# Cashless Cities

## Technical Appendix

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VISA

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This Technical Appendix provides a detailed note regarding the methodology used to arrive at the net benefit and catalytic impacts estimates in the Cashless Cities report. As such, the Technical Appendix only focuses on methodology used for determining impacts in the Achievable Cashless scenario. However, net benefits and catalytic impacts estimates for other scenarios (such as 100% cashless, or custom levels of cashlessness) follow the same framework as outlined in this Technical Appendix. In order to ensure uniformity and consistency in data sources for the 100 cities, GDP and population data was retrieved from McKinsey's Urban World App for 2015. For additional information regarding the data, please refer to:
https://www.mckinsey.com/mgi/overview/in-the-news/urban-world-app

Cashless Cities is a Visa-commissioned study, carried out by Roubini Thoughtlab. Throughout this Technical Appendix, Roubini Thoughtlab is referred to as RT. Additionally, please note that the Calls to Action (referenced in the Action Roadmap section of the Study) were developed by Visa Inc. staff in coordination with Roubini Thoughtlab and intend to be suggestions for relevant stakeholders to consider where appropriate.

# 1.0 Representative City Selection

The potential costs and benefits associated with moving toward greater digital payments adoption could vary by a city's socio-economic dynamics as well as the level of digital payments usage. The first step in the analysis was to select a balanced mix of six cities that provide a good cross-section of city characteristics, and that could form the basis for benchmarking across a broad range of cities globally. In order to help select the cities, Roubini Thoughtlab (RT) classified countries as to their level of digital payment readiness and digital payment usage.

This was done by calculating digital payment readiness and digital payment usage scores for each city. Each metric is comprised of several variables from the World Bank's Global Financial Inclusion database[1] (Figure 1.1). Due to data limitations at the city-level, the analysis was based on country-level data.[2]

*Figure 1.1: Digital Payment Readiness and Usage Index Indicators*


The first step in calculating the Digital Payment Usage and the Digital Payment Readiness scores was to normalize and index the data. This was done using the Min-Max method, which normalized the indicators so that they all have an identical range of 0 to 1.

*Table 1.1 summarizes the scores and index values for each metric.*

| | Digital Payment Readiness Score | Digital Payment Usage Score | Digital Payment Readiness Index | Digital Payment Usage Score |
|---|---|---|---|---|
| Min[3] | 00.0 | 00.0 | 00.0 | 00.0 |
| Max | 4.49 | 2.83 | 1.00 | 1.00 |
| Median | 2.09 | 0.76 | 0.47 | 0.27 |
| Mean | 2.22 | 1.04 | 0.50 | 0.37 |

[1]See http://www.worldbank.org/en/programs/globalfindex for additional information.
[2]Uniform, consistent and comparable data at the city-level for indicators used to determine readiness and usage are not readily available.
[3]The World Bank data that was used to calculate the Electronic Payment Usage and Electronic Payment Readiness scores did not include information for Cuba, as such the scores for each metric for Cuba was a 0.

The next step was to define the cutoffs to distinguish high readiness/usage from low readiness/usage. RT used four usage categories (Highest, High, Medium, and Low) and three readiness categories (Highest, High, and Low). This resulted in six usage/readiness combinations:

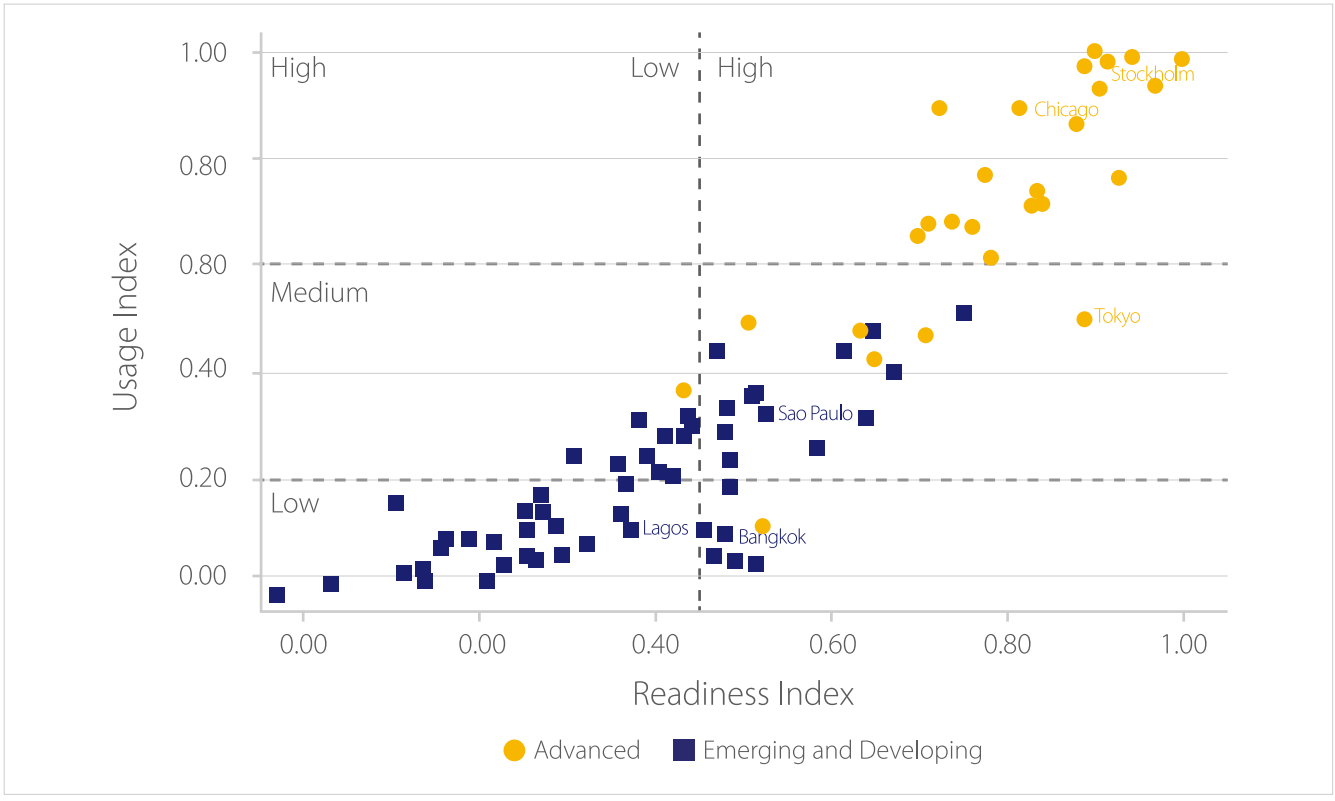
- Low Readiness / Low Usage
- Low Readiness / Medium Usage
- High Readiness / Low Usage
- High Readiness / Medium Usage
- High Readiness / High Usage
- Highest Readiness / Highest Usage

Table 1.2 summarizes the cutoff for each usage and readiness category and Figure 1.2 plots the usage and readiness scores for each of 100 cities included in the analysis.

*Table 1.2: Usage and Readiness Category Cutoffs*

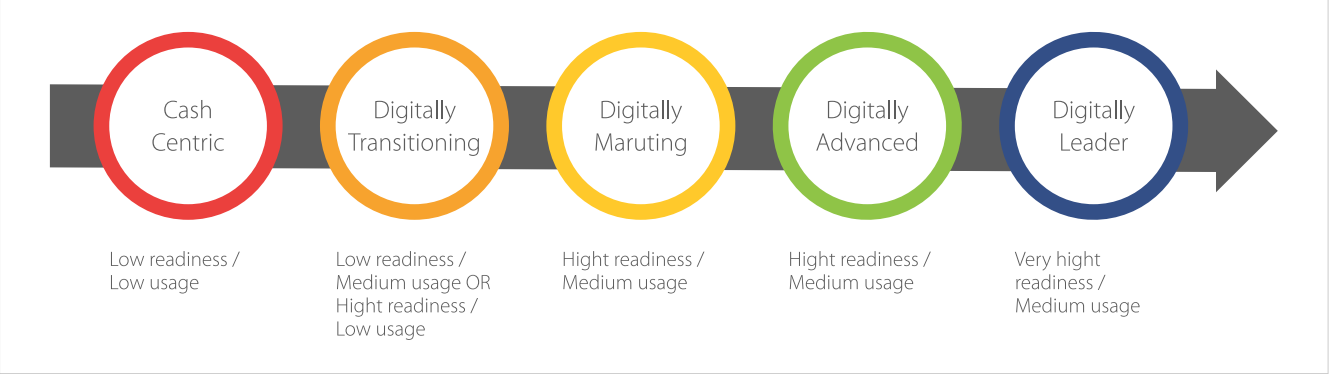
| | Digital Payment Readiness Score | Digital Payment Usage Score |
|---|---|---|
| Highest | >0.85 | >0.85 |
| High | 0.45 to 0.85 | 0.60 to 0.85 |
| Medium | N/A | 0.20 to 0.60 |
| Low | <0.45 | <0.20 |

*Figure 1.2: Usage and Readiness Scores by City*



RT then classified each of the usage/readiness combinations into one of five digital payment maturity categories. The classifications are illustrated in Figure 1.3

*Figure 1.3: Digital Maturity Segmentation*




1. From each category, RT then selected one city to serve as the benchmark city for the category. Given the fact that the Digitally Maturing category included a mix of advanced, and emerging and developing economies, RT included two benchmark cities, Sao Paulo and Tokyo, to account for differences across city types. These cities were chosen because they represented different levels of digital payments readiness and usage, and could credibly characterize other similar cities around the world, in terms of both digital payment usage and readiness. These representative cities are:

- Lagos, Nigeria has low digital payments readiness and low digital payments usage. It is representative of other Cash Centric cities in our list of 100 cities
- Bangkok, Thailand, has medium digital payments readiness and low digital payments usage. It serves as benchmark for other Digitally Transitioning cities in our Study.
- Sao Paulo, Brazil has high digital payments usage, but low digital payments readiness. Tokyo, Japan on the other hand, has high digital payments readiness, but relatively low usage. These two cities together, represent other similar Digitally Maturing cities in our Study.
- Chicago, USA, has high digital payments readiness and relatively high usage, typifying other similarly Digitally Advanced cities.
- Finally, Stockholm, Sweden, has the most advanced digital payments infrastructure and widespread digital payments usage, which is representative of other Digital Leaders.

This Technical Appendix only focuses on methodology used for determining impacts in the Achievable Cashless scenario. However, net benefits and catalytic impacts estimates for other scenarios (such as 100% cashless, or custom levels of cashlessness) follow the same framework as outlined in this Technical Appendix.

# 2.0 Consumer Net-Benefit Model

To quantify the impacts of increasing digital payments use on consumers, RT focused on the following net benefits:

- Time savings
  - Banking and related activities (bill paying, balancing checkbooks)
  - Transportation (avoiding toll booth lines, quicker bus and train boarding, etc.)
  - Retail/shopping (quicker checkout times)
- Avoidance of late payment fees
- Reduced crime

RT also took into account the fact that increased use of digital payments could require bank accounts, which could potentially translate to increased costs – specifically, costs related to providing personal bank accounts to the unbanked population.

The analysis used a combination of survey data[4] and secondary data. RT estimated the costs and benefits of increased digital payment usage under the achievable cashless scenario, defined as follows:

- **Achievable Cashless:** Each city reaches the level of digital maturity as the top 10% of the local users. The definition of top 10% users is city-specific and differs from city-to-city.

## 2.1 Digital Payment Score

The first step in the analysis was to calculate a digital payment score for each survey respondent. The purpose of the score was to assess the digital payment "maturity" of each of the survey respondents.

- **Question 11:** If you were to receive a paper check, either from your employer, the government or another individual, how would you cash or deposit the check?
  - In person at a bank that I have an account with
  - Using a mobile phone app from a bank that I have an account with
  - In person at the bank that issued the check
  - In person at a bank that I do not have an account with
  - At an ATM machine
  - At a retailer that offers check-cashing services
  - At a check-cashing establishment

- **Question 13:** For each of the following monthly bills, which payment method do you most often use?
  - Rent/mortgage
  - Government taxes, fees, and fines
  - Utility payments
  - Insurance
  - Other recurring bills (e.g., gym membership, credit card
  - Tuition/school expenses

[4]Please see Appendix C for additional details on the survey.

- **Question 17:** For each of the following spending categories, which payment method do you use most often?
    - Groceries/drugs
    - Personal attire
    - Healthcare
    - Hobby/sporting goods
    - Professional services
    - Domestic help
    - Transportation/parking
    - Entertainment/meals
    - Durable goods
    - Travel and vacation

For Question 11, survey respondents were given 1 point if they deposited checks "using a mobile phone app" or "at an ATM machine." For Questions 13 and 17, the payment choices included: cash, check, money order, stored value card, credit card, debit card, electronic/online bill payment, and mobile payment account. Respondents were given one point for each payment typically made using a digital payment method[5] and zero points for each payment typically made using non-digital methods. Not every respondent made purchases in each of the categories included in Question 13 and 17. The responses to Questions 13 and 17 were weighted to account for differences in the number of categories in which spending occurred. This was done to ensure that an individual's score was not artificially lower due to the fact that they did not make purchases in every category.

The digital payment score ranged from 0 to 18, with an average score of 10.75 and a median score of 11.67. The score was calculated separately for each age-cohort. Table 2.1 and Figure 2.1 presents the digital payment maturity score by age-cohort and City and Figure 2.2 presents the unweighted and weighted average score for each City. The weighted score was calculated based on the population distribution in each of the six cities (Table 2.2). Digital payment scores for the top 10% users – i.e. the Achievable Cashless scenario are presented in Table 2.3 and Figure 2.3.

*Table 2.1: Baseline Consumer Digital Payment Score by Age Cohort*

| | Chicago | Bangkok | Lagos | Sao Paulo | Stockholm | Tokyo |
|---|---|---|---|---|---|---|
| 18 to 34 | 12.2 | 7.6 | 7.4 | 12.7 | 14.9 | 6.5 |
| 35 to 50 | 13.1 | 7.1 | 7.3 | 13.1 | 15.8 | 8.7 |
| 51 to 69 | 11.9 | 7.6 | 5.9 | 14.3 | 15.1 | 9.9 |
| 70 and over | 11.4 | 7.6 | 5.9 | 14.4 | 15.9 | 10.4 |
| Weighted Average | 12.3 | 7.5 | 7.2 | 13.4 | 15.4 | 8.8 |
| Unweighted Average | 12.1 | 7.4 | 7.4 | 13.2 | 15.4 | 9.1 |

[5]RT considered the following payment methods to be digital: debit card, credit card, stored value card, electronic/online bill payment, wire transfer, and mobile payment account.

*Figure 2.1: Consumer Digital Payment Score by Age Cohort and City*

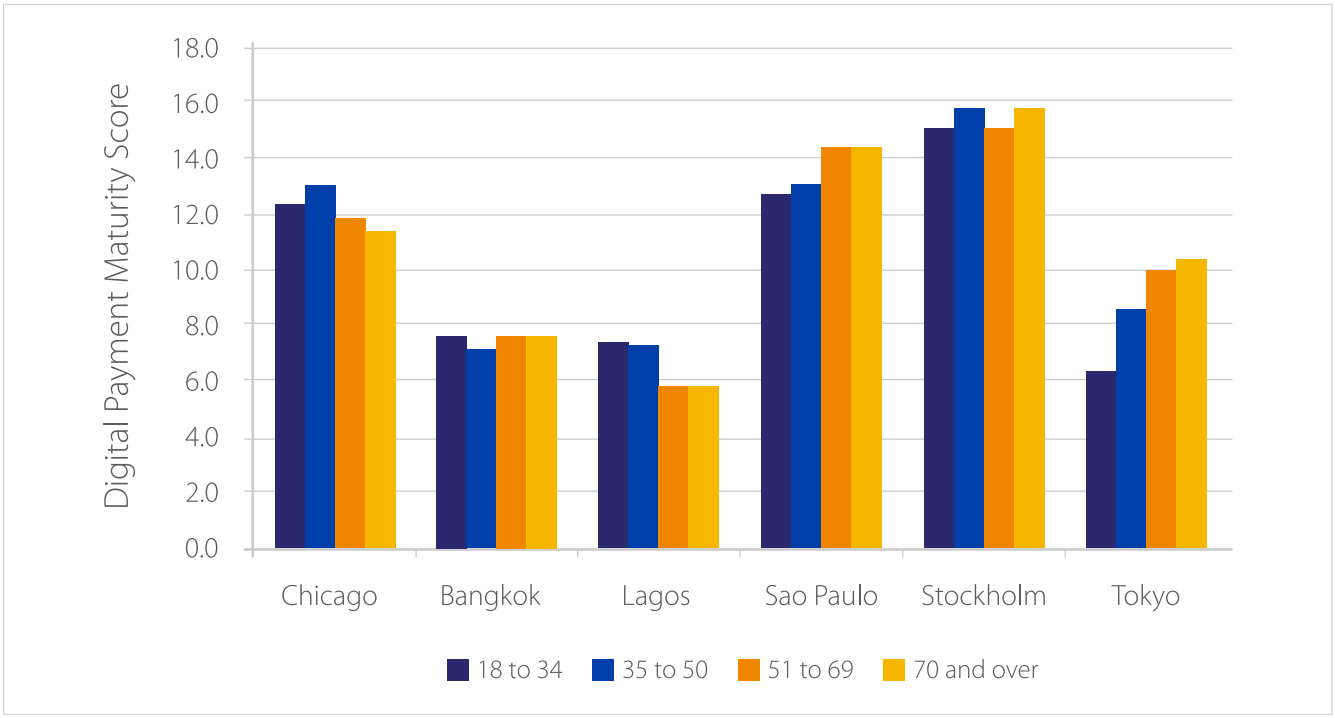



*Figure 2.2: Unweighted and Weighted Average Digital Payment Score by City*

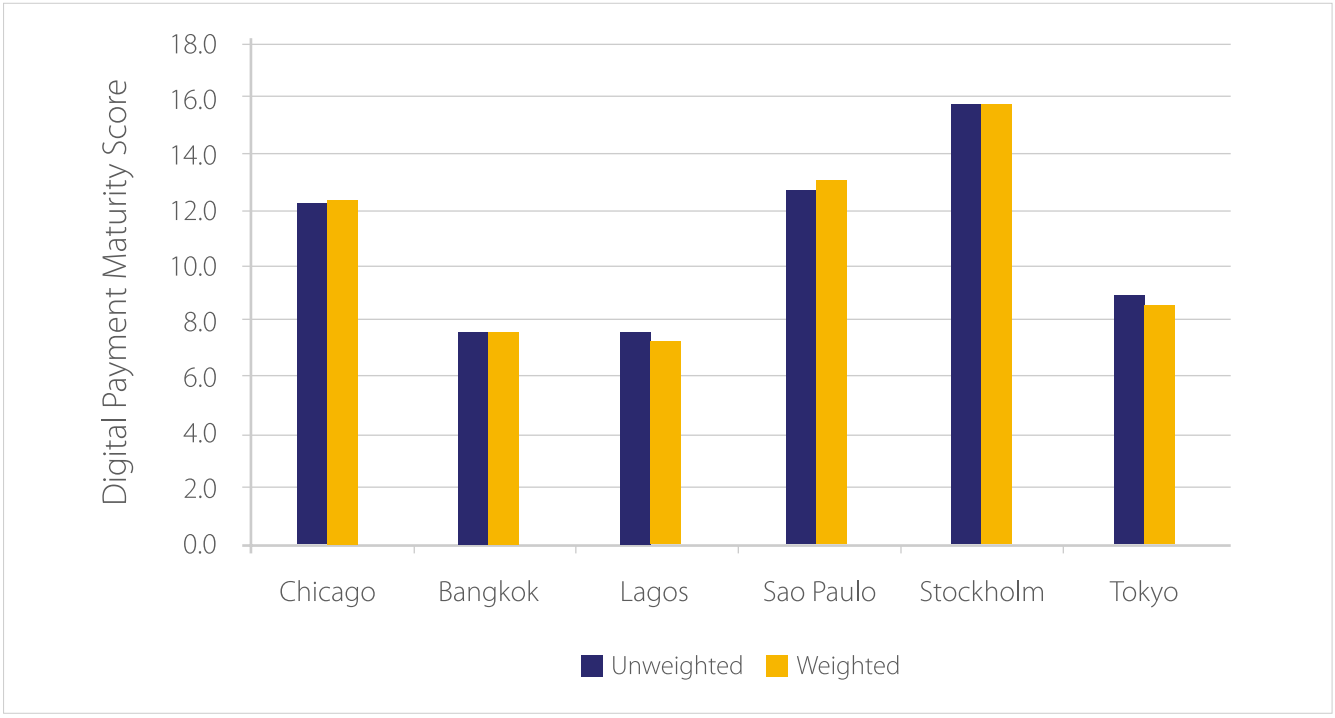


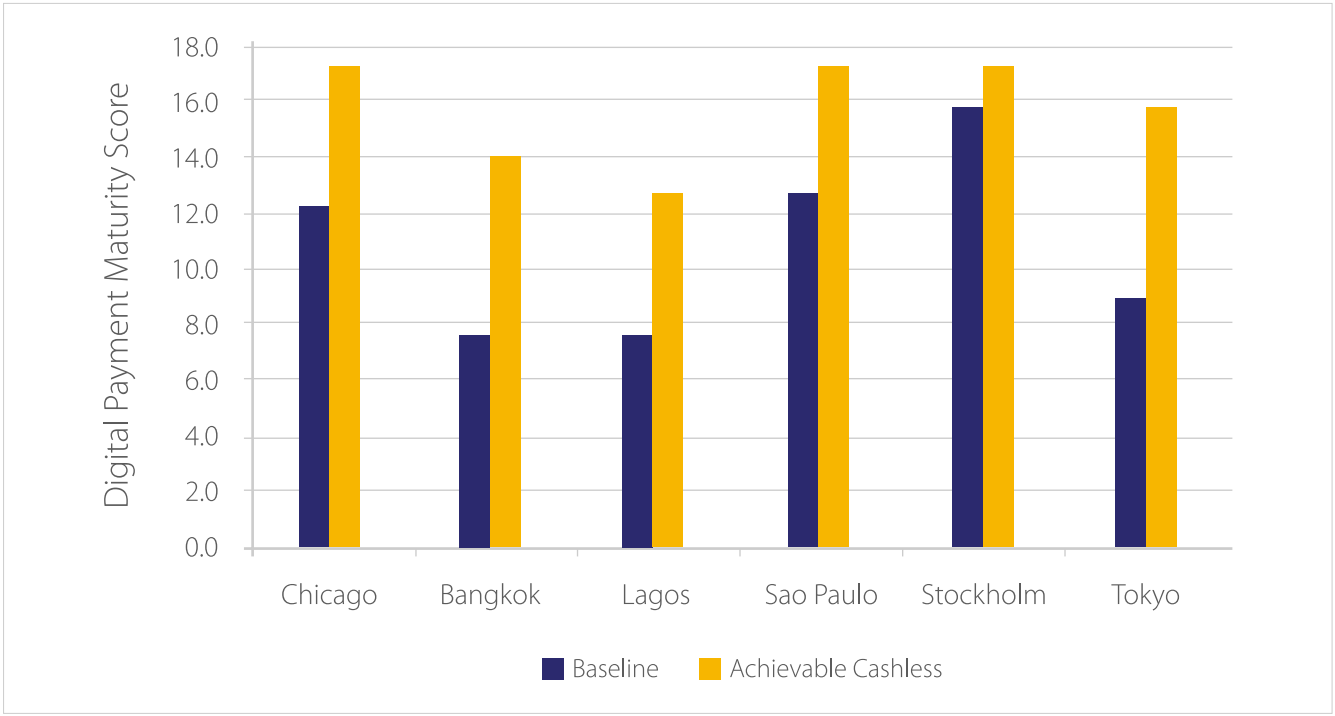
*Table 2.2: Age Cohort Population Weights*

| | Chicago | Bangkok | Lagos | Sao Paulo | Stockholm | Tokyo |
|---|---|---|---|---|---|---|
| 18 to 34 | 36.3% | 40.3% | 57.6% | 34.0% | 32.1% | 25.3% |
| 35 to 50 | 27.2% | 33.9% | 28.1% | 30.9% | 29.4% | 28.5% |
| 51 to 69 | 26.6% | 20.5% | 11.7% | 27.2% | 25.8% | 29.0% |
| Over 70 | 9.9% | 5.3% | 2.6% | 8.0% | 12.6% | 17.1% |

*Table 2.3: Achievable Cashless Scenario Consumer Digital Payment Maturity Scores*

| | Chicago | Bangkok | Lagos | Sao Paulo | Stockholm | Tokyo |
|---|---|---|---|---|---|---|
| 18 to 34 | 18.0 | 15.0 | 13.0 | 17.0 | 17.5 | 15.0 |
| 35 to 50 | 17.0 | 14.0 | 13.0 | 18.0 | 17.0 | 15.9 |
| 51 to 69 | 17.0 | 12.6 | 11.0 | 18.0 | 17.0 | 16.0 |
| 70 and over | 15.8 | 12.0 | 10.5 | 17.0 | 17.0 | 15.4 |
| Weighted Average | 17.2 | 14.0 | 12.7 | 17.6 | 17.2 | 15.6 |

*Figure 2.3: Comparison of Scenario Digital Payment Maturity Scores by City*




## 2.2 Banking Time Savings

The increased use of digital payments could reduce consumers' need to carry cash for everyday transactions, thereby potentially reducing the number of times that an individual will need to visit an ATM, bank, or other financial institution. Digital payment usage also has the potential to reduce the amount of time that individuals spend paying bills and balancing their checkbook.

**Methodology**
As part of the survey, RT asked survey respondents how often they visit a bank, ATM, or other financial institution in a typical month and how much time, on average, each visit takes. RT also asked survey respondents how much time they spend paying their bills in a given month as well as how much time they spend balancing their check book.
Based on the survey responses, RT calculated the total amount of time that individuals spend in a given month on the following banking related tasks:

- Visiting a bank, ATM, or other financial institution;
- Balancing their check book; and
- Paying monthly bills.

The amount of time that people spend visiting a bank, ATM, or other financial institution varies materially by city. This suggests that many people could see significant time savings as a city's payment systems become more digital. The time people spend balancing checkbooks and paying bills varies less among cities.

Some respondents spend an unusually large amount of time visiting a bank, ATM, and other financial institutions. To control for these outliers, RT dropped survey responses where the amount of time spent on banking related activities was more than 500 minutes in a month.

To estimate how the amount of time spent on banking related activities could change as the level of digital payment maturity changes, RT developed a simple regression model to quantify how changes in digital payment maturity score could impact the amount of time spent on banking related activities. In addition to the digital payment maturity score, the regression model also included a series of dummy variables to control for the city, as well as the age cohort of the respondent

The coefficient on the digital payment maturity score was statistically significant and had the expected sign (Table 2.6). The regression model found that the amount of time spent on banking related activities decreases by 0.19 percent for each 1 percent increase in the digital payment maturity score.

