# Measurement and use of cash for payments by half the world's population

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## ABSTRACT

*The use of cash for payments is not well measured. This paper argues that the value of cash withdrawn from automated teller machines (ATMs), or as a share of all payments, provides a more accurate and timely measure of the cash used for payments compared with the standard measure of the value of currency in circulation (CIC), or as a ratio to gross domestic product (GDP). CIC is a stock of cash used for legal payments, hoarding and illegal activities, but lacks a corresponding measure of the velocity or turnover of that cash used for payments. Cash from ATMs is a flow. It reflects both a stock of cash and its velocity and is primarily used for legal transactions. This paper compares these two measures for 14 advanced and emerging market economies, which together account for one-half of the world's population and two-thirds of world GDP. The time pattern of both measures over*

*2005–2020 is illustrated graphically. Often, one measure rises while the other falls, or one is stable while the other is not, or both are rising or falling but at different rates. After reaching a peak in cash use between 2005 and 2018, the per capita share of cash withdrawn from ATMs in almost all of our countries begins to fall, consistent with what some merchants report, while CIC keeps rising. A measure of cash from ATMs may better inform monetary policy (demand for money) and regulatory decisions concerning access to and use of cash in a country.*

## INTRODUCTION

The history of payments in any country is one of a particular instrument replacing another or, if failing to do so, dropping from the mix. It is no surprise that physical cash, cheque and paper giro–type payments have been and are continuing to be replaced by electronic instruments in many countries. This occurs using automated clearing house and electronic giro–type transactions as well as payment cards and instant (or fast) payments.[1,2] All but cash payments appear to be reasonably well measured at the national level.

   In what follows, this paper provides a brief summary of emerging regulatory developments associated with access to cash in select countries and acceptance of cash for payments at the point of sale (POS).

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The standard way of measuring cash use is currency in circulation (CIC) or CIC as a ratio to gross domestic product (GDP). This paper suggests an alternative: the value of cash withdrawn from a country's automated teller machines (ATMs), or as a share of total payments (excluding large-value wire or credit transfers).

The paper compares these measures using a sample of 14 economies over a study period starting in 2005 and ending in 2020. The results indicate that one measure is often rising while the other is falling, or, if both are moving in the same direction, one is rising or falling faster than the other. In other words, with respect to trends in cash use, the different measures yield different results.

For each country, the paper provides graphs to illustrate the share of cash in total payment value for the period from 2005 to 2020, from which one can see when cash share reached its peak before starting to decline.

Local currency payment values for both measures are transformed into purchasing power parity (PPP) US dollars for all countries. This allows us to assess the overall trend in cash use for payments among economies at different levels of development using a common metric. When aggregated across countries, the overall trend in both measures is shown for half the world's population. The aggregate ATM cash measure rose after 2005, reached a peak in 2017, and falls thereafter. Results for the standard measure (CIC) do not reach a peak and do not fall over this period.

The final section concludes, and an appendix presents country comparisons not shown in the body of the paper.

## REGULATORY AND MEASUREMENT ISSUES CONCERNING CASH USE

### Access to cash and acceptance for payments

The value of cash used for payments is important for monetary policy (demand for money), for access to cash by persons with or without bank accounts, for banks that incur the cost of providing cash to depositors, and for businesses that bear the cost of accepting cash at the POS. Access to cash and cash acceptance by merchants has become an issue in some countries where falling demand for cash for payments has led to banks reducing access to cash. When cash use is low, banks have responded by reducing their ATM networks with a view to cutting their overheads. At the same time, merchants have sought to reduce the costs associated with having to accept cash. However, as bank and merchant cash expenses have certain fixed cost elements, significant reductions in the provision or acceptance of cash do not lead to proportional reductions in expense.

Some examples of regulatory efforts to preserve access to and acceptance of cash for payments are provided below:[3]

- *The Netherlands*: The Dutch central bank has set 3,850 ATMs as the minimum number in the country to ensure adequate access to cash services.[4] The central bank has also entered into a (non-regulatory) agreement between representatives from banks, retailers and consumers relating to cash deposits, cash withdrawals and the acceptance of cash by retailers;
- *Norway:* Amendments to existing financial institution regulations make it clear that consumers have a right to pay for goods and services in cash, and clarify the obligation of banks to enable customers to deposit and withdraw cash, either directly at ATMs/banks or through an arrangement with other cash service providers.[5] In addition, the government, with the support of the central bank, plans to assess the future role of cash in the event of natural disasters or situations where merchants may wish to receive non-cash payments only;

- *Sweden*: Rules have been established to ensure the 'adequate' geographic coverage of ATMs, and the Swedish Act on Payment Services 2010 was amended in 2021 to obligate the six largest banks to provide certain cash services to ensure a minimum level of access to cash for consumers and companies.[6] Banks providing consumer deposit accounts are also obliged to supply facilities for cash withdrawals;
- *Switzerland*: Rules are in place to ensure adequate facilities for cash withdrawals;
- *United Kingdom*: The Financial Services Act 2021 provides for the widespread adoption of cash-back at the POS so that consumers can access cash without having to make a purchase.[7,8] In addition, the Financial Conduct Authority will have new powers to ensure that cash withdrawal and deposit facilities are available in all communities across the country. The UK Payment Systems Regulator has also issued a special directive to ensure the broad geographic coverage of free-to-use ATMs;[9]
- *USA*: A number of large cities have made it unlawful for retailers to refuse to accept cash for payment or from charging higher prices to customers who choose to pay by cash rather than other means of payment.[10] In addition, several states have introduced pro-cash legislation to make it illegal for businesses to refuse to accept cash, and similar legislation is being considered at the federal level;
- *Euro area*: The European Commission has proposed legislation to ensure cash is both easily accessible by consumers and businesses and is accepted widely for payments in the euro area.[11]

If cash positions reach low levels in other countries, similar regulations, rules or voluntary agreements among providers and acceptors of cash payments may spread.

