However, Williston, ND, was the epicenter for the shale oil boom in the Bakken formation over the past decade, which led to a large increase in available jobs (Maniloff and Mastromonaco 2017). Similarly, The Villages, FL, and Lincolnton, NC, had higher population growth than might be expected. However, as mentioned previously, these are areas with warmer winters and high natural amenities, which may help explain their robust growth.

Previous research has documented that due to the self-sustaining nature of economic development, urban areas that are initially similar can become very different over time as small differences are magnified (Moretti 2012). As an example, we compare the urban areas Austin, TX; Oklahoma City, OK; and Buffalo, NY. While the three areas had similar initial populations in 2000, their initial population turnover rates were different, potentially explaining their subsequent differences in growth. Chart 5 shows that Austin had both the highest initial population turnover rate in 2000 and the highest population growth from 2000 to 2017. Likewise, Buffalo had the lowest initial population turnover rate and the lowest subsequent population growth.

Together, our findings suggest differences in population turnover across urban areas may be an important factor in explaining differences in population growth. To the extent population turnover captures labor market adjustment, our findings may help explain why some urban

Chart 5

Population Turnover versus Population Growth by Urban Area



Note: CBSAs are labeled with the names of their primary cities.
Sources: IRS, U.S. Census Bureau, and authors' calculations.

areas, despite a similar initial size, experience different growth trajectories. These differences are likely amplified in areas where the knowledge economy accounts for a greater share of economic activity, as innovative firms and innovative workers cluster in larger urban areas where population turnover is highest.

Conclusion

U.S. domestic migration has declined dramatically over the past several decades, leading to differences in population turnover across urban areas of different size. We measure population turnover using data from the IRS and find that population turnover is higher in larger urban areas. In addition, we find that higher population turnover, a proxy for labor market adjustment, is positively associated with population growth over a longer time horizon. Higher population turnover may facilitate better matches between employer and employee. Higher population turnover may also help with the dissemination of knowledge between people and firms as people come into an area with new ideas or take ideas with them to other locations.

Given the differences in population turnover between the smallest and largest urban areas, smaller locations may be at risk of lower levels of labor market adjustment. As a result, these areas may also be more likely to struggle in the event of a future economic downturn. Recessions often lead to a redistribution of resources and activity across sectors in the economy, and labor markets in areas with higher population turnover may be able to adjust to these changes more quickly. If the gap between the turnover rates of small and large urban areas persists or widens further, the gap between their economic fortunes may widen as well.

Endnotes

[1]The 2003 CBSA definitions, released by the Office of Management and Budget, were used to construct urban area measures of business turnover. Metropolitan statistical areas have at least one urbanized area with a population of 50,000 or greater plus "adjacent territory that has a high degree of social and economic integration with the core as measured by commuting ties." Micropolitan statistical areas have at least one urban area with a population between 10,000 and 50,000 plus "adjacent territory that has a high degree of social and economic integration with the core as measured by commuting ties."

[2]The correlation is similar in size if estimated separately for micropolitan, small, and medium and large urban areas.

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Mobile Banking Use and Consumer Readiness to Benefit from Faster Payments

By Fumiko Hayashi and Ying Lei Toh

The U.S. payments industry is currently implementing faster payments that will enable consumers and businesses to send and receive payments almost instantly at any time of day, any day of the year. Interfaces that allow consumers to access faster payments will include new or updated mobile and online banking services as well as mobile wallet or payment applications (apps) offered by non-bank payment service providers. Mobile banking in particular may allow consumers to realize the full benefits of faster payments. Compared with other interfaces, mobile banking enables consumers to make faster payments across the greatest variety of uses, from bill payments to person-to-person transfers to in-person and online purchases. The unique alert feature of mobile banking also enables consumers to be notified of an incoming payment almost instantly, wherever they are.

Because of mobile banking's advantages in accessing faster payments, consumers who already use mobile banking for transactions are likely to adopt faster payments more easily and quickly and use faster payments for a wider variety of uses than other consumers, especially in the near term. In contrast, consumers who lack the technologies to use mobile and online banking, such as a smartphone and home internet access, are less likely to benefit from faster payments. As a result, a

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consumer's use of mobile banking is a good indicator of their readiness to fully realize the benefits of faster payments.

In this article, we examine which consumer characteristics are associated with mobile banking use, a proxy for readiness to fully benefit from faster payments, as well as what other factors may influence consumer readiness. We find that banked households that are younger, higher income, college-educated, employed, or that occasionally use alternative financial services are significantly more likely to have used mobile banking for transactions, implying they are the most ready to fully benefit from faster payments. In contrast, banked households that are lower income, less educated, older, not in the labor force, disabled, unmarried, or in a rural area are significantly more likely to lack a smartphone and home internet access, implying they are the least ready to realize the benefits. We identify three additional factors that may influence consumer readiness: the availability and cost of digital infrastructure such as high-speed broadband internet and mobile wireless services, the availability of mobile banking and its transaction functions, and consumers' perceptions of and savviness with mobile banking and related technologies.

Section I discusses why mobile banking may enable banked consumers to more fully realize the benefits of faster payments than other interfaces. Section II considers the spectrum of consumers who may fully benefit from faster payments and examines which consumer characteristics are associated with those who are the most ready versus those who are the least ready. Section III discusses other factors that may influence consumers' readiness to benefit from faster payments.

I. Mobile Banking and Access to Faster Payments

In the United States, the implementation of faster payments is still at an early stage. In November 2017, the Clearing House launched the Real Time Payment (RTP) network, which provides real-time payment and settlement service to banks; as of January 2020, 21 large banks were in the network (Murphy 2020). The Federal Reserve is currently developing a similar service called FedNow, which is expected to be available in 2023 or 2024. The RTP network and FedNow are intended to connect more than 10,000 banks across the country, enabling those banks to provide faster payments to their customers for a wide variety

of uses. In addition, as of February 2020, more than 700 banks had joined Zelle, a network that uses payment card and automated clearinghouse infrastructures to offer instant person-to-person transfers via a mobile app.[1]

The vast majority of banks have yet to offer faster payment services to their customers, making it hard to identify the consumers who will be the most likely to adopt and benefit from these services. One potential way to identify these consumers is through their means of access. Banks will likely provide faster payments services through various means, including mobile banking, online banking, ATMs, and physical bank branches. Of these, mobile banking may enable consumers to most fully realize the benefits of faster payments.

Mobile banking has three distinct advantages over its alternatives as a way to access faster payments. First, mobile banking allows consumers to access faster payments anytime, anywhere, while other means limit access to particular times and locations. When a consumer makes a faster payment at a bank branch or an ATM inside a retail store, for example, the consumer needs to be present during its operating hours. Although online banking does not limit access to specific times of day, it may limit access to faster payments to locations with personal computers, which are less portable and may have limited connectivity, especially when consumers are not at home or at work. Consumers may be able to access online banking through the browser of a mobile device, but doing so is likely less convenient than using an interface designed for mobile use. As a result, ATM, bank branch, and online banking may not allow consumers to fully realize a key feature of faster payments—24/7/365 availability.

Second, mobile banking may allow consumers to make faster payments for a wider variety of uses than other means. Mobile banking will likely be able to support person-to-person transfers, bill payments, online and in-person purchases, and payments for services such as ride-sharing and public transit. In contrast, other means of access may only support a few of these uses. At ATMs and branches, consumers may be able to make faster payments only for person-to-person transfers and bill payments. Through online banking, consumers may be able to make faster payments for person-to-person transfers, bill payments, and online purchases, but not for in-person purchases, kiosk or vending machine transactions, and ride-sharing.

Third, mobile banking may give consumers more control and flexibility over the timing of payments. For example, mobile banking has an alert function, allowing consumers to make time-sensitive bill payments as soon as they are notified of an incoming payment. Online banking gives consumers similar control but is less flexible than mobile banking, especially when consumers are not at home or work as discussed previously. Mobile banking's greater flexibility and control over the timing of payments may reduce the incidence of cash flow shortfalls arising from misalignments between the time incoming funds are received and the time spending needs to occur. Therefore, accessing faster payments through mobile banking may be particularly beneficial for cash-strapped consumers.

Mobile banking may also have advantages over mobile wallet or payment apps offered by nonbank payment service providers. Preexisting mobile payment apps typically limit their use.[2] For example, Venmo and Square Cash focus on person-to-person transfers, while Apple Pay and Samsung Pay focus on in-person and remote purchases.[3] As a result, consumers may need to use multiple apps to fulfill their faster payment needs. Moreover, some mobile payment apps require consumers to prefund the mobile payment account, complicating cash management for consumers. In contrast, mobile banking allows consumers to make faster payments for a variety of uses from a single app and keep their funds in a single account.

International experiences underscore the importance of mobile banking in accessing faster payments. In countries that have implemented faster payments more recently, such as Australia, Hong Kong, and Singapore, many banks provide both mobile banking and online banking as means to access faster payments. When the United Kingdom implemented its faster payments system in 2008, banks typically offered faster payments through online banking but not through mobile banking. At that time, consumers had not widely adopted smartphones, which were introduced in 2007. Since then, consumers have increasingly adopted smartphones, and their demand for mobile banking to access faster payments has increased. To meet this demand, UK banks now offer faster payments through mobile banking.

These countries have also broadened the uses of faster payments made through mobile devices. For example, in the United Kingdom, a few banks have recently started offering a new function of mobile

banking called "Pay by Bank app" that enables consumers to make faster payments for remote purchases. In Australia, NPP Australia, a company responsible for maintaining and developing the New Payments Platform (NPP), has released a standardized quick response (QR) code specification for the NPP to support real-time payments via a QR code for point-of-sale, online, and bill payments. Hong Kong and Singapore also use a common QR code for both faster payments and other mobile payments at the point of sale. To make faster payments through mobile banking at the point of sale, consumers open their mobile banking app, scan the merchant's QR code, and enter the payment amount to instruct their bank to send the funds to the merchant's bank (Bradford, Hayashi, and Toh 2019). In these countries, technological innovation has further enhanced the benefits of using mobile banking to access faster payments relative to other methods.

II. Consumer Readiness to Fully Benefit from Faster Payments

Given mobile banking's advantages in accessing faster payments, consumers who already use mobile banking are most likely to fully benefit from faster payments when they are implemented. As a result, we treat mobile banking usage as a proxy for readiness to benefit from faster payments in our subsequent analysis. However, consumers are not simply "ready" or "not ready" for faster payments—instead, consumer readiness likely falls on a spectrum.

Consumers who already use mobile banking for transactions may be the most willing and able to use mobile banking for faster payments. Consumers who use mobile banking only for non-transaction activities, such as to check their account balances or receive alerts, may be slightly less likely to use mobile banking for faster payments. To the extent these consumers do not use mobile banking for transactions due to security concerns, they may not be willing to use mobile banking for faster payments, either.

Consumers who have used online banking but not mobile banking are the next most ready to benefit. These consumers are likely to be ready to access faster payments through online banking. However, they may not benefit as fully as those who use mobile banking, due to the limitations of online banking discussed previously.

Slightly further down the readiness spectrum are consumers who have not yet used mobile or online banking services but nevertheless have the technologies to do so. These consumers would need to adopt mobile or online banking to realize a key benefit of faster payments—24/7/365 availability—and are thus less ready to benefit from faster payments than current users of mobile and online banking. However, because these consumers already have the technologies necessary to use mobile or online banking (specifically, smartphones or home internet access), they are more ready to benefit than consumers who lack these technologies.

Consumers who lack smartphones or home internet access are likely the least ready to benefit from faster payments. Although these consumers could make outgoing faster payments at ATMs and bank branches, they could not access faster payments on a 24/7/365 basis and could not make faster payments for various uses such as in-person and online purchases. Because these consumers would need to take at least two steps to benefit from faster payments—acquire technologies and adopt mobile or online banking—they are at the bottom of the spectrum of consumer readiness.

To understand consumer readiness in greater detail, we next examine which consumer characteristics are associated with the readiness to benefit from faster payments. We use a weighted sample of 30,440 banked households from the 2017 FDIC National Survey of Unbanked and Underbanked Households.[4] The FDIC survey includes detailed information on these households' sociodemographic characteristics, banking status, technology adoption, means to access a bank account, and mobile banking activities.[5]

Based on each household's mobile banking activities and technology adoption, we divide households into three groups in terms of their readiness to fully benefit from faster payments: the "most ready," "least ready," and "in-between." The most ready households are those who have used mobile banking for transactions. We place households in this group if they have conducted at least one of the following mobile banking transactions in the 12 months prior to the survey: bill payments, person-to-person transfers, transfers between accounts owned by the same households, and remote check deposits. About 35 percent of banked households in our sample fall into this group. We place

households in the least ready group if they have neither a smartphone nor internet access at home. About 12 percent of banked households in our sample are in this group. The remaining 53 percent of banked households in our sample are in the in-between group. This group includes households who have used mobile banking only for non-transaction activities (4.5 percent), households who have used online banking but not mobile banking (26.3 percent), and households who have the technologies to use mobile banking or online banking but have used neither (22.6 percent).

The readiness to benefit from faster payments is likely to vary by household characteristic. Previous research has found adoption of new technology like mobile technology generally starts with younger, higher-income, and more-educated consumers (Gulamhuseinwala, Bull, and Lewis 2015; Lee, Lee, and Eastwood 2003). In addition, several studies have documented gaps in access to technology between rural and urban households and between low- and high-income households (Anderson 2018; Anderson and Kumar 2019). As a result, we examine the relationship between household readiness and 11 characteristics that may influence households' ability or willingness to use mobile banking, including age, income, education, employment status, and location.

