Finance I
Fall 2012

Session 5:
Risk, Portfolio Risk and
Opportunity Cost of Capital

1

Agenda

1. **Recap**

2. **Risk, Portfolio Risk and Opportunity Cost**

3. **Closing**

Are you enrolled?

- **If you aren't in the list, then you aren't enrolled… please leave now**

ABRELL . ANNA
ALLENDE PERÓ ROBERTO
ANASTASSIOU ROJAS PEDRO
CABALLERO BLANCO FELIPE ANDRES
CAMBARA PARRO MIGUEL ANGEL
CARRASCO BARBIERI ANDRES
CORREA SOZA ANTONIO
DE SASIA RUBIO LANDER XABIER
DIAZ NEIRA MARTIN ANDRES
HADDAD AGUAD CARLOS ANDRES ABDALA
HAUTANEN . TERHI
ILI NUÑO ALEJANDRA JESUS
JIAN . CHONG-REN
LABRA NAVARRO JAVIER ALFONSO
LACEY ARAYA GAVIN ANDREW
MAKKONEN . LAURI
ROBLES MEYER JOSEFA ANDREA
SILBERSTEIN BUZZI JAVIER
TOLEDO ACUÑA DANIELA ALEJANDRA
VAN DER MEER GONZALEZ SIVA CAROLINA
VIDELA BLACK MARTINA PAZ

- **Just kidding, please talk to Carmen Gloria as soon as possible**

Are you paying attention?

✔ 1. **Yes**
2. **No**

Fastest users

▶ **Short term returns vary a lot, long term returns not so much, so to compare you should use _____ term returns**

▶ **Risk can be measured by:**

▶ **To determine the opportunity cost of capital you should compare with the required return of assets with _____ level of risk**

▶ **In order to use historic returns as estimates of required rates of return you must accept the following assumptions:**

Agenda

1. **Recap**

2. **Risk, Portfolio Risk and Opportunity Cost**

3. **Closing**

Which portfolio of assets has had a higher standard deviation, from 1900 to 2000?

1. U.S. Treasury Bills
2. U.S. Government Bonds
✔ 3. U.S. Common Stocks

▶ **As the common stock shows higher risk and higher return, it validates that higher risk leads to higher return**

WRONG!!!!!!

▶ **The correct concept is: In order to take higher risk, you REQUIRE AN EXPECTED higher return**

Which asset should have a higher opportunity cost?

1. 50% $50 and 50% $100
2. 50% -$50 and 50% -$100
✔ 3. Both are equal

2. Risk and Return

▶ **Remember that risk determines opportunity cost of capital… NOT profitability**

▶ **NPV determines the investment decision**

3. Portfolio Risk and Return

▶ **What if instead of one (1) asset, we consider two (2) or more different assets together? How do we measure risk in that scenario?**

▶ **We consider the possible outcomes and probabilities of the portfolio**

- As long as the assets don't have a perfect positive correlation, (meaning they have different probabilities and different outcomes) the overall risk <u>decreases</u>

- The risk of a portfolio of imperfectly correlated assets will always be less than the weighted average of the assets' risk

- If the assets have perfect negative correlation, the risk is ELIMINATED

- The diversifiable risk of an asset (the part of the risk that can be eliminated by holding a portfolio) is called "specific" or "unsystematic" risk

- The non diversifiable risk is called "systematic risk" (AKA market risk)

3. Portfolio Risk and Return

$$asset\ weight = x_1$$

$$correlation\ coefficient = \rho_{12}$$

$$covariance = \sigma_{12} = \rho_{12}\sigma_1\sigma_2$$

$$Portfolio\ variance = x_1^2\sigma_1^2 + x_2^2\sigma_2^2 + 2x_1x_2\sigma_{12}$$

▶ **Looks scary…**

▶ **… it's actually very simple. Remember that you don't need to memorize the formula!!!**

