ATM Cost Analysis

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This paper outlines the variance in ATM costs worldwide. Absent primary data on the cost to maintain ATM fleets in a number of countries, we estimate from secondary sources. The key data sources present in this report are:

- Number of ATMs in each country.
- Maintenance cost of an ATM.
- Cost of funds in the ATM.
- Capital expense for the ATM itself.

The following sections treat each cost in turn; followed by an explicit model for how the costs were calculated.

ATM count

The World Bank estimates ATMs per capita, population and GDP per capita.

```
## Loading required package: ggplot2
## Loading required package: data.table
## Loading required package: xtable
## Loading required package: stargazer
##
## Please cite as:
##
##  Hlavac, Marek (2014). stargazer: LaTeX code and ASCII text for well-formatted regression and summary
##  R package version 5.1. http://CRAN.R-project.org/package=stargazer


##  [1] "atmcap"          "ATMcost"         "ATMcostvars"
##  [4] "ATMusa"          "eurointerest"    "eurozone"
##  [7] "gdpcap"          "interest"        "intrate"
## [10] "metadata"        "pop"             "pppconv"
## [13] "ppplevel"        "tab.rankunitcost" "tab_rankunitcost"
## [16] "tab1"            "tab2"            "USdepositrate"
## [19] "USdiscountrate"  "USlendingrate"   "USmoneyrate"


##       Country.Code Country.Name ATMper100k population      ATMs
##   1:          ABW         Aruba   115.8796     102048    118.25
##   2:          AFG   Afghanistan     0.6198   29117538    180.48
##   3:          AGO        Angola    15.7307   20189681   3175.98
##   4:          ALB       Albania    32.5179    2829123    919.97
##   5:          AND       Andorra        NaN      78402       NaN
##  ---
## 254:          WSM         Samoa    26.9822     187485     50.59
## 255:          YEM   Yemen, Rep.     3.7464   23311326    873.34
## 256:          ZAF  South Africa    58.6913   51591046  30279.46
## 257:          ZMB        Zambia     7.5777   13657910   1034.96
## 258:          ZWE      Zimbabwe     4.7241   13439720    634.90
```

```
##    Country.Code         Country.Name   ATMper100k        population
## ABW    :  1   Afghanistan   :  1   Min.   :  0.03   Min.   :9.84e+03
## AFG    :  1   Albania       :  1   1st Qu.:  9.37   1st Qu.:1.33e+06
## AGO    :  1   Algeria       :  1   Median : 30.85   Median :8.41e+06
## ALB    :  1   American Samoa:  1   Mean   : 42.84   Mean   :1.95e+08
## AND    :  1   Andean Region :  1   3rd Qu.: 58.34   3rd Qu.:3.81e+07
## ANR    :  1   Andorra       :  1   Max.   :274.54   Max.   :6.96e+09
## (Other):252   (Other)       :252   NA's   :49       NA's   :11
##      ATMs
## Min.   :      2
## 1st Qu.:    414
## Median :   2112
## Mean   :  75461
## 3rd Qu.:  17034
## Max.   :2199554
## NA's   :49


##    Country.Code Country.Name ATMper100k population    ATMs
## 1:          USA United States      137.7  311536582  428830


##        NAME     NROW MB
## [1,] atmcap     258 1
## [2,] ATMcost    258 1
## [3,] ATMusa       1 1
## [4,] gdpcap     258 1
## [5,] interest   181 1
## [6,] intrate    483 1
## [7,] pop        258 1
## [8,] pppconv    258 1
## [9,] ppplevel   258 1
##      COLS
## [1,] Country.Name,Country.Code,Indicator.Name,Indicator.Code,X2004,X2005,X2006,X2007,
## [2,] Country.Code,Country.Name,ATMper100k,population,ATMs
## [3,] Country.Name,cost_permo,cost_maint,cost_funds,cost_capex
## [4,] Country.Name,Country.Code,Indicator.Name,Indicator.Code,X2009,X2010,X2011,X2012,
## [5,] Country,deposit,discount,lending,moneymarket,ratiodiscount,ratiolending,ratiomon
## [6,] Country,Concept,Unit,Data.Source,Status,Scale,X2008,X2009,X2010,X2011,X2012,X201
## [7,] Country.Name,Country.Code,Indicator.Name,Indicator.Code,X2009,X2010,X2011,X2012,
## [8,] Country.Name,Country.Code,Indicator.Name,Indicator.Code,X2009,X2010,X2011,X2012,
## [9,] Country.Name,Country.Code,Indicator.Name,Indicator.Code,X2009,X2010,X2011,X2012,
##      KEY
## [1,] Country.Code
## [2,] Country.Code
## [3,]
## [4,] Country.Code
## [5,] Country
## [6,] Country
## [7,] Country.Code
## [8,]
## [9,]
## Total: 9MB
```
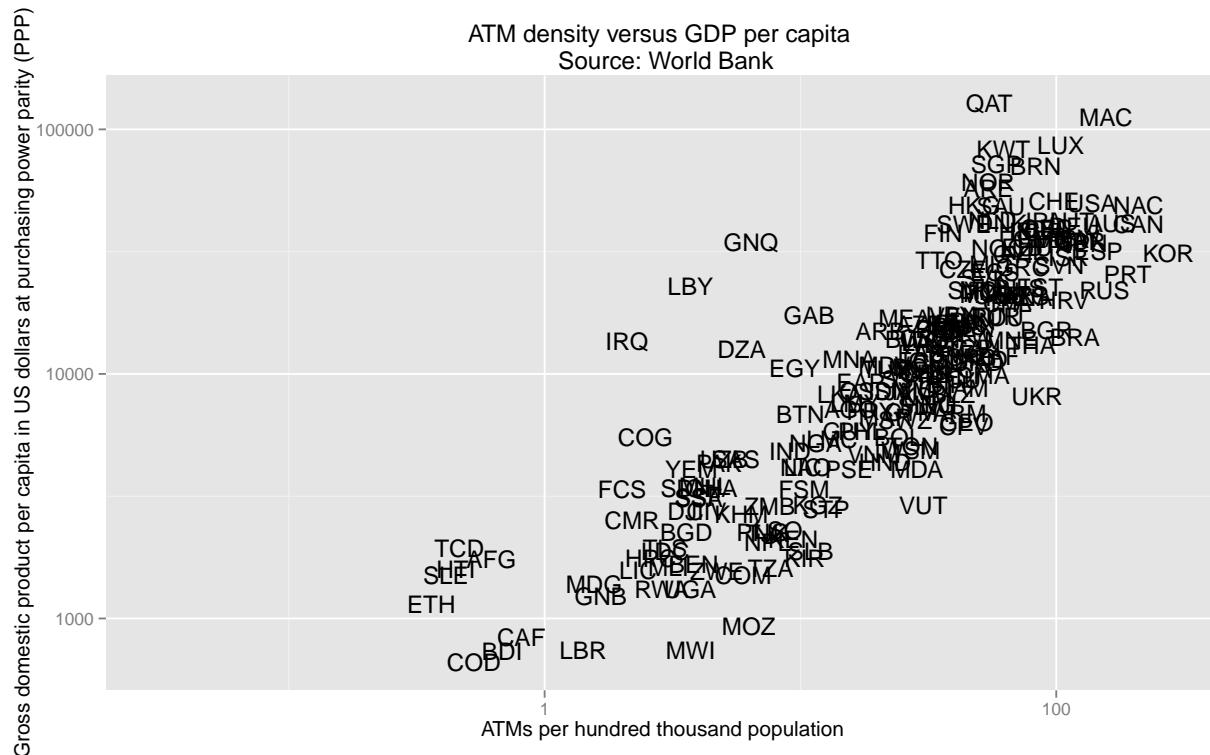
ATM density versus GDP per capita
Source: World Bank