## Currency in circulation, cash withdrawn from ATMs, and the importance of velocity

CIC, or the ratio of CIC to the level of domestic economic activity as indicated by GDP, is a common way of monitoring the use of or demand for cash. In a recent paper, Ashworth and Goodhart show that CIC peaked in the late 1940s, flattened out during the 1980s, but after the early 2000s rose steadily once more for a select group of economies, including the euro area, Japan, the UK and USA.[12] More recent information on how CIC to GDP has varied across a broader selection of advanced and emerging market countries is provided by Bech *et al.*,[13] who find that the ratio rose for 20 out of the 25 countries they studied. The ratio only fell in five countries: China, Norway, Russia, South Africa and Sweden.

An alternative to the standard measure of cash — cash withdrawn at ATMs in a country — focuses on the use of cash for payments, largely leaving aside other uses (hoarding and illegal use). When ATM cash withdrawals are expressed as a ratio to the total value of all payments in a country (excluding large-value wire or credit transfers), it is conceptually similar to the standard measure of the ratio of CIC to GDP. The production of GDP includes small-value (retail) as well as large-value (wholesale) credit transfer payments. Large-value wire credit transfer systems include Fedwire, CHIPS and security transfer systems in the USA, CHAPS in the UK, TARGET in the euro area, and similar payment and securities transfer systems in other countries. The value of wire credit transfers in the euro area and the USA are more than 15 times larger than the value of all other payment instruments in these two countries. The share of credit transfers as a total for 24 advanced, emerging market and developing countries, reached 90 per cent of the value of all payments in 2021.[14] These large-value credit transfers are not substitutes for the use of cash, cards or

instant payments, or for most cheques, and are thus functionally separable from other payment instruments and hence excluded from our analysis. Unfortunately, the available BIS payment data do not separate large-value credit transfers from smaller-value retail credit transfer payments. In the absence of separate data, both types of credit transfers are excluded from our analysis.

Other measures of cash use do exist. Amromin and Chakravorti recognised that most cash is used for lower-value purchases and focused on the ratio of coin and lower-value currency denominations (small CIC) to GDP for 13 advanced economies.[15] Additional countries were covered by Bech *et al.*[16] and Arango-Arango and Suarez-Ariza.[17] Use of small CIC separates the stock of cash used mostly for purchases, from the stock of cash held as a precautionary reserve, used to facilitate illegal activities, or held and used overseas. While small CIC actually excludes large-denomination currency notes, ATMs are typically stocked with medium-value currency notes that are commonly used for legal payment transactions.

Payment diary studies are a new, but limited, additional source of cash data — to date, only ten payment diary studies appear to have been published. These studies track the number and value of cash purchases by a small (typically non-random) selection of individuals over a week or more for one or more years. The results indicate that cash use is typically lower among younger adults than it is among older ones. Given that the younger generation of adults continues to expand in numbers while the population of older adults inevitably declines, we would expect that the value of cash used for purchases would fall somewhat over time (unless inflation is high).

Compared with CIC, ATM cash likely provides a more accurate picture of the cash being used for payments. In a similar manner, small CIC also provides a more accurate measure of the cash used for legal payments by excluding large-value notes that are typically used for hoarding and illegal activities — activities that are included in the stock of CIC. In addition, for two large economies (USA and the euro area), significant portions of their CIC are held and used outside their borders (an estimated 30 per cent of the value of euros and 55 per cent of dollars), which distorts the value of CIC used to measure the domestic demand for money.[18,19]

A second reason to favour cash withdrawn from ATMs is that it is a flow measure. It reflects both the stock of currency used for consumer purchases as well as the level and changes in the velocity (or turnover) of cash resulting from the substitution of cards, cheques and other payment instruments for cash over time. A simple way of putting the velocity issue is to re-express the well-known macroeconomic relationship of money supply ($M$) × velocity ($V$) = price level ($P$) × number of transactions ($T$). The national money supply ($M$) is usually defined as equalling CIC + liquid bank and other financial institution deposits + liquid assets such as treasury and exchange bills + (in more inclusive definitions) bonds and equity when dealing with $P \times T$ = GDP. Using CIC/GDP as a measure of cash use gives a rather strange measure of the implied velocity of currency in circulation. With CIC × $V$ = GDP, $V$ not only reflects the turnover of cash, but also the turnover of all the other forms of payment that are included in GDP, including wire transfers.

A more reasonable expression would focus on $M' \times V' = P' \times T'$, which we define as the value of cash used for (legal) payments, rather than GDP. It is argued that cash withdrawn from ATMs reflects $P' \times T'$ (value of cash used for transactions) better than does CIC. The reason is that ATM cash, as it is a flow, equals $M' \times V'$ as a total, while CIC reflects $M'$ only. With CIC, velocity ($V'$) is missing and unknown. The only way it could be derived would be to assume a value

for the right-hand side of the equation that reflects the flow of cash used for purchases. But even if this is done, and $V'$ is solved for, it yields the wrong velocity as CIC includes the value of hoarding and illegal activities which goes beyond the value of cash used for (legal) purchases. Effectively, the stock of cash loaded into ATMs is replenished during the year and reflects the velocity of use of ATM cash. Cash removed but not spent during December of the current year should be very similar to cash spent in January that was removed in December of the prior year.

To conclude, CIC and small CIC, are measures of the stock of cash ($M'$) only, while cash withdrawn from ATMs is a measure of the annual flow of cash used to make payments and already reflects $M' \times V'$ together. Separate information on the stock of ATM cash or its velocity is not needed as the value of cash withdrawn from ATMs already includes both.

One drawback to using cash withdrawn from ATMs is the general lack of cross-country data regarding over-the-counter (OTC) cash withdrawals at bank offices and cash withdrawn via retailers offering 'cash-back' at the POS. Time-series data on these two sources of cash are rarely available. Furthermore, cash withdrawn OTC by consumers is comingled with cash withdrawn by businesses, but business use is for making change, not (usually) for payments.

