

Derivatives

Prof. José Fajardo
Fundação Getulio Vargas

Financial Instrument

- Contract
- Two parties



- Looking for a set of payments and returns
- Short vs Long
- Time Horizon

Returns

The returns will depend on one or more variables:

- Stock prices
- Indexes
- Interest Rates
- Exchange Rates
- Commodity prices
- Specific Events: Earthquakes, Life-expectancy
- Bitcoin

Derivatives

- A Derivative is a financial instrument whose returns *derives* from the market price of another or more real and financial assets
- In spot market, buy and sell physically or financially a trade at the same moment.
- In *derivatives market*, we trade contracts with with maturities and liquidations in a future date.

Commodities



Energia



Metais



Comida



Animais



Grão

Derivatives

Future and Forwards

Swaps


Calls

Puts

Other Derivatives

Corporate Bonds
Sovereign Bonds
Mortgages
Insurances
Exotic Options
Credit Default Swaps

Classification Matrix

	Present	Future
Present	Cash 	Borrowing
Future	Lending	Derivative

Derivatives: Why do we need them?

To construct a hedging strategy:

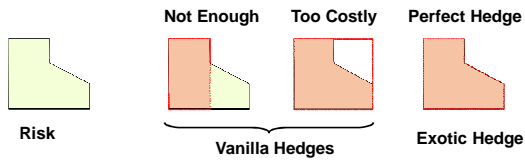
- Protection against an increase or decrease of prices
- Protection against an increase or decrease of interest rate

What about speculation and arbitrage ?

Risk Management

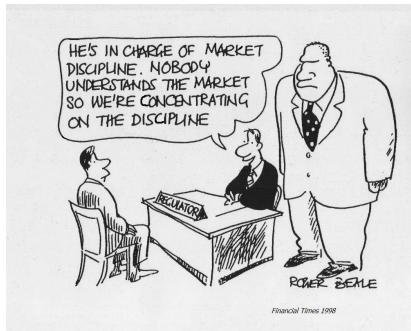
Client has risk exposure

Buys a product from a bank to limit its risk



Client transfers risk to the bank which has the technology to handle it

Product fits the risk



Derivative Markets

- Japan, 17th century, *Rice Future Market*
- Chicago Board of Trade-CBOT (1848), *Future Markets*
- Chicago Mercantile Exchange-CME (1898),
- New York Futures Exchange (1979),
- Bolsa de Mercadorias & Futuros-BM&F (1985), 31/1/1986 –Gold Future Contracts, next month Ibovespa Future Contracts

Brazilian Markets

- BM&F : Future Market
(Bolsa de Mercadorias e Futuros - www.bmf.com.br)
Open 1985-Ticker BMEF3 (11/29/2007)
- Bovespa : Spot Market
(Bolsa de Valores de São Paulo- www.bovespa.com.br)
Created in 1967, but began 1895-Ticker BOVH3 (10/25/2007)
- BVRJ : Carbon Market
(Bolsa de Valores de Rio de Janeiro-www.bvrj.com.br)
Open in 1845 and Brokedown 1986

Regulated by

- CVM : like Security Exchange Comision (SEC)
(Comissão de Valores Mobiliários- www.cvm.gov.br/)

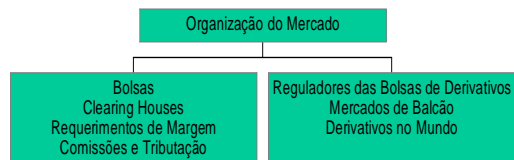
BMFBOVESPA

- 03/25/2008 Boards agree to merge BM&F and Bovespa.
- As a result a new market called BM&FBovespa become the third in the world.



- <http://www.bmfbovespa.com.br/>
- Ticker: BVMF3 (08/20/2008)

Market Organization



Margin Requirements

Example:

- Initial margin= 50%
- Margin call= 25%

Buy 1 share of asset in future market for R\$100:

Margin=50/100=50%

If share price *increase to 125*, margin=75/125=60%

You can use R\$12.50 , which results in a 50% margin

Margin Requirements

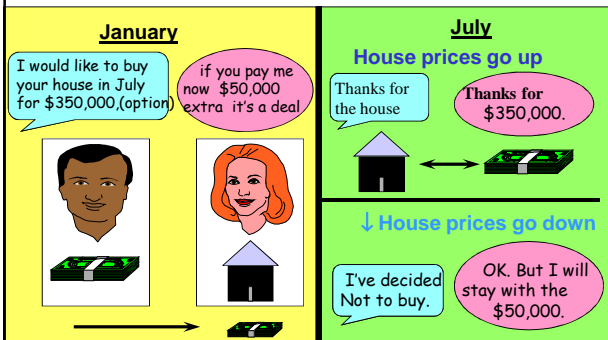
If asset price *decrease to 75*, margin results in to $25/75=33.3\%$

