the PYMNTS.com

Global Cash Index™

a CARDTRONICS collaboration

AUGUST 2017

AUSTRALIA EDITION

133 Number of ATMs per 100,000 people

$12 Median size of cash payment in 2016

60% Percentage of small value transactions powered by cash

$143 BILLION
Total use of cash in 2015

$103 BILLION
Total ATM withdrawals in 2015

CASH USAGE IN AUSTRALIA: INTRODUCTION

In Australia, cash is vying to remain head of the payments pack, while alternate forms of payment are nipping at its heels. The country, with a population of 24 million, has a lower cash share of GDP than other countries in the Asia Pacific region, yet its overall use of cash remains very high. Nearly half of Australian transactions are paid in cash.

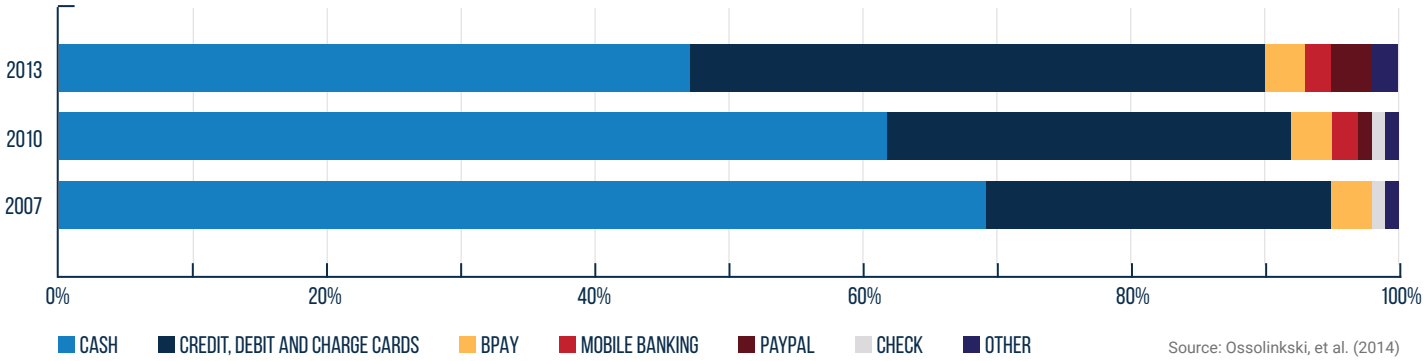
An analysis of overall transaction volume reveals that cash powers 47 percent of transactions, whereas cards are used to pay for 43 percent of transactions. Other digital payment methods account for the rest of the transaction volume.

While cash continues to outweigh card-based payments, the overall volume of cash transactions has taken a hit over the past decade.

In 2007, 69 percent of transactions were paid using cash and 26 percent using cards. However, by 2013, when the last national payments survey was conducted, use of cash decreased by 22 percent.[1] Figure 1 shows the evolution of consumer payments by number of transactions between 2007 and 2013.

In this report, we take a deep dive into the cash share of GDP in the country — and the rise of alternative payment methods — to compare the evolution of payment methods in Australia with other countries in the Asia Pacific region.