Fortunately, some detailed payment data from 2022 are available for 19 euro area countries, giving some indication of the magnitude of this data issue, at least for the euro area. For the euro area, ATM cash used by consumers accounts for approximately 85 per cent of the total (74 per cent from ATMs plus 11 per cent from cash reserves, mostly obtained from prior, larger ATM withdrawals but not carried in a wallet for day-to-day use), while 6 per cent is from OTC withdrawals, 3 per cent from POS 'cash-back', and an even smaller amount from cash received in the form of change

from a cash transaction at a shop (which is not actually 'new' cash obtained for making consumer payments).[20]

What if the share of ATM cash, relative to all consumer sources of cash in a country (ATM cash plus OTC cash plus 'cash-back'), turns out to be higher or lower than that for the euro area? If ATM cash is a relatively stable share of cash from all consumer cash sources, the current measured divergence of ATM cash relative to CIC in a country should well reflect the divergence of all sources of cash relative to CIC, which is the main issue in this paper. If the share is unstable, the most likely cause is that cash users are (usually slowly) shifting from OTC cash withdrawals to ATM withdrawals. If so, the measured divergence between ATM cash and CIC shown in Figure 1 (discussed next) can overstate the actual increase — or understate the actual decrease — in the use of all consumer sources of cash in a country relative to CIC.

Overall, banks and merchants form a circle for cash used for payments. Consumers typically withdraw medium-value currency notes from ATMs and spend it at the POS. Merchants receive these notes, which are too high to make change with, and deposit them at their bank. At the same time, merchants withdraw lower-value notes and coins to make change with. Banks then use the deposited notes to restock their ATMs. Medium-value notes make a full circle and consequently do not last as long as the largest-value notes before needing to be replaced.

## DIFFERENCES IN CASH USE ACROSS 14 ECONOMIES

The graphs on the left-hand side of Figure 1 show the value of CIC per adult and ATM cash per adult for five of our largest economies: China, euro area, India, Russia and the USA. The graphs reflect different measures of the trend in the level of cash

use in each economy from 2005 to 2020. The values are in local currency and the euro area is treated as a single country as it has a single currency. The corresponding CIC/GDP and ATM cash payment share measures are shown on the right-hand side. These are relative measures and are more comparable across countries. The standard measure of cash use is the stock of CIC relative to the flow of total domestic economic activity (GDP) while our alternative measure is the share of the flow of ATM cash relative to the flow of other domestic payments in a country, such as cards, instant payments, cheques, and direct debits. Recall that large-value wire transfers are not a substitute for cash but are unfortunately comingled in the data with retail credit transfers, which can be a substitute, hence both are excluded from the analysis. Our payment data are in value terms but we would see the same rising or falling trends if numbers of transactions were available instead.[21]

In the graph showing the local value of currency use per adult in China, we see that ATM cash per adult (CASHPP, solid line) had a 98 per cent rise in nominal terms from 2005 to when it reached a peak in 2017. This was associated with rapid internal output, domestic consumption, and overall payment growth in China. After the peak, and relative to the base period 2005, use of ATM cash fell by 42 per cent over the next three years to 2020.

In contrast, CIC per adult in China (CICPP, dashed line) rose by 32 per cent up to 2017 but then continued to rise by an additional 47 per cent (relative to 2005). Thus, the CIC measure did not account for most of the rise in cash use that occurred during 2005–17 and it missed the reduction in use over 2017–20 when ATM cash was falling but CIC was still rising. The main inconsistency here is that ATM cash is falling while CIC is rising (Difference 1).

There is a less dramatic pattern in the graphs for the euro area and USA. Here,

CIC is rising while ATM cash is relatively stable, rather than falling for more than one year toward the end of our sample (Difference 2). Lastly, for India and Russia, ATM cash is rising faster than CIC at different points in time, while the reverse occurs for the USA and (less so) for the euro area (Difference 3), likely due to having a significant portion of CIC held and used outside their borders. Graphs for the other nine countries are shown in the Appendix.

The inconsistencies for the 14 economies may be summarised as follows:

- Inconsistencies between CIC and ATM cash:
  - *Difference 1*: One level measure is rising; the other is falling — Australia, China;
  - *Difference 2*: One level measure is rising or falling, the other is relatively stable — euro area, Norway, Singapore, UK, USA;
  - *Difference 3*: One level measure rising or falling faster than the other one — India, Indonesia, Malaysia, Mexico, Russia, Sweden, Thailand;
- Inconsistencies between ratios CIC/GDP and ATM cash/payment value:
  - *Difference 1*: One relative measure is rising; the other is falling — Australia, China;
  - *Difference 2*: One measure is rising or falling, the other is relatively stable — euro area, India, Indonesia, Malaysia, Norway, Russia, Singapore, UK, USA;
  - *Difference 3*: One measure rising or falling faster than other one: Mexico, Sweden (in Thailand, the measures are basically parallel, no problem).

Each inconsistency involves a different trend between our two measures of the level of cash use in a country. The most serious concerns trends moving in opposite directions — one rising while the other is falling at certain points over time — and that this occurs for

Figure 1: Value and share of currency per adult for China, euro area, India, Russia and the USA, 2005–20

more than just one year (Difference 1). This applies to China and Australia.

Less serious, but still misleading in terms of the direction of the trend, is where one trend is either rising or falling while the other is relatively stable (Difference 2). This seems to affect five countries for some time periods.

Finally, the most frequent problem is when both trends are generally rising or falling together, but the slope of the trend differs. Here, one trend rises or falls faster than the other, reflecting a different rate of change in cash use over time (Difference 3). This affects seven countries.

All three differences involve misleading information. The question then is which measure likely best reflects the true situation in terms of cash use for payments in a country? For us, this would be ATM cash as it includes the turnover or velocity of cash use while CIC does not but does include non-payment activity (hoarding) and illegal payment activity (the extent of which is largely unknown).

In making comparisons across countries, it is helpful to have a numeraire. Here, the level of cash use is shown relative to an indicator of total income, or GDP, or the value of payments in a country. The information one wants here is in the trend, not so much in the level of a computed ratio or payment share. Trends in the first set of graphs discussed above can differ somewhat from the relative trend measures shown in the second set of (right hand side) graphs titled 'share of currency use' in Figure 1.

Regardless of whether CIC or ATM cash are viewed absolutely as a level or relatively as a share, in neither case do they provide the same information about the trend in cash use. Instances where CIC or CIC/GDP may be rising, but some local merchants report that they are seeing less cash used at the point of sale, have been called a 'cash paradox',[22] which has implications for monetary policy and the demand for money.[23] A quick look at the cash measures in Figure 1 may help to explain the apparent paradox. Taking the example of the USA, CIC and CIC/GDP are both rising over the study period, while ATM cash is rather stable absolutely and very stable as a share of payments. Thus, the paradox may be due to the fact that CIC includes domestic use of cash plus large holdings and use of large-value US currency notes overseas. Alternatively, merchants may only be seeing one part of a larger environment where cash is used.