3. Portfolio Risk and Return

▶ **You need each assets':**

- Variance or standard deviation

- Correlation coefficient

- Weight in the portfolio

▶ **Asset 1**

- Std. Dev = 19.8

- Correlation coefficient = 1

- Weight in the portfolio= 60%

▶ **Asset 2**

- Std. Dev = 29.7

- Correlation coefficient = **1**

- Weight in the portfolio = **40%**

▶ **Only 4 items… not so scary, just tedious**

3. Portfolio Risk and Return

$$Portfolio\ variance = x_1^2\sigma_1^2 + x_2^2\sigma_2^2 + 2x_1x_2\sigma_{12}$$

▶ **Replacing with assets' values**

▶ **$0.6^2*19.8^2 + 0.4^2*29.7^2 + 2*0.6*0.4*1*19.8*29.7$**

▶ **$0.36*392.04 + 0.16*882.09 + 0.48*1*588.06$**

▶ **$141.13 + 141.13 + 282.26*1$**

▶ **564.52 = portfolio's variance**

▶ **23.76 = portfolio's standard deviation**

▶ **As the correlation coefficient is 1, the portfolio's standard deviation is equal to the weighted average of each assets' standard deviation**

▶ **$0.6*19.8+0.4*29.7=23.76$**

3. Portfolio Risk and Return

$$Portfolio\ variance = x_1^2\sigma_1^2 + x_2^2\sigma_2^2 + 2x_1x_2\sigma_{12}$$

▶ **Assuming a correlation coefficient of 0 (no correlation)**

▶ **$0.6^2*19.8^2 + 0.4^2*29.7^2 + 2*0.6*0.4*0*19.8*29.7$**

▶ **$0.36*392.04 + 0.16*882.09 + 0.48*0*588.06$**

▶ **141.13 + 141.13 + 0**

▶ **282.26 = portfolio's variance**

▶ **16.8 = portfolio's standard deviation**

▶ **If the assets are NOT correlated, the standard deviation is reduced, but not eliminated**

