NATIONAL RESEARCH UNIVERSITY

**GSOM Emerging Markets Conference-2016**

# Size Effect: Evidence from Emerging Markets

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CFCenter

# Main Idea

We study the size effect in asset pricing models.

**The main purpose** of the research:
to find out whether there is the size effect in emerging capital markets

**Motivation**:

- controversial empirical evidence on the size effect in developed and emerging markets
- some drawbacks of well-known risk measures and models associated with them

- nevertheless, there is a common practice to assess the cost of equity including a size premium in a model

# Previous Studies

There is a significant number of research aimed at establishing the size effect.

Banz (1981) discovered the size effect based on data from American stock market.
Further, there was controversial empirical evidence from other research because:
– data from different capital markets / different periods
– various proxy of company's size

The modeling portfolio construction in emerging markets faces difficulties because of:
– the lack of publicly traded companies
– the short history of the stock markets

We use an idea of Ang et al. (2006) and follow the Fama-Macbeth procedure

# Methodology

**Stage 1**

1. Construction of portfolios based on size and growth factors
2. Comparison of returns on portfolios of large, medium and small companies
3. The calculation of the size factor (MMB) and the growth factor (HML)

**Stage 2**

1. Determination of the sensitivity of return to fluctuations in premiums: Fama-French model
2. Construction of the model describing the dependence of the cost of equity by 3 risk factors obtained in the previous step: Fama-MacBeth methodology

**Stage 3**

1. Evaluation of size premium based on the modified Ibbotson methodology

**Proxy of size:**

- Market capitalization
- Sales / revenue

# Sample Description

## DATA

Moscow Interbank Currency Exchange
Amount of companies: **101**
Time period: **2007-2014**

Risk free rate: long term government OFZ bond yields

Source: Thomson Reuters, Bloomberg, Central Bank of the Russian Federation

Excluded companies:
— from financial industry
— with very low liquidity

Weekly data (return, premiums, etc.)

# Stage 1.1: Construction of Portfolios

**9 portfolios (3x3)**:

1. Splitting the sample into **3 portfolios** using cluster analysis
2. Splitting each of 3 portfolios after clustering for another **3 groups**

**Stage 1 этап. Clustering criteria** :

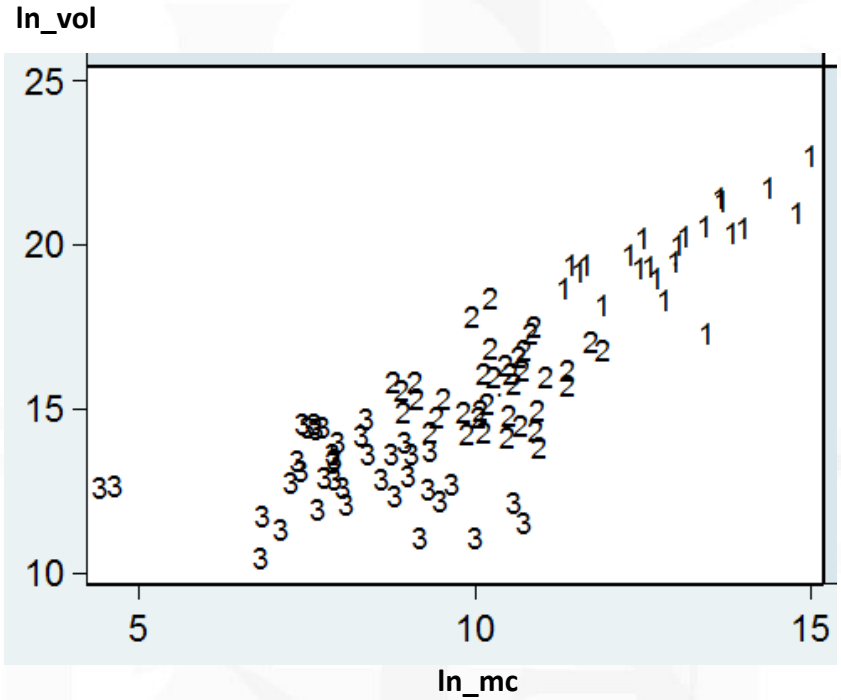
- Company size
  - Market capitalization
  - Sales / revenue
- The trading volume in money terms

