


Cash in the time of Covid

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By Ellen Caswell, Miranda Hewkin Smith, David Learmonth and Gareth Pearce (Notes Directorate).[1], [2]

- During the Covid-19 (Covid) pandemic the way people use cash has changed, with less being used for transactions. That is partly because consumer spending as a whole has fallen, but may also reflect concerns about the risk of banknotes transmitting the virus. We have commissioned research to understand how the virus behaves on banknotes. Our analysis indicates that the risk of transmission via banknotes is low.
- People are spending less cash, but the total value of banknotes in circulation has increased as people appear to choose to hold more cash. These trends have persisted for a number of years, but have been magnified by the pandemic.
- As the UK's central bank, we are responsible for banknote production and ensuring banknotes are high quality, durable and difficult to counterfeit. We also monitor trends in cash usage and cash demand to understand what is behind changing behaviours so we know how many notes we need to produce in the future, and how best we can support access to cash for those who want to use it.

Overview


As the UK's central bank, we produce and issue banknotes and oversee many of the other payment systems people use every day. While cash continues to play a key role in the UK economy, we have seen a gradual decline in cash usage for transactions over the past decade and a corresponding shift towards other payment methods.[3]

Changing technology and an evolving financial services market account for some of the shift in demand. But other factors also have a role to play, especially in the short term.

This article explores the impact of the Covid pandemic on cash usage. Our work to understand the impact of the pandemic on cash use is ongoing, and we will continue to build upon our initial analysis. This will include monitoring the impact of local, regional and national restrictions implemented in different parts of the UK.

Introduction: trends in cash demand

Cash demand before Covid

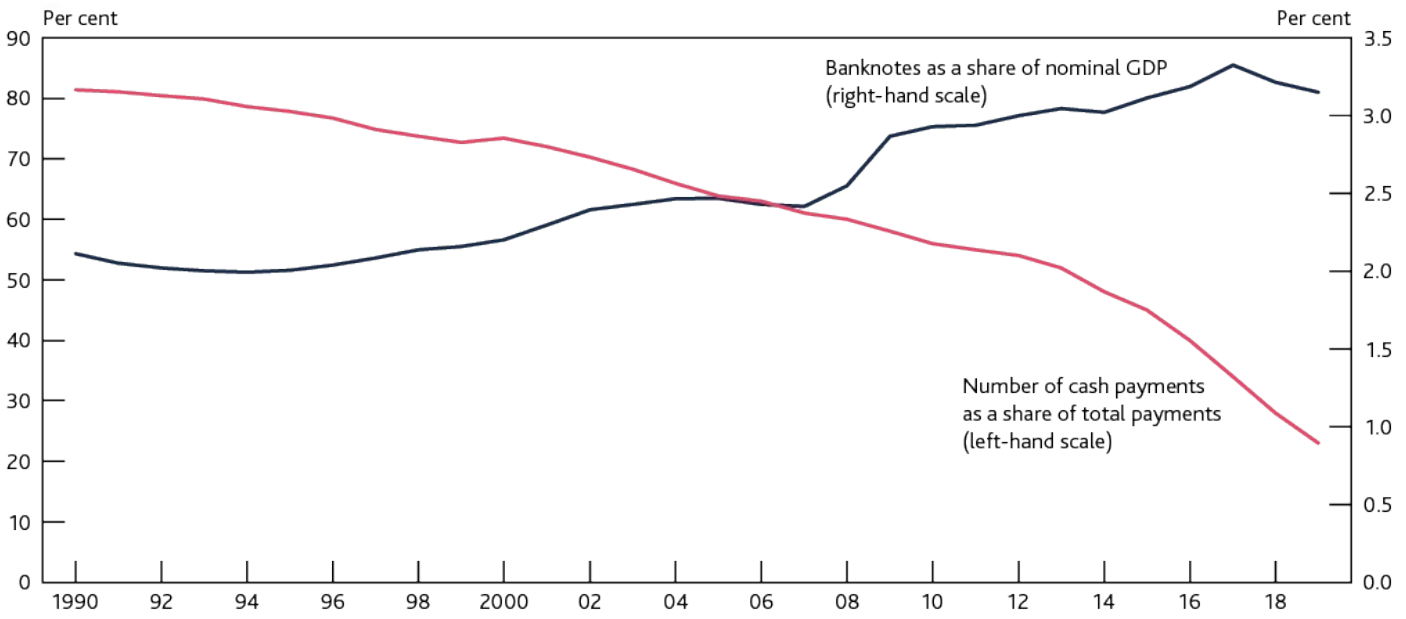
Cash remains an important part of the UK economy, with [an estimated 9.3 billion](#)  cash payments made in 2019 and 2.1 million people who mainly use cash for their day-to-day purchases.

People use cash as a medium of exchange when buying or selling goods and services, and as a store of value. Cash's use as a medium of exchange has fallen dramatically in recent years. Only 23% of all payments in 2019 were made using cash, down from close to 60% a decade earlier, as people increasingly turn to other methods to make transactions, such as debit cards and digital payments.

While the transactional use of cash has declined, the value of notes in circulation (NIC) has increased (Chart 1). Between 2005 and 2017, the value of banknotes in circulation doubled. Even adjusting for rising economic activity and price levels, NIC has generally been trending upwards since the early 1990s. This fall in the use of cash for transactions, but continued growth in demand for notes, has been called the 'paradox of banknotes'. [4]

The apparent paradox is explained by an increasing role for cash as a store of value. This is likely to be driven by a variety of factors. In part, it results from historically low interest rates which, along with lower levels of inflation since the early 1990s, have reduced the opportunity cost of holding banknotes (as a non interest bearing asset). Relative exchange rates also matter, with increases in demand for banknotes observed when sterling weakens: there was an increase in demand for £50 banknotes — the highest denomination note — in 2016 when sterling fell sharply. But there are also notable increases in cash demand when there are concerns about banks or the economy. For example, in 2008–10 as people were concerned about the health of banks, they opted to hold more cash.