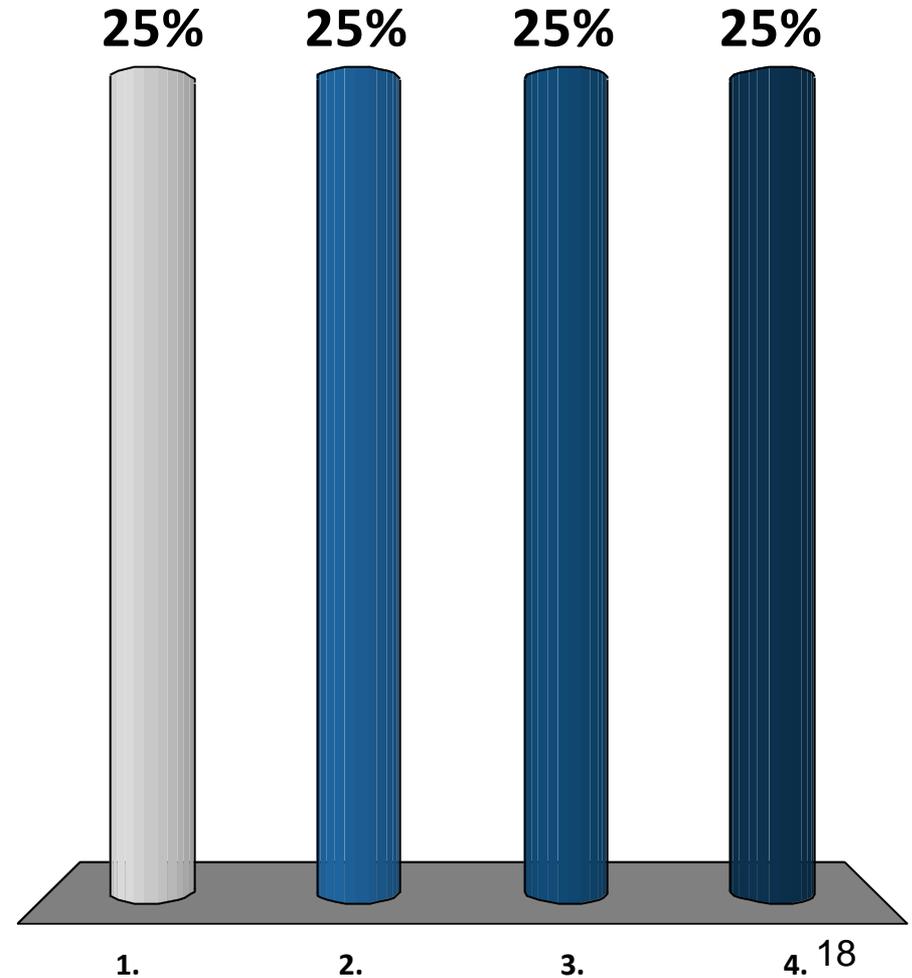# 3. Portfolio Risk and Return

$$Portfolio\ variance = x_1^2\sigma_1^2 + x_2^2\sigma_2^2 + 2x_1x_2\sigma_{12}$$

▶ **Assuming a correlation coefficient of -1 (perfect negative correlation)**

▶ **$0.6^2*19.8^2 + 0.4^2*29.7^2 + 2*0.6*0.4*-1*19.8*29.7$**

▶ **$0.36*392.04 + 0.16*882.09 + 0.48*-1*588.06$**

▶ **$141.13 + 141.13 - 282.26$**

▶ **0 = portfolio's variance**

▶ **0 = portfolio's standard deviation**

▶ **If the assets have perfect negative correlation, the standard deviation is eliminated**

What type of correlation reduces portfolio risk?

1. **Lower than 1** ✔
2. **Lower than 0**
3. **-1**
4. **Depends on the risk of each asset**

25%   25%   25%   25%

1.   2.   3.   4.

18

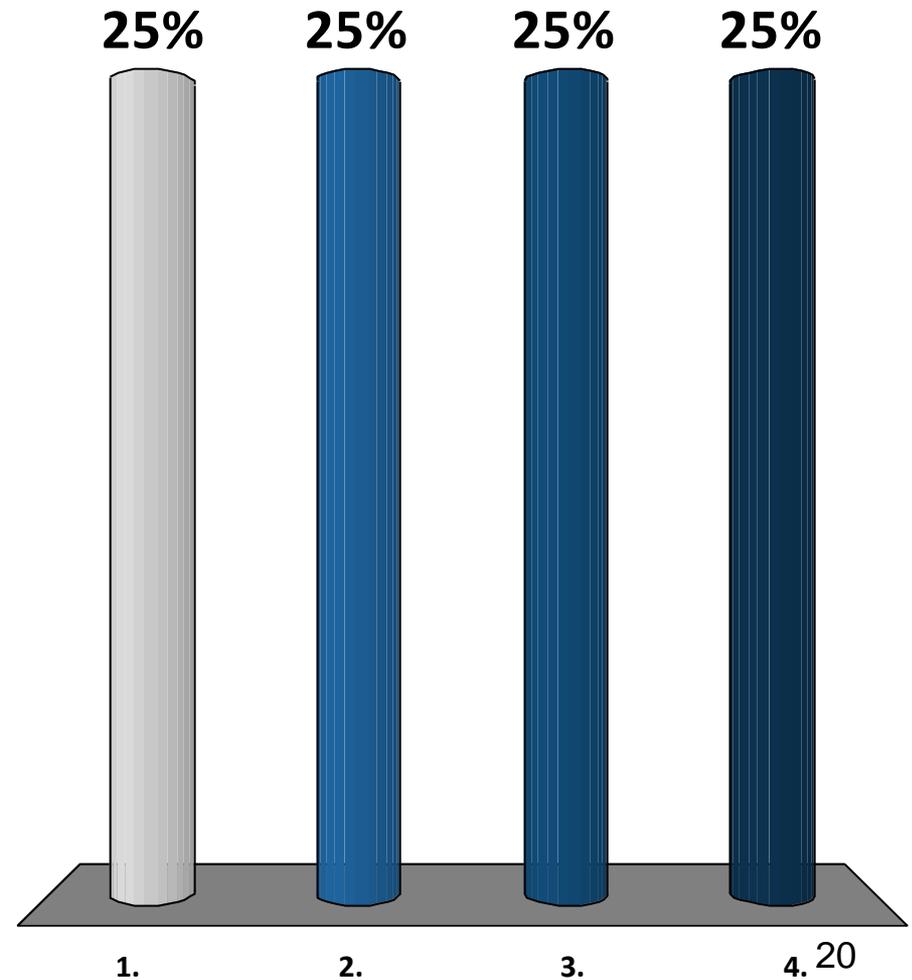# 3. Portfolio Risk and Return

$$Portfolio\ variance = x_1^2\sigma_1^2 + x_2^2\sigma_2^2 + 2x_1x_2\sigma_{12}$$

▶ **Assuming a correlation coefficient of 0.999 (almost perfect positive correlation)**

▶ **$0.6^2*19.8^2 + 0.4^2*29.7^2 + 2*0.6*0.4*0.999*19.8*29.7$**

▶ **$0.36*392.04 + 0.16*882.09 + 0.48*0.999*588.06$**

▶ **$141.13 + 141.13 + 282.26*0.999$**

▶ **564.23 = portfolio's variance**

▶ **23.75 = portfolio's standard deviation**

▶ **Even if the assets are very close to perfect positive correlation, portfolio's risk is reduced**

What type of correlation increases portfolio profitability?

