Search during Covid-19 pandemic: evidence from retail deposit market

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Abstract

This paper explores the impact of social distancing restrictions on the U.S. retail deposit market during Covid-19 pandemic. Mapping a mobile phone data tracking 20 million devices daily in US with branch level weekly deposit rates data since 2019, I find bank branch offers substantially lower deposit rates when its customers visit branch less and stay at home more. The effect exists even after considering both demand and supply of deposits. Consumers suffer a larger drop in deposit rate from reduced activities when their branch faces a higher surge in deposits supply and higher pre-crisis local competition. The finding suggests a search-based channel where exogenous negative shock on physical search activities increase consumer' search frictions and strengthen banks' market power. Such friction concentrates during lock down period and online search can partially mitigate the friction.

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1. Introduction

Covid-19 pandemic has imposed unprecedented health risk challenge across the world. Many countries and regions responded to the early wave of the crisis with restrictions on individual's social activities. In United States, since former president Donald Trump declared a state of national emergency over Covid-19 pandemic on 13th March 2020, most states introduced such restrictions (see Figure 1) and there is a steep 26% surge in the national average stay-at-home activities (see Figure 2). These severely restricts consumers' ability to physically search products due to policies like shelter in place and non-essential business closure. Even banks are regarded as essential businesses, bank customers reduce their branch visits by between 17% to 28% up to 24 weeks since the onset of pandemic. This paper highlights while previous debates focused on the supply shock of bank deposit induced during the pandemic, search frictions significantly contribute to the prise dispersion in the deposit market.

Use exogenous shock induced by Covid-19 pandemic, this paper explores the relationship between reduced physical search activities and bank deposit price in United States. I find bank branch offer lower deposit rate when its customers' stay-at-home activities surge (See Figure 3) and visits bank branches less (See Figure 4) during the pandemic after controlling deposit demand (loan growth), deposit supply (deposit growth), online search, local infection rate, pre-Covid local competition, stock performance, local economic and fiscal shocks, bank characteristics, county characteristics and state-week fixed effects. Use instrumental variable approach, the result suggests 10% increases in the lagged regional stay-at-home activities would increase the local branches' deposit rate of the following week by 8.35 bp or 20% of national average deposit rate between April 2020 to August 2020 in our sample.

One of the empirical challenges for search literature is national wide physical search activities are usually difficult to observe. This paper measures bank branch customers' physical search activities in two approaches (See Figure 5). First, I calculate branch located county's weekly

median stay-at-home activities in 2020 (indirect approach). This is an indirect measure of bank customers' physical search activities. The implicit assumption for this method being valid is consumers reduce their physical search intensity for deposit products when they stay at home more. Nevertheless, if customers' physical search activities are disproportionally changed regard to different goods, our indirect approach using regional stay-at-home activities may not fully capture the scale of physical search intensity change for bank products. For instance, some restrictions on social distancing focus on non-essential business closure. Since banks are regarded as essential business, while general stay-at-home activities increased after the pandemic, consumers' physical search intensity for bank products may not change. Therefore, we also use a second approach which captures the weekly visits at each bank branch and directly measure the consumer's physical search activities at the branch level (direct approach).

There are two potential issues concern the usage of mobile data. First, the branch visit is based on the devices in our mobile data sample instead of the whole population. While our mobile data is well presented across broad regions in US, specific branch's customers may be underrepresented in certain regions. Therefore, we use 2019 data to establish the baseline of branch visits and calculate relative visits in 2020 instead of directly using raw visits numbers. Second, since mobile data checks the geo location of the devices, some noise can be picked. For instance, we have some observations of branch visits on weekends in our raw data. To mitigate the impact of such noise for our analysis, we only account weekdays activities for both indirect and direct approaches in the data.

The first part of this paper presents the analysis use the indirect approach: using bank branch located county's weekly median stay-at-home activities in 2020 to proxy regional consumer physical activities. There are a wide range of studies documents the heterogeneity in regional compliance with social distancing driven by different social economic factors (Allcott et al., 2020; Bazzi, Fiszbein, & Gebresilasse, 2020b; Chiou & Tucker, 2020; Simonov, Sacher, Dubé,

& Biswas, 2020). For instance, Arkansas having similar new cases surge pattern to California (See Figure 6), but its state level stay-at-home activities behave very distinctly comparing to California since the pandemic (See Figure 7). Exploring these heterogeneous responses at the county level and controlling for local infection rate, bank characteristics, county characteristics and state-week fixed effects, we find deposit rates offer by branches in the high stay-at-home counties are lower than branches in the low stay-at-home counties. Furthermore, this paper controls for demand and supply change of deposits during the pandemic as well as pre-Covid bank competition environment. Our findings in main results sustain. In addition, the deposit rate reduction related to search activities drop is more severe for branches received higher surge in the deposit amount and in markets pre-Covid local competition is higher. Everything else being equal, consumers in regions have higher demand for deposit product combined with higher stay-at-home activities receive the lowest deposit rate. On the other hand, although local competition increases regional deposit rates in general, high stay-at-home activities will sabotage the benefit of competition on pricing and consumer welfare. The search shock is more severe for consumers with large choice sets.

Another crucial concern is the alternative search method for consumers through internet. In recent three decades, online search becomes a rising search method comparing to traditional physical search in product markets and there is a wide range of literatures discussing its effectiveness on search outcomes (Dinerstein, Einav, Levin, & Sundaresan, 2018; Jolivet & Turon, 2019). For instance, Brown and Goolsbee (2002) find the adoption of internet comparison shopping sites in 1990 reduced the price of term life insurance by 8-15 percent. Using consumers' regional online search intensity of deposit on Google, we find online search can only partially substitute the reduced physical search and mitigate the return drop for consumers.

To address the concern of unobserved variables can affect both stay-at-home activities and bank deposit rate, we use three instrumental variables for lagged weekly county stay-at-home activities: 1. Lagged county weekly new Covid-19 cases; 2. County partisanship based on 2016 and 2020 presidential election results; 3. County's historical Total Border Frontier Experience (TFE). Use two stage least square regression analysis, we evaluation the relationship between stay-at-home activities and bank deposit rate independent of unobserved variables. The first stage outcomes show higher lagged new local cases, higher support for former president Donald Trump in 2016 and 2020 presidential elections and higher total border frontier experience at county level will lead to higher stay-at-home activities. The second stage outcomes provide consistent result with main analysis. Use all three IVs, the result suggests 10% increases in the region's stay at home activities would increase the local branches' deposit rate by 8.35 bp or 20% of national average deposit rate between April 2020 to August 2020 in our sample. Lastly, we run additional robustness checks to control for stock market performance and local fiscal and economic shocks and our findings still hold.

This second part of this paper directly use weekly bank branch visits to proximate consumer physical activities at branch level. Figure 8 shows consumers' bank branch visits dropped significantly after the onset of the Covid-19 pandemic in United State. Comparing to pre-Covid weeks in 2019 and 2020, bank branch visits dropped by 24% in the 12 weeks after the national emergency over Covid-19 pandemic on 13th March 2020. Using cross sectional regression for each week between January 2020 and August 2020, we show branch visits have positive and statistically significant relationships with the deposit rate offered at the branch in 10 out of 12 weeks during the lock down period (From Covid-19 national emergency announcement to last states reopen and ease their restrictions). For weeks before the pandemic and weeks after state lifted restrictions, branch visits do not establish significant relationships with the deposit rates.

This provides direct evidence the search friction's effect on deposit rates concentrates in lock down periods and it is induced by the state social distancing policies.

This paper is related to Levine, Lin, Tai, and Xie (2020), but to address a different research question. They investigate four potential views related with the supply and demand of deposits to explain deposit surge during the Covid-19 crisis. They find bank branch located in high infection rate counties offer lower deposit rate and experience a higher surge in the supply of precautionary savings. This paper directly explores the impact of Covid-19 related social distancing restrictions on bank branch level deposit pricing, after controlling for regional infection rate, both realised demand and supply of deposits. This allows us to evaluate how heterogenous regional social distancing reaction to the same Covid-19 case shock can affect the pricing mechanism of deposit market, independent of the supply and demand. To my best knowledge, this is the first study to explore how change in social distancing restriction directly affect local market physical search.

Lastly, while our findings can draw implications on broader physical search activities in product market during the pandemic, retail deposit has a few appealing features. Unlike most of the financial products, deposits have relatively low risk, wide customer base and are easily accessible to consumers. To further eliminate the risk heterogeneity, we consider a common time deposit product for consumer to analyse bank deposit rate pricing: 12-month certificates of deposit with an account size of $10,000. Since the amount of the deposit product is fully covered by the deposit insurance, we can argue this product is risk free. On the other hand, all commercial banks offer deposits. As of 30/09/2020, total deposits provide funding for 80.52% of the total assets for U.S. banks[2]. In this market, we have more than 5,000 banks and near 90,000 branches offer a homogeneous product to U.S. savers. It enables us to directly explore

[2] As of 30/09/2020, the aggregate value of total assets is $ 21,315,403 million and the aggregate value of total deposits is $17,163,010 million for U.S.'s banks.

how heterogeneity in the physical search activities in response to Covid-19 pandemic would affect the pricing in the market. Furthermore, banks are regarded as essential businesses. While most of states close non-essential business, we can still observe branch-level weekly customer activities for banks which enables us to investigate the dynamic relationship between physical search activities shocks and product pricing for a homogeneous product.

