the PYMNTS.com

Global Cash Index™

a CARDTRONICS collaboration

JULY 2018

AUSTRALIA EDITION



37%
Portion of all consumer transactions paid in cash in 2016

6%
Annual growth rate of the value of cash in circulation in 2016

11% Cash share of Australia's GDP in 2016

135 Number of ATMs per 100,000 people in 2016

22.0 Number of bank branches per 100,000 people in 2016



INTRODUCTION

Australia is one of the most developed economies in the Asia Pacific region — and one of the most unique. It holds the record for the longest-lasting gross domestic product (GDP) growth streak of any nation in recorded history, having maintained an increased GDP for 26 consecutive years. Cash has historically played a large role in facilitating its impressive growth, but recent statistics suggest that Australians' relationship with printed legal tender is beginning to change.

Cash still serves a crucial function in the nation's economy, with many Australians using it to pay for smaller purchases or keeping it in their homes — instead of a bank — to store value. At the same time, card and mobile payment methods are becoming more common with each passing year. Australia's unique economic situation creates an apparent contradiction in its citizen's cash usage. Though many are increasingly using alternative payment methods, the value of cash in circulation within its borders is actually increasing. That means the monetary value of the bills Australians keep on hand has grown, too.

Our previous report on Australia found that cash was still the preferred payment method for smaller transactions. Our latest findings suggest the continuation of this trend, with cards becoming the standard for more expensive buys.

As shown in Figure 1, cash helped facilitate 37 percent of total consumer transactions in 2016, whereas 52 percent were carried out with credit or debit cards. This accounted for the vast majority of purchases within Australian borders that year, as the remaining 11 percent were made with newer, niche payment methods — some of which have yet to achieve widespread usage. These included BPAY (2 percent), PayPal (3 percent), traditional internet and phone banking (2 percent) and other payment platforms (4 percent).

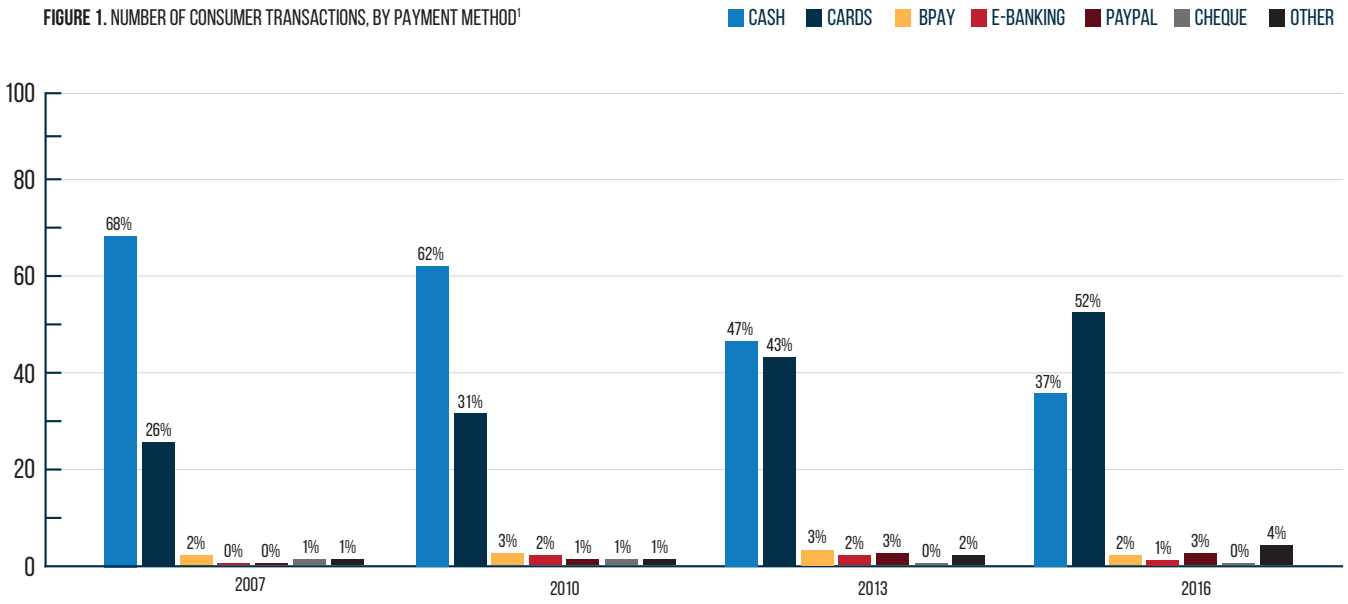


Figure 1 also displays the decline of cash as a payment method in terms of transactions facilitated. Sixty-nine percent of all transactions in the country were made with cash in 2007, and only 26 percent were completed using credit or debit cards. The former figure decreased to 47 percent by 2013, and then to 37 percent in 2016. Conversely, the percentage of Australian consumer transactions made via credit or debit card increased to 43 percent by 2013 and 52 percent by 2016.

The data told a similar story when we examined the value of cash's penetration of the Australian transactional market. As seen in Figure 2, the dollar value of cash exchanged has decreased since 2007. Thirty-eight percent of all commercial transactions in Australia were paid in cash that year, but that figure had dropped to 29 percent by 2010. In both 2013 and 2016, the Reserve Bank of Australia (RBA) calculated cash transactions to have accounted for 18 percent of the total dollar value of all commercial exchanges within Australia's borders.

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FIGURE 1. NUMBER OF CONSUMER TRANSACTIONS, BY PAYMENT METHOD[1]



The RBA observed a continual increase in credit and debit cards' share of the Australian market. Consumers used cards to pay for 43 percent of their transactions in both 2007 and 2010. Card use climbed to 53 percent by 2013. Fifty-four percent of the dollar amount spent annually by Australian consumers could be attributed to credit or debit card payments by 2016. As such, the portion of card payments by volume and by value are both increasing.

The Australian economy's percentage of cash payments by value has historically been lower than that by volume, according to this data. The proportion of cash payments by value was 38 percent in 2007, while the proportional cash share by volume was 69 percent. This ratio was measured at 29 percent over 62 percent in 2010.