## COMPARING SHARES OF CURRENCY USE PER ADULT ACROSS COUNTRIES

Figure 2a shows those countries that, at some point, had a cash share of 12 per cent or higher, while 2B shows countries with lower shares between 2005 and 2020. These are the same ATM cash shares shown in Figure 1 and the Appendix but are shown all together here for comparison. In Figure 2a, Indonesia and Russia have very high cash shares, reaching over 70 per cent at their highest point. They then fall rapidly to 40 per cent and 20 per cent, respectively, by 2020. The shares for Sweden and Norway start at 24 per cent and 13 per cent in 2005, fall over the period, and each end up almost at the same level in 2020, with shares of 4 per cent and 3 per cent, respectively. Mexico was the only country where the cash share rose continuously for the whole period. The shares for Malaysia and India also rose initially but then levelled off or fell slightly. By 2020 their respective shares were 15 per cent and 17 per cent.

Figure 2b includes countries that have initial cash shares lower than either Sweden or Norway but also fall much less over the period. The initial dispersion in 2005 of the six countries shown ranges from 10 percentage points (11 per cent for Thailand to only 1 per cent for China and the USA) and falls only slightly to 8 percentage points
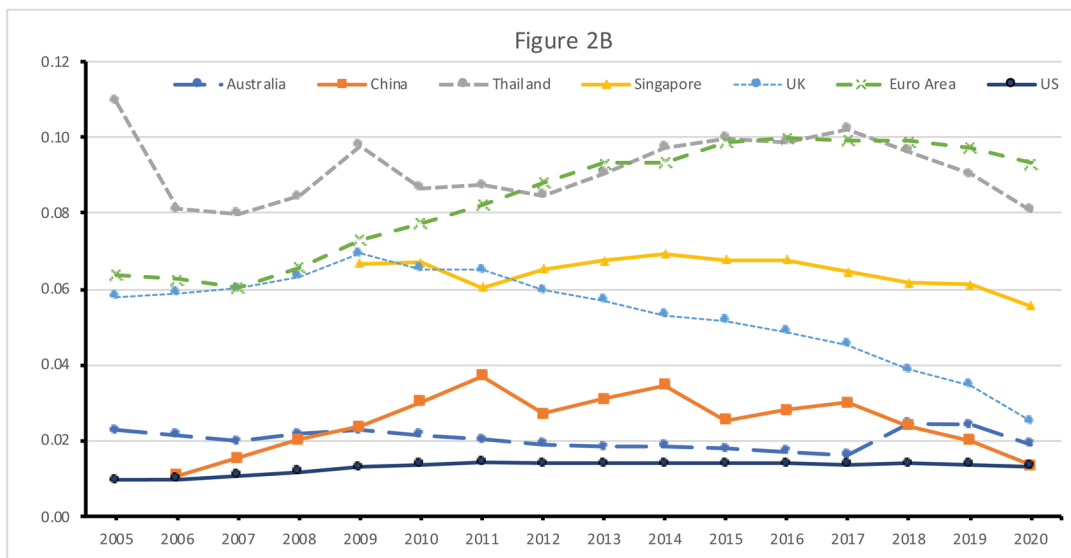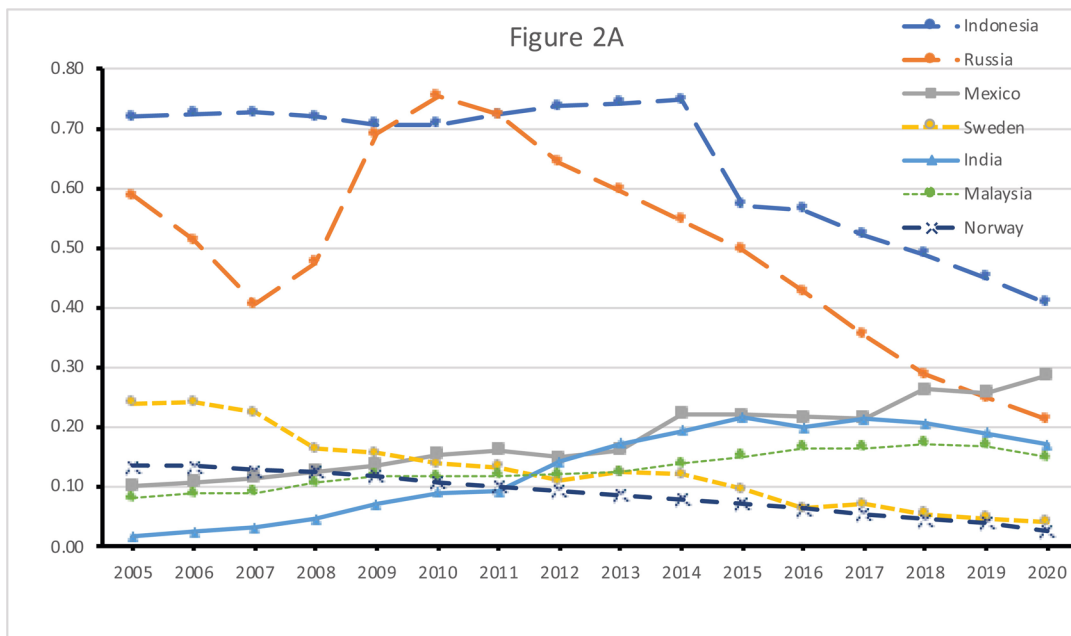
Figure 2: Share of ATM cash in payments

(pp) by 2020 (9 per cent for the Euro area, still 1 per cent for China and the USA). For Australia, China and the USA, any changes in their shares between 2005 and 2020 were so small that their beginning and ending shares may be considered almost equal.

The trend in cash use for payments shown in Figures 2a and 2b is shown in more detail in Table 1. The countries are ranked by their percentage point decline in cash use after reaching a peak sometime over 2005–20 (Column 5). The initial and ending ATM cash shares are shown in Columns 1 and 2 respectively, while Column 3 shows the overall difference between 2005 and 2020. Column 4 denotes the year that a country's cash share peaked, along with the value of the share of cash at its peak.