The margin account now is restricted,

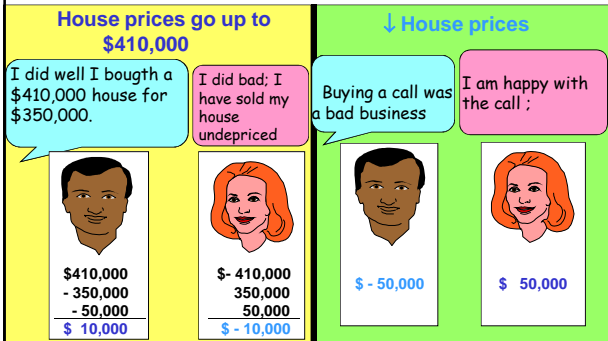
If asset price *decrease to 60*, margin would be $10/60=16.7\%$

(Liquidation or additional deposit of R\$20, margin $30/60=50\%$)

Another Example: CALLS.



Liquid results: "Zero Sum Game"



Derivative Pricing

- Example: Earthquake Insurance

Payoff Table

Earthquake Insurance

Richter	damage	Return
0 - 4.9	nothing	\$ 0
5.0 - 5.4	soft	750
5.5 - 5.9	small	10,000
6.0 - 6.9	medium	25,000
7.0 - 8.9	Large	50,000

Expected Return

- Insurance Return: $(X_1, X_2, \dots, X_j, \dots, X_n)$
- Historical Probabilities: $(Q_1, Q_2, \dots, Q_j, \dots, Q_n)$

$$0 \leq Q_j \leq 1 \text{ for all } j$$

and

$$Q_1 + Q_2 + \dots + Q_j + \dots + Q_n = 1$$

$$\text{Expected Return} = Q_1X_1 + Q_2X_2 + \dots + Q_jX_j + \dots + Q_nX_n$$

Alternatively: $E(X) \equiv \sum_j Q_j X_j$

Present Value: $r=5\%$

Historical Probability \times Risk Aversion Adjustment = Risk Neutral Probability

Richter Escalate	damage	Return	Probability Historical	Adjust Risk Neutral	Probability Risk Neutral	Expect Return Risk Neutral
0 - 4.9	nothg	\$ 0	.850	\times .9939	= .845	0
5.0 - 5.4	soft	750	.100	\times .9976	= .100	75
5.5 - 5.9	small	10,000	.030	\times 1.0472	= .031	310
6.0 - 6.9	medium	25,000	.015	\times 1.1430	= .017	425
7.0 - 8.9	large	50,000	.005	\times 1.3787	= .007	350
Expected Future Value:						\$1,160

$$\sum_j P_j X_j = .845(0) + .100(750) + .031(10,000) + .017(25,000) + .007(50,000) = 1,160$$

Present Value: $\$1,160/1.05 = \$1,104.76$

Arbitrage Opportunities

A Arbitrage Opportunity exists if and only if:

- Two portfolios can be constructed with identical returns, but with different costs.
- Two portfolios can be constructed with equal costs but with different returns.

Fundamental Theorem of Asset Pricing

“Risk Neutral Probabilities exist if and only if there is no arbitrage opportunities”

Final Thought

After 2008 financial crisis:

“Derivatives are financial weapons of mass destruction...” Warren Buffet

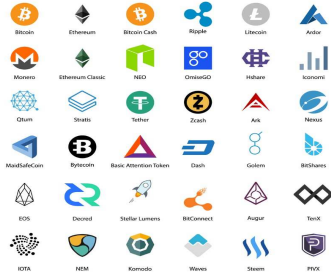
- Do we need derivatives?
- Do we need more regulation?

But..

Satoshi Nakamoto (2008).

- Do we need Centralization?
- Bitcoin

Where we are now...



The response...

“They will have to be held accountable so that they can be fully trusted,”

“Technology companies entering the banking space forcefully must be subject to regulation”

“We don’t want innovation that would shake the system so much that we would lose the stability that is needed,”

“First they ignore you then they laugh at you then they fight you then you win” ...

Facebook

- [Libra](#)
- [Fed](#)

Facebook

“Facebook Warns Investors That Libra Stablecoin May Never Launch”