FIGURE 1. CONSUMER PAYMENTS BY NUMBER OF TRANSACTIONS, BY PAYMENT METHOD

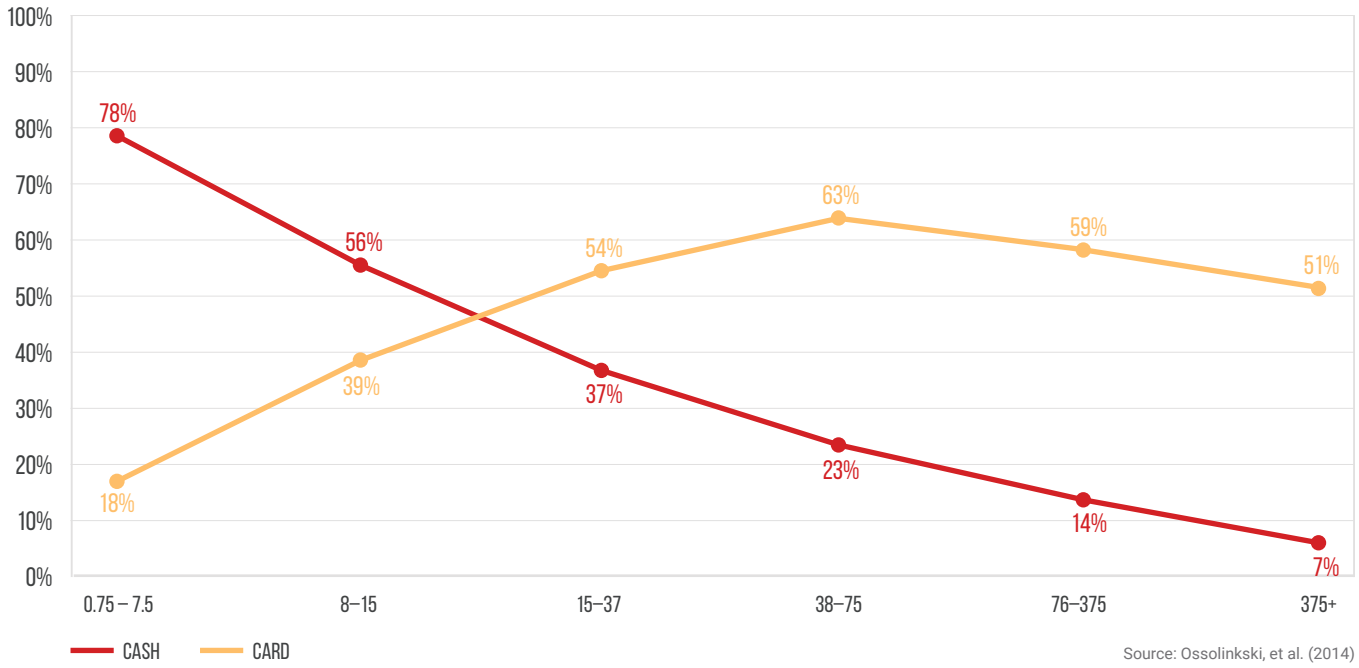


Source: Ossolinkski, et al. (2014)

[1] Ossolinkski, Crystal; Lam, Tai and Emery, David. The changing way we pay: trends in consumer payments. Reserve Bank of Australia, Research Discussion Paper. https://www.rba.gov.au/publications/rdp/2014/pdf/rdp2014-05.pdf. Accessed July 2017.

While use of cash has declined, it still dominates small-value transactions. As of 2013, 78 percent of transactions valued lower than $7.50 were paid for in cash, down from 95 percent in 2007. Meanwhile, 7 percent of transactions valued over $375 were made in cash, down from 18 percent in 2007.

FIGURE 2. PERCENT OF TRANSACTIONS MADE WITH CASH AND CARDS, BY VALUE OF TRANSACTION



Source: Ossolinkski, et al. (2014)

The gradual reduction in cash use seems to have resulted from an increase in use of tap-and-go contactless payments at POS systems. As of late 2016, nearly 82 percent of Australians used tap-and-go to make payments every week, according to a Mastercard study.[2] However, Australians still continue to prefer cash for small-value transactions. The Reserve Bank of Australia estimates that cash powered more than 60 percent of transactions valued at $10 or less in 2016.[3]