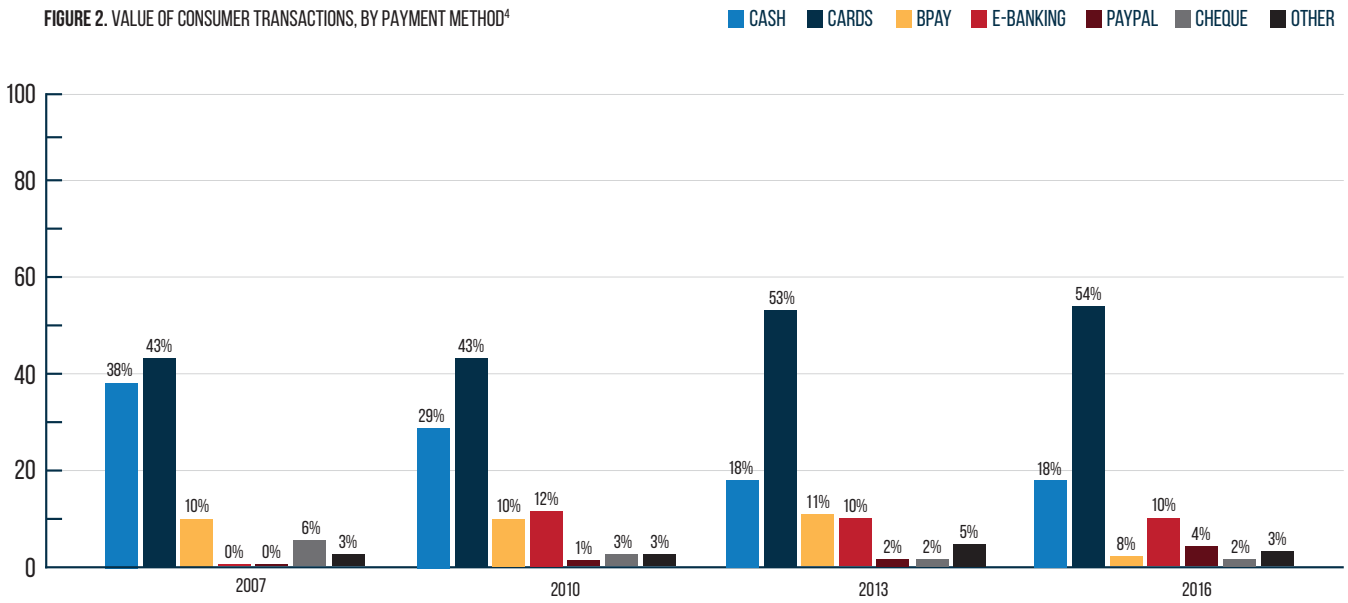


It appears Australians simply tend to use cash for smaller purchases and cards for larger ones. As seen in Figure 3, consumers used cash to pay for smaller transactions, especially items valued at $7 or less, which comprised 62 percent of purchases in 2016.[2] Just 32 percent of these low-value transactions were made with credit or debit cards. Conversely, 11 percent of goods and services with a price tag of $373 or more were purchased with cash that year, while half were paid for with a credit or debit card.[3]

[1] Doyle, M.; Fisher, C.; Tellez, E. and Yadav, A. How Australians pay: evidence from the 2016 consumer payments survey. Reserve Bank of Australia. 2017. https://www.rba.gov.au/publications/rdp/2017/pdf/rdp2017-04.pdf. Accessed June 2018.
[2] Values do not add up to 100 percent because other payment methods were used.
[3] We used an average exchange rate of 1.34 AUD/$1 USD in 2016 when converting Australian to U.S. dollars.

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FIGURE 2. VALUE OF CONSUMER TRANSACTIONS, BY PAYMENT METHOD[4]



There are other factors impacting Australia's cash economy, though. Its government recently vocalized an intent to ban the use of cash for purchases of any good or service of $10,000 or more by 2019, an incentive to alter consumer behavior. The official reason for this decision lies in the government's drive toward digitization to deter tax evasion. Such a ban would only apply to a tiny percentage of domestic purchases, but is expected to generate an additional $3 billion in annual tax revenue.[5]

Additionally, the RBA implemented a payments infrastructure in early 2018 that will likely enact long-term effects. The New Payments Platform (NPP) will allow consumers with accounts at different banks to transfer money between those accounts in real time, something that was previously quite difficult.[6] This system has the potential to further speed the proliferation of digital payments, as it eases consumers' ability to transfer money between accounts at different financial institutions (FIs) and makes direct transfers more convenient.

Until recently, cash served as a pragmatic alternative to the cumbersome process of transferring funds between different accounts. With the NPP in place to streamline inter-account transfers, consumers now have the option to choose between using cash and transfer funds digitally.

Even without new payment products entering the market, the NPP's ability to work with multiple payment platforms makes it a disruptive force in the financial and payments industries. It is designed to accommodate BPAY's Osko person-to-person (P2P) money transfer platform, for example, the first of its kind to be supported by the NPP. Furthermore, NPP is expected to help bolster payments innovation because it was designed to support multiple and potentially competing services.[7]

As the average Australian appears to be using cash less frequently and for fewer transactions with each passing year, a casual observer would be forgiven for assuming that the value of cash in circulation is decreasing. The case is quite

[4] Doyle, M.; Fisher, C.; Tellez, E. and Yadav, A. How Australians pay: evidence from the 2016 consumer payments survey. Reserve Bank of Australia. 2017. https://www.rba.gov.au/publications/rdp/2017/pdf/rdp2017-04.pdf. Accessed June 2018.
[5] Novak, Matt. Australia bans cash for all purchases over $7,500 starting July of 2019. Gizmodo. 2018. https://gizmodo.com/australia-bans-cash-for-all-purchases-over-7-500-start-1825946888. Accessed June 2018.
[6] Author unknown. Aussie's new payments platform (called New Payments Platform) goes live. PYMNTS. 2018. https://www.pymnts.com/news/2018/new-payments-platform-australia-npp-adrian-lovney/. Accessed June 2018.
[7] Fitzsimmons, Caitlin. Goodbye cash and cheques, faster electronic payments are nearly here. The Sidney Morning Herald. 2018. https://www.smh.com.au/opinion/goodbye-cash-and-cheques-faster-electronic-payments-are-nearly-here-20180101-h0c41k.html. Accessed June 2018.

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the opposite, however, as the real value of cash circulating in Australia is increasing at an annual rate of approximately 6 percent.

The disparity between the falling nominal and ascending real values of cash in circulation may be attributed to several factors, according to the RBA. First, there are likely transactions throughout the country that are not used in official calculations. These take place in the underground economy — and are difficult, if not impossible, to trace — but are potentially skewing official calculations.