*Table 2.6: Regression Results*

| | Standard | | |
|---|---|---|---|
| | Sao Paulo | Stockholm | Tokyo |
| Log of Digital Payment Score | -0.193 | 0.021 | -9.420 |
| Low Income Dummy | 0.076 | 0.049 | 1.550 |
| Moderate Income Dummy | 0.040 | 0.051 | 0.780 |
| Middle Income Dummy | -0.107 | 0.047 | -2.290 |
| High Income Dummy | -0.203 | 0.047 | -4.360 |
| Age 35-50 Dummy | -0.220 | 0.036 | -6.120 |
| Age 51-69 Dummy | -0.562 | 0.038 | -14.990 |
| Age 70-plus Dummy | -0.585 | 0.063 | -9.320 |
| Intercept | 5.055 | 0.060 | 83.690 |
| Observations | 2,777 | | |
| R-squared | 0.1671 | | |

The results of the regression model were used to estimate the percentage change in the amount of time spent on banking related tasks under the achievable cashless scenario. To control for differences across age cohorts, the estimations were carried out separately for each age cohort.

The first step was to calculate the difference between the baseline digital payment maturity score and the achievable cashless digital payment maturity score for each age cohort. The change in the digital payment maturity score was multiplied by the regression coefficient (-0.19) to estimate the percentage change in time spent on banking related activities. The percent change was then applied to the baseline banking time for each age cohort (Table 2.7) to calculate change in the time spent on banking related activities. The total amount time saved was calculated by multiplying the average time savings by the population of each age cohort (Table 2.8). RT used the population of the metropolitan region that includes each city.

*Table 2.7: Average Baseline Banking Time by Age Cohort and City*

| | Chicago | Bangkok | Lagos | Sao Paulo | Stockholm | Tokyo |
|---|---|---|---|---|---|---|
| 18 to 34 | 106.4 | 130.5 | 206.8 | 106.0 | 59.4 | 64.3 |
| 35 to 50 | 76.4 | 157.7 | 207.1 | 114.0 | 61.4 | 54.4 |
| 51 to 69 | 52.9 | 120.1 | 196.1 | 121.2 | 54.0 | 49.8 |
| 70 and over | 56.4 | 120.1 | 196.1 | 75.0 | 52.5 | 56.1 |

*Table 2.8: Population by Age Cohort and City*

| | Chicago | Bangkok | Lagos | Sao Paulo | Stockholm | Tokyo |
|---|---|---|---|---|---|---|
| 18 to 34 | 2,606,030 | 3,449,110 | 7,025,830 | 5,185,760 | 607,610 | 7,902,280 |
| 35 to 50 | 1,954,520 | 2,901,510 | 3,434,080 | 4,712,390 | 556,320 | 8,896,480 |
| 51 to 69 | 1,906,620 | 1,749,890 | 1,427,720 | 4,147,760 | 488,370 | 9,053,160 |
| 70 and over | 708,990 | 450,260 | 314,450 | 1,220,550 | 238,870 | 5,329,910 |
| Total | 7,176,160 | 8,550,770 | 12,202,080 | 15,266,460 | 1,891,170 | 31,181,830 |

The value of the time savings was quantified by multiplying the aggregate time savings by 40 percent of the median hourly wage in each city. [6]

## 2.3 Transit Time Savings

### 2.3-1 Public Transit Travel Time Savings

To estimate the potential benefits generated by increasing the proportion of digital transit payments, RT used data on transit ridership for each transit system, coupled with survey data on how people pay for transit and the average amount of time it takes to pay for each trip using various payment methods.

**Methodology**

Dwell time, the time it takes for the transit riders to board the transit vehicle, is affected by a variety of factors, including: passenger activity, bus crowding, fare collection and payment method, driver experience, and time of the day. Research has found that passengers boarding with prepaid fare are the fastest to board, as they have no interaction with fare box and only have to show their pass to the driver. Prepaid riders take an average of 2.2 seconds per passengers to board, followed by passenger using a magnetic swipe card (3.0 seconds) and cash (4.2 seconds). For the purposes of this analysis, RT assumed that the time taken for digital payments is the average of the prepaid and swipe card (2.6 seconds)[7]. The time savings for switching from cash to digital is equal to the difference between the digital (2.6 seconds) and the cash time (4.2 seconds), or 1.6 seconds.

The total number of transit trips in each city that were paid through non-digital means was estimated using transit ridership data (Table 2.9) and data from the survey on how people people typically pay for transit trips. Table 2.10 summarizes the percent of transit trips in each city that are paid through non-digital means – this was derived from survey data. It is important to note that in Bangkok the bus system only accepts cash and in Stockholm the bus system does not accept cash payments.

In addition, in Sao Paulo, only a fraction of the bus trips are paid for using cash, with the remaining trips paid using electronic ticketing.[8] Other than these exceptions the percent of transit trips paid through non-digital means was based on the survey data.

The reduction in the number of transit trips paid using non-digital methods under each scenario was calculated based on the ratio of the digital payment score under the achievable cashless scenario and the maximum digital payment score (18). For example, if average digital payment maturity score for a given city was 16, then RT assumed that the number of non-digital trips was reduced by 89 percent.[9] Table 2.11 summarizes the reduction in the non-digital trips under the achievable cashless scenario.

[6]The use of 40% of the wage rate to value time savings is standard for benefit costs analysis. See https://www.transportation.gov/sites/dot.gov/files/docs/USDOT%20VOT%20Guidance%202014.pdf for additional information.

[7]Fletcher, G., El-Geneidy, A. (2013). Effects of Fare Payments and Crowding on Dwell Time. Journal of Transportation Research Board. Retrieved from https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&cad=rja&uact=8&ved=0ahUKEwiU9pHW2P7SAhVO0GMKHRLlDqAQFggg-MAE&url=http%3A%2F%2Ftram.mcgill.ca%2FResearch%2FPublications%2FTranslink_Dwell_Analysis.pdf&usg=AFQjCNEwtmSW76bQB4xN6-5BPvsajX-30mQ&sig2=LldFNzPlEtHX11Erfbt-NQ.

[8]Bruha, P. (2014, December 22). Bus Travelling in Brazilian Cities. The Brazil Business. Retrieved from http://thebrazilbusiness.com/article/bus-traveling-in-brazil

[9]The reduction was calculated as follows: the average digital payment maturity score/maximum digital payment maturity score = 16/18=0.8889.

*Table 2.9: Transit Ridership by Mode and by City*

| | Chicago | Bangkok | Lagos | Sao Paulo | Stockholm | Tokyo |
|---|---|---|---|---|---|---|
| Bus | 274,288,700 | 950,267,500 | 62,827,600 | 4,292,381,700 | 179,058,700 | 858,820,100 |
| BRT[10] | 3,926,700 | | | | | |
| Rail | 241,676,100 | 283,640,000 | | 1,690,600,000 | 412,503,100 | 13,694,034,900 |
| Total | 519,891,500 | 1,233,907,500 | 62,827,600 | 5,982,981,700 | 591,561,800 | 14,552,855,000 |

*Table 2.10: Percent of Transit Trips Paid Using Non-Digital Payment Methods by City*

| | Chicago | Bangkok | Lagos | Sao Paulo | Stockholm | Tokyo |
|---|---|---|---|---|---|---|
| Bus | 27% | 100% | 84% | 37% | 0% | 38% |
| BRT | 27% | N/A | N/A | N/A | N/A | 38% |
| Rail | 27% | 60% | N/A | 37% | 4% | 38% |

*Table 2.11: Percent of Transit Trips Paid Using Digital Payment Methods under the Achievable Cashless Scenario by City*

| | Chicago | Bangkok | Lagos | Sao Paulo | Stockholm | Tokyo |
|---|---|---|---|---|---|---|
| Bus | 27% | 100% | 84% | 37% | 0% | 38% |
| BRT | 27% | N/A | N/A | N/A | N/A | 38% |
| Rail | 27% | 60% | N/A | 37% | 4% | 38% |

[10]Bus Rapid Transit system

The time savings from public transit is comprised of two components. The first component stems from the delay faced by the individual paying the fare - paying for a transit trip using a non-digital method could delay the individual by taking longer for the individual to pay their own fare. The second component stems from the delay faced by others; non-digital payments by an individual could delay everyone on the bus, as well as everyone waiting in line behind them to board the bus. The first component was calculated by multiplying the number of non-digital trips by 1.6 seconds.

The second component was calculated assuming that there is an average of 15 other riders[11] on the bus that are delayed, which results in a delay of 24 seconds.[12] In addition to the 1.6 seconds per non-digital transaction delay, the use of non-digital payments could also lead to additional delays. One such example is that the additional time that it takes for non-digital payers to board the bus, which in some instances, could cause the bus to miss the green light and have to wait for the traffic light to cycle, thus increasing the delay for everyone on the bus. In order to account for this additional delay, RT assumed that on average, the additional delay is equal to 24 seconds.

It is important to note that second component only impacts bus riders and does not impact rail transit riders. In addition, RT assumed that for bus riders in Bangkok, the second component is equal to zero. This is due to the particulars of Bangkok's bus system. Rather than paying the fare at fare box as consumers board the bus, in Bangkok, everyone boards the bus and there is a conductor that comes around and collects everyone's fare. As a result, the other bus riders are not impacted by an individual's choice of payment method; only the individual that is making the payment is impacted.

The value of the transit travel time savings was quantified by multiplying the aggregate time savings by 40 percent of the median hourly wage in each city.[13]

### 2.3.2 Toll Road Travel Time Savings

To estimate the potential benefits generated by increasing the proportion of digital toll payments, RT used available government data on toll transactions, coupled with data on usage of digital payments by toll users, and the time associated with paying tolls using digital and non-digital methods.

#### Methodology

Table 2.12 summarizes the toll road usage and the percent of transactions paid for using electronic toll collection (ETC) (e.g. EZ-Pass).

*Table 2.12: Toll Road and ETC Usage by City*

| | Chicago | Bangkok | Lagos | Sao Paulo | Stockholm | Tokyo |
|---|---|---|---|---|---|---|
| Total Transactions | 881,615,000 | 623,900,000 | N/A | 394,535,000 | N/A | 354,050,000 |
| Percent of Transactions Paid ETC | 87% | 34% | | 34% | | 95% |
| Non-Digital Transactions | 114,609,950 | 411,774,000 | N/A | 260,393,100 | N/A | 17,702,500 |

[11] This is an approximation of average bus riders across various cities, and is conservative

[12] 15 passenger * 1.6 seconds/passenger = 24 seconds.

[13] The use of 40% of the wage rate to value time savings is standard for benefit costs analysis. See https://www.transportation.gov/sites/dot.gov/files/docs/USDOT%20VOT%20Guidance%202014.pdf for additional information.

The reduction in the number of toll transactions paid using non-digital methods under the achievable cashless scenario was calculated based on the ratio of the digital payment score for achievable cashless scenario and the maximum digital payment score (18) (see Table 2.11)

RT calculated the time savings by using the difference between the time that it takes to pay a toll using ETC methods and cash. Toll systems are able to process an average of 350 cash transactions per hour compared to 1,200 non-high speed ETC transactions per hour. This amounts to 10.3 secs per cash transaction and 3 seconds per cash ETC transaction:[14] the difference (7.3 seconds) is the amount of time that each non-ETC transaction would generate if it were to be converted to an ETC transaction.

In addition to the time savings from participating in the actual toll transaction, the driver could need to come to complete stop. This could generate additional time costs with the deceleration and the acceleration after paying the toll. However, when using an ETC transaction, the driver probably does not need to come to complete stop, but rather slow down to a designated speed. Not having to come to complete stop could generate additional time savings. For the purposes of this analysis, RT assumed that deceleration time and acceleration time is each equal to 1.5 times the transaction time savings.[15] This results in an average total time savings of 29.1 seconds for each transaction.

Similar to public transit time savings, switching from cash to ETC generates time savings for the individual paying the toll as well as the other drivers in line. For the purposes of this analysis, RT assumed that there are 1.5 other drivers in line.[16]

As such, RT assumed that switching from cash to ETC methods will generate 102 seconds per driver.[17]

The value of the travel-time savings was quantified by multiplying the aggregate time savings by 40 percent of the median hourly wage in each city.[18]

## 2.4 Consumer Transaction Time Savings

Point-of-sale payments are a daily activity of all consumers and may be executed with different types of payment instruments. Each payment method has a different time efficiency associated with it. To estimate the potential benefits generated for consumers from using more digital payment methods, RT used secondary data on the number of transactions, coupled with survey data on the usage of payment methods by consumers, and the time associated with using each method.

### Methodology

The first step in the analysis was to calculate the total number of consumer transactions. Based on data research from the European Central Bank and Federal Reserve Bank of Boston, the average number of annual per-capita consumer transactions is 633 transactions[19] (Table 2.13).

[14]Peters, J. et al. (2006). Transitioning Barrier Toll Collection Systems to Open Road Tolling: Flow and Management Issues. Retrieved from AgEcon Search at http://ageconsearch.umn.edu/bitstream/208048/2/2006_8B_TollCollection_paper.pdf

[15]This is an approximation across cities and is conservative

[16]ibid

[17]The Illinois Tollway estimates that using I-Pass reduced the average trip time by 10 minutes compared to cash tolls (see https://www.illinoistollway.com/tolling-information/about-ipass for additional information). For the toll associated time savings in Chicago, RT used 10 minutes rather than 102 seconds per transaction.

[18]The use of 40% of the wage rate to value time savings is standard for benefit costs analysis. See https://www.transportation.gov/sites/dot.gov/files/docs/USDOT%20VOT%20Guidance%202014.pdf for additional information.

[19]Bagnall, J. et al. (2014, June). Consumer Cash Usage: A Cross-Country Comparison with Payment Diary Survey Data. European Central Bank Working Paper Series. Retrieved from https://www.ecb.europa.eu/pub/pdf/scpwps/ecbwp1685.pdf

*Table 2.13: Average Number of Consumer Transactions Per-Person*

| | Transactions Per-Person-Per-Day | Total Transactions Per Year |
|---|---|---|
| Australia | 2.1 | 767 |
| Austria | 1.6 | 584 |
| Canada | 1.7 | 621 |
| France | 1.5 | 548 |
| Germany | 1.4 | 511 |
| Netherlands | 1.8 | 657 |
| US | 1.6 | 584 |
| US (Boston Fed) (per Month)[20] | 66.1 | 793 |
| Average | | 633 |
| Median | | 602 |

The aggregate number of transactions was calculated by multiplying the average number of annual transactions per-capita by the adult population in each city (Table 2.14).

*Table 2.14: Total Annual Consumer Transactions by City*

| | Total AdultPopulation | Average Transactions Per-Capita | Total Transactions |
|---|---|---|---|
| Chicago | 9,581,000 | 633 | 6,064,414,000 |
| Bangkok | 10,650,000 | 633 | 6,741,051,000 |
| Lagos | 21,000,000 | 633 | 13,292,213,000 |
| Sao Paulo | 21,227,000 | 633 | 13,435,895,000 |
| Stockholm | 2,409,000 | 633 | 1,524,807,000 |
| Tokyo | 37,486,000 | 633 | 23,727,232,000 |

[20]Data included to account for monthly estimate, as well as provide a variation within cities

Tables 2.15 and 2.16 summarize the breakdown of consumer transactions by different payment methods in percentage terms and in terms of the number of transactions. The transaction breakdown is based on survey data.

*Table 2.15: Consumer Transactions by Payment Type by City (Percentage)*

| | Chicago | Bangkok | Lagos | Sao Paulo | Stockholm | Tokyo |
|---|---|---|---|---|---|---|
| Non-digital[21] | 42.0% | 59.5% | 52.6% | 33.5% | 34.2% | 61.8% |
| Debit and Credit Card | 33.4% | 12.9% | 15.6% | 28.6% | 31.0% | 13.3% |
| Contactless | 18.3% | 16.1% | 16.2% | 24.3% | 26.5% | 14.8% |
| Mobile | 6.3% | 11.5% | 15.6% | 13.6% | 8.4% | 10.1% |

*Table 2.16: Consumer Transactions by Payment Type by City (Number)*

| | Non-Digital | Debit and Credit Cards | Contactless | Mobile | Total |
|---|---|---|---|---|---|
| Chicago | 2,544,095,500 | 2,025,078,600 | 1,112,146,200 | 383,093,700 | 6,064,414,000 |
| Bangkok | 4,008,517,700 | 872,847,300 | 1,083,261,200 | 776,424,700 | 6,741,051,000 |
| Lagos | 6,995,641,800 | 2,072,157,700 | 2,156,735,500 | 2,067,678,000 | 13,292,213,000 |
| Sao Paulo | 4,503,676,800 | 3,841,667,300 | 3,265,214,000 | 1,825,336,900 | 13,435,895,000 |
| Stockholm | 520,789,200 | 472,699,500 | 403,968,700 | 127,349,500 | 1,524,807,000 |
| Tokyo | 14,657,618,600 | 3,148,264,400 | 3,514,729,100 | 2,406,619,900 | 23,727,232,000 |

The baseline aggregate transaction time was estimated by multiplying the number of transactions by payment method[22] (Table 2.16) by the transaction time per second for each payment method (Table 2.17). To quantify the time associated with non-digital transactions, a weighted average of cash and check/money order was used. The weights were based on the distribution of cash and check/money order usage in each city. As such, the non-digital transaction times varied between cities (Table 2.18).

[21]Non-digital includes cash, check, and money order.

[22]The results are based on data from the European Central Bank (https://www.ecb.europa.eu/pub/pdf/scpops/ecbocp137.pdf) and First Data ((https://www.firstdata.com/downloads/thought-leadership/contactless-payments-benefits.pdf).

*Table 2.17: Transaction Times by Payment Type*[23]

| City | Time per Transaction (Seconds) |
|---|---|
| Cash | 27.9 |
| Check/Money Order | 89.0 |
| Credit/Debit Card | 28.9 |
| Contactless | 12.5 |
| Mobile Payment | 12.5 |

*Table 2.18: Non-digital Transaction Time by City*

| | Weights | | | Seconds per Transaction | | | |
|---|---|---|---|---|---|---|---|
| | Cash | Check | Money Order | 27.85 Cash | 89 Check | 89 Money Order | Total |
| Chicago | 57.5% | 27.3% | 15.2% | 16.01 | 24.32 | 13.51 | 53.84 |
| Bangkok | 72.4% | 15.6% | 12.0% | 20.16 | 13.90 | 10.69 | 44.74 |
| Lagos | 82.3% | 17.7% | 0.0% | 22.93 | 15.72 | 0.00 | 38.65 |
| Sao Paulo | 54.2% | 9.0% | 36.8% | 15.09 | 8.04 | 32.75 | 55.87 |
| Stockholm | 78.9% | 9.6% | 11.4% | 21.98 | 8.59 | 10.18 | 40.74 |
| Tokyo | 74.2% | 17.0% | 8.8% | 20.66 | 15.16 | 7.82 | 43.64 |

The aggregate transaction time for each scenario was calculated by modifying the distribution of transactions across payment methods to reflect current usage of digital payments by top 10% users in each city (i.e. the achievable cashless scenario). The transaction time savings was calculated by taking the difference between the baseline aggregate transaction time and the achievable cashless scenario aggregate transaction time.

The value of the transaction time savings was quantified by multiplying the aggregate time savings by 40 percent of the median hourly wage in each city.

[23]It is noted that digital payments, on average have lower transaction times as compared to physical money. Over the next few years, it is expected that mobile and contactless payments usage will increase, further reducing transaction times for digital payments.

## 2.5 Late Payment Fees

Individuals could make late payments for a number of reasons, including: forgetfulness, lack of available funds, being busy, and other reasons. Digital payments that allow an individual to set up automatic bill payments could help reduce the incidence of late payments, especially those that are due to busyness and forgetfulness.

### Methodology

Using data from the survey, RT estimated the proportion of survey respondents that have made a late payment over the last year (Table 2.19).

*Table 2.19: Proportion of Individuals that Made at Least One Late Payment over the Last Year by Age Cohort and City*

| | Chicago | Bangkok | Lagos | Sao Paulo | Stockholm | Tokyo |
|---|---|---|---|---|---|---|
| 18 to 34 | 39% | 4% | 51% | 58% | 36% | 8% |
| 35 to 50 | 30% | 11% | 36% | 59% | 39% | 8% |
| 51 to 69 | 10% | 7% | 23% | 42% | 25% | 4% |
| 70 and over | 1% | 5% | 18% | 22% | 18% | 7% |

According to research from Citigroup that surveyed American consumers[24], 42 percent of people that made a late payment did so because of lack of available funds, 61 percent because of forgetfulness, and 39 percent because they are busy. The use of digital payments is unlikely to reduce the number of late payments due to lack of available funds, but the use of automatic bill payment could help to significantly reduce the number of late payments that are due to forgetfulness or lack of time. To estimate the potential reduction in the number of people that will make late payments due to increased use of digital payments, RT assumed the following:

- 42 percent of late payments are due to lack of available funds at the time payment is due and as such, the use of automatic digital bill payment will not reduce this amount.

*Table 2.20: Average Late Payment Amounts by City*

| City | Average Late Payment Amount |
|---|---|
| Chicago | $38.12 |
| Bangkok | $20.94 |
| Lagos | $22.78 |
| Sao Paulo | $27.84 |
| Stockholm | $30.76 |
| Tokyo | $24.21 |

[24]Citi Simplicity Says Goodbye to Frustration of Late Fees in New Advertising Campaign. (2013, May 14). Citigroup. Retrieved from http://www.citigroup.com/citi/news/2013/130514a.htm

- The remaining 58 percent of late payments are due to forgetfulness and people being too busy. Of those, RT assumed that a baseline of 10 percent will continue to occur.
- To estimate the reduction in late payments that could occur under the achievable cashless scenario, RT multiplied the remaining late payment proportion by the ratio of the average digital payment maturity score for each age cohort under the achievable cashless scenario to the maximum digital payment maturity score.

RT estimated the current number of late payments by age cohort using the data in Table 2.19 coupled with the population of each age cohort (see Table 2.8).

RT calculated the cost of the late payments using data from the survey, on the average cost of each late payment.[25] Table 2.20 summarizes the average late payment costs per city.

## 2.6 Reduced Crime

Cash often plays a critical role in fueling street crime, with most street crime (larceny, burglary, and robbery) being motivated by the need for cash. Cash is necessary for functioning of the illicit and illegal markets, and most street crime activities are driven by the need for cash to be able to participate in the market. As such, any reduction in the amount of cash in circulation could result in a concomitant reduction in street crime.[26]

### Methodology

As part of the survey, RT asked respondents if they or a member of their immediate family had been a victim of a crime where cash was stolen[27] (Table 2.21). RT used the response to this question to estimate the cash-related crime rate for each age cohort and city. RT focused on cash-related crime rate for each city, rather than the overall crime rate because it is the cash-related crimes that could most likely to be impacted by a reduction in amount of cash in the economy.

RT calculated the total number of baseline cash-related crime victims by multiplying the crime rate in Table 2.21 by the number of households in each city (Table 2.22). In order to estimate the potential reduction in the number of cash-related crime, RT assumed that the crime rate was reduced by the ratio of the achievable cashless digital payment maturity score for each age cohort, to the maximum digital payment maturity score (18) (see Table 2.12). RT further assumed that there would continue to be a baseline level of crime that would occur, regardless of the level of digital payments use. For the purposes of this analysis the, the baseline level of crime was assumed to be 10%. Tables 2.23 summarizes the crime reductions by scenario.

*Table 2.21: Average Annual Cash-related Crime Rate by City*

| City | Crime Rate |
|---|---|
| Chicago | 2.3% |
| Bangkok | 10.5% |
| Lagos | 11.1% |
| Sao Paulo | 10.2% |
| Stockholm | 4.1% |
| Tokyo | 0.6% |

*Table 2.22: Total Households by City*

| City | Households |
|---|---|
| Chicago | 3,535,000 |
| Bangkok | 2,412,000 |
| Lagos | 5,837,500 |
| Sao Paulo | 6,783,000 |
| Stockholm | 1,224,000 |
| Tokyo | 17,299,000 |

[25] Consumer Survey Q16. In a given year, how much do you pay in late payment fees?

[26] Wright, Richard and Tekin, Erdal et al; "Less Cash, Less Crime: Evidence from the Electronic Benefit Transfer Program." NBER Working Paper No. 19996; Web; March 2014. http://www.nber.org/papers/w19996

[27] Question 25: Have you or anyone in your immediate family been a victim of a crime where cash was stolen over the last three years?

*Table 2.23: Achievable Cashless Scenario: Cash-related Crime Reduction*

| | Chicago | Bangkok | Lagos | Sao Paulo | Stockholm | Tokyo |
|---|---|---|---|---|---|---|
| Baseline Crimes | 82,200 | 252,500 | 648,600 | 695,000 | 49,800 | 103,200 |
| Achievable Cashless Reduction | 74,000 | 185,200 | 404,000 | 586,900 | 43,400 | 75,700 |

Savings from reduced incidences of cash-related crime was calculated by multiplying the projected reduction in crimes under the achievable cashless scenario, by the costs of cash-related crime. Crime generates substantial costs to society at the individual, community, and national levels.

The costs of crime can be divided into the following categories:

- **Victim Costs.** Direct economic losses suffered by crime victims, including medical care costs, lost earnings, and property loss/damage.
- **Pain and Suffering.** The pain and suffering, decreased quality of life, and psychological distress costs associated with being a victim of a crime.
- **Criminal Justice System Costs.** Local, state, and federal government funds spent on police protection, legal and adjudication services, and corrections programs, including incarceration.
- **Crime Career Costs.** The opportunity costs associated with the criminal's choice to engage in illegal, rather than legal and productive activities.

For the purposes of this analysis, RT only considered the victim costs and the pain and suffering costs.[28] McCollister et al. (2010)[29] calculated the crime costs associated with number of different crimes ranging from murder to fraud and embezzlement. For the purposes of this analysis, RT focused on the following crime type: robbery, stolen property, household burglary, and larceny/theft (Table 2.24). Table 2.25 presents the weights that were used to calculate the weighted average crime costs.

*Table 2.24: Crime Costs by Crime Type*

| | Crime Victim Costs | Criminal Justice Costs | Crime Career Costs | Pain and Suffering | Total |
|---|---|---|---|---|---|
| Robbery | $3,299 | $13,287 | $4,272 | $4,976 | $25,834 |
| Stolen Property | | $6,842 | $1,132 | | $7,974 |
| Household Burglary | $1,362 | $4,127 | $681 | | $6,170 |
| Larceny/Theft | $480 | $2,879 | $163 | | $3,522 |
| Average Costs | $1,714 | $6,784 | $1,562 | $4,976 | $10,875 |

[28] RT included the criminal justice system cost savings as part of the government benefits.

[29] McCollister, K. et al. (2010, April 1). The Cost of Crime to Society: New Crime-Specific Estimates for Policy and Program Evaluation. Drug Alcohol Depend. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2835847/

*Table 2.25: Crime Weights*

| City | Weight |
|---|---|
| Robbery | 0.2 |
| Stolen Property | 0.2 |
| Household Burglary | 0.3 |
| Larceny/Theft | 0.3 |

The cost of crime is likely to vary across cities due to differences in costs as well as incomes across cities. The McCollister et al., data is specific to the United States. RT adjusted costs across cities using the ratio of the US income to the income in the given city. Tables 2.26 through 2.31 summarize the adjusted crime costs fo each city.