Table 1 reports summary statistics for the weighted sample of banked households, including the share of households with each characteristic and the shares of the most ready, in-between, and least ready households with that characteristic. For example, banked households are assigned one of three banking status characteristics: fully banked, lightly underbanked, or heavily underbanked. Fully banked households are those that did not use alternative financial services (AFS) such as nonbank money orders, check-cashing services, payday loans, auto title loans, and pawnshop loans in the 12 months prior to the survey. In contrast, both lightly and heavily underbanked households used AFS, though the intensity of their use differed. Heavily underbanked households used AFS to pay bills and receive income in a typical month, while lightly underbanked households did not use AFS in a typical month. About 80 percent of households in our sample are fully banked, and the remaining 20 percent are almost evenly split between lightly underbanked and heavily underbanked. The last three columns of Table 1 show that 33.4 percent of fully banked households are in the most

Table 1

Summary Statistics for Banked Household Characteristics

Category	Characteristic	Share of sample	Share of households based on readiness: Most ready (percent)	In-between (percent)	Least ready (percent)
All		100.0	34.8	53.4	11.8
Banking status	Fully banked	79.9	33.4	53.9	12.7
	Lightly underbanked	9.8	44.9	49.2	5.9
	Heavily underbanked	10.4	36.4	53.4	10.2
Income	Below $30,000	23.6	18.1	54.5	27.4
	$30,000 to $74,999	39.6	32.4	57.7	9.9
	$75,000 and above	36.7	48.1	48.2	3.7
Education	High school diploma or less	32.4	21.6	56.0	22.4
	Some college	29.4	35.1	55.9	9.0
	College degree	38.2	45.7	49.5	4.8
Age	34 or younger	20.9	58.4	38.4	3.2
	35 to 54	34.1	44.4	50.2	5.4
	55 or older	44.9	16.5	62.9	20.6
Race	Black	12.1	34.7	51.7	13.6
	Hispanic	11.4	37.7	50.5	11.8
	White	69.8	33.7	54.7	11.6
	Asian or other	6.7	40.9	49.4	9.7
Employment status	Employed	63.0	44.9	50.1	5.0
	Unemployed	2.2	40.3	51.4	8.3
	Not in labor force or unknown	34.8	16.1	59.6	24.3
Homeownership	Homeowner	67.1	32.5	56.1	11.4
	Non-homeowner	32.9	39.5	48.0	12.5
Disability status	Not disabled or not applicable	92.4	35.8	53.1	11.2
	Disabled, age 25–64	7.6	23.0	59.1	17.9

Table 1 (continued)

Category	Characteristic	Share of sample	Share of households based on readiness: Most ready (percent)	In-between (percent)	Least ready (percent)
Marital status	Not married	50.3	31.5	52.5	16.0
	Married	49.7	38.2	54.4	7.4
Region	Northeast	17.5	32.1	56.2	11.7
	South	37.7	33.4	53.9	12.7
	Midwest	22.1	33.4	55.3	11.3
	West	22.8	40.5	48.9	10.6
Location	Rural	13.6	22.5	59.2	18.3
	Nonrural	86.4	36.7	52.6	10.7
Income volatility	Not volatile or unknown	79.1	32.8	53.6	13.6
	Volatile	20.9	42.2	53.2	4.6

Notes: The most ready households are those who have used mobile banking for transactions. The least ready households are those who have neither a smartphone nor internet access at home. We exclude banked households with unknown underbanked status from this analysis.
Sources: 2017 FDIC Survey and authors' calculations.

ready group, 53.9 percent are in the in-between group, and 12.7 percent are in the least ready group.

To identify which characteristics are strongly associated with readiness to benefit from faster payments, we examine whether a group of households with a given characteristic has a greater tendency to be in the most ready group. More specifically, we consider a household characteristic to have a strong, positive association with readiness if more than 43.5 percent of households with that characteristic are in the most ready group. This threshold of 43.5 percent corresponds to 125 percent of the average share of most ready households among all banked households of 34.8 percent (34.8 × 1.25 = 43.5 percent).

Using this criterion, we identify six characteristics that have strong, positive associations with the most ready households: lightly underbanked, household income at or above $75,000, college-educated, age 34 or younger, age 35 to 54, and employed.[6] Among households with these characteristics, those age 34 or younger have by far the highest share of most ready households at 58.4 percent. Households with income at or above $75,000 have the second highest share of most ready

households at 48.1 percent. The other four groups—those who are lightly underbanked, college-educated, age 35 to 54, and employed—have similar shares of most ready households ranging from 44 to 46 percent. Our results suggest that about half of all households with at least one of these six characteristics are in the group most ready to fully benefit from faster payments.

We perform a similar calculation to attempt to identify characteristics that are strongly associated with in-between households. We consider a characteristic to have a strong, positive association with in-between households if the share of households with that characteristic surpasses 66.8 percent of households. This threshold again corresponds to 125 percent of the average share of in-between households among all banked households (53.4 × 1.25 = 66.8 percent). However, we find no characteristic meets or exceeds this threshold, implying none of our characteristics have a strong association with the share of in-between households.

Finally, to identify characteristics that are strongly associated with the least ready households—as defined by their lack of a smartphone and home internet access—we compare the share of the least ready households with a given characteristic to the share of the least ready households among all banked households. We consider a characteristic to have a strong, positive association with the least ready households if more than 14.7 percent of households with that characteristic are in the least ready group. This threshold again corresponds to 125 percent of the average share of the least ready households among all banked households of 11.8 percent (11.8 × 1.25 = 14.7 percent).

We find seven characteristics have strong, positive associations with the share of least ready households: income below $30,000, less educated, age 55 or older, not in the labor force, working-age disabled, not married, and living in a rural area. Among households with these characteristics, those with incomes below $30,000 have the highest share of least ready households at 27.4 percent, followed by those that are not in the labor force at 24.3 percent. Households that have a high school education or less have the third highest share of least ready households at 22.4 percent, while households with householders age 55 or older have the fourth highest share at 20.6 percent. Households that live in a rural area, are working-age disabled, and are unmarried have shares ranging from 16.0 to 18.3 percent. Our results suggest that, among households

with one or more of these seven characteristics, at least one in six have neither a smartphone nor internet access at home and are, therefore, least ready to fully benefit from faster payments.

III. Factors that Influence Consumer Readiness

Consumer readiness to fully benefit from faster payments significantly varies by consumer characteristic. Households that are younger, higher income, college-educated, employed, or lightly underbanked are more likely to be in the most ready group, while households that are lower income, less educated, older, not in the labor force, disabled, unmarried, or in rural areas are more likely to be in the least ready group. Based on these characteristics, we identify three possible factors that influence consumer readiness.

The first possible factor influencing consumer readiness is the availability and cost of technologies needed to access mobile banking or online banking: namely, a smartphone and mobile broadband or wireless broadband internet access. In particular, the digital divide between rural and nonrural areas may help explain our finding that rural households are more likely to lack technologies for mobile and online banking. A Pew Research Center survey found that 24 percent of consumers in rural areas perceived a lack of high-speed internet access to be a major problem in their areas, more than double the shares of consumers in urban and suburban areas (Anderson 2018). A report from the Federal Communications Commission (FCC) also noted a substantial gap in deployment rates of high-speed fixed and mobile broadband between urban and rural areas (FCC 2019). In urban areas, the deployment rates of high-speed fixed and mobile broadband in 2017 were 98 percent and 93 percent, respectively, while in rural areas, these rates were 74 percent and 69 percent. Moreover, consumers in rural areas tend to have fewer providers to choose from. According to another FCC report, 30 percent of rural consumers lived in areas covered by three or fewer mobile wireless networks in 2016, while more than 98 percent of urban consumers lived in areas covered by four or more wireless networks (FCC 2017). Limited competition among networks in rural areas may result in higher costs of services for rural consumers and, consequently, lower adoption of broadband services.

Even when broadband services are available, some consumers may not be able to afford them. The high costs of broadband services as well as smartphones may render these technologies unaffordable for many low-income households. Indeed, our analysis in the previous section shows that households with lower income or that are not in the labor force are much less likely to have a smartphone and home broadband access.

The second possible factor influencing consumer readiness to fully benefit from faster payments is the availability of mobile banking services at consumers' banks. Even if consumers have a smartphone and internet access, they will not be able to use mobile banking for transactions unless their banks offer this service. Data from the 2016 Mobile Financial Services Survey of Financial Institutions (mobile FS survey) show that small community banks are less likely to offer (or plan to offer) mobile banking services than their larger counterparts and credit unions.[7] Specifically, only about 85 percent of community banks with total assets below $100 million either offered mobile banking in 2016 or planned to do so within the next two years. In contrast, almost all larger banks with total assets above $100 million and 92 percent of credit unions with total assets below $100 million did or planned to do the same. In addition, we find small community banks are less likely than larger banks to offer mobile transaction functions. For example, only 68 percent of small community banks offered (or planned to offer) mobile bill payments in 2016, and only 46 percent offered (or planned to offer) mobile person-to-person transfers. In contrast, 97 percent and 82 percent of larger banks, respectively, offered (or planned to offer) mobile bill payments and mobile person-to-person transfers.

Together, these findings from the mobile FS survey suggest that consumers who bank with small community banks may be less likely to use mobile banking for transactions. These consumers may also be lower income, as small community banks offer services that are more attractive to lower-income customers. For example, small community banks offer checking accounts that are less expensive for consumers with low account balances. According to Moebs Service (2019), community banks with total assets below $100 million were more likely than other types of banks to offer checking accounts with no monthly account fee and a low overdraft fee. Our finding in the previous section of lower-income households' tendency not to use mobile banking for

transactions may, therefore, be at least partly explained by the tendency of small community banks not to offer mobile banking.

The third possible factor influencing consumer readiness to fully benefit from faster payments is consumers' perception of and familiarity with mobile banking and related technologies. Consumers who have positive perceptions of mobile banking and know how to use it may be more willing to use mobile banking to access faster payments than those who have negative perceptions of mobile banking or do not know how to use it. A 2016 consumer survey on mobile financial services asked banked consumers who owned a mobile phone but did not use mobile banking why they chose not to use mobile banking (Dodini and others 2016). While the two most cited reasons are associated with the lack of perceived benefits from mobile banking, the third, fifth, and seventh most cited reasons are associated with negative perceptions of mobile banking, including security concerns (73 percent), a lack of trust in technology (40 percent), and difficulty in using mobile banking (18 percent).[8] The survey also asked consumers about their confidence in their ability to understand and navigate the mobile phone technology and features. Although more than half of consumers were very confident in their ability (51 percent), 37 percent of consumers were somewhat confident, and 11 percent were not confident.

Using data from the 2016 consumer survey, we find consumer perception and savviness are both associated with each other and associated with some consumer characteristics. Those who are less confident in their ability to understand and navigate the mobile phone technology tend both to lack trust in the technology and find it difficult to use. These consumers tend to be older, less educated, lower income, and not in the labor force. Our finding in the previous section of lower consumer readiness to benefit from faster payments among households that are older, less educated, lower income, or not in the labor force may be partly explained by these households' low technological savvy and negative perceptions of mobile banking.

Conclusion

The U.S. payments industry is currently implementing faster payments that will enable consumers and businesses to send and receive payments almost instantly on a 24/7/365 basis. Although U.S.

consumers may be able to access faster payments through various means, mobile banking is most likely to allow them to fully realize the benefits of faster payments. Mobile banking allows consumers not only to make faster payments for a wide variety of uses from a single app anytime, anywhere, but also gives consumers more control and flexibility over the timing of payments. Because of these features, whether consumers use mobile banking is a good indication of their readiness to fully benefit from faster payments.

We examine which consumer characteristics are associated with their readiness to realize the benefits of faster payments and what other factors may influence consumers' readiness. We find younger, higher-income, college-educated, employed, or lightly underbanked households tend to be the most ready to fully benefit from faster payments. In contrast, lower-income, less educated, older, not in the labor force, disabled, unmarried, or rural households tend to be the least ready. We identify three additional factors that may influence consumer readiness: the availability and cost of technologies needed to use mobile or online banking, the availability of mobile banking at consumers' current banks, and consumers' perception of and familiarity with mobile banking.

Our findings suggest that promoting mobile banking along with faster payments to consumers is an important step for the U.S. payment industry as it implements faster payments. Encouraging community banks to offer mobile banking, ensuring the security of mobile banking, and increasing consumers' familiarity with mobile banking and technology may also be important. Finally, narrowing the digital divide between rural and urban areas may help ensure the benefits of faster payments extend broadly to U.S. consumers.

Endnotes

[1]The number of financial institutions that participate in Zelle is reported on the company's website.

[2]Notable exceptions are Alipay and WeChat Pay in China, which enable consumers to make a wide range of payments, including person-to-person transfers, remote and in-person transactions, bill payments, and public transit fare payments, with a single app. However, no such apps are currently available in the United States.

[3]Many of these apps use payment card or automated clearinghouse infrastructure.

[4]We exclude unbanked consumers—those who do not have a checking or savings account—from our analysis because having a bank account is a prerequisite to using mobile and online banking. Many unbanked consumers rely heavily on cash and lack a smartphone and home internet access. Providing unbanked consumers with access to faster payments presents a unique set of challenges, which are beyond the scope of this article. We also exclude households from our sample if their banking status is unknown.

[5]In the FDIC survey, mobile banking activities are defined as activities that use a bank's mobile website or app.

[6]For characteristics that vary across individuals in a household, such as education, age, race, employment status, and disability status, the reported characteristics are those of the householder, who owns or rents the home. If a home is owned or rented jointly, the householder is designated as the "reference person" to whom the relationship of any other household members is recorded.