2. Related Literature

2.1 Importance of deposits

First, this paper is related to a broad literature discussing the importance of deposit for banks and financial stability. Past literatures have emphasis deposit plays important roles for bank's liquidity management (Diamond & Dybvig, 1983) and credit supply (Acharya & Mora, 2015) and overall Financial stability (Egan, Hortaçsu, & Matvos, 2017). In addition, Drechsler, Savov, and Schnabl (2017) proposed a deposit channel for the transmission of monetary policy. When fed funds rise, banks widen deposit spread based on their market power. Deposits become less competitive comparing to outside investment options for households. Consequently, funds flow out of deposits and this can lead to contraction in bank's lending. They further claim such channel can account for the entire transmission of monetary policy through bank balance sheets. Deposit spread is one key component determining the effectiveness for transmission of monetary policy in this channel. My findings suggest deposit channel of monetary policy becomes less efficient if banks pose a lower deposit rate and widen the spreads when consumers search less during the pandemic.

2.2 Covid-19 banking papers

Covid-19 crisis does not start as financial crisis, but as rather a health risk induced economic crisis. Unlike the liquidity crisis happened on the onset of Global Financial Crisis between

2007 to 2009[3] , Li, Strahan, and Zhang (2020) show bank successfully accommodated the liquidity demand surges in the early wave of Covid-19 crisis. One of the key reasons listed in their paper is that banks enjoyed historically large deposit inflows. Meanwhile, Levine et al. (2020) attribute the surge in the supply of deposits to precautionary savings. They find the surge further leads to lower deposit rate, particularly for regions are infection rate is higher. Unlike their paper, this paper controls local infection rate and the supply and demand of deposits during pandemic and I find branches in regions where people stay at home longer are offering a lower deposit rate. This paper supplements Levine et al. (2020)'s precautionary savings argument on the supply side and suggests consumers' physical search in deposit market is disrupted by the restrictions on social distancing. Heterogeneity in local stay-at-home activities explains the difference in bank branches' deposit rates dispersion after controlling for precautionary saving.

2.3 Search theory

Lastly, this paper is related to literatures discussing search frictions in product market. There are increasing pool of empirical studies to investigate the impact of search frictions on price dispersion and the consumer welfare in retail financial product markets (Allen, Clark, & Houde, 2019; Honka, Hortaçsu, & Vitorino, 2017; Hortaçsu & Syverson, 2004). In a study on US personal computer industry, Goeree (2008) shows search frictions can lead to incomplete information set for costumers and higher mark-up for firms. Honka (2014) find elimination of search costs is the main lever to increase consumer welfare in the auto insurance industry. Similarly, Allen et al. (2019) find search friction reduce sizable consumer surplus and half of the reduction is associated with search cost use mortgage market data. This paper argues restrictions on social distancing impose additional search cost and constrains for consumer's

[3] For instance, see (Acharya & Mora, 2015) for a detailed analysis of bank liquidity provision and deposit flows during GFC.

physical search activities. Such exogeneous search friction induced by the Covid-19 pandemic could sabotage consumer's search of financial products. Consequently, consumer would reduce their search intensity given the shock and reduce their information set. Sellers, in this case banks, would charge a higher information rent and offer a lower deposit rate given the consumers' reduced search intensity and incomplete information.

3. Hypothesis

There are three potential channels can explain the relationship between consumers' stay-at-home activities and the deposit rate offered by the bank branch in the region (See Figure 9). On one hand, stay-at-home activities can be associated with regional Covid-19 economic shock and affect the characteristics of the product itself like risk and supply. On the other hand, stay-at-home can be viewed as measurement of search activities.

3.1 Risk channel

Covid-19 pandemic proposed unprecedented challenge for banks in March 2020 since firms drew funds on a massive scale from pre-existing credit lines in anticipation of cash flow and financial disruptions (Li et al., 2020). Borrowers' disrupted business operation and cash flows combined with increased leverage could brew into credit risk for banks[4] (Acharya & Steffen, 2020). Correspondingly, depositors may charge additional risk premium for putting deposit into banks face higher exposure. This leads to our first hypothesis:

Hypothesis 1 (risk channel): *If regional stay-at-home activities are positively associated with credit shocks banks encountered, bank will offer a higher deposit rate when consumers in the region stay-at-home more*.

[4] For instance, largest banks increased their provision for credit losses in expectation of increasing credit risks in the first half of 2020. See https://news.bloomberglaw.com/daily-tax-report/big-banks-dial-back-loan-loss-reserves-but-uncertainty-looms.

3.2 Precautionary saving channel

Levine et al. (2020) suggest bank branches in regions with higher Covid-19 infection rates lower their deposit rate more than other branches due to a large surge in the supply of precautionary savings. If the regional stay-at-home activities are positively associated with consumers' precautionary saving behaves, it can increase the local branches deposit supply and lower the deposit rate through the surge in supply. This leads to our second hypothesis:

Hypothesis 2 (precautionary saving channel): *If regional stay-at-home activities are positively associated with local economic shock, consumers may react with a surge in precautionary savings. Consequently, bank will offer a lower deposit rate when consumers in the region stay-at-home more due to the surge in deposit supply.*

3.3 Search channel

When consumers aware of more options and search more, they can find better alternatives (Honka et al., 2017). In the contrast, Covid-19 pandemic can exogenously increase consumers' travel costs, limit physical search capacity, and dampen physical search activities through additional health risk exposure and states government restrictions on social distancing. Reduced search intensity can limit consumer's information set and increase bank's bargaining power against consumers. Consequently, bank will charge a higher information rent and offer lower deposit rate in regions with high consumers search drop. This leads to our third hypothesis:

Hypothesis 3 (search channel): *If regional stay-at-home activities are positively associated with consumer search activities, bank will impose a lower deposit rate when consumers in the region stay-at-home more due to higher information asymmetry.*

4. Data

4.1 Deposit rate

The deposit rate information is provided by RateWatch which collects product-level weekly deposit rate from bank branches on each Wednesday of the week. In the full sample, it covers 17,318 bank branches since 2000. The final sample in this paper have 167,624 observations covering 5,082 bank branches from January 2020 to August 2020. Following Drechsler et al. (2017), this paper use one of the most common time deposit products to analyse bank deposit rate pricing: 12-month certificates of deposit with an account size of $10,000 ($10K 12-month CDs).

4.2 Mobile data

The mobile data used in this paper is provided by SafeGraph. It tracks 20 million devices and foot traffic information of 6 million venues/points-of-interest (POI) in US since 2019. Specifically, two mobile datasets are used to both indirectly and directly capture consumer's physical search activities in this paper :1. Social Distancing Metrics; 2. Weekly Patterns.

We use Social Distancing Metrics to indirectly measure the consumer's physical search of deposits by capturing bank branches' located county's stay-at-home activities. It summarises daily stay-at-home activities at a census block group level since 2019. The dataset covers 99% of the census block group in United States. To match it with other data, I aggregate the data to weekly county level. For each census block group, the data provides information on medium level of hours stay at home activities. I recalculate the medium stay-at-home activities of the county across all census block groups for each day. Then, for each week, I choose the average stay-at-home activities on weekdays to get the final county level weekly stay-at-home information. In the main analysis, I only include weekdays activities for two reasons. First, weekend stay at home activities would be irrelevant with consumers' physical search for bank

products since banks branches are generally closed on weekends. Second, weekend stay at home activities are less affected by restrictions on social distancing and much less informative in general. Nevertheless, the results are consistent when I use the average of full week observations.

On the other hand, Weekly Patterns is used to directly measure the consumer's physical search of deposits by capturing bank branches' foot traffic. It provides the weekly foot traffic information for 6 million POI since 2019. I match the locations of banks branches specified in FDIC's Summary of Deposit Data with POI use bank name and branch address information. 45,554 bank branches are matched in the POI sample, 53% of bank branches in US. Since mobile data does not capture the foot traffic of branch visits for the whole branch customer population, rather than using the level of visits in the data, I calculate the weekly relative visits of bank branches in 2020 comparing to its 2019 average.

$$Relative\ Branch\ Visits_{b,t} = \frac{Branch\ Visits_{b,t}}{Average\ weekly\ branch\ visits\ in\ 2019}$$

Figure 8 compares national average weekly bank branch visits in 2019 versus national average visits in 2020 in our mobile sample. In the first eleven weeks, national average is higher in our sample. Starting from week 12, the week after the national emergency over Covid-19 pandemic, bank branch visits drop significantly and did not pick up until states progressively reopen. It is not until week 24, the bank branch visits recovered and became parallel to 2019 level. Figure 1 illustrates stat- level social distancing restriction policies responding to the first wave of case surges in United States since March 2020. Most state level state of emergency announcement is close to the date national emergency announcement except the early hit States like Washington and California. In late March, most states introduced non-essential business closure and stay at home announcements. From late April to early June, states started to progressively reopen and to ease restrictions. On the other hand, Table 1 demonstrates the

average bank branch visits before and after the U.S. national emergency announcement. Using different windows between 4 weeks to 24 weeks, the reduction in consumers' bank branch visits drops between 17% to 28%. This provides direct evidence that pandemic lock down policies lead to reduced bank branch physical search activities. This paper defines the first wave lock down period in response to Covid-19 pandemic as the 12 weeks starting from the U.S. national emergency announcement (i.e., the week after U.S. national emergency announcement to the last state reopened), which captures the period consumer face the most severe shock on their search activities. In our lock down period, consumers' bank branch visits drop by 24% comparing to pre-Covid scenario.

