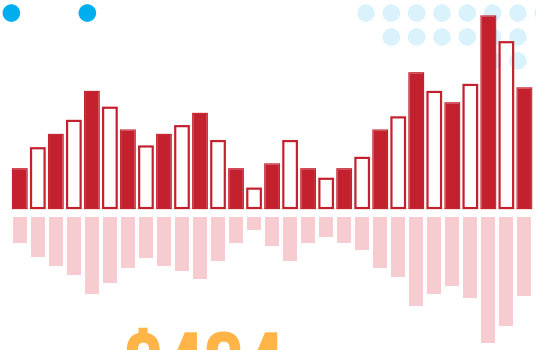
the PYMNTS.com

Global Cash Index™

a CARDTRONICS collaboration

JUNE 2017

SOUTH AFRICA EDITION



58.2% Cash's share as a percentage of South Africa's GDP

50% Percentage of consumers who prefer to pay in cash

53.6% Percentage of consumers that pay by cash-on-delivery for online purchases

$464 BILLION

Projected use of cash in South Africa by 2020

CASH USAGE IN SOUTH AFRICA: INTRODUCTION

South Africa, the largest economy in Africa, has an undying love for cash.

Today, over half of consumer transactions in the country are still paid in cash, and with the economy picking up again, overall usage is bound to go up.[1]

The country's gross domestic product (GDP), which stood at $312.8 billion in 2015, is projected to grow at an 8 percent compound annual growth rate (CAGR) until 2020. And with this solid growth, cash will continue to be the most used payment method — even with a growing acceptance of mobile and card-based payments.

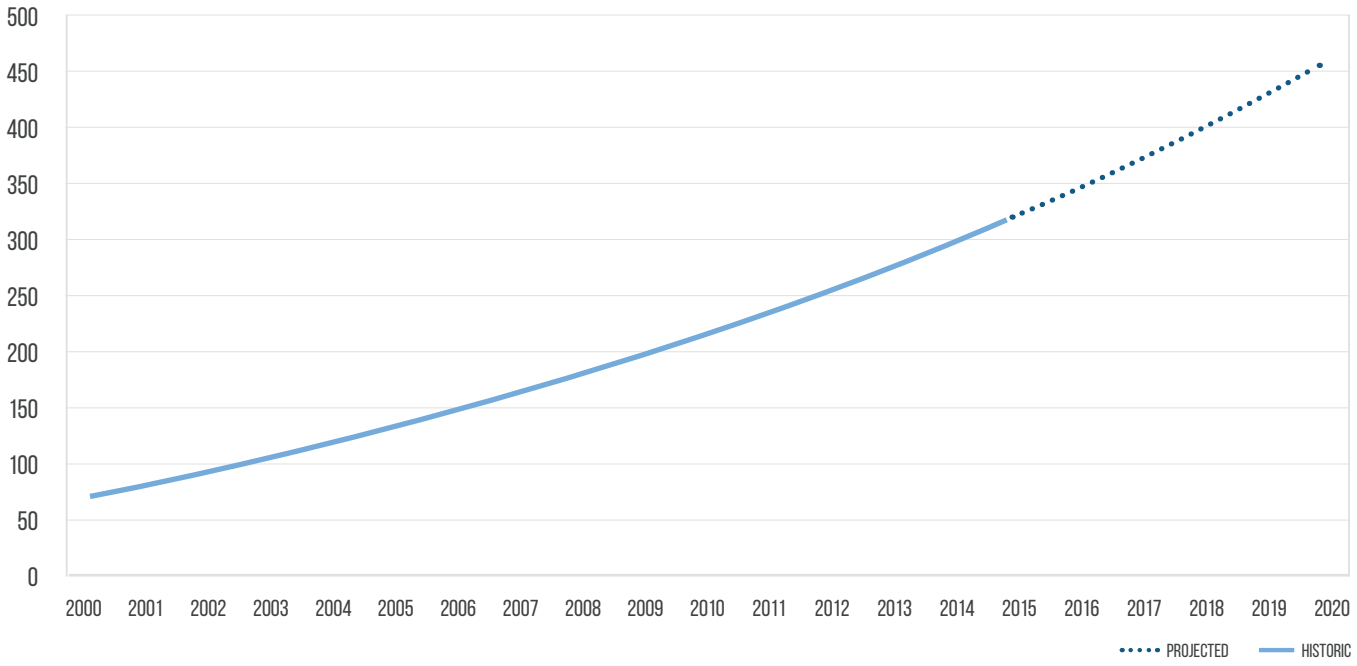
Figure 1 shows the evolution of South African GDP from 2000 to 2015 and the projection until 2020.