[7]We are able to access the data of the mobile FS survey because the Federal Reserve Bank of Kansas City is one of the seven Federal Reserve Banks that conducted the survey. Crowe, Tavilla, and McGuire (2017) provide consolidated findings from the survey.

[8]The lack of perceived benefits from mobile banking services may have little influence on consumers' readiness. Because consumers may not be able to fully realize the benefits of faster payments without using mobile banking, the availability of faster payments through mobile banking will likely increase consumers' perceived benefits, and therefore adoption, of mobile banking.

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Corporate Leverage and Investment

By W. Blake Marsh, David Rodziewicz, and Karna Chelluri

The sustained growth in corporate debt over the past decade has revived concerns about potential risks to financial stability and economic growth. Highly indebted firms are more likely to default in the event of an economic downturn, which could constrain lending to businesses and households as lender balance sheets weaken. Given the substantial economic costs of severe financial strains, such as the high unemployment and tepid wage growth evident during the Great Recession, these concerns are not unfounded. However, extreme indebtedness may affect a firm's decision-making even in the absence of increased financial stability risks. Elevated corporate debt can discourage future investment and spending on capital equipment, thereby leading to lower realized economic growth today and reduced productive capacity in the longer run.

High levels of leverage—that is, high levels of debt relative to assets or income—can restrict firms' ability to finance new investment in several ways. Most importantly, leverage requires firms to make debt service payments, which reduce net income that could otherwise finance future investment. At the same time, higher debt levels drive credit costs up as default risk rises, incentivizing firms to invest in riskier projects with greater expected returns to recoup their funding costs. In an

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extreme case known as debt overhang, investors may be unwilling to finance new firm investments if they fear that any investment returns will be claimed by more senior debt holders.

In this article, we examine the relationship between high corporate leverage and future firm investment spending on structures, machinery, and equipment. In other words, we examine how debt influences the growth of a firm's capital stock or fixed assets. We find that, on average, more leveraged firms across industries tend to have lower levels of investment activity in the future. Specifically, we find that the negative relationship between debt and investment is strongest for the most highly indebted firms and is evident in both economic downturns and expansions.

Section I explores the rise of corporate leverage in recent years and discusses channels through which indebtedness can affect investment decision-making. Section II introduces a regression model to estimate the relationship between firm indebtedness and investment spending. Section III shows that highly leveraged firms spend less on investment, a result that is consistent over time and throughout the business cycle.

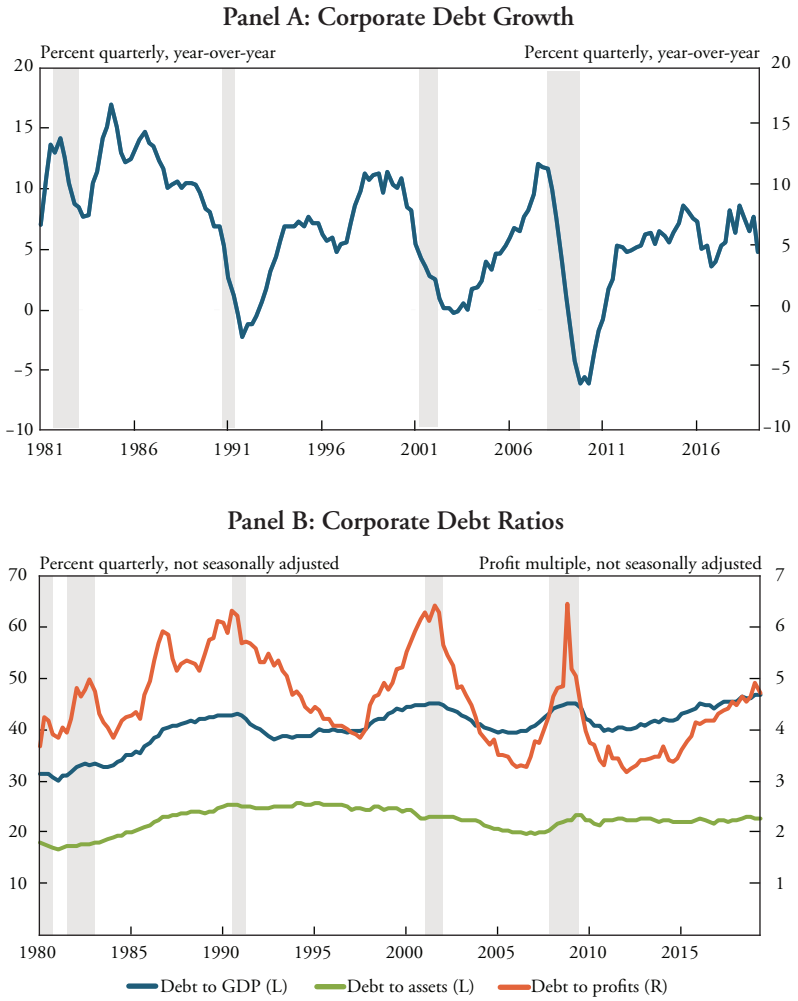
I. The Relevance of Leverage and Investment

Corporate debt growth has been prominent during the recovery from the 2008 financial crisis. Panel A of Chart 1 shows that after a dramatic decline during the post-crisis recession, growth in outstanding corporate debt increased sharply during the subsequent recovery. Since 2011, growth in outstanding corporate debt has consistently averaged more than 5 percent year-over-year, with only one period of tepid growth during the mild 2015–16 economic slowdown.

Sustained growth in corporate debt has consequently driven aggregate leverage measures higher in the United States. Panel B of Chart 1 shows three such measures: the debt-to-GDP ratio, the debt-to-profits ratio, and the debt-to-assets ratio. Specifically, Panel B shows that total outstanding corporate debt has reached an all-time high relative to GDP, as the debt-to-GDP ratio (blue line) has climbed steadily higher during the recovery. Similarly, the debt-to-profits ratio (orange line) has reached post-crisis highs and continues to climb, but to date remains within its longer-run historical range. While these ratios are a rough proxy for firms' ability to repay outstanding debt, they do not fully convey the value of the collateral backing outstanding debt.

Chart 1

Corporate Debt Growth and Leverage



Notes: Gray bars denote National Bureau of Economic Research (NBER)-defined recessions. Corporate debt includes debt securities and bank loans. Profits are corporate profits before tax with inventory valuation and capital consumption adjustments.
Sources: Federal Reserve Board Flow of Funds (Z.1) Release and NBER.

The debt-to-assets ratio (green line), which accounts for this value, has increased modestly during the post-crisis recovery, reflecting that firms have also accumulated assets as debt growth has accelerated.[1]

High levels of leverage may factor into corporate decision-making through their effect on profit usage and increased firm riskiness. One of the primary uses of firm debt is financing new investment projects.[2] However, researchers are divided on whether debt acts as a disciplining device or a deterrent for investment spending. On the one hand, debt requires firm managers to make payments to bondholders, who can claim the assets of the firm under bankruptcy. This promise to pay could incentivize firms to invest prudently in projects that increase the value of the firm and generate income sufficient to cover debt liabilities (Jensen 1986). On the other hand, debt reduces internal funds available for investment and increases firms' default probability, thereby increasing the cost of future debt issuance. In extreme cases, investors may be unwilling to issue new equity financing because any investment returns will accrue to existing bondholders, a condition known as debt overhang (Meyers 1977).[3]

Most previous studies generally find a negative relationship between debt and investment, though these studies disagree on when the relationship affects firm behavior. For example, Lang, Ofek, and Stulz (1996) test debt overhang theories for the 1970–89 period and find a negative relationship only for firms that have poor investment opportunities. Other studies have found a more widespread relationship between debt and investment. Kalemli-Özcan, Laeven, and Moreno (2019), for example, find that European firms with high levels of debt—particularly those with more short-term debt or that are reliant on weak banks for funding—reduced investment during recent European banking crises. Borensztein and Ye (2018) find a negative relationship between leverage and investment for firms in emerging market countries driven primarily by highly leveraged firms. In contrast, Popov and others (2018) find that highly leveraged European firms in their sample actually invest *more* if they have promising investment opportunities; the negative relationship they find between leverage and investment is instead largely driven by firms with greater short-term debt levels.

II. Measuring Leverage and Investment

To assess whether the negative relationship between indebtedness and investment holds more contemporaneously among U.S. public firms, we collect quarterly public financial filings from the S&P Global Market Intelligence Compustat database.[4] Our sample includes firms incorporated in the United States that reported filings in U.S. dollars from 1985:Q1 to 2019:Q2.[5] We drop firms in the real estate and finance sectors, firms without industry classifications, firms with acquisitions larger than 5 percent of their total assets, international firms trading on U.S. exchanges (American depository receipts or "ADRs"), and firms with fewer than 12 reporting quarters.[6]

We follow previous studies in creating two investment measures. Our first investment measure—capital expenditure or "capex"—is a firm's spending on acquiring, maintaining, and upgrading physical assets. We divide reported capex over a four-quarter period by average total assets to generate a firm-specific measure of capital spending relative to size. Our second investment measure is the growth of a firm's capital stock over a given horizon. We follow Ottonello and Winberry (2019) to construct a firm's capital stock as its initial stock of gross property, plant, and equipment (PP&E). We then add net changes in PP&E over the subsequent quarter.[7] The change in the capital stock is approximately equal to capex spending over a given horizon. Therefore, the capital stock growth rate is roughly equivalent to capex spending scaled by total capital stock in the base period. Following Ottonello and Winberry (2019), we trim outliers in these investment measures outside the 1st and 99th percentiles.

We use a standard leverage definition of the total book value of a firm's debt divided by the total book value of its assets.[8] Using book values of debt and assets omits the influence of market default expectations on firm investment. Moreover, using book values yields a more stable leverage measure: unlike some leverage measures, such as the ratio of debt to earnings before interest, tax, depreciation, and amortization (EBITDA), our measure is not subject to sharp profitability and market changes. Thus, our measure better reflects a firm's desired leverage level rather than the level obtained due to changes in the business cycle.[9]

We include several firm characteristics in the regression to control for differences in firms' profitability, size, and past investment patterns,

which influence future investment beyond firms' leverage levels. For example, larger firms are more likely to have access to productive capital, such as new technologies, and can thus vary their capital intensity in ways small firms cannot. As a result, we include the log of total assets as a proxy for firm size. In addition, firms with more total cash flow generated through lower expenses or greater sales growth are likely to have more internal funds available for investment. To control for these differences in profitability and thereby funds available for investment, we include sales growth and the ratio of cash flow to total assets. We also include lagged capex as a share of fixed assets to control for persistence in firm investment.

Our final sample includes 379,966 unique company-quarter observations drawn from 11,706 unique companies. Table 1 shows summary statistics for the variables of interest after eliminating the capex-to-assets outliers. On average, firms in our sample have a debt-to-assets ratio of about 31 percent and an average three-year capital growth of 10 percent. The median firm holds about $160 million in total assets, while the average firm holds over $2.6 billion, indicating that our sample includes many extremely large firms as measured by total assets. On average, firms in our sample increase sales about 1 percent annually, which generates a cash flow of about 11 basis points relative to assets.

To examine the relationship between leverage and firm investment, we estimate the following model:

$$investment_{i,s,t+h} = \alpha_0 + \alpha_1 leverage_{i,s,t} + \alpha_2 X_{i,s,t} + \gamma_i + \eta_{s,t} + \varepsilon_{i,s,t}, \quad (1)$$

where $investment_{i,s,t+h}$ denotes investment at firm i in sector s at some future horizon $t+h$, $X_{i,s,t}$ denotes a set of firm characteristics, γ_i denotes firm fixed effects, and $\eta_{s,t}$ denotes sector-time fixed effects.[10]

We include firm fixed effects to allow us to control for time-invariant firm characteristics. Such characteristics may include long-run management strategies, firm investment culture, or other time-invariant or slow-moving changes unique to a specific firm. More concretely, the firm fixed effect estimates a firm-specific parameter that represents the average relative capital spending or capital stock growth of a firm over the full sample. Thus, the fixed effect captures the investment strategy or philosophy unique to a firm and controls for differentials that may arise between firms that are more risk-averse or that otherwise pursue different investment strategies.

Table 1

Summary Statistics

Variable	Mean	Standard deviation	25th percentile	Median	75th percentile
Debt/assets	31.34	43.41	7.57	24.55	41.17
Cash flow/assets	0.11	51.95	−1.18	0.81	3.56
Sales growth	0.91	23.28	−2.40	0.68	4.03
Log assets	5.09	2.52	3.28	5.07	6.90
Assets	2,627.09	15,350.79	26.54	158.46	981.58
Tobin's Q	1.61	1.32	0.90	1.32	1.89
Capex/fixed assets	6.62	229.20	1.89	4.02	7.78
Capital growth (one year)	2.35	26.83	−6.71	0.80	10.21
Capital growth (three years)	10.20	57.40	−13.62	7.90	32.85

Notes: Assets and log assets are in millions of dollars. All other statistics are in percentages.
Sources: S&P Global Market Intelligence Compustat and authors' calculations.

In addition, we include a set of sector-time fixed effects that allow us to control for time-varying shocks at the sector level. We define industries using two-digit Global Industry Classification Standard (GICS) codes and multiply these codes by a full set of quarterly indicators. These parameters absorb any time-specific shocks to a given industry but allow for differential effects across industries and time periods. For example, a sharp drop in the price of oil will affect all industries that either trade oil-based products or use oil-based products in their production processes. The sector-time fixed effects, in this example, would at least partially estimate the sector-specific effect of a change in oil prices in a given quarter on each industry. Including sector-time fixed effects allows us to interpret the coefficient on the leverage ratio as the effect of higher leverage *relative to a firm's industry peers* at time *t.* This consideration is important because some industries are more highly leveraged than others, and investment patterns can differ materially across them. Without sector-time fixed effects, our results would only capture average investment patterns in more leveraged industries.