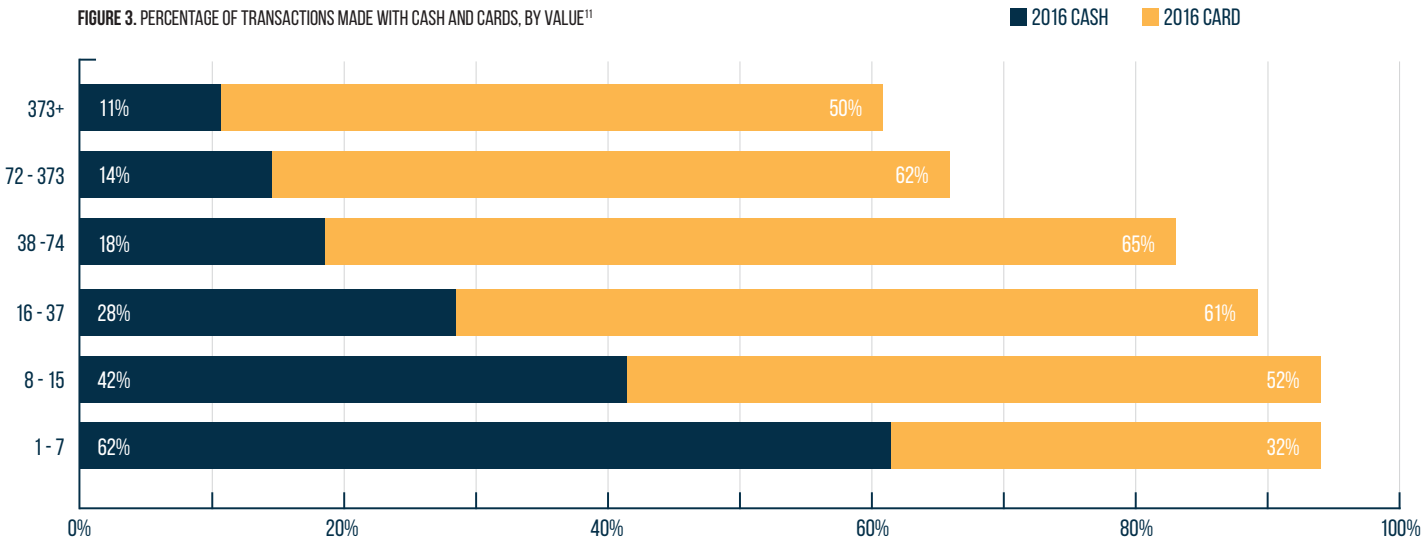
Second, cash is not moving as quickly between hands as it once did. Consumers are instead hoarding it, storing it themselves, in their own homes, instead of relying on a bank to do so for them. In technical terms, this suggests that the velocity of circulation has decreased.[8] This is significant, because it means that though it is not being used to generate more commercial transactions, the nominal value of cash in the economy can remain constant.

The RBA mentions several factors that contribute to this behavior. The financial crisis may have affected the level of general confidence and increased consumers' uncertainty levels, raising the demand for cash held for precautionary purposes. Also, low global and domestic interest rates may have increased cash's appeal compared to other assets. As with the transactional demand for cash, population growth, inflation and real income growth also increase the underlying demand for cash held as a store of value.[9]

Finally, Australian citizens are slowly drifting away from the traditional use of cash as a transactional mechanism, but foreign nationals in the country still have a high demand for it. Tourists and business visitors are using cash to make payments during their visits, thereby increasing the demand for the number of Australian banknotes in circulation.[10] For them, using cash is still more convenient than using a foreign credit or debit card.

This report focuses on the use of cash to purchase goods and services rather than to store value. The following sections will explore the evolving function of cash in the Australian economy. How are Australians using it? How much less frequently are they using it, and why? What is likely to take cash's place as their primary payment method? Our research has unearthed the answers.

FIGURE 3. PERCENTAGE OF TRANSACTIONS MADE WITH CASH AND CARDS, BY VALUE[11]



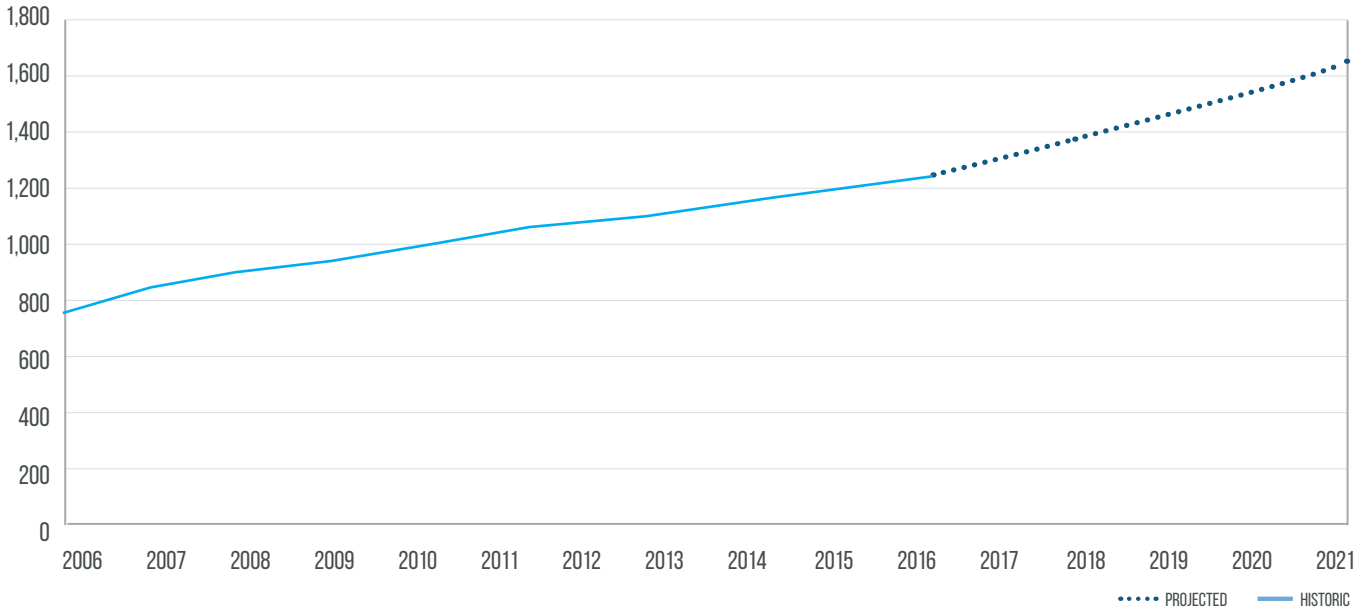
[8] Velocity of circulation is defined as the average number of times a banknote is used in certain period.
[9] Flannigan, G. and Staib, A. The growing demand for cash. Reserve Bank of Australia. 2017. https://www.rba.gov.au/publications/bulletin/2017/sep/pdf/bu-0917-8-the-growing-demand-for-cash.pdf. Accessed June 2018.
[10] Flannigan, G. and Staib, A. The growing demand for cash. Reserve Bank of Australia. 2017. https://www.rba.gov.au/publications/bulletin/2017/sep/pdf/bu-0917-8-the-growing-demand-for-cash.pdf. Accessed June 2018.
[11] Doyle, M.; Fisher, C.; Tellez, E. and Yadav, A. How Australians pay: evidence from the 2016 consumer payments survey. Reserve Bank of Australia. 2017. https://www.rba.gov.au/publications/rdp/2017/pdf/rdp2017-04.pdf. Accessed June 2018.

