THE ASIA-PACIFIC EDITION

8.4% Compound annual growth rate of increase in total cash use in Asia-Pacific, based on weighted average across countries between 2010 and 2015

7.5% Estimated compound annual growth rate of increase in total cash use in Asia-Pacific based on weighted average across countries between 2015 and 2020

26.6% Weighted average cash use as a percent of GDP in Asia-Pacific in 2015
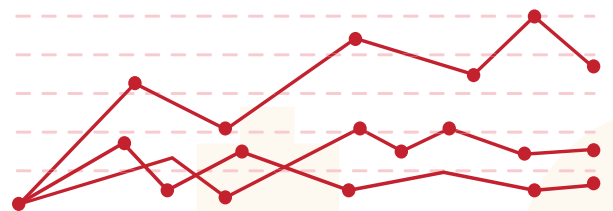
1.3% Percentage point increase in cash share of GDP in Asia-Pacific between 2010 and 2015

1.1% Estimated percentage point decline in cash share of GDP in Asia-Pacific between 2015 and 2020

6.62% Estimated percentage point annual increase in the GDP for Asia-Pacific region between 2015 and 2020

$8.1 TRILLION

Total estimated amount of cash to be used for payments in Asia-Pacific in 2020

$5.6 TRILLION

Total amount of cash used for payments in Asia-Pacific in 2015

CASH USE INDEX:
THE ASIA-PACIFIC EDITION

Cash is physical money: banknotes and coins or, in the days of yore, gold ingots and cowrie shells, depending on the era and where in the world you were. Today, though, cash shares the payment landscape with other payment methods such as cards, checks, direct debits and even digital currencies.

The PYMNTS.com Global Cash Index powered by Cardtronics analyzes **how significant cash is as a payment method.** Unlike virtually all reported estimates of cash, our proprietary data analysis focuses on the use of cash for making payments rather than on hoarding it. Each report we pick a different section of the world and discuss how cash is faring there.

In our Q4 report, we told you all about how cash is doing in the Americas. For this report, we'll cross the ocean and talk to you about the Asia-Pacific region. The countries included in this issue are Australia, China, India, Japan, Korea, Singapore, Saudi Arabia and South Africa. China, India and Japan account for 82 percent of the group's GDP.

$5.6 trillion: Total amount of cash used for payments in Asia-Pacific in 2015

8.4%: Compound annual rate of increase of total cash use in Asia-Pacific, based on weighted average across countries between 2010 and 2015

7.5%: Estimated compound annual rate of increase in total cash use in Asia-Pacific based on weighted average across countries between 2015 and 2020

26.6%: Weighted average cash use as a percent of GDP in Asia-Pacific in 2015

1.3%: Percentage point increase in cash share of GDP in Asia-Pacific between 2010 and 2015

1.1%: Estimated percentage point decline in cash share of GDP in Asia-Pacific between 2015 and 2020

6.62%: Estimated percentage point annual increase in the GDP for Asia-Pacific region between 2015 and 2020

$8.1 trillion: Total estimated amount of cash used for payments in Asia-Pacific in 2020

TABLE 1. SUMMARY STATISTICS BY COUNTRY IN THE ASIA-PACIFIC REGION

COUNTRY	POPULATION (MM)	GDP (BILLION DOLLARS)	CASH PROPENSITY (2015)	TOTAL CASH GROWTH (2015-2020)
AUSTRALIA	23.8	1222.0	11.7%	-2.1%
CHINA	1371.2	11078.2	33.9%	7.5%
INDIA	1311.1	2115.6	51.8%	11.9%
JAPAN	127.0	4123.0	4.2%	-6.5%
SOUTH KOREA	50.6	1376.0	4.5%	2.8%
SINGAPORE	5.5	289.9	16.9%	2.9%
SAUDI ARABIA	31.5	632.1	25.3%	-1.1%
SOUTH AFRICA	55.0	315.6	58.2%	4.4%

IN 2016, India declared a war on cash. On Nov. 8, Prime Minister Modi announced that 500- and 1,000-rupee notes would no longer be accepted. This represented roughly 86 percent of the cash circulating in India's economy.[1] Modi gave the population four hours' notice. Cities clogged as people rushed to the banks and ATMs to get their cash exchanged.

Meanwhile, over the past couple of years, China — the first country in the world to print cash — has slowly been weaning itself off of cash. The government has issued a slew of policies that encourage citizens to use other payment methods.[2] China's central bank is even considering issuing digital currency to help ensure the decline of cash.[3] Meanwhile, there are 4.2 billion credit and debit cards in the economy — about three times the population.[4]

But both China and India are economies that historically loved cash. In India, about 90 percent of transactions are cash-based.[5] In China, people frequently pay for large purchases like houses and cars with cash.[6] So what's next? A bright future for cash or a slow death?

All over the world, cash is taking some knocks. Card payments grew to 103.3 billion transactions with a value of $5.72 trillion in 2015, up from 19.9 billion transactions worth $1.07 trillion in 2012.[7] That said, cash is still an important player in the market and will probably maintain a strong presence.

Since 2013, we've been providing analysis on cash's role in the global economy. Governments document how much cash is in circulation but don't have much data on cash's daily life. We look at the amount of cash withdrawn every year to develop our insights. More about our methods and data gathering process can be found in our methodology section at the very end of this report.

In our analysis we discuss two aspects of cash. Cash share refers to the percent of payments that are made with cash over a year — how much of a wallet is devoted to cash as opposed to a different payment method, such as a card or check. Cash use refers to the total number of payments that are made with cash.