Standard errors are clustered at the firm level to account for any correlations within a given firm's set of observations. The implicit assumption is that errors are uncorrelated across firms but not across time within a firm. Given that firm and sector-time fixed effects are included, this is not a strong assumption.

Finally, in some specifications, we control for investment opportunities using Tobin's Q. Tobin's Q is a measure of the market value of a firm's assets relative to the book value of its assets. Conceptually, Tobin's Q measures the investment opportunities available to a firm. Firms with good investment opportunities will be rewarded with a greater market value of common stock relative to their book value and will thus have a higher Tobin's Q. Likewise, firms with fewer investment opportunities will see less investor demand to hold common stock and consequently will have a lower market value relative to book value and thus a lower Tobin's Q.

We follow Ottonello and Winberry (2019) to calculate Tobin's Q and define the market value of assets as the book value of assets plus the market value of common stock, deferred taxes, and investment credits less the book value of common stock.[11] We calculate the market value of common stock using share prices and shares outstanding from Compustat. However, the widest sample available to us only provides market data for firms in the S&P 1500 index since 1994. For this reason, we report these regressions as robustness checks on our main specification.

III. The Persistent Effects of High Leverage on Investment

We find a strong negative relationship between increased leverage and investment. Table 2 reports the results of estimating equation (1). Column 1 of Panel A shows results for the full sample using capex relative to fixed assets one year ahead. The results show that a 1 percentage point increase in a firm's debt-to-assets ratio would reduce its relative capex spending one year ahead by about 7 basis points. Columns 2 and 3 of Panel A show results for the smaller sample of S&P 1500 firms and reveal a similar effect of increased leverage on investment. Specifically, a 1 percentage point increase in a firm's debt-to-assets ratio is associated with about a 17 basis point decline in capex spending relative to total assets in the next year.

Next, we test whether this relationship holds after controlling for differences in investment opportunities. Column 4 of Panel A shows results from a robustness check interacting Tobin's Q with our measure of leverage. The coefficient of 0.031 is positive and statistically significant, suggesting leveraged firms invest more when they have better investment opportunities. However, the increase in investment is small—

Table 2

Association between Leverage and Investment Outcomes

Panel A: Capex to Fixed Assets

	(1)	(2)	(3)	(4)
Variable	Full sample	Tobin's Q sample		
Debt/assets	–0.067***	–0.171***	–0.165***	–0.228***
	(0.009)	(0.022)	(0.021)	(0.032)
Cash flow/fixed assets	0.032**	0.183***	0.163***	0.164***
	(0.015)	(0.031)	(0.030)	(0.030)
Capex/fixed assets	0.0004***	0.482***	0.465***	0.465***
	(0.00008)	(0.025)	(0.024)	(0.024)
Sales growth	0.101***	0.294***	0.264***	0.262***
	(0.017)	(0.030)	(0.028)	(0.028)
Log assets	–4.122***	–5.641***	–5.195***	–5.011***
	(0.357)	(0.606)	(0.571)	(0.568)
Tobin's Q			2.935***	2.578***
			(0.381)	(0.378)
Debt/assets × Tobin's Q				0.031***
				(0.013)
Constant	46.378***	61.268***	52.186***	51.425***
	(2.240)	(4.916)	(4.830)	(4.795)
Observations	297,919	67,310	67,310	67,310
Firms	11,103	2,356	2,356	2,356
Adjusted R^2	0.04	0.21	0.23	0.23

Panel B: One-Year Capital Stock Growth

	(1)	(2)	(3)	(4)
Variable	Full sample	Tobin's Q sample		
Debt/assets	–0.048***	–0.220***	–0.216***	–0.304***
	(0.005)	(0.020)	(0.019)	(0.033)
Cash flow/fixed assets	0.019*	0.193***	0.176***	0.177***
	(0.010)	(0.024)	(0.023)	(0.023)
Capex/fixed assets	0.0001**	0.260***	0.245***	0.245***
	(0.00005)	(0.019)	(0.018)	(0.018)
Sales growth	0.079***	0.340***	0.312***	0.310***
	(0.010)	(0.033)	(0.032)	(0.032)
Log assets	–4.171***	–6.551***	–6.109***	–5.859***
	(0.226)	(0.485)	(0.470)	(0.473)
Tobin's Q			2.516***	2.003***
			(0.317)	(0.331)
Debt/assets × Tobin's Q				0.042***
				(0.014)
Constant	25.319***	57.818***	49.557***	48.619***
	(1.454)	(4.069)	(4.056)	(4.046)
Observations	323,019	75,075	75,075	75,075
Firms	11,226	2,397	2,397	2,397
Adjusted R^2	0.05	0.14	0.15	0.15

Table 2 (continued)

Panel C: Three-Year Capital Stock Growth

	(1)	(2)	(3)	(4)
Variable	Full sample	Tobin's Q sample		
Debt/assets	−0.120***	−0.473***	−0.461***	−0.650***
	(0.012)	(0.051)	(0.049)	(0.076)
Cash flow/fixed assets	0.031**	0.315***	0.281***	0.281***
	(0.012)	(0.050)	(0.049)	(0.049)
Capex/fixed assets	0.0001***	0.265***	0.237***	0.238***
	(0.00005)	(0.039)	(0.038)	(0.038)
Sales growth	0.111***	0.508***	0.448***	0.444***
	(0.011)	(0.060)	(0.059)	(0.059)
Log assets	−22.158***	−24.479***	−23.623***	−23.067***
	(0.663)	(1.367)	(1.326)	(1.320)
Tobin's Q			5.110***	4.036***
			(0.545)	(0.554)
Debt/assets × Tobin's Q				0.092***
				(0.033)
Constant	166.978***	242.561***	225.931***	223.515***
	(4.686)	(11.466)	(11.261)	(11.212)
Observations	275,856	69,085	69,085	69,085
Firms	10,061	2,197	2,197	2,197
Adjusted R^2	0.11	0.22	0.23	0.23

* Significant at the 10 percent level
** Significant at the 5 percent level
*** Significant at the 1 percent level

Note: Firm clustered standard errors are shown in parentheses.
Sources: S&P Global Market Intelligence Compustat and authors' calculations.

about 3 basis points for every 1 percentage point increase in a firm's leverage ratio, given their Tobin's Q ratio.

Moreover, the negative overall effect of leverage still holds taking account of Tobin's Q, and the effect is stronger. The average firm in our sample has a Tobin's Q of 1.61, suggesting that a 1 percentage point increase in leverage would decrease investment by about 17 basis points, similar to what we found in the S&P 1500 sample. For the interaction effect to dominate, Tobin's Q would need to be about 7.4, or more than four standard deviations above our mean Tobin's Q level. This level is well above even the 75th percentile observed in our sample and is unlikely to occur. Thus, we interpret these results to mean that the leverage effect dominates, suggesting highly leveraged firms are likely to invest less than their less-leveraged peers.

To test whether this relationship holds using an alternative measure of investment, we next estimate a similar model using the one-year-ahead growth of capital stock (Table 2, Panel B). Column 1 of Panel B shows that for the full sample without Tobin's Q, increased leverage is associated with slower growth in capital spending. Specifically, a 1 percentage point increase in a firm's debt-to-assets ratio is associated with a 5 basis point decline in the one-year-ahead growth rate of its capital stock. As with capex-to-fixed assets, this relationship is stronger in the smaller sample of S&P 1500 firms shown in columns 2 through 4. In this sample, a 1 percentage point increase in a firm's debt-to-assets ratio is associated with about a 22 basis point drop in capital stock growth even after controlling for investment opportunities. We find a similarly dominant effect when controlling for the interaction between debt and investment opportunities.

The negative relationship between leverage and investment persists over a longer horizon when investment is measured by growth in the capital stock. Panel C of Table 2 reports results using a three-year growth horizon for capital stock. In the full sample, a 1 percentage point increase in leverage is associated with a 12 basis point decline in capital stock growth. For the Tobin's Q sample, the associated decline is nearly 50 basis points, and the relationship continues to hold even after controlling for differences in investment opportunities.

The results in Table 2 suggest a strong, statistically significant, negative relationship between increased leverage and future investment. The results are economically significant as well. For example, a one-standard-deviation increase in leverage among the full sample of firms is associated with about a 3 percentage point drop (-0.067×43.41) in capital spending relative to assets in the following quarter. For larger firms in the S&P 1500, this decline is even greater.

However, the results in Table 2 do not control for the relative leverage levels of firms within industries. Just as some industries are more highly leveraged, on average, than others, some firms may be more highly leveraged than their peers, raising the possibility that these highly leveraged firms are driving our results. To account for this possibility, we split the sample into terciles based on the firms' debt-to-assets ratios within industry groups. Low-leverage firms are those in the bottom third of the leverage distribution within their two-digit GICS industry,

medium-leverage firms are in the middle third, and high-leverage firms are in the top third.

The results in Table 3 show that after splitting the sample by industry leverage, the negative relationship between leverage and investment strengthens as a firm's leverage increases relative to its industry. With this specification, we can interpret the coefficients as relative to the firm's own industry group. Column 1 of Panel A reports the results for the full sample. A medium-leverage firm—a firm in the middle third of its industry leverage distribution—has about 8.4 percentage points lower capex relative to fixed assets in the next year than its less leveraged industry peers. A high-leverage firm—a firm in the upper third of its industry leverage distribution—has over 14 percentage points lower capex relative to fixed assets than firms in the bottom third of the leverage distribution.

Again, the relationship is stronger when we measure investment using capital stock growth. Column 1 of Panel B shows that for the full sample, medium-leverage firms have more than 5 percentage points lower growth in their capital stock one year later than low-leverage firms, while high-leverage firms have nearly 11 percentage points slower growth than low-leverage firms. The results in columns 2 and 3 of Panel B show that the relationship holds qualitatively for large firms and after controlling for Tobin's Q, though the results are somewhat weaker. Specifically, a medium-leverage firm's capital stock grows about 3.7 percentage points more slowly after controlling for investment opportunities, while a high-leverage firm's capital stock grows about 7 percentage points more slowly.

This result again holds over longer horizons. Panel C of Table 3 reports the results for capital stock growth three years into the future. In the full sample, a medium-leverage firm's capital stock grows more than 11 percentage points more slowly three years later than a low-leverage firm's capital stock, while a high-leverage firm's capital stock grows about 20 percentage points more slowly. The results hold qualitatively for the largest firms, though the total effect is somewhat smaller.[12]

One concern is whether our results may be driven by recessionary periods or other times when debt service costs rise substantially. To address this concern, we examine the relationship between leverage and investment at different points in the business cycle. Specifically,

Table 3

Differential Association of Leverage and Investment

Panel A: Capex to Fixed Assets

	(1)	(2)	(3)
Variable	Full sample	Tobin's Q sample	
Medium leverage	−8.377***	−3.943***	−3.614***
	(0.514)	(0.532)	(0.507)
High leverage	−14.438***	−6.516***	−6.142***
	(0.649)	(0.753)	(0.729)
Cash flow/fixed assets	0.031**	0.183***	0.164***
	(0.015)	(0.031)	(0.030)
Capex/fixed assets	0.0004***	0.484***	0.467***
	(0.00007)	(0.025)	(0.024)
Sales growth	0.100***	0.295***	0.265***
	(0.017)	(0.030)	(0.028)
Log assets	−3.269***	−5.513***	−5.088***
	(0.345)	(0.594)	(0.563)
Tobin's Q			2.914***
			(0.380)
Constant	47.680***	59.384***	50.396***
	(2.119)	(4.838)	(4.739)
Observations	297,919	67,310	67,310
Firms	11,103	2,356	2,356
Adjusted R^2	0.05	0.21	0.23

Panel B: One-Year Capital Stock Growth

	(1)	(2)	(3)
Variable	Full sample	Tobin's Q sample	
Medium leverage	−5.414***	−4.012***	−3.719***
	(0.334)	(0.466)	(0.458)
High leverage	−10.641***	−7.446***	−7.112***
	(0.430)	(0.626)	(0.612)
Cash flow/fixed assets	0.017*	0.193***	0.177***
	(0.010)	(0.024)	(0.023)
Capex/fixed assets	0.0001**	0.263***	0.249***
	(0.00004)	(0.019)	(0.018)
Sales growth	0.079***	0.341***	0.314***
	(0.010)	(0.033)	(0.032)
Log assets	−3.492***	−6.471***	−6.051***
	(0.220)	(0.476)	(0.463)
Tobin's Q			2.495***
			(0.319)
Constant	25.680***	55.255***	47.084***
	(1.388)	(3.952)	(3.942)
Observations	323,019	75,075	75,075
Firms	11,226	2,397	2,397
Adjusted R^2	0.05	0.13	0.14

Table 3 (continued)

Panel C: Three-Year Capital Stock Growth

	(1)	(2)	(3)
Variable	Full sample	Tobin's Q sample	
Medium leverage	−11.095***	−8.803***	−8.184***
	(0.901)	(1.176)	(1.141)
High leverage	−20.659***	−15.341***	−14.649***
	(1.175)	(1.542)	(1.500)
Cash flow/fixed assets	0.029**	0.313***	0.279***
	(0.011)	(0.050)	(0.049)
Capex/fixed assets	0.0001**	0.272***	0.244***
	(0.00005)	(0.039)	(0.038)
Sales growth	0.112***	0.514***	0.454***
	(0.011)	(0.060)	(0.059)
Log assets	−20.622***	−24.351***	−23.530***
	(0.650)	(1.349)	(1.314)
Tobin's Q			5.089***
			(0.547)
Constant	165.515***	237.290***	220.792***
	(4.578)	(11.236)	(11.033)
Observations	275,856	69,085	69,085
Firms	10,061	2,197	2,197
Adjusted R^2	0.11	0.21	0.22