(y-axis) Gross domestic product per capita in US dollars at purchasing power parity (PPP)

(x-axis) ATMs per hundred thousand population

Maintenance cost

Cost of maintenance is assumed proportional to the PPP price level ratio.

```
## Data live in data.table ppplevel
##      Create a new variable named c_maint
##      Merge on "Country.Code"
setkey(ATMcost, "Country.Code"); setkey(ppplevel, "Country.Code")

# ATMcostvars <- names(ATMcost)
# rm(ATMcostvars)
tables()
```

```
##          NAME      NROW MB
##   [1,] atmcap      258 1
##   [2,] ATMcost     258 1
##   [3,] ATMusa        1 1
##   [4,] gdpcap      258 1
##   [5,] interest    181 1
##   [6,] intrate     483 1
##   [7,] pop         258 1
##   [8,] pppconv     258 1
##   [9,] ppplevel    258 1
##          COLS
##   [1,] Country.Name,Country.Code,Indicator.Name,Indicator.Code,X2004,X2005,X2006,X2007,
##   [2,] Country.Code,Country.Name,ATMper100k,population,ATMs,GDPcap
##   [3,] Country.Name,cost_permo,cost_maint,cost_funds,cost_capex
##   [4,] Country.Name,Country.Code,Indicator.Name,Indicator.Code,X2009,X2010,X2011,X2012,
```

```
##    [5,] Country,deposit,discount,lending,moneymarket,ratiodiscount,ratiolending,ratiomon
##    [6,] Country,Concept,Unit,Data.Source,Status,Scale,X2008,X2009,X2010,X2011,X2012,X201
##    [7,] Country.Name,Country.Code,Indicator.Name,Indicator.Code,X2009,X2010,X2011,X2012,
##    [8,] Country.Name,Country.Code,Indicator.Name,Indicator.Code,X2009,X2010,X2011,X2012,
##    [9,] Country.Name,Country.Code,Indicator.Name,Indicator.Code,X2009,X2010,X2011,X2012,
##         KEY
##    [1,] Country.Code
##    [2,] Country.Code
##    [3,]
##    [4,] Country.Code
##    [5,] Country
##    [6,] Country
##    [7,] Country.Code
##    [8,]
##    [9,] Country.Code
## Total: 9MB
```

```r
ATMcost <- ATMcost[ppplevel[,.SD, .SDcols=c("Country.Code","estimate")],]
setnames(ATMcost, "estimate", "c_maint")
```

```
##         Now c_maint gives the PPP level ratio of each country relative to the USA.
```

```r
tables()
```

```
##         NAME      NROW MB
##    [1,] atmcap     258 1
##    [2,] ATMcost    258 1
##    [3,] ATMusa       1 1
##    [4,] gdpcap     258 1
##    [5,] interest   181 1
##    [6,] intrate    483 1
##    [7,] pop        258 1
##    [8,] pppconv    258 1
##    [9,] ppplevel   258 1
##         COLS
##    [1,] Country.Name,Country.Code,Indicator.Name,Indicator.Code,X2004,X2005,X2006,X2007,
##    [2,] Country.Code,Country.Name,ATMper100k,population,ATMs,GDPcap,c_maint
##    [3,] Country.Name,cost_permo,cost_maint,cost_funds,cost_capex
##    [4,] Country.Name,Country.Code,Indicator.Name,Indicator.Code,X2009,X2010,X2011,X2012,
##    [5,] Country,deposit,discount,lending,moneymarket,ratiodiscount,ratiolending,ratiomon
##    [6,] Country,Concept,Unit,Data.Source,Status,Scale,X2008,X2009,X2010,X2011,X2012,X201
##    [7,] Country.Name,Country.Code,Indicator.Name,Indicator.Code,X2009,X2010,X2011,X2012,
##    [8,] Country.Name,Country.Code,Indicator.Name,Indicator.Code,X2009,X2010,X2011,X2012,
##    [9,] Country.Name,Country.Code,Indicator.Name,Indicator.Code,X2009,X2010,X2011,X2012,
##         KEY
##    [1,] Country.Code
##    [2,] Country.Code
##    [3,]
##    [4,] Country.Code
##    [5,] Country
##    [6,] Country
##    [7,] Country.Code
##    [8,]
##    [9,] Country.Code
```

```
## Total: 9MB
```

```
# ##      Check USA is the numeraire
# ATMcost["United States",]
summary(ATMcost)
```

```
##   Country.Code        Country.Name    ATMper100k        population
## ABW    :  1   Afghanistan   :  1   Min.   :  0.03   Min.   :      9843
## AFG    :  1   Albania       :  1   1st Qu.:  9.37   1st Qu.:   1330534
## AGO    :  1   Algeria       :  1   Median : 30.85   Median :   8413002
## ALB    :  1   American Samoa:  1   Mean   : 42.84   Mean   : 195243017
## AND    :  1   Andean Region :  1   3rd Qu.: 58.34   3rd Qu.:  38083502
## ANR    :  1   Andorra       :  1   Max.   :274.54   Max.   :6963908391
## (Other):252   (Other)       :252   NA's   :49       NA's   :11
##      ATMs              GDPcap          c_maint
## Min.   :      2   Min.   :   662   Min.   :0.27
## 1st Qu.:    414   1st Qu.:  3440   1st Qu.:0.43
## Median :   2112   Median : 10669   Median :0.53
## Mean   :  75461   Mean   : 16924   Mean   :0.62
## 3rd Qu.:  17034   3rd Qu.: 22274   3rd Qu.:0.70
## Max.   :2199554   Max.   :127698   Max.   :1.59
## NA's   :49        NA's   :35       NA's   :68
```