**Stage 2. Criteria**:

- Book-to-market

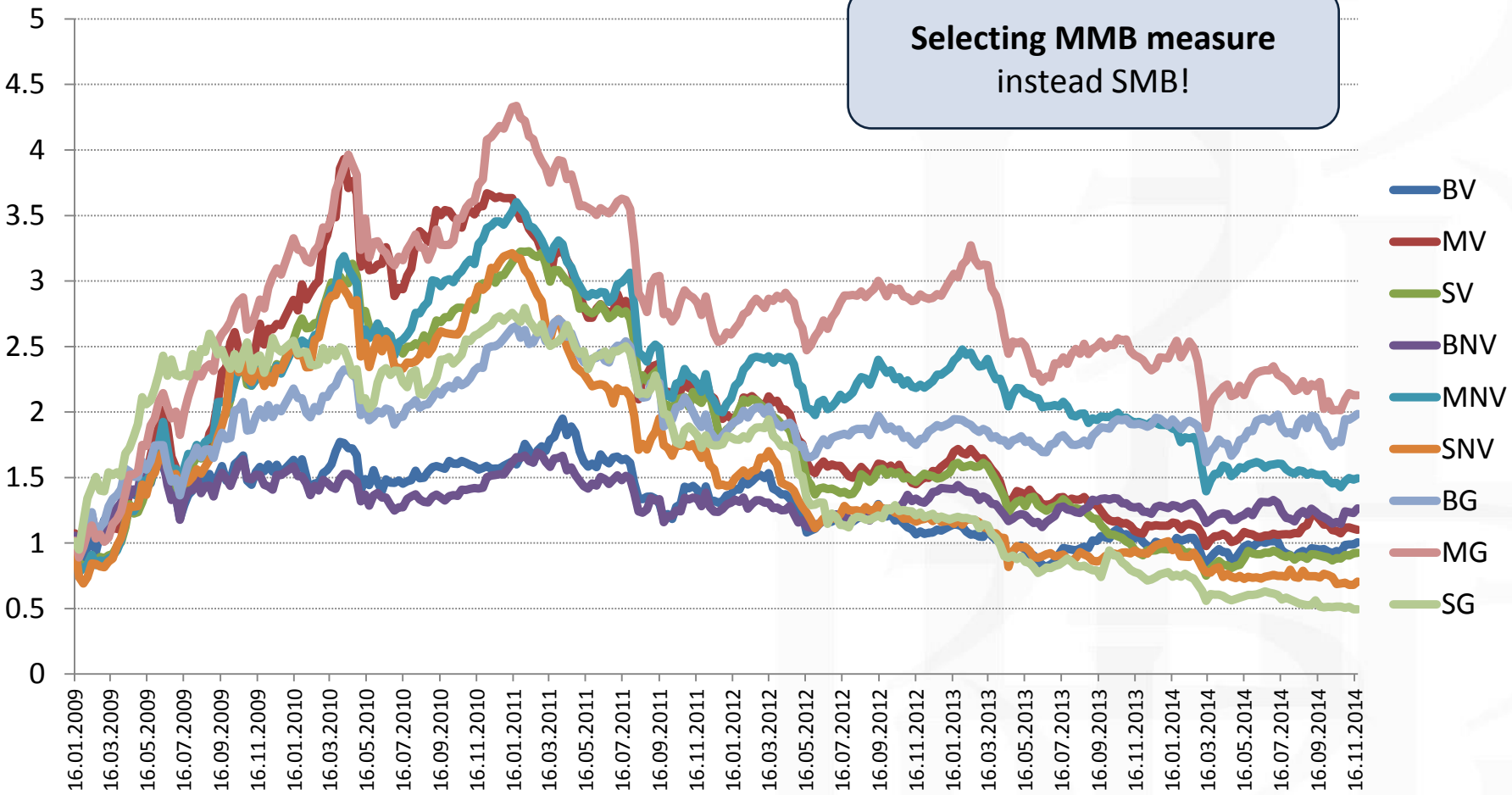
Rebalancing portfolios every year

**AN ILLUSTRATION OF THE CLUSTER ANALYSIS (2014 r.)**

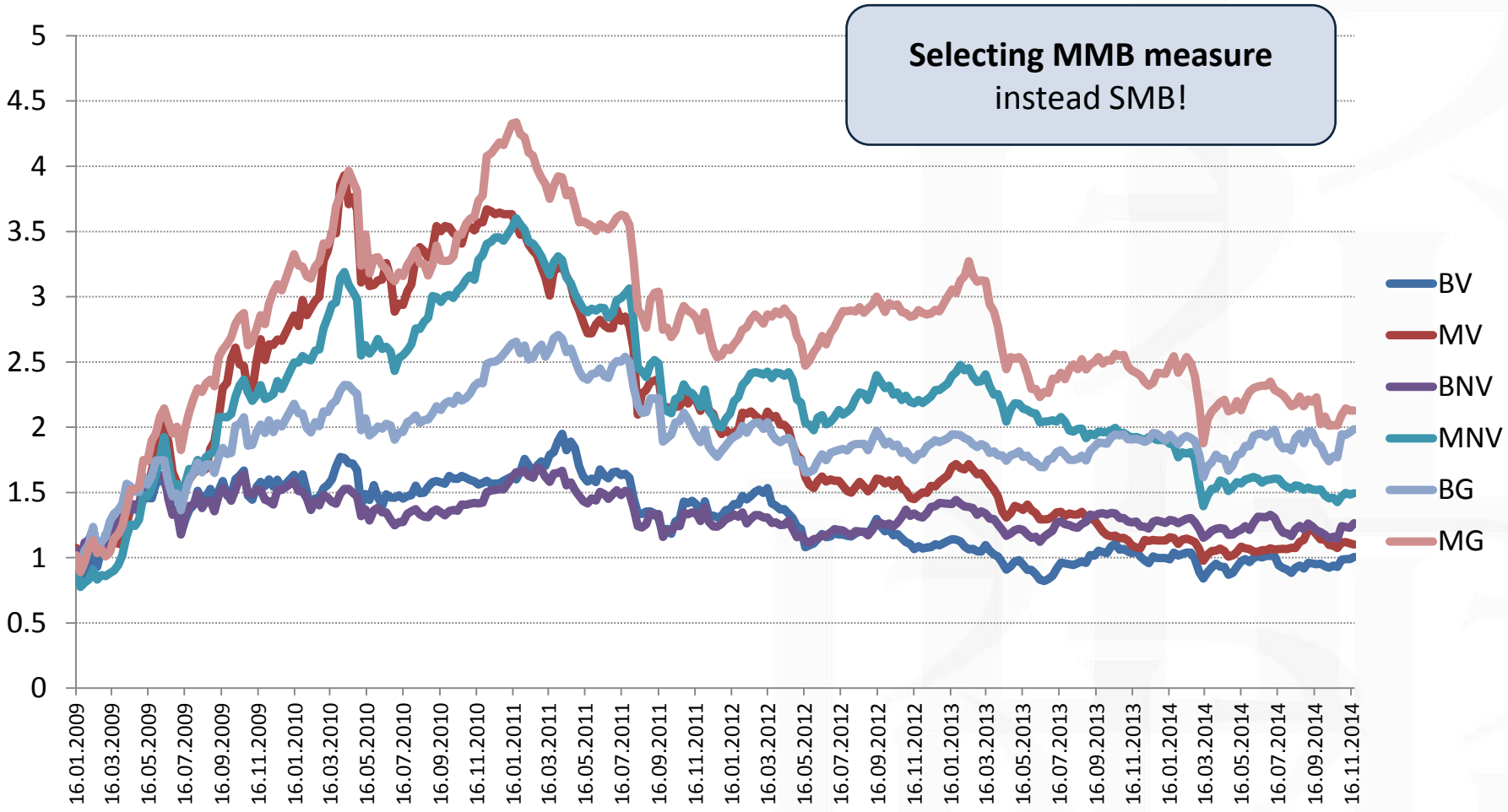


# Stage 1.2: Comparison of Returns

**Selecting MMB measure**
instead SMB!

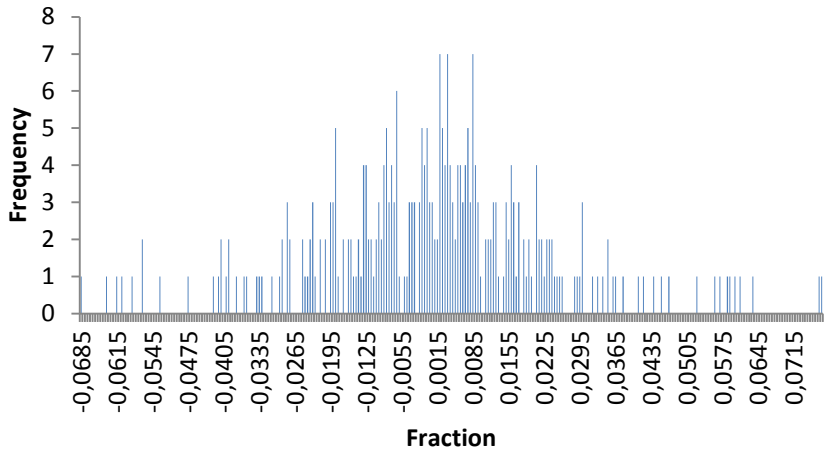


# Stage 1.2: Comparison of Returns



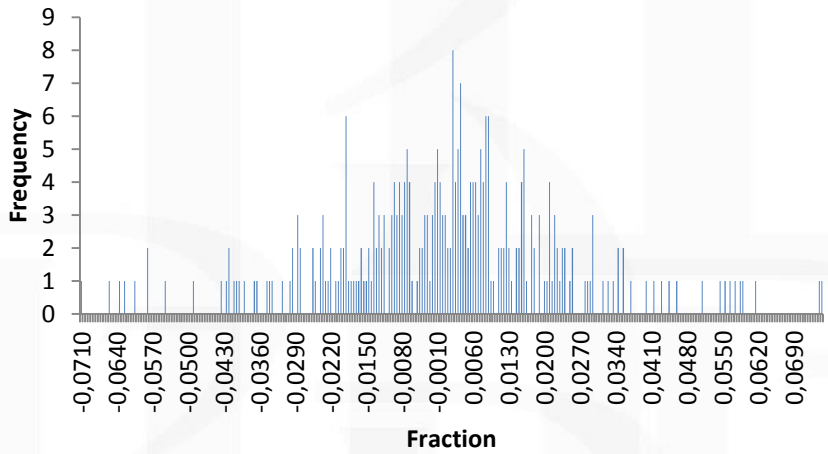
# Stage 1.3: Evaluation of MMB Measure

## NORMAL DISTRIBUTION




## LOGARITHMIC DISTRIBUTION

**THE OUR CHOISE:** less skewness!



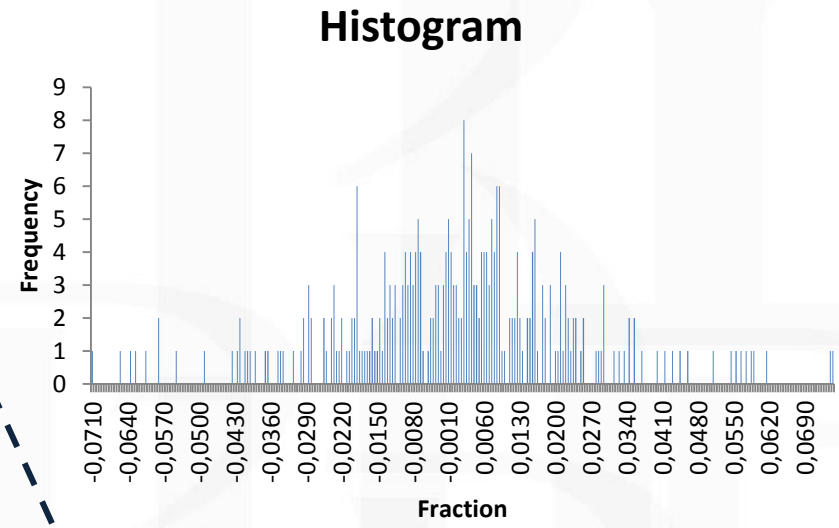
# Stage 1.3: Evaluation of MMB Measure

## LOGARITHMIC DISTRIBUTION

| MEASURE | AMOUNT |
|---|---|
| Mean | 0,00004 |
| Standard error | 0,00133 |
| **Median** | **0,00154** |
| Mode | --- |
| Standard deviation | 0,02305 |
| Dispertion | 0,00053 |
| Kurtosis | 1,23665 |
| Skewness | 0,00457 |
| Interval | 0,14513 |
| Minimum | -0,07097 |
| Maximum | 0,07416 |

## LOGARITHMIC DISTRIBUTION

**THE OUR CHOISE:** less skewness!




The size premium is **~8,4% per annum**