*Table 2.26: Chicago Crime Costs*

| | Crime Victim Costs | Criminal Justice Costs | Crime Career Costs | Pain and Suffering | Total |
|---|---|---|---|---|---|
| Robbery | $1,090 | $4,389 | $1,411 | $1,644 | $8,533 |
| Stolen Property | $0 | $1,507 | $249 | $0 | $1,756 |
| Household Burglary | $300 | $909 | $150 | $0 | $1,359 |
| Larceny/Theft | $159 | $951 | $54 | $0 | $1,163 |
| Average Costs | $1,548 | $7,755 | $1,864 | $1,644 | $12,811 |

*Table 2.27: Bangkok Crime Costs*

| | Crime Victim Costs | Criminal Justice Costs | Crime Career Costs | Pain and Suffering | Total |
|---|---|---|---|---|---|
| Robbery | $103 | $415 | $134 | $156 | $808 |
| Stolen Property | $0 | $143 | $24 | | $166 |
| Household Burglary | $28 | $86 | $14 | | $129 |
| Larceny/Theft | $15 | $90 | $5 | | $110 |
| Average Costs | $147 | $734 | $176 | $156 | $1,213 |

*Table 2.28: Lagos Crime Costs*

| | Crime Victim Costs | Criminal Justice Costs | Crime Career Costs | Pain and Suffering | Total |
|---|---|---|---|---|---|
| Robbery | $55 | $223 | $72 | $83 | $433 |
| Stolen Property | $0 | $76 | $13 | | $89 |
| Household Burglary | $15 | $46 | $8 | | $69 |
| Larceny/Theft | $8 | $48 | $3 | | $59 |
| Average Costs | $79 | $394 | $95 | $83 | $650 |

*Table 2.29: Sao Paulo Crime Costs*

| | Crime Victim Costs | Criminal Justice Costs | Crime Career Costs | Pain and Suffering | Total |
|---|---|---|---|---|---|
| Robbery | $1,293 | $5,208 | $1,674 | $1,950 | $10,126 |
| Stolen Property | $0 | $1,788 | $296 | | $2,084 |
| Household Burglary | $356 | $1,078 | $178 | | $1,612 |
| Larceny/Theft | $188 | $970 | $64 | | $1,222 |
| Average Costs | $1,837 | $9,044 | $2,212 | $1,950 | $15,043 |

*Table 2.30: Stockholm Crime Costs*

| | Crime Victim Costs | Criminal Justice Costs | Crime Career Costs | Pain and Suffering | Total |
|---|---|---|---|---|---|
| Robbery | $705 | $2,841 | $913 | $1,064 | $9,286 |
| Stolen Property | $0 | $975 | $161 | $0 | $1,137 |
| Household Burglary | $194 | $588 | $97 | $0 | $925 |
| Larceny/Theft | $103 | $616 | $35 | $0 | $755 |
| Average Costs | $1,002 | $5,020 | $1,207 | $1,064 | $12,102 |

*Table 2.31: Tokyo Crime Costs*

| | Crime Victim Costs | Criminal Justice Costs | Crime Career Costs | Pain and Suffering | Total |
|---|---|---|---|---|---|
| Robbery | $744 | $2,996 | $573 | $668 | $4,981 |
| Stolen Property | | $1,543 | $152 | | $1,695 |
| Household Burglary | $461 | $1,396 | $137 | | $1,994 |
| Larceny/Theft | $162 | $974 | $33 | | $1,169 |
| Average Costs | $1,367 | $6,909 | $895 | $668 | $9,838 |

## 2.7 Float Benefits

Digital payment methods provide people with a means to access funds in an emergency, by either providing them with credit (credit cards) or with a means to access the money in their bank accounts (debit cards). Without a means to access funds in emergency situations, individuals could be forced to keep a store of cash on hand. By keeping money at home and not in a bank, individuals could miss out on potential interest income that they could earn on the money.

### Methodology

As part of the survey, RT asked respondents how much money they typically have in their wallet or purse, and how much they keep at home.[30] RT assumed that the money in their wallet or purse is for use for everyday transactions, while the money that is kept at home is for emergency purposes. Using survey data, for each age cohort and city, RTthe amount of money that an average person kept at their house (Table 2.32).

*Table 2.32: Average Amount of Cash Kept at Home by Age Cohort and City*

| | Chicago | Bangkok | Lagos | Sao Paulo | Stockholm | Tokyo |
|---|---|---|---|---|---|---|
| 18 to 34 | $352.18 | $11.91 | $43.20 | $160.98 | $69.79 | $809.89 |
| 35 to 50 | $312.34 | $70.45 | $74.07 | $406.07 | $128.76 | $601.62 |
| 51 to 69 | $163.48 | $49.91 | $30.68 | $704.94 | $104.50 | $650.39 |
| 70 and over | $224.79 | $47.92 | $29.46 | $522.73 | $86.67 | $735.45 |

[30]Consumer Survey Q.19: How much cash do you typically carry with you and how much do you keep at home?

If this money was kept in a bank, individuals could potentially earn interest income on the money. However, by keeping the money at home, rather than in a bank, individuals are forgoing this potential interest income. By reducing the need to be able to access a source of cash in an emergency, access to digital payment methods could allow individuals to keep this money in a bank account and thereby, potentially earn interest income on the money.

RT assumed that the number of individuals that would no longer keep an emergency stock of money at home to be equal to the ratio of the average digital payment maturity score under the achievable cashless scenario to maximum digital payment maturity score (Table 2.12).

RT calculated the aggregate amount of cash kept at home by multiplying data in Table 2.32 by the population of each age cohort (Table 2.8). The potential interest revenue was calculated based on the interest rates in Table 2.33.

*Table 2.33: Interest Rates by City*

| City | Interest rates[31] |
|---|---|
| Chicago | 1.05% |
| Bangkok | 2.80% |
| Lagos | 5.00% |
| Sao Paulo | 5.95% |
| Stockholm | 0.56% |
| Tokyo | 0.10% |

## 2.8 Additional Bank Fees

The increased use of digital payments could likely require many of the unbanked individuals in each city to open a bank account. For some individuals this may lead to banking fees that they otherwise would not have incurred.

### Methodology

Using data from the World Bank Financial Inclusion Survey[32], RT estimated the number of individuals in each city that do not currently have a bank account.

The percentage of the population without access to bank account ranges from 0 percent in Stockholm to 56 percent in Lagos (Table 2.34).

*Table 2.34: Percent of Adults with a Bank Account*

| City | Percent of Adults with a Bank Account |
|---|---|
| Chicago | 94% |
| Bangkok | 78% |
| Lagos | 44% |
| Sao Paulo | 68% |
| Stockholm | 100% |
| Tokyo | 97% |

[31] http://www.deposits.org/ Accessed November, 2016

[32] See http://www.worldbank.org/en/programs/globalfindex for additional information.

Under the achievable cashless scenario, RT assumed that bank account penetration rates will reach 95 percent.

The costs associated with increased bank account penetration were calculated by multiplying the number of new bank accounts by the average annual bank account fees (Table 2.35).

*Table 2-35 Average Annual Bank Account Fees*

| | Percent of Adults with a Bank Account | Average Annual Bank Account Fees[33] |
|---|---|---|
| Chicago | 94% | $118.00 |
| Bangkok | 78% | $29.00 |
| Lagos | 44% | $7.00 |
| Sao Paulo | 68% | $7.00 |
| Stockholm | 100% | N/A |
| Tokyo | 97% | N/A |

[33]Data Point: Checking Account Overdraft. (2014, July). Consumer Financial Protection Bureau. Retrieved from http://files.consumerfinance.gov/f/201407_cfpb_report_data-point_overdrafts.pdf

# 3.0 Business Net-Benefit Model

To quantify the business impacts, RT focused on the following impacts:

- Costs associated with processing incoming payments;
- Labor savings associated with processing incoming payments;
- Time savings from consumer point-of-sale transactions;
- Labor savings associated with processing outgoing payments;
- Increased business revenues; and
- Float costs

The net benefits were calculated using a combination of survey data and secondary data, and were calculated separately for firms at different points across the size spectrum. For the purposes of this analysis, RT used the following size definitions:

- Small businesses – less than 20 employees
- Medium businesses – 20 or more employees and less than 50 employees
- Large businesses – 50 or more employees and less than 250 employees
- Very Large businesses – more than 250 employees

### Total Revenue

The first step to estimate each of the impacts was to calculate the total revenue of all the business located in each city.

Based on business survey responses, RT estimated the average revenue per employee. The average revenue per employee was then multiplied by the total number of employees in each city to arrive at an estimate of the total revenue of all the business located in each city (Table 3.1). Table 3.2 summarizes the total revenue by firm size.

*Table 3.1: Total Annual Revenue by City*

| | Revenue per Employee | Total Employment | Total Revenue ( Millions) | City GDP ( Millions) | Ratio of Revenue to GDP |
|---|---|---|---|---|---|
| Chicago | $268,979 | 4,686,900 | $1,260,678 | $582,143 | 2.17 |
| Bangkok | $85,484 | 4,400,100 | $376,139 | $99,946 | 3.76 |
| Lagos | $42,705 | 3,800,000 | $162,279 | $71,979 | 2.25 |
| Sao Paulo | $93,590 | 10,172,000 | $951,995 | $367,308 | 2.59 |
| Stockholm | $321,560 | 1,110,040 | $356,944 | $166,801 | 2.14 |
| Tokyo | $411,840 | 8,860,000 | $3,648,900 | $1,706,749 | 2.14 |

*Table 3.2: Total Annual Business Revenue by Firm size and City (Millions)*

| | Chicago | Bangkok | Lagos | Sao Paulo | Stockholm | Tokyo |
|---|---|---|---|---|---|---|
| Small | $167,216 | $90,769 | $49,091 | $162,707 | $92,390 | $825,334 |
| Medium | $94,024 | $46,973 | $26,434 | $84,770 | $39,044 | $415,290 |
| Large | $170,637 | $130,681 | $86,754 | $167,219 | $73,046 | $751,416 |
| Very Large | $828,801 | $107,716 | | $537,297 | $152,465 | $1,656,869 |
| Total | $1,260,678 | $376,139 | $162,279 | $951,994 | $356,944 | $3,648,909 |

## Digital Payments Transactions

The next step was to estimate the proportion of payments for firms that was conducted through digital methods. The survey asked each firm what percentage of their transactions, both in terms of the number of transactions and the total value of the transactions, came through various payment methods. Tables 3.3 and 3.4 summarize the physical and digital transactions and Figure 3.1 graphs the weighted average of the breakdown between digital and physical transactions.

The weights are based on the distribution of total revenue between firms of different sizes (Table 3.2). Tables 3.5 and 3.6 summarize the distribution of revenue from physical and digital sources, while Figure 3.2 compares the weighted average.

*Table 3.3: Percentage of Physical Transactions by Firm Size and City*

| Physical | Chicago | Bangkok | Lagos | Sao Paulo | Stockholm | Tokyo |
|---|---|---|---|---|---|---|
| Small | 59.5% | 68.8% | 64.2% | 45.9% | 30.6% | 67.9% |
| Medium | 46.2% | 66.7% | 49.1% | 51.6% | 31.0% | 48.8% |
| Large | 43.7% | 50.7% | 49.1% | 40.0% | 31.9% | 47.9% |
| Very Large | 35.8% | 48.8% | | 37.8% | 33.7% | 53.0% |
| Weighted Average | 40.8% | 56.5% | 53.7% | 40.8% | 32.2% | 54.8% |

*Table 3.4: Percentage of Digital Transactions by Firm Size and City*

| Physical | Chicago | Bangkok | Lagos | Sao Paulo | Stockholm | Tokyo |
|---|---|---|---|---|---|---|
| Small | 40.5% | 31.2% | 35.8% | 54.1% | 69.4% | 32.1% |
| Medium | 53.8% | 33.3% | 50.9% | 48.4% | 69.0% | 51.2% |
| Large | 56.3% | 49.3% | 50.9% | 60.0% | 68.1% | 52.1% |
| Very Large | 64.3% | 51.2% | | 62.2% | 66.3% | 47.0% |
| Weighted Average | 59.3% | 43.5% | 46.3% | 59.2% | 67.8% | 45.2% |

*Figure 3.1: Proportion of Digital vs Physical Transactions by City*

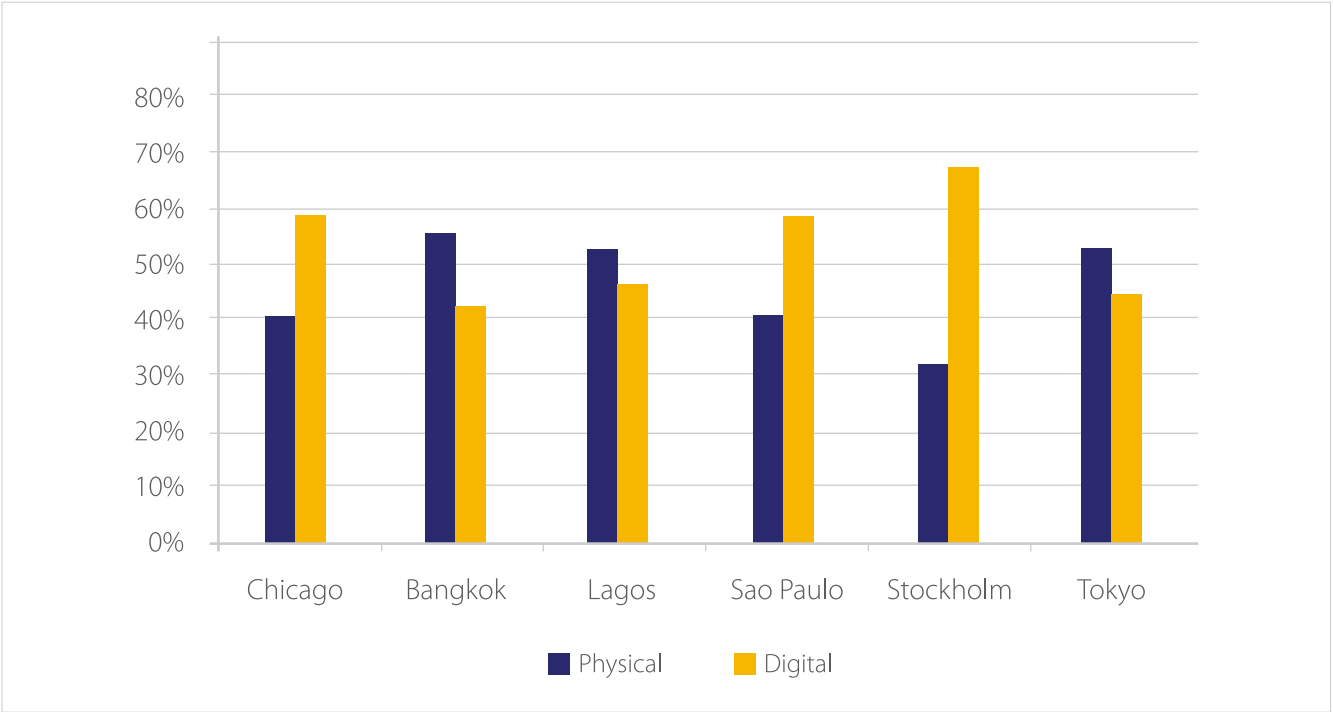


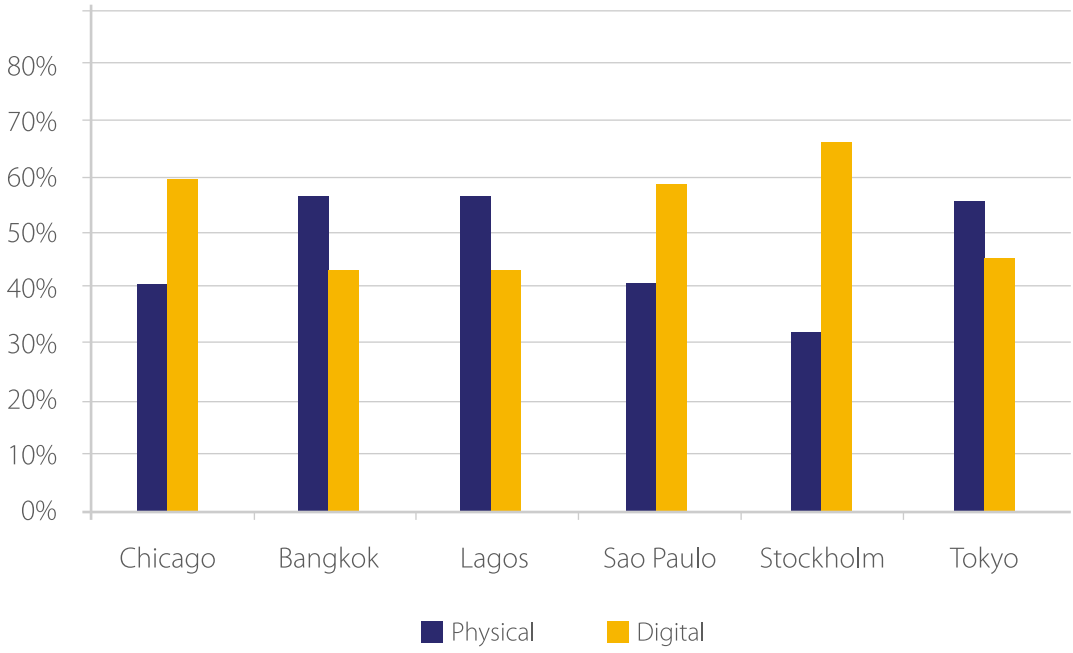
*Table 3.5: Percentage of Physical Revenue by Firm Size and City*

| Physical | Chicago | Bangkok | Lagos | Sao Paulo | Stockholm | Tokyo |
|---|---|---|---|---|---|---|
| Small | 59.5% | 67.9% | 64.6% | 46.2% | 30.6% | 68.5% |
| Medium | 46.1% | 70.2% | 49.4% | 54.1% | 33.3% | 46.2% |
| Large | 41.7% | 50.4% | 54.0% | 39.7% | 32.1% | 48.7% |
| Very Large | 35.9% | 47.5% | 0.0% | 39.0% | 34.9% | 52.9% |
| Weighted Average | 40.6% | 56.3% | 56.5% | 41.7% | 33.0% | 54.8% |

*Table 3.6: Percentage of Digital Revenue by Firm Size and City*

| Digital | Chicago | Bangkok | Lagos | Sao Paulo | Stockholm | Tokyo |
|---|---|---|---|---|---|---|
| Small | 40.5% | 32.1% | 35.4% | 53.8% | 69.4% | 31.5% |
| Medium | 53.9% | 29.8% | 50.6% | 45.9% | 66.7% | 53.8% |
| Large | 58.3% | 49.6% | 46.0% | 60.3% | 67.9% | 51.3% |
| Very Large | 64.1% | 52.5% | 0.0% | 61.0% | 65.1% | 47.1% |
| Weighted Average | 59.5% | 43.7% | 43.5% | 58.3% | 67.0% | 45.2% |

*Figure 3.2: Proportion of Digital vs Physical Revenue by City*




## 3.1 Payment Acceptance Cost Impacts

Using and accepting cash (and checks) could be expensive for businesses and merchants. When businesses handle cash and paper checks, they could potentially suffer losses from shrinkage through employee theft, inaccurate cash handling, check fraud, and expensive procedures required to minimize these losses. Businesses also face costs associated with accepting digital payments; this includes the infrastructure necessary to accept digital payments as well as transaction fees.

### Methodology

The survey asked business the following questions to quantify the costs associated with processing payments received from customers:

- **Question 32:** As a percent of your total revenue, please estimate how much your business spends in a given month on cash and check/money order related fees and expenses. This includes bank processing fees, change fees, third-party transportation costs (if applicable), bank check processing fees, bounced check fees, other check related fees, and equipment for processing cash and check payment.
- **Question 33:** As a percent of your total revenue, how much cash does your business lose to theft, cash register shortages, counterfeit currency, bounced/returned checks, counterfeit money orders, etc. in a given month?
- **Question 35:** As a percent of your total revenue, please estimate how much your business spends in a given month on electronic payments related fees and costs, including costs related to the payment infrastructure, POS terminals and dedicated phone/communications lines and processing fees associated with accepting credit and debit card payments (e.g., fixed monthly fees for network access, any per-transaction fees, and fees based on the value of thetransaction),any fees associated with accepting payment from online eWallet payment platforms (such as Paypal, 2C2P, PagSeguro etc.), and any fees associated with accepting mobile account payments.
- **Question 36:** As a percent of your total revenue, how much does your business lose due to card fraud (skimming, fake cards, etc.) that is not covered by your credit card companies and banks in a given month?

Questions 32 and 33 quantify the costs associated with processing non-digital (i.e. physical) payments and Questions 35 and 36 quantify the costs associated with processing digital payments.

For each survey respondent, RT calculated the baseline non-digital costs by multiplying the non-digital cost percentage by the total revenue. The baseline digital costs were calculated by multiplying the digital cost percentage by the total revenue. RT then estimated the non-digital costs as a percent of non-digital revenue by dividing the non-digital costs by non-digital revenue and similarly, estimated digital costs as a percent of digital revenue by dividing the digital costs by the digital revenue.

The next step was to calculate average non-digital and digital cost percentages by city and company size (Tables 3.7 and 3.8 and Figure 3.3). The cost percentages were then applied to the aggregate non-digital and digital revenue estimates by firm size for each city. The costs were then aggregated to arrive at a total cost for each city.

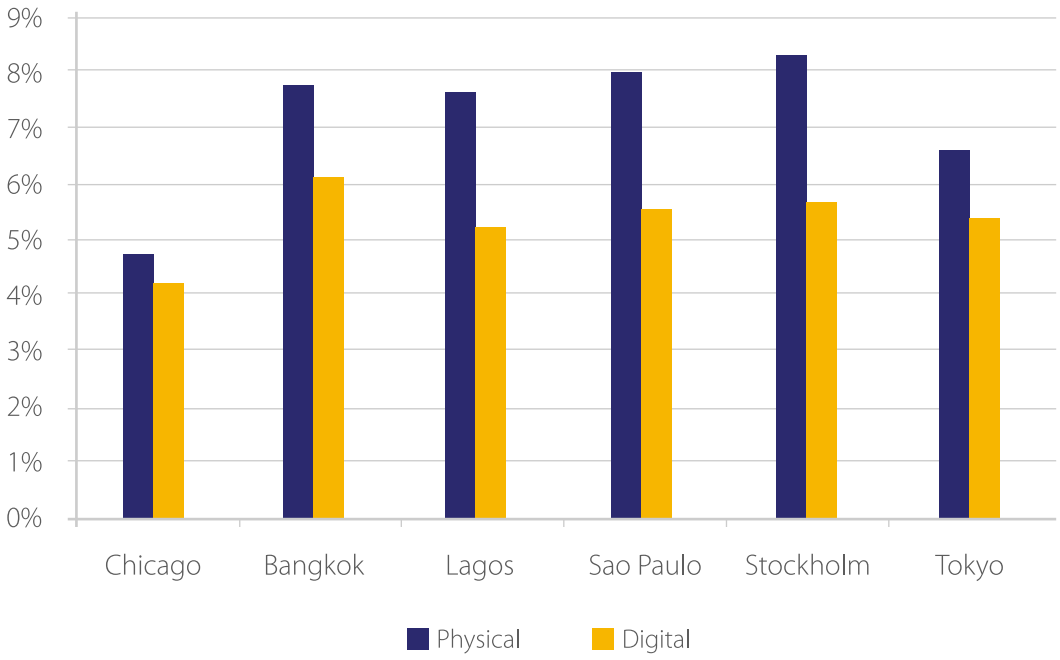
*Table 3.7: Average Non-Digital (i.e. physical) Payment Acceptance Cost Percentages by City and Company Size*

| Non-Digital | Chicago | Bangkok | Lagos | Sao Paulo | Stockholm | Tokyo |
|---|---|---|---|---|---|---|
| 18 to 34 | 2.3% | 5.1% | 6.6% | 7.0% | 8.4% | 6.2% |
| 35 to 50 | 5.0% | 7.7% | 6.6% | 6.8% | 8.4% | 6.2% |
| 51 to 69 | 5.8% | 7.7% | 8.4% | 8.5% | 8.4% | 8.1% |
| 70 and over | 5.0% | 9.9% | | 8.4% | 8.2% | 6.2% |
| Weighted Average | 4.7% | 7.7% | 7.6% | 8.0% | 8.3% | 6.6% |
| Unweighted Average | 5.0% | 7.7% | 7.2% | 8.5% | 8.4% | 6.2% |

*Table 3.8: Average Digital Payment Acceptance Cost Percentage by City and Company Size*

| Digital | Chicago | Bangkok | Lagos | Sao Paulo | Stockholm | Tokyo |
|---|---|---|---|---|---|---|
| 18 to 34 | 2.1% | 5.9% | 4.7% | 5.3% | 5.3% | 5.4% |
| 35 to 50 | 3.6% | 5.9% | 5.3% | 8.0% | 5.3% | 5.4% |
| 51 to 69 | 4.0% | 5.9% | 5.7% | 5.1% | 5.5% | 5.5% |
| 70 and over | 4.8% | 7.0% | | 5.3% | 5.9% | 5.4% |
| Weighted Average | 4.3% | 6.2% | 5.3% | 5.5% | 5.6% | 5.4% |
| Unweighted Average | 3.6% | 5.9% | 5.3% | 5.1% | 5.3% | 5.4% |

*Figure 3.3: Digital and Non-Digital (i.e. physical) Payment Acceptance Cost Comparisons*




The table below provides projections of the proportion of payments received digitally for firms in the achievable cashless scenario. Using these projections, RT adjusted the non-digital/digital revenue distribution and recalculated the associated aggregate costs. The difference between the baseline and the achievable cashless scenario is the estimated cost impact associated with increased usage of digital payments.

Please note that non-digital payment percentage is equal to the 100 minus the digital payment percentage indicated in the table below.

*Table 3.9: Achievable Cashless Scenario Digital Payment Percentage for Businesses*

| Digital Leader | Chicago | Bangkok | Lagos | Sao Paulo | Stockholm | Tokyo |
|---|---|---|---|---|---|---|
| Small | 80.0% | 100.0% | 90.0% | 100.0% | 100.0% | 100.0% |
| Medium | 95.0% | 70.0% | 90.0% | 98.0% | 100.0% | 100.0% |
| Large | 92.0% | 100.0% | 75.0% | 100.0% | 100.0% | 100.0% |
| Very Large | 100.0% | 100.0% | | 100.0% | 100.0% | 100.0% |
| Weighted Average | 96.0% | 96.3% | 82.0% | 99.8% | 100.0% | 100.0% |

## 3.2 Labor Savings from Processing Incoming Payments

RT's survey indicated that businesses spend a considerable amount of time processing payments received from customers. For cash and check payments this includes cash counting and reconciliation, prepping and filling cash registers, preparing deposits, transporting cash and checks to and from the bank, and security monitoring. For credit, debit, and prepaid card payments this includes storing and filing of card signature slips, card reconciliation, checking terminals for security, and dealing with card fraud investigations.

### Methodology

The incoming payments labor impacts calculations were based on the number of transactions processed per full-time-equivalent employees (FTE), estimated from survey data. The first step in the analysis was to calculate the number of annual transactions per million dollars of revenue (Table 3.10).

RT then calculated the total number of transactions (Table 3.11) and the breakdown between non-digital and digital transactions (Tables 3.12 and 3.13), using digital payment transactions percentage as estimated earlier.