Cost of funds

The cost of funds is calculated on a per-machine basis. The per-machine cost is a simple ratio of the cost of funds in the United States to the cost of funds in country i.

```
##        NAME    NROW MB
## [1,] atmcap    258 1
## [2,] ATMcost   258 1
## [3,] ATMusa      1 1
## [4,] gdpcap    258 1
## [5,] interest  181 1
## [6,] intrate   483 1
## [7,] pop       258 1
## [8,] pppconv   258 1
## [9,] ppplevel  258 1
##       COLS
## [1,] Country.Name,Country.Code,Indicator.Name,Indicator.Code,X2004,X2005,X2006,X2007,
## [2,] Country.Code,Country.Name,ATMper100k,population,ATMs,GDPcap,c_maint
## [3,] Country.Name,cost_permo,cost_maint,cost_funds,cost_capex
## [4,] Country.Name,Country.Code,Indicator.Name,Indicator.Code,X2009,X2010,X2011,X2012,
## [5,] Country,deposit,discount,lending,moneymarket,ratiodiscount,ratiolending,ratiomon
## [6,] Country,Concept,Unit,Data.Source,Status,Scale,X2008,X2009,X2010,X2011,X2012,X201
## [7,] Country.Name,Country.Code,Indicator.Name,Indicator.Code,X2009,X2010,X2011,X2012,
## [8,] Country.Name,Country.Code,Indicator.Name,Indicator.Code,X2009,X2010,X2011,X2012,
## [9,] Country.Name,Country.Code,Indicator.Name,Indicator.Code,X2009,X2010,X2011,X2012,
##       KEY
## [1,] Country.Code
## [2,] Country.Code
## [3,]
```

```
##  [4,] Country.Code
##  [5,] Country
##  [6,] Country
##  [7,] Country.Code
##  [8,]
##  [9,] Country.Code
## Total: 9MB


## [1] "Country.Name"  "deposit"       "discount"      "lending"
## [5] "moneymarket"   "ratiodiscount" "ratiolending"  "ratiomoney"
## [9] "estimate"


## Loading required package: countrycode


##                                            Country.Name deposit discount
##   1:               Afghanistan, Islamic Republic of      NA       NA
##   2:                                          Albania  5.1503       NA
##   3:                                          Algeria  1.7500     4.00
##   4:                                           Angola  4.3526    20.56
##   5:                                         Anguilla  3.8407     6.50
##  ---
## 177:                                          Vietnam 10.5457       NA
## 178: West African Economic and Monetary Union (WAEMU)  3.5000       NA
## 179:                               West Bank and Gaza  0.4933       NA
## 180:                               Yemen, Republic of 18.2500       NA
## 181:                                           Zambia  6.8381    10.74
##      lending moneymarket ratiodiscount ratiolending ratiomoney estimate
##   1:  15.075       0.200            NA        4.638      1.718   15.848
##   2:  11.046          NA            NA        3.399         NA   11.613
##   3:   8.000       1.394         5.333        2.462     11.976    5.333
##   4:  17.074       7.635        27.407        5.254     65.597   27.407
##   5:   9.250       5.718         8.667        2.846     49.130    8.667
##  ---
## 177:  13.600          NA            NA        4.185         NA   14.298
## 178:      NA          NA            NA           NA         NA       NA
## 179:   6.877          NA            NA        2.116         NA    7.230
## 180:  23.861          NA            NA        7.342         NA   25.085
## 181:  13.502          NA        14.315        4.155         NA   14.315
##      Country.Code
##   1:          AFG
##   2:          ALB
##   3:          DZA
##   4:          AGO
##   5:          AIA
##  ---
## 177:          VNM
## 178:          ZAF
## 179:          WBG
## 180:          YEM
## 181:          ZMB


##                                            Country.Name deposit discount
##   1:               Afghanistan, Islamic Republic of      NA       NA
```

```
##   2:                                            Albania  5.1503       NA
##   3:                                            Algeria  1.7500     4.00
##   4:                                             Angola  4.3526    20.56
##   5:                                           Anguilla  3.8407     6.50
##  ---
## 177:                                            Vietnam 10.5457       NA
## 178: West African Economic and Monetary Union (WAEMU)  3.5000       NA
## 179:                                West Bank and Gaza  0.4933       NA
## 180:                                Yemen, Republic of 18.2500       NA
## 181:                                            Zambia  6.8381    10.74
##      lending moneymarket ratiodiscount ratiolending ratiomoney estimate
##   1:  15.075       0.200            NA        4.638      1.718   15.848
##   2:  11.046          NA            NA        3.399         NA   11.613
##   3:   8.000       1.394         5.333        2.462     11.976    5.333
##   4:  17.074       7.635        27.407        5.254     65.597   27.407
##   5:   9.250       5.718         8.667        2.846     49.130    8.667
##  ---
## 177:  13.600          NA            NA        4.185         NA   14.298
## 178:      NA          NA            NA           NA         NA       NA
## 179:   6.877          NA            NA        2.116         NA    7.230
## 180:  23.861          NA            NA        7.342         NA   25.085
## 181:  13.502          NA        14.315        4.155         NA   14.315
##      Country.Code
##   1:          AFG
##   2:          ALB
##   3:          DZA
##   4:          AGO
##   5:          AIA
##  ---
## 177:          VNM
## 178:          ZAF
## 179:          WBG
## 180:          YEM
## 181:          ZMB


## [1] 180  10

## [1] "Country.Code" "Country.Name" "ATMper100k"   "population"
## [5] "ATMs"         "GDPcap"       "c_maint"      "estimate"

## [1] "Country.Name" "deposit"      "discount"      "lending"
## [5] "moneymarket"  "ratiodiscount" "ratiolending" "ratiomoney"
## [9] "estimate"     "Country.Code"

##         NAME    NROW MB
## [1,] atmcap    258  1
## [2,] ATMcost   180  1
## [3,] ATMusa      1  1
## [4,] gdpcap    258  1
## [5,] interest  180  1
## [6,] intrate   483  1
## [7,] pop       258  1
## [8,] pppconv   258  1
```

```
## [9,] ppplevel  258 1
##      COLS
## [1,] Country.Name,Country.Code,Indicator.Name,Indicator.Code,X2004,X2005,X2006,X2007,
## [2,] Country.Code,Country.Name,ATMper100k,population,ATMs,GDPcap,c_maint,c_int
## [3,] Country.Name,cost_permo,cost_maint,cost_funds,cost_capex
## [4,] Country.Name,Country.Code,Indicator.Name,Indicator.Code,X2009,X2010,X2011,X2012,
## [5,] Country.Name,deposit,discount,lending,moneymarket,ratiodiscount,ratiolending,rat
## [6,] Country,Concept,Unit,Data.Source,Status,Scale,X2008,X2009,X2010,X2011,X2012,X201
## [7,] Country.Name,Country.Code,Indicator.Name,Indicator.Code,X2009,X2010,X2011,X2012,
## [8,] Country.Name,Country.Code,Indicator.Name,Indicator.Code,X2009,X2010,X2011,X2012,
## [9,] Country.Name,Country.Code,Indicator.Name,Indicator.Code,X2009,X2010,X2011,X2012,
##      KEY
## [1,] Country.Code
## [2,]
## [3,]
## [4,] Country.Code
## [5,] Country.Code
## [6,] Country
## [7,] Country.Code
## [8,]
## [9,] Country.Code
## Total: 9MB


##   Country.Code          Country.Name    ATMper100k
## ABW    :  1   Afghanistan       :  1   Min.   :  0.03
## AFG    :  1   Albania           :  1   1st Qu.:  9.41
## AGO    :  1   Algeria           :  1   Median : 33.39
## ALB    :  1   Angola            :  1   Mean   : 43.08
## ARG    :  1   Antigua and Barbuda:  1  3rd Qu.: 56.76
## (Other):166  (Other)           :166   Max.   :274.54
## NA's   :  9  NA's              :  9   NA's   :18
##   population            ATMs           GDPcap          c_maint
## Min.   :     31060  Min.   :    11  Min.   :    733  Min.   :0.266
## 1st Qu.:   2008713  1st Qu.:   308  1st Qu.:   3733  1st Qu.:0.430
## Median :   7241879  Median :  1410  Median : 10411  Median :0.527
## Mean   :  40942790  Mean   : 19628  Mean   : 16919  Mean   :0.602
## 3rd Qu.:  28271523  3rd Qu.:  6600  3rd Qu.: 22011  3rd Qu.:0.685
## Max.   :1344234000  Max.   :428830  Max.   :127698  Max.   :1.518
## NA's   :9           NA's   :18      NA's   :13       NA's   :14
##     c_int
## Min.   : 0.40
## 1st Qu.: 5.00
## Median : 8.87
## Mean   :10.64
## 3rd Qu.:14.29
## Max.   :60.45
## NA's   :17
```

Capital expense

Most market research on national ATM fleets is proprietary. RBR London reports on sales, features, and cost. Those numbers are not useful for this benchmarking exercise unless we can reach an agreement with them to share our models and theirs.

We treat all fleets as equally expensive on a capital expenditure basis.