# Stage 2.1: Time Series Analysis

$$r_{i,t+1,s} - r_{0,t+1,s} = \gamma_{0,i} + \beta^{mr}_{i,t+1}(r_{w,t+1,s} - r_{0,t+1,s}) + \beta^{size}_{i,t+1} \cdot MMB + \beta^{b/m}_{i,t+1} \cdot HML + \sigma^{\varepsilon}_{i,s} z_{i,s}$$

where $r_{i,t+1,s}, r_{w,t+1,s}, r_{0,t+1,s}$ - return of the asset *i*, the market portfolio and the risk free rate for the period $(s, s+1) \in (t, t+1)$

$\beta^{mr}_{i,t+1}$ - the coefficient of sensitivity to changes in returns of the market portfolio

$\beta^{size}_{i,t+1}$ - the coefficient of sensitivity to changes in the size premium

$\beta^{b/m}_{i,t+1}$ - the coefficient of sensitivity to changes in book-to-market

$\sigma^{\varepsilon}_{i,s}$ - the volatility of errors in the GARCH(1,1) model

Volatility clustering!

↓

MODEL: GARCH(1,1)

101 companies x 286 shifted periods of 2 years (step 1 week)

# Stage 2.2: Panel Data Analysis

$$mr_{i,t+1} = \lambda_{0i} + \lambda_{1i}\beta^{mr}_{i,t+1} + \lambda_{2i}\beta^{size}_{i,t+1} + \lambda_{3i}\beta^{b/m}_{i,t+1} + \varepsilon_{i,t}$$

where $mr_{i,t+1}$ - average weekly return of the asset *i* minus risk free rate for the period $(t, t+1)$

$\lambda_{ji}, j = 0, \dots, 3$ – the sensitivity to risk factors