The PYMNTS.com Global Cash Index powered by Cardtronics updates and extends our analysis to 40 countries. Each quarterly issue focuses on a particular region of the world and reports the historical changes in the use of cash and presents projections on cash use in the future. This issue we're focusing on eight countries in the Asia-Pacific region, including China and India.

[1] Rowlatt, J. "Why India wiped out 86% of its cash overnight," BBC. Retrieved from http://www.bbc.com/news/world-asia-india-37974423

[2] Waldmeir P., Simon Rabinovitch. "China falls out of love with cash," Financial Times. Retrieved from https://www.ft.com/content/e1469cf0-9cf5-11e3-9360-00144feab7de

[3] Huang, Z. "China's central bank thinks digital currency can do one thing cash can't," Quartz. Retrieved from https://qz.com/942413/peoples-bank-of-china-pboc-wants-to-replace-cash-with-its-cryptocurrency-in-case-interest-rates-go-negative/

[4] Waldmeir P., Simon Rabinovitch. "China falls out of love with cash," Financial Times. Retrieved from https://www.ft.com/content/e1469cf0-9cf5-11e3-9360-00144feab7de

[5] Rowlatt, J. "Why India wiped out 86% of its cash overnight," BBC. Retrieved from http://www.bbc.com/news/world-asia-india-37974423

[6] Waldmeir P., Simon Rabinovitch. "China falls out of love with cash," Financial Times. Retrieved from https://www.ft.com/content/e1469cf0-9cf5-11e3-9360-00144feab7de

[7] Federal Reserve System. The Federal Reserve Payments Study 2016. Retrieved from https://www.federalreserve.gov/newsevents/press/other/2016-payments-study-20161222.pdf. Accessed May 9, 2017.
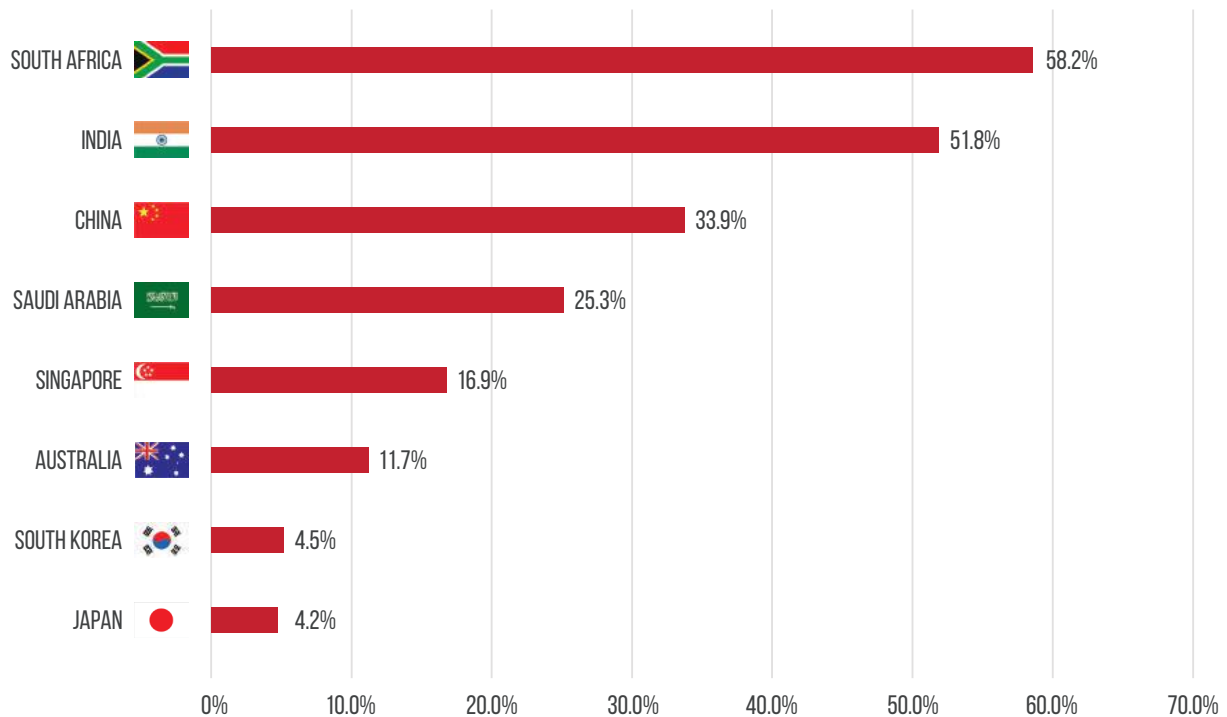
CASH SHARE OF THE WALLET

CASH SHARE
IN ASIA-PACIFIC

Cash share describes total spending as a percentage of the GDP. This allows us to measure how much cash is used compared to other payment methods.

Overall, Asia-Pacific still likes its cash despite China's and India's recent actions. Figure 1 below ranks Asian-Pacific countries by their cash share from highest to lowest. The median cash share was 21.1 percent, while the average was 38.4 percent.

FIGURE 1. CASH SHARE FOR COUNTRIES IN ASIA-PACIFIC

Country	Cash Share
SOUTH AFRICA	58.2%
INDIA	51.8%
CHINA	33.9%
SAUDI ARABIA	25.3%
SINGAPORE	16.9%
AUSTRALIA	11.7%
SOUTH KOREA	4.5%
JAPAN	4.2%

Countries with the lowest cash shares such as Japan and Australia have seen their cash shares decline over the past decade. Table 2 tracks the change in cash share throughout the past decade.