Chart 1: Cash payments have declined, but the value of banknotes in circulation has risen



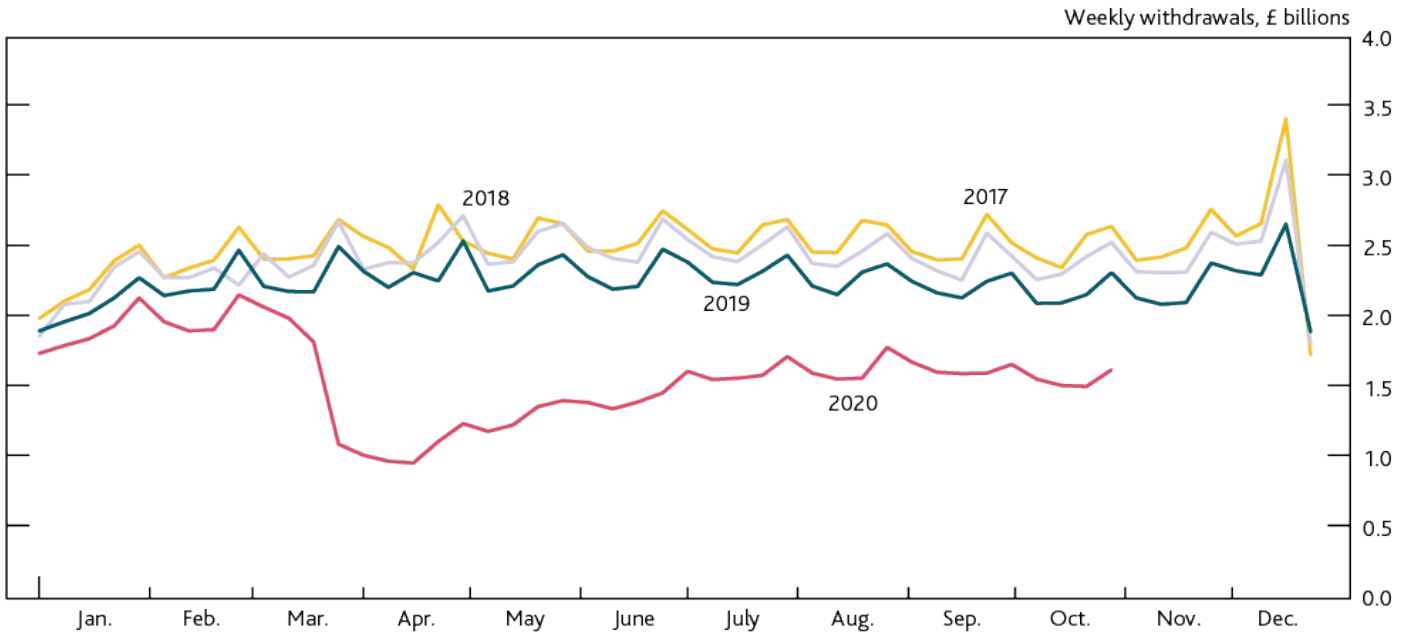
Sources: Bank of England statistics and UK Finance – UK Payment Statistics.

What has been the impact of Covid?

These trends in cash use and demand have continued — and in fact been magnified — as a result of Covid.

There has been a significant fall in cash withdrawn from ATMs (Chart 2). Both the volume and value of cash withdrawn from the ATM network overseen by LINK, a private not-for-profit company run on behalf of its commercial members, were approximately 60% lower in late March 2020 than the same period in 2019. Cash withdrawals from ATMs increased slowly over subsequent weeks but remain well below previous levels. By the second week of October ATM volumes and values were still about 40% and 30% lower respectively than the previous year.

Chart 2: ATM withdrawals have fallen sharply



Source: LINK ATM network.

Tourist hotspots and cities saw some of the biggest falls in people taking out cash during lockdown. According to [LINK](#), the cities of London and Glasgow saw the biggest year-on-year falls in the first six months of the pandemic, with withdrawals between April and September shrinking by 81% and 71% respectively compared to the same period last year. Tourist areas, such as parts of the Lake District and the Yorkshire Dales, were also among those seeing the largest declines in cash withdrawals. In contrast, some of the most deprived areas of the country saw the smallest falls year-on-year as people continued to use cash during lockdown. Cash withdrawals in Liverpool Walton fell by just 23% during the first six months of the pandemic.

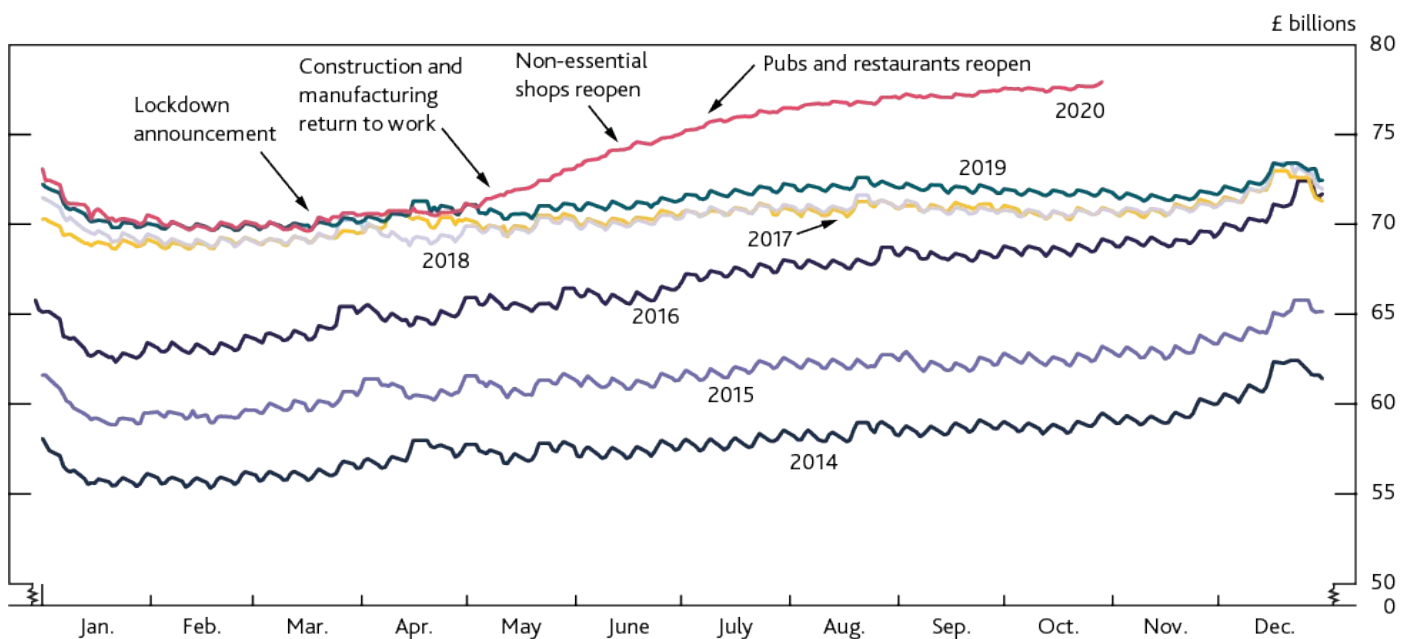
People acquire about 90% of their cash from ATMs, with most of the rest coming from bank branches, Post Office branches, cashback and wages. Although the pandemic saw some closures of bank branches and Post Office branches, closure rates have now largely stabilised and most branches are now open, though some are still operating at reduced hours.

Growth in demand for banknotes

The Covid pandemic intensified the decline in the transactional use of cash. As set out earlier, the other key cash trend we have observed in recent years is increased demand for banknotes.

The so-called banknote paradox showed no signs of disappearing during the Covid crisis; in fact, the gap between cash usage and banknote demand appears to have widened, with the value of banknotes in circulation increasing sharply in 2020 (Chart 3).