$\beta^{mr}_{i,t+1}$ - the coefficient of sensitivity to changes in returns of the market portfolio

$\beta^{size}_{i,t+1}$ - the coefficient of sensitivity to changes in the size premium

$\beta^{b/m}_{i,t+1}$ - the coefficient of sensitivity to changes in book-to-market

$\varepsilon_{i,t}$ - errors

Autocorrelation and heteroscedasticity!



MODEL: Newey-West

# Stage 2.2: Betas and Average Returns for the Second Stage

## MARKET CAPITALIZATION

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| $r_{i,t+1,s} - r_{0,t+1,s}$ | 25 809 | -0.0015 | 0.0088 | -0.0673 | 0.0920 |
| $\beta_{i,t+1}^{mr}$ | 25 375 | 0.9260 | 0.3334 | -0.0858 | 5.2465 |
| $\beta_{i,t+1}^{size}$ | 15 231 | 0.8467 | 0.3777 | 0.0002 | 8.7237 |
| $\beta_{i,t+1}^{b/m}$ | 7 558 | 0.6395 | 0.2638 | 0.0016 | 1.9225 |

## SALES / REVENUE

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| $r_{i,t+1,s} - r_{0,t+1,s}$ | 25 617 | -0.0022 | 0.0090 | -0.0661 | 0.0759 |
| $\beta_{i,t+1}^{mr}$ | 25 155 | 0.9102 | 0.3190 | -0.0001 | 4.7360 |
| $\beta_{i,t+1}^{size}$ | 15 446 | 0.7388 | 0.3313 | 0.0001 | 4.8499 |
| $\beta_{i,t+1}^{b/m}$ | 7 276 | 0.6243 | 0.2994 | 0.0002 | 3.8288 |