1. Lower than 1
2. Lower than 0
3. -1
✔ 4. None

25% 25% 25% 25%

1. 2. 3. 4. 20

3. Portfolio Risk and Return

▶ **As the number of assets increases, the weight (importance) of the correlation becomes greater than the weight of the assets' variance**

▶ **Using real stock data, it takes only 10 assets to diversify almost all unsystematic risk**
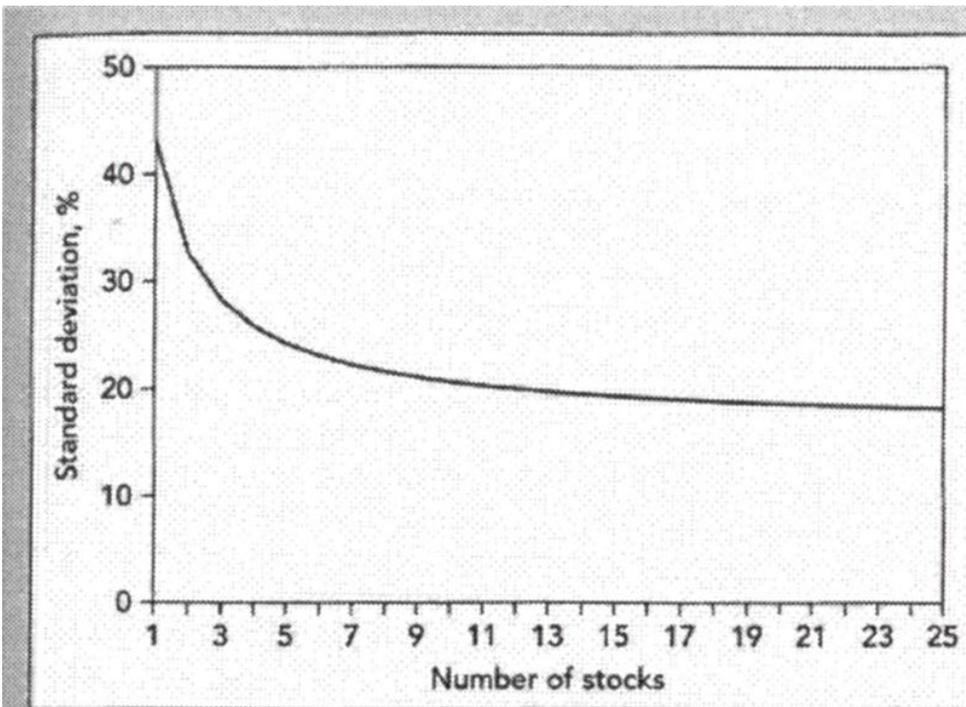

FIGURE 8.9

The risk (standard deviation) of randomly selected portfolios containing different numbers of New York Stock Exchange stocks. Notice that diversification reduces risk rapidly at first, then more slowly.

Which type of risk should you consider to determine the appropriate cost of opportunity to purchase an asset?