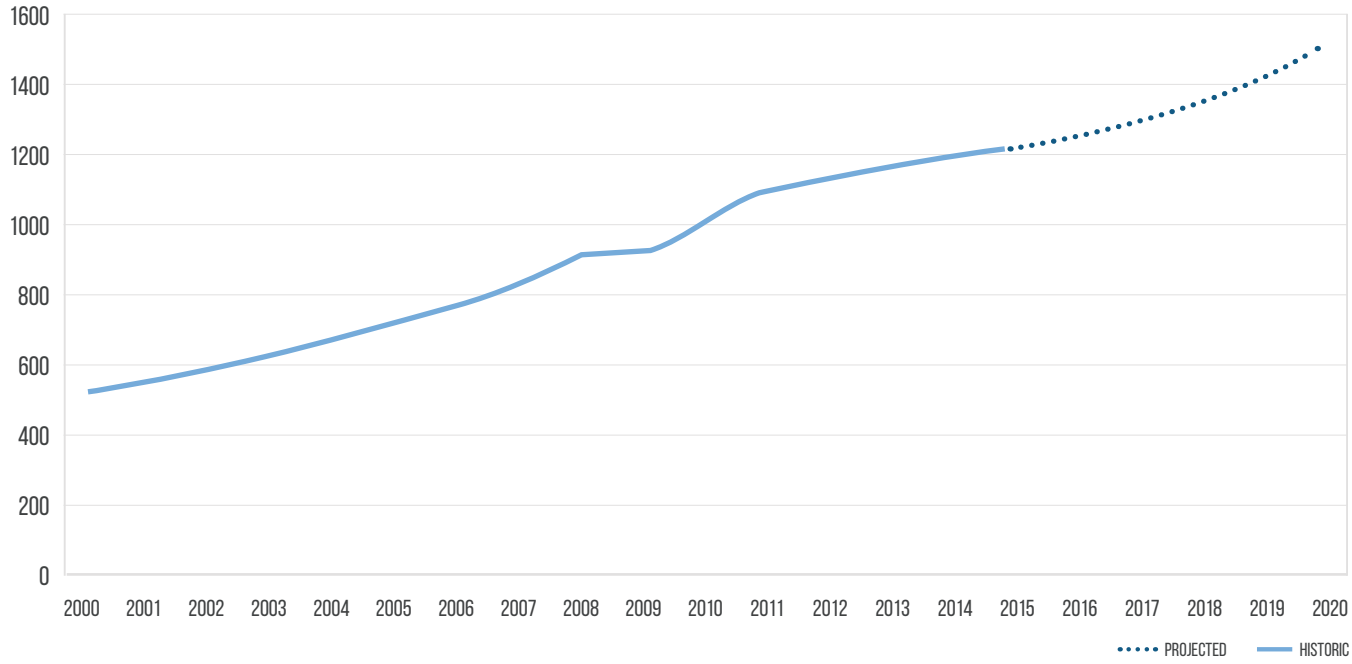
GDP
AND ITS EFFECT ON CASH USAGE

Australia is the fifth largest economy in the Asia Pacific region, with a GDP of more than $1,222 billion, ranking right behind China, Japan, India and South Korea. As shown in Figure 3, the nominal GDP is projected to increase at a CAGR of 4.6 percent between 2015 and 2020, to reach a GDP of $1,530 billion dollars.

[2] Unknown. Tap and go technology reigns in Australia. Mastercard. March 15, 2017. https://newsroom.mastercard.com/asia-pacific/press-releases/tap-and-go-technology-reigns-in-australia/. Accessed August 2017.

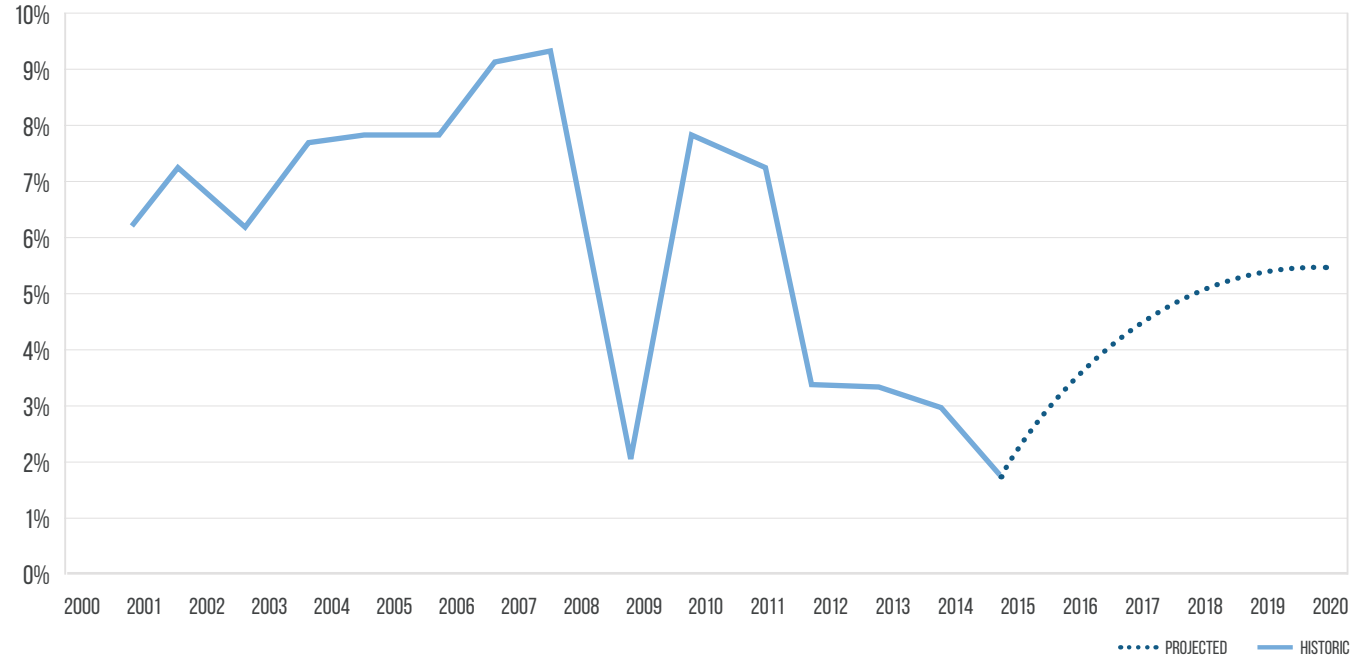
[3] Doyle, Mary-Alice; Fisher, Chay; Tellez, Ed; and Yadav, Anirudh. How Australians pay: new survey evidence. March 2017. https://www.rba.gov.au/publications/bulletin/2017/mar/pdf/bu-0317-7-how-australians-pay-new-survey-evidence.pdf. Accessed August 2017.