CASH SHARE OF THE WALLET

TABLE 2. CASH SHARE PER COUNTRY IN ASIA-PACIFIC

COUNTRY	2007	2010	2015	2020
AUSTRALIA	18.2%	16.3%	11.7%	8.4%
CHINA	29.6%	35.0%	33.9%	33.6%
INDIA	35.3%	49.4%	51.8%	50.8%
JAPAN	9.7%	6.0%	4.2%	2.8%
SOUTH KOREA	5.8%	4.8%	4.5%	4.1%
SINGAPORE	–	20.3%	16.9%	14.6%
SAUDI ARABIA	43.1%	38.1%	25.3%	17.8%
SOUTH AFRICA	–	73.0%	58.2%	49.1%
WEIGHTED AVERAGE CASH SHARE		25.3%	26.6%	27.7%
VARIATION 2010 — 2015			1.3%	1.1%

Overall, we predict cash share use will continue to be high through 2020. After all, it will take a long time to replace a payment system as popular as cash. That said, we do think cash share will continue to decline and the number of countries with a cash share below 20 percent will grow from four to five from 2015 to 2020.

We also forecast that the median cash share will decline from 21.1 percent in 2015 to 16.2 percent by 2020, while the average cash share will decline from 38.4 to 34.8 percent.

However, according to our calculations, the weighted average cash share will actually increase. This is because China accounts for a large chunk of Asia-Pacific's GDP and has a higher-than-average cash share, which will inflate the share for the region.

By 2020, we expect individual countries to radically change their cash share. South Africa will drop from being the country with the highest cash share. We project that South Africa's cash share will drop from 58.2 percent of the GDP in 2015 to 49.1 percent by 2020. We predict that India's cash share will drop by one percent, making it the country with the highest cash share in 2020. However, we're not sure of the long-term effects Modi's regulations will have on India's cash share. What we are fairly sure of is that Japan will continue reducing use of cash and the cash share will be 2.8 percent by 2020, one of the lowest in the world.

CASH SHARE OF THE WALLET

FIGURE 2. CASH SHARE FOR COUNTRIES IN ASIA-PACIFIC IN 2020

Country	Cash Share
INDIA	50.8%
SOUTH AFRICA	49.1%%%
CHINA	33.6%
SAUDI ARABIA	17.8%%
SINGAPORE	14.6%
AUSTRALIA	8.4%
SOUTH KOREA	4.1%
JAPAN	2.8%
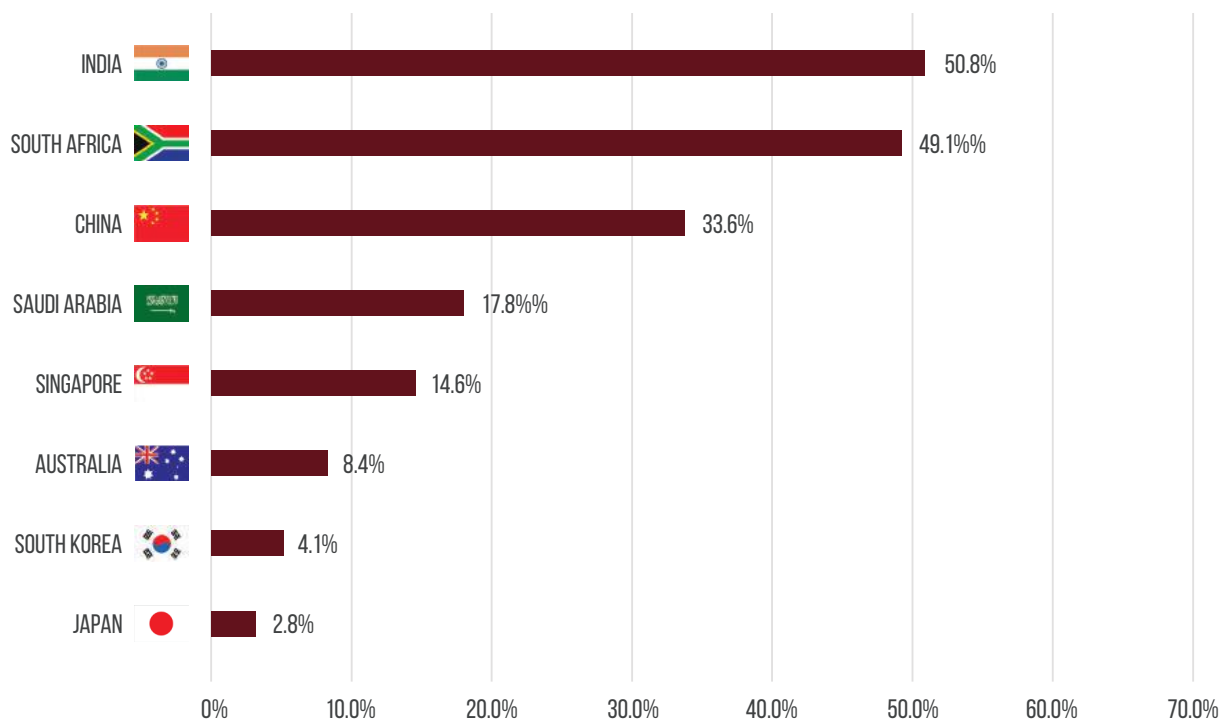
TOTAL CASH USE

S everal countries in the Asia-Pacific region have seen their total cash share decline. However, total use of cash also depends on a country's GDP. While overall we predict that cash share in the Asia-Pacific region will decline or remain stagnant, the region's GDP is booming. Since 2010, the GDP for the 14 countries has grown by 7.3 percent (weighted by country GDP) — with a low of 0.7 percent in Japan and a high of 11.8 percent in India. Therefore, we expect that cash use will increase. Table 3 displays the historic and predicted cash use for Asia-Pacific from 2007 to 2020, along with the annual growth rate.