Over the years, while the country's GDP has had its ups and downs, the total use of cash has been on an upward trajectory, as seen in Table 1.

After hitting its peak in 2002, South Africa's GDP fell sharply in 2003, but began a slow climb leading up to the subprime crisis in 2007. Since then, the economy hasn't grown back to its pre-recession level, but it is once again showing signs of improvement. The International Monetary Fund estimates the GDP to grow between 6 and 8.5 percent until the end of 2017.

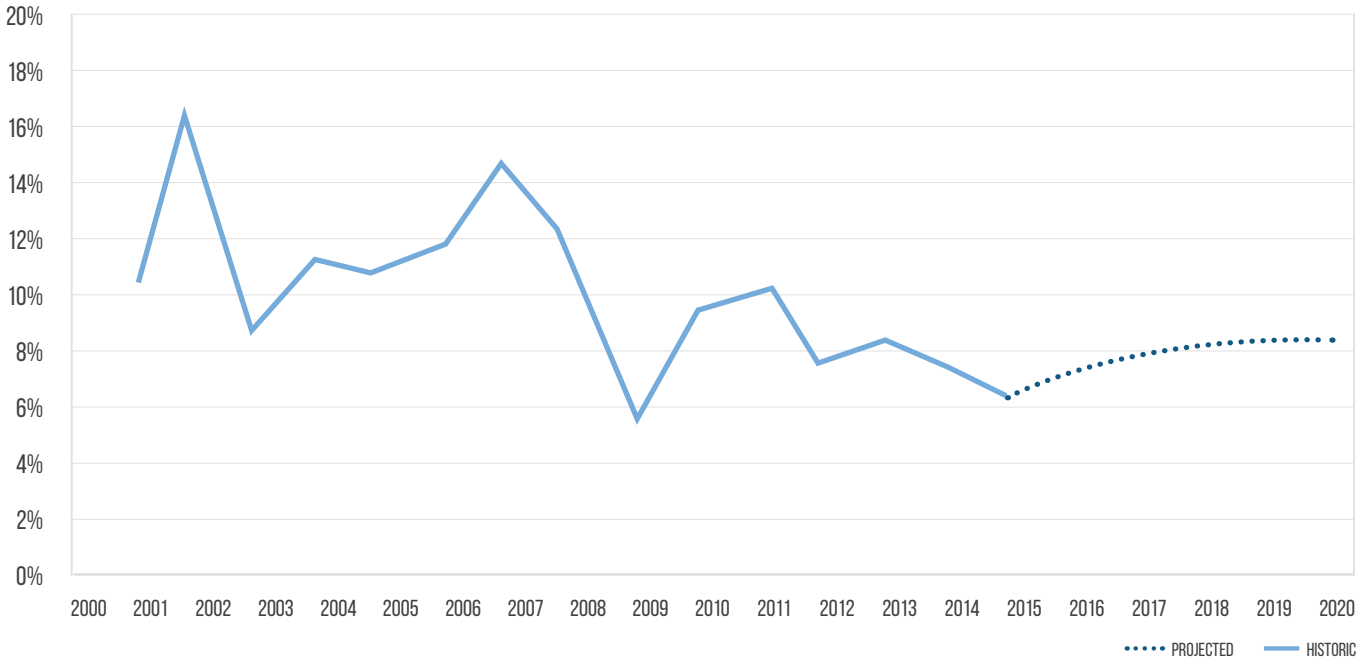
Figure 2 shows the historic growth rate of GDP and the projected growth for South African GDP until 2020.