FIGURE 3. HISTORIC AND PROJECTED GDP FOR AUSTRALIA, 2020-2000 (NOMINAL IN BILLION DOLLARS)



The increase comes after a remarkable drop during the Subprime crisis, which plummeted Australia's GDP growth rate from 9.2 percent to just 2 percent. While the GDP showed some signs of growth in 2010, it declined even further, reaching a growth rate of 1.7 percent in 2015. It has since started improving and projections suggest that it will clock a 5.4 percent growth rate by 2020.

FIGURE 4. HISTORIC AND PROJECTED GDP GROWTH FOR AUSTRALIA, 2020-2000



CASH SHARE
IN AUSTRALIA

Australia has experienced a steady reduction in use of cash as a percentage of its GDP over the last 10 years.

Overall cash usage decreased from 18.9 percent of Australia's GDP in 2006 to 11.7 percent in 2015. Much of this reduction has come as a result of the decline in ATM and over-the-counter (OTC) withdrawals — particularly after the sharp decline in 2009 which proved to be an inflection point.

While the share of ATM and OTC transactions remained flat between 2006 and 2009, it has been on a downward path since.

In 2006, cash share represented 18.9 percent of the GDP, with ATM transactions accounting for 12.5 percent of cash withdrawals and OTC withdrawals representing 6.4 percent. By 2015, cash share represented 11.7 percent of GDP with ATM withdrawals making up 8.7 percent of the usage and OTC withdrawals representing 3.3. percent.

FIGURE 5. HISTORIC ATM, OTC AND CASH SHARE AS PERCENTAGE OF GDP

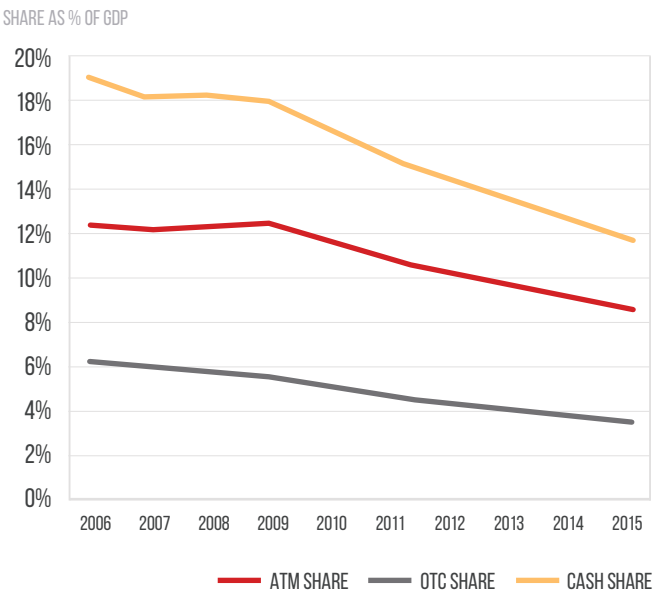


TABLE 1. GDP AND CASH USAGE DATA FOR AUSTRALIA (IN BILLION DOLLARS)

YEAR	NOMINAL GDP IN USD	CASH USAGE			ATM SHARE	OTC SHARE	CASH SHARE
		ATM	OTC	TOTAL			
2006	778.3	97.5	49.5	147.0	12.5%	6.4%	18.9%
2007	848.9	103.8	50.5	154.4	12.2%	6.0%	18.2%
2008	927.1	115.4	54.0	169.3	12.4%	5.8%	18.3%
2009	945.4	117.3	52.9	170.1	12.4%	5.6%	18.0%
2010	1019.5	116.1	50.5	166.6	11.4%	5.0%	16.3%
2011	1093.4	115.4	48.6	164.0	10.6%	4.4%	15.0%
2012	1129.9	114.3	46.7	161.0	10.1%	4.1%	14.2%
2013	1167.0	111.2	44.1	155.4	9.5%	3.8%	13.3%
2014	1201.0	108.3	41.8	150.1	9.0%	3.5%	12.5%
2015	1222.0	103.3	39.9	143.2	8.5%	3.3%	11.7%

The gradual decrease in cash usage can be further explained by the country's experienced increase in the use of alternative payment methods, including credit, debit and prepaid cards and electronic funds transfer methods such as BPAY. For P2P payments, digital wallets such as PayPal have also gained popularity.

CASH VERSUS ALTERNATIVE PAYMENT METHODS

Alternate payment methods quickly gained a foothold in the Australian market over the last 10 years, and today they are strong competitors to cash.