4.3 Other data

We gather daily county Covid-19 confirmed cases and new cases from Johns Hopkin Coronavirus Resource Centre. 2016 and 2020 presidential election county level data is collected from MIT Election Lab (MIT, 2021). To control for stock market performance, we gathered daily volatility and return information on S&P 500 index. To control alternative online search method, we gathered the daily level of internet search on deposit using Google Trend at state level. Finally, to control for the local economic shock induced by Covid-19 and corresponding government fiscal policy's impact, we collect loan level Paycheck Protection Program loan information from Small Business Administration (SBA).

We obtain commercial bank's information from their call reports. Specifically, we collect information on each commercial bank's reliance on deposit financing (Total deposit/Total liabilities), leverage ratio (Total equity/Total assets), credit risk (Loan Loss Allowance/total loans), bank size (Total assets) and loan change (Total $loan_{t-1}$/Total $loan_{t-1}$). Banks are two-sided financial intermediations. Bank loan change on the asset side can capture the banks' demand for deposits. Therefore, we use the quarterly loan change to control the demand of deposit during the pandemic. The Federal Deposit Insurance Corporation (FDIC) provides

information on branch level deposits holdings for all FDIC-insured institutions by June each year in its Summary of Deposits (SOD) dataset. I use the deposit amount change from 2019 to 2020 in each branch to proxy the supply of deposit during the pandemic.

Lastly, we collect county-year level socioeconomics information including metropolitan information, gender ratio, average age, racial composition, median income, poverty, population, education level and internet access from U.S. Census. We also collect county unemployment data from U.S. Bureau of Labor Statistics.

5. Empirical results

5.1 Stay-at-home activities

Baseline

In the baseline analysis, I explore how lagged bank branch located county's stay-at-home activities will affect the deposit rate offered by the branch after controlling the local Covid-19 confirmed cases like Levine et al. (2020). The sample period is from January 2020 to August 2020 and data frequency is weekly.

Table 2 shows the simple OLS regression outcomes of lagged stay-at-home activities on bank deposit rate after control for state-week fixed effects and local infection. Column (1) and (2) covers the regression results in full sample. Column (1) only uses lagged confirmed cases and finds consistent results with Levine et al. (2020). Column (2) introduces the variable of interest in this paper: lagged bank branch located county's stay-at-home activities. After control for the confirmed cases, lagged stay-at-home activities are negatively related with bank branch's deposit rate which rejects our hypothesis 1 (risk channel).

To take in account the effect of fiscal policy during our sample period, namely The Coronavirus Aid, Relief, and Economic Security Act, which is a $2.2 trillion economic stimulus bill passed by the 116th U.S. Congress and signed into law by Former President

Donald Trump on March 27, 2020 in response to the economic fallout of the COVID-19 pandemic in the United States, Column (3) to (6) repeat the same analysis in subsamples based on the before and after the release of CARES Act. The coefficients of stay-at-home activities remain negative and statistically significant at 1% level in both sub sample periods.

Nevertheless, banks would change their deposit rate in respond to changes in Fed Fund rate. In March 2020, the Federal Reserve Bank cut federal funds rate twice by a total of 150 basis points. To reflect the fed rate changes, I use an alternative rate variable: mark-up/deposit spread. Specifically, we define deposit mark-up as following:

$$Markup_{br,c,t} = (Rate_{br,c,t} - FF_t)/(1 + FF_t)$$

Table 3 repeats the analysis in Table 2 using this alternative specification for deposit rate and finds consistent results.

Main analysis

In this part, we further introduce bank level controls and county controls to the baseline. Specifically, I evaluate the relationship between stay-at-home activities and deposit rate use the following regression:

$$Rate_{br,c,t} = \alpha_0 + \beta_1 Ln(Cases\ per\ capita)_{c,t-1} + \beta_2 Stayathome_{c,t-1} + branchcontrls + bankcontrols + countycontrols + \alpha_{state,t} + \varepsilon_{c,t}$$

All standard errors are clustered at state level.

Table 4 illustrates the regression outcome of the main result use both specifications for bank deposit rate. Consistently, lagged bank branch located stay-at-home activities are negatively related with branch deposit rate offered in following. Bank size is negatively related with deposit rate bank branch offers which indicates large banks use their market power to extract more rent in the deposit market. On the other hand, we find the relationship between bank's

credit risk and its deposit rate are not statistically significant related. This finding further rejects Hypothesis 1: risk channel. This is consistent with our choice of deposit product. Since 12-month certificates of deposit with an account size of $10,000 is fully covered by deposit insurance, even bank defaults, depositors can fully recover their claims through FDIC. Therefore, bank's credit risk is not relevant to the deposit pricing.

Deposit supply and local competition

In the first half of 2020, banks in U.S. experienced historical surge of deposit inflow (Levine et al., 2020). When bank branches experience high supply of deposits, they will lower deposit rate. To consider of deposit supply at branch level, we use the change of deposit amount from June 2019 to June 2020 using SOD data. Meanwhile, deposit market is localised for U.S. banking industry. Local competition of bank branches can also impact the deposits rate. Table 5 adds deposit supply change and local branch competition to our main analysis specification as well as their interactions with lagged confirmed cases and lagged stay-at-home activities. Column (2) of Table 5 demonstrates after control for deposit supply, the relationship between lagged stay-at-home activities and bank deposit is negative. This provides direct evidence support our hypothesis 3 (search channel). Consistent with Levine et al. (2020), we find banks offer lower deposit rate when they receive higher surge of deposit inflows. In addition, the coefficient on the interaction between lagged stay-at-home and deposit change is negative. This indicates the reduced physical search activities amplifies the deposit supply shock during the pandemic. 10% increase in stay-at-home activities at bank branch located county would further intensify the deposit rate drop given same increased supply by 3.4%. On the other hand, the coefficient of local competition is positive and statistically significant. Increasing the number of the bank branches in the local market would increase the deposit rate offered in the region due to a more competitive local market. More interestingly, the coefficient on the interaction term between stay-at-home activities and local competition is negative. Stay-at-home activities

would reduce the bank deposit more in a more competitive market compare to a less competitive market. While reduced search activities induced by Covid-19 pandemic creates a negative exogenous shock on local competition, the marginal benefit is higher for banks in a more competitive market.

Online Search

The key focus of the paper is how reduced physical search intensity from consumers can influence the pricing strategy of banks on their deposit during the pandemic. Nevertheless, consumers can use online search to substitute the constrained physical search activities. For instance, Figure 10 demonstrates the search activities on Google in US increases dramatically during our defined lock down period. Since most of the U.S. remained in lock down in early April (see Figure 1 for states policies), consumers switch from physical search to online search as alternative search method.

Online search is important for our analysis for two reasons. First, as a rising search approach, one may interest in how online search can affect bank's pricing strategy. Second, it is valuable to test if online search can serve as perfect substitute for physical search when physical search is severely restrained.

To explore the effectiveness of online search, we repeat our main analysis by including the lagged weekly Google search of the term "deposits" in the branch's located state. In column (1) of Table 8 shows deposit rate offered by the branch is still negatively related with lagged local stay at home activity after controlling online search intensity. Therefore, online search cannot search as perfect substitute for physical search in the deposit market. Nevertheless, deposit rate offered by the branch is positively related with online search intensity. This indicates online search can *partially* mitigate the deposit rate drop induced by consumers' the constrained physical intensity.

Instrumental variable

Nevertheless, previous analysis may not enough due to potential concern of endogeneity and unobserved variables affect both deposit rate and regional stay at home activities. In this section, I use three instrumental variables to conduct two stage least square regression and address such concerns.

New cases

Households will stay at home longer when there are new cases in the region last week. Figure 12 demonstrates counties report new cases last week have 11% higher stay-at-home activities than counties report no new cases last week. That is households in counties with new cases last week spend 2.6 hours longer at home comparing to households in no new cases counties. On the other hand, number of new cases last week is not likely to directly influence bank's deposit rate after controlling for the total confirmed cases. Therefore, we use bank branch located county's weekly new cases *two weeks before* the deposit rate pricing as the first IV for the *one week* lagged stay-at-home activities.

Partisanship

Previous studies have shown areas with more Republicans engaged in less social distancing (Allcott et al., 2020). We also observe a consistent result in our sample (Figure 6 & 7 compare Covid-19 exposures and stay-at-home responses in Arkansas (Republican dominated state) Versus California (Democratic dominated state)). On the other hand, to my best knowledge, there is no direct evidence that regional partisan difference would affect bank's pricing strategy. Therefore, I use the county level partisanship to serve as our second instrumental variable for stay-at-home activities.

Specifically, we calculate the former president of United States of America Donald Trump's vote lead against his Democratic opponent in each county for both 2016 presidential election and 2020 presidential election.

$$Trump\ Lead_{c,t} = \frac{Trump\ votes_{c,t} - Democratic\ candidate\ votes_{c,t}}{Total\ votes_{c,t}}$$

Then we separate the observations into ten deciles for both elections and create IV: *Trump lead Decile*, which range from 1 to 10. Table 6 shows the Two Stage Least Square regression results using both *Trump lead Decile2016* and *Trump lead Decile2020*. We find consistent results with our main findings using both elections' IVs. Bank branch located county stay-at-home activities are negatively related with branch's deposit rate in the second stage results. Nevertheless, 2020 election Trump lead appears to be a stronger predictor for county stay-at-home activities in the first stage analysis. In the second stage analysis, the magnitude of coefficient on stay-at-home activities is larger using 2020 election results comparing to coefficient using 2016 election results. This is reasonable given 2020 presidential election is more recent, and Covid-19 is one of the key agendas in 2020 election debate. Consequently, 2020 presidential election *Trump lead Decile* is used as the IV for later part of IV analysis.