*Table 3.10: Number of Payments per Million Dollars of Revenue*

| | Transactions per $1 Million |
|---|---|
| Small | 30,612 |
| Medium | 28,635 |
| Large | 13,495 |
| Very Large | 10,202 |

*Table 3.11: Total Payments Received by City and Company Size Annually*

| Millions of Transactions | Chicago | Bangkok | Lagos | Sao Paulo | Stockholm | Tokyo |
|---|---|---|---|---|---|---|
| Small | 5,118.8 | 2,778.6 | 1,502.8 | 4,980.8 | 2,828.2 | 25,265.1 |
| Medium | 2,692.4 | 1,345.1 | 756.9 | 2,427.4 | 1,118.0 | 11,891.8 |
| Large | 2,302.7 | 1,763.5 | 1,170.8 | 2,256.6 | 985.8 | 10,140.4 |
| Very Large | 8,455.4 | 1,098.9 | 0.0 | 5,481.5 | 1,555.4 | 16,903.4 |
| Total | 18,569.3 | 6,986.2 | 3,430.5 | 15,146.3 | 6,487.5 | 64,200.7 |

*Table 3.12: Total Non-Digital Payments Received by City and Company Size Annually*

| Millions of Transactions | Chicago | Bangkok | Lagos | Sao Paulo | Stockholm | Tokyo |
|---|---|---|---|---|---|---|
| Small | 3045.7 | 1886.7 | 970.8 | 2301.1 | 865.4 | 17306.6 |
| Medium | 1241.2 | 944.3 | 373.9 | 1313.2 | 372.3 | 5494.0 |
| Large | 960.2 | 888.8 | 632.2 | 895.9 | 316.4 | 4938.4 |
| Very Large | 3035.5 | 522.0 | 0.0 | 2137.8 | 542.8 | 8941.9 |
| Total | 8282.6 | 4241.7 | 1976.9 | 6648.0 | 2097.0 | 36680.9 |

*Table 3.13: Total Digital Payments Received by City and Company Size Annually*

| Millions of Transactions | Chicago | Bangkok | Lagos | Sao Paulo | Stockholm | Tokyo |
|---|---|---|---|---|---|---|
| Small | 2,073.1 | 891.9 | 532.0 | 2,679.7 | 1,962.8 | 7,958.5 |
| Medium | 1,451.2 | 400.8 | 383.0 | 1,114.2 | 745.7 | 6,397.8 |
| Large | 1,342.5 | 874.7 | 538.6 | 1,360.7 | 669.4 | 5,202.0 |
| Very Large | 5,419.9 | 576.9 | 0.0 | 3,343.7 | 1,012.6 | 7,961.5 |
| Total | 10,286.7 | 2,744.4 | 1,453.6 | 8,498.3 | 4,390.4 | 27,519.8 |

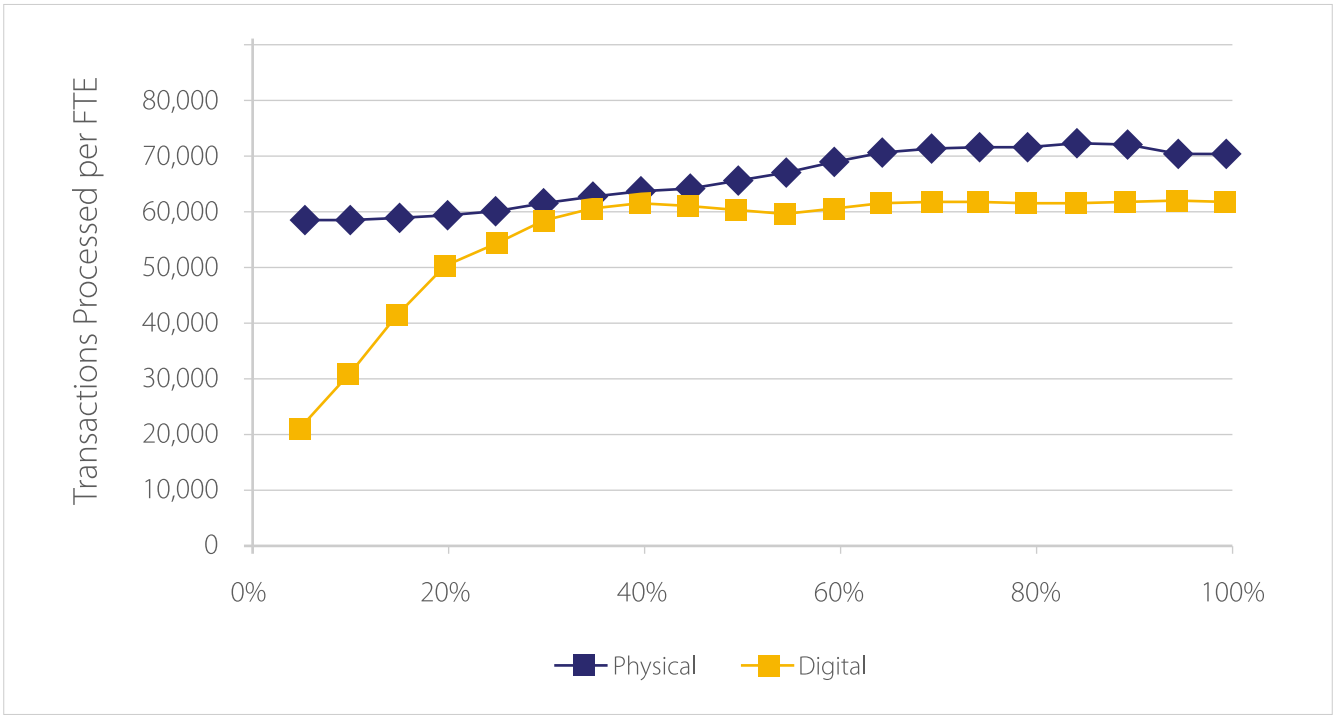
The survey asked each respondent how many hours they spend in a given month processing accounts receivable payments[34] and what percent of the time is spent processing non-digital and digital payments.[35] The total number of annual hours spent processing payments was calculated by multiplying the monthly hours by 12. The annual hours were converted into the number of full-time equivalent employees by dividing the annual hours by 2,000 hours. RT then estimated the number of FTEs required to process non-digital and digital payments.

The next step was to calculate the number of transactions processed per FTE. Based on the survey data, number of transactions that got processed per employee exhibited economies of scale - as the percentage of transactions that are digital or non-digital increased, the number of transactions processed increased. In other words, employees are able to process more transactions as the number of transactions increases. Figure 3.4 summarizes the relationship between percentage of transactions and the number of transactions processed per FTE.

[34]Question 29: Please estimate the total amount of time spent by all of your employees (including yourself) on processing payments in a given month from all payment methods.

[35]Question 30: Please estimate what percent of time is spent processing each of the following payment types. Please provide percentages adding to 100%.

*Figure 3.4: Payments Processed per FTE*




For each company size category, RT used the data on the average percentage of non-digital (and digital) transactions, the number of transactions processed per FTE (Figure 3.4), and number of non-digital and digital transactions to calculate the baseline aggregate incoming payments employment.

The aggregate incoming payments employment for achievable cashless scenario was calculated by modifying the distribution of transactions across payment methods, using the estimated data in Table 3.9. The labor savings are equal to the difference between the baseline aggregate employment and the scenario aggregate employment. RT quantified the value of these time savings by multiplying the aggregate time savings by the average hourly wage in each city.

## 3.3 Time Savings from Consumer Point of Sale Transactions

Point-of-sale payments could account for considerable labor costs for consumer businesses. Most businesses accept a variety of payment instruments, with each payment method having a different time efficiency associated with it. To estimate the potential benefits generated for businesses from consumers using more digital payment methods, RT used survey data on the usage of payment methods by consumers, and secondary data to estimate the number of transactions, as well as the time associated with using each method.

### Methodology

The first step in the analysis was to calculate the total number of consumer transactions. Based on research from the European Central Bank and Federal Reserve Bank of Boston, the average number of annual per-capita consumer transactions was estimated at 633 transactions (Refer to table 2.13).

The aggregate number of transactions was calculated by multiplying the average number of annual transactions per-capita (633) by the adult population in each city.

Tables 3.14 and 3.15 summarize the breakdown of consumer transactions by different payment methods in percentage terms and in terms of the number of transactions. The percentages were estimated specifically for each city and based on data from the business survey for consumer-focused industries.[36]

*Table 3.14: Consumer Transactions by Payment Type*

| | Chicago | Bangkok | Lagos | Sao Paulo | Stockholm | Tokyo |
|---|---|---|---|---|---|---|
| Non-digital | 42.0% | 59.5% | 52.6% | 33.5% | 34.2% | 61.8% |
| Debit and Credit Card | 33.4% | 12.9% | 15.6% | 28.6% | 31.0% | 13.3% |
| Contactless | 18.3% | 16.1% | 16.2% | 24.3% | 26.5% | 14.8% |
| Mobile | 6.3% | 11.5% | 15.6% | 13.6% | 8.4% | 10.1% |

*Table 3.15: Total Consumer Transactions by Payment Type and City Annually*

| | Non-Digital | Debit and Credit Cards | Contactless | Mobile | Total |
|---|---|---|---|---|---|
| Chicago | 2,544,095,500 | 2,025,078,600 | 1,112,146,200 | 383,093,700 | 6,064,414,000 |
| Bangkok | 4,008,517,700 | 872,847,300 | 1,083,261,200 | 776,424,700 | 6,741,051,000 |
| Lagos | 6,995,641,800 | 2,072,157,700 | 2,156,735,500 | 2,067,678,000 | 13,292,213,000 |
| Sao Paulo | 4,503,676,800 | 3,841,667,300 | 3,265,214,000 | 1,825,336,900 | 13,435,895,000 |
| Stockholm | 520,789,200 | 472,699,500 | 403,968,700 | 127,349,500 | 1,524,807,000 |
| Tokyo | 14,657,618,600 | 3,148,264,400 | 3,514,729,100 | 2,406,619,900 | 23,727,232,000 |

The baseline aggregate transaction time was estimated by multiplying the number of transactions by payment method (Table 3.15), by the transaction time per second for each payment method (Table 3.16).[37]

[36]Consumer-focused industries included: Retail Trade, Arts, Entertainment, Recreation, Accommodations and Food Services, and Other Services.

[37]Transaction times based on report from First Data (https://www.firstdata.com/downloads/thought-leadership/contactless-payments-benefits.pdf).

The baseline aggregate transaction time was estimated by multiplying the number of transactions by payment method (Table 3.15), by the transaction time per second for each payment method (Table 3.16).[28]

To quantify the time associated with non-digital transactions, a weighted average of cash and check/money order was used. The weights were based on the distribution of cash and check/money order usage in each city based on data from the business survey and specific for each city.

As such, the non-digital transaction times varied between cities (Table 3.17).

*Table 3.16: Average Transaction Time (in Seconds) by Payment Type[38]*

| | Time per Transaction (Seconds) |
|---|---|
| Cash | 27.9 |
| Check/Money Order | 89.0 |
| Credit/Debit Card | 28.9 |
| Contactless | 12.5 |
| Mobile Payment | 12.5 |

*Table 3.17: Non-digital Transaction Time (in Seconds) by Payment Type*

| | Weights | | | Seconds per Transaction | | | |
|---|---|---|---|---|---|---|---|
| | Cash | Check | Money Order | 27.85 Cash | 89 Check | 89 Money Order | Total |
| Chicago | 57.5% | 27.3% | 15.2% | 16.01 | 24.32 | 13.51 | 53.84 |
| Bangkok | 72.4% | 15.6% | 12.0% | 20.16 | 13.90 | 10.69 | 44.74 |
| Lagos | 82.3% | 17.7% | 0.0% | 22.93 | 15.72 | 0.00 | 38.65 |
| Sao Paulo | 54.2% | 9.0% | 36.8% | 15.09 | 8.04 | 32.75 | 55.87 |
| Stockholm | 78.9% | 9.6% | 11.4% | 21.98 | 8.59 | 10.18 | 40.74 |
| Tokyo | 74.2% | 17.0% | 8.8% | 20.66 | 15.16 | 7.82 | 43.64 |

The aggregate transaction time for achievable cashless scenario was calculated by modifying the distribution of transactions across payment methods and recalculating the transaction time, based on Table 3.9. The transaction time savings was calculated by taking the difference between the baseline aggregate transaction time and the achievable cashless scenario aggregate transaction time. RT quantified the value of these time savings by multiplying the aggregate time savings by the average hourly wage in each city.

[38]It is noted that digital payments, on average have lower transaction times as compared to physical money. Over the next few years, it is expected that mobile and contactless payments usage will increase, further reducing transaction times for digital payments.

## 3.4 Labor Savings from Processing Outgoing Payments

RT estimated the net labor impacts associated with processing outgoing payments using non-digital and digital methods.

### Methodology

The outgoing payments labor impacts calculations are based on the number of transactions processed per full-time-equivalent employee (FTE). The first step in the analysis was to estimate the number of transactions per million dollars of revenue (Table 3.18) using survey data and then calculate the total number of transaction (Table 3.19).

*Table 3.18: Outgoing Payments Transactions per Million Dollars of Revenue Annually*

| | Transactions per Million |
|---|---|
| Chicago | 353.1 |
| Bangkok | 388.1 |
| Lagos | 345.9 |
| Sao Paulo | 160.4 |
| Stockholm | 360.2 |
| Tokyo | 205.7 |

*Table 3.19: Total Outgoing Payments Transactions by City and Company Size Annually*

| Millions of Transactions | Chicago | Bangkok | Lagos | Sao Paulo | Stockholm | Tokyo |
|---|---|---|---|---|---|---|
| Small | 59.0 | 35.2 | 17.0 | 26.1 | 33.3 | 169.8 |
| Medium | 33.2 | 18.2 | 9.1 | 13.6 | 14.1 | 85.4 |
| Large | 60.2 | 50.7 | 30.0 | 26.8 | 26.3 | 154.6 |
| Very Large | 292.6 | 41.8 | 0.0 | 86.2 | 54.9 | 340.8 |
| Total | 445.1 | 146.0 | 56.1 | 152.7 | 128.6 | 750.6 |

The next step was to estimate the number of non-digital and digital outgoing payments transactions. Survey data was used to estimate the proportion of accounts payable transactions that were paid using non-digital methods (Table 3.20) and the proportion paid using digital methods (Table 3.21).

*Table 3.20: Non-digital Outgoing Payments Transactions Percentage by City and Company Size*

| Non-digital | Chicago | Bangkok | Lagos | Sao Paulo | Stockholm | Tokyo |
|---|---|---|---|---|---|---|
| Small | 52.1% | 63.5% | 60.3% | 40.8% | 17.5% | 67.9% |
| Medium | 48.3% | 71.0% | 50.7% | 53.3% | 31.9% | 52.3% |
| Large | 43.7% | 58.0% | 46.6% | 38.6% | 37.3% | 52.5% |
| Very Large | 40.9% | 40.9% | | 38.0% | 34.8% | 53.5% |
| Weighted Average | 43.3% | 56.1% | 51.4% | 39.9% | 30.5% | 56.4% |

*Table 3.21: Digital Outgoing Payments Transactions Percentage by City and Company Size*

| Digital | Chicago | Bangkok | Lagos | Sao Paulo | Stockholm | Tokyo |
|---|---|---|---|---|---|---|
| Small | 47.9% | 36.5% | 39.7% | 59.2% | 82.5% | 32.1% |
| Medium | 51.7% | 29.0% | 49.3% | 46.7% | 68.1% | 47.7% |
| Large | 56.2% | 42.0% | 53.4% | 61.4% | 62.7% | 47.5% |
| Very Large | 54.6% | 59.1% | | 62.0% | 65.2% | 46.5% |
| Weighted Average | 53.7% | 43.9% | 48.6% | 60.1% | 69.5% | 43.6% |

RT used data from the 2014 Accounts Payable Benchmark report commissioned by Acumen Data Pty Ltd.[39] to estimate the number of accounts payable transactions per FTE. Based on a survey of approximately 1,500 firms over the 2011-2013 period, the survey calculated the number of transactions per FTE for three different levels of accounts payable automation, as defined in the 2014 Accounts Payable Benchmark Report.

RT assumed that non-digital transactions are equivalent to category 1 and digital transactions are equivalent to an average of categories 2 and 3. Table 3.22 summarizes the results of the benchmark survey and Table 3.23 calculates the transactions per FTE used in the analysis for this Study.

[39]Acumen Data Accounts Payable Benchmark report 2014: Australia and New Zealand http://www.accountspayable.net.au/accounts-payable-benchmark-report-2014/

*Table 3.22: Accounts Payable Transactions per FTE by Level of Accounts Payable Automation*

| | 2013 | 2012 | 2011 | |
|---|---|---|---|---|
| Degree of Automation | AP transactions/ month/employee | AP transactions/ month/employee | AP transactions/ month/employee | Average |
| 1 | 640 | | 593 | 616.5 |
| 2 | 1,014 | 1,093 | 1,209 | 1,105.3 |
| 3 | 3,402 | 2,344 | 2,492 | 2,746.0 |

For each company size category, RT used the data on the number of transactions processed per FTE (Table 3.23), and number of non-digital and digital transactions (Tables 3.20 and 3.21) to calculate the baseline aggregate outgoing payments employment.

*Table 3.23: Accounts Payable Transactions per FTE for Digital and Non-digital Payments*

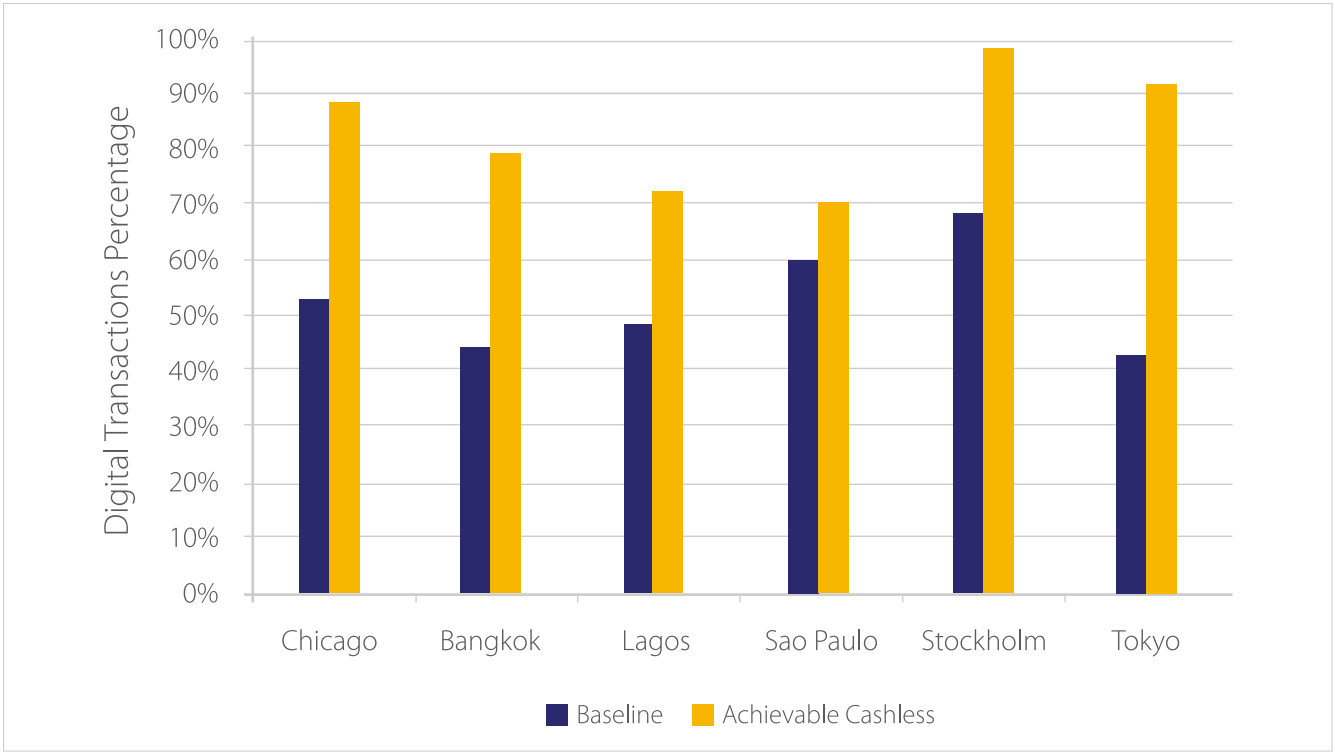
| | Transaction per FTE |
|---|---|
| Non-Digital | 7,400 |
| Digital | 23,100 |

The aggregate outgoing payments employment for achievable cashless scenario was estimated by modifying the distribution of transactions across payment methods Table 3.24 to reflect digital payments use by top 10% users in each city. The labor savings are equal to the difference between the baseline aggregate employment and the achievable cashless scenario aggregate employment. RT quantified the value of these time savings by multiplying the aggregate time savings by the average hourly wage in each city.

*Table 3.24: Achievable Cashless Scenario Outgoing Payments Digital Payment Percentage for Businesses*

| Outgoing Payments | Chicago | Bangkok | Lagos | Sao Paulo | Stockholm | Tokyo |
|---|---|---|---|---|---|---|
| Small | 100.0% | 75.0% | 80.0% | 1.0% | 100.0% | 100.0% |
| Medium | 98.0% | 60.0% | 70.0% | 70.0% | 100.0% | 70.0% |
| Large | 90.0% | 85.0% | 70.0% | 90.0% | 100.0% | 80.0% |
| Very Large | 85.0% | 80.0% | | 83.0% | 96.0% | 100.0% |
| Weighted Average | 88.6% | 78.0% | 73.0% | 69.1% | 98.3% | 92.5% |

*Figure 3.5: Outgoing Payments Digital Transaction Percentage by City*




## 3.5 Float Costs

When a business receives cash, usually, it is immediately available for use. However, that may not be the case with other payment methods. For example, it may take a few days from when a check is deposited, for it to become available for use by the businesses, or it may take a few days between the time that a credit card transaction is completed and the funds are available in the businesses' bank account. This delay may cost businesses money and is referred in this study as float.

### Methodology

As part of the business survey,[40] RT asked businesses how long it takes from the time that the business receives payment to when it is available for use by the business. Table 3.25 summarizes the average float time for each city by payment type.

[40]Question 38: On average, how long does it take (in days) for each of the following payment methods to go from the time you accept the payment until the time when the funds are available in your bank account?

*Table 3.25: Average Float Days by Payment Type and City*

| | Chicago | Bangkok | Lagos | Sao Paulo | Stockholm | Tokyo |
|---|---|---|---|---|---|---|
| Cash | 1.20 | 1.73 | 0.61 | 2.03 | 2.72 | 1.21 |
| Check | 2.27 | 2.56 | 2.97 | 2.75 | 2.88 | 2.79 |
| Money Order | 2.00 | 2.01 | 1.95 | 2.10 | 2.65 | 2.02 |
| Debit Card | 2.07 | 2.03 | 1.40 | 2.38 | 2.63 | 1.75 |
| Credit Card Stored | 2.77 | 2.32 | 1.59 | 3.25 | 2.77 | 2.33 |
| Value Card | 1.17 | 1.41 | 2.02 | 2.50 | 2.71 | 2.09 |
| Mobile Transaction | 1.66 | 1.69 | 0.82 | 2.01 | 1.49 | 1.42 |
| Wire Transfer | 2.09 | 2.26 | 1.89 | 2.48 | 2.89 | 1.76 |

The delay in receiving payment could generate costs for businesses in the form of foregone interest revenue. The shorter the amount of time that it takes for a business to receive their money, the quicker that the money is available for use by the business to support their operations. By reducing the amount of time from when a business receives a payment until it is available in their bank account, accumulated interest could generate greater amounts of revenue for businesses.

RT used survey data to estimate the distribution of revenue across payment methods by firm size and city (see beginning of section 3 for more details), and calculated total float costs. Table 3.26 calculates the average float time by firm size and city. The results are driven by the float time for different payments methods in each city and the distribution of revenues across payment methods. This delay may cost businesses money and is referred in this study as float.