# Stage 2.2: Results

## MARKET CAPITALIZATION

```
. newey2 av_wret_rf beta_micex beta_mmb beta_hml, lag(50) force

Regression with Newey-West standard errors                Number of obs   =      6233
maximum lag : 50                                          F(  3,  6229)   =      9.20
                                                          Prob > F        =    0.0000
```

| av_wret_rf | Coef. | Newey-West Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| beta_micex | -.0094739 | .0021994 | -4.31 | 0.000 | -.0137854 | -.0051624 |
| beta_mmb | .0048915 | .0019721 | 2.48 | 0.013 | .0010254 | .0087576 |
| beta_hml | -.0068296 | .0021773 | -3.14 | 0.002 | -.0110978 | -.0025613 |
| _cons | .0034585 | .0021377 | 1.62 | 0.106 | -.000732 | .0076491 |

5% level of significance

# Stage 2.2: Results

## SALES / REVENUE

```
. newey2 av_wret_rf beta_micex beta_mmb beta_hml, lag(50) force

Regression with Newey-West standard errors                Number of obs   =      5476
maximum lag : 50                                          F(  3,  5472)   =     16.28
                                                          Prob > F        =    0.0000
```

| av_wret_rf | Coef. | Newey-West Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| beta_micex | -.0133275 | .0019995 | -6.67 | 0.000 | -.0172474 | -.0094076 |
| beta_mmb | .0049044 | .0019555 | 2.51 | 0.012 | .0010708 | .008738 |
| beta_hml | -.0034815 | .0021762 | -1.60 | 0.110 | -.0077478 | .0007847 |
| _cons | .0061215 | .0021082 | 2.90 | 0.004 | .0019886 | .0102543 |

5% level of significance

# Stage 3.1: Size premiums for portfolios / Ibbotson

**5 portfolios**:

Stage 1:

— An equal number of companies in each portfolio
— Criteria is a market capitalization

Stage 2:

— Evaluation of the beta for each company
— Removing companies with beta below 0.9

**Steps**:

— Evaluation of average returns of each portfolio (equally weighted)
— Evaluation of the beta for each portfolio
  – Period for each beta is 2 years
  – Step is 1 year