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CASH SHARE IN AUSTRALIA

Australia boasts the fifth-largest economy in the Asia Pacific region with a nominal GDP of $1.278 billion in 2016, and its dollar value is expected to increase to more than $1.6 billion by 2021. Figure 4 provides the country's historical and projected GDP growth from 2006 to 2021.

FIGURE 4. HISTORIC AND PROJECTED GDP FOR AUSTRALIA, 2006-2021 (NOMINAL IN BILLION DOLLARS)[12]



Australia's nominal GDP grew at a compound annual growth rate (CAGR) of 5 percent between 2006 and 2016, as also displayed in Figure 4, and it is expected to pick up its pace to a CAGR of 5.2 percent between 2017 and 2021. This is an impressive streak, one made even more so considering it is only the tail end of a 26-year spurt. Australia has seen steady nominal growth since 1992, an historically long period of economic progress.[13]

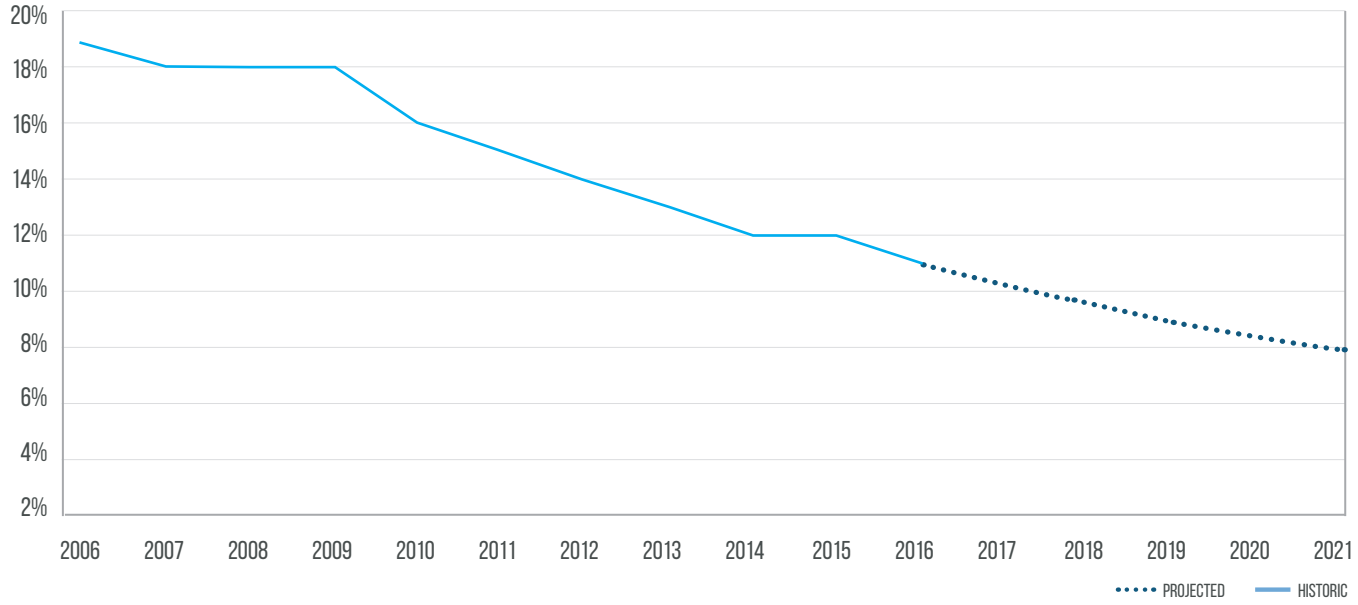
The Australian economy has grown consistently for many years. How, then, has the role of cash in this dynamic economy altered? Has nominal GDP growth, or its growth rate, changed the way citizens interact with the printed legal tender? Furthermore, how will these projected variations in Australia's nominal GDP and its growth rate impact its citizens' future cash usage?

We expect Australia's cash share to continue to slip until 2021, at least, as seen in Figure 5.

[12] Author unknown. World Economic Outlook Database. IMF. 2017. https://www.imf.org/external/pubs/ft/weo/2016/02/weodata/index.aspx. Accessed June 2018.
[13] Author unknown. How Australia broke the record for economic growth. The Economist. 2017. https://www.economist.com/blogs/economist-explains/2017/09/economist-explains-3. Accessed June 2018.

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FIGURE 5. HISTORIC AND PROJECTED CASH SHARE WITH LOGARITHMIC TREND, 2016-2021



Australian cash share remained largely flat between 2006 and 2009, decreasing only slightly from 18.9 percent to 18 percent. Thereafter, its rate of decline magnified, falling to 11.2 percent by 2016. This makes for a CAGR of approximately -5.1 percent between 2006 and 2013. For reference, the projected GDP CAGR between 2016 and 2021 is approximately -5.6 percent.

We may reasonably attribute our 2006 to 2009 measurements to the onset of the global financial crisis. Confidence in the global economy stalled during this period, consumers worldwide grew cynical toward their banking systems, and many turned to cash to pay for their expenses.

According to a speech delivered by Guy Debelle, Australia's assistant governor of financial markets, the circumstances leading up to and beyond the 2008 financial crisis had a definite impact on cash use in the country. Specifically, the events made Australian banks reluctant to lend cash, which led to an increase in domestic demand. The RBA responded by increasing the supply in the Australian economy.[14] This likely explains its cash share's relative stability between 2006 and 2009, as a conscious effort was made to increase the amount of cash in the system during that time.

What are we to make of Australian cash share's post-2009 rate of decline, then? We attribute this observed and projected acceleration to Australia's evolving ATM and over-the-counter (OTC) withdrawals as a share of GDP. We observed that both ATM and OTC withdrawals as a share of GDP increased between 2006 and 2009, then fell until 2016. This data can be seen in Table 1.