Total Border Frontier Experience (TFE)

Bazzi, Fiszbein, and Gebresilasse (2020a) suggest Counties with greater border frontier exposures exhibit more pervasive individualism. Following studies have shown this can explain heterogeneity in the social distancing across regions during the pandemic (Bazzi et al., 2020b; Bian, Li, Xu, & Foutz, 2020). Meanwhile, it is not likely a county's individualism level would directly impact the pricing of deposit product within the region. Therefore, I apply the total border frontier experience (TFE) as in Bazzi et al. (2020a) for each bank branch's located county as our third instrumental variable for that county's stay-at-home activities.

Table 7 illustrates the second stage results of two stage least regressions using three instrumental variables individually as well as combined using deposit rate. Like the main analysis, we control for state fixed effects, bank characteristics and county social economics features in the regression. The coefficients of lagged bank branch located county's stay-at-home activities are all statistically significant and negative. For instance, column 4 of Table 8 demonstrates the second stage outcome of two stage least regressions using all three instrumental variables. The combined IVs pass over identification test at 1% confidence level. The result suggests 10% increases in the region's stay at home activities would increase the local branches' deposit rate by 8.35 bp or 20% of national average deposit rate between April 2020 to August 2020 in our sample.

5.2 Bank branch visits

In the previous section, the physical search intensities are indirectly measured by each bank branch located county's stay-at-home activities. In this section, I use a direct measure of consumers' physical search intensities by calculating the weekly branch's visits in 2020 relative to its average visits in 2019 for each branch.

Then, I evaluate the relationship between lagged branch visits and deposit rates in cross sectional regressions for each week from January 2020 to August 2020. Figure 11 demonstrates the value and 95% confidence interval of the coefficient on branch visits for each week in our sample period. In the first 11 weeks of 2020, there are no statistically significant relationship between branch visits and deposit rates expect one week. Starting from week 12, after the national emergency over Covid-19 pandemic, the coefficients of bank branch visits on deposit rates remain positive and statistically significant until states reopen. The coefficients become indifferent with zero and statistically insignificant after our defined lock down period. This finding supports search channel and suggests Covid-19 pandemic directly shocks consumers'

search activities through lock down policies and banks offer higher deposit rates when they receive more visits in the week before.

6. Robustness Check

6.1 Stock market performance

The stock market experiences high level of volatility in 2020, mainly due to the pandemic. Lin (2020) suggests there could be substitution between deposits and stock market investment by investors. The stock market performance can affect the deposit market through two channels. One channel is flying to safety channel. Volatile performance in the stock market can lead to retail investors flee out of equity market into deposits. This increases the supply of deposits and reduce the deposit rate. The other channel is limited attention. When market performs well, retail investors may put less attention on other financial products and vice versa. To control for both channels, I include two additional controls variables into the previous main analysis: *Stock volatility*$_{t-1}$ and *Stock total return*$_{t-1}$.

Column (2) of Table 8 illustrates that after introducing the lagged stock market performance, deposit rate offered by the branch is still negatively related with lagged local stay at home activity. The coefficient of stock volatility is negative and statistically significant, which supports the flying to safety channel. The coefficient of stock total return is negative and statistically significant, which supports the limited attention channel.

6.2 Local economic shock

As of 8th August 2020, 5,212,128 loans have been approved, providing $525 billion to small businesses through Paycheck Protection Program (PPP). PPP loans are government sponsored lending targeting small businesses struggle with business operations during the pandemic. Follow Levine et al. (2020), we use weekly accumulated PPP loans in bank located county to proximate the magnitude of local economic shock not captured by number of confirmed cases.

In column (3) of Table 8, deposit rate offered by the branch remains negatively related with lagged local stay-at-home activity after controlling local economic shocks triggered by the pandemic. Nevertheless, the explanation power of confirmed cases becomes positive and statistically insignificant once we introduced this direct proxy of economic shock. Counties have a higher PPP loan values are more impacted by the pandemic. Surge of deposit supply leads to a lower deposit rate through precautionary saving channel as discussed by Levine et al. (2020).

7. Discussion

This paper explores the impact of Covid-19 related social distancing restrictions in the 15.6 trillion U.S. deposit market. Use weekly data on stay-at-home activities on county level and weekly branch level foot traffic, we investigate local bank branches' response to their customers' reduced activities. Consistent with search channel, we find banks offer lower deposit rate in branches with lower branch visits and in regions with higher stay-at-home activities, after control for the realised changes in the demand and the supply of deposits. Moreover, more social distancing leads to larger deposit rate drops when deposit surge at the branch level is greater during the pandemic and when local market is more competitive. In both conditions, marginal benefit of search is higher, and banks charge a higher information rent when consumers' physical search activities are dampened by social distancing restrictions. In a week-by-week cross-sectional analysis, we further show the relationship between bank customer branch visits and deposit rate concentrates during the first wave of lock down period in U.S., which provide further evidence the effect is induced by the search frictions related to social distancing restrictions.

Another key finding in this paper is online find can only partially mitigate the exogeneous shock on physical search frictions during pandemic. The fact online search is not fully effective could be explained by two reasons. First, U.S. consumers have not fully adopted online banking.

Brick and mortar banking remains a major part of U.S. banking services. As of 23/01/2021, 86,357 branches in US. Potential switching cost from physical search to online search could be high for a full transmission in the whole population. Secondly, online search could be limited for consumers located in areas with poor internet access. De los Santos, Hortaçsu, and Wildenbeest (2012) find having a broadband connection decreases search costs when they explore consumers web browsing and purchasing behaviour using online stores. Chiou and Tucker (2020) suggest the digital divide could explain the inequality in people's ability to self-isolate and remote working behaviours. The same digital divide could explain the inequality in people's ability to online search. Increasing internet access may mitigate the heterogeneous effect of Covid-19 pandemic on the consumer products' price dispersion.

Lastly, Drechsler et al. (2017) propose a deposit channel of monetary policy transmission and claims it can explain most of transmission through bank balance sheet. Based on that channel, lower fed rate during the Covid-19 crisis could lead to lower deposit spread and attract more deposits inflows. Therefore, everything else being equal, lock down policies may sabotage such deposit channel by allowing branches widen the spread in response to customers' lower search activities and consequently attract less deposit inflows comparing to a counterfactual scenario that consumers' physical search activities are unrestricted or online search can serve as a perfect substitute for physical search.