FIGURE 1. HISTORIC AND PROJECTED GDP FOR SOUTH AFRICA, 2020–2000 (NOMINAL IN BILLION DOLLARS)



[1] Cash Usage Costs SA Consumers R23bn. Banking and Finance News. May 5, 20017. Retrieved from http://www.bizcommunity.com/Article/196/163/161340.html. Accessed June 16, 2017.

FIGURE 2. HISTORIC AND PROJECTED GDP GROWTH FOR SOUTH AFRICA, 2020–2000



The country's high propensity for cash is something that it shares with other emerging economies around the world.

In this report, we will analyze cash share as a percentage of South Africa's GDP, its evolution over the past 10 years and its growing competition from alternative payment methods.

CASH SHARE IN SOUTH AFRICA

While cash continues to dominate in South Africa, its share as a percent of GDP has seen some reduction, decreasing from 73.9 percent in 2009 to 58.2 percent in 2015.

Much of this reduction has come as a result of a decline in share of over-the-counter (OTC) withdrawals, which represented 53.5 percent of GDP in 2009 and 38.1 percent in 2015. Meanwhile, share of ATM withdrawals remained flat during the same period, representing 20 percent of the country's GDP.

Figure 3 shows the evolution of cash share, OTC withdrawals share and ATM withdrawals share as a percentage of GDP.

FIGURE 3. HISTORIC ATM, OTC AND CASH SHARE AS PERCENTAGE OF GDP

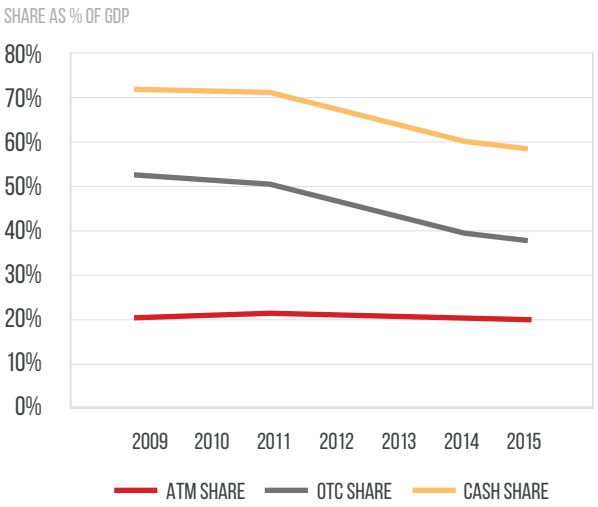


TABLE 1. GDP AND CASH USAGE DATA FOR SOUTH AFRICA (IN BILLION DOLLARS)

YEAR	NOMINAL GDP IN USD	CASH USAGE			ATM SHARE	OTC SHARE	CASH SHARE
		ATM	OTC	TOTAL			
2009	196.2	40.1	104.9	145.0	20.4%	53.5%	73.9%
2010	215.0	45.5	111.4	156.9	21.2%	51.8%	73.0%
2011	236.6	52.0	119.2	171.2	22.0%	50.4%	72.4%
2012	255.2	55.6	119.5	175.1	21.8%	46.8%	68.6%
2013	276.5	59.3	119.6	178.9	21.4%	43.3%	64.7%
2014	297.0	61.9	117.3	179.2	20.9%	39.5%	60.4%
2015	315.6	63.5	120.2	183.7	20.1%	38.1%	58.2%

CASH VERSUS ALTERNATIVE PAYMENT METHODS

In South Africa, cash is holding strong in its tug of war with alternative forms of payment.

The country, with 55 million citizens, leads other African nations when it comes to smartphone penetration, with 37 percent of the population owning a smartphone.[2]

This relatively high smartphone penetration, however, has done little to boost the use of mobile payments in the country. Mobile money transfer app M-Pesa, for instance, failed to gain critical mass and was rolled back by its parent company Vodacom in 2016, six years after its launch.[3]

Nonetheless, FinTech companies and card processors such as Mastercard and Visa are betting on the country's unbanked population, 23 percent[4] of which does not have access to bank accounts and is overwhelmingly reliant on cash for making payments.[5]

To bring the unbanked population into the fold, Mastercard is planning to introduce biometric cards by the end of 2017, which would be compatible for use at EMV terminals. The biometric card would require cardholders to dip their card in the terminal and place their thumb over the embedded biometric sensor.[6]

[2] Shaban, A.R.A. South Africa Leads Adult Smartphone Use on the Continent. africanews. Jun 1, 2016. http://www.africanews.com/2016/06/01/south-africa-leads-adult-smartphone-use-on-the-continent/. Accessed June 16, 2017.