* Significant at the 10 percent level
** Significant at the 5 percent level
*** Significant at the 1 percent level

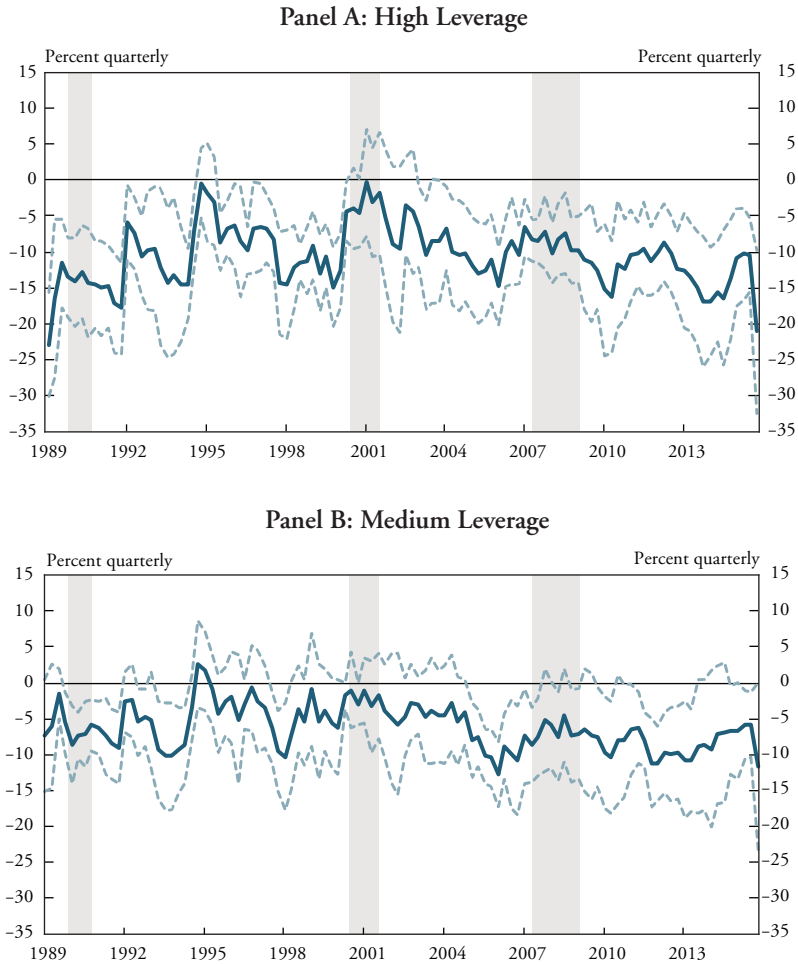
Notes: Estimates include firm fixed effects. Firm clustered standard errors are shown in parentheses.
Sources: S&P Global Market Intelligence Compustat and authors' calculations.

we look at the 12 quarters following any given date (the "base period") and define a firm's leverage level as of the preceding quarter. In other words, we consider a firm highly leveraged if it was in the upper third of its industry leverage distribution one quarter before the base period. Our dependent variable is the three-year growth rate of capital stock beginning at the base period. All remaining control variables are averaged over the 12-quarter period, which accounts for a firm's prevailing business conditions during that period. We include sector fixed effects in each regression and cluster the standard errors by sector.

We repeat this exercise for each quarter in our sample from 1989:Q3 to 2016:Q2.[13] Chart 2 shows the coefficients for each leverage category, as well as a 95 percent confidence interval, for each quarter in our sample. Both medium-leverage (Panel A) and high-leverage (Panel B) firms have lower three-year capital growth rates

Chart 2

Time-Varying Correlation of Leverage and Investment



Notes: Dashed lines denote 95 percent confidence intervals. Gray bars denote NBER-defined recessions.
Sources: S&P Global Market Intelligence Compustat, NBER, and authors' calculations.

than their low-leverage peers. Three-year capital growth rates are, on average, around 6 to 7 percent lower for medium-leverage firms than low-leverage firms, though the result is not always statistically significant at the 5 percent level. For high-leverage firms, the correlation is much stronger and nearly always statistically significant: their three-year capital stock growth rates are more than 10 percentage points lower, on average, than for low-leverage firms.

Overall, our results show a persistent negative relationship between indebtedness and investment at the firm level. Higher leverage is associated with relatively lower investment in both short-term (one-year ahead) and longer-term (three-year ahead) horizons. In addition, this negative relationship is stronger for the most highly indebted firms and persists across time and throughout the business cycle.

Conclusion

Policymakers have grown increasingly concerned about rising corporate debt during the current recovery. However, most have focused on the risks that elevated leverage poses to financial stability—should corporate defaults increase, financial firms that are under stress might tighten lending standards. In this article, we argue that increased leverage may also have a direct effect on firms' investment decisions. We find that the most highly leveraged firms have lower investment spending relative to their industry peers. This relationship holds across a large sample of highly diverse firms and also holds across time, suggesting that indebtedness can matter to economic outcomes even during nonrecessionary periods.

An important caveat is that our analysis cannot address the total investment level in the economy. Instead, our results only speak to the investment levels for firms relative to their peers in a given time period. All firms could be increasing their capital spending by a robust amount; our results simply suggest that the most highly leveraged firms will likely increase their capital spending more slowly.

Nonetheless, our results indicate that high leverage levels appear to be a significant and perennial headwind for firm investment. Overall, we find support for the idea that the most indebted firms may have trouble raising additional investment capital, whether from internal funds or external financial markets.

Endnotes

[1]As debt levels have increased, interest coverage ratios, or the ratio of income to interest expenses, have declined as well—though they remain historically high due to low interest rates (Kumbhat, Palomino, and Perez-Orive 2017). However, these data suggest firms are allocating relatively more income to debt payments and will retain less income for future investment.

[2]Debt can also be used for noninvestment purposes, such as funding buybacks and dividends, or for mergers and acquisitions. For a discussion on the uses of debt and recent patterns, see Kovner and Zborowski (2019).

[3]As an example of the debt-overhang problem, consider a firm that owes $100 to debt holders at year-end. The firm expects to generate $110 with a 50 percent probability and $70 with a 50 percent probability. The firm can pursue an investment opportunity that costs $1 and pays $5 with certainty. The expected value of the firm is $110 × 0.5 + $70 × 0.5 = $55 + $35 = $90, which is less than the $100 the firm owes at year-end. Should the bad state occur where the firms earn only $70, then the $5 return generated by the investment would accrue only to the existing debt holders and the new investors would not earn a return. Given this possibility, new investors would supply the necessary capital only if the investment opportunity paid at least $10. In that case, the new investors would begin to realize a return on their investment because expected income would meet or exceed the debt holders' payment value. See Allen and others (2008) and Chatterjee (2013) for additional examples of debt overhang.

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[5]Because we use three-year-ahead growth rates for capital growth, our regression sample stops in 2016:Q2.

[6]Our sample selection closely follows previous studies. See, for example, Ottonello and Winberry (2019), Rodziewicz (2018), and Rodziewicz and Sly (2019). The results are robust to several variations in sample construction, such as including firms with large acquisitions or extending the reporting periods.

[7]See the data appendix of Ottonello and Winberry (2019) for computational details.

[8]All financial ratio components are calculated as four-quarter averages for stock variables and four-quarter sums for flow variables. This limits the amount of volatility from the reported quarterly numbers and reduces the influence of outliers.

[9]Changes in financial ratios generated by changes in market conditions rather than by firm actions are well-known in the financial landscape. For instance, many loans include maintenance covenants that require firms to meet financial ratio targets on an ongoing basis as opposed to incurrence covenants that consider changes only when a firm takes an action. See Nini, Smith, and Sufi (2012) for more information.

[10]In an unreported robustness check, we also include a firm-specific time trend to control for steady increases in firm level variables. Our results are not qualitatively changed in that specification from those reported here.

[11]We also calculate an alternative annual value of Tobin's Q according to Chung and Pruitt (1994). The results are qualitatively similar using this measure.

[12]Our results continue to hold in unreported robustness checks that remove the firm fixed effects and in samples that drop all firms that do not shift leverage groups. In the first case, including firm fixed effects generates zeros in the leverage variable for firms that do not shift leverage groups during the sample period. This will cause our standard errors to be artificially small. We check that our inference holds by repeating the regression only for the sample that has firms that do shift leverage groups. This implies that firms in the high leverage group must have moved there from below.

[13]The earliest part of our sample contains few observations per quarter, so we start in 1989:Q3 to increase the sample size on a per quarter basis.

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Reshuffling in Soybean Markets following Chinese Tariffs

By Cortney Cowley

In 2018, China significantly increased tariffs on imports of several agricultural commodities from the United States, including a 25 percentage point rise in the tariff on soybeans. Higher tariffs on U.S. soybeans, considered to be a retaliation against earlier U.S. tariffs on Chinese exports, have disrupted international soybean markets. China has been the primary foreign destination for U.S. soybeans over the past decade, accounting for a majority of U.S. soybean exports. Moreover, U.S. production of soybeans has outpaced domestic consumption. In fact, domestic consumption has accounted for only half of total production during this period, underscoring the importance of exports for U.S. soybean markets.

A disruption in soybean markets could have broad implications for the U.S. agricultural sector. Soybeans are an important agricultural commodity in the United States, accounting for a majority of the growth in exports of bulk agricultural commodities and a growing share of crop production and farm revenues over the past two decades. Because tariffs targeted U.S. soybeans, demand for relatively cheaper soybeans from other countries has increased and caused some reshuffling in world soybean markets.

In this article, I examine the initial market responses and potential long-term implications of Chinese tariffs amid other supply and

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demand disruptions, such as severe weather in the United States and African swine fever in China. I find that although some U.S. soybean exports reshuffled to other trading partners, total exports of soybeans declined 21 and 14 percent relative to the previous five-year average in 2018 and 2019, respectively, following the implementation of tariffs. Despite the signing of a "phase one" trade deal in January 2020, tariffs could, in the longer term, lead to expanded production in and exports from other countries, a further reshuffling of global soybean exports, and reduced competitiveness for U.S. soybeans in world markets.

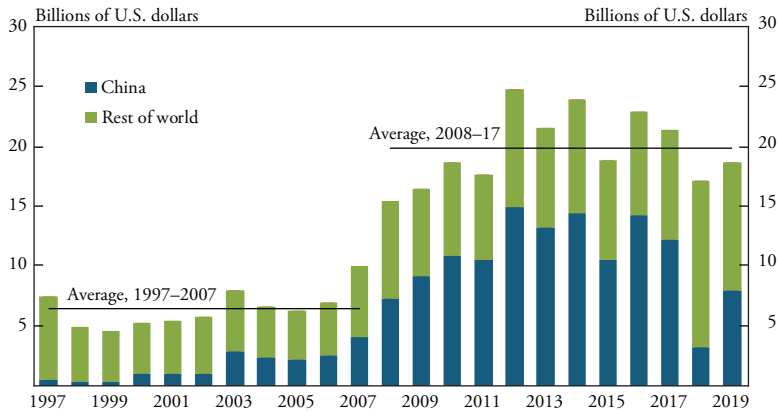
Section I outlines developments in U.S. agricultural trade with China leading up to the first round of soybean tariffs in 2018 as well as the timeline in which tariffs were implemented. Section II examines changes in the soybean industry following the implementation of tariffs. Section III reviews how other countries have responded following the U.S.-China trade dispute and argues that the long-term effects on U.S. agriculture could include reduced competitiveness in world markets and an extended period of low prices.

I. U.S. and China Soybean Trade Prior to Tariffs

Over the past two decades, the United States and China have developed a strong trade relationship in soybeans. In 1997, the United States exported less than $1 billion in soybeans to China, which represented only 5 percent of total soybean exports from the United States (Chart 1). International purchases of U.S. soybeans remained relatively flat through 2007. However, from 2007 to 2017, exports of U.S. soybeans more than tripled from their level in the previous decade as shipments to China grew rapidly. By 2017, the total value of U.S. soybean exports had reached $21.5 billion, and China accounted for a much larger share than in previous years.

Elevated demand for soybeans in China alongside limited Chinese production contributed to the growing trade relationship. Over the last 15 years, rising living standards, changing consumption patterns, and rapid expansion of livestock production and processing facilities have all helped drive a substantial increase in consumption and imports of soybeans in China (Gale, Hansen, and Jewison 2015; Gale, Valdes, and Ash 2019; Muhammed and Smith 2018). Livestock production in particular has increased demand for soybeans to crush into soybean meal,

Chart 1
U.S. Soybean Exports



Source: U.S. Department of Agriculture (USDA).

a high-protein component of animal feed (Gale, Hansen, and Jewison 2015; Muhammed and Smith 2018). However, China's soybean production has not scaled with its demand, and China has largely turned to imports from other countries. In fact, in 2017, imports accounted for 89 percent of total soybean consumption in China; one-third of these imports were from the United States.

As Chinese demand for soybeans has grown over the past two decades, so, too, has the U.S. soybean industry. In the United States, the share of acres harvested in soybeans grew substantially in the 1990s and 2000s and was above trend from 2014 to 2018. In 2017 and 2018, soybeans accounted for almost 30 percent of all harvested cropland in the United States. Prior to the trade dispute with China, soybeans accounted for a growing share of total bulk agricultural exports. In fact, from 2012 to 2017, soybeans accounted for almost 50 percent of bulk agricultural exports from the United States, up from around 25 percent in the early 2000s.