TABLE 3. HISTORICAL AND FORECAST TOTAL USE OF CASH BY COUNTRY IN ASIA-PACIFIC

COUNTRY	2007	2010		2015		2020	
	CASH USE	CASH USE	CAGR 2007-2010	CASH USE	CAGR 2010-2015	CASH USE	CAGR 2015-2020
AUSTRALIA	154.4	166.6	1.5%	143.2	-3.0%	129.0	-2.1%
CHINA	1278.4	2287.5	12.3%	3757.9	10.4%	5387.0	7.5%
INDIA	274.4	599.3	16.9%	1095.1	12.8%	1921.3	11.9%
JAPAN	410.5	237.8	-10.3%	173.4	-6.1%	124.2	-6.5%
SOUTH KOREA	53.6	53.2	-0.1%	61.5	2.9%	70.8	2.8%
SINGAPORE	–	47.6	–	49.0	0.6%	56.6	2.9%
SAUDI ARABIA	179.1	200.5	2.3%	160.0	-4.4%	151.4	-1.1%
SOUTH AFRICA	–	156.9	–	183.7	3.2%	228.0	4.4%
TOTAL	2350.43	3749.51	8.6%	5623.93	8.4%	8068.35	7.5%

CAGR = COMPOUND ANNUAL GROWTH RATE*

From 2010 to 2015, the median growth rate for total cash use in Asia-Pacific was 10.4 percent, while the average growth rate (weighted by GDP) was 5.5 percent. We forecast that cash use will increase in five out of eight countries. The median growth will drop slightly to 7.5 percent, while the average growth will drop slightly to 4 percent.
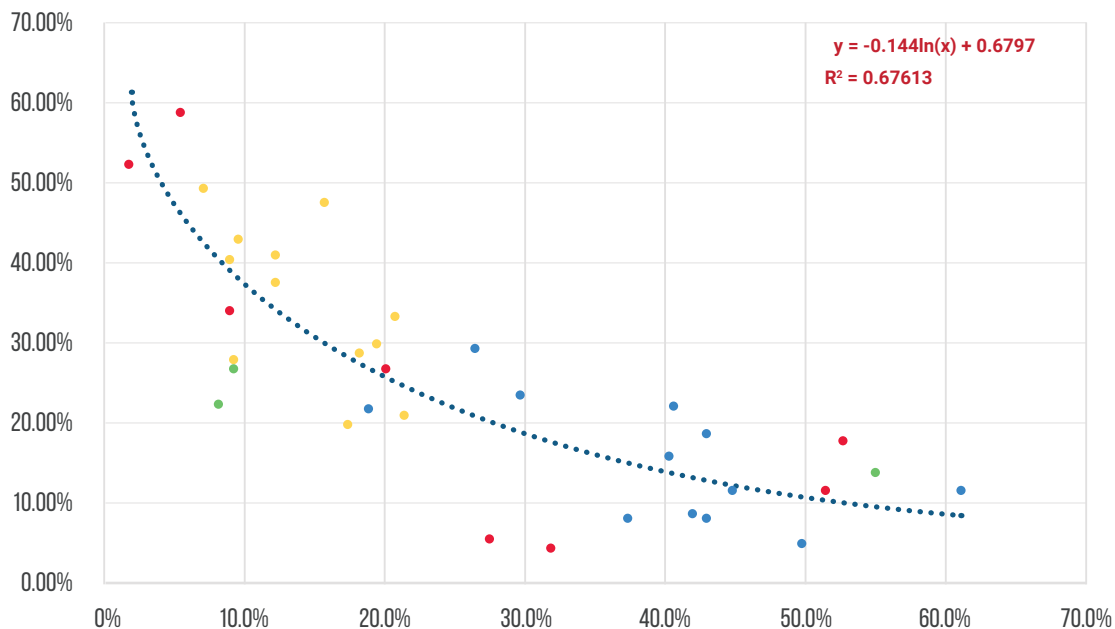
WEALTH AND CASH
USAGE

In previous issues of this report, we compared the relationship between a country's wealth and its use of cash and found that there's a strong relationship between a country's wealth and its cash share. Wealthier countries tend to have a lower cash share. The Asia-Pacific region confirms this pattern.

Figure 3 presents the relationship between GDP per capita and cash share for Western and Eastern Europe, the Americas and Asia-Pacific. For clarity, the orange dots represent the countries in Eastern Europe, blue are for those in Western Europe, green for the countries in Americas, and red for the countries in Asia-Pacific.

FIGURE 3. GDP PER CAPITA AND CASH USAGE FOR WESTERN AND EASTERN EUROPE, AMERICAS AND ASIA-PACIFIC

$$y = -0.144\ln(x) + 0.6797$$
$$R^2 = 0.67613$$

There's a clear logarithmic relationship between country GDP and cash share (R^2 is 0.67). In other words, higher GDP per capita is related to lower use of cash.

We did some further analysis to determine how the presence of point-of-sale (POS) and ATM terminals affects people's use of cash. We hypothesized that in places with more POS terminals, people tend to use less cash because they have more opportunities to use debit or credit cards. Our analysis confirmed this hypothesis. For countries in all four regions, the higher the availability of POS terminals per 100,000 people, the lower the cash share of the country. The logarithmic relationship isn't as clear-cut as it is for GDP per capita and cash share — the R^2 is only 0.27.

Again, we used orange dots for the countries in Eastern Europe, blue for those in Western Europe, green for the countries in Americas, and red for the countries in Asia-Pacific.