[3] Mbele, L. Why M-Pesa Failed in South Africa. BBC News. May 11, 2016. http://www.bbc.com/news/world-africa-36260348. Accessed June 16, 2017.

[4] Results from FinScope South Africa 2016 Survey on Financial Inclusion November 8, 2016. https://www.finmark.org.za/results-from-finscope-south-africa-2016-survey-on-financial-inclusion/. Accessed June 16, 2017.

[5] 2017: The Year FinTech Shifts its Focus to Africa. Banking Technology. February 2, 2017. http://www.bankingtech.com/676041/2017-the-year-fintech-shifts-its-focus-to-africa/. Accessed June 16, 2017.

[6] Ebun-Amu, C. The End of PINs in South Africa: Enter Biometric Cards. The Market Mogul. May 2, 2017. http://themarketmogul.com/south-africa-biometric-cards/. Accessed June 16, 2017.

The move follows Visa's partnership with Absa Bank that enabled biometrics authentication through chip-based cards in 2015.[7]

Meanwhile, the eCommerce market in Africa, while still relatively small, is heating up.

To tap into the market, Mastercard and Visa are competing with the rollout of their respective buy buttons, Masterpass and Visa Checkout.[8]

Meanwhile, Samsung is planning to debut its digital wallet Samsung Pay in the country by Q3 2017.

The growth in eCommerce market, which now accounts for one percent of overall retail sales,[9] has also resulted in increased investment activity in the country.

Notably, Naspers, a Cape Town-based tech company, is investing an additional $69 million in eCommerce retailer Takealot, which will make Naspers the largest shareholder in the company.[10]

And Yoco, a payments provider, is another company that recently completed its Series A funding round with investors from the U.S. and Netherlands to further bolster its presence in the country.[11]

However, despite the increased investment activity and growing eCommerce business, there are several technological and infrastructure impediments that stand in the way of digital payments.

First off, a mere 14 percent of point-of-sale (POS) terminals in South Africa support contactless payments, and most of the mobile payment methods available in the country are NFC-reliant, with the exception of Samsung Pay.[12]

Also, eCommerce activity, while growing, is still nascent in South Africa. By end of 2017, the total transactional value of eCommerce activity is expected to be just around $322 million. And while eCommerce activity in the country is projected to be worth $2.7 billion by 2021, marking a 74.6 percent growth,[13] the growth will likely be backed by an increase in the use of digital payments.

In South Africa, nearly $9.8 billion is now transacted through digital payments, and the volume is forecast to grow by 16.2 percent between 2017 and 2021. The change underpins a growing population base that now has access to digital payments.

[7] Visa Introduces EMV Chip-based Biometrics. Business Wire. September 15, 2015. http://www.businesswire.com/news/home/20150915005607/en/Visa-Introduces-EMV-Chip-based-Biometrics. Accessed June 16, 2017.

[8] Probyn, J. How Visa Wants to Increase E-Commerce Payments in South Africa. How We Made it In Africa. March 6, 2017. https://www.howwemadeitinafrica.com/visa-wants-increase-e-commerce-payments-africa/. Accessed June 16, 2017.

[9] South Africa B2C E-Commerce Market 2016 – Research and Markets. Business Wire. May 27, 2016. http://www.businesswire.com/news/home/20160527005713/en/South-Africa-B2C-E-Commerce-Market-2016. Accessed June 16, 2017.

[10] Mohapi, T. Naspers Invests $69 Million into South African E-Commerce Business Takealot, Takes its Shareholding to over 50%, IAFRIKAN, April 11, 2017. https://www.iafrikan.com/2017/04/11/naspers-invests-69-million-into-south-african-e-commerce-business-takealot-takes-its-shareholding-to-over-50/. Accessed June 16, 2017.