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Figures and Tables

Figure 1

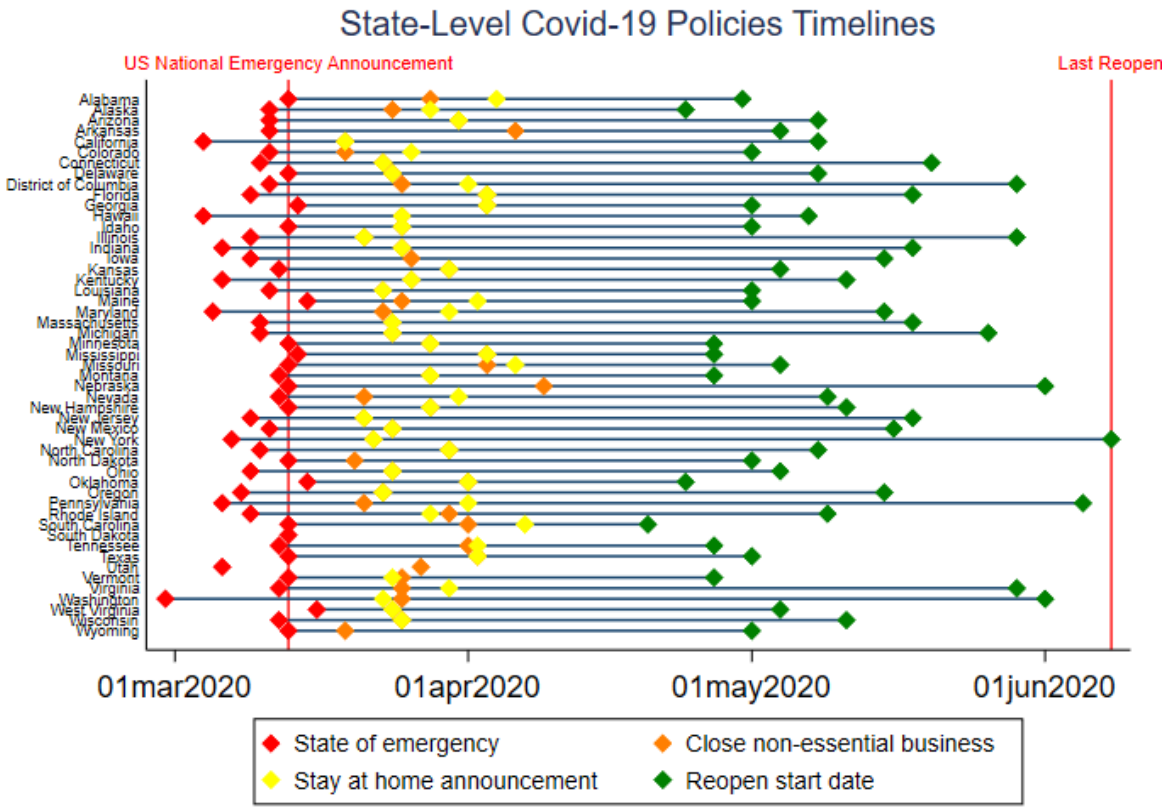

Figure 2

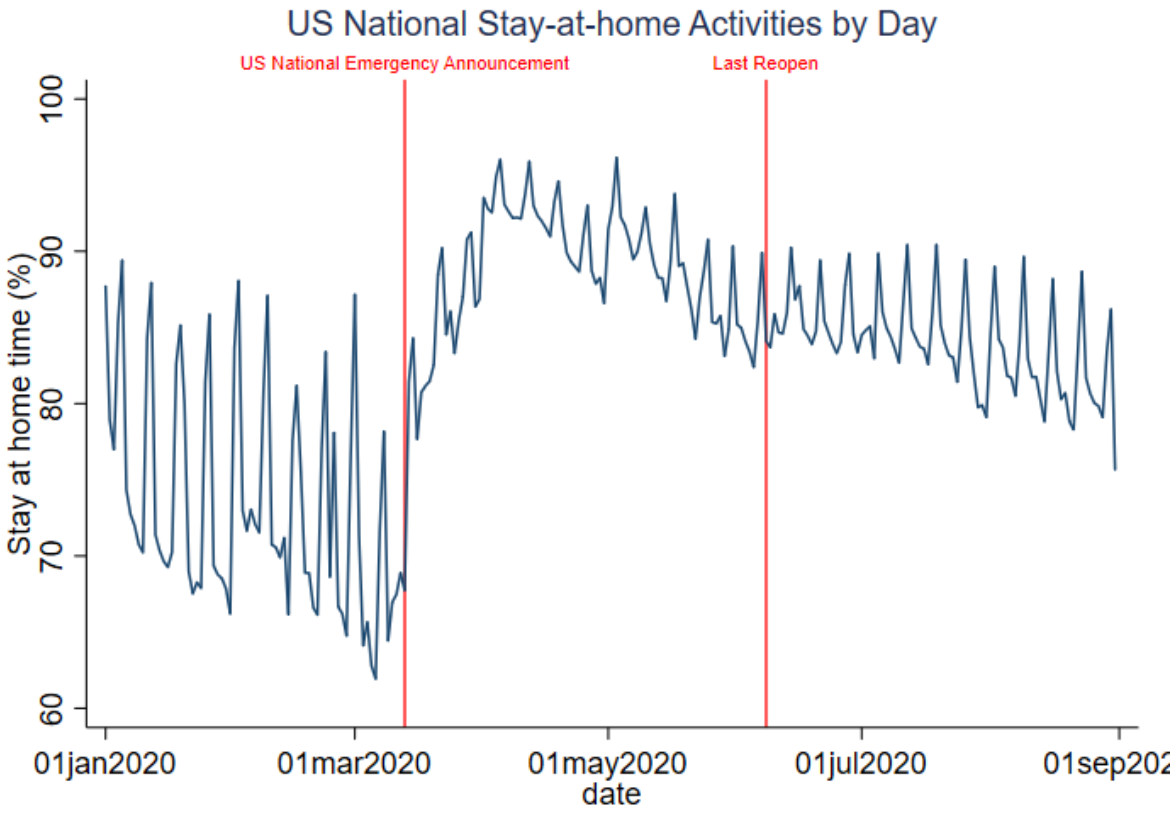
US National Stay-at-home Activities by Day
US National Emergency Announcement
Last Reopen
Stay at home time (%)
100
90
80
70
60
01jan2020
01mar2020
01may2020
01jul2020
01sep202
date

Figure 3

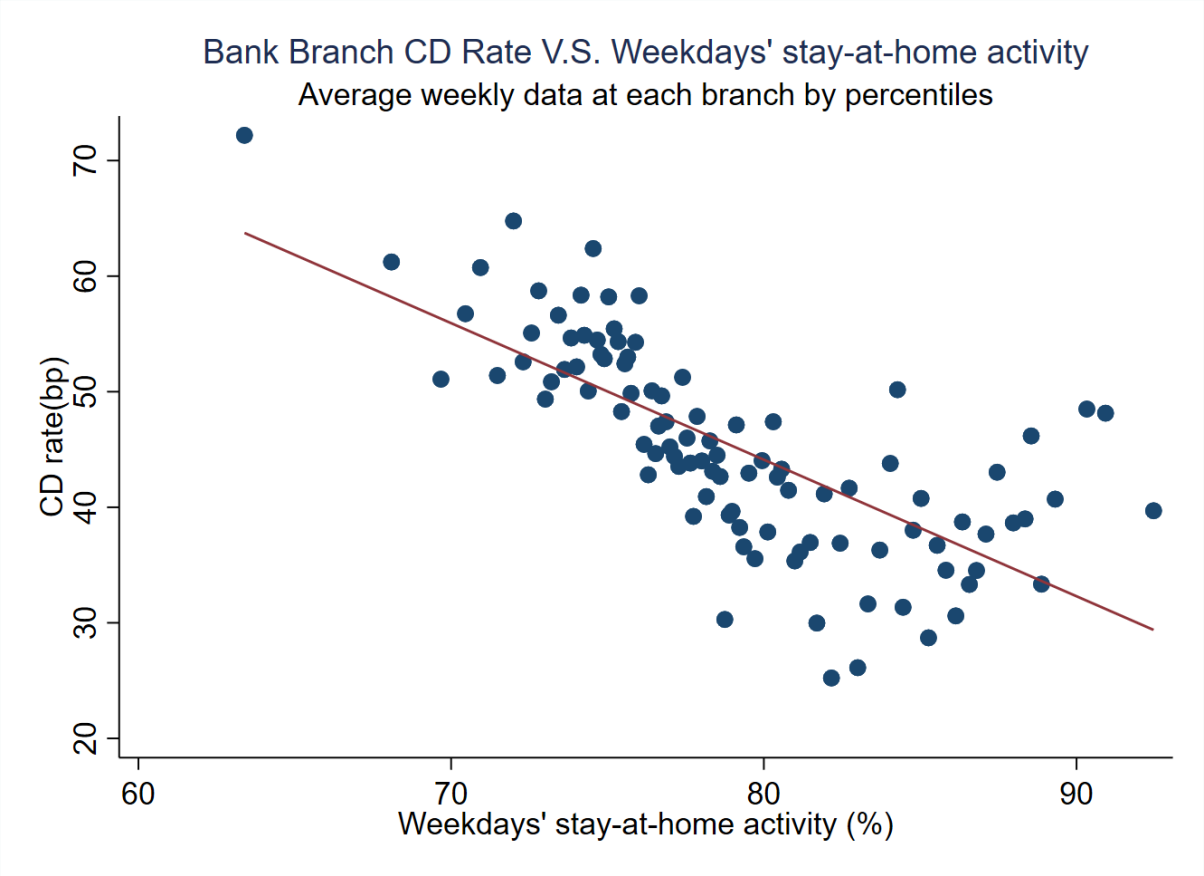
Bank Branch CD Rate V.S. Weekdays' stay-at-home activity
Average weekly data at each branch by percentiles
CD rate(bp)
20
30
40
50
60
70
60
70
80
90
Weekdays' stay-at-home activity (%)

Figure 4

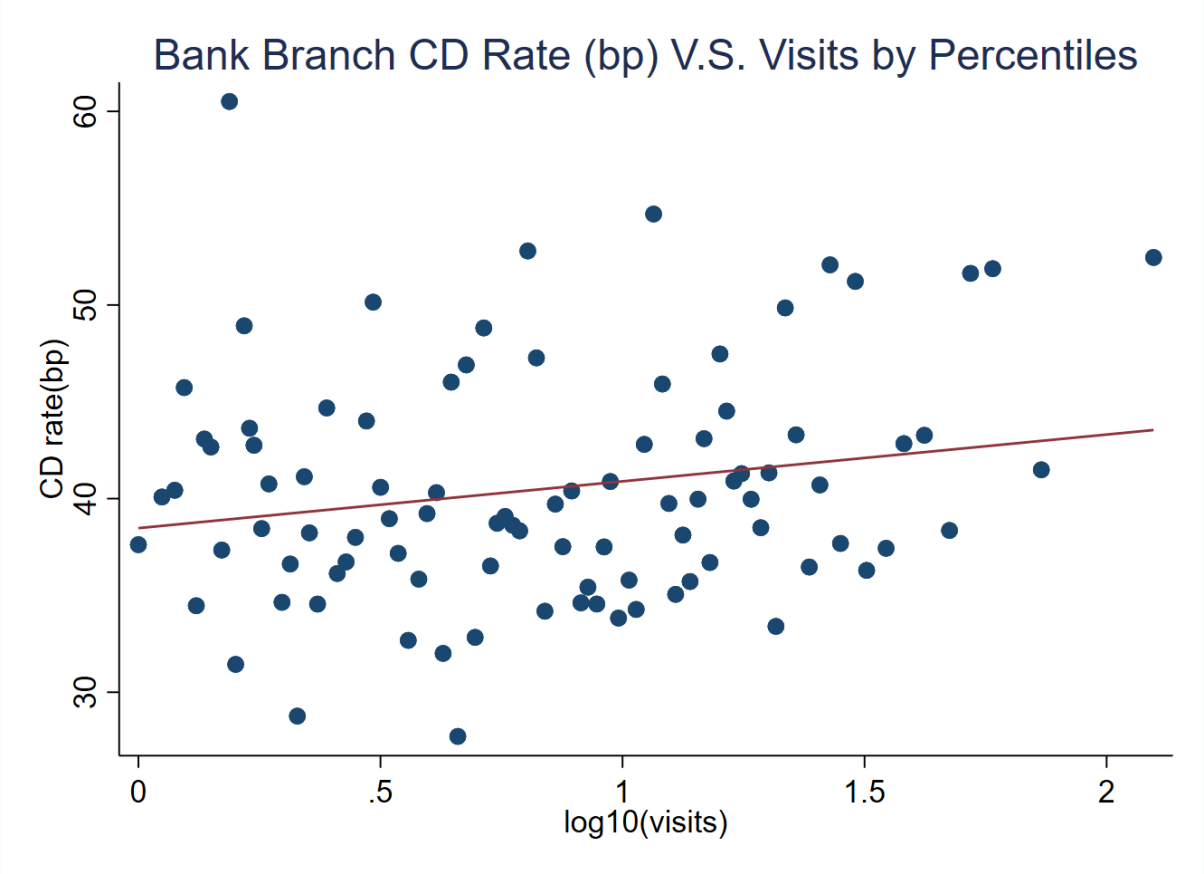
Bank Branch CD Rate (bp) V.S. Visits by Percentiles
CD rate(bp)
30
40
50
60
0
.5
1
1.5
2
log10(visits)

Figure 5: Two bank customers' physical search measures.