As an additional analysis, we wanted to study the impact of both of these. Certainly a high GDP correlates with a low cash share and having many POS terminals correlates with a low cash share, but what about a situation where a country has a high GDP and a high number of POS terminals?

We created a multivariable model that included both GDP per capita and POS per 100,000 and examined their relationship to cash share.

The regression we did is the following:

$$Cash\ \widehat{Share} = \beta_1\ GDP\ per\ capita +\ \beta_2 POS\ per\ 100{,}000\ people + \varepsilon$$

Our results were particularly strong. Both variables demonstrated statistical significance. The R2 of the multivariate regression is 0.73. In other words, a low cash share is highly correlated with countries that have a high GDP and a high number of POS terminals. In Table 4 we show the coefficients of the regression for both variables.

TABLE 4. MULTIVARIATE REGRESSION COEFFICIENTS

VARIABLE	REGRESSION COEFFICIENT
GDP PER CAPITA	-0.0054
POS PER 1000,000 PEOPLE	-0.0709

IN INDIA,
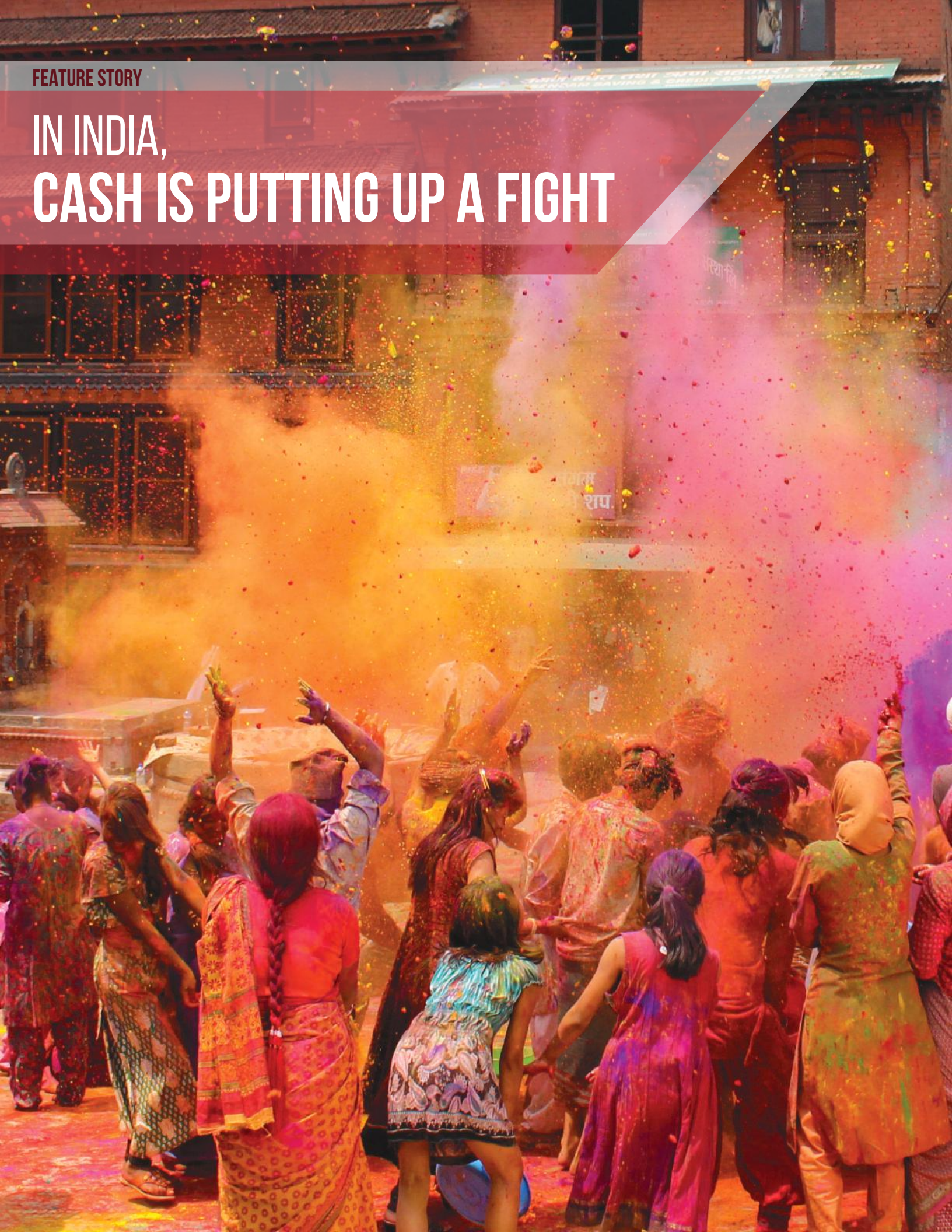# CASH IS PUTTING UP A FIGHT

On the night of Nov. 9, 2016, a surprise announcement by India's Prime Minister Narendra Modi demonetized 500 and 1,000-rupee bank notes, essentially removing from circulation 86 percent of the currency in this heavily cash-reliant country.

The campaign, as Modi dubbed it, was a war on black money — some $2 trillion of which was estimated to be stashed abroad — and an attempt to set India and its 1.3 billion citizens on track for a cashless future, hopefully putting an end to the country's parallel underground economy.

Six months later, however, data from Reserve Bank of India (RBI) shows that a cashless future remains a long way off.

In March 2017, total withdrawals amounted to $35.2 billion, a 0.6 percent increase over the same period in 2016. While the growth was miniscule compared to the 11.4 percent rise noted in March 2015, cash usage shows no signs of slowing down.