Back in 2007, alternate payment methods represented only 31 percent of transactions, though their use went up to 53 percent in 2013. The growth was powered by a rise in use of card-based payment methods, which increased from 26 percent in 2007 to 43 percent in 2013.

During this period, use of debit cards increased from 15 percent in 2007 to 24 percent in 2013, and credit cards' share went up from representing 11 percent of transaction volume to 19 percent in 2013.

Meanwhile, other alternative payment methods haven't gained as much traction.

More recently, the advent of mobile payment methods has generated a lot of buzz, but thus far has failed to gain significant traction in the Australian market. Take Apple Pay, which was launched in November 2015, and continues to struggle with low consumer adoption and opposition from banks.[4]

Apple Pay's launch was followed by rollout of Samsung Pay in June 2016, with support from American Express and Citibank.[5] Around the same time, Google launched Android Pay in partnership with American Express and Visa.[6] In 2016, Alipay, which is owned by Alibaba's financial arm, Ant Financials, also announced its entry into the market with plans to soon launch in Australia.[7]

While there's a growing number of players entering the market, they are increasingly facing resistance from Australian banks. In February this year, some of Australia's largest banks filed an antitrust complaint with the Australian Competition and Consumer Commission (ACCC) in hopes of gaining access to the iPhone's NFC functionality. Without access to NFC, the banks allege, consumer choice is hampered.[8]

Meanwhile, Australian banks are increasingly focused on developing their own Android-based mobile payments apps that are compatible with contactless terminals. ANZ Mobile Pay, Commonwealth Bank's Tap & Pay and Westpac Tap and Pay are some of the many options now available to consumers.[9]

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[4] Siegel, Matt; Wagstaff, Jeremy and Auchard, Eric. Early days, but Apple Pay struggles. news.com.au. June 7, 2016. http://www.news.com.au/finance/business/breaking-news/early-days-but-apple-pay-struggles/news-story/72b8f90e9faf49f47911d4513ed58940. Accessed July 2017.

[5] Boden, Rian. Samsung Pay launches in Australia. NFC World. June 15, 2016. https://www.nfcworld.com/2016/06/15/345552/samsung-pay-launches-australia/. Accessed July 2017.

[6] Boden, Rian. Samsung Pay launches in Australia. NFC World. June 15, 2016. https://www.nfcworld.com/2016/06/15/345552/samsung-pay-launches-australia/. Accessed July 2017.

[7] Perez, Bien. Alipay steps up mobile payments expansion in Australian stores. South China Morning Post. December 7, 2016 http://www.scmp.com/tech/china-tech/article/2052638/ali-pay-steps-mobile-payments-expansion-australian-stores. Accessed July 2017.

[8] Boden, Rian. Australian banks lose fight to gain access to NFC functionality in Apple iPhones. NFC World. April 3, 2017. https://www.nfcworld.com/2017/04/03/351418/australian-banks-lose-fight-to-gain-access-to-nfc-functionality-in-apple-iphones/. Accessed July 2017.

[9] Williams, Hayley. Compared: all the mobile payments services in Australia. lifehacker. July 8, 2016. https://www.lifehacker.com.au/2016/07/samsung-apple-and-more-all-the-mobile-payments-services-in-australia/. Accessed July 2017.

The launch of these mobile wallets comes with a rapidly expanding network of NFC terminals.[10] As of 2015, contactless accounted for 60 percent of face-to-face transactions powered by Visa, which boasts some 100,000 contactless terminals.[11] Meanwhile, Mastercard supported a network of 600,000 contactless terminals in the Australian market.[12]

When it comes to contactless payments, mobile wallets are also competing with contactless cards, which have higher penetration and usage. By 2014, approximately 69 percent of the Australian population had access to at least one contactless card, whereas only 43 percent of the population used them for day-to-day transactions.[13]

CASH AND THE STATE OF ATMS IN AUSTRALIA

To analyze the evolution of cash, we examined the state of ATM terminals, bank branches and POS terminals, then compared the data to that from other countries in the Asia Pacific region.

Today, Australia has the largest number of POS terminals, with nearly 3,573 available per 100,000 people — 36 percent higher than Singapore, which comes in second with 2,628 POS terminals available per 100,000 people.

When it comes to ATM terminals, however, Australia ranks second with 133 ATM terminals per 100,000 people, just behind South Korea, which is home to 242 ATM terminals per 100,000 people. The high penetration of ATMS has also driven up use of cards, which has lately made Australia a more card-intensive country.

However, Australia leads South Korea when it comes to average per capita payment of card-based transactions — with average annual spending of $15,443 per user — and ranks as the most card-intensive population in Asia Pacific region.

[10] Author unknown. Why do Australians lead the way in contactless payments. Banter Payments News & Highlights. February 25, 2016. http://www.bpaybanter.com.au/news-views/why-do-australians-lead-the-way-in-contactless-pay. Accessed July 2017.