Accordingly, the U.S. trade relationship with China has become more important over the past decade, as the U.S. supply of soybeans has continued to outpace domestic demand. Historically, consumption of soybeans in the United States has accounted for 65 percent of production, on average. However, starting around 2007, when demand from China began to increase, U.S. production grew at a faster pace than domestic use. By 2017, only 50 percent of the soybeans produced in

the United States were consumed there. By comparison, the share of U.S. corn and wheat production consumed domestically has increased steadily over the last decade. In the case of soybeans, U.S. production grew in parallel with Chinese use, elevating the co-dependence of the United States and China in soybean markets. However, this growing dependence on China may have made U.S. soybean markets more vulnerable to disruptions associated with trade barriers, such as tariffs.

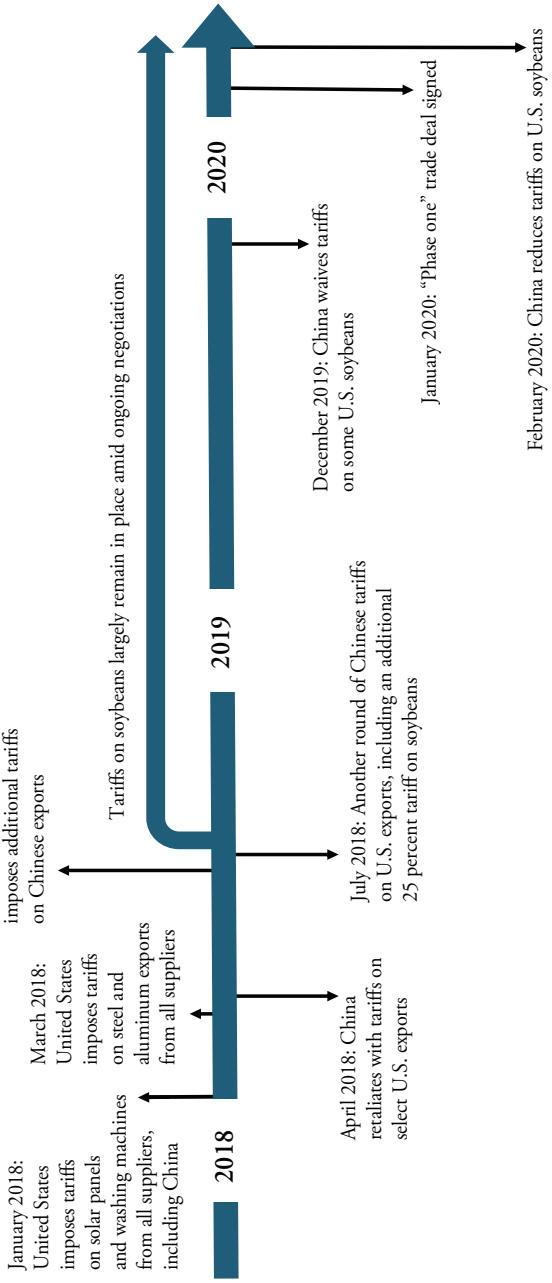
Trade relations with China began to worsen in 2018. Figure 1 shows a timeline of U.S. and Chinese tariffs that influenced soybean markets. In January 2018, the U.S. administration announced tariffs on solar panels and washing machines from all suppliers. Although the tariffs were not specific to China, China is the world's largest exporter of solar panels and accounted for the largest share of U.S. imports of finished washers. U.S. tariffs on steel and aluminum followed in March 2018 along with additional levies specifically targeted at China, raising concerns about the implications of a trade dispute for U.S. agricultural commodity markets.

Following the imposition of U.S. tariffs, China imposed retaliatory tariffs on April 2, 2018. This initial round of tariffs did not yet include soybeans but did include pork, fruit, and nuts. The United States announced another round of tariffs on June 15. Subsequently, on July 6, China retaliated by imposing tariffs of 25 percent on $34 billion of U.S. exports, including soybeans.

In theory, Chinese tariffs should lower the country's demand for U.S. soybeans. Tariffs essentially create an artificial increase in the cost of U.S. soybeans to Chinese importers. Given this higher cost, Chinese importers should purchase fewer soybeans from the United States, thereby depressing prices for U.S. soybeans while raising prices for Chinese consumers. As a result, the quantity of soybeans traded between the two countries should decline.

However, several intermediate steps follow the implementation of a tariff and could influence the magnitude of outcomes in U.S. markets. For example, the tariff is not directly applied to U.S. farmers, agribusinesses, or exporters but is instead applied to soybeans as they are purchased at the port of entry by Chinese importers. The Chinese importer who pays the tariff has the option of passing the costs on to the Chinese consumer or submitting a plea for tariff relief or exemptions to

Figure 1
Timeline of U.S. and Chinese Tariffs



the Chinese Ministry of Commerce. Moreover, soybean markets and commerce are structured differently in China than in the United States. For example, a large portion of soybeans are purchased by state-owned enterprises as opposed to publicly traded companies. As a result, the economic effects of the recent tariffs on soybean markets are challenging to estimate in practice.

II. Developments in the U.S. Soybean Industry following Tariffs from China

When China first threatened soybean tariffs in early 2018, analysts in the agricultural industry predicted relatively minor effects on the U.S. soybean industry due to the limited number of soybean exporters in the world and China's historically strong consumption growth (Zheng and others 2018; Muhammad and Smith 2018; Teheripour and Tyner 2018). In fact, the United States and Brazil export approximately 80 percent of the world's soybeans. However, analysts who predicted these minimal effects assumed soybean consumption would continue to grow at the same pace in China after the tariffs. This assumption did not hold. In 2018 and 2019, total consumption—a measure that includes food, feed, and industrial uses—in China fell below the previous 20-year trend and declined for the first time since 2003. China consumed 4 percent fewer soybeans in 2018 after consumption had increased at an average rate of 9 percent per year since 2000.

Factors influencing Chinese demand

Several factors unexpectedly reduced demand for soybeans in China, including African swine fever (ASF). The first case of ASF in China was confirmed in August 2018, shortly after the first round of tariffs were imposed on U.S. soybean exports (Shao and others 2018). Estimated losses to China's hog herd have been difficult to determine (Pan 2019). However, researchers at Iowa State University estimate a 14 percent decline in pork production in China as a result of ASF (Zhang and others 2019). Under this scenario, the volume of soybeans needed for hog feed would be reduced by 8 million metric tons.

Updated feed standards may also have lowered demand for soybean imports in China. In October 2018, the China Feed Industry Association published new standards for swine and poultry feed (Zhang and

others 2019). The new feed standards lowered crude protein levels by 1.5 and 1 percent for swine and poultry feed, respectively (Sun, Pan, and Chiang 2018). According to China's Ministry of Agriculture, the new standards could reduce China's annual soybean use by 14 million metric tons (Ministry of Agriculture of the People's Republic of China 2018).

In total, the combination of ASF and lower protein requirements for animal feed may have reduced Chinese demand for soybeans by 22 million metric tons. Falling U.S. exports to China provide evidence for this reduction in demand. In 2018, U.S. soybean exports to China fell to 8.2 million metric tons, roughly 22 million metric tons less than the prior four-year average. At the same time, China's imports of soybeans from the rest of the world were increasing, particularly imports from Brazil.

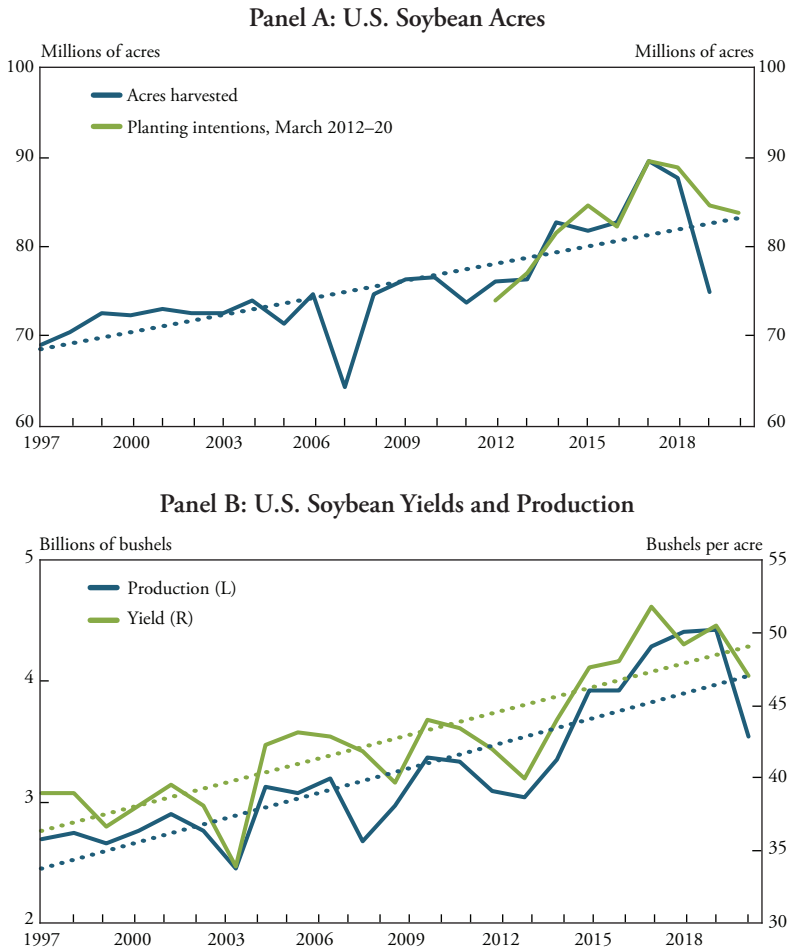
Factors influencing U.S. supply

Alongside reduced demand from China, several factors could have contributed to elevated supplies in the United States, intensifying the influence of tariffs on U.S. soybean markets (Grant and others 2019). In 2018, U.S. production of soybeans was at a record high. Panel A of Chart 2 shows that in 2018, the number of acres of soybeans harvested in the United States was the second highest on record. In fact, soybean acres reached parity with corn acres for the first time since 1984. In addition, Panel B of Chart 2 shows that soybean yields have been on an increasing trend since the 1960s. In 2018, yields were above trend for the fourth consecutive year. The combination of a record-high number of harvested acres and above-trend yields resulted in unprecedented soybean production in the United States in 2018.

Government policy may also have contributed to larger supplies of soybeans in the middle of the trade dispute. In 2018, the U.S. Department of Agriculture (USDA) implemented the Market Facilitation Program (MFP) to provide direct payments to farmers to "offset some of the adverse effects of retaliatory tariffs from China" (USDA 2018). These payments, which were applied to farmers' production, amounted to $1.65 per bushel of soybeans. Prospects for positive profit margins improved for soybean farmers with the implementation of MFP payments. In fact, in 2018, government payments accounted for approximately 20 percent of U.S. farm income. Although the MFP was renewed in 2019, payments that year were made based on a pre-specified

Chart 2

U.S. Soybean Production



Source: USDA.

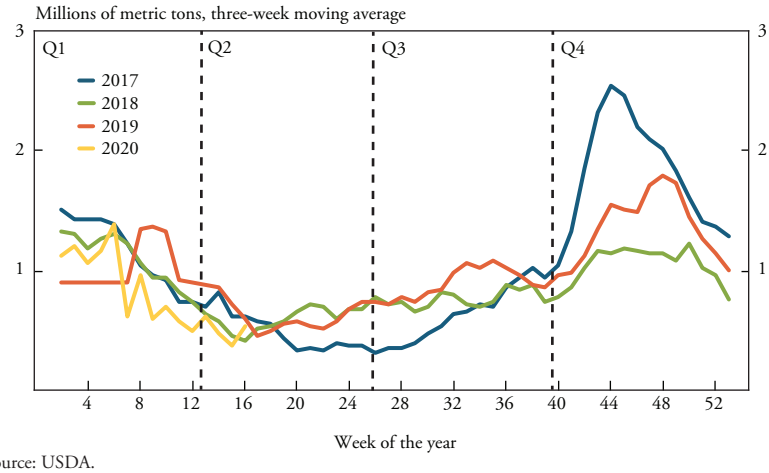
county rate and the number of total acres planted in MFP-eligible crops (USDA 2019). In 2019, trade relief payments increased net farm income by about 14 percent (Glauber 2019 and author's calculations). Agricultural lenders have also indicated that MFP payments have provided support for farm finances and agricultural credit conditions. For example, nearly 90 percent of agricultural lenders surveyed in the Tenth Federal Reserve District reported that trade relief payments have provided at least moderate support to farm income and loan repayment (Kauffman and Kreitman 2020).

Although trade relief payments may have had a material effect on producer profit margins and net farm income, it is unclear how and to what extent these payments may have affected producers' planting decisions in 2019 (Westhoff, Davids, and Soon 2019). According to Hitchner, Menzie, and Meyer (2019), in March 2019, producers had planned to plant 5 percent fewer soybeans than the previous year due to high inventories, low prices, and uncertainty surrounding trade. Despite the slight pullback, acres intended for soybeans remained higher than in all years prior to the trade dispute except 2017, suggesting the trade relief payments may have supported soybean plantings. If trade relief payments had a positive effect on producers' decisions to plant soybeans, they may also have contributed to larger supplies of soybeans in 2019.