1. Asset's total risk
2. Asset's diversifiable risk
✓ 3. Asset's non diversifiable risk

33%   33%   33%

1.   2.
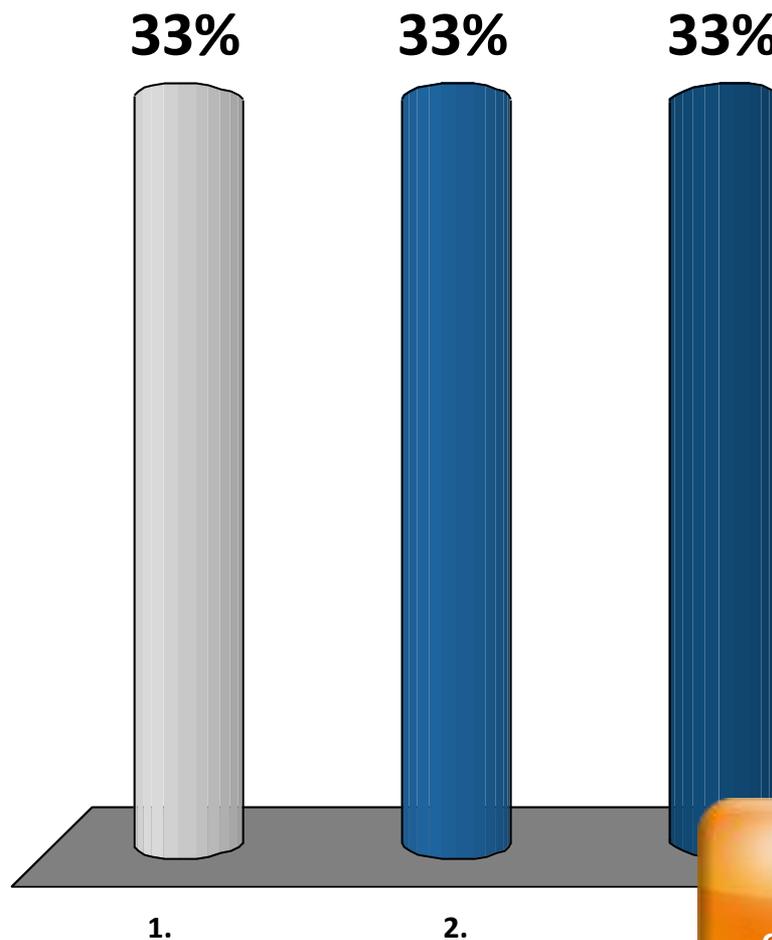
30
Countdown

3. Portfolio Risk and Return

▶ **Putting it all together:**

- A dollar today is worth more than a dollar tomorrow
- A safe dollar is worth more than a risky dollar

▶ **The opportunity cost of capital is the highest return available for assets of the same risk level**

- The effective return is equal to the required return of investors
- The current required return is equal to the past required return

▶ **To determine the opportunity cost of capital we compare the historic return of assets with the same risk and assume that's equal to the historic required return and it will remain the same in the future**

- If assets don't have perfect positive correlation

▶ **The specific risk can be diversified in a portfolio, leaving only non diversifiable risk**

3. Portfolio Risk and Return

▶ **To determine the opportunity cost of capital we compare the historic return of assets with the same non diversifiable risk and assume that's equal to the historic required return and it will remain the same in the future**

▶ **Our benchmark for that comparison will be the "market"**

▶ **We'll assume that the portfolio of traded common stock is the most diversified portfolio, having only non diversifiable risk (from now on, market risk or systematic risk)**

▶ **An asset's risk will be determined by the contribution to the risk of the portfolio**

- How sensitive the asset is to market behavior (beta = β)
- If it's more sensitive, it would mean that if you start owning only the market portfolio and add an additional unit of the asset, the new portfolio will be more risky

3. Portfolio Risk and Return

▶ **Why do we compare with the market risk?**

▶ **Because has we mentioned, we need a benchmark to determine appropriate opportunity cost**

- Assuming diversification… why???
- Because it wouldn't be rational not to diversify
- If we don't use the market (remember that is the most diversified portfolio) we would use a less diversified portfolio, thus considering greater risk than rationally required

▶ **What is the required return for the market risk?**

- The difference of return compared to risk free assets
- Consensus: the spread between the long term T Bill return and common stock market, ranging from 5% to 8%

Agenda

1. Recap

2. Risk, Portfolio Risk and Opportunity Cost

3. Closing

▶ **Diversification reduces diversifiable risk (specific risk)**

▶ **Diversification doesn't reduce non diversifiable risk (market risk)**

▶ **Diversification doesn't impact the expected profitability**

▶ **Only non diversifiable risk should be considered when determining the opportunity cost**

▶ **The opportunity cost is usually determined by comparing the non diversifiable risk of an asset to the market risk**

3. Closing

▶ **Study chapter 9 BMA**

▶ **Review quantitative methods on CFA reading. (includes exercices and solutions). Available at Coplan**

▶ **We won't have classes nor TA session on Wednesday**

▶ **You will receive the following link in your email**

https://docs.google.com/spreadsheet/viewform?formkey=dEw1enc0T2pKaXZPVlB6X1lvTmZjU2c6MQ

▶ **You must answer BEFORE Wednesday 21st at 16:00**

Puntuaciones de participantes

45	Participante 5916EC		
40	Participante 58CA5D		
40	Participante 591715		
40	Participante 58CAB2		
35	Participante 5917FF		