Chart 3: The value of banknotes in circulation has increased since March



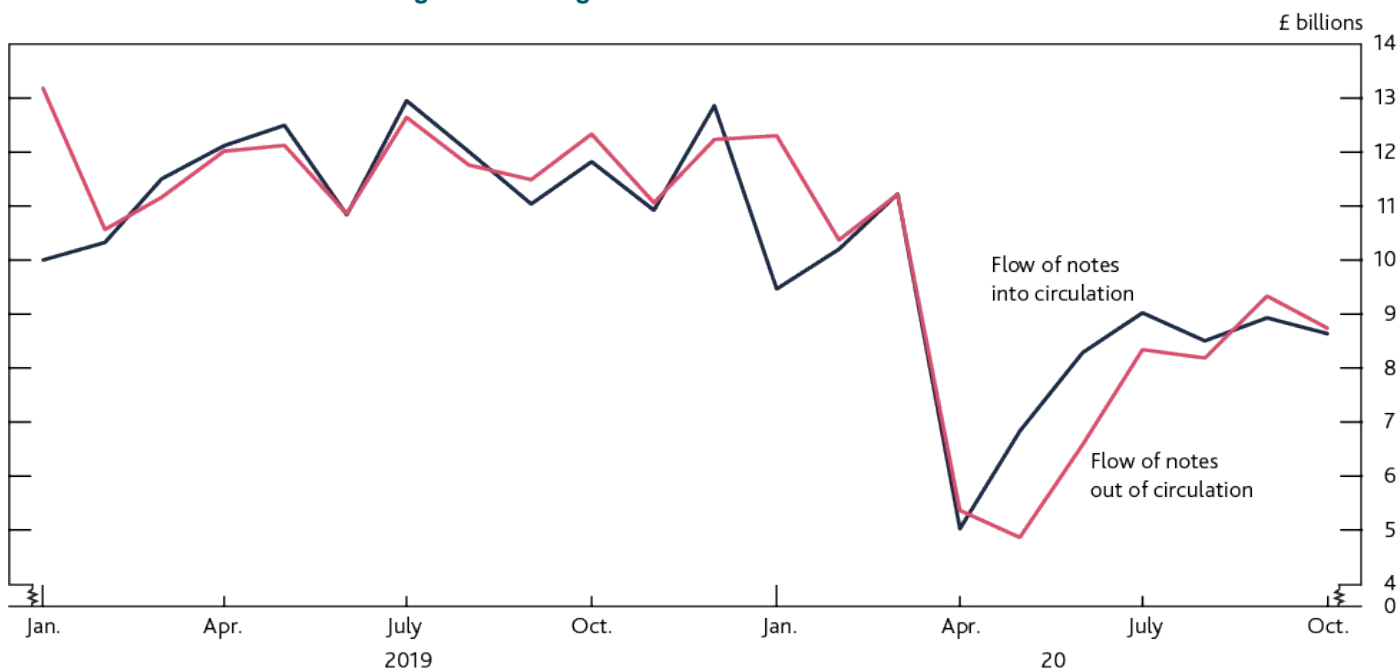
Source: Bank of England.

Growth in demand for banknotes increased slightly in late March around the time the Prime Minister first announced lockdown measures. This is likely to be due to people withdrawing some extra cash as a precautionary response to heightened uncertainty. The level of banknotes in circulation then remained broadly flat until the start of May, following which there was very strong growth in the value of notes in circulation. This occurred around the same time that economic activity began to recover. The trend of increasing cash demand continued when non-essential shops, and pubs and restaurants began to gradually reopen.

The number of banknotes in circulation can increase either because more banknotes are being issued from industry cash centres to meet customer demand (entering circulation), or because fewer are being returned from customers (removed from circulation).

Chart 4 shows that, before Covid, the value of banknotes flowing into and out of circulation was broadly balanced. The sharp decline in cash use in late March was reflected in both significantly lower inflows and outflows. Between April and August, the flow of notes into circulation recovered faster than the flow of notes out of circulation, which explains the increase in notes in circulation over that period: although fewer banknotes were being withdrawn from ATMs than normal, even fewer were being returned via banks and retailers. That pushed up the total amount of banknotes in circulation. Since September, inflows and outflows have returned to being broadly balanced, and as a result the number of notes in circulation has remained relatively steady since then.

Chart 4: More banknotes entering than leaving circulation

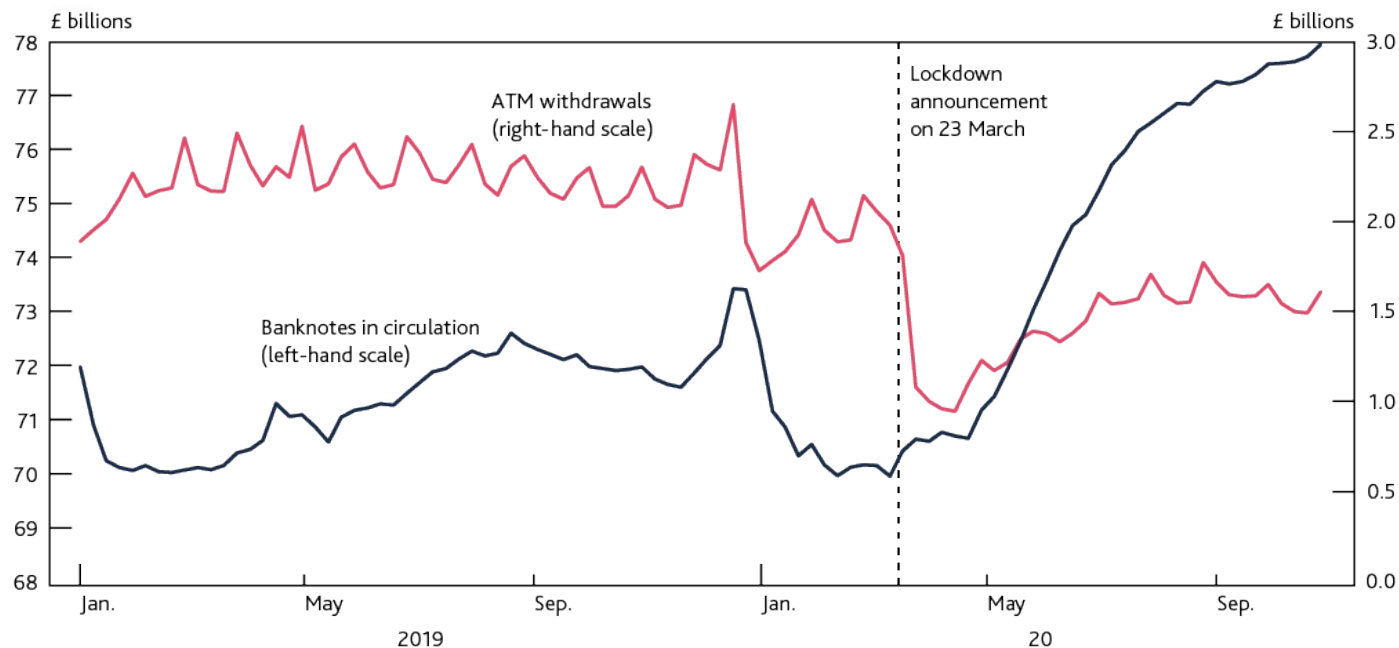


Source: Bank of England and Note Circulation Scheme members. Flows approximated using cash centre inflows and outflows.