*Table 3.26: Average Float Days by City and Company Size*

| | Chicago | Bangkok | Lagos | Sao Paulo | Stockholm | Tokyo |
|---|---|---|---|---|---|---|
| Small | 1.94 | 1.95 | 1.28 | 2.34 | 2.45 | 1.52 |
| Medium | 2.13 | 2.09 | 1.51 | 2.35 | 2.42 | 1.94 |
| Large | 2.08 | 2.07 | 1.50 | 2.45 | 2.42 | 1.83 |
| Very Large | 2.19 | 2.07 | | 2.35 | 2.34 | 1.88 |
| Weighted Average | 3.1 | 2.7 | 2.2 | 3.3 | 3.4 | 2.3 |

*Figure 3.6: Weighted Average Float Days by City*

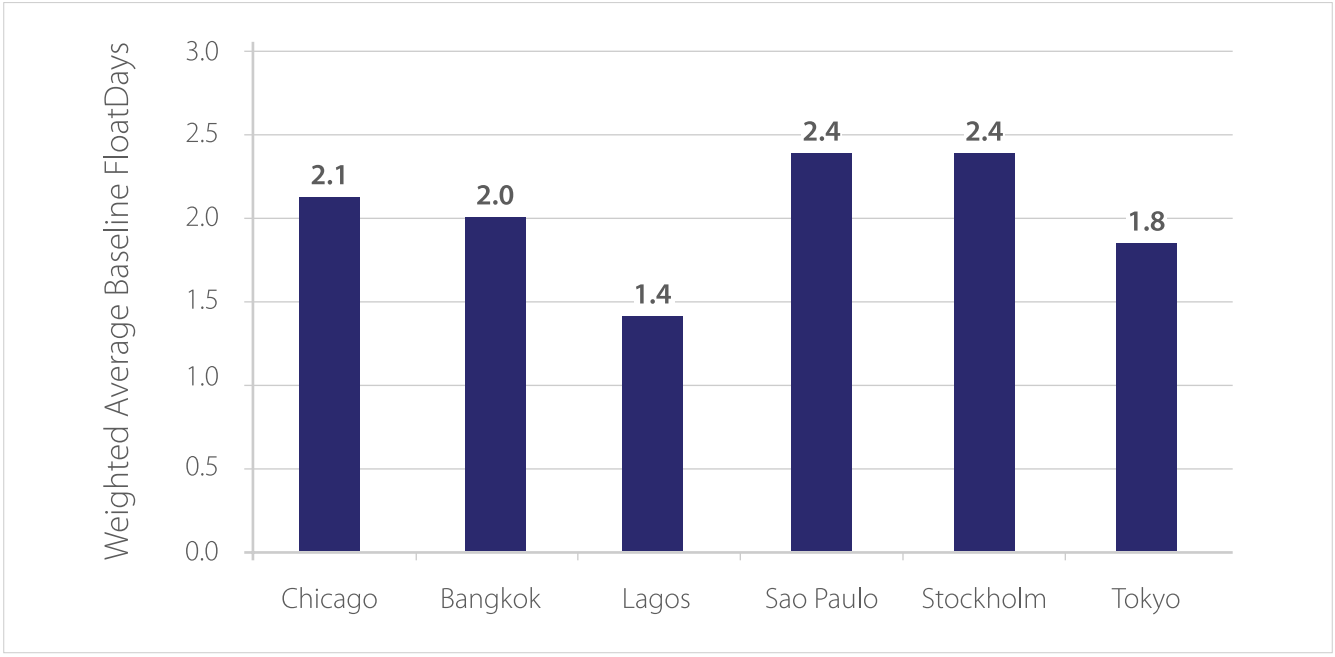
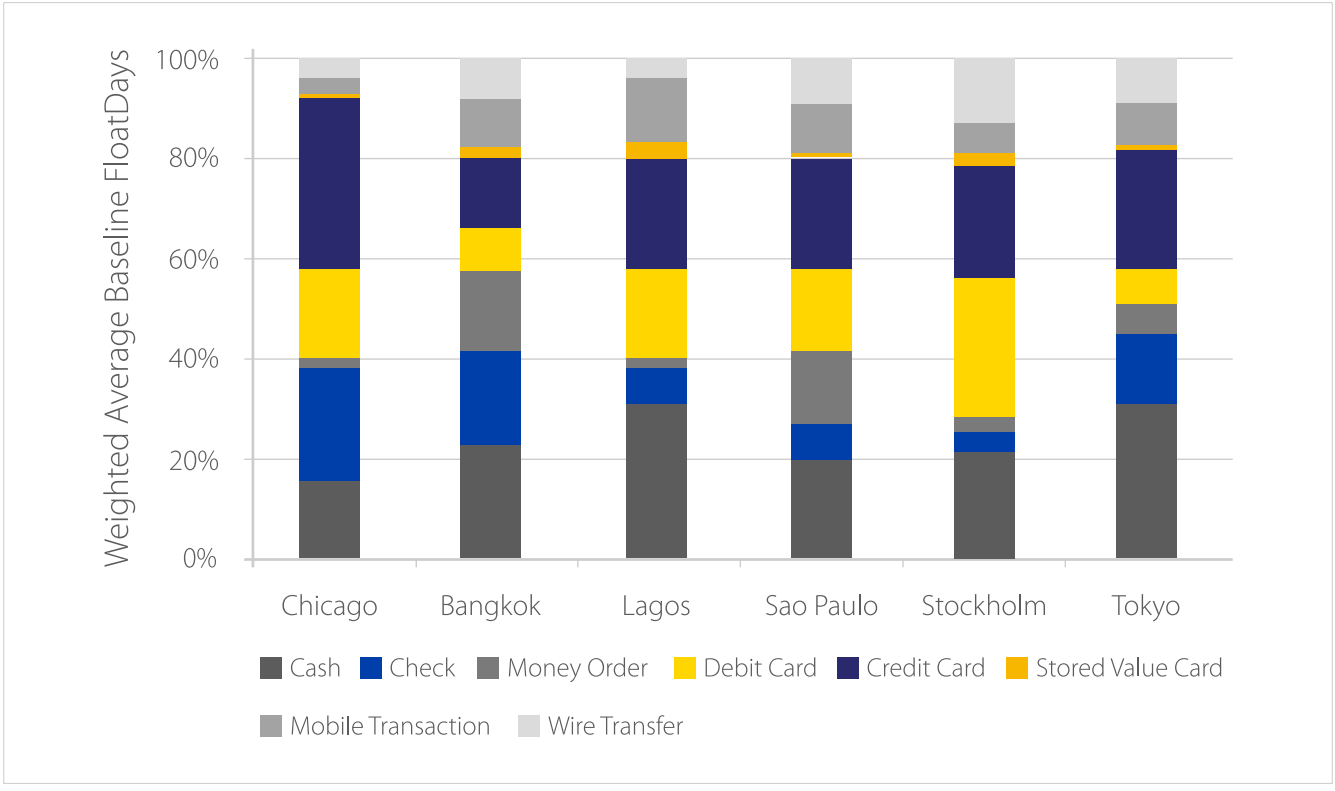



*Figure 3.7: Weighted Average Transactions by City*

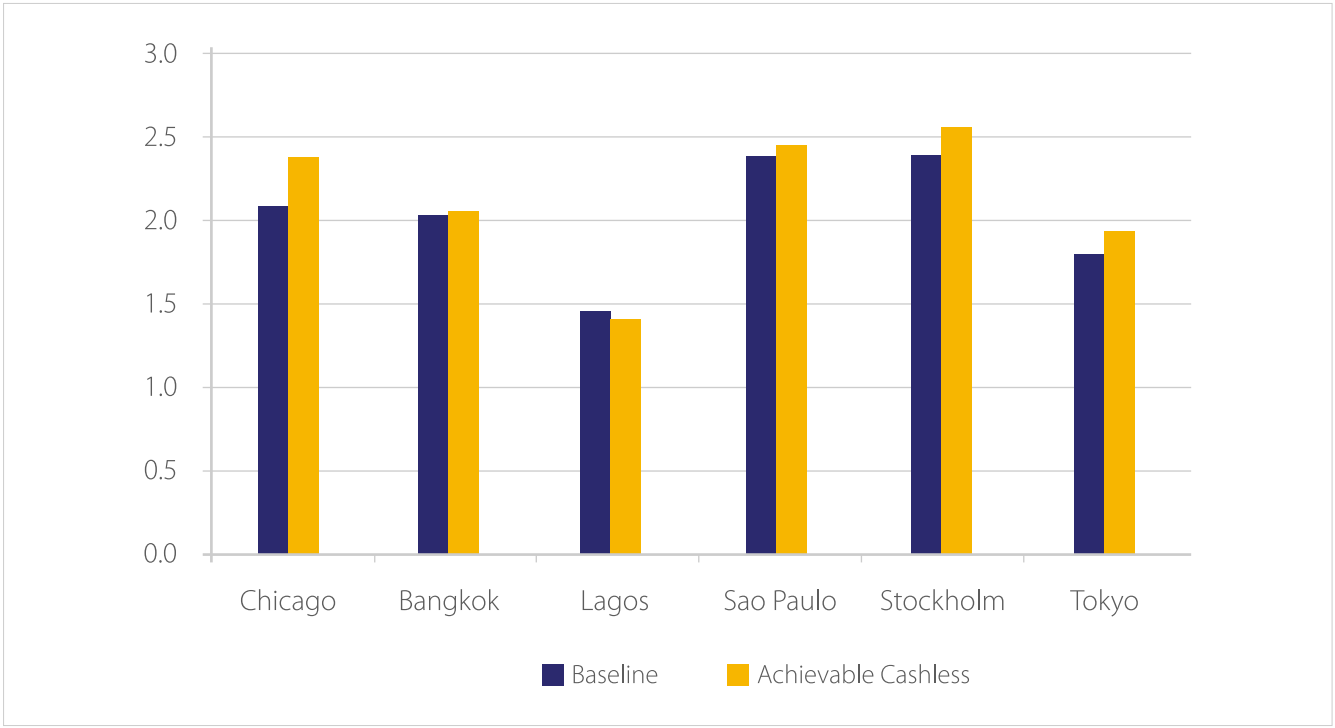


The float cost for achievable cashless scenario was calculated by modifying the distribution of revenue across payment methods and recalculating the interest costs based on the interest rate in each city (Table 3.27). Figure 3.8 summarizes float days under the achievable cashless scenario for each city. Given the fact the float time is longer for digital payment methods compared to non-digital payment methods, one would expect the float time to increase as the proportion of digital payments increase. The total estimated float cost is equal to the difference between the baseline costs and achievable cashless scenario costs.

*Table 3.27: Interest Rates by City*

| | Interest rates [41] |
|---|---|
| Chicago | 1.05% |
| Bangkok | 2.80% |
| Lagos | 5.00% |
| Sao Paulo | 5.95% |
| Stockholm | 0.56% |
| Tokyo | 0.10% |

*Figure 3.8: Weighted Average Float Days by City and Scenario*




[41] http://www.deposits.org/ Accessed November 2016

## 3.6 Increased Business Revenues

The acceptance of digital payment methods enables merchants to sell goods and services to consumers that prefer digital payment methods. It also allows businesses to sell their products through online channels outside of their local market, all of which could increase their revenues.

### Methodology

The potential increased revenue from the acceptance of digital payments was calculated based on the experience of firms that recently began to accept (within the last 5 years) digital payments.[42] The first step in the analysis was to estimate the proportion of revenue for firms that do not accept digital payments (Table 3.28). The weighted average was calculated based on the distribution of revenue by company size for each city. RT estimated the amount of revenue from firms[43] that do not currently accept digital payments by multiplying the revenue from each business size category (Table 3.2) by the data in Table 3.28.

*Table 3.28: Proportion of Revenue from Companies that Do Not Currently Accept Digital Payments*

| | Chicago | Bangkok | Lagos | Sao Paulo | Stockholm | Tokyo |
|---|---|---|---|---|---|---|
| Small | 8.0% | 88.7% | 82.1% | 70.5% | 0.0% | 16.2% |
| Medium | 0.6% | 16.4% | 10.2% | 16.1% | 0.0% | 90.9% |
| Large | 0.1% | 0.4% | 0.5% | 18.9% | 0.1% | 3.2% |
| Very Large | 23.6% | 4.7% | | 9.9% | 1.9% | 32.9% |
| Weighted Average | 16.7% | 24.9% | 26.8% | 22.4% | 0.8% | 29.6% |

Not all industries are likely to experience an increase in revenue as a result of beginning to accept digital payments. For example, a manufacturing firm is not likely to see an increase in revenue as a result of beginning to accept digital payments, while a retailer may be able to attract customers that prefer to use digital payments, which could lead to an increase in revenue. For the purposes of this analysis, RT assumed that firms in the following industries are likely to experience an increase in revenue as a result of accepting digital payments:

- Retail Trade
- Arts, Entertainment, and Recreation
- Accommodations and Food Services
- Other Services

Table 3.29 summarizes the percentage of revenue from each business size category that is from one of the target industries. Table 3.30 presents the weighted average for each city. The revenue that is likely to see an increase as a result of digital payments was calculated by multiplying the revenue from firms that do not currently accept digital payments (Table 3.28) by the data in Table 3.30.

[42]Question 23: When did you first start accepting electronic payments (e.g., credit card, debit card, stored-value card, mobile payment account, etc.)?

[43]RT excluded data from enterprise firms, which is defined as firms with more than 1,000 employees.

*Table 3.29: Percent of Revenue from Industries Likely to See an Increase from Digital Payments by Company Size*

| | Percent of Revenue From Key Industries |
|---|---|
| Small | 37.0% |
| Medium | 51.5% |
| Large | 26.0% |
| Very Large | 7.6% |

*Table 3.30: Weighted Percent of Revenue from Industries Likely to See an Increase from Digital Payments by City*

| | Percent of Revenue from Key Industries |
|---|---|
| Chicago | 17.3% |
| Bangkok | 26.6% |
| Lagos | 37.6% |
| Sao Paulo | 19.8% |
| Stockholm | 23.8% |
| Tokyo | 23.1% |

For firms that began to accept digital payments within the last 5 years, the survey asked businesses how their revenue changed as a result of beginning to accept digital payments.[44] Table 3.31 summarizes the average increase in revenue as a result of accepting digital payments. To account for the fact that under a given scenario, not all revenue will become digital, RT adjusted the data in Table 3.31 by the percentage of revenue from digital payment methods.

The additional business revenue was then converted to increase in economic activity using the revenue to GDP ratio specific to each city.

*Table 3.31: Average Increase in Revenue as a Result of Accepting Digital Payments*

| | Revenue Increase |
|---|---|
| Chicago | 12.8% |
| Bangkok | 12.9% |
| Lagos | 16.3% |
| Sao Paulo | 16.7% |
| Stockholm | 18.2% |
| Tokyo | 9.9% |

# 4.0 Government Net-benefit Model

The use of digital payments could have significant benefits for government. Cash could help fuel the informal economy, which is untaxed and untraceable. This generates costs for government in the form of lost tax revenue. The use of digital payments by governments could help improve transparency and enable the government to strengthen financial controls, minimize fraud, and increase revenue. The processing and handling of cash could also generate significant costs for transit agencies and toll road authorities.

To quantify the government impacts, RT focused on the following impacts:

- Increased government revenue from taxes generated from recapturing the grey economy;
- Increased government revenue from taxes generated from increased growth;
- Increased government revenue from taxes generated from additional business revenue;[45]
- Government efficiency savings;
- Criminal justice cost savings from reduced crime; and
- Toll road and transit agency cost savings.

For the purposes of this analysis, RT uses government to refer collectively to all levels of government (federal, state, and local). The benefits were calculated using a combination of survey data and secondary data.

## 4.1 Increased Government Revenue from recapturing the Grey Economy

The informal economy relies on cash to function. A move to digital payments could reduce the size of the informal economy and boost tax revenue for government.

### Methodology

The first step was to estimate the size of the informal economy in each city, using city GDP data and informal economy measured as a percentage of GDP[46] (Table 4.1).

*Table 4.1: Size of the Informal Economy by City*

| | GDP (Billion) | Informal Economy as % of GDP [47] | Informal Economy (Billion) |
|---|---|---|---|
| Chicago | $582 | 8% | $46 |
| Bangkok | $100 | 43% | $43 |
| Lagos | $72 | 47% | $34 |
| Sao Paulo | $367 | 32% | $119 |
| Stockholm | $167 | 16% | $27 |
| Tokyo | $1,707 | 9% | $157 |

[45]Note that tax revenues stem from both increased business sales as well as increased economic growth. The latter is driven by factors in addition to increased business sales

[46]Schneider, F., & Williams, C. (2013). The Shadow Economy. The Institute of Economic Affairs. Retrieved from https://iea.org.uk/wp-content/uploads/2016/07/IEA%20Shadow%20Economy%20web%20rev%207.6.13.pdf

[47]ibid

The informal economy is comprised of two main components – underground purchases that are undertaken to avoid taxation and to conduct illegal activities, such as drug dealing, prostitution, and corruption. The portion of the informal economy that is from illegal activities is unlikely to generate tax revenue if it is reduced; as such we removed the portion of the informal economy from illegal activities from the estimation of potential tax revenue.

A recent report[48] found that approximately 18% of the shadow economy is derived from illegal activities. RT multiplied the estimated size of the shadow economy by 82% (100% - 18%) to remove the portion of the shadow economy that is from illegal activities (Table 4.2).

*Table 4.2: Underground vs Illegal Informal Economy by City (Annual)*

| | GDP (Billion) | Underground Informal Economy (Billion) | Illegal Informal Economy (Billion) |
|---|---|---|---|
| Chicago | $46 | $38 | $8 |
| Bangkok | $43 | $35 | $8 |
| Lagos | $34 | $27 | $6 |
| Sao Paulo | $119 | $97 | $22 |
| Stockholm | $27 | $22 | $5 |
| Tokyo | $157 | $128 | $28 |

Another recent study indicated that digital payments have the potential to reduce the shadow economy by as much as 40 percent. However, most cities are already using digital payments to some extent; as a result, they have likely already achieved some portion of the 40 percent reduction. The increased use of digital payments may only result in incremental decrease. Only a city that goes from 100 percent cash usage to 100 percent digital usage could achieve the full 40 percent reduction. Most cities include a mix of digital and non-digital payments; as such none of the cities are likely to achieve the full 40 percent reduction.

RT reduced the 40 percent based on the difference between the current digital payment maturity score in each city and the estimated score for achievable cashless scenario. RT estimated that each 1-point increase in the digital payment score is equal to a 2.2 percentage point decrease in size of the grey economy. Tables 4.3 and 4.4 present estimated reductions in the size of the informal economy under the Achievable Cashless scenario.

[48]Thomas, H., & Mellyn, K. (2012, October). Is There Such A Thing As Having Too Much Cash? MasterCard Advisors. Retrieved from https://www.mastercardadvisors.com/content/dam/advisors/en-us/documents/too_much_cash.pdf

[49]Accelerating Payment Acceptance, Expanding Economic Opportunities. Visa. Retrieved from https://usa.visa.com/dam/VCOM/regional/na/us/visa-everywhere/documents/visa-accelerating-acceptance-infographic.pdf

*Table 4.3: Achievable Cashless Scenario Percentage Reduction in the Informal Economy*

| | Baseline Digital Payments Score | Achievable Cashless Scenario Digital Payment Score | Reduction in the Size of the Informal Economy |
|---|---|---|---|
| Chicago | 12.1 | 17.2 | 11% |
| Bangkok | 7.5 | 14.0 | 15% |
| Lagos | 7.2 | 12.7 | 12% |
| Sao Paulo | 13.4 | 17.6 | 9% |
| Stockholm | 15.4 | 17.2 | 4% |
| Tokyo | 8.8 | 15.6 | 15% |

*Table 4.4: Achievable Cashless Scenario Reduction in the Informal Economy (Annual)*

| | Formal Economy (Billions) | Informal Economy as % of GDP | Reduction in the Informal Economy | Value of the Reduction (Billions) | Reduction as % of Formal Economy |
|---|---|---|---|---|---|
| Chicago | $582.1 | 8.0% | 11.5% | $4.4 | 0.7% |
| Bangkok | $99.9 | 43.0% | 14.6% | $5.1 | 5.1% |
| Lagos | $72.0 | 46.6% | 12.3% | $3.4 | 4.7% |
| Sao Paulo | $367.3 | 32.4% | 9.3% | $9.1 | 2.5% |
| Stockholm | $166.8 | 16.2% | 4.0% | $0.9 | 0.5% |
| Tokyo | $1,706.7 | 9.2% | 15.3% | $19.6 | 1.1% |

Reducing the size of the informal economy is likely to lead to an increase in government revenue from increased tax collections as formally untaxed transactions now get taxed. However, not all tax revenues are likely to be impacted by a reduction in a size of the informal economy. For the purposes of this analysis, RT assumed that that property tax revenue does not increase as a result of a decrease in the size of the informal economy.

RT estimated the resulting increase in government revenue by using data on government tax revenue as a percent of GDP from the World Bank. RT reduced the percentage by the percent of tax revenue from property taxes estimated from OECD data (Table 4.5).[50] Figure 4.1 summarizes the tax rates for each city included in the analysis.

[50]The OECD detailed tax revenue data does not provide coverage for all of the cities included in the analysis. The OECD does provide data for Chicago, Stockholm, and Sweden. RT assumed that Bangkok has a similar tax structure to South Korea, Sao Paulo to Chile, and Lagos to the OECD average.

*Table 4.5: Non-Property Tax Revenue as Percentage of GDP*

| | Tax Rev as % of GDP | Property Tax Revenue as a Percent of Total Tax Revenue | Non-Property Tax Revenue as % of GDP |
|---|---|---|---|
| Chicago | 11% | 10% | 10% |
| Bangkok | 16% | 18% | 13% |
| Lagos | 3% | 11% | 3% |
| Sao Paulo | 13% | 8% | 12% |
| Stockholm | 26% | 3% | 26% |
| Tokyo | 11% | 8% | 10% |

*Figure 4.1: Non-Property Tax Revenue as a Percent of GDP by City*

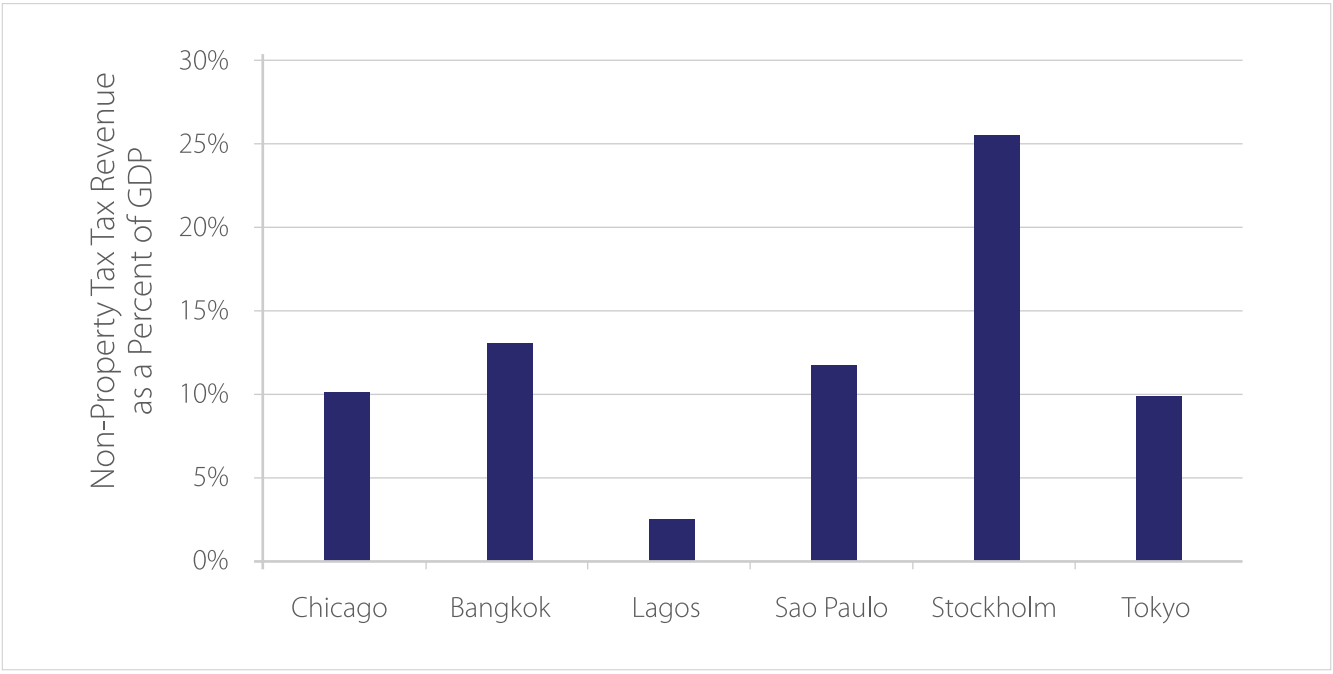



Table 4.6 summarize the tax revenue impacts result from the reduction of the informal economy resulting from increased digital payment usage under the achievable cashless scenario.

*Table 4.6: Achievable Cashless Scenario Increased Tax Revenue Resulting from a Reduction in the Size of the Informal Economy*

| | Reduction in the Size of the Informal Economy (Billions) | Non-Property Tax Revenue as % of GDP | Increased revenue (Billions) |
|---|---|---|---|
| Chicago | $4.4 | 10.2% | $0.4 |
| Bangkok | $5.1 | 14.4% | $0.7 |
| Lagos | $3.4 | 2.9% | $0.1 |
| Sao Paulo | $9.1 | 12.6% | $1.1 |
| Stockholm | $0.9 | 25.6% | $0.2 |
| Tokyo | $19.6 | 10.0% | $2.0 |

## 4.2 Increased Government Revenue from Increased Growth

Increased use of digital payments may potentially do more than just save time and reduce costs for consumers, businesses, and governments, it could also result in productivity gains for the economy. The increased productivity could generate increased economic growth above baseline forecasts.

### Methodology

Using the results of the consumer and business models, RT used the National Institute Global Econometric Model (NiGEM model) to estimate the increased GDP growth that would result from the increased use of digital payments. Using the difference between the average annual baseline and achievable cashless scenario results from NiGEM, RT estimated the increase in GDP growth resulting from the use of digital payments. RT then used data on the government revenue as a percent of GDP to estimate the increase in tax revenue

Table 4.7 summarizes the additional tax revenue that could result from the increased GDP growth rates for the Achievable Cashless scenario.

*Table 4.7: Achievable Cashless Scenario Increased Tax Revenue Resulting from Increased GDP Growth (Annual)*

| | Baseline GDP Growth | Scenario GDP Growth | Difference | Baseline GDP (Billions) | Additional GDP (Billions) | Non-Property Tax Revenue as % of GDP | Increased revenue (Billions) |
|---|---|---|---|---|---|---|---|
| Chicago | 1.5% | 1.9% | 0.4% | $582.1 | $2.4 | 10.2% | $0.2 |
| Bangkok | 3.9% | 4.7% | 0.8% | $99.9 | $0.8 | 14.4% | $0.1 |
| Lagos | 6.0% | 6.3% | 0.3% | $72.0 | $0.2 | 2.9% | $0.0 |

[51] See Section 5 for additional details.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Sao Paulo | 2.5% | 2.7% | 0.2% | $367.3 | $0.8 | 12.6% | Increased revenue $0.1 |
| Stockholm | 2.3% | 3.0% | 0.0% | $166.8 | $0.0 | 25.6% | $0.0 |
| Tokyo | 0.4% | 0.8% | 0.3% | $1,706.7 | $5.3 | 10.0% | $0.5 |

## 4.3 Increased Government Revenue from Increased Sales

The increased revenue that could result from an increased use of digital payments, could also lead to an increased tax revenue.

### Methodology

As part of the business model, RT estimated the potential increase in revenues for businesses in each city as a result of an increase in the use of electronic payments.[52] RT converted the business revenue to additional GDP and then used World Bank data on government revenue as a percent of GDP to estimate the potential increase in government revenue. (Table 4.8).

Table 4.8 summarizes the additional tax revenue that will result from the increased business revenue for the Achievable Cashless scenario.

*Table 4.8: Achievable Cashless Scenario: Increased Tax Revenue Resulting from Increased Business Revenue*

| | Increased Tax Revenue (Millions) |
|---|---|
| Chicago | $275.3 |
| Bangkok | $179.6 |
| Lagos | $26.9 |
| Sao Paulo | $437.7 |
| Stockholm | $161.0 |
| Tokyo | $1,469.8 |

[52]See Section 3.6 for additional details.

## 4.4 Payment Efficiency Cost Savings

The use of digital payments by government could reduce administrative processes, cut paperwork, and improve productivity, which could lead to reduced costs for government. The use of digital payments could also facilitate the growing trend for better integration and information sharing across all levels of government.

### Methodology

The total amount of government spending in each city was estimated by multiplying annual per-capita spending by the total population of each city. This estimation utilized data from World Bank on the amount of government spending as the percent of GDP.[53] RT then divided the total government spending by the total population to arrive at an estimate of per-capita government spending (Table 4.8). RT then used the per-capita spending combined with the population of each city to estimate the total amount of government spending (Table 4.9).

*Table 4.9: Per-capita Government Spending by City*

| | Govt Spending as Percent of GDP | GDP (Billions $) | Govt Spending estimate (Billions) | Population | Spending per capita |
|---|---|---|---|---|---|
| United States | 14.4% | $17,947.0 | $2,584.4 | 321,418,820 | $8,040 |
| Thailand | 17.2% | $395.3 | $68.0 | 67,959,359 | $1,000 |
| Nigeria | 6.7% | $481.1 | $32.2 | 182,201,962 | $177 |
| Brazil | 20.2% | $1,774.7 | $358.5 | 207,847,528 | $1,725 |
| Sweden | 25.9% | $492.6 | $127.6 | 9,798,871 | $13,021 |
| Japan | 20.4% | $4,123.3 | $841.1 | 126,958,472 | $6,625 |

*Table 4.10: Total Government Spending by City*

| | Spending per-capita | Population | Total Spending (Billions) |
|---|---|---|---|
| Chicago | $8,040 | 9,581,000 | $77.0 |
| Bangkok | $1,000 | 10,650,000 | $10.7 |
| Lagos | $177 | 21,000,000 | $3.7 |
| Sao Paulo | $1,725 | 21,227,000 | $36.6 |
| Stockholm | $13,021 | 2,409,000 | $31.4 |
| Tokyo | $6,625 | 37,486,000 | $248.4 |

[53]https://data.worldbank.org/indicator/NE.CON.GOVT.CD

RT used data from OECD on government spending to estimate the portion of government spending that goes towards administrative expenses.[54] Table 4.11 summarizes the total government administrative spending for each city.

*Table 4.11: Government Administrative Spending by City*

| | Total Government Spending (Billions) | Administrative Spending | Total Administrative Spending (Billions) |
|---|---|---|---|
| Chicago | $77.0 | 14.1% | $10.9 |
| Bangkok | $10.7 | 13.1% | $1.4 |
| Lagos | $3.7 | 13.1% | $0.5 |
| Sao Paulo | $36.6 | 12.7% | $4.6 |
| Stockholm | $31.4 | 14.7% | $4.6 |
| Tokyo | $248.4 | 10.9% | $27.0 |

A recent study[55] found that the use of digital payments could reduce administrative spending by 75%. Most cities are already taking advantage of digital payments to some extent, and as a result they may have already achieved a portion of the 75 percent cost reduction. The increased use of digital payments may only result in an incremental cost decrease. Only a government that goes from 100 percent cash usage to 100 percent digital usage could achieve the full 75 percent cost reduction. The government operations of most cities include a mix of digital and non-digital payments; as such none of the cities may achieve the full 75 percent cost reduction.