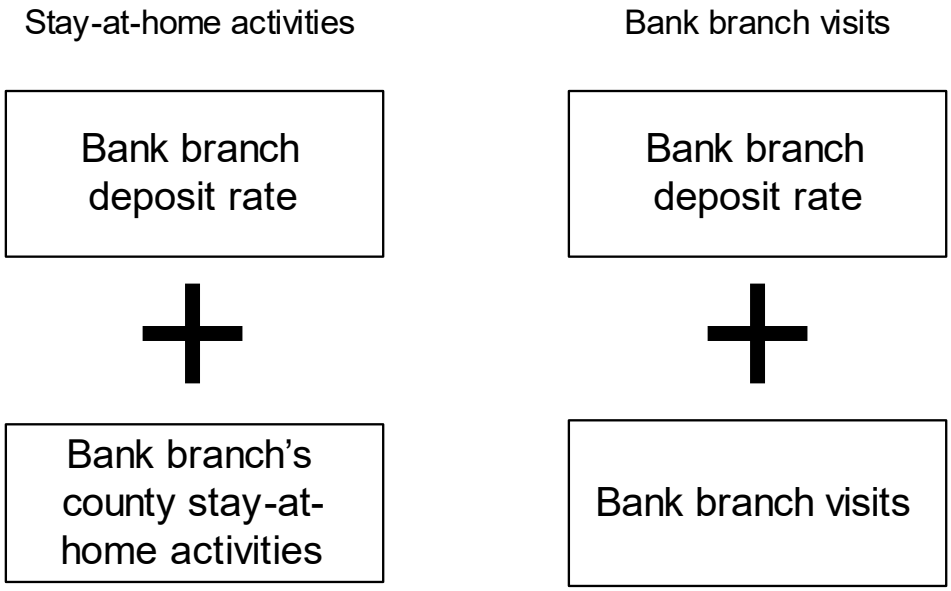

Figure 6: Daily new cases (Arkansas Versus California)

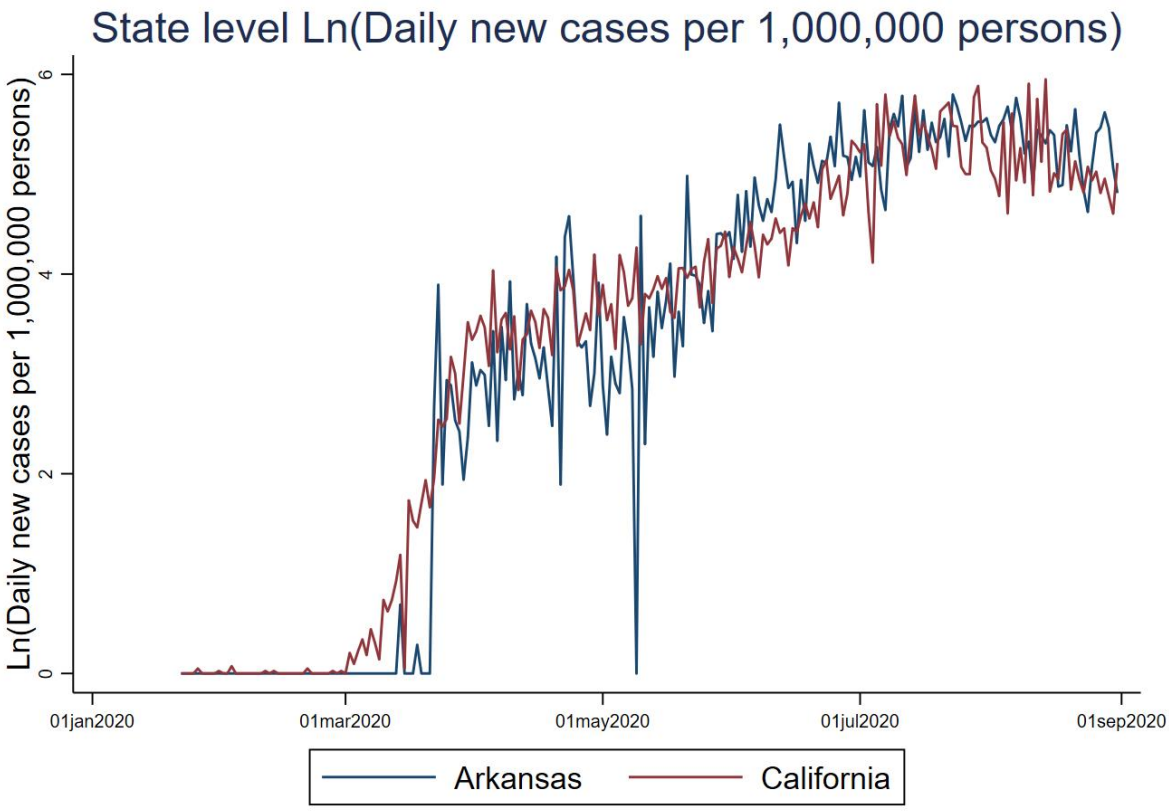

Figure 7: Daily stay-at-home activities (Arkansas Versus California)