Modeled cost

Using the model below, we calculate per-machine maintenance costs worldwide. The basic inputs to the model are USA costs per machine for maintenance, funds, and capital expense. The output is a per-machine cost worldwide; from which we calculate the national cost worldwide.

```r
ATMusa <- data.table("United States", 1290.05, 971.41, 81.27, 237.37)
names(ATMusa) <- c("Country.Name", "cost_permo", "cost_maint", "cost_funds", "cost_capex")
```

```
## Warning: The names(x)<-value syntax copies the whole table. This is due to
## <- in R itself. Please change to setnames(x,old,new) which does not copy
## and is faster. See help('setnames'). You can safely ignore this warning if
## it is inconvenient to change right now. Setting options(warn=2) turns this
## warning into an error, so you can then use traceback() to find and change
## your names<- calls.
```

```r
attr(ATMusa, "table.label") <- "Cost of a single ATM in the United States in 2012, based on US GDP defla
str(ATMusa)
```

```
## Classes 'data.table' and 'data.frame':    1 obs. of  5 variables:
##  $ Country.Name: chr "United States"
##  $ cost_permo  : num 1290
##  $ cost_maint  : num 971
##  $ cost_funds  : num 81.3
##  $ cost_capex  : num 237
##  - attr(*, ".internal.selfref")=<externalptr>
##  - attr(*, "table.label")= chr "Cost of a single ATM in the United States in 2012, based on US GDP d
```

```r
names(ATMcost)
```

```
## [1] "Country.Code" "Country.Name" "ATMper100k"   "population"
## [5] "ATMs"         "GDPcap"       "c_maint"      "c_int"
```

```
##    Calculate worldwide per-machine costs of ATM operations
ATMcost[,gamma_maint := c_maint * ATMusa$cost_maint]
```

```
##       Country.Code Country.Name ATMper100k population      ATMs GDPcap
##   1:            NA           NA         NA         NA        NA     NA
##   2:           ABW        Aruba   115.8796     102048    118.25  36016
##   3:           AFG  Afghanistan     0.6198   29117538    180.48   1743
##   4:           AGO       Angola    15.7307   20189681   3175.98   7145
##   5:            NA           NA         NA         NA        NA     NA
##  ---
## 176:           WSM        Samoa    26.9822     187485     50.59   4866
## 177:           YEM  Yemen, Rep.     3.7464   23311326    873.34   4070
## 178:           ZAF South Africa   58.6913   51591046  30279.46  11837
## 179:            NA           NA         NA         NA        NA     NA
## 180:           ZMB       Zambia     7.5777   13657910   1034.96   2881
```

```
##      c_maint  c_int gamma_maint
##   1:      NA  5.000          NA
##   2:  0.7040  1.333       683.9
##   3:  0.3420 15.848       332.2
##   4:  0.6854 27.407       665.8
##   5:      NA  8.667          NA
##  ---
## 176:  0.6739 10.521       654.6
## 177:  0.3313 25.085       321.9
## 178:  0.5844  9.199       567.7
## 179:      NA 13.667          NA
## 180:  0.4582 14.315       445.1
```

```
ATMcost[,gamma_int := c_int * ATMusa$cost_funds]
```

```
##      Country.Code Country.Name ATMper100k population      ATMs GDPcap
##   1:           NA           NA         NA         NA        NA     NA
##   2:          ABW        Aruba   115.8796     102048    118.25  36016
##   3:          AFG  Afghanistan     0.6198   29117538    180.48   1743
##   4:          AGO       Angola    15.7307   20189681   3175.98   7145
##   5:           NA           NA         NA         NA        NA     NA
##  ---
## 176:          WSM        Samoa    26.9822     187485     50.59   4866
## 177:          YEM  Yemen, Rep.     3.7464   23311326    873.34   4070
## 178:          ZAF South Africa   58.6913   51591046  30279.46  11837
## 179:           NA           NA         NA         NA        NA     NA
## 180:          ZMB       Zambia     7.5777   13657910   1034.96   2881
##      c_maint  c_int gamma_maint gamma_int
##   1:      NA  5.000          NA     406.3
##   2:  0.7040  1.333       683.9     108.4
##   3:  0.3420 15.848       332.2    1288.0
##   4:  0.6854 27.407       665.8    2227.4
##   5:      NA  8.667          NA     704.3
##  ---
## 176:  0.6739 10.521       654.6     855.1
## 177:  0.3313 25.085       321.9    2038.7
## 178:  0.5844  9.199       567.7     747.6
## 179:      NA 13.667          NA    1110.7
## 180:  0.4582 14.315       445.1    1163.4
```

```
ATMcost[,gamma_capex := ATMusa$cost_capex]
```

```
##      Country.Code Country.Name ATMper100k population      ATMs GDPcap
##   1:           NA           NA         NA         NA        NA     NA
##   2:          ABW        Aruba   115.8796     102048    118.25  36016
##   3:          AFG  Afghanistan     0.6198   29117538    180.48   1743
##   4:          AGO       Angola    15.7307   20189681   3175.98   7145
##   5:           NA           NA         NA         NA        NA     NA
##  ---
## 176:          WSM        Samoa    26.9822     187485     50.59   4866
## 177:          YEM  Yemen, Rep.     3.7464   23311326    873.34   4070
## 178:          ZAF South Africa   58.6913   51591046  30279.46  11837
## 179:           NA           NA         NA         NA        NA     NA
```

```
## 180:          ZMB      Zambia   7.5777   13657910 1034.96   2881
##       c_maint  c_int gamma_maint gamma_int gamma_capex
##   1:      NA  5.000          NA     406.3       237.4
##   2:  0.7040  1.333       683.9     108.4       237.4
##   3:  0.3420 15.848       332.2    1288.0       237.4
##   4:  0.6854 27.407       665.8    2227.4       237.4
##   5:      NA  8.667          NA     704.3       237.4
##  ---
## 176:  0.6739 10.521       654.6     855.1       237.4
## 177:  0.3313 25.085       321.9    2038.7       237.4
## 178:  0.5844  9.199       567.7     747.6       237.4
## 179:      NA 13.667          NA    1110.7       237.4
## 180:  0.4582 14.315       445.1    1163.4       237.4
```

```
##     Calculate worldwide per-machine cost
ATMcost[,gamma_sum := gamma_maint + gamma_int + gamma_capex]
```

```
##       Country.Code Country.Name ATMper100k population     ATMs GDPcap
##   1:          NA          NA         NA         NA       NA     NA
##   2:         ABW       Aruba   115.8796     102048   118.25  36016
##   3:         AFG Afghanistan     0.6198   29117538   180.48   1743
##   4:         AGO      Angola    15.7307   20189681  3175.98   7145
##   5:          NA          NA         NA         NA       NA     NA
##  ---
## 176:         WSM       Samoa    26.9822     187485    50.59   4866
## 177:         YEM Yemen, Rep.     3.7464   23311326   873.34   4070
## 178:         ZAF South Africa   58.6913   51591046 30279.46  11837
## 179:          NA          NA         NA         NA       NA     NA
## 180:         ZMB      Zambia    7.5777   13657910  1034.96   2881
##       c_maint  c_int gamma_maint gamma_int gamma_capex gamma_sum
##   1:      NA  5.000          NA     406.3       237.4        NA
##   2:  0.7040  1.333       683.9     108.4       237.4      1030
##   3:  0.3420 15.848       332.2    1288.0       237.4      1858
##   4:  0.6854 27.407       665.8    2227.4       237.4      3131
##   5:      NA  8.667          NA     704.3       237.4        NA
##  ---
## 176:  0.6739 10.521       654.6     855.1       237.4      1747
## 177:  0.3313 25.085       321.9    2038.7       237.4      2598
## 178:  0.5844  9.199       567.7     747.6       237.4      1553
## 179:      NA 13.667          NA    1110.7       237.4        NA
## 180:  0.4582 14.315       445.1    1163.4       237.4      1846
```

```
summary(ATMcost)
```

```
##   Country.Code               Country.Name   ATMper100k
##   ABW    :  1   Afghanistan        :  1   Min.   :  0.03
##   AFG    :  1   Albania            :  1   1st Qu.:  9.41
##   AGO    :  1   Algeria            :  1   Median : 33.39
##   ALB    :  1   Angola             :  1   Mean   : 43.08
##   ARG    :  1   Antigua and Barbuda:  1   3rd Qu.: 56.76
##   (Other):166   (Other)            :166   Max.   :274.54
##   NA's   :  9   NA's               :  9   NA's   :18
##    population                ATMs            GDPcap           c_maint
```

```
## Min.    :      31060   Min.    :     11   Min.    :     733   Min.    :0.266
## 1st Qu.:    2008713   1st Qu.:    308   1st Qu.:    3733   1st Qu.:0.430
## Median :    7241879   Median :  1410   Median :  10411   Median :0.527
## Mean   :   40942790   Mean   : 19628   Mean   : 16919   Mean   :0.602
## 3rd Qu.:   28271523   3rd Qu.:  6600   3rd Qu.: 22011   3rd Qu.:0.685
## Max.   :1344234000   Max.   :428830   Max.   :127698   Max.   :1.518
## NA's   :9            NA's   :18        NA's   :13        NA's   :14
##      c_int        gamma_maint       gamma_int        gamma_capex
## Min.   : 0.40    Min.   : 259    Min.   :  33    Min.   :237
## 1st Qu.: 5.00    1st Qu.: 417    1st Qu.: 406    1st Qu.:237
## Median : 8.87    Median : 512    Median : 721    Median :237
## Mean   :10.64    Mean   : 585    Mean   : 865    Mean   :237
## 3rd Qu.:14.29    3rd Qu.: 665    3rd Qu.:1161    3rd Qu.:237
## Max.   :60.45    Max.   :1474    Max.   :4913    Max.   :237
## NA's   :17       NA's   :14       NA's   :17
##    gamma_sum
## Min.   : 680
## 1st Qu.:1305
## Median :1595
## Mean   :1705
## 3rd Qu.:1932
## Max.   :5460
## NA's   :29
```

```r
qplot(GDPcap, gamma_sum, data=ATMcost, geom="text", label=Country.Code, log="xy")+
  labs(title="Unit Cost of ATM Maintenance", x="GDP per capita", y="Modeled monthly cost per ATM, USD")
```

```
## Warning: Removed 29 rows containing missing values (geom_text).
```