[11] Author unknown. The Visa-RFi group Australian payments report. Visa. June 2015. https://www.visa.com.au/content/dam/VCOM/regional/ap/australia/global-elements/Documents/research-and-trends-visa-rfi-australian-payments-report.pdf. Accessed July 2017.

[12] Duckett, Chris. Almost two-thirds of Australians prefer NFC to cash: Mastercard. ZDNet. December 1, 2015. http://www.zdnet.com/article/almost-two-thirds-of-australians-prefer-nfc-to-cash-mastercard/. Accessed July 2017.

[13] Author unknown. Australia hooked on tap and go payments: Visa payWave. News.com.au. February 8, 2014. http://www.news.com.au/finance/money/australia-hooked-on-tap-and-go-payments-visa-paywave/news-story/abbc91388c52d1ae5eab0a321cb7fbcc. Accessed July 2017.

Meanwhile, per capita card usage in Australia is 4,818 percent higher than in India, which ranks the lowest when it comes to card usage.

TABLE 2. COMPARISON OF FEATURES BETWEEN AUSTRALIA AND THE ASIAN PACIFIC COUNTRIES, 2014

DESCRIPTION	AUSTRALIA	CHINA	INDIA	JAPAN*	KOREA	SINGAPORE	SAUDI ARABIA	SOUTH AFRICA	TOTAL
Bank branches per 100,000 people	23.22	—	10.68	42.70	15.11	8.92	6.21	7.72	13.41
ATM terminals per 100,000 people	133	45	15	108	242	50	48	51	39
POS terminals per 100,000 people	3,573	1,165	88	1,535	—	2,628	451	680	711
ATM withdrawals per capita (USD)	4,588	2,539	274	809	1,057	8,670	6,258	1,147	1,495
OTC withdrawals per capita (USD)	1,770	25	519	625	128	394	313	2,172	325
Card payments per capita	15,443	4,930	314	3,036	11,039	10,337	7,969	--	2,982
ATM withdrawal per ATM terminal (Million USD)	3.4	5.6	1.8	0.8	0.4	17.3	13.1	2.2	3.9
OTC withdrawals per bank branch (Million USD)	7.6	—	4.9	1.5	0.8	4.4	5.0	28.1	4.4

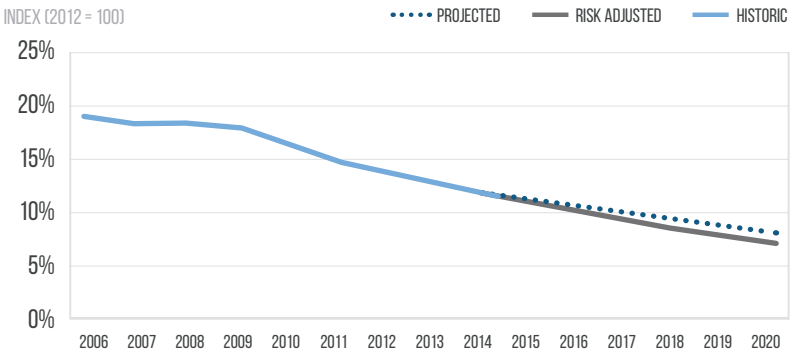
*Japan information about POS terminals and bank branches corresponds to 2013

For a comparison between countries in the Asia Pacific region, we analyzed the ratio of cash to card-based payments and found that for every dollar spent using cards, $0.41 is spent with cash in Australia. This makes it the second least cash-intensive country in the Asia Pacific region. The ratio for the other countries in Asia Pacific is $0.11 for South Korea, $0.47 in Japan, $0.52 in China, $0.82 in Saudi Arabia, $0.88 in Singapore and $2.52 in India.

RISK ADJUSTMENTS

Considering the overall Australian population and its distribution among different age groups, the cash usage projection below shows reduction of cash could be accelerated by 50 percent among 19- to 24-year-olds, 30 percent among 25- to 34-year-olds, 15 percent among 35- to 44-year-olds and 5 percent among 45- to 54-year-olds. Assuming these reductions are realized over a five-year time period, the risk-adjusted cash share as depicted in Figure 6 could reach 7.4 percent in 2020, lower than the 8.4 percent projected for 2020.

FIGURE 6. HISTORIC AND RISK-ADJUSTED CASH SHARE PROJECTION



TOTAL CASH USAGE

We have typically seen a reduction in cash share of GDP for most of the countries analyzed in the Global Cash Index, which comes along with growth in total use of cash powered by overall growth of GDP. However, that is not the case for Australia.