[14] Debelle, Guy. Some effects of the global financial crisis on Australian Financial Markets. Reserve Bank of Australia. https://www.rba.gov.au/speeches/2009/sp-ag-310309.html. Accessed July 2018.

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TABLE 1. GDP AND CASH USAGE DATA FOR AUSTRALIA (IN BILLION DOLLARS)

YEAR	NOMINAL GDP IN DOLLARS	CASH USAGE — BILLION DOLLARS			ATM SHARE	OTC SHARE	CASH SHARE
		ATM	OTC	TOTAL			
2006	782.1	97.8	49.7	147.5	12.5%	6.4%	18.9%
2007	852.8	104.2	50.7	154.9	12.2%	5.9%	18.2%
2008	931.3	115.8	54.2	170.0	12.4%	5.8%	18.3%
2009	949.5	117.7	53.1	170.8	12.4%	5.6%	18.0%
2010	1024.0	116.5	50.7	167.3	11.4%	5.0%	16.3%
2011	1098.0	115.8	48.8	164.7	10.6%	4.4%	15.0%
2012	1135.7	114.7	46.9	161.6	10.1%	4.1%	14.2%
2013	1174.6	111.7	44.3	156.0	9.5%	3.8%	13.3%
2014	1209.9	108.7	41.9	150.7	9.0%	3.5%	12.5%
2015	1231.4	105.9	43.2	149.1	8.6%	3.5%	12.1%
2016	1277.9	100.8	42.0	142.8	7.9%	3.3%	11.2%

Between 2006 and 2009, for example, the nominal value of Australia's GDP attributable to ATM withdrawals increased from $97.8 billion to $117.7 billion. Its proportion of domestic GDP therefore remained relatively stable, dipping from 12.5 percent to 12.4 percent. It then began to decrease, falling to 7.9 percent in 2016, with $100.8 billion being withdrawn from the nation's ATMs that year.



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CASH VERSUS
ALTERNATIVE PAYMENT METHODS

Alongside cash use, credit and debit cards' popularity continues to flourish in Australia. The share of card payments in the country's GDP by number of transactions stood at 26 percent in 2007. It had doubled by 2016, with 52 percent of all domestic transactions being carried out via credit or debit card. Card payments are now Australians' favorite way to pay for their goods and services.

We speculate that there is more to this story than that, however. There have been several technological advancements in recent years that have made card payments even more convenient.

One obvious example is the development of contactless card payments, which have seen growth in popularity over the years. Only one-fifth of all point-of-sale (POS) card payments were contactless in 2007, but that number increased to almost two-thirds in 2016, representing approximately one-third of all POS transactions.[15] These have gained popularity because more merchants are beginning to accept them.

There are more new payment methods on the rise, however, and mobile payments have attracted particular attention. This might appear premature, as only about 1 percent of Australians currently pay with mobile phones in stores, but recent data collected by the Australia and New Zealand Banking Group (ANZ) suggests Australian interest in mobile payments is swelling at a rapid pace.[16] It reported that the number of domestic mobile payments increased 140 percent between December 2016 and December 2017, when 3.9 million transactions were calculated to have been supported by mobile payment systems. Some of the newer, less widely used platforms include eWallets like Fitbit and Garmin Pay.[17]

Mobile payment systems may not have achieved extensive market penetration, but they are still attracting investments from eager FIs. Some banks have already formed partnerships with mobile wallets to gain a competitive advantage and get ahead of the curve. A recent examples is Citibank, which announced in April 2018 that it would allow its Australian customers to use Apple Pay. It has been enabling Samsung Pay since 2016.

Citibank currently offers mobile payment features. Some of the most popular digital wallets in Australia are Google Pay, Samsung Pay, Apple Pay and Garmin Pay.

Some observers have attributed the increasing popularity of mobile wallets to the fact that fewer Australians between the ages of 25 and 49 are using credit and debit cards, however.[19]



[15] Doyle, M.; Fisher, C.; Tellez, E. and Yadav, A. How Australians pay: evidence from the 2016 consumer payments survey. Reserve Bank of Australia. 2017. https://www.rba.gov.au/publications/rdp/2017/pdf/rdp2017-04.pdf. Accessed June 2018.
[16] Ronngard, Harje. Is Australia going cashless? Money Morning. 2018. https://www.moneymorning.com.au/20180510/is-australia-going-cashless.html. Accessed June 2018.
[17] Christian, Roma. ANZ: mobile wallet payments soar 140% in 2017. ChannelNews. 2018. https://www.channelnews.com.au/anz-mobile-wallet-payments-soar-140-in-2017/. Accessed June 2018.
[18] Hendry, Justin. Citi signs up to Apple Pay. IT News. 2018. https://www.itnews.com.au/news/citi-signs-up-to-apply-pay-489767. Accessed June 2018.
[19] Author unknown. The rise of mobile payments in Australia. Loyalty Corp. Date unknown. https://loyaltycorp.com.au/the-rise-of-mobile-payments-in-australia/. Accessed June 2018.

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CASH AND THE STATE OF ATMS IN AUSTRALIA

We examined several additional indicators to assess the evolution of cash use in Australia, including the number of ATM terminals, bank branches and POS terminals per 100,000 citizens. Such statistics tend to correlate, negatively or otherwise, with the prominence of alternative payment methods.

In Australia, card payments by value per capita increased at an average annual rate of 5.4 percent, from $13,390 in 2007 to $22,659 in 2016, demonstrating a positive correlation with the popularity of alternative payment options. Meanwhile, the number of POS terminals per 100,000 grew at a CAGR of 2.7 percent in the same time frame, from 2,992 to 3,917.



TABLE 2. CASH USE INDICATORS

DESCRIPTION	2007	2010	2013	2016
Bank branches per 100,000 people	25.0	24.5	23.5	22.0
ATM terminals per 100,000 people	124.0	135.7	129.8	135.0
POS terminals per 100,000 people	2,992.1	3,190.1	3,454.8	3,917.5
ATM withdrawals per capita (USD)	4,960	5,255	4,796	4,137
OTC withdrawals per capita (USD)	2,413	2,288	1,903	1,725
Card payments per capita (USD)	13,390	16,414	19,380	22,659
ATM withdrawals per ATM terminal (MM USD)	4.0	3.9	3.7	3.1
OTC withdrawals per bank branch (MM USD)	9.6	9.3	8.1	7.8

Conversely, the number of ATM withdrawals per capita appeared to decrease alongside the increase in card-based payments. We observed 4,960 ATM withdrawals per 100,000 Australian citizens in 2007, but that number had dropped to 4,137 by 2016. This represents a CAGR of -1.8 percent.