[11] Alexander, M. Yoco Concludes Series-A Funding Round, Plans International Expansion. Venture Burn. March 1, 2017. http://ventureburn.com/2017/03/yoco-concludes-series-funding-round/. Accessed June 16, 2017.

[12] Johnston, R. Contactless Payments. NCR, Jun 30, 2016. https://www.ncr.com/company/blogs/financial/contactless-payments. Accessed June 16, 2017.

[13] Mobile Payments. Statista. https://www.statista.com/outlook/331/112/mobile-payments/south-africa#takeaway. Accessed June 16, 2017.

A recent Mastercard survey found that nearly 31 percent of respondents used mobile payments and approximately 70 percent used applications such as FlickPay, GustPay, SnapScan and Zapper.[14]

The growth in usage of mobile payments comes with an increased consumer interest in shopping online for lower prices and fast delivery of products. Nearly 22 percent of internet users in South Africa said they had shopped online, and another 48 percent said they planned to do so in the future, according to a study by Ipsos.[15]

While the growth in eCommerce is bound to drive use of mobile and card-based payments, which in the future would continue to nip at cash's share, it will be a while before the balance tilts away from cash's dominance. As of 2015, 53.6 percent of South Africans said, when available, they preferred cash on delivery for online purchases.[16]

Overall, cash still powers over 50 percent of the total value of all consumer transactions.[17]

CASH USE IN SOUTH AFRICA
AND OTHER EMERGING MARKETS

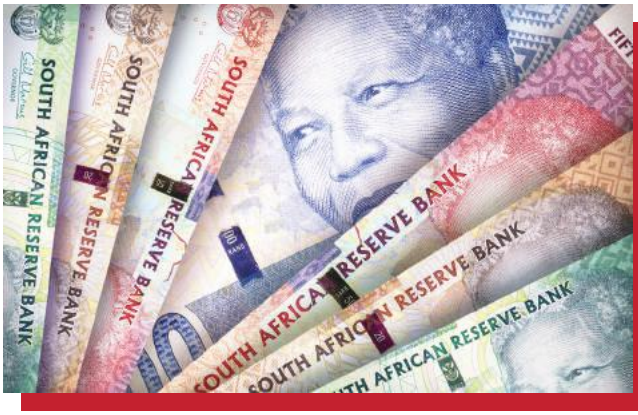
In previous editions of the Global Cash Index, we analyzed the evolution of ATM terminals, bank branches and POS terminals against the size of the population in different countries in the Asia-Pacific and European region.

Many of the counties we studied previously, including Bulgaria, Greece, Hungary, India, Poland, Romania and Slovakia, were found to have striking similarities with South Africa when it comes to the use of cash.

Upon analysis, we found that while these countries saw similar levels of cash usage in 2015, there were different factors powering their growth in use of cash.

Among the nine countries, South Africa has the lowest number of bank branches, with an average of just 6.95 available per 100,000 citizens. Bulgaria, on the other hand, has the highest penetration of bank branches, with 52.1 present per 100,000 people. However, the penetration of bank branches seems to have little effect on OTC withdrawals.

Poland, which has 40.7 branches per 100,000 citizens, sees the highest OTC withdrawals with a per capita average of $16,596 per year.



A similar scenario is observed when we compare the availability of POS terminals and use of cards among the nine countries.

Greece has the highest number of POS terminals, with 2,523 available per 100,000 people, yet it doesn't see the highest volume of card-based payments. Poland, on the other hand, has the highest card transaction volume with $3,887 per capita, but when it comes to penetration of POS terminals, it places fourth after Greece, Bulgaria and Hungary.

[14] Mulligan, S. Digital Payment Taking Hold in South Africa. Mobeewave. March 7, 2017. http://mobeewave.com/en/2017/03/07/digital-payment-solutions-taking-hold-in-south-africa/. Accessed June 16, 2017.

[15] Study Reveals that E-Commerce is on the Rise in South Africa. IT News Africa. March 19, 2015. http://www.itnewsafrica.com/2015/03/study-reveals-that-e-commerce-is-on-the-rise-in-south-africa/. Accessed June 16, 2017.

[16] Online Shopping Rapidly Increasing in South Africa. PayU. July 8, 2015. https://www.payu.co.za/press-room/online-shopping-rapidly-increasing-south-africa. Accessed June 16, 2017.