Unit Cost of ATM Maintenance
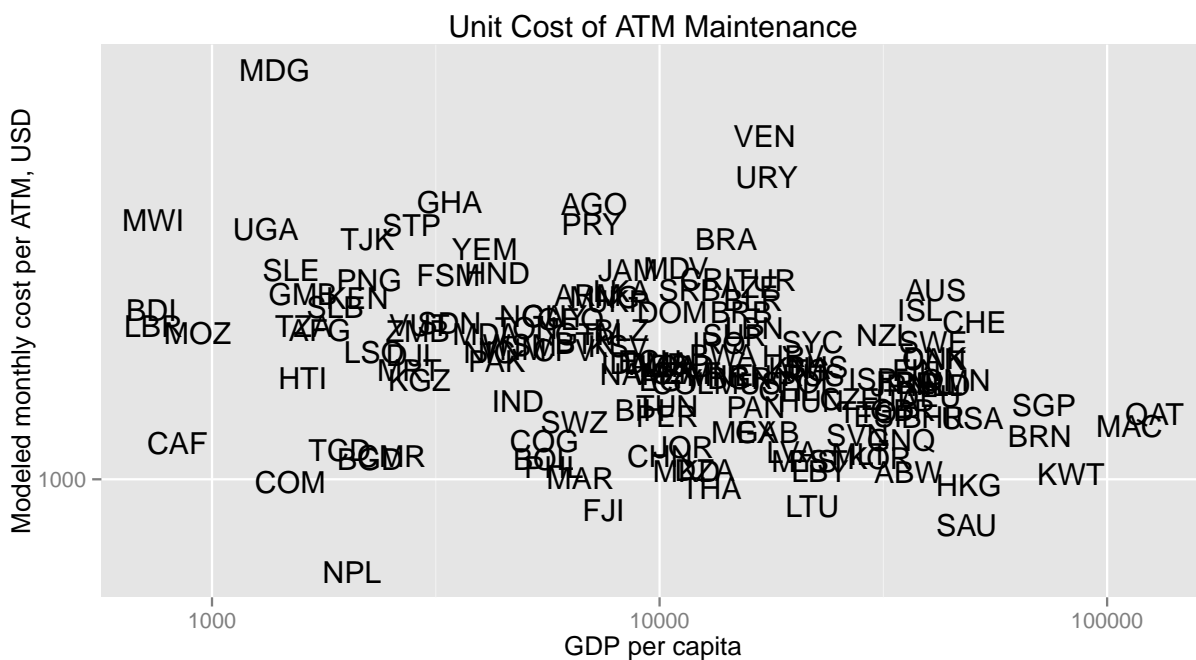
```
##    Calculate national fleet costs
ATMcost[,national := gamma_sum * ATMs]
```

```
##      Country.Code Country.Name ATMper100k population      ATMs GDPcap
##   1:           NA           NA         NA         NA        NA     NA
##   2:          ABW        Aruba   115.8796     102048    118.25  36016
##   3:          AFG  Afghanistan     0.6198   29117538    180.48   1743
##   4:          AGO       Angola    15.7307   20189681   3175.98   7145
##   5:           NA           NA         NA         NA        NA     NA
##  ---
## 176:          WSM        Samoa    26.9822     187485     50.59   4866
## 177:          YEM  Yemen, Rep.     3.7464   23311326    873.34   4070
## 178:          ZAF South Africa   58.6913   51591046  30279.46  11837
## 179:           NA           NA         NA         NA        NA     NA
## 180:          ZMB       Zambia     7.5777   13657910   1034.96   2881
##      c_maint  c_int gamma_maint gamma_int gamma_capex gamma_sum national
##   1:      NA  5.000          NA     406.3       237.4        NA       NA
##   2:  0.7040  1.333       683.9     108.4       237.4      1030   121751
##   3:  0.3420 15.848       332.2    1288.0       237.4      1858   335260
##   4:  0.6854 27.407       665.8    2227.4       237.4      3131  9942677
##   5:      NA  8.667          NA     704.3       237.4        NA       NA
##  ---
## 176:  0.6739 10.521       654.6     855.1       237.4      1747    88379
## 177:  0.3313 25.085       321.9    2038.7       237.4      2598  2268866
## 178:  0.5844  9.199       567.7     747.6       237.4      1553 47012401
## 179:      NA 13.667          NA    1110.7       237.4        NA       NA
## 180:  0.4582 14.315       445.1    1163.4       237.4      1846  1910388
```

```
summary(ATMcost)
```

```
##   Country.Code              Country.Name   ATMper100k
##   ABW    :  1    Afghanistan        :  1   Min.   :  0.03
##   AFG    :  1    Albania            :  1   1st Qu.:  9.41
##   AGO    :  1    Algeria            :  1   Median : 33.39
##   ALB    :  1    Angola             :  1   Mean   : 43.08
##   ARG    :  1    Antigua and Barbuda:  1   3rd Qu.: 56.76
##   (Other):166    (Other)            :166   Max.   :274.54
##   NA's   :  9    NA's               :  9   NA's   :18
##     population              ATMs            GDPcap         c_maint
##   Min.   :     31060   Min.   :    11   Min.   :   733   Min.   :0.266
##   1st Qu.:   2008713   1st Qu.:   308   1st Qu.:  3733   1st Qu.:0.430
##   Median :   7241879   Median :  1410   Median : 10411   Median :0.527
##   Mean   :  40942790   Mean   : 19628   Mean   : 16919   Mean   :0.602
##   3rd Qu.:  28271523   3rd Qu.:  6600   3rd Qu.: 22011   3rd Qu.:0.685
##   Max.   :1344234000   Max.   :428830   Max.   :127698   Max.   :1.518
##   NA's   :9            NA's   :18       NA's   :13       NA's   :14
##      c_int         gamma_maint      gamma_int       gamma_capex
##   Min.   : 0.40   Min.   : 259   Min.   :  33   Min.   :237
##   1st Qu.: 5.00   1st Qu.: 417   1st Qu.: 406   1st Qu.:237
##   Median : 8.87   Median : 512   Median : 721   Median :237
##   Mean   :10.64   Mean   : 585   Mean   : 865   Mean   :237
##   3rd Qu.:14.29   3rd Qu.: 665   3rd Qu.:1161   3rd Qu.:237
```

```
## Max.  :60.45    Max.   :1474   Max.   :4913   Max.   :237
## NA's  :17       NA's   :14     NA's   :17
##   gamma_sum        national
## Min.  : 680    Min.   :    24948
## 1st Qu.:1305    1st Qu.:  380644
## Median :1595    Median :  2479707
## Mean  :1705    Mean   : 29244988
## 3rd Qu.:1932    3rd Qu.: 10821788
## Max.  :5460    Max.   :631777659
## NA's  :29       NA's   :33
```

```
qplot(population, national, data=ATMcost, geom="text", label=Country.Code, log="xy")+
  labs(title="National Cost of ATM maintenance", x="Population",y="National cost of ATMs")
```

```
## Warning: Removed 33 rows containing missing values (geom_text).
```
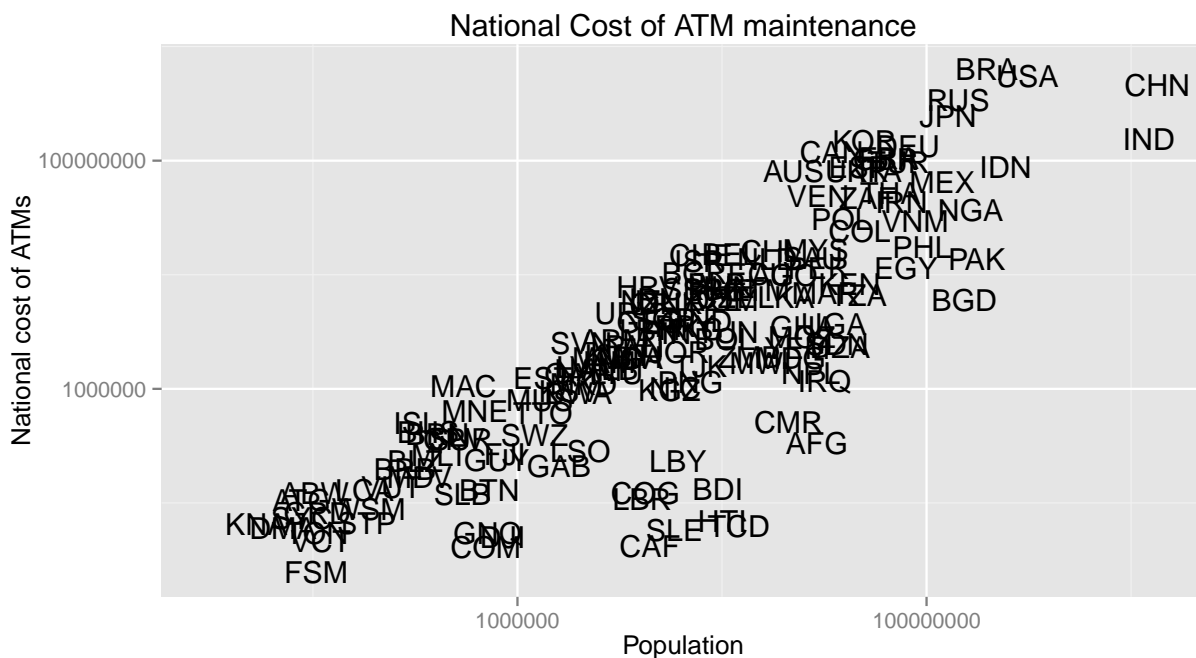