The UK is not alone in experiencing a sharp increase in the value of cash in circulation during the Covid pandemic. In both the [US and the euro area](#), total currency in circulation in September was more than 10% higher than a year earlier, with a similar pattern in [Canada](#) and many other countries.

In summary, cash is being used less for transactions since the start of the pandemic, yet the value of banknotes in circulation has increased (Chart 5). In the next two sections, we consider what might be behind these divergent trends in the demand for cash.

Chart 5: Cash use has declined, but the demand for banknotes has increased



Sources: Bank of England and LINK ATM Network.

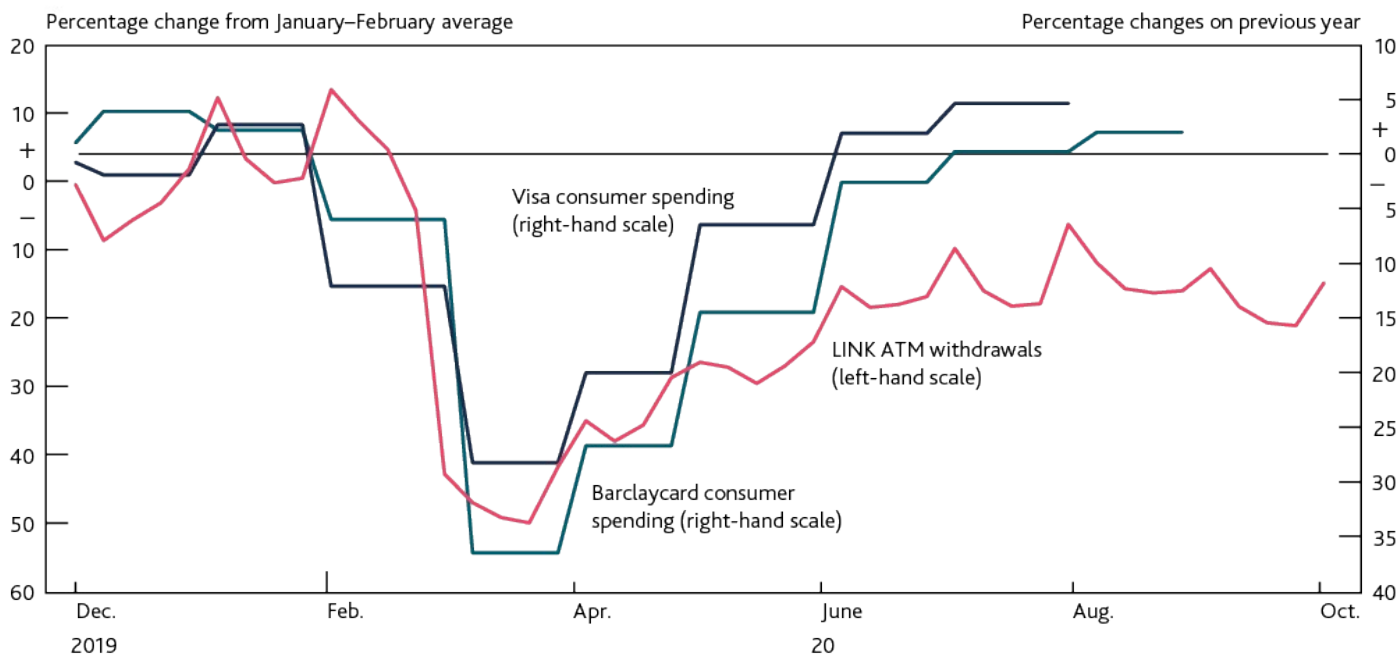
What drove the changes in transactional cash use?

The first key driver was the big fall in consumption at the start of the pandemic (Chart 6). The temporary closure of shops and restaurants, and the implementation of social distancing rules during the Covid pandemic, led to significant declines in household spending. Lower volumes of transactions require less cash to support them. The decline in household spending also led to a decrease in debit and credit card use: total household expenditure fell by almost 30% in April, [according to Visa](#), while the value and volume of contactless card transactions [also fell](#) in April, by 40% and 44% respectively.

Chart 6 shows that between March and April ATM withdrawals — while only a proxy for the transactional use of cash — fell and began to recover with a similar profile to consumer electronic payments.

However, from June onwards, consumer electronic payments have continued to recover while ATM withdrawals have levelled off. This suggests that Covid may ultimately have longer-lasting effects on cash than on electronic payments. We will explore this in a [later section](#) of this article.

Chart 6: Consumer spending across a range of categories fell sharply



Sources: Barclaycard, LINK and Visa.

Concerns about virus transmission

The Covid pandemic has changed the way that people shop. In response to social distancing guidelines, more people are shopping online, meaning fewer cash payments.

Online shopping [accounted](#) for 28% of UK retail spending in September 2020, compared with 19% a year earlier, having peaked at 33% in June. At least some of this increase can be attributed to the Covid crisis. For example, 21% of UK survey respondents said they are shopping online for the first time, according to a [survey](#) by online payments company Paysafe, conducted in March and April.

As well as prompting a shift towards online shopping, Covid has also affected how people pay for things in shops. This is partly due to retailers' actions, but also due to consumer preference.

The Government has advised retailers to minimise contacts around transactions, for example, by considering using contactless payments. In line with this, many retailers, including major supermarkets, have been encouraging consumers to use contactless payments, while still accepting cash. Upon reopening their stores after the initial lockdown period, a number of other retailers announced that they would no longer accept cash payments at all. Forty-two per cent of people had visited a store in the previous six months that did not accept cash, based on a survey we ran in July. That represents a significant increase on the January figure of 15%.

Even where cash is accepted, some consumers may opt for contactless payments. The Paysafe survey found that 56% of respondents are happier to use a contactless card now than they were a year ago. And our July survey found that 71% of respondents were using less cash compared with before the pandemic, with the perceived length of time respondents can go without using cash increasing. Forty-four per cent of respondents said they could go for more than a month without using cash, up from 32% pre-pandemic. The main reasons cited by respondents for using less cash were retailers not accepting cash (44%) and concerns about handling cash (35%). The latter may be due to concerns that the virus could be transmitted via banknotes.

We have commissioned testing to better understand the actual risks of transmitting Covid via banknotes.

Can coronavirus survive on banknotes?

Concerns that cash can be a potential carrier of bacteria or viruses is nothing new; there is a small body of scientific literature that has looked at the ability of pathogens (primarily bacteria) to survive on banknotes and coins. Bacteria and viruses are present on a wide variety of surfaces that people come into contact with in everyday life; cash is just one of those many surfaces.