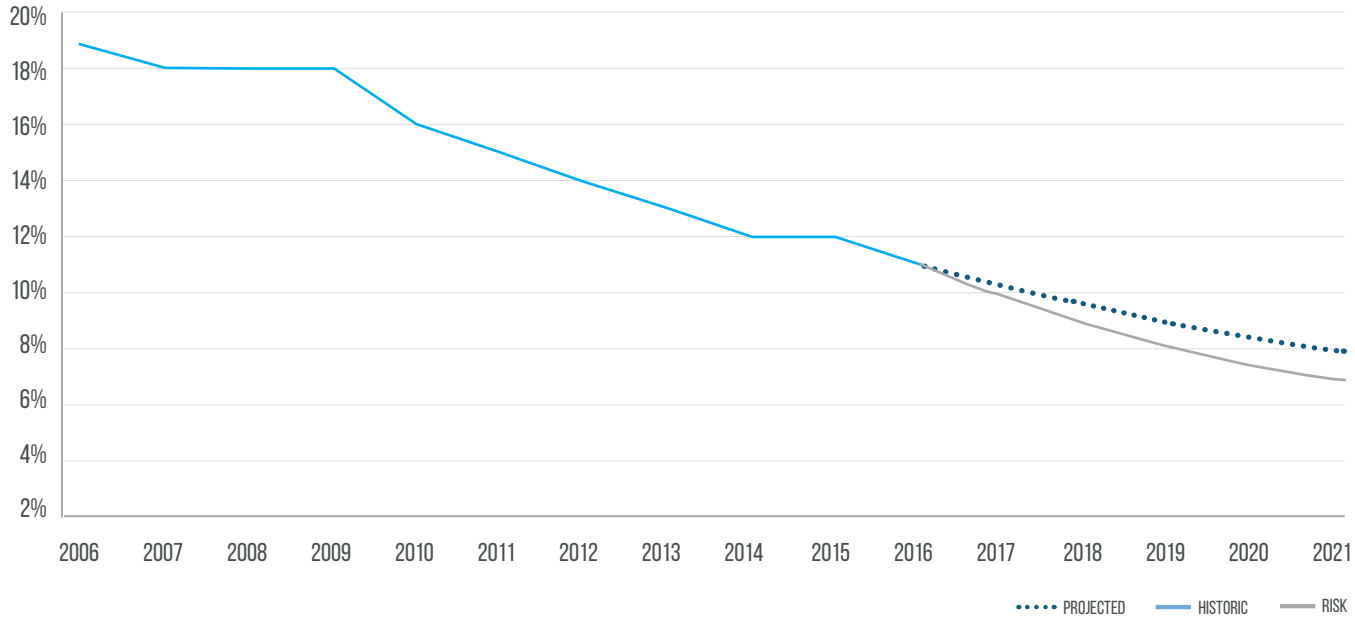
Meanwhile, Australia's OTC withdrawals per capita declined between 2007 and 2016, as did ATM withdrawals per ATM terminal and OTC withdrawals per bank branch. These are all indicators we would expect to see as use of card payments increases.

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RISK
ADJUSTMENTS

Younger Australians appear to be weaning themselves off printed cash faster than older consumers. We took these demographic considerations into account when compiling a forecast of cash's declining usage in the country. The adjusted results can be seen in Figure 6.

FIGURE 6. HISTORIC AND RISK-ADJUSTED CASH PROJECTION



Our data suggests that reduction in cash usage may accelerate by 50 percent among 19- to 24-year-olds, 30 percent for 25- to 34-year-olds and 15 percent among 35- to 44-year-olds. Meanwhile, Australians aged 45 to 54 are only projected to decrease their cash usage by approximately 5 percent.

If we presume these accelerated cash usage declines are realized over a period of five years, Australian cash share could reach 7.2 percent by 2021, as opposed to the non-adjusted projection of 8.4 percent.

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TOTAL CASH USAGE

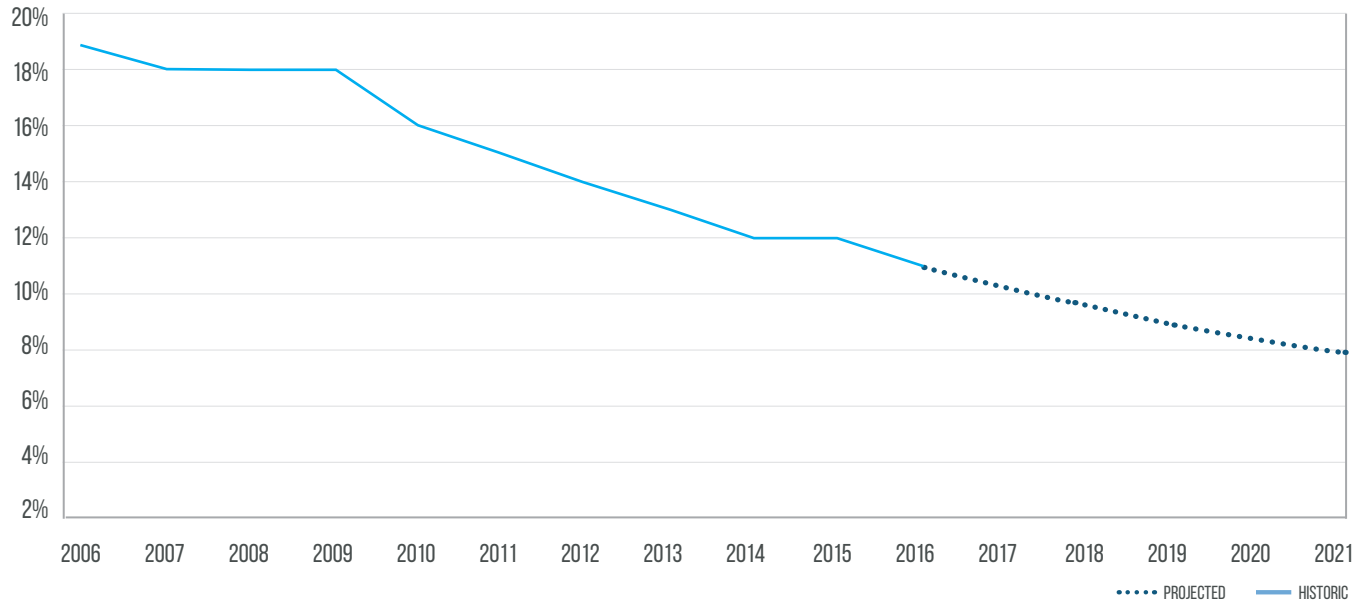
When it comes to total cash usage, Australia presents a unique case. As explored in our latest Asia Pacific Cash Index report, total cash use usually increases alongside a growing GDP. In Australia, however, we are seeing gradual decline in total use of cash — despite the rise in the GDP.