Total use of cash in the country has been decreasing since 2008, and we project it will keep decreasing through 2020. As a developed nation, Australia's GDP growth is steady, but low. With slow growth in GDP, cash shares at -0.5 CAGR estimated for 2015 to 2020 is quite the same as the CAGR observed between 2010 and 2015.

With GDP expected to continue growing at 4.6 percent CAGR between 2015 and 2020, the total cash usage is expected to decrease from the $143 billion in 2015 to $129 billion in 2020, a -2.07 percent CAGR between 2015 and 2020 that is almost 1 percent lower that the decline it experienced between 2010 and 2015.

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

	CASH USAGE AND PROJECTIONS					COMPOUND ANNUAL GROWTH RATE	
	2000	2006	2010	2015	2020	2010 – 2015	2015 – 2020
CASH SHARE	—	18.9%	16.3%	11.7%	8.4%	-0.54%	-0.51%
GDP	514	778	1,020	1,222	1,530	3.69%	4.60%
TOTAL CASH USAGE	—	147	167	143	129	-2.98%	-2.07%

FIGURE 7. HISTORIC AND PROJECTED CASH SHARE

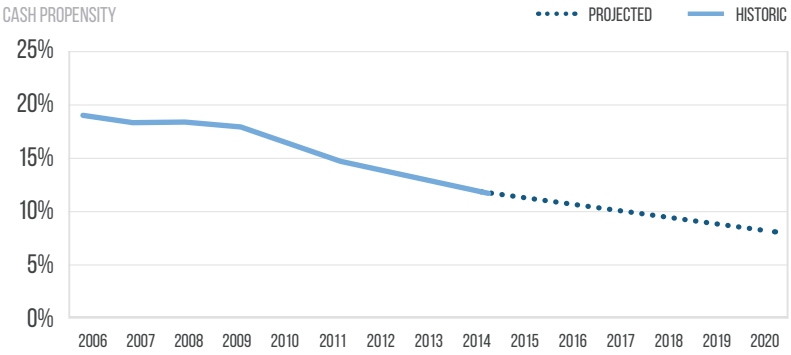
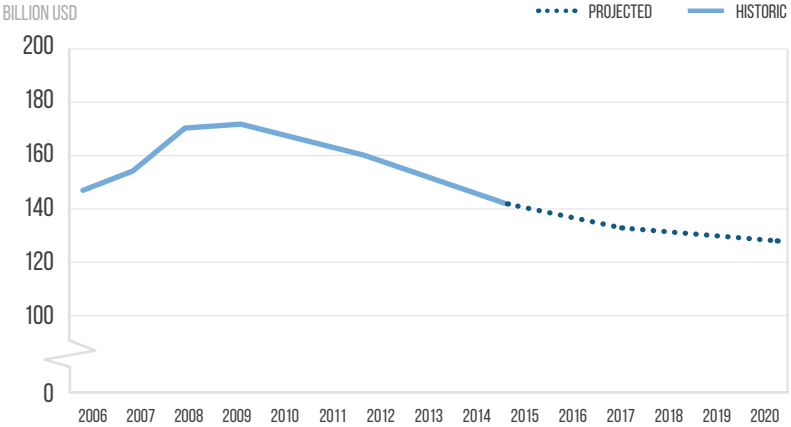


FIGURE 8. HISTORIC AND PROJECTED TOTAL CASH USAGE (IN BILLION DOLLARS)



THE STATE OF CASH
IN AUSTRALIA

Taking overall transaction volume into account, cash is still the most prominent payment method in Australia. In fact, **47 PERCENT** of transactions are still paid for in cash.

While growth in use and availability of alternative payment methods is likely to affect overall cash use in the country, the share of mobile wallets still remains low — similar to levels seen in other developed economies in the Western European region. Digital payment methods, on the other hand, are increasingly being used for high-value transactions.

When it comes to small-value transactions, however, **cash is well positioned to dominate in Australia.**

FEATURE STORY

DOWN UNDER, CASH REMAINS STEADY

When it comes to making payments, Australian consumers tend to alternate between contactless and cash.

Between 2013 and 2016, growth in popularity of tap-and-go payments reportedly propelled the use of contactless card payments from nearly 20 percent to more than 60 percent at POS terminals. While the change indicates a growing preference for payments through debit and credit cards, the country still heavily relies on cash usage. In fact, Australians made $143 billion in cash payments in 2015, according to the PYMNTS Global Cash Index.

To gauge the factors influencing payment preferences in Australia, and to discuss what's driving cash usage in a market now dominated by card-based contactless payments, PYMNTS recently caught up with Raghavendra Bhat, Australia and New Zealand (ANZ) Banking Group's head of technology. Digital payments in Australia have come a long way, Bhat said, but cash continues to compete and remains the go-to payment method for many consumers across the spectrum.

