Market Risks

Luciano Bonomo

Research Centre on International Cooperation
(CCI) – research group on Finance and Development
(FinDev) www.unibg.it/findev

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Exchange risk **(or currency risk)**

Exchange risk

- The more complex are the operations of a financial intermediary, more important become a detailed analysis of currency risk.

- However, for MFIs is equally important to carefully analyze the risk of currency. MFIs often do not make investments in other currencies – assets side - , but they can still be affected from funding sources (loans from MIVs, donors or other international organizations) – liabilities side .

INTRODUCTION

DEFINITION - Exchange risk

It is one of the market risk (or financial). It is the potential loss that the institution suffers when it has part of its assets or liabilities denominated in currencies different from the currency used as a basis for their daily operations..

…Although the value of the currency does not depend on the institution itself, yet the extent of impact depends on risk management strategies applied by MFIs.

INTRODUCTION: Survey (ACCION, 2006)

- Survey: Sample Of 20 MFIs Operating In Latin America.

  MFIs - THREE CATEGORIES:

  A. With Foreign Currency Liabilities;

  B. In Dollarized Economies;

  C. No Liabilities In Foreign Currency.

INTRODUCTION: Survey (ACCION, 2006)

Factors which influence the decisions to use funds in foreign currency:

1. attractive Interest Rates;

2. other conditions of loan (frequency of payments, grace period and method of payment;);

3. prestige (in the eyes of the investor);

4. other financing options;

5. fees (fees, interest rates, wire transfer, reserve requirements required by law, legal fees).

INTRODUCTION: Survey (ACCION, 2006)

The exchange risk can affect MFIs as following:

-- Mismatching between assets and liabilities => balance non equilibrium

-- Net effect on revenue

→**Management strategies**:

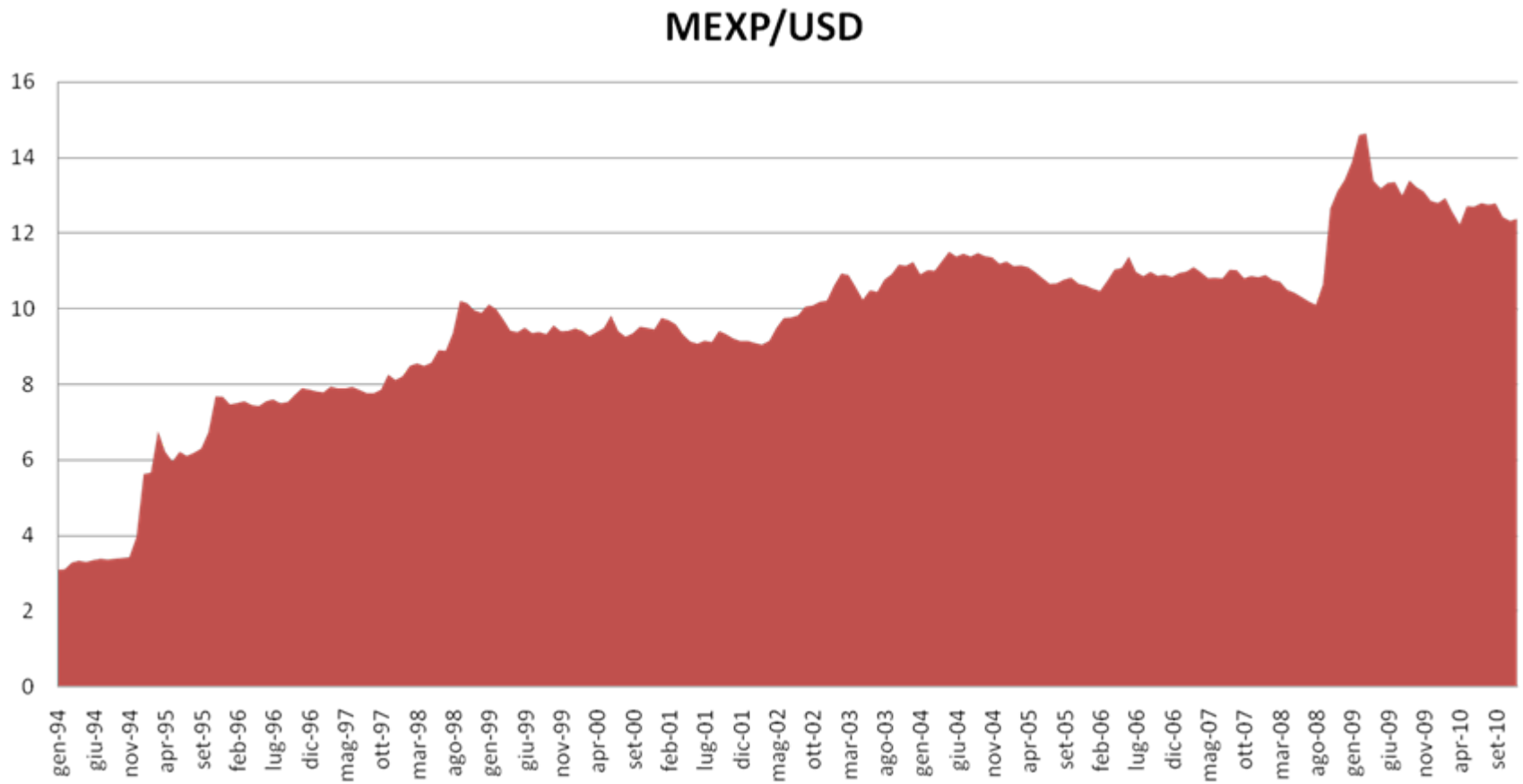
-- Search matching (active management, ALM)