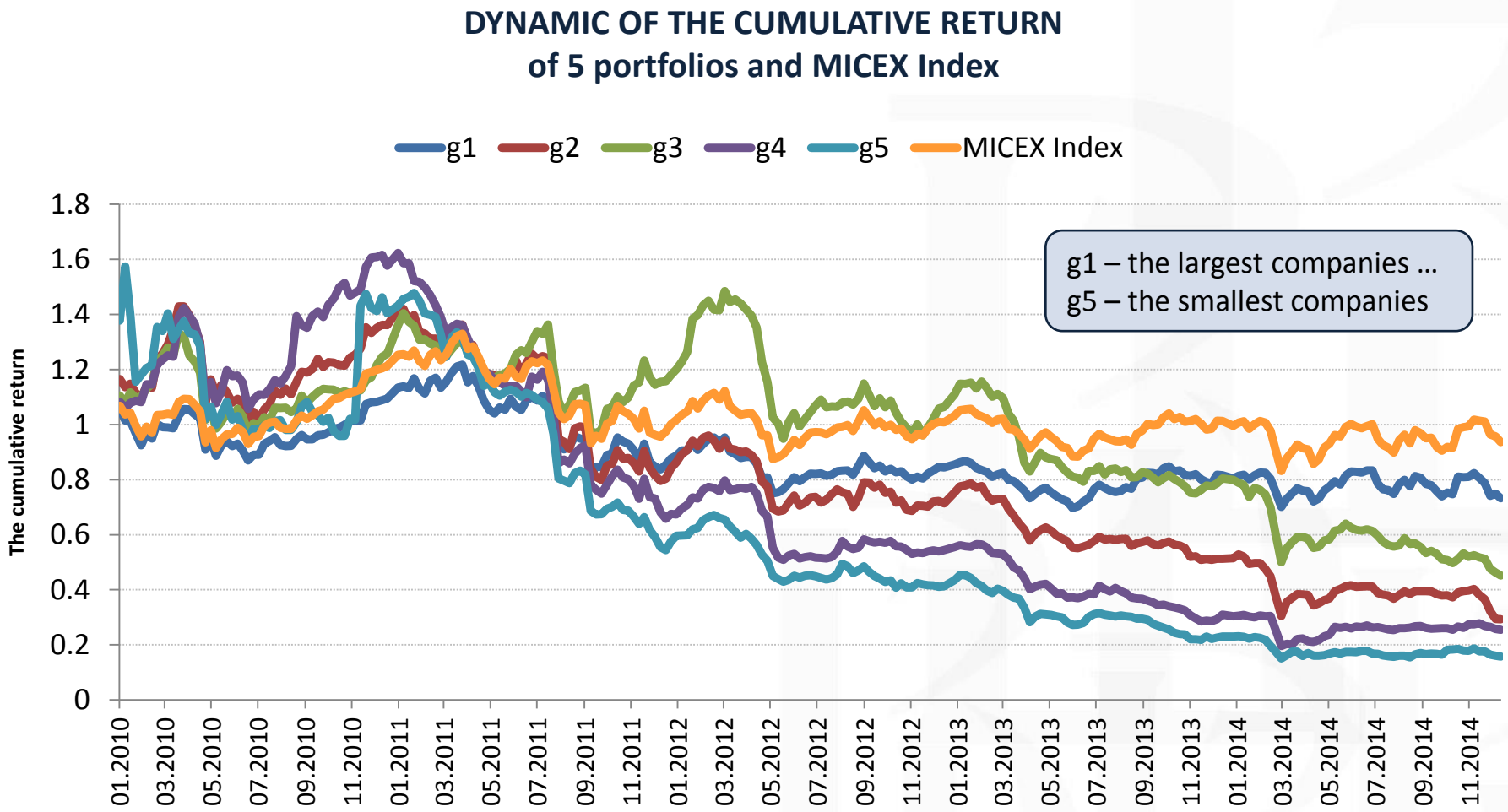
→ **7 time segments**

— Determining actual and estimated returns of portfolios

— Evaluation of size premium for each group

$$\text{size premium}_{i,t} = r_{i,t}^{real} - r_{i,t}^{CAPM}$$

# Stage 3.1: Size premiums for portfolios / Ibbotson



# Stage 3.1: Size premiums for portfolios / Ibbotson

**THE SIZE PREMIUM,**
**calculated based on the modified Ibbotson methodology**

the largest companies

the smallest companies

| | g1 | g2 | g3 | g4 | g5 |
|---|---|---|---|---|---|
| **2007-2008** | 2% | -15% | -38% | 6% | --- |
| **2008-2009** | -6% | 17% | -18% | --- | --- |
| **2009-2010** | 1% | 46% | 24% | 19% | 21% |
| **2010-2011** | -6% | -9% | 8% | -17% | -17% |
| **2011-2012** | -8% | -20% | -2% | -34% | -41% |
| **2012-2013** | -4% | -22% | -19% | -34% | -37% |
| **2013-2014** | -6% | -29% | -31% | -29% | -34% |
| **AVERAGE SIZE PREMIUM (period: 2010-2014)** | 0% | 3% | 4% | -12% | -15% |

# Conclusion

## MAIN CONCLUSIONS

— **Company size is a significant determinant of the cost of equity**

— **The size premium is 3-4%** depending on the considered portfolio

# Future work

## METHODOLOGY

Taking into consideration:

— other proxy of the company size
— economic cycles and seasonality
— Industry analysis
— other factors

## EXTENSION OF THE SAMPLE

— Analysis of the other emerging markets, primarily other countries from BRICS
— Research on American data and samples of other developed markets

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# Thank you for your attention!

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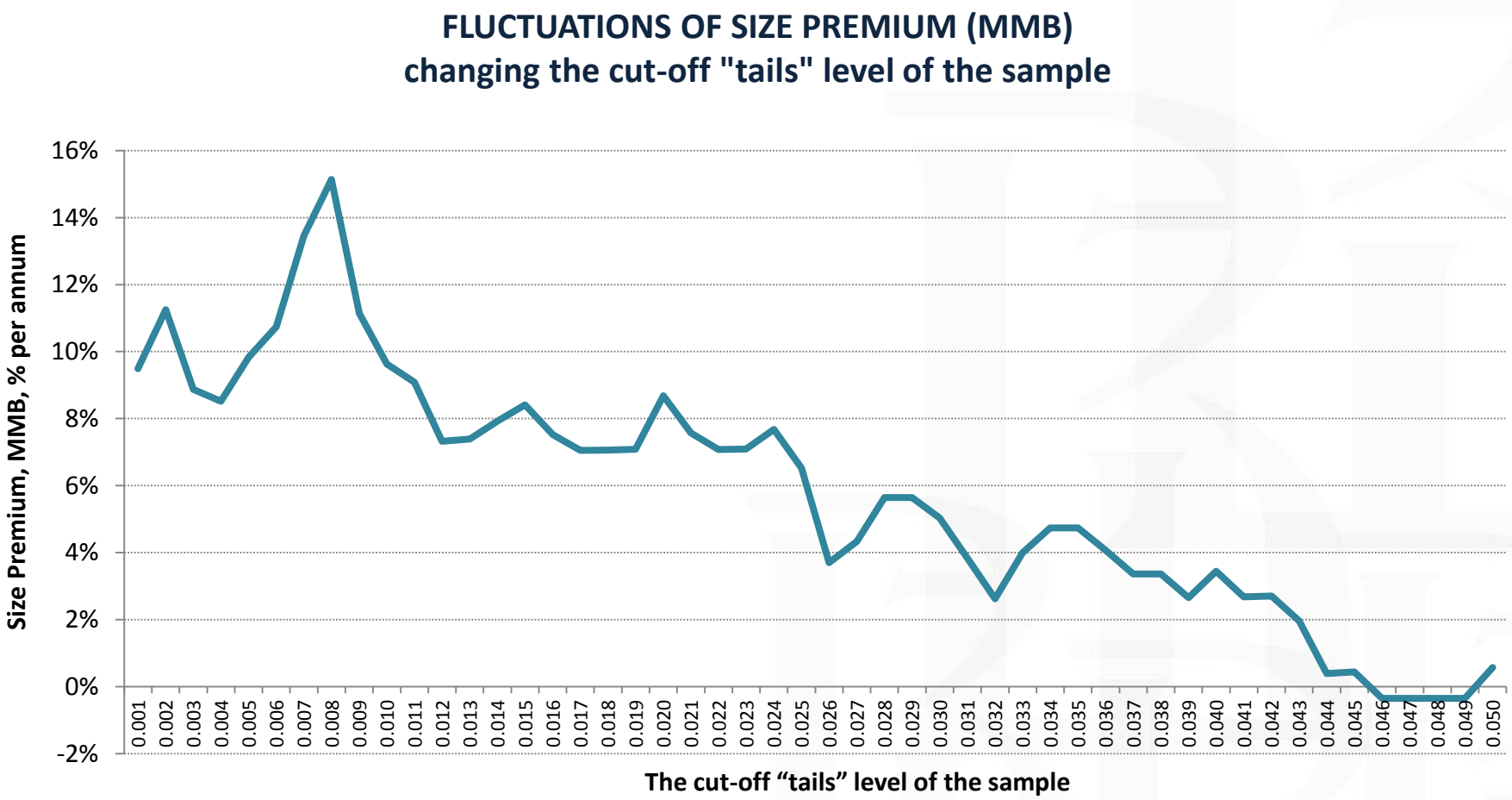
# Stage 1.3: Evaluation of MMB Measure