SMBs love cash

While Australian consumers tend to prefer credit and debit cards for making day-to-day payments, cash is often their hands-down choice when it comes to making small-value transactions. According to the Reserve Bank of Australia (RBA), the median size of cash payments has remained stable at $12 since 2013, and as of 2016, cash reportedly powered more than 60 percent of transactions valued at $10 or less. Propensity to use cash for small value transactions is particularly high among smaller businesses in both rural and urban areas, according to Bhat.

"A lot of businesses in the service industry, like restaurants and mom-and-pop stores, prefer cash over cards so they don't have to deal with the interchange rates that are associated with it," Bhat said.

Smaller merchants, he said, don't necessarily see value in accepting card-based payments unless they have modern-day POS systems like Square and Hero extending value-added services such as inventory management. When it comes to accepting cards, according to Bhat, it's not uncommon for smaller Australian merchants to pass the cost of those interchange fees on to the consumer.

"They generally incentivize people to pay in cash," Bhat said. "If, for example, you use credit cards to pay for lunch, they generally charge you more to pay for that transaction."

Recent findings of the RBA's 2016 Consumer Payments Survey noted many merchants continue to only accept cash, even today.

Among consumers, 19 percent of respondents said the most

common reason for using cash was that merchants did not accept other payment methods or had a minimum spend requirement. Another 16 percent cited a desire to avoid card surcharge fees, whereas 7 percent noted discounts for using cash as their primary reason for paying with it.

Unless smaller businesses see an incentive in value-added services offered by processors and acquirers, they are not going to move toward use of alternate payment methods, Bhat said. The disposition of small businesses for using cash also points to its resilience and simplicity, traits which have powered its use among merchants and consumers for generations.

> *"There's still a significant runway in front of us before we become a cashless country."*

Changing cash accessibility

Similar to recent banking happenings in the U.S., leading Australian banks have moved to shutter some of their brick-and-mortar locations over the last few years amidst rising real estate costs and changing consumer preferences.

Between 2015 and 2016 alone, the number of physical branches of the Big Four banks in Australia — including ANZ, National Australia Bank (NAB), Westpac and Commonwealth Bank of Australia (CBA) — fell from 3,884 to 3,680, according to the Sydney Morning Herald.

The shift comes as banks focus on utilizing their branch locations to offer customer services such as loan advisement or mortgage and personal finance management rather than straightforward transactions such as cash withdrawals and deposits, which have slowly been declining, Bhat explained.

And rightfully so. According to the PYMNTS Global Cash Index, total over-the-counter withdrawals in Australia fell from $50.5 billion in 2010 to $39.9 in 2015. At the same time, banks are increasingly focused on serving customers through smart ATMs, which both dispense cash — the ATM bread and butter, as it were — and provide a slew of other banking services, Bhat said.

The operational costs of relying more on ATMs, according to Bhat, are offset by the value of in-person, relationship-based banking through which financial institutions are working with customers on high-touch transactions.

In remote areas with fewer bank locations, banks such as Westpac and ANZ are also partnering with Australia Post, the government-owned postal service, to make cash accessible and offer other banking services through its network of 3,000 locations. The intent is to make up for brick-and-mortar branch closures and lack of access to banking services in remote parts of the country.

Cash will survive

In Australia, much of the recent shift toward adoption of digital payments has been driven by rapid adoption of contactless payments. In 2016, nearly one-third of POS transactions were conducted using contactless cards — three and a half times more than in 2013, according to the RBA.

But, while Australia is collectively moving toward greater use of digital payments, it still has a long way to go as cash continues to be popular among older consumers. Consumers over the age of 65 paid for more than half of their transactions with cash in 2016 and, among 50- to 64-year-olds, more than 40 percent of transactions were cash-based. Though cash was not found to be the top choice among younger millennials, it was still used to pay for nearly one-third of their transactions, according to the RBA.

"I think, there's still a significant runway in front of us before we become a cashless country," Bhat said. "I don't think that's going to happen anytime in the next five to 10 years."

Bhat advised that for a radical payment method shift to happen — as seen in countries like Sweden — digital payments need to be incentivized for all players in the value chain, from customers and merchants to acquirers and processors. Moreover, an overhaul of policy framework is crucial to the success of digitizing payments.

"Compared to Nordics, it'd be still a long way out where, perhaps, [that] we will be cashless," Bhat said.

Until that happens, cash will continue to maintain its position as an imperative payment instrument in the country.

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			

APPENDIX

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.[14] We also gathered data to project cash usage including projected GDP and projected population by age group.[15]

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.

[14] 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]

[15] 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.

- **TWO:** Estimate the logarithm trend of the OTC to ATM ratio from 2000 through 2014 for each of the potentially comparable countries.[16]

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

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

[16] 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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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			✓

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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