[17] Cash Usage Costs SA Consumers R23bn. Banking and Finance News. May 5, 2017. http://www.bizcommunity.com/Article/196/163/161340.html. Accessed June 16, 2017.

TABLE 2. COMPARISON OF FEATURES BETWEEN SOUTH AFRICA AND COUNTRIES WITH SIMILAR CASH SHARE, 2014

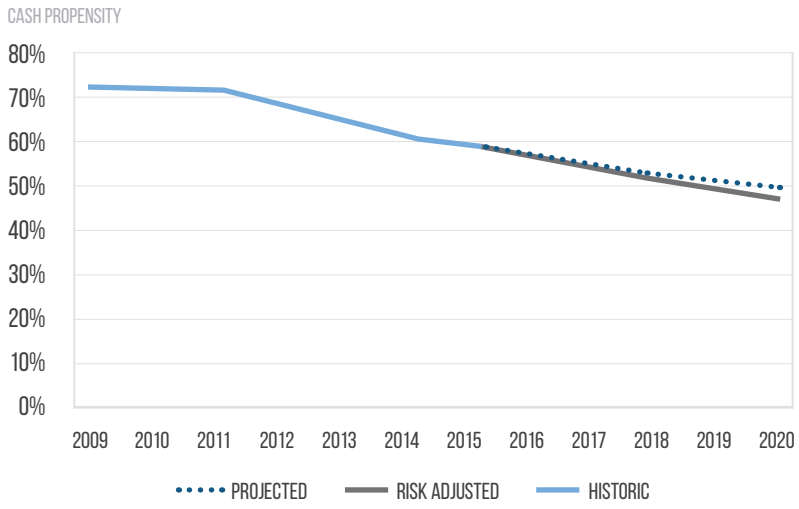
DESCRIPTION	BULGARIA	GREECE	INDIA	POLAND	RUSSIA	SOUTH AFRICA	HUNGARY	ROMANIA	SLOVAKIA
Cash share 2015	**48.6%**	**57.1%**	**52.0%**	**41.0%**	**34.8%**	**58.2%**	**36.7%**	**43.1%**	**46.8%**
Bank branches per 100,000 people	52.1	28.1	10.2	40.7	31.5	7.0	32.8	27.4	23.2
ATM terminals per 100,000 people	81	65	13	50	97	50	49	54	48
POS terminals per 100,000 people	978	2,523	85	857	672	579	916	640	774
ATM withdrawals per capita (USD)	1,422	3,969	243	8,449	2,190	1,116	1,955	1,475	2,475
OTC withdrawals per capita (USD)	2,793	7,797	491	16,596	1,102	2,251	2,557	2,905	4,834
Card payments per capita	265	577	276	3,887	923	—	840	346	2,260
ATM withdrawal per ATM terminal (Million USD)	1.8	6.1	1.9	17.0	2.2	2.2	4.0	2.74	5.2
OTC withdrawals per bank branch (Million USD)	5.4	27.7	4.8	40.8	3.5	32.4	7.8	10.59	20.8

RISK ADJUSTMENTS

We calculated the risk-adjusted projection of cash usage in South Africa by accounting the distribution of cash among different age groups within the country's population.

Our research estimates that for the population in the 19-to-24-year old bracket, the reduction in cash usage could be accelerated by 10 percent, whereas it might be accelerated by 6 percent among 25-to-34-year-olds and by 3 percent among 35-to-44-year-olds. Assuming that these reductions are realized over a five-year time period, the risk-adjusted cash share as depicted in Figure 4 could reach a cash share of 47.7 percent by 2020.

FIGURE 4. HISTORIC AND RISK-ADJUSTED CASH SHARE PROJECTION



TOTAL CASH USAGE

Despite a reduction in cash share of GDP, the total use of cash in South Africa has continued to rise — a phenomenon that we have also observed in other countries that were previously analyzed in the Global Cash Index.

Between 2009 and 2015, South Africa saw its cash usage increase, but our estimate projects that cash growth will slow down until 2020.

As shown in Table 3 and Figures 5 and 6, cash share has been declining at a very low rate, with the CAGR of the GDP's cash share hovering between -0.6 and -0.7 percent between 2010 and 2020.