"Things are changing, but not really at the pace one would expect," said Nirupama Soundararajan, an economist at Pahle India, a New Delhi-based political research think tank. Soundararajan believes that the slow rate of change is also reflective of India's struggle to adopt digital banking services.

PYMNTS caught up with Soundararajan to gauge the state of cash in India and to discuss how demonetization has affected overall cash usage.

Demonetization and the rise in cash usage

India has long been a cash economy. Until November last year, nearly 95 percent of transactions were conducted in cash, with nearly 90 percent of merchants unable to accept any other form of payment.

With demonetization, however, the country experienced a massive cash crunch.

With the surprise demonetization announcement, ATMs weren't stocked sufficiently and consumer withdrawals were limited by transaction amount and frequency, Soundararajan said. It was only in March this year when the RBI lifted the cash withdrawal limits, she added.

After the slump observed in November and December, the spike in cash usage in March, as Soundararajan views it, is a response to immediately going back to doing something that consumers were denied previously.

On the other hand, this spike could also be due to a new population of Indians gaining access to cash, or the increase in availability of cash driving up spending, she said.

And it will be several months before numbers can be analyzed again to reach a conclusion on the increase in cash usage, Soundararajan said— adding that, for a country the size of India, it can be difficult to quickly amass data and then work the numbers.

Digital payments, making inroads?

Demonetization may not yet be making a significant dent on overall Indian cash usage, but it did give digital payments a jump start.

A month after demonetization, daily transaction volume from digital wallets such as Oxigen, Paytm and MobiKwik reportedly went up by 271 percent – from 1.7 million to 6.3 million.

Even so, March 2017 data from the RBI poured cold water on proponents of digital payment.

The volume of overall digital transactions, which had increased by 42 percent from 672 million in November to 958 million in December 2016, declined by 20 percent to 763 million in February 2017.

That is, demonetization led to a sudden increase in use of digital payments in November and December of last year, but then with an increasing availability of cash in spring 2017, digital payments usage again declined in February 2017, the RBI noted.

Still, Soundararajan and others are optimistic about the future of digital payments in India, pointing to the fact that many small vendors have begun accepting non-cash payments since demonetization.

In India, service providers ranging from seamstresses to rickshaw drivers have all moved to accepting payments thru Paytm, a digital payments platform, she said. "The [anecdotal] evidence of that is much stronger."

Despite this anecdotal evidence, however, a significant hurdle impeding the growth of digital payments in India is its consumers' lack of interest in using mobile internet for accessing banking services, Soundararajan said. About 66 percent of Indian consumers use mobile internet connectivity primarily to access social networking sites, with 46 percent using it for entertainment websites, according to a 2016 Pahle India study.

"[Indians] are perfectly comfortable using their phone to stream videos, to download entertainment apps and watch YouTube," she said. "However, the movement leading up to adoption of mobile banking has been very, very slow. Largely, it is a trust issue."

Under RBI's current mandate, Indian consumers can be partially liable for the cost of fraud if they fail to report it within three days of occurrence, so fraud concerns could have a real impact on Indian consumers' day-to-day lives and their ability to make ends meet.

To top that off, fraud settlements are often painfully drawn-out processes, leading consumers to mistrust their financial institutions, Soundararajan said.

The focus for the digital payments industry needs to be on not just touting the benefits of these services, but also on educating consumers about their security, she added.

Meanwhile, for consumers, continuing to use cash keeps their security and trust woes at bay.

> " *the movement leading up to adoption of mobile banking has been very, very slow* "

Future of cash

In India, the growth of digital payments remains bogged down by old regulations, which weren't cut out to support the recent growth of FinTech firms. For digital payments to grow, Soundararajan said, regulations will have to be reworked.

Thankfully, the Indian government seems to be moving in that direction. In February, Finance Minister Arun Jaitley called for the creation of a Payments Regulatory Board under RBI, as well as an overhaul of the Payment and Settlements Act of 2007.

Still, even the loosening of regulations may do little to erode India's love for cash, Soundararajan said. "I don't think India will ever become a cashless society," she said.

If anything, Soundararajan believes, cash usage is bound to increase as more people gain access to financial services. And, as the spending power of the middle class improves, there will be a spike in cash usage firstly, perhaps followed by an increase in digital or card-based payments usage, she added.

The findings of the PYMNTS Global Cash Index™ corroborate this argument. Total use of cash in India is estimated to grow at a 11.9 percent CAGR through 2020.

With cash continuing to make strides, it will remain the most-used payment method in India for the foreseeable future.

APPENDIX

METHODOLOGY
AND DATA

The PYMNTS.com Global Cash Index powered by Cardtronics analyzes the level of overall cash usage and projected trends over the next five years for 40 countries around the world that provide sufficient data to make estimates on cash usage.

These countries are divided into four regions, and we will publish reports that review cash share and total cash usage, covering one region each quarter. The four regions are as follows:

WESTERN EUROPE	EASTERN EUROPE	THE AMERICAS	ASIA AND OTHER
AUSTRIA	BULGARIA	UNITED STATES	AUSTRALIA
BELGIUM	CROATIA	MEXICO	CHINA
FINLAND	CZECH REPUBLIC	BRAZIL	INDIA
FRANCE	ESTONIA		JAPAN
GERMANY	GREECE		SOUTH KOREA
IRELAND	HUNGARY		SINGAPORE
ITALY	LATVIA		SAUDI ARABIA
LUXEMBOURG	LITHUANIA		SOUTH AFRICA
MALTA	POLAND		
NETHERLANDS	ROMANIA		
PORTUGAL	RUSSIA		
SPAIN	SLOVAKIA		
SWEDEN	SLOVENIA		
SWITZERLAND	TURKEY		
UNITED KINGDOM			

Total cash usage is the combination of two overall factors:

- The first factor is cash share, or the amount of total purchases that are made with cash. We measure cash share as the total amount of cash used by a country divided by the country's annual GDP. The total cash used by citizens of the country is assumed to be equal to the total amount of cash withdrawn at ATM machines plus the total amount of cash withdrawn OTC at bank branches in the country.