However, a bacteria or virus being present on a surface does not necessarily mean that somebody touching that surface risks picking up an infection. To understand better how coronavirus behaves on our banknotes we commissioned scientific testing to explore the viability with time.

The understanding of the potential transmission routes of SARS-CoV-2, the virus that causes the disease Covid, is currently limited and evolving.[5], [6], [7], [8] The most common way that people can contract the disease is by inhaling droplets or aerosols exhaled by an infected person, or by potentially touching a surface where droplets from an infected person have fallen.[9], [10], [11] Banknotes are not typically directly involved in these transmission routes, as they are rarely exposed directly to the environment.

For the purposes of our study, a very high dose of a coronavirus,[12] representing a plausible worst-case scenario, was applied to a banknote. The dosage was equivalent to someone coughing or sneezing directly onto the note, and as such is highly unlikely to occur in day-to-day life. However, it does allow us to gain accurate data on how fast the virus declines and how this compares to other everyday surfaces.

Our study looked at both paper banknotes and polymer banknotes. For comparison purposes, it also examined how Covid behaved on stainless steel and plastic, which are representative of typical surfaces that people come into contact with in everyday life. The study also looked for any differences between used and new banknotes.

Findings

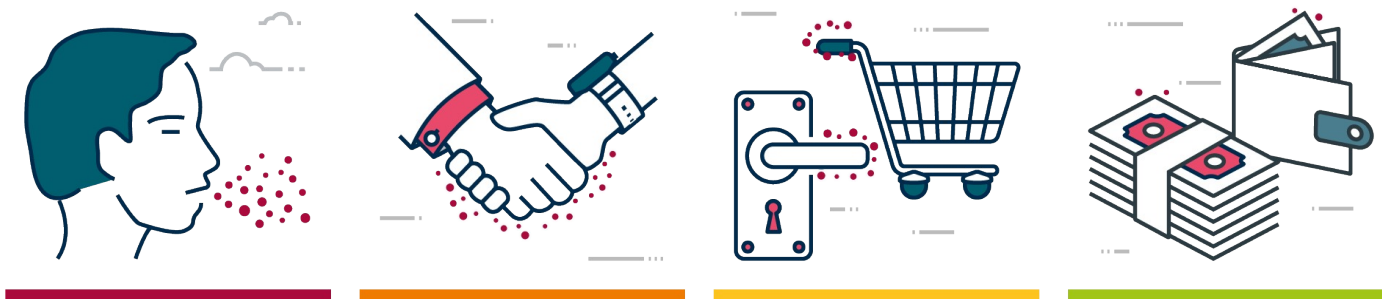
Our study found that the level of virus found on a banknote remained stable for one hour after exposure. Over the next five hours, the amount of the virus present declined rapidly (for more detail, see Box B).

After six hours, virus droplets on banknotes had declined to 5% or less of their initial level on both paper and polymer notes. Similar declines were seen on plastic and steel surfaces, although the decline in viability on some of these reference surfaces wasn't as large as on banknotes. Importantly, 24 hours after exposure, the virus was only present at very low levels on all surfaces tested by our study.

What are the key conclusions we can draw from these data? First, in this study the virus does not survive at high levels for very long on banknotes. A few hours after infection, even at high doses, the levels and therefore associated risk of infection appear low. We also conclude that there is no material difference in the viability of the virus on polymer and paper banknotes. Further, the survival of virus on banknotes is no greater — indeed appears potentially less — than on reference surfaces representative of the many surfaces that people may come into contact with in their routine life.

What therefore is the relative risk associated with handling cash? (Figure 1) In a retail environment, the major infection risk would be directly from breathing in exhaled droplets or aerosols when in close proximity to an infected person within the shop, or potentially from touching a 'high touch' object such as the handles of shopping baskets or shopping trolleys, PIN keypads, products on open shelves or the touchscreens of self-checkout terminals.

Figure 1: The risk of Covid transmission by banknotes is low



Cash is typically stored securely in wallets, tills or safes, meaning its risk of direct contamination is much lower than exposed surfaces in retail or domestic environments onto which exhaled droplets from an infected person can fall. Contamination of banknotes, where it could occur, is most likely to be indirectly by transfer from the hands of an infected person or when someone touches a contaminated surface and then touches a banknote. Any contamination by these routes would be likely to result in much lower levels of the virus than by direct contamination modelled in this study.

Where contamination does happen, this work shows that the virus typically declines rapidly over a period of hours, and it represents no greater risk than other surfaces people come into contact with as part of their everyday lives.

The data from our study are broadly consistent with other early viability data in this field (with the exception of one study)^[13] in showing that the virus decays rapidly on surfaces, with some evidence that the virus decays more slowly on smooth surfaces such as stainless steel than on banknotes. And where low levels persist, it is not clear whether they are present at levels that could potentially establish infection.^[14]

In summary, any risk from handling cash should be low. Current government regulations to wear masks in shops to minimise the spread of exhaled droplets and aerosols, and government advice to maintain good hand hygiene to help mitigate any risk from touching the many surfaces that people encounter in their daily or working lives, remains, including when visiting shops. Brief interactions with cash are just part of that wider environment and should be viewed in context.

What caused the increase in cash demand?

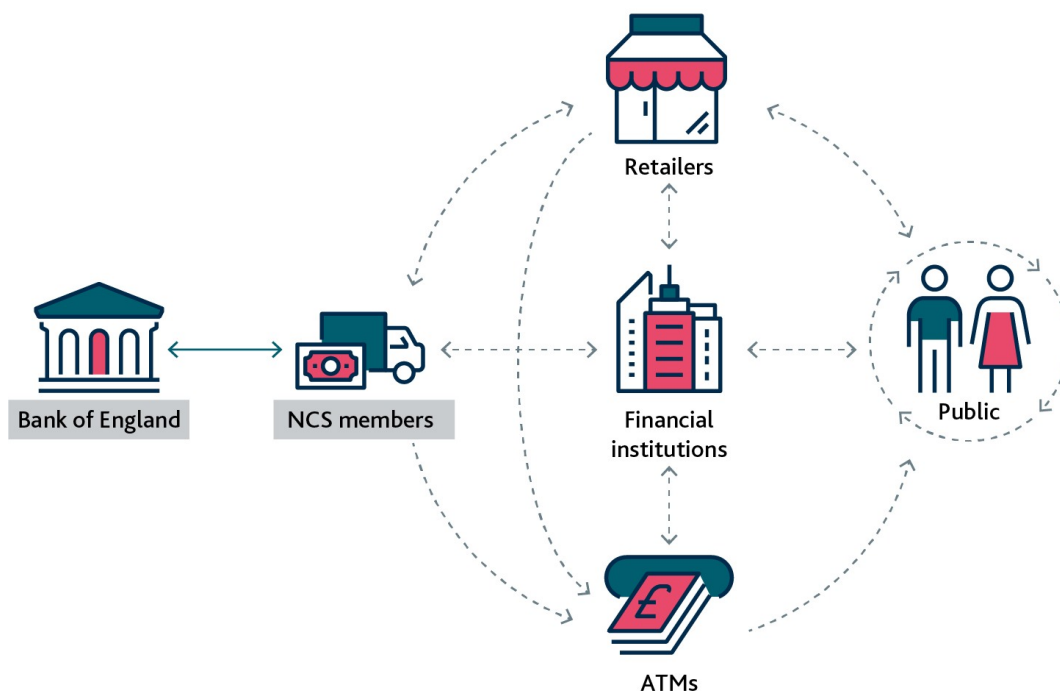
As noted earlier, while both declines in consumption and concerns over virus transmission have reduced the use of cash for transactional purposes, the demand for banknotes has increased.