RT reduced the 75 percent based on the difference between the current digital payment maturity score in each city and the assumed score for the achievable cashless scenario. RT estimated that each 1-point increase in the digital payment score is equal to 4.17 percentage point decrease in administrative costs. For example, the baseline digital payment score for Stockholm is 15.4 and under the Achievable Cashless scenario, RT assumed that Stockholm's score would increase to 17.2, an increase of 1.8 points. As a result, the government's administrative costs would be reduced by 7.5% (1.8/18*75%). Table 4.12 presents the estimated percentage reductions under the Achievable Cashless scenario.

[54]The OECD did not have data for Brazil, Nigeria, or Thailand. RT used data from Chile and Mexico as a proxy for Brazil; for Nigeria and Thailand, RT used an average of the results for US, Japan, Sweden, and Brazil.

[55]http://siteresources.worldbank.org/FINANCIALSECTOR/Resources/General_Guidelines_Govt_Payment_Aug2012.pdf

*Table 4.12: Achievable Cashless Scenario Administrative Cost Savings*

| | Baseline Digital Payments Score | Achievable Cashless Scenario Digital Payment Score | Administrative Cost Reductions |
|---|---|---|---|
| Chicago | 12.1 | 17.2 | 21.5% |
| Bangkok | 7.5 | 14.0 | 27.3% |
| Lagos | 7.2 | 12.7 | 23.0% |
| Sao Paulo | 13.4 | 17.6 | 17.5% |
| Stockholm | 15.4 | 17.2 | 7.5% |
| Tokyo | 8.8 | 15.6 | 28.6% |

Table4.13 summarizes the additional administrative cost savings that could result from the increased use of digital payments by government in the Achievable Cashless scenario.

*Table 4.13: Achievable Cashless Scenario Total Administrative Cost Savings*

| | Total Administrative Spending (Billions) | Additional Admin Cost Savings | Total Admin Cost Savings (Billions) |
|---|---|---|---|
| Chicago | $10.9 | 21.5% | $2.3 |
| Bangkok | $1.4 | 27.3% | $0.4 |
| Lagos | $0.5 | 23.0% | $0.1 |
| Sao Paulo | $4.6 | 17.5% | $0.8 |
| Stockholm | $4.6 | 7.5% | $0.3 |
| Tokyo | $27.0 | 28.6% | $7.7 |

## 4.5 Reduced Crime Costs

In addition to costs for the crime victims[56], crime could also generate costs for government. This includes costs associated with investigating crimes and arresting criminals, the costs associated with prosecuting the crimes and the costs associated with incarcerating the convicted criminals.

[56]See Section 2.6 for additional details on the crime victim impacts.

## Methodology

Using data from the consumer survey, RT estimated the number of cash related crimes and the number of potential crime reductions due to increased use of digital payments and decreased use of cash (See Table 2.23).

McCollister et al. (2010)[57] calculated the crime costs associated with number of different crimes ranging from murder to fraud and embezzlement. For the purposes of this analysis, RT focused on the following crime type: robbery, stolen property, household burglary, and larceny/theft (Table 4.14). Table 4.15 presents the weights that were used to calculate the weighted average crime costs.

*Table 4.14: Criminal Justice Costs by Crime Types*

| | Criminal Justice Costs |
|---|---|
| Robbery | $13,287 |
| Stolen Property | $6,842 |
| Household Burglary | $4,127 |
| Larceny/Theft | $2,879 |
| Average Costs | $6,784 |

*Table 4.15: Crime Weights*

| | Weight |
|---|---|
| Robbery | 0.2 |
| Stolen Property | 0.2 |
| Household Burglary | 0.3 |
| Larceny/Theft | 0.3 |

The cost of crime is likely to vary across cities due to differences in costs as well as incomes across cities. The McCollister et al., data is specific to the United States. The costs were adjusted using the income ratio between the United States and the country of interest. Table 4.16 summarizes the adjusted crime costs for each city

*Table 4.16: Criminal Justice Cost Savings by City*

| | Chicago | Bangkok | Lagos | Sao Paulo | Stockholm | Tokyo |
|---|---|---|---|---|---|---|
| Robbery | $14,629 | $5,105 | $4,046 | $8,353 | $14,923 | $14,980 |
| Stolen Property | $7,533 | $2,629 | $2,083 | $4,301 | $7,685 | $7,714 |
| Household Burglary | $4,544 | $1,586 | $1,257 | $2,594 | $4,635 | $4,653 |
| Larceny/Theft | $3,170 | $1,106 | $877 | $1,810 | $3,234 | $3,246 |
| Average Costs | $7,755 | $2,706 | $2,145 | $4,428 | $7,911 | $7,941 |

[57]McCollister, K. et al. (2010, April 1). The Cost of Crime to Society: New Crime-Specific Estimates for Policy and Program Evaluation. Drug Alcohol Depend. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2835847/

Not all crimes are reported to the police and as such the unreported crimes do not generate criminal justice costs.

Before calculating the criminal justice costs, RT reduced the estimated crime reduction by proportion of crimes that are not reported, using data from crime victimization studies in each country. Table 4.17 summarizes the criminal justice cost savings for each city under the Achievable Cashless scenarios.

*Table 4.17: Achievable Cashless Scenario Reported Crime Reduction and Criminal Justice Cost Savings*

| | Crime Reduction | %-age Reported | Reduction in Reported Crimes | Criminal Justice Cost Savings (Millions) |
|---|---|---|---|---|
| Chicago | 70,500 | 30.0% | 21,150 | $164.0 |
| Bangkok | 171,300 | 20.0% | 34,260 | $92.7 |
| Lagos | 220,300 | 20.0% | 44,060 | $94.5 |
| Sao Paulo | 609,300 | 34.0% | 207,162 | $917.3 |
| Stockholm | 42,500 | 54.0% | 22,950 | $181.6 |
| Tokyo | 79,200 | 30.0% | 23,760 | $188.7 |

## 4.6 Transit and Toll Agency Cost Savings

Handling and processing cash generates large costs for transit agencies. Using survey and secondary data, RT quantified the potential costs savings associated with reduced cash transit and toll payments.

### Methodology

#### Transit Agency

RT used a combination of data from the consumer survey and data from each transit agency to estimate the number of transit trips that were paid for using cash, and the number paid for using digital methods. This includes cash used onboard the bus or train to pay the fare, as well as using cash to purchase a ticket from vending machines and to reload transit passes. RT used the percentage of trips as a proxy for the percentage of fare revenue received as cash.

*Table 4.18: Non-digital Transit Revenue by City*

| | Total Trips | Non-Digital Trips | Total Revenue [58] (Millions) | Non-Digital Revenue (Millions) |
|---|---|---|---|---|
| Chicago | 519,891,500 | 20.6% | $630.8 | $129.8 |
| Bangkok | 1,233,907,500 | 92.3% | $324.1 | $299.3 |
| Lagos | 62,827,600 | 85.7% | $20.1 | $17.2 |

[58]The transit agencies revenue estimates were obtained from each of transit agencies operating in the respective cities.

| | | | | |
|---|---|---|---|---|
| Sao Paulo | 5,982,981,700 | 27.1% | $2,026.2 | $549.3 |
| Stockholm | 591,561,800 | 5.7% | $767.6 | $43.5 |
| Tokyo | 14,552,855,000 | 44.2% | $13,065.1 | $5,775.6 |

RT assumed that the non-digital revenue is reduced by the ratio of the digital payment maturity score for the achievable cashless scenario to the maximum digital payment maturity score. For example, if the digital payment maturity score for the achievable cashless scenario is 16, RT assumed that 89 percent (16/18=0.889) of the non-digital revenue would be converted to digital revenue, while the remaining 11 percent would continue to be generated from non-digital sources.

Research has found that transit agencies spend an average of 14.5 cents for every dollar of cash revenue compared to 4.2 cents for electronic payments.[59] For the non-digital revenue that could become digital, RT estimated the cost associated with processing the payments as cash by multiplying the cash revenue by 14.5%. RT then estimated the costs if the non-digital revenue was processed as an electronic payment by multiplying the cash revenue by 4.2%. The difference between the two estimates constitutes potential cost savings.

Table 4.19 summarizes the transit cost savings for each city under the Achievable Cashless scenario.

*Table 4.19: Achievable Cashless Scenario Transit Agency Cost Savings*

| | Non-digital revenue that could become digital (Millions) | Cash Cost - % | Cash Costs (Millions) | Non-Digital Costs - % | Non-Digital Cost (Millions) | Potential Savings (Millions) |
|---|---|---|---|---|---|---|
| Chicago | $124.4 | 14.5% | $18.0 | 4.2% | $5.2 | $12.9 |
| Bangkok | $238.4 | 14.5% | $34.6 | 4.2% | $9.9 | $24.6 |
| Lagos | $12.4 | 14.5% | $1.8 | 4.2% | $0.5 | $1.3 |
| Sao Paulo | $533.4 | 14.5% | $77.3 | 4.2% | $22.2 | $55.1 |
| Stockholm | $41.4 | 14.5% | $6.0 | 4.2% | $1.7 | $4.3 |
| Tokyo | $5,075.4 | 14.5% | $735.9 | 4.2% | $211.5 | $524.5 |

### Toll Road Cost Savings

RT used a combination of data from the consumer survey and data from each toll road authority to estimate the number of transactions that were paid for using cash, and the number paid for using digital methods. RT used the percentage of trips as a proxy for the percentage of fare revenue received as cash.

[59]Stone D. (2006, October 3). Micropayments/Open Payment Systems and the UTA Pilot. Smart Card Alliance Annual Conference. Retrieved from http://www.smartcardalliance.org/secure/events/20061003/T08b_Stone.pdf

*Table 4.20: Non-digital Toll Revenue by City*

| | Total Transactions 60 | Electronic-Pass -%age 61 | Non-Electronic-pass Trips | Total revenue (Millions) 62 | Non-Electronic Pass Revenue (Millions) |
|---|---|---|---|---|---|
| Chicago | 881,615,000 | 87.0% | 13.0% | $1,146.6 | $149.1 |
| Bangkok | 623,900,000 | 34.0% | 66.0% | $449.7 | $296.8 |
| Lagos [63] | | | | | |
| Sao Paulo | 6,300,000 | 34.0% | 66.0% | $624.0 | $411.8 |
| Stockholm [64] | | | | | |
| Tokyo | 354,050,000 | 95.0% | 5.0% | $2,223.7 | $111.2 |

Similar to the transit calculations, RT assumed that the non-digital revenue is reduced by the ratio of the digital payment maturity score for the achievable cashless scenario to the maximum digital payment maturity score (See Table 4.20).

Research has found that toll road authorities spend an average of 12.2 cents for every dollar of cash revenue compared to 6.4 cents for electronic payments.[64] For the non-digital revenue that could become digital, RT estimated the cost associated with processing the payments as cash by multiplying the cash revenue by 12.2 percent. RT then estimated the costs if the non-digital revenue was processed as digital payment by multiplying the revenue by 6.4 percent. The difference between the two estimates is the potential cost savings.

Table 4.21 summarizes the toll road savings for each city under the Achievable Cashless scenario.

[60]Total toll transaction estimates were obtained from each of toll road authorities operating in the respective cities.

[61]EZ-Pass utilization estimates were obtained from each of toll road authorities operating in the respective cities.

[62]Toll revenue estimates were obtained from each of toll road authorities operating in the respective cities.

[63]Lagos does not currently have any toll roads

[64]All toll transactions currently use digital methods.

[65]Fleming, D. (2012, November). Dispelling the Myths: Toll and Fuel Tax Collection Costs in the 21st Century. Reason Foundation. Retrieved from http://reason.org/files/dispelling_toll_and_gas_tax_collection_myths.pdf

*Table 4.22: Achievable Cashless Scenario Toll Road Cost Savings*

| | Non-electronic pass revenue that could become electronic-pass revenue (Millions) | Non-electronic Pass Cost - %age | Non-electronic Pass Costs (Millions) | Electronic-Pass costs - %-age | Electronic-Pass Costs (Millions) | Cost Savings (Millions) |
|---|---|---|---|---|---|---|
| Chicago | $142.8 | 12.2% | $17.4 | 6.4% | $9.2 | $8.2 |
| Bangkok | $236.4 | 12.2% | $28.8 | 6.4% | $15.2 | $13.6 |
| Lagos | | | | | | |
| Sao Paulo | $399.9 | 12.2% | $48.7 | 6.4% | $25.7 | $23.0 |
| Stockholm | | | | | | |
| Tokyo | $97.7 | 12.2% | $11.9 | 6.4% | $6.3 | $5.6 |

# 5.0 Catalytic Impact Modelling

Increased use of digital payments does not just potentially reduce costs for consumers, businesses, and governments. It could also generate spillover impacts in terms of increased GDP growth, employment growth, increased productivity, and wage impacts. Increased use of digital payments could result in significant time savings for individuals and businesses, which allows them to be more productive. It could also generate costs savings for businesses. Both of these impacts could generate increased economic growth above baseline forecasts.

RT used the National Institutes Global Econometric Model (NiGEM)[66] to estimate the GDP, employment, and productivity impacts that could result from increased use of digital payments. NiGEM integrates 60 rigorous country and regional models through trade and financial flows, with comprehensive forecasts out to 2044 and historical data back to 1961. The model is updated quarterly.

## 5.1 Methodology

NiGEM is a country-level model; so the time savings for consumers and business, and the costs savings for businesses for each city, needed to be scaled up to the country-level. To scale the consumer time savings up to the national level, RT first calculated the per-capita time savings and then multiplied the per-capita time savings by the population of the country. RT then reduced the time savings by the labor force participation rate to account for the fact that not all of the time savings will be devoted to pvroductive activities. To scale the business time savings, and business costs savings, RT first calculated the per-employee time and costs savings for each city. RT then multiplied the per employee impacts by the total employment of the country.

The NIGEM model did not include a country-level model for Nigeria or Thailand. So RT had to use the Africa regional model to estimate the impacts on Nigeria and the East Asia regional model to estimate the impact on Thailand. RT used a similar scaling procedure, except that RT used regional data, rather than country level data to scale the impacts.

The time savings were modeled as an increase in productivity – the assumption being that time saved by individuals and employees allow them to be more productive. To model this in the NIGEM model, RT translated the labor and time savings into a shock to the "labor augmented technical progress" variable. To model the impact of the business costs savings, RT calibrated a shock to the "unit costs" for businesses variable.

After calibrating the model to account for the productivity and cost impacts, RT ran it to estimate the impact on GDP growth, employment for the 2017-2032 time period. RT then compared the resulting impacts to NiGEM's baseline forecasts for each country.

Individual cities may have different GDP growth rates than the country. To adjust the country level NIGEM results to the city-level, RT used the ratio between the city and country GDP growth rates over the 2015 to 2025 period as estimated by the McKinsey Global Institute in its McKinsey Urban World database.[67] This allowed RT to account for the difference between the country and city level. RT used a similar approach to adjust the employment growth estimates.

RT used the adjusted GDP growth rates, under both the baseline and the achievable cashless scenario, combined with estimated GDP in 2017 to estimate GDP for each year under the baseline and the scenario. RT followed a similar process to estimate employment growth. RT calculated the productivity impacts by dividing the GDP in each year by employment. This provided an estimate of GDP per employee. RT then estimated the productivity growth rate over the 2017-2032 time period. To estimate the impact on wages, RT used data on the relationship between productivity growth and wage growth.[68]

[66] For additional information on the NIGEM model, please see: https://nimodel.niesr.ac.uk/

[67] http://www.mckinsey.com/mgi/overview/in-the-news/urban-world-app

[68] Global Wage Report 2012/13: Wages and Equitable Growth. International Labor Organization. Retrieved from http://www.ilo.org/global/research/global-reports/global-wage-report/2012/WCMS_194843/lang--en/index.htm and The Relationship Between Labor Productivity and Real Wage Growth in Canada and OECD Countries. (2008, December). Center for the Study of Living Standards. Retrieved from http://www.csls.ca/reports/csls2008-8.pdf

# 6.0 100 City Model

To help policymakers and business leaders in cities around the world see where their cities fall on the digital payment maturity curve, and how they may gain the biggest benefit from reducing cash, RT extrapolated the results from the 6 benchmark cities to 94 additional cities from 80 countries. The additional cites included a mix of national capitals and major economic centers. The cities were chosen to provide a mix of cities across size, level of development, geography, and digital payment usage. Table 6.1 lists the cities by their level of digital payment maturity.

*Table 6.1 – The 100 Cities*

| Digital Maturity Scale | | | | | |
|---|---|---|---|---|---|
| | Cash Centric | Digitally Transitioning | Digitally Maruting | Digitally Advanced | Digitally Leader |
| Benchmark city (Primary survey data available) | Lagos | Bangkok | Sao Paulo<br>Tokyo | Chicago | Stockholm |
| | Algiers | Minsk | Brasilia | Vienna | Canberra |
| | Luanda | Santiago | Beijing | Brussels | Sydney |
| | Buenos Aires | San Jose | Shanghai | Paris | Ottawa |
| | Baku | Athens | Shenzhen | Berlin | Toronto |
| | Dhaka | Bangalore | Tianjin | Frankfurt | Copenhagen |
| | Phnom Penh | Chennai | Prague | Hong Kong | Helsinki |
| | Bogota | Delhi | Budapest | Dublin | Auckland |
| | Santo Domingo | Mumbai | Tehran | Tel Aviv | London |
| | Cairo | Nairobi | Rome | Amsterdam | |
| | Accra | Muscat | Osaka | Oslo | |
| | Jakarta | San Juan | Kuwait City | Singapore | |
| | Kingston | Doha | Kuala Lumpur | Seoul | |
| | Amman | Bucharest | Ulan Bator | Barcelona | |
| | Astana | Moscow | Warsaw | Madrid | |
| | Beirut | Saint Petersburg | Lisbon | Austin | |
| | Mexico City | Riyadh | Belgrade | New York City | |
| | Monterrey | Colombo | Bratislava | San Francisco | |
| | Casablanca | Ankara | Durban | Washington, DC | |
| | Karachi | Istanbul | Johannesburg | | |
| | Panama City | Kyiv | Zurich | | |
| | Lima | Montevideo | Taipei | | |
| | Manila | Caracas | Dubai | | |
| | Kigali | | | | |
| | Hanoi | | | | |

## 6.1 Extrapolation Methodology

The first step was to calculate digital payment usage and readiness scores (based on data from the World Bank's Financial Inclusion[69] database).[70] Please see Section 1 for detailed discussion of the scoring methodology. The score was used to assign each of the 94 cities to the benchmark that it most closely resembled.

*Table 6.2: Readiness and Usage Index and Benchmark City for each of the 100 Cities*

| City | Country/Region | Readiness Index | Usage Index | Revised Category | Benchmark City |
|---|---|---|---|---|---|
| Algiers | Algeria | 0.32 | 0.08 | Cash Centric | Lagos |
| Luanda | Angola | 0.10 | 0.15 | Cash Centric | Lagos |
| Buenos Aires | Argentina | 0.37 | 0.19 | Cash Centric | Lagos |
| Canberra | Australia | 0.90 | 1.00 | Digital Leader | Stockholm |
| Sydney | Australia | 0.90 | 1.00 | Digital Leader | Stockholm |
| Vienna | Austria | 0.74 | 0.68 | Digitally Advanced | Chicago |
| Baku | Azerbaijan | 0.26 | 0.06 | Cash Centric | Lagos |
| Dhaka | Bangladesh | 0.14 | 0.01 | Cash Centric | Lagos |
| Minsk | Belarus | 0.41 | 0.28 | Digitally Transitioning | Bangkok |
| Brussels | Belgium | 0.83 | 0.71 | Digitally Advanced | Chicago |
| Brasilia | Brazil | 0.53 | 0.32 | Digitally Maturing | Sao Paulo |
| Sao Paulo | Brazil | 0.53 | 0.32 | Digitally Maturing | Sao Paulo |
| Phnom Penh | Cambodia | 0.23 | 0.04 | Cash Centric | Lagos |
| Ottawa | Canada | 1.00 | 0.98 | Digital Leader | Stockholm |
| Toronto | Canada | 1.00 | 0.98 | Digital Leader | Stockholm |
| Santiago | Chile | 0.43 | 0.28 | Digitally Transitioning | Bangkok |
| Beijing | China | 00.48 | 0.29 | Digitally Maturing | Tokyo |

[69]World Bank Financial Inclusion Survey Data (http://datatopics.worldbank.org/financialinclusion/)

[70]Please note that the World Bank Financial Inclusions data is only available at Country level, as such for countries that have multiple cities, the Readiness and Usage Indices are the same for each city.

| City | Country/Region | Readiness Index | Usage Index | Revised Category | Benchmark City |
|---|---|---|---|---|---|
| Shanghai | China | 0.48 | 0.29 | Digitally Maturing | Tokyo |
| Shenzhen | China | 0.48 | 0.29 | Digitally Maturing | Tokyo |
| Tianjin | China | 0.48 | 0.29 | Digitally Maturing | Tokyo |
| Bogota | Colombia | 0.25 | 0.14 | Cash Centric | Lagos |
| San Jose | Costa Rica | 0.42 | 0.21 | Digitally Transitioning | Bangkok |
| Prague | Czech Republic | 0.51 | 0.49 | Digitally Maturing | Tokyo |
| Copenhagen | Denmark | 0.91 | 0.94 | Digital Leader | Stockholm |
| Santo Domingo | Dominican Republic | 0.29 | 0.12 | Cash Centric | Lagos |
| Cairo | Egypt | 0.11 | 0.02 | Cash Centric | Lagos |
| Helsinki | Finland | 0.97 | 0.94 | Digital Leader | Stockholm |
| Paris | France | 0.76 | 0.67 | Digitally Advanced | Chicago |
| Berlin | Germany | 0.93 | 0.77 | Digitally Advanced | Chicago |
| Frankfurt | Germany | 0.93 | 0.77 | Digitally Advanced | Chicago |
| Accra | Ghana | 0.16 | 0.07 | Cash Centric | Lagos |
| Athens | Greece | 0.52 | 0.11 | Digitally Transitioning | Bangkok |
| Hong Kong | China | 0.71 | 0.68 | Digitally Advanced | Chicago |
| Budapest | Hungary | 0.51 | 0.36 | Digitally Maturing | Tokyo |
| Bangalore | India | 0.45 | 0.11 | Digitally Transitioning | Bangkok |
| Chennai | India | 0.45 | 0.11 | Digitally Transitioning | Bangkok |
| Delhi | India | 0.45 | 0.11 | Digitally Transitioning | Bangkok |
| Mumbai | India | 0.45 | 0.11 | Digitally Transitioning | Bangkok |
| Jakarta | Indonesia | 0.26 | 0.05 | Cash Centric | Lagos |

| City | Country/Region | Readiness Index | Usage Index | Revised Category | Benchmark City |
|---|---|---|---|---|---|
| Tehran | Iran | 0.67 | 0.40 | Digitally Maturing | Sao Paulo |
| Dublin | Ireland | 0.78 | 0.77 | Digitally Advanced | Chicago |
| Tel Aviv | Israel | 0.70 | 0.66 | Digitally Advanced | Chicago |
| Rome | Italy | 0.65 | 0.43 | Digitally Maturing | Tokyo |
| Kingston | Jamaica | 0.39 | 0.17 | Cash Centric | Lagos |
| Osaka | Japan | 0.89 | 0.50 | Digitally Maturing | Tokyo |
| Tokyo | Japan | 0.89 | 0.50 | Digitally Maturing | Tokyo |
| Amman | Jordan | 0.13 | 0.03 | Cash Centric | Lagos |
| Astana | Kazakhstan | 0.36 | 0.14 | Cash Centric | Lagos |
| Nairobi | Kenya | 0.31 | 0.24 | Digitally Transitioning | Bangkok |
| Kuwait City | Kuwait | 0.62 | 0.44 | Digitally Maturing | Tokyo |
| Beirut | Lebanon | 0.25 | 0.11 | Cash Centric | Lagos |
| Kuala Lumpur | Malaysia | 0.49 | 0.24 | Digitally Maturing | Tokyo |
| Mexico City | Mexico | 0.27 | 0.17 | Cash Centric | Lagos |
| Monterrey | Mexico | 0.27 | 0.17 | Cash Centric | Lagos |
| Ulan Bator | Mongolia | 0.64 | 0.32 | Digitally Maturing | Tokyo |
| Casablanca | Morocco | 0.21 | 0.02 | Cash Centric | Lagos |
| Amsterdam | Netherlands | 0.88 | 0.88 | Digitally Advanced | Chicago |
| Auckland | New Zealand | 0.91 | 0.98 | Digital Leader | Stockholm |
| Lagos | Nigeria | 0.37 | 0.11 | Cash Centric | Lagos |
| Oslo | Norway | 0.84 | 0.73 | Digitally Advanced | Chicago |
| Muscat | Oman | 0.51 | 0.04 | Digitally Transitioning | Bangkok |

| City | Country/Region | Readiness Index | Usage Index | Revised Category | Benchmark City |
|---|---|---|---|---|---|
| Karachi | Pakistan | 0.03 | 0.00 | Cash Centric | Lagos |
| Panama City | Panama | 0.27 | 0.14 | Cash Centric | Lagos |
| Lima | Peru | 0.19 | 0.09 | Cash Centric | Lagos |
| Manila | Philippines | 0.22 | 0.08 | Cash Centric | Lagos |
| Warsaw | Poland | 0.48 | 0.33 | Digitally Maturing | Sao Paulo |
| Lisbon | Portugal | 0.63 | 0.48 | Digitally Maturing | Tokyo |
| San Juan | Puerto Rico | 0.43 | 0.37 | Digitally Transitioning | Bangkok |
| Doha | Qatar | 0.47 | 0.06 | Digitally Transitioning | Bangkok |
| Bucharest | Romania | 0.49 | 0.19 | Digitally Transitioning | Bangkok |
| Moscow | Russia | 0.44 | 0.32 | Digitally Transitioning | Bangkok |
| Saint Petersburg | Russia | 0.44 | 0.32 | Digitally Transitioning | Bangkok |
| Kigali | Rwanda | 0.16 | 0.09 | Cash Centric | Lagos |
| Riyadh | Saudi Arabia | 0.44 | 0.30 | Digitally Transitioning | Bangkok |
| Belgrade | Serbia | 0.58 | 0.26 | Digitally Maturing | Tokyo |
| Singapore | Singapore | 0.78 | 0.62 | Digitally Advanced | Chicago |
| Bratislava | Slovakia | 0.47 | 0.44 | Digitally Maturing | Tokyo |
| Durban | South Africa | 0.52 | 0.36 | Digitally Maturing | Sao Paulo |
| Johannesburg | South Africa | 0.52 | 0.36 | Digitally Maturing | Sao Paulo |
| Seoul | South Korea | 0.72 | 0.90 | Digitally Advanced | Stockholm |
| Barcelona | Spain | 0.84 | 0.72 | Digitally Advanced | Chicago |
| Madrid | Spain | 0.84 | 0.72 | Digitally Advanced | Chicago |
| Colombo | Sri Lanka | 0.49 | 0.05 | Digitally Transitioning | Bangkok |

| City | Country/Region | Readiness Index | Usage Index | Revised Category | Benchmark City |
|---|---|---|---|---|---|
| Stockholm | Sweden | 0.89 | 0.97 | Digital Leader | Stockholm |
| Zurich | Switzerland | 0.71 | 0.47 | Digitally Maturing | Tokyo |
| Taipei | Taiwan | 0.75 | 0.51 | Digitally Maturing | Sao Paulo |
| Bangkok | Thailand | 0.48 | 0.10 | Digitally Transitioning | Bangkok |
| Ankara | Turkey | 0.39 | 0.24 | Digitally Transitioning | Bangkok |
| Istanbul | Turkey | 0.39 | 0.24 | Digitally Transitioning | Bangkok |
| Dubai | UAE | 0.65 | 0.48 | Digitally Maturing | Sao Paulo |
| London | UK | 0.94 | 0.99 | Digital Leader | Stockholm |
| Kyiv | Ukraine | 0.40 | 0.22 | Digitally Transitioning | Bangkok |
| Montevideo | Uruguay | 0.36 | 0.23 | Digitally Transitioning | Bangkok |
| Austin | US | 0.81 | 0.90 | Digitally Advanced | Chicago |
| Chicago | US | 0.81 | 0.90 | Digitally Advanced | Chicago |
| New York City | US | 0.81 | 0.90 | Digitally Advanced | Chicago |
| San Francisco | US | 0.81 | 0.90 | Digitally Advanced | Chicago |
| Washington, DC | US | 0.81 | 0.90 | Digitally Advanced | Chicago |
| Caracas | Venezuela | 0.38 | 0.31 | Digitally Transitioning | Bangkok |
| Hanoi | Vietnam | 0.30 | 0.06 | Cash Centric | Lagos |

For each city, RT estimated the same consumer, business, and government impacts that were calculated for each of the benchmark cities.[71] The calculations were based on a combination of city-specific data (e.g. GDP, population, employment, transit usage, etc.) and data from the relevant benchmark cities (e.g. banking time, payment usage, etc.). Please see Appendix B for a list of various data sources used in constructing the 100-city model.