And here are the rank orderings by cost.

```
## Rank order by ATM unit cost
setkey(ATMcost, gamma_sum)
tab1 <- xtable(ATMcost[!is.na(gamma_sum),c("Country.Name","Country.Code","gamma_sum"), with=F], label="-
print(tab1, tabular.environment="longtable")
```

```
## Warning: Attempt to use "longtable" with floating = TRUE. Changing to
## FALSE.
```

% latex table generated in R 3.1.1 by xtable 1.7-3 package % Mon Sep 29 16:57:33 2014

Country.Name	Country.Code	gamma_sum

1	Nepal	NPL	680.49
2	Saudi Arabia	SAU	828.35
3	Fiji	FJI	880.59
4	Lithuania	LTU	894.44
5	Thailand	THA	963.71
6	Hong Kong SAR, China	HKG	976.06
7	Comoros	COM	987.89
8	Morocco	MAR	1004.26
9	Kuwait	KWT	1021.72
10	Aruba	ABW	1029.58
11	Libya	LBY	1033.29
12	Macedonia, FYR	MKD	1036.13
13	Algeria	DZA	1040.19
14	Philippines	PHL	1051.42
15	Malaysia	MYS	1076.99
16	Estonia	EST	1078.96
17	Bangladesh	BGD	1086.46
18	Bolivia	BOL	1089.43
19	Korea, Rep.	KOR	1090.77
20	China	CHN	1098.85
21	Cameroon	CMR	1100.80
22	Malta	MLT	1112.01
23	Latvia	LVA	1119.15
24	Chad	TCD	1127.47
25	Jordan	JOR	1140.70
26	Central African Republic	CAF	1163.06
27	Congo, Rep.	COG	1171.31
28	Equatorial Guinea	GNQ	1177.83
29	Brunei Darussalam	BRN	1196.71
30	Slovenia	SVN	1198.65
31	Gabon	GAB	1216.94
32	Mexico	MEX	1217.28
33	Macao SAR, China	MAC	1248.77
34	Swaziland	SWZ	1269.99
35	United States	USA	1290.05
36	Bahrain	BHR	1292.80
37	Peru	PER	1297.36
38	Spain	ESP	1298.27
39	Qatar	QAT	1311.77
40	Trinidad and Tobago	TTO	1318.81
41	United Kingdom	GBR	1329.69
42	Bosnia and Herzegovina	BIH	1330.42
43	Panama	PAN	1347.82
44	Tunisia	TUN	1353.81
45	Singapore	SGP	1359.50
46	India	IND	1381.63
47	Hungary	HUN	1384.56
48	Italy	ITA	1387.63
49	Czech Republic	CZE	1395.24
50	Germany	DEU	1414.46
51	Chile	CHL	1449.56
52	Netherlands	NLD	1474.57
53	Japan	JPN	1480.16

54	Ireland	IRL	1482.31
55	Colombia	COL	1488.99
56	Belgium	BEL	1489.58
57	Mauritius	MUS	1489.77
58	France	FRA	1494.08
59	Poland	POL	1497.01
60	Kyrgyz Republic	KGZ	1506.22
61	Oman	OMN	1508.76
62	Egypt, Arab Rep.	EGY	1510.65
63	Israel	ISR	1511.80
64	Bulgaria	BGR	1518.36
65	Haiti	HTI	1519.38
66	Iran, Islamic Rep.	IRN	1536.61
67	Montenegro	MNE	1538.85
68	Russian Federation	RUS	1543.09
69	Namibia	NAM	1549.12
70	St. Vincent and the Grenadines	VCT	1550.08
71	South Africa	ZAF	1552.62
72	Antigua and Barbuda	ATG	1569.08
73	Mauritania	MRT	1569.40
74	Finland	FIN	1574.87
75	St. Kitts and Nevis	KNA	1584.78
76	Bahamas, The	BHS	1594.98
77	Grenada	GRD	1597.41
78	St. Lucia	LCA	1601.19
79	Albania	ALB	1609.91
80	Dominica	DMA	1615.76
81	Indonesia	IDN	1617.85
82	Ecuador	ECU	1629.91
83	Pakistan	PAK	1633.94
84	Canada	CAN	1648.52
85	Denmark	DNK	1649.97
86	Croatia	HRV	1664.22
87	Djibouti	DJI	1675.11
88	Botswana	BWA	1676.19
89	Nicaragua	NIC	1692.02
90	Lesotho	LSO	1697.34
91	Cabo Verde	CPV	1705.43
92	Vietnam	VNM	1718.13
93	Kosovo	KSV	1733.71
94	Samoa	WSM	1747.06
95	Iraq	IRQ	1760.46
96	Bhutan	BTN	1760.86
97	Sweden	SWE	1762.70
98	Seychelles	SYC	1769.45
99	New Zealand	NZL	1815.56
100	Suriname	SUR	1816.57
101	Moldova	MDA	1825.87
102	Guatemala	GTM	1828.24
103	Mozambique	MOZ	1830.01
104	Zambia	ZMB	1845.86
105	Belize	BLZ	1853.58
106	Afghanistan	AFG	1857.62
107	Lebanon	LBN	1867.95