One way to analyse what might have driven the increase in demand is to consider how changes in behaviour caused by Covid has affected each stage of the cash distribution cycle (Figure 2).

Cash distribution cycle

Once banknotes have been printed, they are sold by the Bank of England to the members of the Note Circulation Scheme (NCS).^[15] NCS members then supply banknotes to (and collect banknotes from) their major customers, primarily banks, ATM operators and merchants. These notes are acquired by the public and either spent or saved as a store of value. Retailers and banks will return excess notes to the NCS, at which point they are sorted to ensure they are genuine and in good condition, and recirculated.^{[16], [17]}

Figure 2: The cash distribution cycle



The constant flow of banknotes around the system means that banknotes are used many times without necessitating an overall increase in the number in circulation. Therefore, the recent increase in demand suggests there has been a change in behaviour at one or more points in the system (Table A), and that banknotes are being held somewhere — among retailers, financial institutions, ATMs, or the public — and not returned to the NCS as usual. In other words, banknotes are circulating less frequently, as demonstrated by the weak recovery in the flow of banknotes into NCS cash centres and out of circulation (Chart 4).

Below we present some explanations for the changes in cash demand. We will continue to develop our analysis in this area.

First, people could be holding more cash than before the Covid crisis began. This is for contingency reasons, in line with cash's established role as an emergency means of payment; a [survey](#) by the ATM network LINK in April found that 14% of respondents were keeping more cash at home in case of emergencies. Our survey in July found that 8% of respondents were keeping more cash at home or in a safe place compared to pre-pandemic and 40% were holding the same amount of cash. People may also be holding more cash than before the Covid crisis began because they have less opportunity to spend it. For example, many venues where cash is often spent, such as pubs and restaurants, have been closed or, when open, subject to restrictions. Box A considers how the recent increase in cash demand compares to more general household savings behaviour.

Second, it is also possible that cash use — particularly in non-retail environments — recovered as lockdown measures eased and economic activity picked up, but cash took longer to be deposited. Cash is often used for person-to-person transactions, such as between family and friends. Indeed, new forms of cash payment may have emerged during the Covid crisis, such as payments made by isolating households to friends and family in return for shopping or other services. Cash is also used as payment for household services including window cleaning and gardening. These services recovered as the economy reopened over the summer. For example, by the start of July, [over half of adults](#) said they felt either very comfortable or comfortable having someone come into their home to carry out an emergency repair. If these cash payments were taking longer than normal to be deposited, that would explain why inflows of banknotes to NCS cash centres were weaker between April and August.

Together, these two factors are probably the primary drivers of the increase in demand for banknotes. Other factors have also contributed to the increased demand for cash, but have likely played a less significant role.

For example, mirroring the behaviour of individuals, retailers may also be running with higher floats than usual (either for contingency purposes or because they are banking less frequently). When lockdown was announced in March, we know a number of retailers deposited cash held on their premises. Shops will then have re-cashed as they prepared for reopening. Overall, however, this is likely to have had a small effect in aggregate and been outweighed by other behaviour.

Similarly, it is possible that a combination of banks, post offices and ATM operators are holding more cash than usual at present. Banks typically prepare for an incident such as a pandemic by ensuring that branches, cash centres and ATMs are fully stocked with banknotes. As such, higher cash holdings among these institutions is likely to be a contributing factor to the increase in cash demand, although our market intelligence suggests that it cannot explain the full extent of the change.

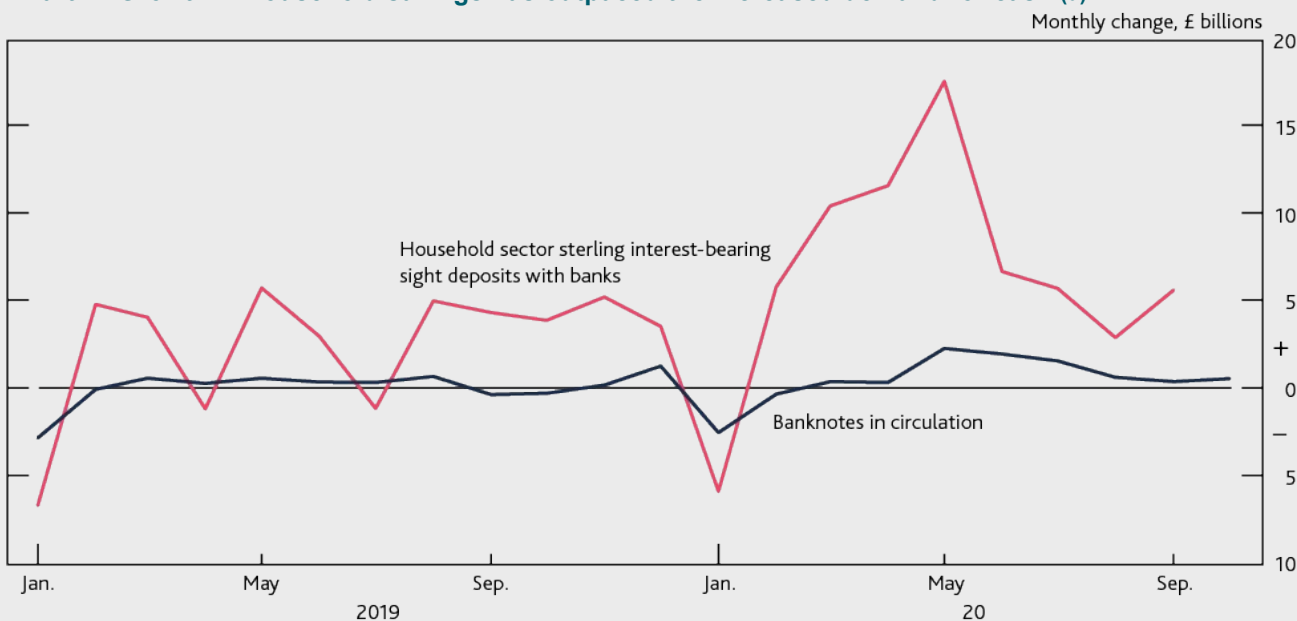
Table A: Explanations for increase in cash demand

Stage of the cash cycle	Explanation	Evidence	Likelihood
Public	People withdrew cash as a contingency.	Use for contingency reasons is a well-established role of cash.	Likely to be a primary driver of the increase.
People and small businesses providing household services	As lockdown restrictions eased, cash use recovered but cash not deposited or spent as normal.	Timing of recovery in social activity and activity such as home maintenance work matches the increase in cash demand. Fewer opportunities for banknotes to re-enter the cash cycle: eg closure of cash-heavy merchants such as pubs and restaurants and reduced bank branch opening hours. Consistent with lower banknote flows out of circulation.	Likely to be a primary driver of the increase.
Merchants	Retailers running with higher floats than usual, either for contingency purposes or banking less frequently.	Would require a substantial increase in float levels. Many retailers banked their cash at the start of lockdown.	Unlikely to explain much of the increase.
Banks, Post Office and ATM operators	Increased cash holdings as a contingency to meet spikes in demand.	Market intelligence suggests front loading of cash occurred. Sector has large cash holdings, so has a large impact on overall cash demand.	Likely to have contributed to the increase.