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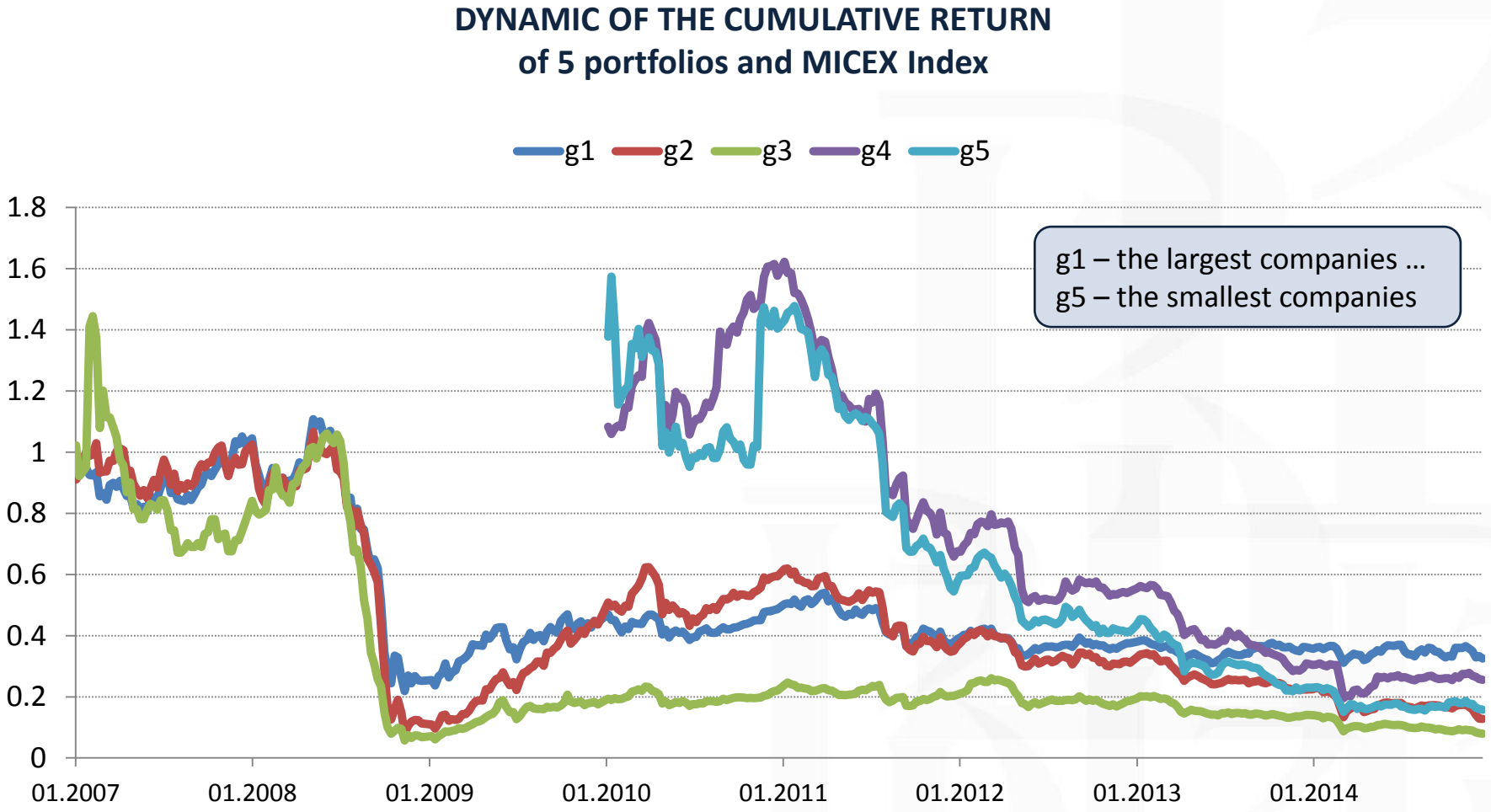