- The second factor is how the overall economy is growing. The total cash usage is estimated as the total cash share multiplied by the country's GDP. As a country's economy develops and grows, more overall spending occurs, which means more cash spending is occurring.

What we have found is that the total cash share is decreasing in most countries; however, because population and GDP are growing, the total cash usage is still growing (albeit at rates lower than the GDP).

In order to calculate the results in this report, we did the following for each country:

- Gather historic and projected data.
- Estimate OTC cash withdrawals for countries that do not report this data.
- Calculate historic cash share.
- Estimate cash share for 2015 forward.
- Estimate total cash usage for 2015 forward.

Gather historic and projected data.

For each country, we collected historic data from 2000 through 2014 on the total population, the GDP, cash withdrawals from ATM and OTC, total card spending data, and data on payment infrastructures including the number of POS machines, the number of ATM machines, and the number of bank branches.[8] We also gathered data to project cash usage including projected GDP and projected population by age group.[9]

We gathered data from 2000 through 2014 and used as much data as is available. We have data on population and GDP for all years and data on cash withdrawals and payments infrastructure for many, but not all years.

For each country, we collected projections for the GDP and for population by age group. This data comes from the International Monetary Fund (IMF) and World Bank, respectively, and is from the same source as the historic data. Population projections are available every five years, and we used a linear interpolation for the years that are not reported. GDP projections are by year, and if we needed time periods beyond the last projected data point, we assumed that final GDP growth rate will be consistent over time.

Estimate OTC cash withdrawals for countries that do not report this data.

As described above, cash share is defined as the total cash withdrawals from ATM machines plus total OTC cash withdrawals. We have selected the 40 countries in our analysis based on the availability of sufficient cash withdrawal data. The 40 included countries produced at least some data on the level of ATM withdrawals each year. If ATM withdrawals are not available, the country is excluded from our analysis.

While all 40 countries provided ATM data, only 12 provided data on OTC cash withdrawals. This means that for the other 28 countries, we had to estimate the level of OTC withdrawals. We did this by looking at each of our 28 target countries (the ones for which we need to estimate OTC withdrawals) and selecting a comparable country from the 12 countries that did provide data (we refer to these as our potential comparable countries).

The estimation procedure is done in the following four steps:

- **ONE:** Calculate the OTC-to-ATM ratio for each of the 12 potential countries that do provide OTC data. These are all potentially comparable countries. This is a simple calculation of dividing the level of OTC withdrawals by the level of ATM withdrawals for each year where data is available.

- **TWO:** Estimate the logarithm trend of the OTC to ATM ratio from 2000 through 2014 for each of the potentially comparable countries.[10]

$$\overline{\left(\frac{OTC}{ATM}\right)}_{Year} = \propto + \beta \times LN(Year) + \varepsilon$$

We do this to remove any data jumps or movements that are due to factors specific to the country. This trend gives us a complete trend of the OTC to ATM ratio for each year from 2000 through 2014.

- **THREE:** Select the potential comparable country. For each country that does not have OTC data (target country), we select the most comparable country from the list of countries that do provide OTC data. This country is selected by comparing the trends and levels in five different variables:

  - ATM withdrawals as a percentage of GDP
  - Card spending as a percentage of GDP
  - Bank branches per 1,000 people
  - ATM terminals per 1,000 people
  - POS terminals per 1,000 people

For each potential comparable country, we calculate a difference in levels and a difference in changes over an eight-year period from 2006 to 2014. These are calculated as follows:

$$Difference\ in\ levels = \sqrt{\sum_{i=2006}^{2014}(Variable_{Comparable/i} - Variable_{Target/i})^2}$$

$$Difference\ in\ changes = \sqrt{\sum_{i=2006}^{2014}\left(\frac{Variable_{Comparable/i}}{Variable_{Comparable/i-1}} - \frac{Variable_{Target/i}}{Variable_{Target/i-1}}\right)^2}$$

In the formula above, i is the year and "Variable" refers to each of the five variables listed above. We perform this calculation for each of the 28 target countries against each of the 12 potential comparable countries. This provides a difference in levels and a difference in changes for each of the five variables for each combination of a target country and comparable comparison country. We then assign a weight of two-thirds to the difference in levels and one-third difference in changes, and for each target and comparable country, we calculate a weighted average difference:

$$Weighted\ Average\ Difference_{ij} = 0.667 * Avg\ difference\ in\ levels + 0.333 * Avg\ difference\ in\ changes$$

where i is the target country and j is the comparable country.

For each target country, we then have a weighted average difference for each of the 12 potential comparable countries. The comparable country for each target is selected as the potential comparable country with the smallest difference for each target

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[10] For three countries, the reduction in OTC-to-ATM ratio was so strong that we used a polinomial trend. These three countries were Latvia, Romania and Slovakia.

country. The following table shows the comparable country selected for each of the 28 target countries.