108	Tonga	TON	1873.86
109	Tanzania	TZA	1883.76
110	Liberia	LBR	1888.42
111	Vanuatu	VUT	1894.02
112	Sudan	SDN	1907.48
113	Switzerland	CHE	1919.96
114	Georgia	GEO	1944.04
115	Guyana	GUY	1964.32
116	Nigeria	NGA	1968.68
117	Dominican Republic	DOM	1996.37
118	Barbados	BRB	1997.20
119	Iceland	ISL	2014.20
120	Burundi	BDI	2016.30
121	Solomon Islands	SLB	2042.02
122	Ukraine	UKR	2091.20
123	Belarus	BLR	2102.01
124	Kenya	KEN	2115.90
125	Mongolia	MNG	2129.17
126	Armenia	ARM	2149.27
127	Gambia, The	GMB	2157.03
128	Sri Lanka	LKA	2180.19
129	Australia	AUS	2192.85
130	Serbia	SRB	2194.21
131	Azerbaijan	AZE	2222.37
132	Papua New Guinea	PNG	2284.67
133	Turkey	TUR	2285.18
134	Costa Rica	CRI	2293.75
135	Micronesia, Fed. Sts.	FSM	2332.78
136	Honduras	HND	2352.66
137	Sierra Leone	SLE	2379.42
138	Jamaica	JAM	2382.77
139	Maldives	MDV	2402.71
140	Yemen, Rep.	YEM	2597.93
141	Tajikistan	TJK	2704.40
142	Brazil	BRA	2706.83
143	Uganda	UGA	2824.35
144	Sao Tome and Principe	STP	2872.34
145	Paraguay	PRY	2882.24
146	Malawi	MWI	2926.49
147	Angola	AGO	3130.59
148	Ghana	GHA	3152.43
149	Uruguay	URY	3493.43
150	Venezuela, RB	VEN	4146.48
151	Madagascar	MDG	5459.69

Table 1: Unit cost of ATM Operations

```
## Rank order by total fleet cost
setkey(ATMcost, national)
tab2 <- xtable(ATMcost[!is.na(national),c("Country.Name","Country.Code","national"),with=F], caption =
print(tab2, tabular.environment="longtable")
```

```
## Warning: Attempt to use "longtable" with floating = TRUE. Changing to
```

FALSE.

% latex table generated in R 3.1.1 by xtable 1.7-3 package % Mon Sep 29 16:57:33 2014

	Country.Name	Country.Code	national
1	Micronesia, Fed. Sts.	FSM	24947.53
2	Comoros	COM	41352.59
3	Central African Republic	CAF	41888.83
4	St. Vincent and the Grenadines	VCT	46125.28
5	Djibouti	DJI	50515.96
6	Tonga	TON	53967.24
7	Equatorial Guinea	GNQ	54186.25
8	Sierra Leone	SLE	57485.18
9	Dominica	DMA	59652.23
10	Chad	TCD	63241.44
11	St. Kitts and Nevis	KNA	64911.62
12	Sao Tome and Principe	STP	66259.07
13	Haiti	HTI	68616.79
14	Seychelles	SYC	73629.49
15	Grenada	GRD	81980.59
16	Samoa	WSM	88379.33
17	Antigua and Barbuda	ATG	105689.03
18	Liberia	LBR	108530.05
19	Solomon Islands	SLB	120662.74
20	Aruba	ABW	121751.24
21	Congo, Rep.	COG	122657.13
22	Bhutan	BTN	128425.26
23	St. Lucia	LCA	129636.74
24	Burundi	BDI	131339.39
25	Vanuatu	VUT	138398.99
26	Maldives	MDV	170109.66
27	Barbados	BRB	198518.38
28	Gabon	GAB	209822.26
29	Belize	BLZ	231639.14
30	Libya	LBY	233985.07
31	Guyana	GUY	239698.05
32	Malta	MLT	260867.14
33	Fiji	FJI	270172.73
34	Lesotho	LSO	282608.82
35	Afghanistan	AFG	335260.34
36	Cabo Verde	CPV	365849.00
37	Suriname	SUR	365906.97
38	Swaziland	SWZ	395381.48
39	Brunei Darussalam	BRN	404738.78
40	Bahamas, The	BHS	420961.91
41	Iceland	ISL	496424.08
42	Cameroon	CMR	512341.30
43	Trinidad and Tobago	TTO	612821.42
44	Montenegro	MNE	636951.41
45	Mauritius	MUS	803590.86
46	Botswana	BWA	911762.82
47	Kosovo	KSV	948194.32
48	Kyrgyz Republic	KGZ	974786.72
49	Nicaragua	NIC	1006684.40

50	Macao SAR, China	MAC	1064545.84
51	Macedonia, FYR	MKD	1107344.81
52	Papua New Guinea	PNG	1143155.74
53	Iraq	IRQ	1175944.90
54	Estonia	EST	1234271.24
55	Qatar	QAT	1354642.58
56	Nepal	NPL	1376035.66
57	Lithuania	LTU	1384005.62
58	Namibia	NAM	1470413.70
59	Albania	ALB	1481068.89
60	Latvia	LVA	1546476.83
61	Tajikistan	TJK	1571216.05
62	Malawi	MWI	1684586.87
63	Jamaica	JAM	1698291.42
64	Madagascar	MDG	1847170.11
65	Mongolia	MNG	1852721.03
66	Moldova	MDA	1854723.74
67	Zambia	ZMB	1910387.93
68	Bosnia and Herzegovina	BIH	1912148.24
69	Kuwait	KWT	1981036.51
70	Jordan	JOR	2080620.05
71	Yemen, Rep.	YEM	2268865.60
72	Algeria	DZA	2314014.62
73	Panama	PAN	2370630.33
74	Sudan	SDN	2479707.46
75	Slovenia	SVN	2531748.56
76	Armenia	ARM	2673880.04
77	Bolivia	BOL	2717715.21
78	Mozambique	MOZ	2827446.96
79	Finland	FIN	3064745.66
80	Tunisia	TUN	3140724.71
81	Lebanon	LBN	3246575.35
82	Hong Kong SAR, China	HKG	3308299.95
83	Ghana	GHA	3510366.89
84	Paraguay	PRY	3566635.79
85	Uganda	UGA	3684568.76
86	Georgia	GEO	3870775.39
87	Honduras	HND	3919319.20
88	Singapore	SGP	4117845.66
89	Uruguay	URY	4576275.97
90	Costa Rica	CRI	5491469.69
91	Denmark	DNK	5615118.32
92	New Zealand	NZL	5926891.39
93	Azerbaijan	AZE	5948733.03
94	Bangladesh	BGD	5952644.21
95	Dominican Republic	DOM	5962323.08
96	Ireland	IRL	6092229.28
97	Czech Republic	CZE	6347475.40
98	Sri Lanka	LKA	6402496.93
99	Tanzania	TZA	6690789.72
100	Morocco	MAR	6954853.75
101	Sweden	SWE	7278658.59
102	Guatemala	GTM	7285584.10
103	Serbia	SRB	7409751.58