Box A: Household savings

It is worth putting the increase in cash demand in context. Social distancing policies have led to a significant increase in household savings. The increase in cash demand, while sizable, is greatly exceeded by the increase in households' bank deposits (Chart A). Unlike the financial crisis of 2008–10, when there was a shift from bank deposits to cash, cash holdings have decreased relative to bank deposits in recent months.

Chart A: Growth in household savings has outpaced the increased demand for cash (a)



Source: Bank of England.

(a) Monthly changes of monetary financial institutions' sterling interest-bearing sight deposits from household sector, not seasonally adjusted.

The longer-term impact of Covid on cash demand

What will happen to cash demand in the medium to long term?

As the sole issuer of banknotes in England and Wales, we need to maintain public confidence in the availability, quality and security of our banknotes to meet our objectives of monetary and financial stability. This includes deciding how many banknotes to print to ensure we meet demand at all times.

In order to achieve this, it is important for us to understand the drivers of demand for cash, as well as whether any changes that we are seeing now are temporary or likely to persist. This in turn will help us balance the risk of running out of banknotes against the risk of printing too many, bearing in mind our responsibility to use public funds wisely.


Understanding trends in the demand for banknotes also informs critical decisions on the infrastructure needed to move cash through our economy. Cash is still an important payment method in the UK, and a critical means of payment for many people. To ensure the smooth production and distribution of banknotes around the country, we need an efficient, resilient and sustainable cash system involving both the public and private sector.[18]



This will help ensure access to cash for those who need it. This is important for financial inclusion reasons. Research from consumer organisation Which? shows that some groups, such as older people, continued to rely on cash for everyday activities during Covid, paying family and friends with cash to buy shopping on their behalf. For these people, the ability to access and use cash will remain an essential service in the longer term.

Drivers of medium to long-term demand for cash

The future rate of growth in the demand for cash is uncertain and there are many variables that could influence both how cash is used (for transactions or as a store of value) and where it is used (in the UK or overseas).

In terms of the transactional use of cash, if consumption fully recovers and payment habits revert to what they were pre-Covid, the pandemic might not have much impact. However it seems unlikely that there will be no impact on payment preferences. According to an April [survey](#)  by LINK, 76% of those surveyed said they thought that Covid would affect their cash use in the next six months. In addition, 34% expected to do more online shopping in the next six months and around half said they expected to use cards more to make payments. According to our July survey on the impact of Covid, 33% of consumers surveyed expect to make more non-cash payments in the next six months. Reasons given for this include convenience of card and contactless payments (16%) and acceptance of contactless versus cash payments (16%). However, 30% of consumers do not think that Covid will affect their cash payments. Going forward, it will be important for us to keep abreast of spending behaviour in traditionally cash-heavy establishments, such as pubs and cafes, in order to come to a view on the medium-term transactional demand for cash.

Predicting how consumer behaviour will be shaped by Covid is especially challenging at the present time, given uncertainty of the wider economic impact of Covid on, for example, consumption (and, linked to that, tourism levels), unemployment and exchange rates. Our econometric modelling suggests consumption and cash demand are positively correlated, while unemployment and exchange rates are negatively correlated with overall cash demand.

Covid could also have a lasting impact on retailers' strategies for cash and, in turn, consumers' use of cash as a medium of exchange. In our interviews with a sample of large retailers in June 2020, we found that the majority of retailers expect cash usage levels to recover, but to remain below pre-Covid levels in the medium to long term. Retailers suggest that the payment methods offered to customers will be driven by customer demand. For some retailers, Covid appears to have led to an acceleration of strategic decisions around payment technologies, such as a switch to cashless self-service terminals.

Yet, the use of cash for transactional purposes is only one part of the picture on overall cash demand. In fact, we estimate that, at any one time, only around 20% to 25% of banknotes are held within the domestic transactional cash cycle. Of the remaining 75%, some are held by individuals within the UK, some are held overseas by investors as a store of value, and some may be held in the shadow economy.

Development in the preferences for cash holdings will have a big impact on cash demand trends in the future. It is possible that as people use cash less in the UK and other jurisdictions, there will be less cash stored by individuals at home for contingency purposes. This could, in turn, result in cash gradually being deposited in favour of electronic money. We have yet to see this happen in practice, though, despite transactional cash usage having fallen for many years already.

In short, at this stage it is hard to know what the long-term effects of Covid will be on cash demand. It seems unlikely that transactional demand for cash will revert fully to the levels of use seen before the pandemic, but it is unlikely to stay at the levels we are seeing today.



Conclusion and next steps

Over the past decade, the fall in transactional use of cash in the UK has been accompanied by an increase in the value of notes in circulation. Covid has intensified this trend.

Both shopping and payment behaviours have changed in response to the virus, with more online shopping and more contactless transactions. Our research — carried out to understand better how the virus behaves on banknotes — indicates that the risk of transmission via banknotes is low.

Some of the change in consumer payment behaviour will depend on the social distancing measures in place, and the opportunities available for consumers to spend cash. We will closely monitor the impact of local, regional and national restrictions implemented in different parts of the UK.

However, the barriers to alternative payment adoption may have been permanently broken by Covid. Past cash trends are therefore less likely to accurately predict future trends.

To understand recent events better, we conducted a consumer survey on the impact of Covid in July 2020, with follow-up surveys planned. These surveys will help us to assess whether Covid will permanently affect consumer behaviour and consumer preferences for cash over other payment methods.

We will continue to engage with NCS members to get an up-to-date view on customer demand for banknotes. We have also held interviews with a range of large retailers to learn more about their holdings of cash and attitudes to cash acceptance, and continue to work with financial institutions to understand how business models and customer demands are changing. This monitoring will contribute to our assessment of whether the recent increase in NIC growth might continue, for how long and by how much. This will, in turn, inform decisions on how many banknotes we need to print to ensure that demand is met at all times.

As a central bank, we are neutral to the public's choice of payment method, supporting both electronic payment and banknote payment mechanisms. However, the payments landscape is rapidly changing. It is therefore important that we continue to work with others to meet this change and to ensure that we support people's ability to choose how they make their payments.