NUMBER	TARGET	COMPARABLE
1	AUSTRALIA	UNITED KINGDOM
2	AUSTRIA	ITALY
3	BELGIUM	NETHERLANDS
4	BRAZIL	MALTA
5	BULGARIA	HUNGARY
6	CHINA	SLOVAKIA
7	CROATIA	MALTA
8	ESTONIA	NETHERLANDS
9	FINLAND	NETHERLANDS
10	FRANCE	ITALY
11	GREECE	HUNGARY
12	INDIA	SLOVAKIA
13	IRELAND	LATVIA
14	JAPAN	GERMANY
15	KOREA	UNITED KINGDOM
16	LUXEMBOURG	ITALY
17	MEXICO	CZECH REPUBLIC
18	POLAND	HUNGARY
19	PORTUGAL	UNITED KINGDOM
20	RUSSIA	ROMANIA
21	SAUDI ARABIA	SLOVAKIA
22	SINGAPORE	NETHERLANDS
23	SLOVENIA	HUNGARY
24	SOUTH AFRICA	SLOVAKIA
25	SWEDEN	NETHERLANDS
26	SWITZERLAND	NETHERLANDS
27	TURKEY	MALTA
28	UNITED STATES	UNITED KINGDOM

- **FOUR:** Calculate the estimated level of OTC withdrawals for the target country. We have 28 target countries for which we are estimating the level of OTC withdrawals. For nine of these countries, we do have data on the OTC-to-ATM ratio for a single year but have no other data that can allow us to understand how it's trending. For these countries, we adjust the value of $\overline{\left(\frac{OTC}{ATM}\right)_{Year}}$

such that it matches the known OTC-to-ATM ratio. This has the result of shifting the OTC-to-ATM ratio for every year up or down such that our estimated trend line passes through the known point. For the other 19 countries, we assume that this adjustment is equal to zero or that the OTC-to-ATM ratio for the selected comparable country is the same as the OTC-to-ATM ratio for the target country.

For each target country, we then take this adjusted value of $\overline{\left(\frac{OTC}{ATM}\right)_{Year}}$ for the selected comparable country and use it to calculate the level of OTC withdrawals for each from 2000 through 2014.

$$OTC\ Withdrawals_{Year} = \overline{\left(\frac{OTC}{ATM}\right)_{Year}} \times ATM\ Withdrawals_{Year}$$

The following table identifies the 12 countries for which OTC data is reported, the nine countries for which we have to estimate the trend based on a comparable country but for which we do have a single known data point to set the level of OTC withdrawals, and the 19 countries for which the trend and OTC-to-ATM ratio are derived from the comparable country.

ASIA AND OTHER

NO	COUNTRY	SOURCE OF OTC DATA		
		OTC DATA AVAILABLE	KNOWN DATA POINT	VALUE IS DERIVED
1	AUSTRALIA		✔	
2	CHINA			✔
3	INDIA			✔
4	JAPAN			✔
5	SOUTH KOREA			✔
6	SINGAPORE			✔
7	SAUDI ARABIA			✔
8	SOUTH AFRICA			✔

WESTERN EUROPE

NO	COUNTRY	SOURCE OF OTC DATA		
		OTC DATA AVAILABLE	KNOWN DATA POINT	VALUE IS DERIVED
1	AUSTRIA			✔
2	BELGIUM			✔
3	FINLAND		✔	
4	FRANCE		✔	
5	GERMANY	✔		
6	IRELAND		✔	
7	ITALY	✔		
8	LUXEMBOURG			✔
9	MALTA	✔		
10	NETHERLANDS	✔		
11	PORTUGAL		✔	
12	SPAIN	✔		
13	SWEDEN		✔	
14	SWITZERLAND			✔
15	UNITED KINGDOM	✔		

EASTERN EUROPE

NO	COUNTRY	SOURCE OF OTC DATA		
		OTC DATA AVAILABLE	KNOWN DATA POINT	VALUE IS DERIVED
1	BULGARIA			✔
2	CROATIA		✔	
3	CZECH REPUBLIC	✔		
4	ESTONIA			✔
5	GREECE			✔
6	HUNGARY	✔		
7	LATVIA	✔		
8	LITHUANIA	✔		
9	POLAND			✔
10	ROMANIA	✔		
11	RUSSIA			✔
12	SLOVAKIA	✔		
13	SLOVENIA		✔	
14	TURKEY			✔

AMERICAS

NO	COUNTRY	SOURCE OF OTC DATA		
		OTC DATA AVAILABLE	KNOWN DATA POINT	VALUE IS DERIVED
1	UNITED STATES		✔	
2	MEXICO			✔
3	BRAZIL			✔

Calculate historic cash share.

The cash share is defined as the total cash spending divided by the GDP. In this sense, cash usage is relative to the overall size of the economy. Total cash spending is defined as ATM withdrawals plus OTC withdrawals. Total cash share is calculated as follows:

$$Cash\ Share_{Year} = \frac{ATM\ Withdrawals_{Year} + OTC\ Withdrawals_{Year}}{GDP_{Year}}$$

Estimate cash share for 2015 forward.

The cash share is estimated as a logarithm trend of the historic data. We then estimate the log trend and adjust the line such that it lines up with the historic data for 2014. This creates a naïve historic cash share trend starting at the historic cash share for 2014, rolling forward for five or 10 years.

We then adjust this naïve cash share based on the demographic trends in the country and the likelihood that younger demographics will be more prone to shift away from cash to new payment methods such as mobile wallets or other new technologies that are becoming available. This adjustment analyzes the proportion of the population that is younger and accounts for the relative amount of spending (because younger people generally earn and spend less than older people). This analysis suggests that the actual cash share is likely to be lower than the naïve cash share estimated above once we take these factors into account.

This analysis results in a projected cash share that is less than the cash share projected using the naïve analysis described above.

Estimate total cash usage for 2015 forward.

The total cash usage is calculated by multiplying the adjusted cash share by the projected GDP for each year, 2015 through 2020.

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