-- Use of management instruments (term contracts and futures; available only in complete financial markets)

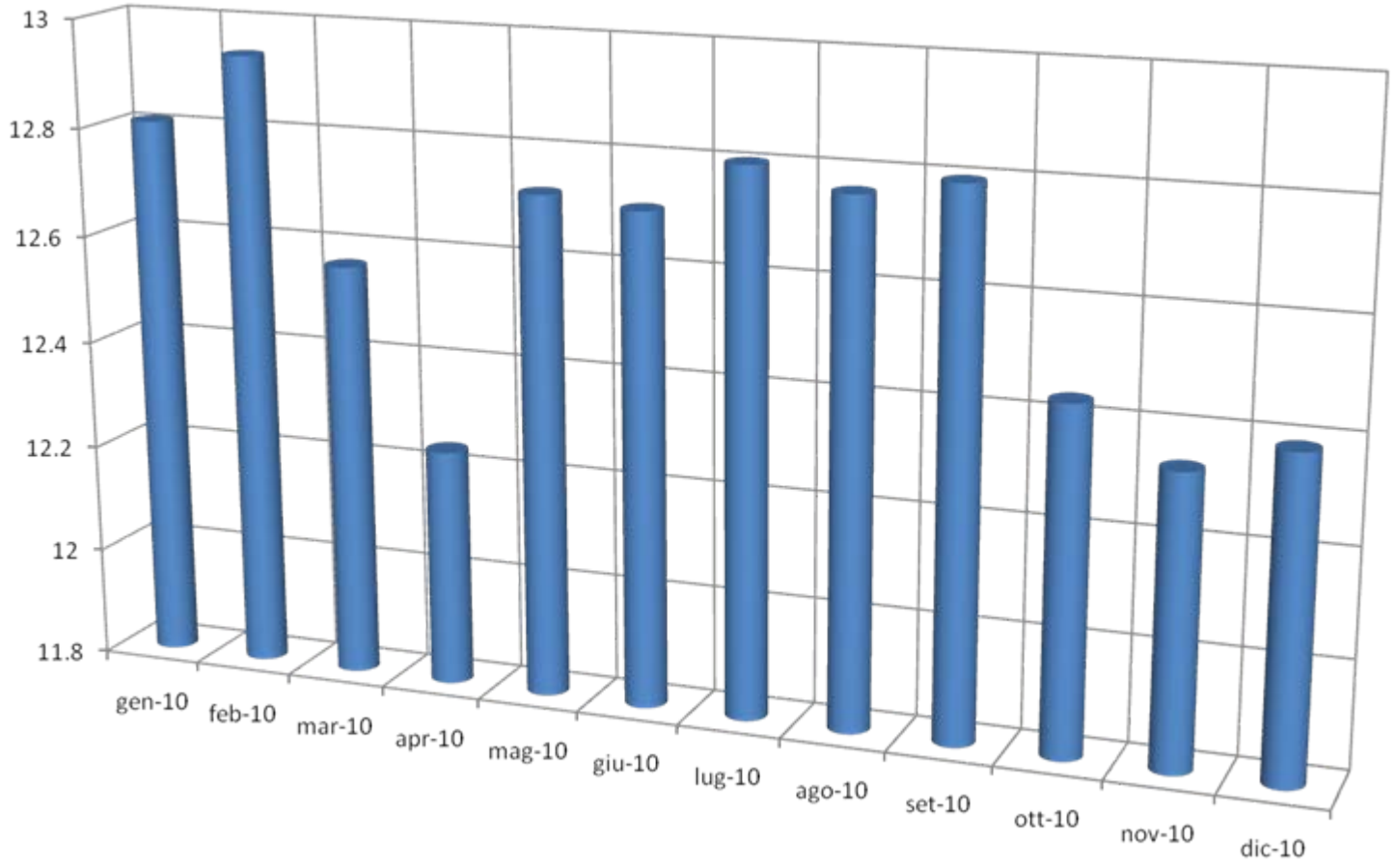
-- Indexing contract => manage borrower inability to mitigate exchange risk (if indexed loans).