**Table 1: Trends in the share of ATM cash per adult in payments**

| Country | % Share in 2005 | % Share in 2020 | Change (pp) | Peak year (and share) | Decline since peak (pp) |
|---------|-----------------|-----------------|-------------|------------------------|--------------------------|
| Russia | 59.0 | 21.0 | −38.0 | 2010 (75%) | −54 |
| Indonesia | 72.0 | 41.0 | −31.0 | 2014 (75%) | −34 |
| Sweden | 24.0 | 4.6 | −19.0 | 2006 (24%) | −20 |
| Norway | 13.0 | 2.5 | −11.0 | 2006 (13%) | −11 |
| India | 1.6 | 17.0 | 15.0 | 2015 (22%) | −5 |
| Thailand | 11.0 | 8.1 | −2.8 | 2005 (11%) | −3 |
| UK | 5.8 | 2.5 | −3.3 | 2009 (7%) | −4 |
| China | 1.1 | 1.3 | 0.2 | 2011 (4%) | −2 |
| Malaysia | 8.1 | 15.0 | 6.7 | 2018 (17%) | −2 |
| Australia | 2.3 | 1.9 | −0.4 | 2018 (2%) | −1 |
| Euro area | 6.4 | 9.3 | 2.9 | 2016 (10%) | −1 |
| Singapore | 6.7 | 5.5 | −1.2 | 2014 (7%) | −1 |
| USA | 1.0 | 1.3 | 0.3 | 2011 (1%) | −0 |
| Mexico | 10.0 | 27.0 | 19.0 | 2020 (29%) | 0 |

pp, percentage points
Notes: all data are rounded; data start in 2009 for Singapore, 2006 for China

Thailand reached a peak in the first year of the sample so the subsequent change in its share covers 15 years in Column 5. In contrast, Mexico reached its highest value in the last year so, strictly speaking, there was no peak over the period. The decline after the peak was greatest for Russia, Indonesia, Sweden and Norway, all of which experienced a decline in cash use greater than 10 percentage points. These same countries also experienced the largest declines in cash use over the entire period (Column 3). For the nine other countries — India, Thailand, UK, China, Malaysia, Australia, euro area, Singapore and USA — the post peak share reduction only ranged from −5 pp to 0.

Two things need to be recognised in Figure 2 and Table 1. First, a small change in a cash share may generate a large change in the level of cash used at the POS (which does not cover other uses of cash, such as peer-to-peer payments). While the euro area cash share in Table 1 was reduced by −1 pp after reaching a peak in 2016, a recent ECB study suggests that the level of the value of cash used only at the POS in the euro area fell by 22 per cent over 2016 to 2022. Based on the number of transactions, it fell by 25 per cent. Thus, a small reduction in a cash share used for payments may have a large effect when expressed as a reduction in the level of cash use in total or per adult at the POS in a country.[24]

Secondly, as seen in Figure 2 (and by comparing Column 4 with Column 5 in Table 1), there is a difference in how fast the use of ATM cash falls after reaching a peak. If the share was high when the peak was reached, as occurs for Russia when its peak was 75 per cent, the following decline is also high, at −54 pp. China's peak share was low at 4 per cent and its post-peak decline of −2 pp is also low. This experience would correspond to an inverse logistic curve where cash is falling at a decreasing rate.

## AGGREGATE USE OF CASH FOR HALF THE WORLD'S POPULATION
Our sample covers 14 economies, which collectively account for 53 per cent of the world's population and two-thirds of world GDP. Given their often-different cash use
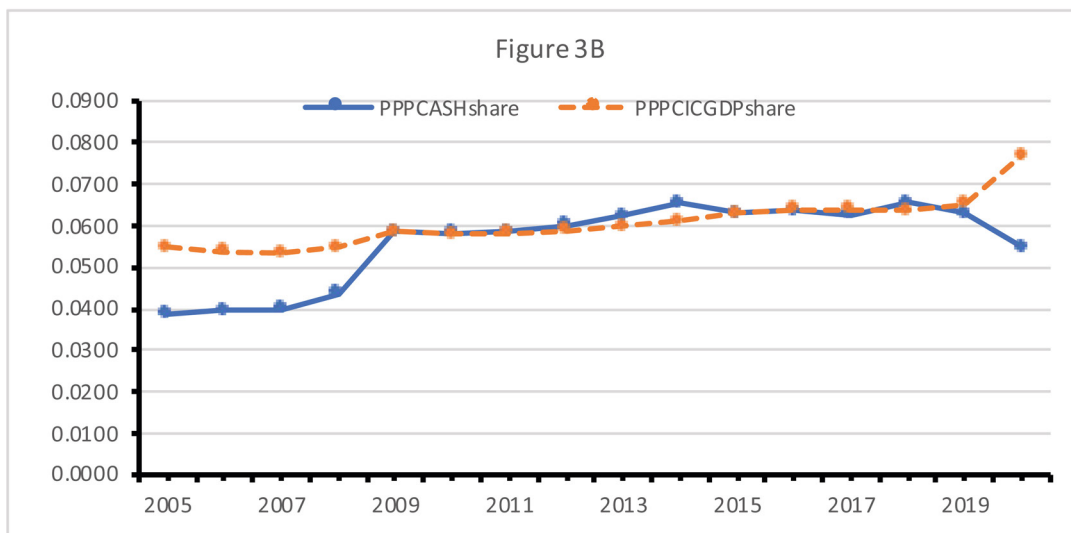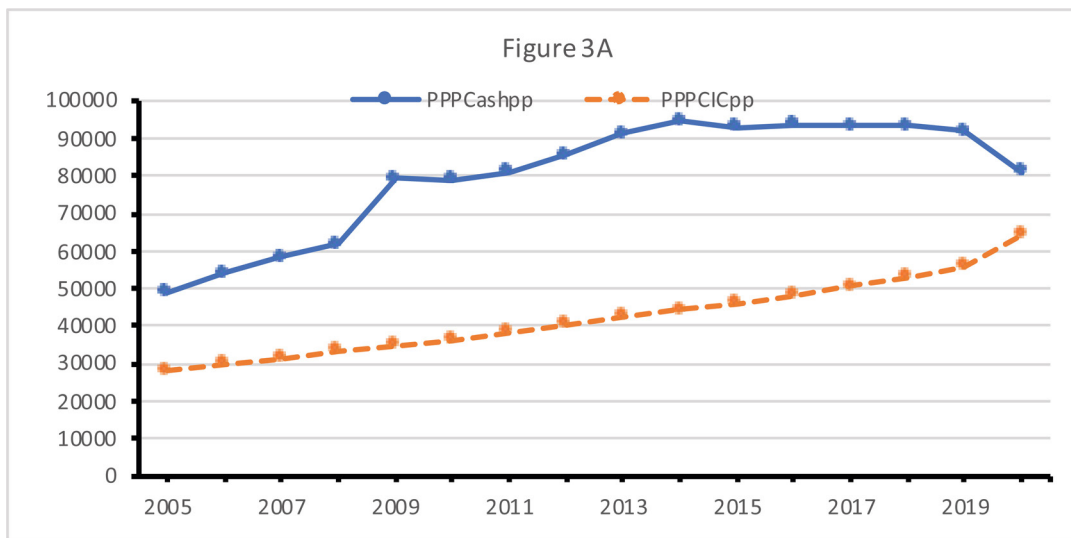
*Figure 3: (a) PPP currency value per adult (US$k, all countries); (b) PPP currency share per adult (all countries)*