[71]Due to data availability limitations, we were unable to include the toll road impacts for consumers and the transit and toll authority cost savings for governments for the 100 cities.

To account for differences between each individual city and its assigned benchmark city, RT adjusted the data from the benchmark city in line with the ratio between their digital payment usage and readiness scores. For example, Algiers, Algeria has usage and readiness scores of 0.08 and 0.32, respectively. The benchmark city for Algiers is Lagos, which has usage and readiness scores of 0.11 and 0.37. To calculate the adjustment factor, RT divided the usage and readiness scores for Algiers by the usage and readiness scores for Lagos and took the average (Table 6.3). The adjustment factors ranged from 0.05 to 2.34. To control for the impact of outliers, RT set a minimum adjustment value of 0.80 and a maximum value of 1.20.

*Table 6.3: Example Adjustment Factor Calculation*

| | Algiers | Lagos | Ratio |
|---|---|---|---|
| Usage Score | 0.08 | 0.11 | 0.74 |
| Readiness Score | 0.32 | 0.37 | 0.87 |
| Average | | | 0.80 |

For countries with multiple cities, such as the United States, Canada, China, and India, RT calculated the per-capita GDP for each city, the average per-capita GDP across the cities included in the dataset, and the ratio of the per-capita GDP for the city to the average per-capita GDP. RT then multiplied the adjustment factor calculated above by the ratio. This helped to control for difference across cities and helped ensure that the results differed by city within a country. RT used per-capita GDP as a proxy for technological advancement. RT assumed that cities with a higher per-capita GDP were more technologically advanced compared to other cities within the same country that had a lower per-capita GDP.

To control for price level difference, RT adjusted the monetary values from the survey for the benchmark city using purchasing power parity (PPP) and average income figures for each country.

For each city, RT undertook the calculations detailed in Sections 2, 3 and 4 above. The only difference was that the survey data from the benchmark city was multiplied by the adjustment factor calculated above. For example, before calculating the banking time savings in Algiers, RT adjusted the banking time data from Lagos using the adjustment factor calculated above. RT then used population and wage data for Algiers to estimate banking time savings in Algiers.

Finally, RT used the National Institutes Global Econometric Model (NiGEM) to estimate the GDP, employment, and productivity impacts that would result from increased use of digital payments. Since the NiGEM model did not include country-level models for each of the 80 countries represented by the 94 cities, for some countries RT had to estimate the impacts using NiGEM's regional models (Africa, Middle East, Far East, and Latin America). To estimate the catalytic impacts for each of 94 additional cities, RT used the methodology detailed in Section 5.

RT adjusted the country-level catalytic impacts using the ratio between the city and country GDP growth rates over the 2015 to 2025 period as estimated by the McKinsey Global Institute in its McKinsey Urban World database.

# Appendix A – Business and Consumer Surveys

To obtain the data for modeling the costs and benefits of going cashless for our benchmark cities, RT conducted two online surveys in each of the six cities: a 35-question survey of 500 consumers, and a 62-question survey of 150 businesses, for a total of 3000 consumer respondents and 900 business respondents. The consumer respondents spanned a range of age and income levels, and the business respondents included a range of company sizes and not only consumer-facing companies, such as retailers, but also those with a more business-to-business or business-to-government focus.

These comprehensive surveys produced data on how consumers and businesses in each city use different types of payments and the time they spend on related tasks and activities. This data can be sorted by a number of variables, including age, gender and income for consumers, and company size, industry, and type for businesses.

This data served as the raw material for developing the benefit-cost models.

## A-1 Consumer Survey Questionnaire

### Introduction

With more than one-half of the world's population now living in urban areas, effective payment systems are especially important for consumers, businesses and public services. Roubini Thoughtlab is conducting this survey to understand the ways you make payments today, and the ones you may be planning to use more often in the future. We thank you for participating in this landmark study.

**1.Where do you live?**

- Chicago, US
- Bangkok, Thailand
- Lagos, Nigeria
- São Paulo, Brazil
- Stockholm, Sweden
- Tokyo, Japan
- Other **(Survey terminated if this option chosen)**

**2. How old are you?**

- Under 18 **(Survey terminated if this option chosen)**
- 18 to 34
- 35 to 50
- 51 to 69
- 70 and over

**3. What is your approximate household Income?**

| Chicago | Bangkok (฿) | Lagos (₦) | Sao Paulo (R$) | Stockholm (kr) | Tokyo (¥) |
|---|---|---|---|---|---|
| Under $21,790 | < 110,890 | <212,560 | < R$7,500 | < kr180,840 | < ¥1,349,650 |
| $21,790 - $32,690 | 110,890 – 177,430 | 212,560 - 340,090 | R$7,500 - R$12,000 | kr180,840 - kr289,340 | ¥1,349,650 - ¥2,159,430 |
| $32,691 - $87,170 | 177,431 - 266,140 | 340,091- 510,140 | R$12,001 – R$17,990 | kr289,341 - kr434,020 | ¥2,159,431 - ¥3,239,150 |
| $87,171 - $174,340 | 266,141 – 665,360 | 510,141 - 1,275,350 | R$17,991 - R$44,980 | kr434,021 - kr1,085,040 | ¥3,239,151 - ¥8,097,880 |
| Over $174,340 | > 665,360 | > 1,275,350 | > R$44,980 | > kr 1,085,040 | > ¥8,097,880 |

## Payment Methods

The first section of the survey will ask you about the various payment methods that you use.

For the purposes of this survey, please use the following definitions:

**Cash:** Coins and paper bills.

**Check:** Paper document directing financial institution to pay a specific amount of money to a person, business or government agency.

**Money Order:** Paper document purchased from a bank or other institution, allowing individual or business named on the order to receive a specified amount of cash.

**Debit Card:** Card issued by a bank that deducts funds from your bank account; used both for making payments and for transactions with an automated teller machine (ATM).

**Credit Card:** Card allowing the holder to purchase goods and services on credit and pay the credit card company later.

**Stored-value Card:** Card that comes loaded with funds at the time of purchase. The card can either be branded and used to purchase goods and services, both in person and online. Also known as "prepaid" or "gift" cards. Stored-value cards issued by transit agencies, such as the Bangkok Transits' Rabbit Card, are an example of stored value cards. **(Examples localized for each city)**

**Electronic/Online Bill Payment:** Allows a customer of a financial institution to transfer money from their transaction or credit card account to a person, business or government agency without disclosing your bank account number.

**Mobile Payment Account:** Mobile phone-based money transfer service that allows users to deposit money into an account stored on their cell phones, send balances using PIN-secured SMS text messages to other users, including sellers of goods and services, and to redeem deposits for regular money. Customers can deposit money from a network of agents including air-time resellers and retail outlets. An example of a mobile payment account is OpenTable (Chicago), M-Pesa (Lagos), iZettle (Stockholm and Bankgkok), Suica (Tokyo), Zuum (Sao Paolo).

**Wire transfer (ACH /EFTS payment):** An electronic transfer of money from one bank account to another, either within a single financial institution or across multiple institutions.

**1. Over the past month, which of the following have you used? Select all that apply.**

- ○ Currency/cash
- ○ Check
- ○ Money order
- ○ Debit card
- ○ Credit card
- ○ Stored-value card
- ○ Electronic/online bill payment
- ○ Mobile payment account
- ○ Wire transfer
- ○ Other (please specify): _____

**2. Over the next year, how do you expect your usage of the following to change? Please respond for each row except "Other" (which is optional).**

| | Decrease significantly (Over 10%) | Decrease slightly (1% – 10%) | Stay the same | Increase slightly (1% – 10%) | Increase significantly (Over 10%) | Don't plan to use |
|---|---|---|---|---|---|---|
| Currency/cash | ○ | ○ | ○ | ○ | ○ | ○ |
| Check | ○ | ○ | ○ | ○ | ○ | ○ |
| Money order | ○ | ○ | ○ | ○ | ○ | ○ |
| Debit card | ○ | ○ | ○ | ○ | ○ | ○ |
| Credit card | ○ | ○ | ○ | ○ | ○ | ○ |
| Stored-value card | ○ | ○ | ○ | ○ | ○ | ○ |
| Electronic/online bill payment | ○ | ○ | ○ | ○ | ○ | ○ |
| Mobile payment account | ○ | ○ | ○ | ○ | ○ | ○ |
| Wire transfer | ○ | ○ | ○ | ○ | ○ | ○ |
| Other | ○ | ○ | ○ | ○ | ○ | ○ |

You selected "other," please specify: _____

## Banking Activity

In this section we will ask several questions to understand how much time you spend going to an ATM, bank or other financial institution to deal with cash and checks.

**3. On average, how many times per month do you visit an ATM, bank or other financial institution to make deposits, withdrawals or other transactions (e.g., check cashing).**

| | None | 1 - 2 times | 3 - 4 times | 5 - 6 times | 7 - 8 times | 9 - 10 times | 11-15 times | Over 15 times |
|---|---|---|---|---|---|---|---|---|
| ATM | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Bank | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Other financial institution | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

**(Question skipped if None to all rows in Q3)**

**4. When you visit a ATM, bank or other financial institution, how long, on average, does the transaction take (e.g., check cashing)?**

This includes, preparing your transaction, waiting in line, completing the transaction, and checking the accuracy of the transaction.

| | Fewer than 5 minutes | 5-9 minutes | 10-15 minutes | 16– 20 minutes | 21-30 minutes | 31-45 minutes | 46-60 minutes | More than 60 minutes |
|---|---|---|---|---|---|---|---|---|
| ATM [show if Q3>"none"] | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Bank [show if Q3>"none"] | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Other financial institution [show if Q3>"none"] | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

**5. How much time on average, do you spend per month balancing your checkbook?**

- Fewer than 10 minutes
- 10 – 15 minutes
- 16 – 20 minutes
- 21 – 30 minutes
- 31 – 45 minutes
- 46 – 60 minutes
- More than 60 minutes

## Receiving Money

In this section we will ask you several questions about how you receive funds.

**6. How do you receive your wages and salaries? Select one.**

- I am not employed
- Cash
- Paper check
- Direct deposit into bank account
- Deposit onto a stored-value card/prepaid payroll card
- Other (please specify): _____

**7. Do you receive recurring payments from the government, such as unemployment, social assistance, pension, etc.?**

- Yes
- No ***(Skip next question)***

**8. How do you receive those payments? Select all that apply.**

- ◯ Cash
- ◯ Paper check
- ◯ Direct deposit into my bank account
- ◯ Deposit onto a stored-value card
- ◯ Other (please specify): _____

**9.** ***(Question shown if "deposit onto a stored-value card/prepaid payroll card" in Q6 or "deposit onto a stored-value card" in Q8)*** **In an average month, how much do you spend on ATM or other fees to access your money?**

- $1 - $5 [Equivalent local currencies used for each city]
- $6 - $10
- $10 - $15
- $15 - $20
- $20 -$25
- $25 - $30
- $30 - $40

- $40 - $50
- More than $50

**10. If a friend, family member, or other individual were to send you money, which method(s) of payment would they typically most likely use? Select all that apply.**

- ◯ Currency/cash
- ◯ Check
- ◯ Money order
- ◯ Debit card
- ◯ Credit card
- ◯ Stored-value card
- ◯ Electronic/online bill payment
- ◯ Mobile payment account
- ◯ Other (please specify): _____

**11. If you were to receive a paper check, either from your employer, the government, or another individual, how would you typically cash or deposit the check? Select all that apply.**

- In person at a bank that I have an account with
- Using a mobile phone app from a bank that I have an account with
- In person at the bank that issued the check
- In person at a bank that I do not have an account with
- At an ATM machine
- At a retailer that offers check-cashing services
- At a check-cashing establishment

**12.** ***(Question shown If following options chosen for Q.11: "at a bank that I do not have an account at" or "at retailer that offers check-cashing services" or "at a check-cashing business")*** **In an average month, how much do you pay in check cashing fees?**

- $0
- $1 - $5 [Equivalent local currencies used for each city]
- $6 - $10
- $10 - $15
- $15 - $20
- $20 -$25
- $25 - $30
- $30 - $40
- $40 - $50
- More than $50

## Recurring Monthly Bills

In this section we will ask you several questions about how you typically pay your recurring monthly bills.

**13. For each of the following monthly bills, which payment method do you use most often? Select one for each row.**

| | Cash | Check | Money order | Stored value card | Debit card | Electronic /online bill payment | Mobile payment account | Wire transfer | Not Applicable |
|---|---|---|---|---|---|---|---|---|---|
| Rent/Mortgage | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Government taxes, fees, and fines | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Utility payments | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Insurance | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Tuition/school expenses | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Sending money to a family member, friend, or other individual | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Other recurring bills (e.g., gym membership, credit card) | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

**14. For each of the following monthly bills, which payment method would you prefer to use if you could? Select one for each row.**

| | Cash | Check | Money order | Stored value card | Credit card | Debit card | Electronic /online bill payment | Mobile payment account | Wire transfer | Not Applicable |
|---|---|---|---|---|---|---|---|---|---|---|
| Rent/Mortgage | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Government taxes, fees, and fines | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Utility payments | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Insurance | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Tuition/school expenses | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Sending money to a family member, friend, or other individual | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Other recurring bills (e.g., gym membership, credit card) | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

**15. In a given month, how much time do you typically spend paying your recurring monthly bills?**

- Fewer than 10 minutes
- 10 – 15 minutes
- 16 – 20 minutes
- 21 – 30 minutes
- 31 – 45 minutes
- 46 – 60 minutes
- More than 60 minutes

**16. In a given year, how much do you typically pay in late payment fees?**

- Don't know
- Nothing
- $1 - $10 ***(Equivalent local currencies used for each city)***
- $11 - $20
- $21 - $30
- $31 - $40
- $41 - $50
- $51 - $75
- $75 - $100
- Over $100

## Everyday Purchases

In this section we are interested in learning how you make everyday purchases.

For this purpose of the next question, we are using the following definitions:

**Groceries/drugs:** Food, alcohol, tobacco, cleaning products, prescriptions.

**Personal attire:** Clothing, accessories, cosmetics.

**Healthcare:** Doctor, dentist, hospital bills.

**Hobby/sporting goods:** craft supplies, toys, sports equipment, books, newspapers

**Professional services:** lawyer, accountant, mechanic, spa services, haircut dry cleaning

**Domestic help:** maids, housekeepers, baby sitters, nannies.

**Transportation/parking:** public transportation, Taxi, parking

**Entertainment/meals:** movies, restaurants, takeout food

**Durable goods:** electronics, furniture, appliances, automobiles, household accessories.

**Travel and vacation:** plane tickets, hotels, and other spending outside of your city while on vacation/holiday.

**17. For each of the following spending categories, which payment method do you use most often? Select one for each row.**

| | Cash | Check | Money order | Stored value card | Credit card | Debit card | Electronic /online bill payment | Mobile payment systems | Wire transfer | Not applicable |
|---|---|---|---|---|---|---|---|---|---|---|
| Groceries/drugs | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Personal attire | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Healthcare | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Hobby/sporting goods | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Professional services | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Domestic help | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Transportation/ parking | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Entertainment/ meals | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Durable goods | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Travel and vacation | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

**18. For each of the following spending categories, which payment method would you prefer to use if you could? Select one for each row.**

| | Cash | Check | Money order | Stored value card | Credit card | Debit card | Electronic /online bill payment | Mobile payment systems | Wire transfer | Not applicable |
|---|---|---|---|---|---|---|---|---|---|---|
| Groceries/drugs | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Personal attire | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Healthcare | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Hobby/sporting goods | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Professional services | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Domestic help | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Transportation/ parking | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Entertainment/ meals | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Durable goods | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Travel and vacation | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

**19. How much cash do you typically carry with you and how much do you keep at home? (Chicago: $; Bangkok: ฿; Lagos: ₦, São Paulo: R$, Stockholm: kr; Tokyo: ¥)**

- Carry with You _____
- Keep at Home _____

### Transportation Expenses

This section investigates how you typically pay for various transportation services.

**20. On average, how many times a week do you use public transportation?**

- None; I do not use public transportation [Skip to Q23 if this option chosen]
- 1-5 times
- 6-10 times
- More than 10 times

**21. How do you typically pay the fare? How would you prefer to pay the fare? Select one for each column.**

| | Non-electronic Pass Cost - %age | Cost Savings (Millions) |
|---|---|---|
| Currency/cash | ○ | ○ |
| Debit card | ○ | ○ |
| Credit card | ○ | ○ |
| Stored-value card issued by your local transit agency | ○ | ○ |
| Unlimited Daily/Weekly/Monthly pass issued by a transit agency | ○ | ○ |
| Other | ○ | ○ |

**22.** ***(Only shown if the following options chosen for Q.21:"Stored-value card issued by your local transit agency" or "Unlimited Daily/ Weekly/Monthly pass issued by your local transit agency")*** **What payment method do you use to add value to your stored value card or to purchase your daily/weekly/monthly pass? Select one.**

- Currency/cash
- Check
- Money order
- Debit card
- Credit card
- Electronic/online bill payment
- Mobile payment account
- Wire transfer
- Pre-tax transportation account
- Other (please specify): _____

**23. If you drive, how do you typically pay tolls on turnpikes, toll roads, bridges, and tunnels or congestion taxes? Select all that apply.**

- don't drive ***(mutually exclusive; Skip to Q25)***
- I don't pay tolls
- Currency/cash
- Debit card
- Stored-value card
- Credit card
- Electronic toll payment system (e.g., I-Pass in Chicago; Sem Parar in São Paulo, ePass24 in Stockholm, ETC in Tokyo, Easy Pass in Bangkok, E-Tag in Lagos)
- Other (please specify): _____

**24.** ***(Only shown if If "Electronic toll payment system" chosen for Q.23)*** **What payment method do you use most often to add value to fund your electronic toll payment system?**

- Currency/cash
- Check
- Money order
- Debit card
- Credit card
- Stored-value card
- Electronic/online bill payment
- Mobile payment account
- Wire transfer
- Pre-tax transportation account
- Other (please specify): _____

## Crime Questions

This section asks about any recent experiences you may have had with crime over the last three years.

**25. Have you or anyone in your immediate family been a victim of a crime where cash was stolen over the last three years?**

- Yes
- No ***(Next question skipped if this option chosen)***

**26. Approximately how much was stolen?**

- Prefer not to answer
- Less than $25 [Equivalent local currencies used for each city]
- $25-$50
- $51-$100
- $101-$200
- $201-$500
- $501-$1000
- More than $1,000 (please specify): _____

## Some Final Questions

**27. How frequently, if at all, have you failed to purchase an item in the past month because you didn't have sufficient cash on hand and the retailer did not accept electronic (including credit or debit card) payments?**

- Never ***(skip to Q29 if this option chosen)***
- Once
- Twice
- 3-5 times
- More than 5 times

**28. How much did the last item you weren't able to purchase cost?**

- Prefer not to answer
- Less than $25 ***(Equivalent local currencies used for each city)***
- $25-$50
- $51-$100
- $101-$200
- $201-$500
- $501-$1000
- More than $1,000 (please specify):

**29. Government agencies and local businesses in cities are increasingly applying digital technology to facilitate interactions and payments (for example through credit cards). Which of the following, if any, do you see as the primary benefits to the use of digital technology for payments? Select all that apply.**

- ◯ Saves time; faster access to funds
- ◯ Saves money
- ◯ More convenient

- ◯ More customized service
- ◯ Reduced risk of crime; safe and secure
- ◯ Easier record keeping
- ◯ Avoid salespeople
- ◯ Loyalty and reward programs
- ◯ Better information and analytics
- ◯ Easier decision making
- ◯ Better for environment
- ◯ Better service
- ◯ Less congestion/traffic
- ◯ Easier communication

## Demographic Questions

**30. What is your gender?**

- Male
- Female

**31. Have you experienced income changes in the past year?**

- Large Negative (over 10%)
- Small Negative (1% to 10%)
- None
- Small Positive (1% to 10%)
- Large Positive (over 10%)

**32. What are your approximate household assets (cash, savings, and investments, including, real estate, less debt)?**

- Under $10,000 ***(Equivalent local currencies used for each city)***
- $10,000 - $100,000
- $100,001 - $500,000
- $500,001 - $1,000,000
- $Over 1,000,000

**33. Do you rent or own your primary residence?**

- Renter
- Homeowner with a mortgage
- Homeowner without a mortgage

**34. What is your employment status?**

- Employed
- Self-employed
- Employed part-time

- Not employed, but actively looking for work
- Not employed, but not actively looking for work
- Disabled and not able to work
- Retired
- Student

**35. Which of the following do you have? Select all that apply.**

- ◯ Mobile/Smart phone with internet access
- ◯ Tablet with internet access
- ◯ Computer with internet access

## A-2 Business Survey Questionnaire

With more than one-half of the world's population now living in urban areas, effective payment systems are especially important for consumers, businesses and public services. Roubini ThoughtLab, a leading research firm, is conducting this survey to understand the ways that your business and your customers make payments, and the costs and benefits associated with these transactions. We thank you for participating in this survey, and we will keep your responses strictly confidential.

### Background Questions

We would first like to ask some questions about yourself and your business.

**1. Where is your business located?**

- Chicago, US
- Bangkok, Thailand
- Lagos, Nigeria
- Stockholm, Sweden
- São Paulo, Brazil
- Tokyo, Japan
- Other ***(Survey terminated if this option chosen)***

**2.Are you familiar with payment methods accepted at your business and processing of those payments? Select one.**

- ◯ Yes, I am familiar with payment methods accepted at my business and the processing of those payment by my business
- ◯ No, I am not familiar with the payment methods accepted by my business and/or the processing of payments ***(Survey terminated if this option chosen)***

**3. Which of the following best describes your job function? Select one.**

- Business owner
- Senior management
- Manager reporting to senior management
- Business or store manager
- Financial director or manager

- Accounting director or manager
- Other ***(Survey terminated if this option chosen)***

**4. Which of the following accounts for most of your business's revenue? Select only one.**

- ◯ Business to consumer (B2C) – Sales that your business makes directly to consumers/individuals
- ◯ Business to business (B2B) – Sales that your business makes directly to other businesses.
- ◯ Business to government (B2G) – Sales that your business makes directly to government entities

**5. What was the annual revenue of your business over the past year? [different currency breaks used for each city][72]**

- ◯ Less than$ 25,000
- ◯ $25,000 to $50,000
- ◯ $50,000 to $100,000
- ◯ $100,000 to $249,000
- ◯ $250,000 to $499,999
- ◯ $500,000 to $749,000
- ◯ $750,000 to $999,999
- ◯ $1 million to $1.4 million
- ◯ $1.5 million to $1.9 million
- ◯ $2 million to 2.9 million
- ◯ $3 million to $4.9 million
- ◯ $5 million to $9 million
- ◯ $10 million to $19 million
- ◯ $20 million to $29 million
- ◯ $30 million to $49 million
- ◯ $50 million to $74 million
- ◯ $75 million to $99 million
- ◯ $100 million to $249 million
- ◯ $250 million to $499 million
- ◯ $500 million to $749 million
- ◯ $750 million to $999 million
- ◯ $1 billion to $1.4 billion
- ◯ $1.5 billion to $1.9 billion
- ◯ $2 billion to $2.4 billion
- ◯ $2.5 billion to $4.9 billion
- ◯ $5 billion to $9.9 billion
- ◯ $10 billion or more

**6. Which of the following best describes your business?**

- ◯ Agriculture, Forestry, Fishing, and Hunting
- ◯ Mining, Quarrying, and Oil and Gas Exploration
- ◯ Utilities
- ◯ Construction
- ◯ Manufacturing
- ◯ Wholesale Trade
- ◯ Retail Trade
- ◯ Transportation and Warehousing
- ◯ Information
- ◯ Finance and Insurance
- ◯ Real Estate and Rental and Leasing
- ◯ Professional, Scientific, and Professional Services
- ◯ Management of Companies and Enterprises
- ◯ Administrative and Support and Waste Management and Remediation Services
- ◯ Educational, Health Care, and Social Assistance Services
- ◯ Arts, Entertainment, and Recreation
- ◯ Accommodations and Food Services
- ◯ Other Service
- ◯ Public Administration / Government
- ◯ Other (please specify): _____

[72]Local currency intervals provided for each city

**6b.** ***(Question asked only for B2C Retail businesses)*****Please select the type of retail:**

- ◯ Food and Beverage Stores
- ◯ Gasoline Stations
- ◯ General Merchandise / Department Stores
- ◯ All other Retail

**6c.** ***[Only asked if "Accommodations and Food Services" chosen for Q.6.]*** **Please select the type of Accommodations and Food Service:**

- ◯ Accommodations
- ◯ Food Service and Drinking Places

## Payment Methods

We are particularly interested in learning about the types of payment that your business accepts from consumers.

For the purposes of this survey, please use the following definitions:

**Cash:** Coins and paper bills.

**Check:** A paper document directing financial institution to pay a specific amount of money to a person or business.

**Electronic check:** An electronic version of a paper check. A customer's paper check is run through an electronic scanner system that captures the customer's banking information and the payment amount. Funds are transferred from your customer's account into your account.

**Money order:** A paper document that can be purchased from a bank or other institution that allows the individual or business named on the order to receive a specified amount of cash on demand.

**Debit card:** A card that deducts funds directly from the customer's bank account.

**Credit card:** A card that allows the cardholder to make a purchase that will be paid back at a later date.

**Stored-value card:** A card that has money stored or loaded onto it. Also known as prepaid or gift card.

**Mobile payment account:** A mobile phone-based money transfer that allows users to deposit money into an account stored on their cell phones, send balances using PIN-secured SMS text messages to other users, including sellers of goods and services, and to redeem deposits for regular money. Customers can deposit money from a network of agents including air-time resellers and retail outlets. An example of a mobile payment account is PayPal and M-Pesa. ***(Examples localized for each city)***

**Wire transfer (ACH/EFTS payment):** An electronic transfer of money from one bank account to another, either within a single financial institution or across multiple institutions through computer-based systems and without the direct intervention of bank staff.