-- Mantain foreign currency reserves.

EXAMPLE: Exchange Rate between U.S. Dollar and Mexican peso (1994-2010) (monthly)



EXAMPLE: Exchange Rate between U.S. Dollar and Mexican peso (only year 2010 - monthly)



Exchange Risk Management

→ **First step**: define open currency positions.

→ **Second step**: make sure to comply with the regulation.

→ **Third step**: analyze and manage risk.

Currency Risk --Define Open currency position

Amount USD	Total	< 90 days	90 – 180 days	181 – 360 days	1-2 years	2-5 years	➢5 years
Total Assets	21464854	6455988	3988702	4952338	5030618	878458	158749
Total Liabilities	22253685	8398601	6587020	3830496	438493	9593	2989482
Open currency position	-788831	-1942613	-2598318	1121842	4592125	868866	-2830733
Open currency position - cumulated		-1942613	-4540931	-3419089	1173036	2041902	-788831

Example PERU: "RESOLUCION 1455-2003"

Article 6 - the companies are subject to the following limits on their overall position in foreign currency:

Limit on the overall oversold position. The overall oversold position of the company may not be greater than ten percent (10%) of its effective equity.

Limit overall overbought position. Overall overbought position of the firm may not be over one hundred percent (100%) of its equity.

Example PERU

Additionally ...

... for banks the regulator requires the implementation of a VAR model.

Example PERU: "RESOLUCION 509-1998"

The proposed regulatory model is a VAR (Value et Risk) of variance and covariance which assumes a zero correlation between currencies, with a confidence level of 99% and a 10 days period for settlement of the position. The data sample must contain 252 daily observations.

Example PERU: computing VAR

First, you need to calculate the value of the volatility of the underlying asset that corresponds to the standard deviation of its profitability over a period of time.