The country's total cash usage declined at a CAGR of 2.81 percent between 2011 and 2016, from $165 billion to $143 billion. We expect this decline to continue at an average annual growth rate of -0.74 percent until 2021, when it is expected to reach $138 billion. This can be seen in Figure 7.

TABLE 3. AUSTRALIA CASH SHARE, GDP AND TOTAL CASH USAGE

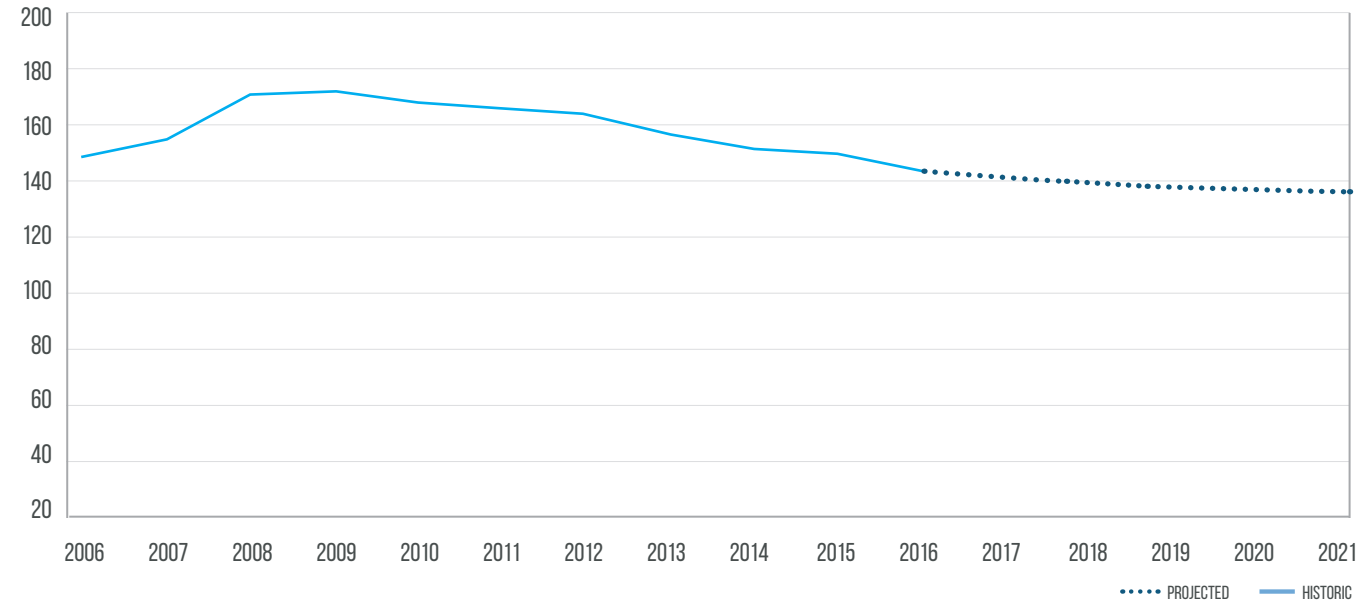
	CASH USAGE AND PROJECTIONS					COMPOUND ANNUAL GROWTH RATE	
	2001	2006	2011	2016	2021	2011 – 2016	2016 – 2021
CASH SHARE	-	18.9%	15.0%	11.2%	8.4%	-0.52%	-0.49%
GDP	549	782	1,098	1,278	1,644	3.08%	5.16%
TOTAL CASH USAGE	-	148	165	143	138	-2.81%	-0.74%

FIGURE 7. HISTORIC AND PROJECTED CASH SHARE



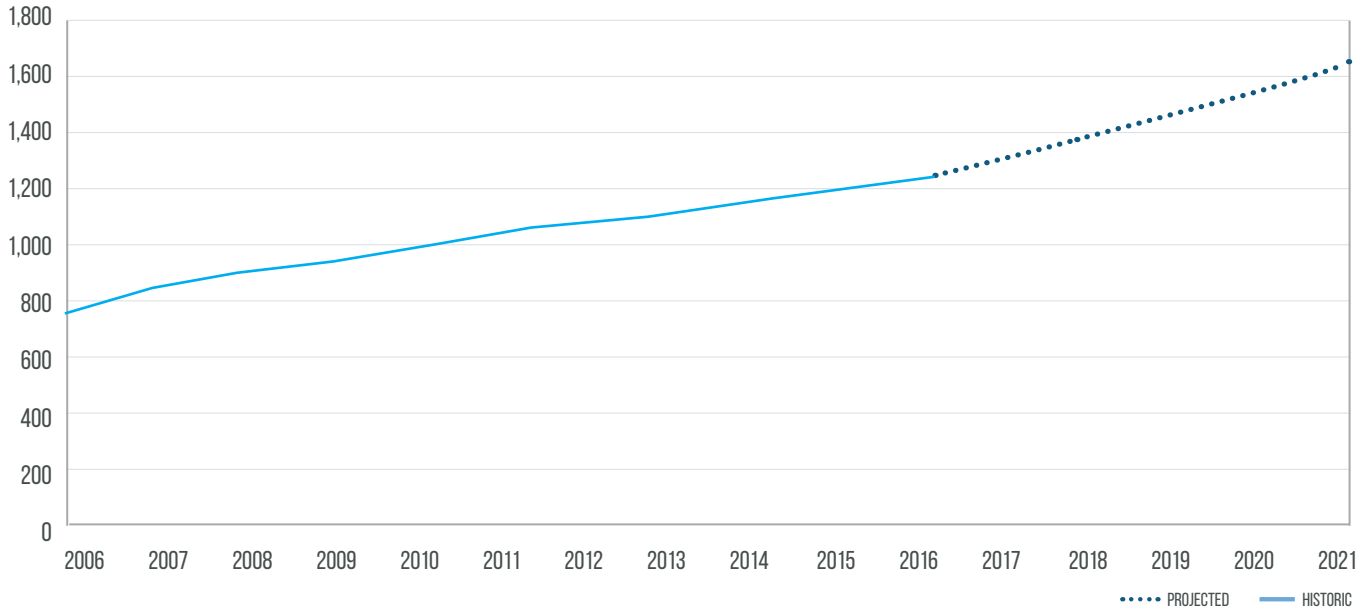
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FIGURE 8. HISTORIC AND PROJECTED TOTAL CASH USAGE (IN BILLION DOLLARS)



The reason for Australia's cash usage decline lies in its long-lasting but minimal economic growth. Though Australia has experienced steady increases in GDP for the past 26 years, that annual increase has been low — so low, in fact, that the rate of economic growth could not compensate for consumers' loss of interest in cash as a payment mechanism.