With the GDP projected to increase at a CAGR of 8.02 percent between 2015 and 2020, the total use of cash is projected to reach $464 billion in 2020 from $183 billion in 2015, which is approximately 1 percent higher than the CAGR observed between 2010 and 2015.

TABLE 3. SOUTH AFRICA CASH SHARE, GDP AND TOTAL CASH USAGE

	CASH USAGE AND PROJECTIONS			COMPOUND ANNUAL GROWTH RATE	
	2010	2015	2020	2010 – 2015	2015 – 2020
CASH SHARE	73%	58.2%	49.1%	-0.68%	-0.62%
GDP	215.0	315.6	464.2	7.98%	8.02%
TOTAL CASH USAGE	156.9	183.7	228.0	3.20%	4.42%

FIGURE 5. HISTORIC AND PROJECTED CASH SHARE

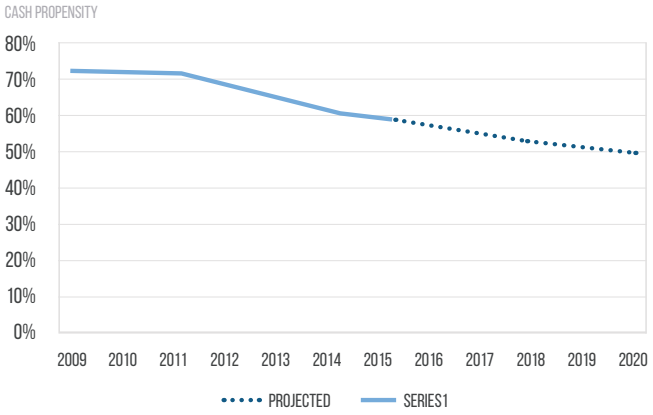
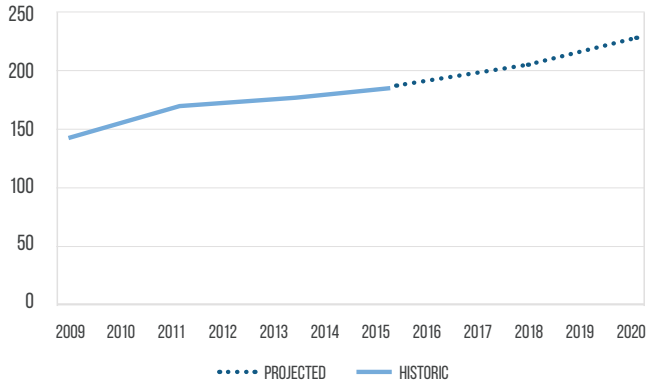


FIGURE 6. HISTORIC AND PROJECTED TOTAL CASH USAGE (IN BILLION DOLLARS)



THE STATE OF CASH
IN SOUTH AFRICA

Cash today powers nearly 50 percent of transactions in South Africa, and its share represents **58.2 PERCENT** OF THE COUNTRY'S GDP.

While there's increased investment activity in the FinTech industry, the country continues to lack the infrastructure it needs to make a shift toward digital payments.

Until that change happens, cash will maintain its dominance over other payment methods currently available in the country.

FEATURE STORY

IN SOUTH AFRICA, CASH IS CONSUMERS' HANDS-DOWN CHOICE

When the money transfer app M-Pesa entered the South African market in 2010, the company behind the app, Vodacom, set a target of reaching 10 million users within three years since its launch. The company was intent on repeating the success it had first achieved in Kenya.

Six years after launching in South Africa, the mobile money giant ceased operations in the country after managing to register only a mere 76,000 users.

In retrospect, M-Pesa's failure in South Africa could have been foreseen, which is, of course, always easier to say in hindsight. With over half of consumer transactions still being paid in cash, South Africa is inherently a cash-driven economy, where despite the growing penetration of mobile phones, consumers continue to use cash to pay for day-to-day needs.

To gauge the evolving state of cash in South Africa and dig into why mobile payments are struggling to gain adoption, PYMNTS recently caught up with Vusi Ndwandwe, head of retail and business banking at Absa Bank.