The standard deviation for the underlying asset *i* is defined as:

$$\sigma_i = \sqrt{\frac{\sum_{t=1}^{T} \left(r_{i,t} - R_i\right)^2}{T-1}}$$

- Where:
  ri,t is the return on asset *i* in period *t*.
  Ri is the average return of asset *i* during the last 252 daily observations.
  T is the number of daily observations of the sample.

Example PERU: computing VAR

- The profitability of the asset *i* in the period *t* is defined as:

$$r_{i,t} = Ln\left(\frac{S_{i,t}}{S_{i,t-1}}\right)$$

where the S*i,t* and S*i,t-1* are the value of the asset *i* in the period *t* and *t-1*

- The average profitability is defined as:

$$R_i = \frac{1}{T}\sum_{t=1}^{T} r_{i,t}$$

Example PERU: computing VAR

In the example of Peru:

Regulatory Value at Risk (VAR) is the square root of individual currency VAR (Var*j*). The individual regulatory Var is defined as:

$$Var_j = P.G._j \times I.C. \times \sqrt{P.L.} \times \sigma_j$$

Where:
PG*j*: Global Position is in the currency *j* expressed in local currency in thousands of monetary units.
IC is the interval of confidence at 99% under the assumption of a normal distribution of returns, for which the confidence level requires a factor of 2.33.
PL: is the deadline for settlement of the position, assumed in 10 days.

Currency Hedging for Microfinance Institutions

- Objective: To stabilize the spread between the lending rate and the cost of financing (national and international). In particular, to maintain the international cost of funding close to domestic deposit (passive) rate.

The Passive Rate under domestic financing can thus be summarized by the following equation:

"Passive Rate Domestic" = Interest Rate Local Currency + Credit Charge (spread) + Cost of Guarantee (i.e. guarantee fund)

Currency Hedging for Microfinance Institutions

"Passive Rate International " = Interest Rate Foreign Currency + Credit Charge + Currency Return

The return on currency is the stochastic element of the equation. For example, the risk coverage with forward or futures contract eliminates the uncertainty about the exchange rate.

Currency Hedging for Microfinance Institutions: Example – **forward Contracts**

→A Forward foreign exchange contract is an agreement to buy or sell a specific amount of one currency with a defined exchange rate at a future date. Contracts are over-the-counter, non-standardized.

→Non-Deliverable Forward (NDF) or non-delivery: the part who has resulted disadvantaged in the forward must pay to the counterparty the net balance resulting from the operation.

→ NDF in dollars are offered by financial institutions in diverse countries.

Currency Hedging for Microfinance Institutions: Example – **forward Contracts** (MXN/USD)

SPOT exchange rate:	12.4
TERM:	360 days
Interest Rate in MXN (annual):	4.50 %
Interest Rate in USD (annual):	0.50 %

Forward Exchange Rate 360 Days =

$$\text{SPOT exchange rate} * \frac{[1 + \text{Interest Rate in MXN} * (\text{term}/360)]}{[1 + \text{Interest Rate in USD} * (\text{term}/360)]}$$

The hedging cost is around 0.50 MXN pesos for USD dollar or 4%.

Currency Hedging for Microfinance Institutions

Passive Rate Hedged = Interest Rate Foreign Currency + Credit Charge (spread) + Cost of Hedging **(it is possible to use as proxy the Δi between international – national rate)**

The cost of "hedging" replaces the return on currency that was the stochastic element of the previous equation => Coverage with forward or futures contract eliminates the uncertainty about the exchange rate.

Interest Rate Risk

Interest Rate Risk

A change in the interest rate has impact on:

→ Net income;

→ The present value of assets and liabilities.

Interest Rate Risk

Gap analysis

→ Preparing data

Interest Rate Risk

- The concept here is different from the previous analysis on liquidity gap.

- For the analysis of interest rate risk, the critical factor is if and how the assets or liabilities are exposed (or sensitive) to changes in interest rates.