FIGURE 9. HISTORIC AND PROJECTED GDP (IN BILLION DOLLARS)



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THE STATE OF CASH IN AUSTRALIA

Overall cash usage may be on the decline in Australia, but it has continued to retain its supremacy over other payment methods — at least when it comes to small-value transactions. When it comes to paying for day-to-day purchases, however, Australian consumers still prefer to pay in chump change.

Card payments, on the other hand, have surpassed cash as Australians' preferred payment method for high-value transactions. Nevertheless, cash is still a necessity for both the country's citizens and the foreign nationals within its borders, many of whom continue to rely on it for smaller, everyday purchases. The data suggests that this trend will continue, and that Australians will come to use cash more frequently for smaller purchases and turn to card payments for larger ones in the coming years. In this way, cash is expected to play a continued role in boosting Australia's economy going forward.



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APPENDIX

METHODOLOGY AND DATA

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

These countries are divided into four regions — Western Europe, Eastern Europe, The Americas and Asia and Other — and we will publish reports reviewing cash share and usage focusing on one region each quarter.

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			

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- The first factor is cash share, or the total amount of purchases 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.

We have found that total cash share is decreasing in most countries. Because both population and GDP are growing, however, total cash usage is also still growing (albeit at rates lower than the GDP).

To calculate the results in this report, we performed the following for each country:

- Gathered historic and projected data.
- Estimateed OTC cash withdrawals for countries that do not report this data.
- Calculated historic cash share.
- Estimated cash share for 2015 and beyond.
- Estimated total cash usage for 2015 forward and beyond.

Gathered historic and projected data.

We collected historic data for each country from 2000 to 2014, including information regarding total population, GDP, cash withdrawals from ATM and OTC, total card spending and payments infrastructure, such as the number of ATM machines and bank branches.[19] We also gathered data to project cash usage, including projected GDP and projected population by age group.[20]

We gathered data from 2000 through 2014 and used as much as was 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.

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

As described, 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.

[19] Data on Population is from the World Bank [http://data.worldbank.org/indicator/SP.POP.TOTL], Data on GDP is from the IMF [http://www.imf.org/external/ns/cs.aspx?id=28], and data on cash with drawals, card spending and the payments infrastructure is from the Bank of International Settlements [http://www.bis.org/cpmi/publ/d142.pdf] or from the European Central Bank [https://www.ecb.europa.eu/pub/pdf/other/art2_mb201104en_pp79-90en.pdf]

[20] Data on projected population is from the World Bank, and projected GDP is from the IMF. If these are the same, combine these footnotes into a single footnote.

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- **TWO:** Estimate the logarithmic trend of the OTC to ATM ratio from 2000 through 2014 for each of the potentially

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

  comparable countries.[21]

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:

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

In this equation, 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

[21] 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.

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APPENDIX

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			✓

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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			✔

Calculated 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:

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

Estimated cash share for 2015 forward.

The cash share is estimated as a logarithmic 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.

Estimated 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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ATM AND BANK BRANCH
AVAILABILITY INDEXES

We have created two indexes based on the availability of ATMs and bank branches per 100,000 people in the following countries. To do this, we used economy data and population data from 40 nations, delineated below:

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

The indexes consider the availability of ATM and bank branches per 100,000 inhabitants in each country. The maximum value an index can achieve is 100 points and zero is the minimum. Each country has been assigned its own score.

We show how we calculated both indexes for each country in the following table. We first obtained the number of ATM and bank branches present per 100,000 people, then took the lowest and the highest number for each index and labeled them 0 and 100, respectively. The rest of the numbers were calculated according to the following equation:

$$Index_i = \frac{x_i - x_{Min}}{x_{Max} - x_{Min}}$$

In this formula, x represents the number of ATM and bank branches per 100,000 people and i represents each country that was neither a minimum nor a maximum score.

COUNTRY	ATM PER 100,000	BANK BRANCHES PER 100,00	INDEX	
			ATM	BANK BRANCHES
AUSTRALIA	132.3	22.89	51.9	27.3
AUSTRIA	156.1	47.49	62.6	67.8
BELGIUM	139.7	31.33	55.2	41.2
BRAZIL	81.4	—	29.1	—
BULGARIA	79.2	51.61	28.1	74.6
CHINA	63.1	—	20.9	—
CROATIA	—	27.84	—	35.4
CZECH REPUBLIC	43.6	19.68	12.2	22.0
ESTONIA	61.0	8.15	20.0	3.0
FINLAND	37.3	19.21	9.3	21.2
FRANCE	96.1	58.45	35.7	85.9
GERMANY	104.5	41.43	39.5	57.8
GREECE	62.8	23.42	20.8	28.2
HUNGARY	48.9	29.38	14.5	38.0
INDIA	16.4	11.15	0.0	7.9
IRELAND	56.9	22.20	18.1	26.1
ITALY	81.6	50.13	29.2	72.2
JAPAN	107.7	—	40.9	—
LATVIA	53.3	13.90	16.5	12.5
LITHUANIA	41.9	19.21	11.4	21.2
LUXEMBOURG	92.0	39.61	33.9	54.8
MALTA	49.9	25.53	15.0	31.6
MEXICO	37.9	10.61	9.6	7.0
NETHERLANDS	41.4	10.42	11.2	6.7
POLAND	56.3	37.64	17.9	51.6
PORTUGAL	149.5	53.81	59.6	78.2
ROMANIA	57.9	24.91	18.6	30.6
RUSSIA	89.5	26.24	32.7	32.8
SAUDI ARABIA	54.9	6.34	17.2	0.0
SINGAPORE	50.8	8.51	15.4	3.6
SLOVAKIA	50.4	23.80	15.2	28.8
SLOVENIA	81.9	28.55	29.3	36.6
SOUTH AFRICA	52.7	7.37	16.2	1.7
SOUTH KOREA	239.7	14.84	100.0	14.0
SPAIN	107.5	67.01	40.8	100.0
SWEDEN	31.9	—	6.9	—
SWITZERLAND	84.6	29.76	30.5	38.6
TURKEY	62.1	15.79	20.5	15.6
UNITED KINGDOM	108.2	30.00	41.1	39.0
UNITED STATES	—	34.83	—	47.0

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