# Эффект размера на развитых рынках капитала. Часть 1

| Авторы, год | Регион | Период |
|---|---|---|
| Banz (1981) | США | 1926-1975 гг. |
| Amihud, Mendelson (1986) | США | 1961-1980 гг. |
| Zhang (2006) | США | 1983 - 2001 гг. |
| | | и другие… |

Эффект наблюдается в группах, где представлены только самые маленькие компании, и является незначимым при сравнении средних и больших компаний

| Причины влияния эффекта размера на доходность компании | |
|---|---|
| Проблема ликвидности | Amihud, Mendelson (1986), Liu (2006), Hearn, Piesse, Strange (2009), Chen et al. (2010) |
| Информационная асимметрия, неопределенность | Gar Za-Gomez et al. (1998), Zhang (2006), Chou et al. (2007), Pathirawasam (2010) |
| Компенсация за более высокий систематический риск | Fama, French(1993) |

# Эффект размера на развитых рынках капитала. Часть 2

## ИСЧЕЗНОВЕНИЕ ЭФФЕКТА РАЗМЕРА

| Авторы, год | Регион | Период |
|---|---|---|
| Fama & French (1992), Eleswarapu & Reinganum (1993), Dichev (1998), Chan et al. (2000), Horowitz et al. (2000a,b), Amihud (2002), Roll (2003) | США | с начала 1980-х гг. |
| Dimson & Marsh (1999), Michou et al. (2010) | Великобритания | с конца 1980-х гг. |
| Fama & French (2011) | 23 развитых страны | ноябрь 1990 г. – сентябрь 2010 г. |

# Эффект размера на развивающихся рынках капитала. Часть 1

| Авторы, год | Регион | Период | Примечания |
|---|---|---|---|
| Chui, Wei (1998) | Гонконг, Корея, Малайзия, Тайвань, Таиланд | июль 1977 г. - июнь 1993 г. | Значимый эффект размера во всех странах (исключение: Тайвань) |
| de Groot, Verschoor (2002) | Индия, Корея, Малайзия, Тайвань, Таиланд | 1984 г. – 2000 г. | Сильный эффект размера |
| Drew, Veeraraghavan (2002) | Малайзия | декабрь 1992 г. - декабрь 1999 г. | Эффект размера существует |
| Wang, Xu (2004) | Китай (акции А-класса) | 1996-2002 | Эффект размера существует |
| Sehgal, Tripathi (2005) | Индия | март 1990 г. – сентябрь 2003 г. | Прокси размера позволяет улучшить модель |
| Malkiel, Jun (2009) | Китай | 1982 г. – 2008 г. | Эффект размера существует |
| Lischewskia, Voronkova (2012) | Польша | январь 1996 г. - март 2009 г. | Больше внимания уделяет ликвидности, но эффект размера имеет значение |

# Эффект размера на развивающихся рынках капитала. Часть 2 + Дополнительные направления исследований

| Авторы, год | Регион | Период | Примечания |
|---|---|---|---|
| Khan et al. (2012) | Пакистан | январь 2001 г. – декабрь 2007 г. | Положительная значимая взаимосвязь между размером компании и рыночными доходностями |
| Barry et al. (2002) | 35 развивающихся рынков | январь 1985 г. - июль 2000 г. | Эффект размера зависит от включения экстремальных значений прокси размера и применяемого метода оценки размера |
| Shum and Tang (2005) | Гонконг, Сингапур, Тайвань | | Ограниченное влияние размера компании на результат, если это влияние вообще существует |

| Другие направления анализа | Рынок капитала, автор, год |
|---|---|
| Наличие эффекта размера в январе | Развитые рынки: Dyl, 1977; Keim, 1983; Kim, Burnie, 2002; Easterday et al., 2009; Crain, 2011<br>Развивающиеся рынки: Wong et al., 1990; Tong, 1992; Lee et al., 1993; Yen, Shyy, 1993; Chui, Wei, 1998; Yen et al., 2001; McGuinness, 2005, Chen, Chien, 2011 |
| Гипотеза экономических циклов | Развитые рынки: Krueger, Johnson, 1991; Bhardwaj, Brooks, 1993; Kim, Burnie, 2002 |

# Существующие методологии исследований эффекта размера

| Метод анализа данных | Автор (год) |
|---|---|
| Разбиение компаний на группы на основе средних доходностей и последующее их сравнение | Banz (1981), Keim (1983), Levis (1985), Fama,French (1992), Horowitz et al. (2000a,b), Easterday et al. (2009), Michou et al. (2010) |
| Оценка линейной cross-sectional регрессии либо панельных данных | Banz (1981), Amihud (2002), Roll (2003), Horowitz et al. (2000a,b), Easterday et al. (2009), Michou et al. (2010) |
| Оценка модели Fama, French (1992) и ее модификаций | Fama, French (1992), Zhang (2006), Khan et al. (2012) |

Daniel, Titman (1997)

B/M и размер компании в большей степени коррелируют с доходностями актива, чем доходности портфелей Фамы и Френча [Fama,French, 1992, 1993]

# Stage 3.1: Size premiums for portfolios / Ibbotson

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