Balance sheet – interest rate sensitivity

	0 – 1 year	1 – 2 year	2 -5 year	5 - 7 year	7 – 10 year	>10 year
Loan Portfolio	12816	4170	872	103	49	7
Investment	0	0	0	0	0	0
Other assets sensitive to interest rate	0	0	0	0	0	0
Total sensitive assets	12816	4170	872	103	49	7
Deposits	10311					
Credit lines	8118	438	10	0	15	0
Bonds (emitted)	0	0	0	0	0	0
Total sensitive Liabilities	18429	438	10	0	15	0
GAP	-5613	3732	862	103	34	7

Interest Rate Risk

- Examples of sensitive assets and liabilities:

  Each installment of an installment plan falls into a sector when it expires;

  A time deposit falls into the group when it expires (the total amount);

  A long-term loan with variable interest rate (Libor + 4%) falls into the group when the contract forces a subsequent adjustment of the interest rate.

Balance Sheet: re-pricing risk – short run

	1 – 30 days	31- 60 days	61 – 90 days	91 – 180 days	181 – 360 days
Loans	1442	1542	1453	3602	4777
Investment	0	0	0	0	0
Other Assets	0	0	0	0	0
Total Assets	1442	1542	1453	3602	4777
Saving deposits	3720				
Time deposits	688	476	1468	1667	2292
Other Liabilities	285	1178	198	4920	1538
Total Liabilities	4692	1653	1666	6587	3830
Periodic net GAP	-3251	-112	-213	-2985	946
Cumulated gap	-3251	-3363	-3576	-6560	-5614

Interest Rate Risk

First Effect:

- The impact on net income

Interest rate risk: interest change effect in the short run **(1st impact on income) - ex. I**

	1 – 30 days	31- 60 days	61 – 90 days	91 – 180 days	181 – 360 days	Total
Total Assets	1442	1542	1453	3602	4777	
Total Liabilities	4692	1653	1666	6587	3830	
Basis point change in assets	0	0	0	100	100	
Basis point change in liabilities	0	0	0	100	100	
Part of the gap year in effect	0.96	0.88	0.79	0.63	0.25	
Annualized Net impact for interest	0	0	0	-18.8	2.4	-16.4

Interest rate risk: interest change effect in the short run **(1st impact on income) – Ex. I**

Expected interest margin (MIE)	26.5%	Differential Margin	5332	Total impact/ MIE	-0.3%
Average Equity	2621			Total impact/ Average equity	-0.6%
Expected return (RE)	1376			Total impact/ RE	-1.2%

Interest rate risk: interest change effect in the short run **(1st impact on income) - ex. II**

	1 – 30 days	31- 60 days	61 – 90 days	91 – 180 days	181 – 360 days	Total
Total Assets	1442	1542	1453	3602	4777	
Total Liabilities	4692	1653	1666	6587	3830	
Basis point change in assets	0	0	0	0	0	
Basis point change in liabilities	0	100	100	200	200	
Part of the gap year in effect	0.96	0.88	0.79	0.63	0.25	
Annualized Net impact for interest	0	-14.5	-13	-82.9	-19.1	-129.8

Interest rate risk: interest change effect in the short run **(1st impact on income) - ex. II**

Expected interest margin (MIE)	26.5%	Differential margin	5332	Total impact/ MIE	-2.4%
Average Equity	2621			Total impact/ Average equity	-4.9%
Expected return (RE)	1376			Total impact/ RE	-9.4%

Interest Rate Risk

Second Effect:

→ The impact on the present value (PV) of the Assets and Liabilities

→ Principle of equity

Duration: cash flows

Example: interest rate 8%, loan amount 500

	Year 1	Year 2	Year 3	Year 4	Total
Cash flow (interest payed)	40	40	40	40	160
Cash flow (principal payed)				500	500
Cash flow discounted for interest rate (principal)				368	368
Cash flow discounted for interest rate (interest payed)	37.04	34.29	31.75	29.40	132
Sum of discounted cash flows					500