"When it comes to payments in South Africa or Africa, in general, cash is still a king. Sometimes, the picture is not painted accurately," Ndwandwe said of the popularity of digital payments in the African continent.

Powering rides to retail

In South Africa, consumers often pick cash over cards for making their purchases, and that's a fact that brands local and international are heeding for finding success.

Take ride-hailing giant Uber, for instance. While the country has a large number of credit card users, when the time came for Uber to expand its operation, accepting cash was a no-brainer.

"When you see the market potential that cash unlocks, it's very hard to ignore that," said Alon Lits, Uber's general manager for sub-Saharan Africa, at the time of the rollout in May 2016.

And rightfully so. Total cash currently being used in South Africa represents over 58 percent of the country's GDP, according to the PYMNTS Global Cash Index.

Meanwhile in the eCommerce industry, top South African eTailers such as Takealot.com are casting a wider net for capturing unbanked and cash-loving shoppers by extending payment options such as cash on delivery in conjunction with card-based payments.

"Cash on delivery is really gaining momentum," Ndwandwe said, adding that top retailers are seeing consumers use cash for payments for close to a quarter of their sales.

However, with improved point-of-sale infrastructure in-store, cash is now facing stiff competition from credit and debit cards and is now the second most used payment method.

P2P is cash's forte

Over the years, South Africa, with the largest economy on the African continent, has seen rapid development of an infrastructure for supporting card-based payments; however, when it comes to P2P payments, digital payments haven't managed to cut in on a sizeable piece of market share.

Cash continues to be the go-to method for P2P payments, Ndwandwe said. Digitizing P2P transactions would require further development of the existing infrastructure, he added.

While banking customers can send P2P payments, they are only able to do so with customers of the same bank, and the vast majority of the country's population maintain a single bank account, according to Ndwandwe.

"There are all-closed loop systems in each bank, but not interbank [networks]," he said of the technological barriers that add friction to digital P2P transfers.

Meanwhile for consumers, cash continues to be a friction-free solution for making P2P payments, not just for banked consumers, but also for the remaining 33 percent of the population who do not have access to a bank account.

> *"For digital payments to really take off, it's not just the infrastructure that you need, but there are also cost issues."*

Growth of cash in the near future

With growing competition from alternate payment methods, cash's popularity has relatively declined in South Africa, but with growth in the country's GDP, cash usage is projected to increase.

In 2015, South Africans used a total of $183.7 billion in cash, up from $156.9 billion in 2010, according to the PYMNTS Global Cash Index. One of the major factors that has contributed to this growth is the country's propensity for using cash for low-value transactions.

"Sixty percent of cash usage is in low-value transactions," Ndwandwe said.

High-value transactions, on the other hand, are now completed through direct debit or credit push payments to comply with anti-money laundering laws and other regulatory requirements, he noted.

Along with digitization of high-value transactions, card-based payments are quickly gaining popularity and have now become the fastest growing payment method, he said. Nonetheless, Ndwandwe believes that cash usage will continue to grow in the country with consumers continuing to use their debit cards for withdrawing cash instead of paying with them directly.

Payments and technological barriers

Other than the convenience that cash offers, there are several reasons that factor into South African consumers' choice for cash over cards and mobile payments.

In a recent survey conducted by the Boston Consulting Group, 33 percent of South Africans cited fear of fraud involving the use of ATMs and mobile banking as the number one reason for transacting in cash.

Additionally, a lack of resources has hampered growth of digital payments.

"For digital payments to really take off, it's not just the infrastructure that you need, but there are also cost issues," Ndwandwe said, adding that in the long run, mobile payments may prove to be a game changer with growth in penetration of smartphones.

However, even with smartphone usage growing in South Africa, other barriers continue to remain in place. Most notably, perhaps, until consumers start feeling comfortable with using payment features on their phones, mobile and other electronic payments won't see widespread adoption, Ndwandwe explained.

Most of these frictions, however, are similar to those experienced in other developing markets.

As the South African market continues to evolve, the balance between share of digital payments and cash is likely to reach a point of congruence where both will go hand in hand. But for now, cash still rules the roost.

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.[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.

[8] 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]

[9] 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.[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

[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.

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			✓

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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