104	Croatia	HRV	7745633.77
105	Hungary	HUN	7853548.39
106	Belarus	BLR	8317528.00
107	Kenya	KEN	8340768.11
108	Angola	AGO	9942677.13
109	Ecuador	ECU	10062331.51
110	Bulgaria	BGR	10237175.85
111	Egypt, Arab Rep.	EGY	11406401.12
112	Peru	PER	11469576.75
113	Israel	ISR	13102020.08
114	Pakistan	PAK	13809852.57
115	Netherlands	NLD	13831180.17
116	Saudi Arabia	SAU	13982765.90
117	Switzerland	CHE	14890347.29
118	Belgium	BEL	15161217.15
119	Chile	CHL	16143697.11
120	Malaysia	MYS	16461043.19
121	Philippines	PHL	17341519.24
122	Colombia	COL	24019246.96
123	Vietnam	VNM	29266433.99
124	Poland	POL	30846263.08
125	Nigeria	NGA	37069949.89
126	Iran, Islamic Rep.	IRN	43212985.09
127	South Africa	ZAF	47012400.66
128	Venezuela, RB	VEN	48791735.35
129	Thailand	THA	51433693.13
130	Mexico	MEX	65461186.62
131	Ukraine	UKR	80577343.09
132	Australia	AUS	80721246.50
133	Italy	ITA	80926719.43
134	Indonesia	IDN	87469214.17
135	Spain	ESP	88508930.58
136	Turkey	TUR	97094723.54
137	United Kingdom	GBR	103840552.02
138	France	FRA	105411321.05
139	Canada	CAN	118738078.90
140	Germany	DEU	135269372.93
141	Korea, Rep.	KOR	148892051.58
142	India	IND	153766260.49
143	Japan	JPN	244108114.27
144	Russian Federation	RUS	340144061.42
145	China	CHN	455728899.78
146	United States	USA	553212277.82
147	Brazil	BRA	631777658.77

Table 2: Rank order of national ATM fleet cost

Countries studied

```
setkey(ATMcost, Country.Name)
ATMcost$Country.Name
```

```
##   [1] <NA>                        <NA>
##   [3] <NA>                        <NA>
##   [5] <NA>                        <NA>
##   [7] <NA>                        <NA>
##   [9] <NA>                        Afghanistan
##  [11] Albania                     Algeria
##  [13] Angola                      Antigua and Barbuda
##  [15] Argentina                   Armenia
##  [17] Aruba                       Australia
##  [19] Azerbaijan                  Bahamas, The
##  [21] Bahrain                     Bangladesh
##  [23] Barbados                    Belarus
##  [25] Belgium                     Belize
##  [27] Benin                       Bhutan
##  [29] Bolivia                     Bosnia and Herzegovina
##  [31] Botswana                    Brazil
##  [33] Brunei Darussalam           Bulgaria
##  [35] Burkina Faso                Burundi
##  [37] Cabo Verde                  Cambodia
##  [39] Cameroon                    Canada
##  [41] Central African Republic    Chad
##  [43] Chile                       China
##  [45] Colombia                    Comoros
##  [47] Congo, Rep.                 Costa Rica
##  [49] Cote d'Ivoire               Croatia
##  [51] Czech Republic              Denmark
##  [53] Djibouti                    Dominica
##  [55] Dominican Republic          Ecuador
##  [57] Egypt, Arab Rep.            El Salvador
##  [59] Equatorial Guinea           Estonia
##  [61] Ethiopia                    Euro area
##  [63] Fiji                        Finland
##  [65] France                      Gabon
##  [67] Gambia, The                 Georgia
##  [69] Germany                     Ghana
##  [71] Grenada                     Guatemala
##  [73] Guinea-Bissau               Guyana
##  [75] Haiti                       Honduras
##  [77] Hong Kong SAR, China        Hungary
##  [79] Iceland                     India
##  [81] Indonesia                   Iran, Islamic Rep.
##  [83] Iraq                        Ireland
##  [85] Israel                      Italy
##  [87] Jamaica                     Japan
##  [89] Jordan                      Kenya
##  [91] Korea, Rep.                 Kosovo
##  [93] Kuwait                      Kyrgyz Republic
##  [95] Lao PDR                     Latvia
##  [97] Lebanon                     Lesotho
##  [99] Liberia                     Libya
## [101] Lithuania                   Macao SAR, China
## [103] Macedonia, FYR              Madagascar
## [105] Malawi                      Malaysia
## [107] Maldives                    Mali
```

```
## [109] Malta                   Mauritania
## [111] Mauritius                Mexico
## [113] Micronesia, Fed. Sts.    Moldova
## [115] Mongolia                 Montenegro
## [117] Morocco                  Mozambique
## [119] Myanmar                  Namibia
## [121] Nepal                    Netherlands
## [123] New Zealand              Nicaragua
## [125] Niger                    Nigeria
## [127] Norway                   Oman
## [129] Pakistan                 Panama
## [131] Papua New Guinea         Paraguay
## [133] Peru                     Philippines
## [135] Poland                   Qatar
## [137] Russian Federation       Rwanda
## [139] Samoa                    San Marino
## [141] Sao Tome and Principe    Saudi Arabia
## [143] Senegal                  Serbia
## [145] Seychelles               Sierra Leone
## [147] Singapore                Slovak Republic
## [149] Slovenia                 Solomon Islands
## [151] South Africa             Spain
## [153] Sri Lanka                St. Kitts and Nevis
## [155] St. Lucia                St. Vincent and the Grenadines
## [157] Sudan                    Suriname
## [159] Swaziland                Sweden
## [161] Switzerland              Syrian Arab Republic
## [163] Tajikistan               Tanzania
## [165] Thailand                 Togo
## [167] Tonga                    Trinidad and Tobago
## [169] Tunisia                  Turkey
## [171] Uganda                   Ukraine
## [173] United Kingdom           United States
## [175] Uruguay                  Vanuatu
## [177] Venezuela, RB            Vietnam
## [179] Yemen, Rep.              Zambia
## 258 Levels: Afghanistan Albania Algeria American Samoa ... Zimbabwe
```

Model

ATM average monthly costs in the United States, c_ω can be decomposed into the maintenance costs, c_m, cost of funds, c_f, and capital expense, c_k.

$$c_\omega = c_m + c_i + c_k$$

Those cost shares are calibrated using a 2006 Dove Consulting study, reported by the Texas chapter of the American Bankers Association in 2011.

Item	Share
Operating expense	75.3%
Cost of funds	6.3%

Item	Share
Depreciation	18.4%

Operating expenses are assumed to be proportional to the price level in each country. The components of maintenance include labor, telecommunications, back office processing, rent and vehicle costs. In short, they are a broad basket of goods and services unlikely to correlate with any specific price index such as headline inflation. Instead we choose the ratio of PPP exchange rates to market exchange rates. The World Bank indicator `Price level ratio` is available here.[1]

Base year cost

Base year costs were $1194. To calculate 2012 price: use the GDP deflator for 2012. [2].

Measure	Value
Cost in 2007	$1194
GDP deflator ratio	1.0804
Cost in 2012, estimated	$1290.05

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[1]World Bank. World Development Indicators. Available at http://data.worldbank.org/indicator/PA.NUS.PPPC.RF

[2]Federal Reserve Economic Data (FRED). Gross Domestic Product: Implicit Price Deflator, Index 2009=100, Annual, Seasonally Adjusted. Available at (http://research.stlouisfed.org/fred2)