Box B: A scientific study of how coronavirus behaves on banknotes

Studies of bacteria and viruses on surfaces typically are one of two types. The first option is a controlled experiment in a laboratory, in which a precise amount of the bacteria or virus is dosed at a high level onto a surface so that scientists can obtain quantitative information on its survival under highly controlled conditions. Alternatively, scientists can carry out environmental testing of surfaces, by testing for bacteria and viruses on surfaces in the 'real world'.

Our study^[19] was of the former type, to explore how coronavirus behaves on banknotes. In this study, a high — but plausible — dose of the virus (> 200,000 viral units) was applied to a banknote to allow for a controlled understanding of how the virus declines with time on surfaces.

This is very much a worst-case — but possible — scenario, representative of someone coughing or sneezing directly onto a banknote. Given that access to SARS-CoV-2 (the virus that causes the disease Covid) is currently highly limited, our study used a surrogate coronavirus that virologists recognise as representative of how SARS-CoV-2 would survive.

The surfaces assessed were paper and polymer £10 Bank of England banknotes (both new and used), stainless steel and plastic (polystyrene). The virus was dosed in two different types of solution to simulate material from a cough or from nasal secretions.

Following dosing the surfaces were stored at room temperature and then tested for levels of infectious virus at 1, 2, 6, 24, 48 and 120 hours. To assess the viability of the virus at each time point, the surface being tested was rinsed with a solution to ensure the transfer of all of the virus from the surface, so that the total amount could be accurately measured. In reality, the transfer rates from casual contact with the surface of a banknote in daily life would be expected to be much lower; likely to be of the order of a few per cent or less of the virus.^[20]

The focus of our study was on whether the virus was 'viable' on a surface at a given time point after initial exposure to the virus. We wanted to know whether there was enough of the virus on the surface to potentially infect someone. Importantly our study does not assess the transfer rates of the subsequent steps required to then infect a person. Each of these steps (transfer from banknote to finger, and from finger to face) further reduce the amount of virus available to potentially infect someone.

After six hours virus levels in solutions representative of a sneeze had declined to less than 1% on all surfaces (Table 1). Virus droplets from solutions more representative of a cough are marginally more likely to survive beyond six hours, but had nevertheless declined to 5% or less on both polymer and paper notes. There was some evidence in this model for slightly enhanced viability on stainless steel at this time point.

Table 1: Six hours after exposure to high levels of coronavirus, at most 5% of the virus particles remain on banknotes

Surface	Coronavirus remaining — ‘cough’ model	Coronavirus remaining — ‘sneeze’ model
Paper banknote — new	2%	<1%
Paper banknote — used	2%	<1%
Polymer banknote — new	3%	<1%
Polymer banknote — used	5%	<1%
Plastic	7%	<1%
Stainless steel	17%	<1%

Source: Testing undertaken by Blutest Laboratories Ltd.

After 24 hours, levels of virus had dropped to less than 1% on all paper and polymer banknotes in both models. By 120 hours, the levels of virus on banknotes was undetectable or at trace levels.

These data are consistent with other early studies on banknotes — where a rapid decline was observed over a number of hours[21], [22] — with the exception of one study[23] where viability within a laboratory setting showed considerably longer viability. These differences are likely due to differences in experimental protocol in these highly controlled laboratory environments. Many factors could play into survival rates, with temperature and humidity also thought to be significant. Other studies also support the finding that the decline in the viability of the virus on banknotes is similar — and in some cases potentially more rapid — to that on other surfaces representative of those that the public come into contact with in everyday life, such as stainless steel.

It should be noted that just because low levels of virus are observed, it does not mean that they are at a level that can cause infection.[24] Understanding of this is evolving, and indeed there is discussion ongoing about the relative risk of transmission from surfaces.[25], [26], [27]

In reality, any initial contamination of banknotes by indirect routes in real life would probably be at much lower levels than tested in this controlled laboratory experiment and as such, the time at which significant levels of virus would be present would also be expected to be shorter than demonstrated here.

1. The authors would like to thank Lewis Mundy-Gill and Graeme McMullen for their help in producing this article.
2. This article was published outside of the normal Quarterly Bulletin publication schedule.
3. Cash includes banknotes and coins, but for this article when we reference cash, we are mainly referring to banknotes. However, some of the data we have used includes both coins and banknotes.
4. See, for example, [Bailey \(2009\)](#).
5. van Doremalen et al (2020), ‘[Aerosol and surface stability of SARS-CoV-2 as compared with SARS-CoV-1](#)’
6. Ben-Shmuel et al (2020), ‘[Detection and infectivity potential of severe acute respiratory syndrome coronavirus 2 \(SARS-CoV-](#)



- 2) environmental contamination in isolation units and quarantine facilities' [↗](#).
7. Harbourt et al (2020), 'Modelling the stability of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) on skin, currency and clothing' [↗](#).
 8. Riddell et al (2020), 'The effect of temperature on persistence of SARS-CoV-2 on common surfaces' [↗](#).
 9. See UK Government background information [↗](#) on Covid.
 10. See US Centers for Disease Control and Prevention information [↗](#) on how Covid spreads.
 11. See World Health Organisation Q&A [↗](#) on Covid.
 12. In this study a surrogate coronavirus — recognised by virologists as representative of SARS-CoV-2 — was used.
 13. See footnote 8.
 14. See European Centre for Disease Prevention and Control Q&A [↗](#).
 15. G4S Cash Solutions (UK) Ltd, Post Office Ltd, National Westminster Bank plc and Vaultex UK Ltd (a joint venture between Barclays plc and HSBC plc).
 16. Banknotes also leave and enter the country through the foreign exchange market. This is largely demand for travel money or for hard currency as a safe store of value. There has been limited international travel over the period in question, and intelligence gathered from the NCS suggests that foreign exchange flows have been low.
 17. Notes held by the NCS members are not classed as notes in circulation, so do not by themselves affect the level of demand.
 18. The Bank of England needs to ensure the system has sufficient capacity to: distribute new notes to where they are needed; sort and recirculate used notes; and destroy old notes when they become unfit for use. We are working with industry to develop a new cash distribution model that enables the demand for cash to be met efficiently and cost-effectively at the wholesale level. A consultation paper on this new model was issued in June 2020.
 19. Testing undertaken by Blutest Laboratories Ltd.
 20. Lopez et al (2013), 'Transfer efficiency of bacteria and viruses from porous and nonporous fomites to fingers under different relative humidity conditions' [↗](#).
 21. Chin et al (2020), 'Stability of SARS-CoV-2 in different environmental conditions' [↗](#).
 22. See footnote 7.
 23. See footnote 8.
 24. See footnote 14.
 25. Mondelli et al (2020), 'Low risk of SARS-CoV-2 transmission by fomites in real-life conditions' [↗](#).
 26. Goldman (2020), 'Exaggerated risk of transmission of Covid-19 by fomites' [↗](#).
 27. See footnote 6.

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