levels and the different years their cash use may have peaked, it is useful to see how the trend in cash use has changed for all countries together. The local currency values shown earlier have been adjusted to be in PPP US dollars per adult in each country and then aggregated.

Figure 3a shows the sum of the US dollar purchasing power parity values of ATM cash per adult in thousands of dollars per year across all countries (PPPCashpp) and the corresponding PPP value of currency in circulation per adult (PPPCICpp). The same inconsistencies seen earlier for individual countries in Figure 1 and Table 1 (China in particular) are also seen in the aggregated data. That is, ATM cash rises faster than CIC, reaches a peak in 2014, and falls slowly with a large drop in 2020 while CIC is still rising. Even at this aggregate level, relying on one measurement (ATM cash) or the other (CIC) gives different information regarding the slope, level and direction of the change in the trend in cash use for payments.
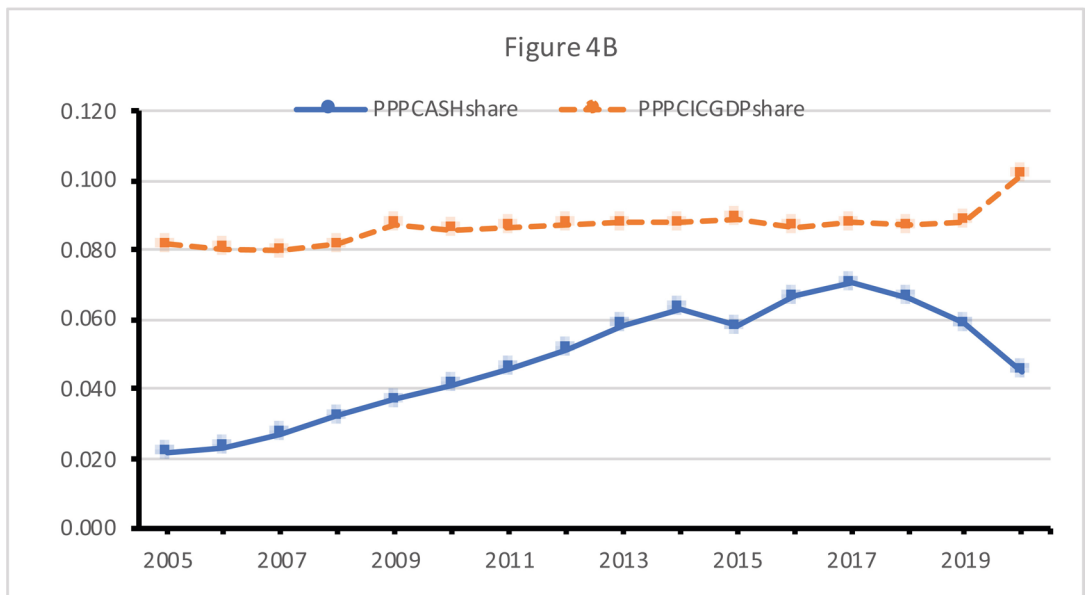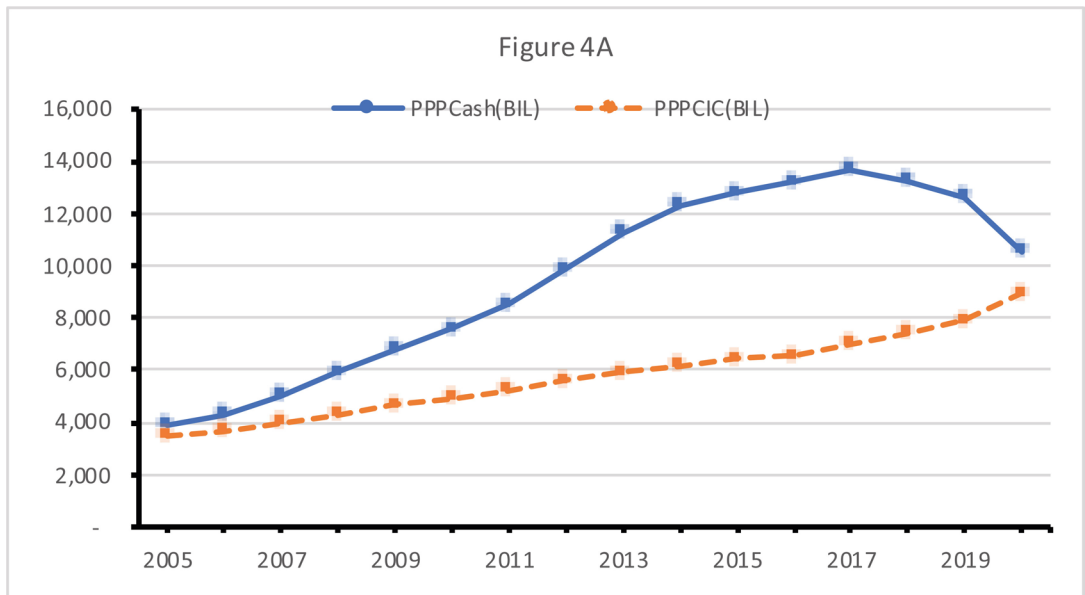
## Figure 4A



## Figure 4B



*Figure 4: (a) Aggregate PPP currency value (US$bn, all countries); (b) aggregate PPP currency share (all countries)*

Figure 3b shows the PPP adjusted value of the share of ATM cash in payments (PPPCASHshare) for all countries per year as well as the share of CIC relative to GDP (PPPCICGDPshare). As noted earlier when similar currency share graphs were shown in Figure 1 in local currency, the important result lies in the trend; a rather stable trend in the ratio of CIC/GDP, while the share of ATM cash is first rising, reaches a peak in 2014, falls slightly, reaches the same peak value in 2018, and then falls in the last two years.