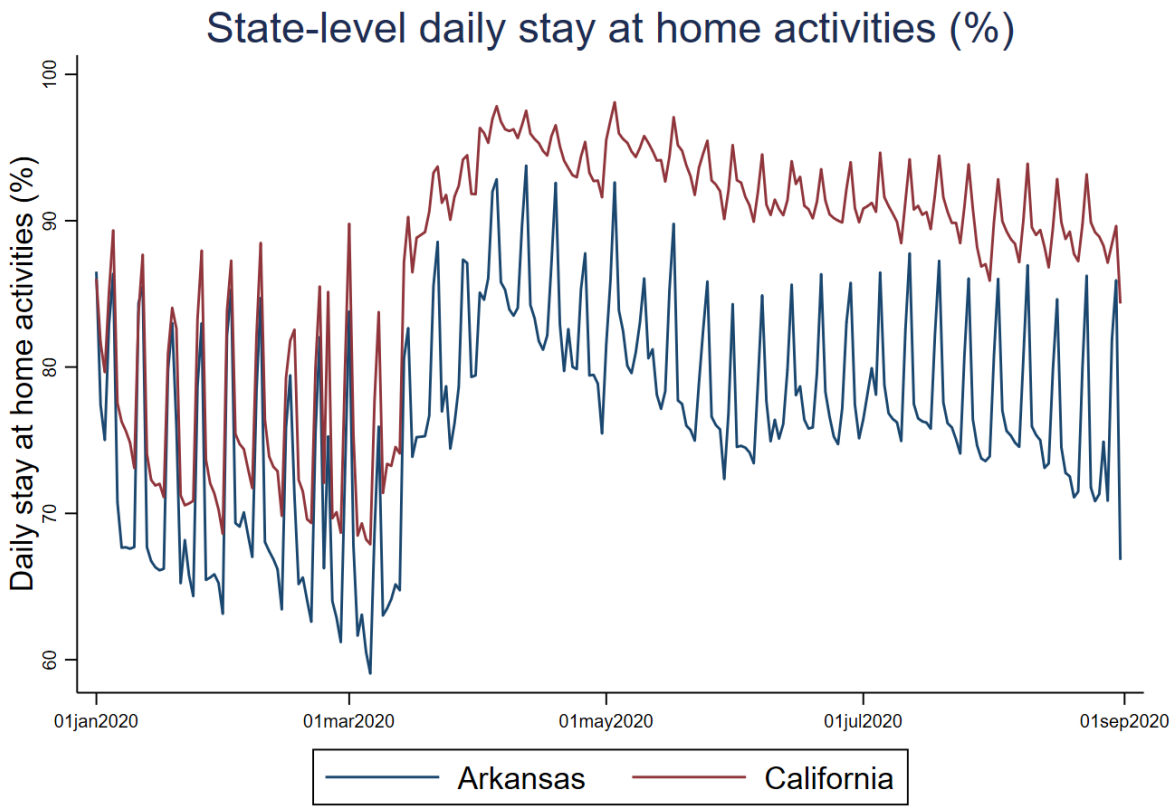

Figure 8

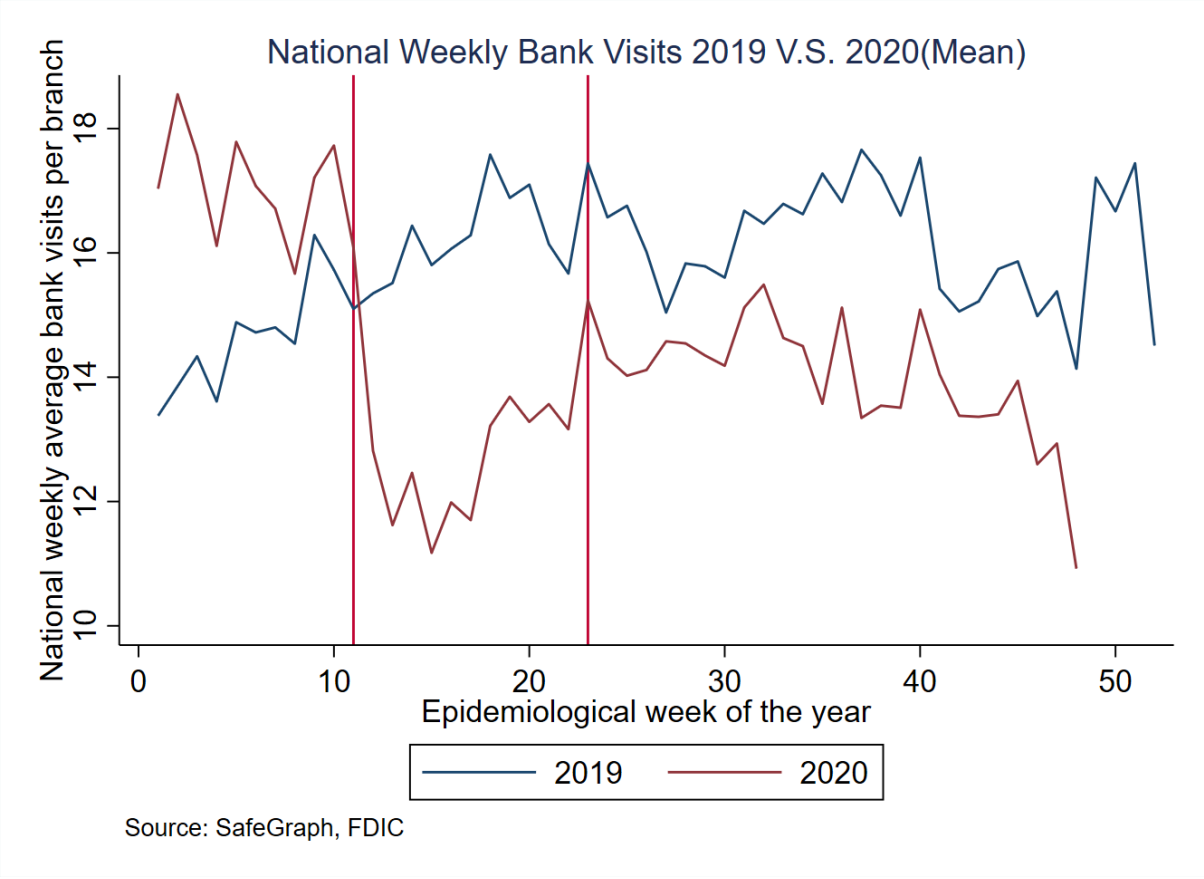
National Weekly Bank Visits 2019 V.S. 2020(Mean)
National weekly average bank visits per branch
10
12
14
16
18
0
10
20
30
40
50
Epidemiological week of the year
2019
2020
Source: SafeGraph, FDIC

Figure 9: Three hypothesis

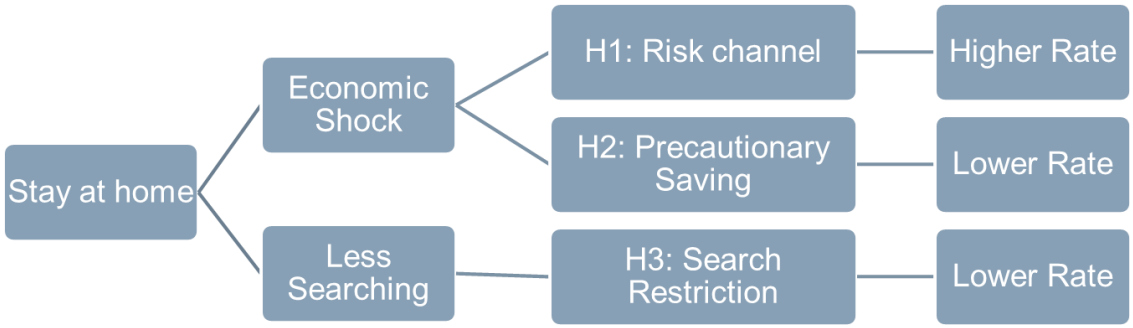

Figure 10

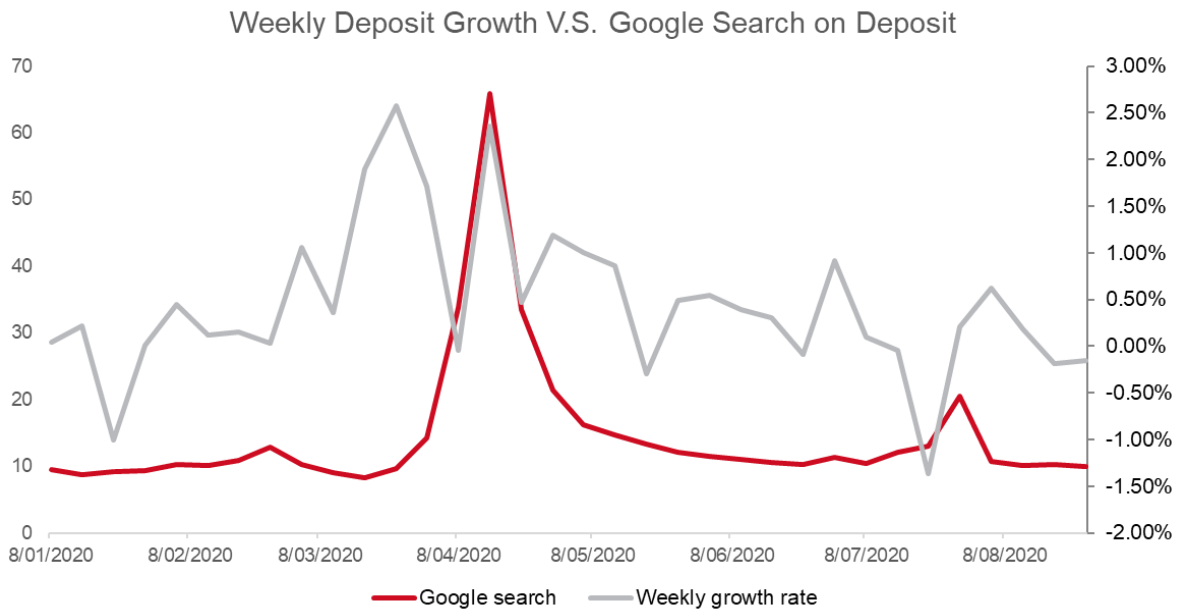
Weekly Deposit Growth V.S. Google Search on Deposit
70
60
50
40
30
20
10
0
3.00%
2.50%
2.00%
1.50%
1.00%
0.50%
0.00%
-0.50%
-1.00%
-1.50%
-2.00%
8/01/2020
8/02/2020
8/03/2020
8/04/2020
8/05/2020
8/06/2020
8/07/2020
8/08/2020
Google search
Weekly growth rate

Figure 11: Coefficient of bank branch visits on bank branch deposit rate in cross-sectional regressions week by week.

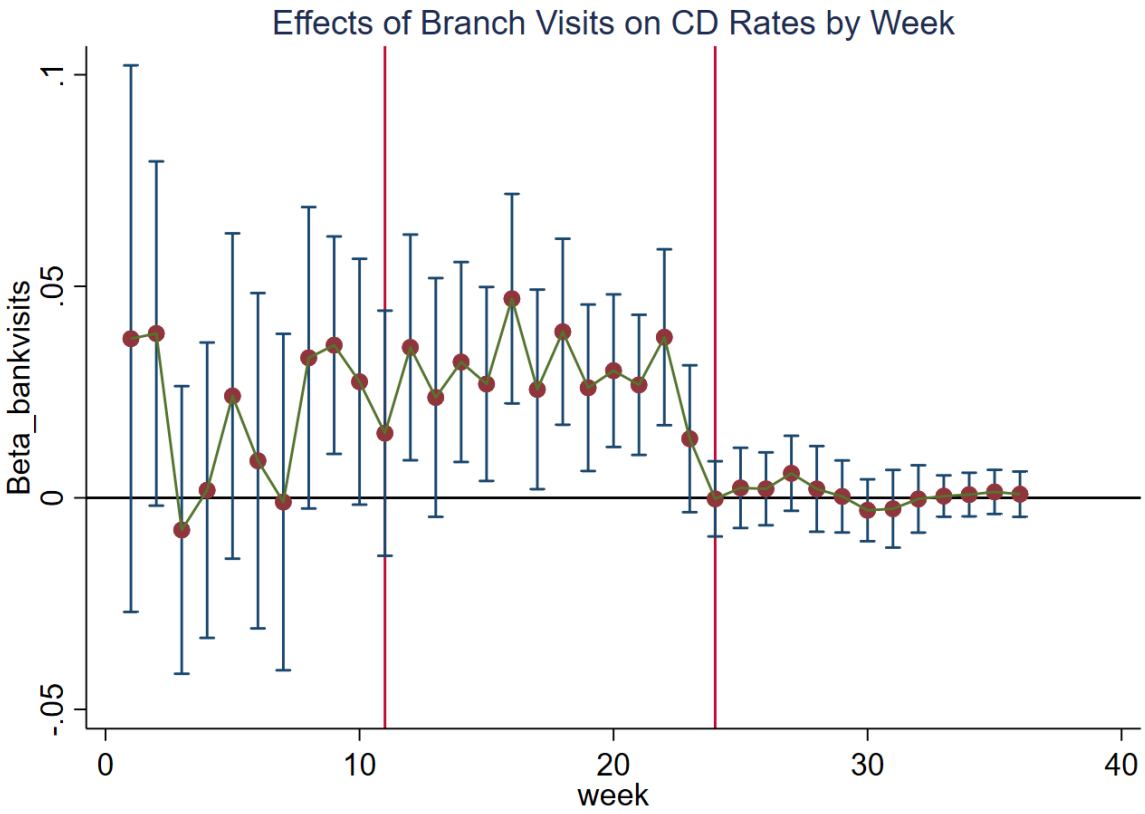

Figure 12: Lagged new cases V.S. Stay at home activities.