Partly offsetting these supply effects, severe weather across a large portion of U.S. farmland reduced soybean production in 2019. Throughout planting, growing, and harvesting seasons, a large portion of the Midwest experienced severe weather, including flooding and abnormally cold temperatures. Significant flooding in the spring in the United States contributed to a dramatic increase in prevented planting—the failure to plant an insured crop by the final planting date designated in a farmer's crop insurance policy.[1] According to the USDA Risk Management Association, severe weather prevented farmers from planting 19.6 million acres of crops in 2019, 23 percent of which were intended for soybeans. Acres planted in soybeans declined in aggregate and in all states that reported soybean production in 2019. Without weather constraints, soybean supplies may have been much larger.

Chart 3

U.S. Soybean Exports as of April 20, 2020



Source: USDA.

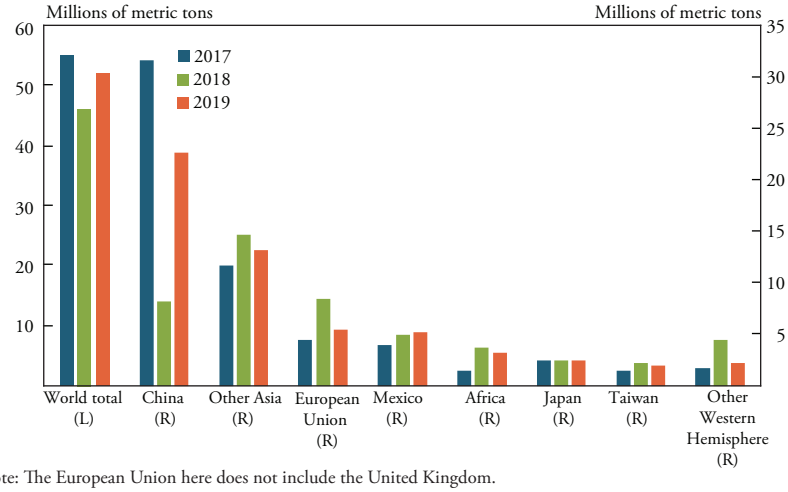
Cumulative influence on U.S. soybean markets

Amid reduced demand from China and large supplies of U.S. soybeans in 2018 and 2019, American soybean exports declined notably following the implementation of Chinese tariffs. Chart 3 shows that weekly shipments in the second and third quarters of 2018 and 2019 were near or above 2017 levels. However, a large majority of U.S. agricultural commodities are sold in the fourth quarter, which is when China typically imports U.S. crop commodities. Exports were flat in the fourth quarter of 2018, and total soybean shipments declined 16 percent in aggregate that year. Fourth-quarter sales continued to lag in 2019 but received some support after China implemented tariff-free quotas and the U.S. government announced the potential for the first phase of a trade agreement. Although exports increased slightly in 2019 compared with 2018, they were still 5 percent below 2017 levels.

A majority of the decline in U.S. soybean exports was attributed to a reduction in purchases from China. Despite prior expectations of reshuffling in international markets, an increase in U.S. sales to other countries was not able to offset the decline in exports to China in 2018. Chart 4 shows that post-tariff trade reshuffling yielded only minor increases in exports to other countries relative to pre-tariff exports. Although exports to the European Union, Africa, and trading partners in the Western

Chart 4

Reshuffling of U.S. Soybean Exports



Note: The European Union here does not include the United Kingdom.
Source: USDA.

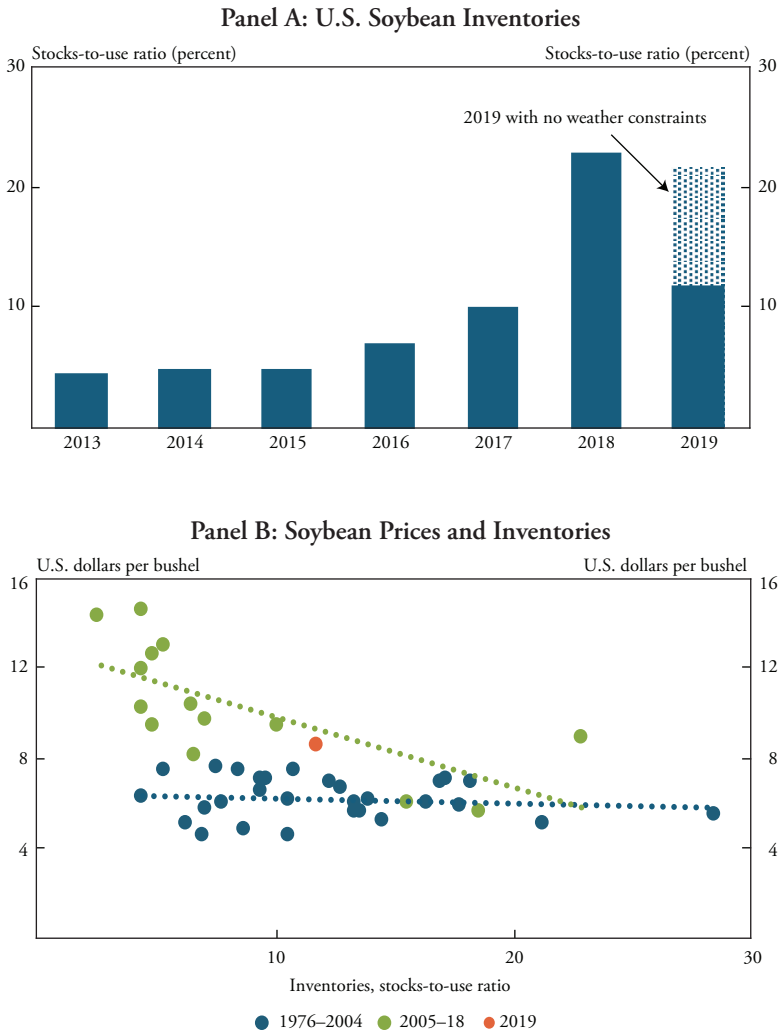
Hemisphere increased from 2017 to 2018, the demand from other countries was not enough to offset reduced demand from China.

Reduced demand for exports to China, combined with strong production in the United States, contributed to a 130 percent increase in U.S. soybean inventories in 2018. Panel A of Chart 5 shows that from 2013 to 2017, soybean inventories—as measured by the stocks-to-use ratio—increased modestly each year. But in 2018, inventories increased dramatically due in part to lower demand from China (Adjemian and others 2019). Inventories are an important indicator of supply and demand fundamentals because they are inversely correlated with prices. Panel B of Chart 5 shows that this inverse relationship appears to have strengthened over time due to the increase in biofuel production and the rapid expansion of Chinese soybean imports (Irwin and Good 2016). From 2005 to 2018, the correlation coefficient between soybean prices and inventories was –0.5, suggesting that a 1 percent increase in inventories was accompanied by a 0.5 percent decline in prices.

Alongside large inventories and uncertainty surrounding tariffs, soybean prices remained below pre-tariff levels through the second half of 2018 and all of 2019. Although soybeans were not included in China's first round of retaliatory tariffs, prices in the United States began to decline in

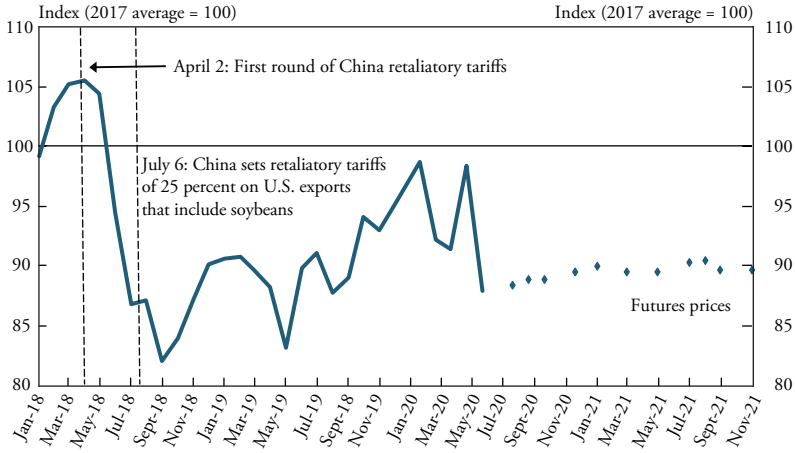
Chart 5

U.S. Soybean Market Fundamentals



Sources: USDA, *Wall Street Journal* (Haver Analytics), and author's calculations.

Chart 6
U.S. Soybean Prices



Sources: *Wall Street Journal* (Haver Analytics) and CME Group.

April 2018, as the prospect of a trade dispute with China in the midst of large expected soybean supplies likely weighed on market expectations (Chart 6). China deployed tariffs of 25 percent in July, and by September 2018, U.S. domestic prices had fallen 20 percent. Although prices rebounded slightly later in the year and continued to improve in the second half of 2019, they never surpassed their 2017 average. In addition, futures prices remain below pre-tariff levels, possibly hinting that the effects of the tariffs on U.S. soybean markets, in addition to negative effects from COVID-19, could linger.

III. Long-Term Implications and Global Response to the U.S.-China Trade Dispute

In the longer term, tariffs from China could make the United States less competitive in world markets. Evidence from previous trade disputes, economic theory, comparisons of factors that drive comparative advantage, and global market dynamics suggest that even if the tariffs were removed, the U.S.-China trade relationship and U.S. soybean markets may be permanently altered (Choe, Hammer, and Montgomery 2019; Zhou and others 2018).

Evidence from previous trade disputes

The 1980 grain embargo provides an historical example of how short-term trade disruptions can have long-term effects. In January 1980, President Jimmy Carter imposed an embargo restricting exports of grain to the Soviet Union (Ghoshal 1981). In the 1970s, international purchases of U.S. grains increased by about 15 percent per year, on average. However, the grain embargo in 1980 contributed to a decline in grain exports (USDA 1986). In response to the embargo, the Soviet Union altered trade flows by replacing U.S. grain with the same or substitute commodities from other sources. The United States lost market share throughout the 1980s. At the time, this was attributed more to world economic conditions—a rising U.S. dollar, a global recession, and high interest rates—than to the embargo (USDA 1986). However, the quantity of U.S. corn and wheat traded in international markets has never exceeded pre-embargo levels (Zulauf and others 2018). In contrast, grain exports from the rest of the world have increased, particularly in the last decade. Furthermore, the U.S. share of corn and wheat in world markets has declined steadily over time. Prior to the grain embargo, the United States comprised 84 percent of world corn exports and 50 percent of world wheat exports. Since the embargo was lifted in April 1981, the U.S. share of world corn and wheat shipments has fallen to 28 and 14 percent, respectively. Although it is difficult to disentangle the effects of the embargo from the global economic conditions of the 1970s and 1980s, evidence does suggest that trade disputes, particularly in the midst of weak economic conditions, can have longer-term effects on markets for agricultural commodities. Thus, the example of the Soviet grain embargo hints that the trade dispute with China could have long-lasting implications.

Competition in world soybean markets

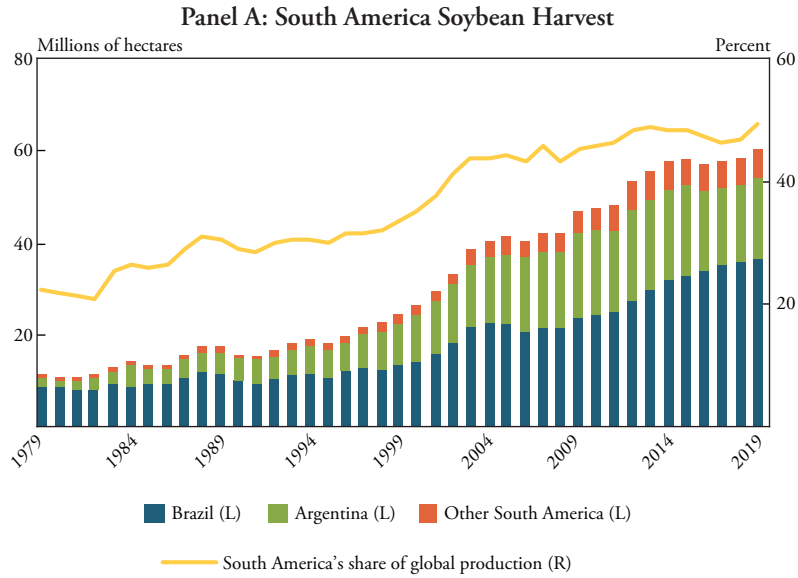
In addition to historical evidence, economic theory suggests the trade dispute may depress the competitiveness of U.S. soybean exports for years to come. One factor that could influence U.S. competitiveness in world markets moving forward is comparative advantage. A country has comparative advantage at producing a good or commodity if it can produce it at a lower opportunity cost than other countries. Due to comparative advantage, land-intensive countries tend to export

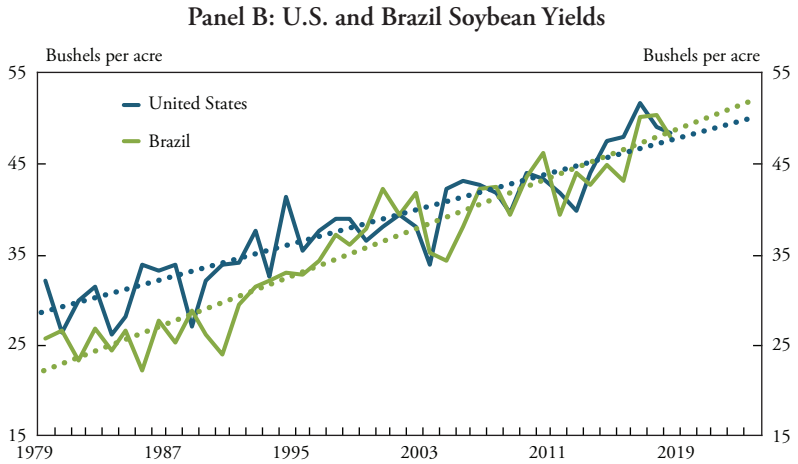
land-intensive products (Reed 2001). The United States, Brazil, and Argentina, for example, have large endowments of land and therefore comparative advantages in growing and exporting commodity crops. Compared with Brazil and Argentina, however, the United States appears to have fewer opportunities for expansion: the South American countries have greater endowments of land suitable for producing soybeans with higher protein levels (Stratfor 2018). After leveling off in 2017, harvested acres of soybeans in South America increased in 2018 and 2019 (Chart 7, Panel A). In 2019, soybean acres reached historically high levels in Brazil, Argentina, and in the rest of South America. The most recent data indicate that South America now accounts for half of all global acres harvested in soybeans. In addition, although soybean yields in Brazil have historically lagged soybean yields in the United States, they have increased at a faster pace over time (Chart 7, Panel B). Although trend yields for soybeans in the United States were higher than in Brazil from 1979 to 2013, Brazilian productivity has since caught up with U.S. productivity.