We obtain a smoother rise and fall of cash use in Figures 4a and 4b if we look at the total aggregate use of cash in US PPP dollars (in billions), rather than looking at use per adult

(in thousands) in Figures 3a and 3b. Either way of expressing the use of cash across the 14 economies shows that the trend in cash use using ATM cash differs from the trend in the use of CIC and in all cases falls toward the end of our period while CIC is rising.

## CONCLUSION

The current and standard way of assessing cash use in a country; the value of CIC, and also CIC as a ratio to GDP, is contrasted with an alternative that may be a more accurate and timelier indicator of the use of cash for payments. This alternative is the value of cash withdrawn from ATMs, and also as a ratio to the total value of payments in a country (excluding large-value credit transfers). These indicators are measured per adult to control for demographic differences across countries and also in terms of total use of cash absolutely.

Measured as a level, or relative to GDP or total payments, the standard measure and the alternative indicator give conflicting information on the use of cash for payments. One measure may be rising while the other is falling, both may be rising or falling but at different rates. This occurs in different countries, at different time periods, but is important enough to be obvious when the data for all countries are expressed in US dollars and aggregated across countries.

The main reason for this divergence lies in the fact that CIC includes cash used for payments, hoarding and illegal use, while ATM cash is focused much more on the use of cash for (legal) payments alone. In addition, the stock of CIC is not adjusted for the turnover or velocity of cash for payments, while ATM cash already includes it as it is a flow measure of payments. CIC is just a stock indicator, without velocity. In most countries, ATM cash has reached a peak and is starting to fall while CIC continues to rise. This seems to address the 'cash paradox' issue where merchants say they see less cash being used at the POS but CIC does not fall (although ATM cash does).

The 14 economies in our sample account for half of the world's population and two-thirds of its GDP. Using the ATM cash measure, four countries with the highest cash shares in 2005 (ranging from 13 to 72 per cent) experienced the largest reductions in cash use by 2020 (falling between 11 and 54 pp). Half of the countries already have low cash shares of 5.5 per cent or less. Considering the largest and smallest users of cash together, when cash shares are high, share reductions are large. And when shares are small, reductions are also small. This pattern reflects an inverse logistic curve where cash use appears to fall at a decreasing rate.

Neither measure of cash use is perfect. CIC includes hoarding and illegal use but excludes a measure of cash velocity. Cash stocked in ATMs is like another indicator of cash use which excludes high-value currency notes thought to be used mostly for hoarding and illegal activities (small CIC). ATMs are typically stocked with medium-value notes that, when withdrawn, reflect the velocity of cash circulation. ATM cash may be preferred when cash use is low and policy makers are concerned about adequate access to cash and its continued use due to merchant costs at the point of sale. It may also be a better indicator of a country's internal demand for money; a consideration in monetary policy.