**7.** ***(Question asked only for B2C businesses)*** **Approximately how many transactions with customers do you have in an average day?**

- ◯ 1 to 5
- ◯ 6 to 10
- ◯ 11 to 15
- ◯ 16 to 20
- ◯ 21 to 25
- ◯ 26 to 30
- ◯ 31 to 40
- ◯ 41 to 50

- ◯ 51 to 75
- ◯ 76 to 100
- ◯ 101 to 150
- ◯ 151 to 250
- ◯ 251 to 500
- ◯ 501 to 1,000
- ◯ 1,001 to 2,500
- ◯ 2,501 to 5,000
- ◯ Over 5,000 (please specify): _____

**8.** ***(Question asked only for B2C businesses)*** **What is the amount of an average transaction?** ***(Open ended: different currency symbols for each city)***

_____

**9.** ***(Question asked only for B2B businesses)*** **Approximately how many accounts receivable transactions does your business participate in with other businesses during a given month?**

- 1 to 5
- 6 to 10
- 11 to 15
- 16 to 20
- 21 to 25
- 26 to 30
- 31 to 40
- 41 to 50
- 51 to 75
- 76 to 100
- 101 to 150
- 151 to 250
- 251 to 500
- 501 to 1,000
- 1,001 to 2,500
- 2,501 to 5,000
- Over 5,000 (please specify)

**10.** ***(Question asked only for B2B businesses)*** **What is the size of an average business-to-business transaction?** ***(open-ended with different currency symbols)***

_____

**11.** ***(Question asked only for B2G businesses)*** **Approximately how many transactions does your business have with government entities in a given month?**

- 1 to 5
- 6 to 10
- 11 to 15
- 16 to 20
- 21 to 25
- 26 to 30
- 31 to 40
- 41 to 50
- 51 to 75
- 76 to 100
- 101 to 150
- 151 to 250
- 251 to 500
- 501 to 1,000
- 1,001 to 2,500
- 2,501 to 5,000
- Over 5,000 (please specify): _____

**12.** ***(Question asked only for B2G businesses)*** **What is the size of an average government transaction (where your company is the supplier)?** ***(open-ended with different currency symbols)***

---

**13.** ***(Question asked only for B2C businesses)*** **Which of following payment methods do you accept from consumers? Select all that apply.**

- ◯ Cash/currency
- ◯ Check
- ◯ Money order
- ◯ Debit card
- ◯ Credit card
- ◯ Stored-value card
- ◯ Mobile payment
- ◯ Wire transfer/ACH /EFTS payment
- ◯ Other (please specify):

***(Question asked only if both cash and (credit cards or debit cards) selected in Q12)***

**14.** ***(Question asked only for B2C businesses)*** **Which of the following describes your company's policies towards cash and credit/debit card transactions? Select all that apply.**

- ◯ We charge the same for cash or credit/debit card transactions
- ◯ We offer a discount for cash payments
- ◯ We apply a surcharge for credit card payments

- ◯ We apply a surcharge for debit card payments
- ◯ We have a minimum transaction amount for credit/debit card payments
- ◯ Other (please specify): _____

**15.** ***(Question asked only for B2B businesses)*** **Which of the following payment methods do you accept from other businesses? Select all that apply.**

- ◯ Cash/currency
- ◯ Check
- ◯ Money order
- ◯ Debit card
- ◯ Credit card
- ◯ Stored-value card
- ◯ Mobile payment
- ◯ Wire transfer/ACH /EFTS payment
- ◯ Other (please specify): _____

**16.** ***(Question asked only for B2B businesses)*** **What are your preferred methods of payment from other businesses? Select all that apply.**

- ◯ We don't have a preferred payment method
- ◯ Cash/currency
- ◯ Check
- ◯ Money order
- ◯ Debit card
- ◯ Stored-value card
- ◯ Credit card
- ◯ Mobile payment
- ◯ Wire transfer/ACH /EFTS payment
- ◯ Other (please specify): _____

**17.** ***(Question asked only for B2G businesses)*** **Which of the following payment methods do you accept from government entities? Select all that apply.**

- ◯ Cash/currency
- ◯ Check
- ◯ Money order
- ◯ Debit cardCredit card
- ◯ Stored-value card
- ◯ Mobile payment
- ◯ Wire transfer/ACH /EFTS payment
- ◯ Other (please specify): _____

**18.** ***(Question asked only for B2G businesses)*** **What are your preferred methods of payment from government entities? Select all that apply**

- ◯ We don't have a preferred payment method
- ◯ Cash/currency
- ◯ Check
- ◯ Money order
- ◯ Debit card
- ◯ Credit card
- ◯ Stored-value card
- ◯ Mobile payment
- ◯ Wire transfer/ACH /EFTS payment
- ◯ Other (please specify): _____

**19. In a given month, how many of your transactions (in percentage terms) typically come through each of the following payment instruments? Please provide percentages adding to 100%.***

- Cash/currency
- Check _____
- Money order _____
- Debit card _____
- Credit card _____
- Stored-value card _____
- Mobile payment
- Wire transfer/ACH /EFTS payment _____
- Other ***(pipe in specified Other above: Q13 for B2C, Q15 for B2B and Q17 for B2G)***

_____

*Force to 100%

**20. In a given month, what is the amount of money (in percentage terms) that typically comes through each of the following payment instruments? Please provide percentages adding to 100%.***

- Cash/currency
- Check _____
- Money order _____
- Debit card _____
- Credit card _____
- Stored-value card _____
- Mobile payment _____
- Wire transfer/ACH /EFTS payment _____
- Other ***(pipe in specified Other above: Q13 for B2C, Q15 for B2B and Q17 for B2G)***

_____

*Force to 100%

**21. Over the past year, how has the usage of various payment methods by your customers changed?**

| | Decreased significantly (over 10%) | Decreased slightly (1% to 10%) | Stayed the same | Increased slightly (1% to 10%) | Don't plan to use |
|---|---|---|---|---|---|
| Cash/currency | ○ | ○ | ○ | ○ | ○ |
| Check | ○ | ○ | ○ | ○ | ○ |
| Money order | ○ | ○ | ○ | ○ | ○ |
| Debit card | ○ | ○ | ○ | ○ | ○ |
| Credit card | ○ | ○ | ○ | ○ | ○ |
| Stored-value card | ○ | ○ | ○ | ○ | ○ |
| Mobile payment | ○ | ○ | ○ | ○ | ○ |
| Wire transfer/ACH /EFTS payment | ○ | ○ | ○ | ○ | ○ |
| Other [pipe in specified Other above: Q13 for B2C, Q15 for B2B and Q17 for B2G] | ○ | ○ | ○ | ○ | ○ |

**22. Over the next year, how to you expect the usage of various payment methods by your customers to change?**

| | Decreased significantly (over 10%) | Decreased slightly (1% to 10%) | Stayed the same | Increased slightly (1% to 10%) | Increase significantly (over 10%) | Will not use |
|---|---|---|---|---|---|---|
| Cash/currency | ○ | ○ | ○ | ○ | ○ | ○ |
| Check | ○ | ○ | ○ | ○ | ○ | ○ |
| Money order | ○ | ○ | ○ | ○ | ○ | ○ |
| Debit card | ○ | ○ | ○ | ○ | ○ | ○ |
| Credit card | ○ | ○ | ○ | ○ | ○ | ○ |
| Stored-value card | ○ | ○ | ○ | ○ | ○ | ○ |
| Mobile payment | ○ | ○ | ○ | ○ | ○ | ○ |
| Wire transfer/ACH /EFTS payment | ○ | ○ | ○ | ○ | ○ | ○ |
| Other [pipe in specified Other above: Q13 for B2C, Q15 for B2B and Q17 for B2G] | ○ | ○ | ○ | ○ | ○ | ○ |

**23.** ***(Question asked only for B2C businesses)*** **When did you first start accepting electronic payments (e.g., credit card, debit card, stored-value card, mobile payment account, etc.)?**

- We don't accept electronic payments
- We have always accepted electronic payments
- Within the last year
- Within the last 5 years
- Within the last 10 years
- More than 10 years ago

**24.** ***(Question asked only for B2C businesses) (Question shown only "If within the last year", "within the last five years" selected above)*** **Did your sales change once you started accepting electronic payments, and, if so, approximately by how much?**

- ◯ More than 20% decrease
- ◯ 10%-20% decrease
- ◯ Less than 10% decrease
- ◯ No increase
- ◯ Less than 10% increase
- ◯ 10-19% increase
- ◯ 20-29% increase
- ◯ 30-39% increase
- ◯ 40-49% increase
- ◯ 50-74% increase
- ◯ 75-100% increase
- ◯ More than 100% increase

**25.** ***(Question asked only for B2C businesses)*** **Do you offer contactless payment terminals that allow the use of digital wallet platforms such as Android Pay, Apple Pay, Samsung Pay, Visa Checkout, and MasterPass?**

- Yes
- No ***(skip next question)***

**26.** ***(Question asked only for B2C businesses)*** **In a given month, approximately what percent of your transactions are through a contactless payment terminal? Move the slider to the correct percentage.**

Slider from 0% to 100%

**27. Do you accept payment from online eWallet payment platforms (such as PayPal, 2C2P, PagSeguro, etc.)?** ***(Examples localized for each city)***

- Yes
- No

## Payment Processing Costs

This section examines how much time your business spends processing different types of payment, and their associated costs.

**28.** ***(Question asked only for B2C businesses)*** **Which of the following determines the number of employees on duty to process payments at your business? Select all that apply.**

- Expected sales
- Types of goods and services expected to sell
- Payment methods used
- Customer traffic
- Time of day or day of the week (peak hours)
- Special sales, offerings, and events
- Seasonal calendar
- Always about the same number of employees [mutually exclusive]

**29. Please estimate the total amount of time spent by all of your employees (including yourself) on processing payments in a given month from all payment methods. Please answer in terms of the number of hours using the slider below.**

- Hypertext for "processing payments" in Question text
- For cash and check payments this includes cash counting and reconciliation, prepping and filling cash registers, ordering change, identifying counterfeit notes, preparing deposits, transporting cash and checks to and from the bank, dealing with lost cash, dealing with bounced checks, and security monitoring.
- For credit, debit, and pre-paid card payments that you accept at the point of sale this includes storing and filing of card signature slips, card reconciliation, checking terminals for security, and dealing with card fraud investigations.
- For mobile payment account payments this includes transaction reconciliation, dealing with fraud investigations, and other tasks.
- For Wire transfer/ACH /EFTS payments this includes transaction reconciliation, dealing with fraud investigations, and other tasks.
- Use Slider from 0 FTE to 500 hours

**30. Please estimate what percent of time is spent processing each of the following payment types. Please provide percentages adding to 100%.**

- Cash/currency, Check, Money order _____
- Debit, Credit, and Stored-value cards _____
- Mobile account payment _____
- Wire transfer/ACH /EFTS payment _____
- Other ***(pipe in specified Other above: Q13 for B2C, Q15 for B2B and Q17 for B2G)***

_____

***(Only shown if Q13=Check)***

**31.How do you process checks that you receive from customers? Select all that apply.**

- As a paper check
- As an electronic check

**32. As a percent of your total revenue, please estimate how much your business spends in a given month on cash and check/money order related fees and expenses. This includes bank processing fees, change fees, third-party transportation costs (if applicable), bank check processing fees, bounced check fees, other check related fees, and equipment for processing cash and check payments.**

- Less than 0.10%
- 0.10% to 0.24%
- 0.25% to 0.49%
- 0.50% to 0.74%
- 0.75% to 0.9%
- 1% to 2.9%
- 3% to 4.9%
- 5% to 6.9%
- 7% to 10%
- More than 10%

Please specify _____

**33. As a percentage of your total revenue, how much cash does your business lose to theft, cash register shortages, counterfeit currency, bounced/returned checks, counterfeit money orders, etc. in a given month?**

- We do not lose any revenue
- Less than 0.10%
- 0.10% to 0.24%
- 0.25% to 0.49%
- 0.50% to 0.74%
- 0.75% to 0.9%
- 1% to 2.9%
- 3% to 4.9%
- 5% to 6.9%
- 7% to 10%
- More than 10%

Please specify _____

**34. *(only asked if cash payments present)* If the amount of cash sales, as a percent of total sales, in your business were to increase substantially how would your business most likely react?**

Please rate each of the following: Strongly disagree (1); Slightly disagree (2); Neither disagree or agree (3); Slightly Agree (4); Strongly Agree (5).

- Spend more on cashiers _____
- Require more cash from the bank _____
- Spend more on accounting _____
- Make additional bank deposits _____
- Use additional armored car pickups _____

- Spend more on cash security _____
- Spend more on counterfeit detection _____

**35.** ***(only asked if credit and/or debit and/or pre-paid card payments or if mobile payment account accepted)*** **As a percent of your total revenue, please estimate how much your business spends in a given month on electronic payments related fees and costs, including costs related to the payment infrastructure, POS terminals and dedicated phone/ communications lines and processing fees associated with accepting credit and debit card payments (e.g., fixed monthly fees for network access, any per-transaction fees, and fees based on the value of the transaction),any fees associated with accepting payment from online eWallet payment platforms (such as Paypal, 2C2P, PagSeguro etc.), and any fees associated with accepting mobile account payments.**

- Less than 0.10%
- 0.10% to 0.24%
- 0.25% to 0.49%
- 0.50% to 0.74%
- 0.75% to 0.9%
- 1% to 2.9%
- 3% to 4.9%
- 5% to 6.9%
- 7% to 10%
- More than 10%, Please specify _____

**36.** ***(only asked if credit and/or debit and/or pre-paid card payments accepted)*** **As a percent of your total revenue, how much does your business lose due to card fraud (skimming, fake cards, etc.) that is not covered by your credit card companies and banks in a given month?**

- Less than 0.10%
- 0.10% to 0.24%
- 0.25% to 0.49%
- 0.50% to 0.74%
- 0.75% to 0.9%
- 1% to 2.9%
- 3% to 4.9%
- 5% to 6.9%
- 7% to 10%
- More than 10%, Please specify _____

**37. [only asked if wire transfer accepted] As a percent of your total revenue, please estimate how much your business spends on fess associated with accepting wire transfer/ACH/EFTS payments in a given month.**

- Less than 0.10%
- 0.10% to 0.24%
- 0.25% to 0.49%
- 0.50% to 0.74%

- 0.75% to 0.9%
- 1% to 2.9%
- 3% to 4.9%
- 5% to 6.9%
- 7% to 10%
- More than 10%, Please specify _____

**38. On average, how long does it take (in days) for each of the following payment methods to go from the time you accept the payment until the time when the funds are available in your bank account? Select one for each row.**

| | Available immediately | Less than 1 day | 1 day | 2 day | 3-5 day | 6 day | 7 day | More 7 day |
|---|---|---|---|---|---|---|---|---|
| Cash/currency | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Check | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Money order | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Debit card | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Credit card | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Stored-value card | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Mobile payment | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Online eWallet payment | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Other ***(pipe in specified Other above: Q13 for B2C, Q15 for B2B and Q17 for B2G)*** | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

## Digital Channels and Technologies

We are interested in learning more about how your business sells to and interacts with customers.

**40. In general, which stage best reflects your current level of digital transformation, and which stage best reflects where you plan to be in 3 years.**

| | Now | In 3 years |
|---|---|---|
| • Early: Beginning to apply digital technologies to support some business activities and starting to acquire and/or develop digital talent and capabilities. | ○ | ○ |
| • Intermediate: Have a digital culture and team in place that is actively applying digital technologies to a growing number of business activities, and generating some sales through a digital sales channel. | ○ | ○ |
| • Very advanced: Fully transformed business that puts digital technology at the center of all that we do and generates significant revenue and cost savings. | ○ | ○ |
| • Not relevant: Digital technology is not relevant for our business. | ○ | ○ |

**41a. Approximately what percentage of your monthly sales (by value) now comes through digital channels (including online, Internet, and mobile)?**

---

**41b. What percentage of your monthly sales (by value) do you expect to come through digital channels (including online, Internet, and mobile) in three years?**

---

**42.Approximately what percentage of your sales typically comes from outside of <<insert city name>>?**

0% (All of our sales are local), 1%-10%, 11%-20% .. 91%-100%, Do not know

---

**43.** ***(Only asked if online and mobile sales present)*** **Has your revenue changed as a result of accepting online and mobile orders (including the ability to sell outside your city location) and, if so, please estimate how much.**

- More than 20% decrease
- 10%-20% decrease
- Less than 10% decrease
- No increase
- Less than 10% increase
- 10-19% increase
- 20-29% increase
- 30-39% increase
- 40-49% increase
- 50-74% increase
- 75-100% increase
- More than 100% increase
- Do not know

**44. Which of the following types of digital technology and analytics does your company use now, and which do you plan to use in three years? Select all that apply.**

| | Now | In 3 years |
|---|---|---|
| 3D printing | ○ | ○ |
| Artificial Intelligence | ○ | ○ |
| Analysis of customer non-spend behaviors | ○ | ○ |
| Big data analytics | ○ | ○ |
| Cloud | ○ | ○ |
| Collaboration and telepresence technologies | ○ | ○ |
| Customer path to purchase analytics | ○ | ○ |
| Cybersecurity | ○ | ○ |
| Micro targeting or situational marketing | ○ | ○ |
| Mobile technology | ○ | ○ |
| Internet of Things (IoT) | ○ | ○ |
| Social media | ○ | ○ |
| Predictive analytics | ○ | ○ |
| Real-time tracking systems | ○ | ○ |
| Website analytics and sentiment analysis | ○ | ○ |

**45. The use of digital technology and analytics can increase or decrease your business's revenue, costs and employee productivity. Over the past year, how has the use of digital technology and analytics affected your business's revenue, costs, productivity and market share? Please answer each row.**

Pull-down menus (Decreased over 25%, Decreased 21% - 25%...Decreased 1% - 5%, No change, Increased 1% - 5% ...., Increased 21% - 25%, Increased over 25%)

- ○ Revenue over past year
- ○ Costs over past year
- ○ Productivity over past year
- ○ Market share over past year

## Accounts Payable

We are now going to ask you a few questions about how your business pays its accounts payable.

**46. Approximately how many accounts payable transactions does your business make in a given month?**

- 1 to 5
- 6 to 10
- 11 to 15
- 16 to 20
- 21 to 25
- 26 to 30
- 31 to 40
- 41 to 50
- 51 to 75
- 76 to 100
- 101 to 150
- 151 to 250
- 251 to 500
- 501 to 1,000
- 1,001 to 2,500
- 2,501 to 5,000
- Over 5,000 (please specify): _____

**47. Approximately how many businesses, including subcontractors and suppliers, do you have transactions with in a given month?**

- 1 to 5
- 6 to 10
- 11 to 15
- 16 to 20
- 21 to 25
- 26 to 30
- 31 to 40
- 41 to 50
- 51 to 75
- 76 to 100
- 101 to 150
- 151 to 250
- 251 to 500
- 501 to 1,000
- 1001 to 2,500
- 2501 to 5,000
- Over 5,000 (please specify): _____

**48. In a typical month, what percentage of your accounts payable (by value) do you pay using the following payment instruments? Please provide percentages adding to 100%.***

Cash/currency _____

Check _____

Money order _____

Debit card _____

Credit card _____

Stored-value card _____

Mobile payment

Wire transfer/ACH /EFTS payment _____

Other ***(pipe in specified Other above: Q13 for B2C, Q15 for B2B and Q17 for B2G)*** _____

*Force to 100%

**49. Please estimate the total amount of time spent by all of your employees (including yourself) on processing accounts payable in a given month. Please answer in terms of hours using the slider below.**

Slider from 0 – 500 hours

**50. Please estimate what percent of time is spent processing accounts payable using each of the following payment types. Please provide percentages adding to 100%.**

Cash/currency _____

Check _____

Money order _____

Debit card _____

Credit card _____

Stored-value card _____

Mobile payment

Wire transfer/ACH /EFTS payment _____

Other ***(pipe in specified Other above: Q13 for B2C, Q15 for B2B and Q17 for B2G)*** _____

**51. Over the past year, how has the usage of various payment methods by your business changed for accounts payable?**

| | Decreased significantly (over 10%) | Decreased slightly (1% to 10%) | Stayed the same | Increased slightly (1% to 10%) | Increased significantly (over 10%) |
|---|---|---|---|---|---|
| Cash/currency | ○ | ○ | ○ | ○ | ○ |
| Check | ○ | ○ | ○ | ○ | ○ |
| Money order | ○ | ○ | ○ | ○ | ○ |
| Debit card | ○ | ○ | ○ | ○ | ○ |

| | Decreased significantly (over 10%) | Decreased slightly (1% to 10%) | Stayed the same | Increased slightly (1% to 10%) | Increased significantly (over 10%) |
|---|---|---|---|---|---|
| Credit card | ○ | ○ | ○ | ○ | ○ |
| Stored-value card | ○ | ○ | ○ | ○ | ○ |
| Mobile payment | ○ | ○ | ○ | ○ | ○ |
| Wire transfer/ACH /EFTS payment | ○ | ○ | ○ | ○ | ○ |
| Other ***(pipe in specified Other above: Q13 for B2C, Q15 for B2B and Q17 for B2G)*** | ○ | ○ | ○ | ○ | ○ |

**52. Over the next year, how do you expect the usage of various payment methods by your business to change for accounts payable?**

| | Decreased significantly (over 10%) | Decreased slightly (1% to 10%) | Stayed the same | Increased slightly (1% to 10%) | Increase significantly (over 10%) | Will not use |
|---|---|---|---|---|---|---|
| Cash/currency | ○ | ○ | ○ | ○ | ○ | ○ |
| Check | ○ | ○ | ○ | ○ | ○ | ○ |
| Money order | ○ | ○ | ○ | ○ | ○ | ○ |
| Debit card | ○ | ○ | ○ | ○ | ○ | ○ |
| Credit card | ○ | ○ | ○ | ○ | ○ | ○ |
| Stored-value card | ○ | ○ | ○ | ○ | ○ | ○ |
| Mobile payment | ○ | ○ | ○ | ○ | ○ | ○ |
| Wire transfer/ACH /EFTS payment | ○ | ○ | ○ | ○ | ○ | ○ |
| Other [pipe in specified Other above: Q13 for B2C, Q15 for B2B and Q17 for B2G] | ○ | ○ | ○ | ○ | ○ | ○ |

**53. In a given month, how much does your business lose on average as a result of purchasing abuse and misuse by your employees? This includes violating policies for personal gain, internal fraud, and external fraud.**

_____ $ [Use local currency symbols]

*(Only asked if wire transfer was selected in 48)*

**54. Please estimate how much your business spends on fees associated with initiating wire transfer/ACH/EFTS payments in a given month.**

Ranges in local currency to follow

**55. Does your company make monthly (or more frequent) payments to the government (e.g., taxes)?**

Yes

No ***(skip to q56)***

**55b. In a typical month, what percentage of your government payments (by value) do you make using the following payment methods? This includes taxes, fees and licenses and other government payments. Please provide percentages adding to 100%.***

Cash/currency _____

Check _____

Money order _____

Debit card _____

Credit card _____

Stored-value card _____

Mobile payment

Wire transfer/ACH /EFTS payment _____

Other ***(pipe in specified Other above: Q13 for B2C, Q15 for B2B and Q17 for B2G)*** _____

*Force to 100%

**56. What percentage of your employees receive their wages and salaries using the following methods?***

• Cash _____%

• Paper check _____%

• Direct deposit into bank account _____%

• Deposit onto a stored-value card/prepaid payroll card _____%

•Other (please specify): _____%

*Force to 100%

**57. In a typical month, how much time, in hours, does your business spend processing payroll?** ***(open ended)***

---

## Demographic questions

These final demographic questions will enable us to categorize survey responses into meaningful groupings.

**58.** ***(Only asked for B2C consumers)*** **Which of the following best describes your business? Select one.**

• Traditional brick and mortar business

• Digital platform company (i.e., a born-digital company that provides products and services almost exclusively through digital means, such as eBay or Uber)

• Combination

**59. How much did your company's revenues last year change versus the previous year? Select one.**

- Down by more than 10%
- Down by 3%-10%
- About the same (+/- 2%)
- Up by 3%-10%
- Up by more than 10%
- Don't know

**60. Is your business registered with the government? Select one.**

- Yes
- No
- Prefer not to answer

**61. What is the ownership structure of your business? Select one.**

- Sole proprietor
- Partnership
- Limited partnership
- Franchised chain
- Regional chain
- National chain
- International chain
- Publicly traded company

**62. How many employees do you have?**

- ◯ Fewer than 10
- ◯ 10 to 14
- ◯ 15 to 19
- ◯ 20 to 24
- ◯ 25 to 29
- ◯ 30 to 49
- ◯ 50 to 74
- ◯ 75 to 99
- ◯ 100 to 249
- ◯ 250 to 499
- ◯ 500 to 999
- ◯ 1,000 to 2,499
- ◯ 2,500 to 4,999
- ◯ 5,000 to 9,999
- ◯ Over 10,000 (please specify): _____

# Appendix B – Data Sources

In addition to the primary data collected for the benchmark cities from the consumer and business surveys and the data sources discussed above, the 100-city model relied on the following data sources.

## B-1 General Data

Digital Payment Usage and Readiness: World Bank Financial Inclusion Survey Data (http://datatopics.worldbank.org/financialinclusion/), 2014

Population: McKinsey Urban World App (http://www.mckinsey.com/mgi/overview/in-the-news/urban-world-app), October 2016

Population Distribution by Age Cohort: United Nations Population Divisions (https://esa.un.org/unpd/wpp/Download/Standard/Population/), 2017

Households: McKinsey Urban World App (http://www.mckinsey.com/global-themes/urbanization/urban-world-mapping-the-economic-power-of-cities), October 2016

GDP: McKinsey Urban World App (http://www.mckinsey.com/mgi/overview/in-the-news/urban-world-app), October 2016

Employment: Calculated using data from the World Bank on labor force participation (http://data.worldbank.org/indicator/SL.TLF.CACT.NE.ZS) and the unemployment (http://data.worldbank.org/indicator/SL.UEM.TOTL.NE.ZS), 2014 and 2016

Income: World Bank GNI/per capita data were used as a proxy for income (http://data.worldbank.org/indicator/NY.GNP.PCAP.CD), 2016

## B-2 Consumer Model

Transit Ridership: Multiple data sources including individual transit agencies,

Interest Rate: http://www.deposits.org/, Accessed November 2016

Percentage of Individuals with a Bank Account: World Bank Financial Inclusion Survey Data (http://datatopics.worldbank.org/financialinclusion/), 2014

## B-3 Business Model

Interest Rate: http://www.deposits.org/, Accessed November 2016

## B-4 Government Model

Size of the Informal Economy: https://iea.org.uk/wp-content/uploads/2016/07/IEA%20Shadow%20Economy%20web%20rev%207.6.13.pdf, 2013

Tax Revenue as a Percent of GDP: World Bank http://data.worldbank.org/indicator/GC.TAX.TOTL.GD.ZS, 2016

Government Spending as Percent of GDP: World Bank https://data.worldbank.org/indicator/NE.CON.GOVT.CD, 2016

Administrative Spending: OECD https://stats.oecd.org/Index.aspx?DataSetCode=SNA_TABLE11, Accessed November, 2016

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