Principle of equity

Interest rate risk: interest change effect (2nd impact PV)

	Maturity 10 years	Maturity 5 years	Maturity 2 years	Maturity 6 years
Repayment	bullet; Annual interest payment	bullet; Annual interest payment	bullet; Annual interest payment	bullet; Annual interest payment
Discounted Cash flow (interest rate 8%)	500	500	500	500
Discounted Cash flow (interest rate 10%)	438.55	462.09	482.64	
Discounted Cash flow (interest rate 6%)	573.6	542.12	518.33	
Price change (increment of 2%)	-12.29%	-7.58%	-3.47%	
Price change (reduction of 2%)	+14.72%	+8.42%	+3.67%	

Excercise 1

- In class

Compute the impact on net income (maturity 6 years) – fill the table, see file excel….

Duration analysis

t	Cash flow	Descunted cash flow	Descunted cash flow X t
1	40	37.04	37.04
2	40	34.29	68.58
3	40	31.75	95.25
4	40	29.40	117.60
5	540	367.52	1837.60
	Sum	500	2156.07
	Duration		4.3

Comparing duration and interest rate change impact

	Maturity 10 years	Maturity 5 years	Maturity 2 years	Maturity 6 years
Repayment	bullet; Annual interest payment	bullet; Annual interest payment	bullet; Annual interest payment	bullet; Annual interest payment
Discounted Cash flow (interest rate 8%)	500	500	500	500
Price change (increment of 2%)	-12.29%	-7.58%	-3.47%	
Price change (reduction of 2%)	+14.72%	+8.42%	+3.67%	
Duration	7.2	4.3	1.9	
Duration x 2%	+14.4%	+8.6%	+3.8%	

The modified duration and price elasticity

Is an explicit analytical measure of the sensitivity of the market value of an asset to changes in rates, represents an elasticity and is presented as:

$$DM = D / (1+r)$$

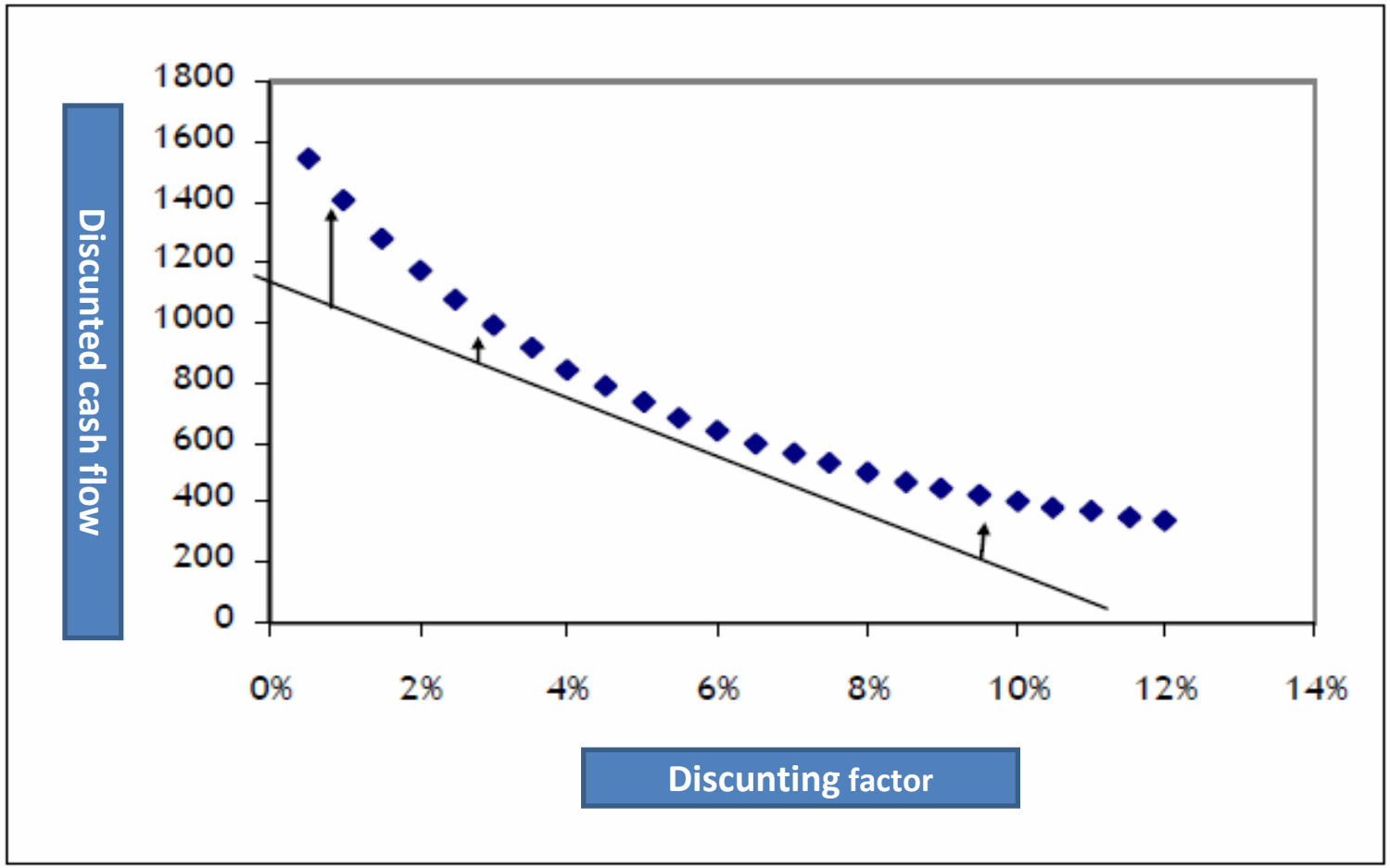
The percentage change in price is:

$$\frac{\Delta P}{P} = -DM \times \Delta i$$

Example: modified duration and price change

	Maturity 10 years	Maturity 5 years	Maturity 2 years	Maturity 6 years
Price change (increment of 2%)	-12.29%	-7.58%	-3.47%	
Price change (reduction of 2%)	+14.72%	+8.42%	+3.67%	
Duration	7.2	4.3	1.9	
Duration x 2%	+14.4%	+8.6%	+3.8%	
(Duration) x 2% / (1+r)	-13.3%	-8.0%	-3.5%	

Duration is a linear approximation: a proxy for price change considering maturity



Excercise 2

- In class

Compute the duration (maturity 6 years) – fill the table, see file excel….

As discussed:

- There is a double impact on:

  → net income;

  → the present value of assets and liabilities (assets);

DURATION GAP

- The duration could be calculated for each item of the balance sheet to determine the sensitivity of each item to interest rate change

- The duration gap is a measure of the exposure to interest rate variation. It could be used to define the effect of price changes (i.e. interest rate) on equity and for re-pricing risk calculation

DURATION GAP

- Define the assets and liabilities at risk (sensitive)
- Define the interest rate for each item both for assets and liabilities.
- Calculate the Duration for each item both for assets and liabilities.
- Define the average duration weighted for assets and liabilities.
- The duration gap is calculated

Ex.: using Duration Gap

- To protect the market value of equity (MVE) the bank would set DGAP to zero:
  - DGAP = DA – (Liabilities/Assets) x DL
  - where

    DA = weighted average duration of assets

    DL = weighted average duration of liabilities

- We can define the change in the MVE as:

$$\Delta MVE \cong -DGAP * \left[\frac{\Delta r}{\left(1 + i_{tot.assets}\right)} \right] * tot.Assets$$

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How relevant is the issue of market risk management for your institution?

Thanks for your attention!!

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E-mail: luciano.bonomo@unibg.it