## AUTHORS' NOTE
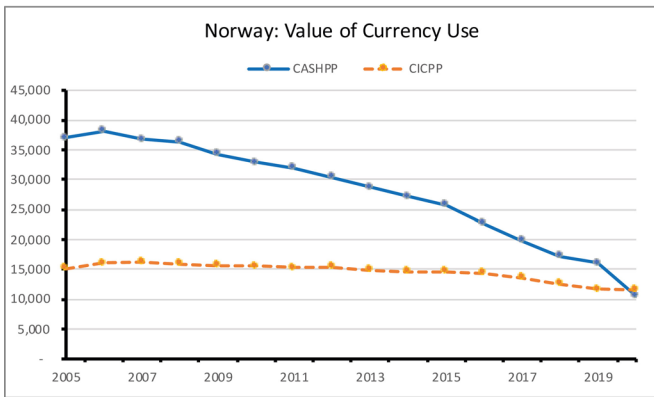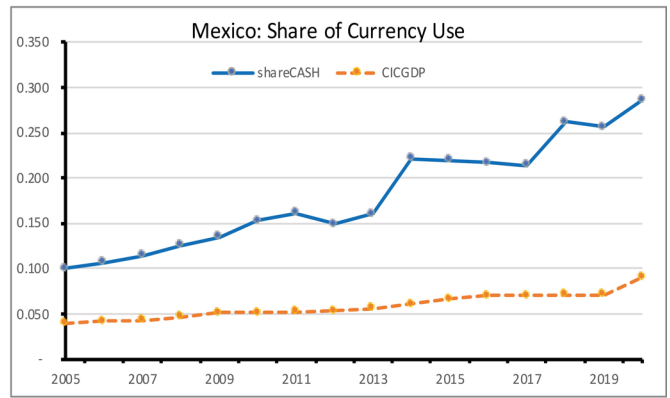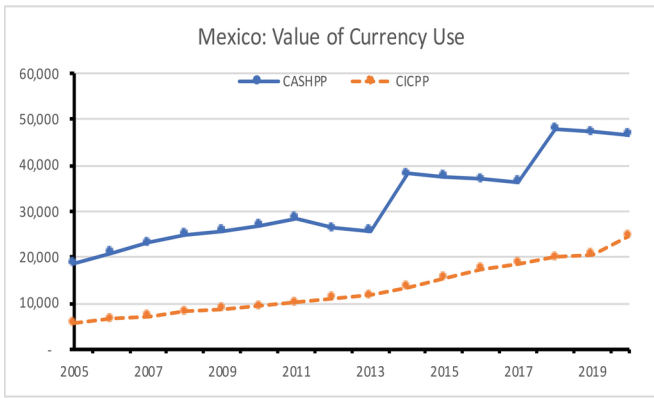
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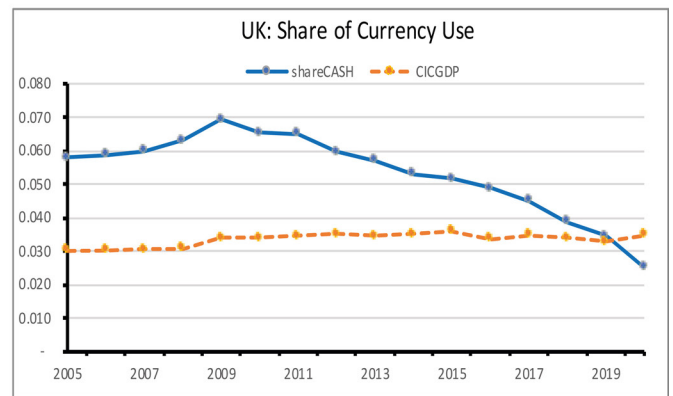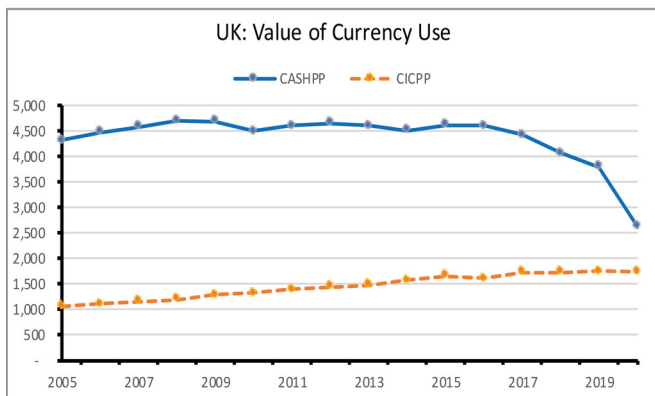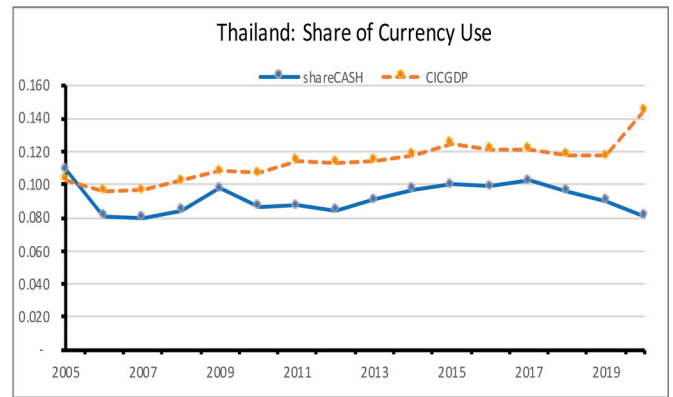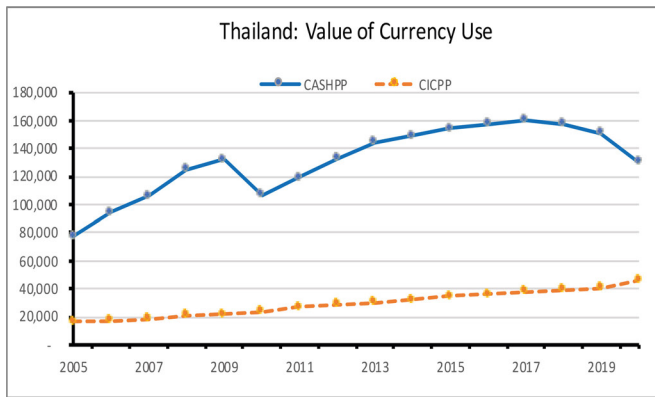(24) European Central Bank, ref. 20 above, Chart 2.

# APPENDIX

**Australia: Value of Currency Use**

CASHPP — CICPP

**Australia: Share of Currency Use**

shareCASH — CICGDP

**Indonesia: Value of Currency Use**

CASHPP — CICPP

**Indonesia: Share of Currency Use**

shareCASH — CICGDP

**Malaysia: Value of Currency Use**

CASHPP — CICPP

**Malaysia: Share of Currency Use**

shareCASH — CICGDP

Mexico: Value of Currency Use



Mexico: Share of Currency Use



Norway: Value of Currency Use



Norway: Share of Currency Use



Singapore: Value of Currency Use



Singapore: Share of Currency Use

## Sweden: Value of Currency Use

Legend: CASHPP, CICPP

## Sweden: Share of Currency Use

Legend: shareCASH, CICGDP

## Thailand: Value of Currency Use

Legend: CASHPP, CICPP

## Thailand: Share of Currency Use

Legend: shareCASH, CICGDP

## UK: Value of Currency Use
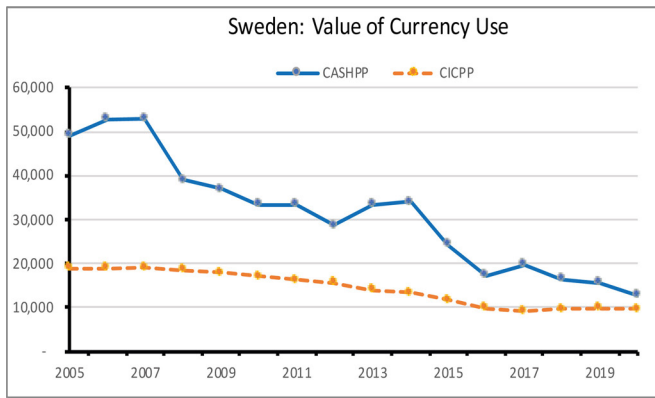
Legend: CASHPP, CICPP

## UK: Share of Currency Use

Legend: shareCASH, CICGDP

*Figure A1: Value and share of currency per adult for Australia, Indonesia, Malaysia, Mexico, Norway, Singapore, Sweden, Thailand and the UK, 2005–2020*

Source: Authors' calculations, Bank for International Settlements, national central banks