Alongside an abundance of land, Brazil has invested substantially in transportation infrastructure, which could give the country some additional advantages. Commodity crops are low-unit-value, high-demand products, so high-volume transport such as railways and barges are typically more economically efficient and ensure more competitive prices. Historically, Brazil has had relatively high transportation costs compared with the United States and Argentina because the country has used less efficient means, such as trucks and roadways, to travel long distances (Guan and others 2019). At the end of the 1980s, more than 75 percent of grain and seed cargo in Brazil was transported on the road, compared with 40 percent for the United States (Friend and Lima 2011). In addition, more than half of Brazil's soybean production is located in the large, landlocked state of Mato Grosso, making high-volume transport to ports difficult and expensive (Stratfor 2018). However, beginning in the 1990s, the privatization and deregulation of railways and ports and elimination of export controls contributed to more investment in infrastructure and lower transportation costs. Over the last five years, Brazil has also begun construction of port terminals in the northern Amazon region, allowing for more efficient access to the Atlantic Ocean and the Panama Canal.

Chart 7

Soybean Production in South America





Source: USDA.

Comparing transportation costs between locations in the United States and Brazil shows that given the improvements to Brazilian infrastructure, tariffs have made U.S. soybeans less price-competitive. Chart 8 shows that, historically, soybean producers in Iowa have had relatively higher production costs but substantially lower transportation costs than soybean producers in key Brazilian provinces, such as Mato Grosso and Goiás. However, recent investments in infrastructure in Brazil have caused notable reductions in transportation costs, particularly from Mato Grosso. Despite these improvements, total costs in Iowa would be similar to Mato Grosso without tariffs. With the addition of tariffs, soybeans produced in Iowa become more expensive.

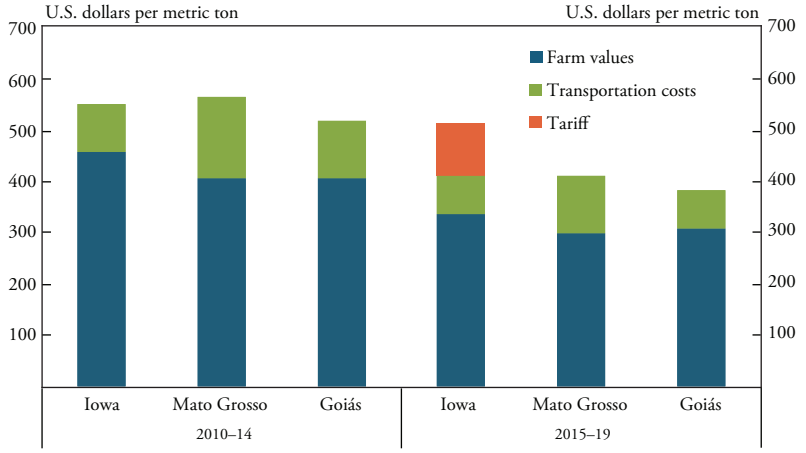
U.S. farmers were already facing more competitive global markets before the trade dispute with China began, and tariffs may have made it even more difficult to regain market share. For example, Panel A of Chart 9 shows that until 2013, the United States (blue line) was the leading exporter of soybeans. In 2014, however, the value of U.S. soybean exports began to weaken, and Brazil (green line) took over as the leading exporter. One way to assess the competitiveness of U.S. soybeans is by examining its normalized revealed comparative advantage (NRCA), an index that compares the ratio of soybean exports to total exports in the United States to the same ratio in other countries (Traill and Gomes da Silva 1996; Yu, Cai, and Leung 2009; Crespi and Chen 2019). An NRCA greater than zero indicates that a country has a comparative advantage. Panel B shows the associated NRCA indexes for major soybean exporters. Although the index for the United States remains above zero, it has been lower than the index for Brazil since 2014, indicating that U.S. soybeans have been relatively less competitive in global markets in recent years. Following tariffs in 2018, Brazil's comparative advantage over the United States widened substantially.

Other market factors

Several other market factors have weighed on U.S. soybean exports during the trade dispute. One such factor reducing the price competitiveness of U.S. soybeans is the strength of the U.S. dollar. In 2018 and 2019, the U.S. dollar appreciated relative to the Chinese yuan, the Brazilian real, and the trade-weighted average of all other world currencies. Furthermore, U.S. currency rose 6 percent relative to the Chinese yuan at the end of 2019 in the midst of the coronavirus outbreak in China.

Chart 8

Costs of Transporting Soybeans from the United States and Brazil to China



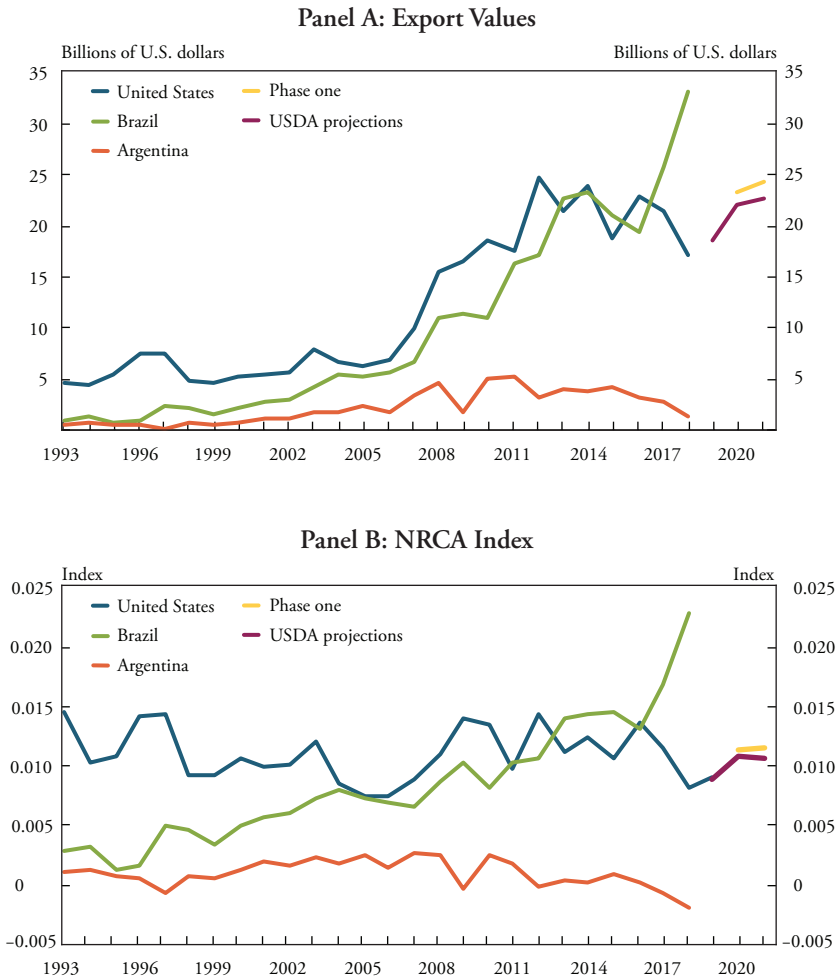
Notes: Transportation costs are the costs to ship from the farm to Shanghai, China. Data in this chart are based on the assumptions that Iowa soybeans are shipped to China through the U.S. Gulf, soybeans grown in Mato Grosso are shipped from the port in Santos, Brazil, and soybeans originating in Goiás are shipped via Paranaguá, Brazil. The total price, or landed cost, for a buyer in China would equal the farm value plus the transportation costs.
Source: USDA.

The coronavirus outbreak has generated concerns about disruptions to the Chinese and global economies that have weakened global growth and further strengthened the dollar. A stronger dollar, particularly in a trade environment where tariffs remain in place, would further increase the costs of U.S. soybeans in Chinese and world markets, contributing to lower demand for U.S. products.

The United States also has a slight quality disadvantage in soybeans, which may make overcoming tariffs more difficult in the long term. Brazilian soybeans have historically had higher protein contents than U.S. soybeans, which is important for buyers interested in processing soybeans for animal feed (Mano 2019). For example, Chinese export contracts have quality requirements that specify a protein content of 34 percent. In 2019, the average protein content of beans in the United States was 34.1 percent, while protein content in Brazil was 36.8 percent (William, Dahl, and Hertsgaard 2019; Mano 2019; Naeve and Miller-Garvin 2019; USSEC 2006). Given both tariffs and China's lower overall soybean import needs due to ASF, Chinese buyers can be more selective about purchases, which may make the cheaper, higher-protein soybeans from Brazil more competitive.

Chart 9

Export Values and Indices of Comparative Advantage for Soybeans



Sources: USDA, United Nations, Office of the U.S. Trade Representative, and author's calculations.

Going forward, a trade deal between the United States and China could alleviate some concerns about the long-term implications of tariffs. On January 15, 2020, the United States and China signed "phase one" of a trade agreement that would significantly increase the value of U.S. agricultural exports to China. Using the 2017 baseline of $23.8 billion in agricultural purchases, the phase one trade agreement includes a commitment from China to import an extra $12.5 billion of agricultural products from the United States in 2020 and an extra $19.5 billion in 2021.

However, developments in soybean prices immediately following the signing of the trade deal indicate the deal may not be as supportive as the U.S. agricultural industry hoped. Soybean prices declined 3 percent in the day following the signing and tariffs remained intact. Moreover, the phase one agreement contains no strong enforcement mechanisms to ensure China follows through on its commitments. In fact, China's representatives indicated that purchases for agricultural products, including soybeans, would be "based on market conditions," which have been less favorable for U.S. agricultural commodities (Plume and Polansek 2020). For example, Brazil remains more price-competitive in world soybean markets and is expected to harvest a record crop in 2020. Furthermore, the coronavirus outbreak could make it more difficult for China to fulfill its commitments. In January and February 2020, weekly outstanding orders of soybeans were 60 percent lower than in the same weeks in 2019, on average. In addition, the phase one deal is only for two years (2020 and 2021), which may not be enough to unwind the adverse effects associated with tariffs.

Even if China were to fulfill its commitments for U.S. soybean purchases, the United States could still remain at a disadvantage to Brazil. Panels A and B of Chart 9 show projections based on data from the USDA (purple lines) for U.S. soybean export values and comparative advantage alongside my estimates of the effects of the phase one trade deal (yellow lines). According to my calculations, even with the addition of the phase one trade deal, the United States could not reach Brazil's recent levels of export values or comparative advantage in global soybean markets. For all agricultural exports, the USDA's projections are slightly below commitments specified in the trade deal. Specifically,

the USDA expects total agricultural exports to China to equal $14 billion in 2020, which would fall short of the $36 billion in commitments China made in the phase one trade deal. The USDA's estimates could increase if concerns around coronavirus decline and if orders increase from China. However, lingering tariffs, the strength of the dollar, and declining competitiveness are key headwinds in the longer-term outlook for U.S. soybean markets.

Conclusion

Prior to 2018, the United States and China had developed a strong trade relationship for soybeans. The United States is one of the world's largest producers of soybeans and is highly dependent on exports. Similarly, China is one of the world's largest consumers of soybeans and is very dependent on imports. However, following the implementation of retaliatory tariffs, U.S soybean exports to China declined, and importers in China sourced more lower-cost soybeans from other countries, primarily Brazil. Although U.S. exports of soybeans increased to all other trading partners, the increase in exports to other countries could not overcome the decline in exports to China. Therefore, inventories increased dramatically in 2018, leading to a sharp decline in U.S. soybean prices.

Although Chinese tariffs on U.S. soybeans initially disrupted markets and created widespread uncertainty, additional supply and demand factors have also contributed to a reshuffling in soybean markets. In 2018 and 2019, the effects of the tariffs were intensified by reduced demand for soybeans in China following an outbreak of African swine fever and the implementation of new feed standards. On the other hand, reduced demand from China was somewhat offset by severe weather in the United States in 2019, which reduced supplies.

The implementation of the phase one trade agreement may provide some support to U.S. soybean markets; however, China is committed to purchasing U.S. agricultural commodities only if market conditions are favorable. Given that tariffs remain in place, and COVID-19 has contributed to a decline in global economic activity and an increase in the value of the U.S. dollar, markets will likely continue to favor Brazil.

If Brazil strengthens its comparative advantage by expanding production and further improving its infrastructure, the United States may see its share of global exports fall further, creating greater financial difficulties for U.S. soybean farmers in the longer term.

Endnote

[1]Producers affected by adverse weather conditions such as flooding and hurricanes can elect to enroll their acres in prevented plant and receive government insurance payments. If a producer is unable to plant, they can collect prevented plant payments on the acres left unplanted.

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