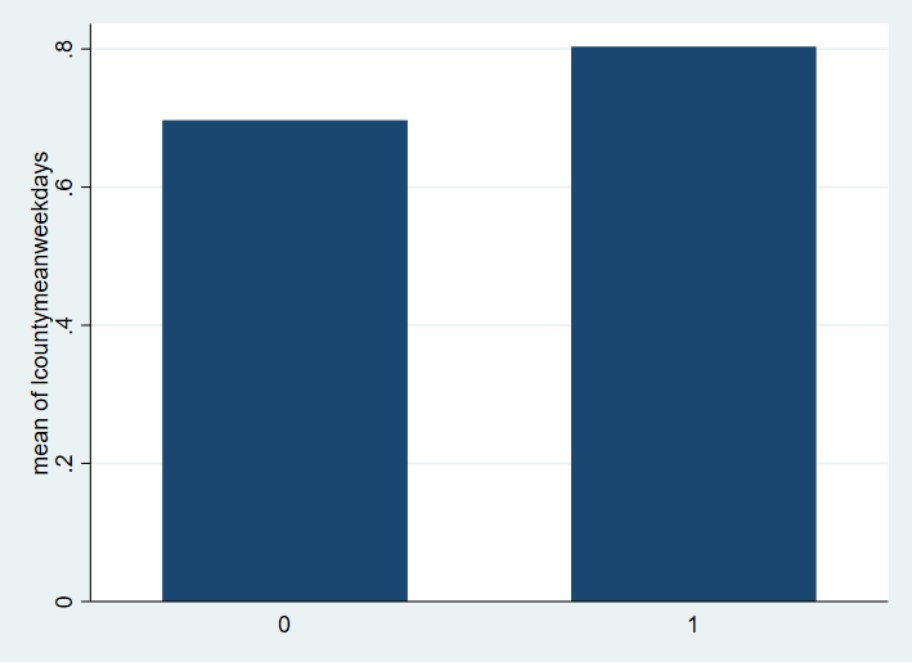

Table 1 : National average bank branch visits before and after 13th March 2020

	4 weeks	8 weeks	12 weeks	24 weeks
Visits Before	16.67	16.80	16.84	16.36
Visits After	12.02	12.33	12.83	13.64
Change	-28%	-27%	-24%	-17%

Table 2: baseline model (deposit rate)

	Rate					
	Full sample		Before CARE		After CARE	
	(1)	(2)	(3)	(4)	(5)	(6)
Lag_ln(casespercap)	-2.281***	-0.880	-4.434***	-2.436***	-1.937***	-0.666
	(-3.87)	(-1.50)	(-5.22)	(-2.62)	(-3.22)	(-1.11)
Lag_stayathome		-52.774***		-60.267***		-49.664***
		(-7.01)		(-4.92)		(-6.75)
State-week FE	X	X	X	X	X	X
Observations	150444	150444	44706	44706	105731	105731
R-square	0.274	0.278	0.171	0.173	0.135	0.142

Table 3: baseline model (Markup)

	Markup					
	Full sample		Before CARE		After CARE	
	(1)	(2)	(3)	(4)	(5)	(6)
Lag_ln(casespercap)	-2.270***	-0.887	-4.363***	-2.447***	-1.938***	-0.667
	(-3.85)	(-1.52)	(-5.16)	(-2.66)	(-3.22)	(-1.11)
Lag_stayathome		-52.095***		-57.774***		-49.642***
		(-6.97)		(-4.83)		(-6.75)
State-week FE	X	X	X	X	X	X
Observations	149147	149147	43409	43409	105731	105731
R-square	0.654	0.655	0.584	0.585	0.159	0.165

Table 4: main analysis

	Rate	Markup
	(1)	(2)
$Confirmed\ Cases_{t-1}$	0.672	0.668
	(1.29)	(1.29)
$Stay\ at\ home_{t-1}$	-16.913**	-16.638**
	(-2.13)	(-2.11)
Size	-0.883***	-0.874***
	(-10.68)	(-10.64)
Loan loss allowance/	9.945	6.403
Total loan	(0.14)	(0.09)
Bank controls	X	X
County controls	X	X
State-week FE	X	X
Observations	127481	126332
R-square	0.347	0.667

Table 5: deposit supply change and local competition

	Rate		Markup	
	(1)	(2)	(3)	(4)
$Confirmed\ Cases_{t-1}$	-0.508	-0.012	-0.495	-0.022
	(-1.06)	(-0.03)	(-1.03)	(-0.04)
$Stay\ at\ home_{t-1}$		-25.909***		-25.604***
		(-2.99)		(-2.98)
$\Delta Deposit_{2019-2020}$	-0.811***	-0.679***	-0.800***	-0.658***
	(-18.87)	(-6.68)	(-18.87)	(-6.61)
$Confirmed\ Cases_{t-1} * \Delta Deposit_{2019-2020}$	0.118***	0.150***	0.115***	0.147***
	(15.20)	(13.60)	(15.02)	(13.45)
$Stay\ at\ home_{t-1} * \Delta Deposit_{2019-2020}$		-0.233*		-0.246**
		(-1.96)		(-2.09)
Local competition:	0.016***	0.052**	0.016***	0.049**
(County branch counts in 2019)	(2.59)	(2.36)	(2.58)	(2.31)
$Stay\ at\ home_{t-1} * Local\ competition$		-0.042**		-0.039**
		(-2.13)		(-2.06)
State-week FE & controls	X	X	X	X
Observations	87449	87449	86318	86318
R-square	0.319	0.321	0.692	0.693

Table 6: partisanship

	2016 Election			2020 Election		
	First stage	Second stage		First stage	Second stage	
	$Stay\ at\ home_{t-1}$	Rate	Markup	$Stay\ at\ home_{t-1}$	Rate	Markup
	(1)	(2)	(3)	(4)	(5)	(6)
Trump lead Decile	-0.456***			-0.469***		
	(-73.39)			(-74.52)		
$Confirmed\ Cases_{t-1}$	0.010***	1.453***	1.430***	0.010***	1.682***	1.654***
	(33.07)	(7.03)	(6.99)	(32.87)	(8.16)	(8.10)
$Stay\ at\ home_{t-1}$		-70.463***	-69.199***		-86.208***	-84.645***
		(-7.46)	(-7.43)		(-9.20)	(-9.16)
Bank controls	X	X	X	X	X	X
County controls	X	X	X	X	X	X
State-week FE	X	X	X	X	X	X
Observations	127481	127481	126332	127481	127481	126332
R-square	0.822	0.025	0.025	0.822	0.022	0.022

Table 7: IVs

	2SLS State Two Results Dependent Variable: Rate			
	(1)	(2)	(3)	(4)
	1. New case	2. Partisanship	3.TFE	1+2+3
$Confirmed\ Cases_{t-1}$	2.522***	1.654***	1.171**	1.650***
	(2.72)	(8.10)	(2.51)	(7.24)
$Stay\ at\ home_{t-1}$	-142.930***	-84.645***	-51.132*	-83.479***
	(-2.83)	(-9.16)	(-1.68)	(-7.28)
Bank controls	X	X	X	X
County controls	X	X	X	X
State-week FE	X	X	X	X
Observations	126929	126332	127481	126929
R-square	0.003	0.022	0.028	0.023

Table 8: robustness check

	Rate		
	Online Search	Stock Performance	Local Shock
	(1)	(2)	(3)
$Confirmed\ Cases_{t-1}$	-8.423***	-10.646***	0.494
	(-31.04)	(-49.34)	(0.93)
$Stay\ at\ home_{t-1}$	-45.553***	-19.543***	-20.154**
	(-9.12)	(-5.55)	(-2.20)
$Google\ trend\ hits_{t-1}$	0.036***		
	(2.78)		
Stock volatility$_{t-1}$		-243.409***	
		(-28.49)	
Stock total return$_{t-1}$		-9.948***	
		(-6.49)	
County ln(PPP loan value)$_t$			-1.434**
			(-2.50)
County ln(PPP loan numbers)$_t$			2.031***
			(2.67)
Controls & FE	X	X	X
Observations	87103	127485	71451
R-square	0.252	0.304	0.152