Managing Market Risk

Max Silberberg

Defining Market Risk

- Market risk is exposure to an adverse change in value of financial instrument caused by movements in market variables.
- Market risk exposures are created by trading, investing and funding activities in:
  - Interest Rate and Credit Spread
  - Foreign Exchange
  - Equity
  - Commodity
- Business units transact in these products for many reasons
  - Market-Making
  - Hedging
  - Proprietary trading
  - Underwriting

Risk Management Framework

Diversified Approach

- JPMorgan Chase emphasizes a diversified approach to market risk management
- Market risk businesses are both large and well diversified by:
  - Geography
  - Product
  - Sources of value:

	Revenue Stability	Risk
Sales	High	Low
Market Making	High	Medium
Investment Activities	High	Medium
Arbitrage	Medium	Medium
Positioning	Low	High

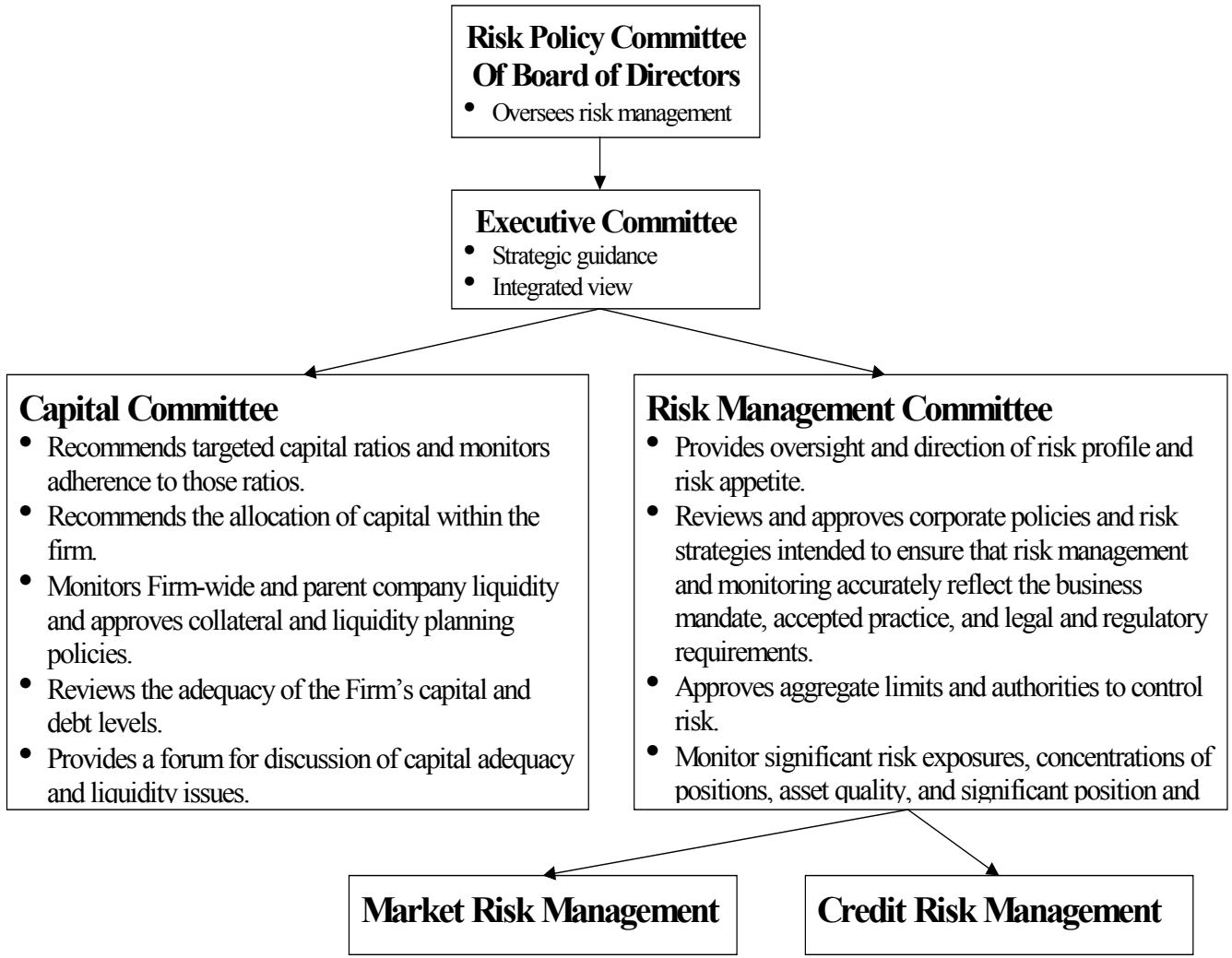
Risk Management Framework

Diversified Approach

Wide variety of traded products in Global Centers:

- FX in 73 currencies
  - Spot & Forward
  - FX Options
- Derivatives
  - Futures, FRAs
  - Interest Rate Swaps & Options
  - Cross Currency Swaps
  - Commodity & Equity Derivatives
  - Structured Derivatives
- Government Debt
  - U.S. Treasuries
  - OECD Sovereign Debt
- Emerging Market Debt
  - Sovereign Loans
  - Brady Bonds
  - Eurobonds
  - Euro CP/CDs
- Other Securities
  - Money Market
  - U.S. Corporate
  - Asset Backed
  - Mortgaged Backed
  - High Yield
  - Non-U.S. Corporate and Bank

Market Risk Delegation



Market Risk Management

- **Identify, measure, monitor, and control market risk exposures**
  - Review models
  - Review new products
  - Measure Market Risk (VAR, stress testing, etc.)
  - Calculate Market Risk Capital
  - Establish market risk limits
  - Risk aggregation and reporting

Risk Measurement

- Value-at-Risk (VAR)
- Stress Testing
- Notional
- Basis Point Value
- 10% credit spread widening
- Loss given default
- Equity Delta

VAR -vs- DE@R

- **Statistical estimate of maximum loss for confidence interval and given holding period**

VAR	DE@R
Historical Simulation	Historical Simulation
1 year historical lookback	6 mo. historical lookback
Equal weighting	Exponential weighting
99th percentile loss estimation	95th percentile loss estimation
One day holding period	One day holding period
Position level feeds	Aggregate feeds

Calculating VAR

The most common methods for calculating VAR are:

- Parametric (Variance - Covariance) - uses volatility of individual portfolio positions & their correlation
- Monte Carlo - all positions are revalued according to simulated market scenarios. This produces a probability distribution of gains & losses.
- Historical Simulation - JPMorganChase's method of choice

How VAR is Calculated => Historical Simulation

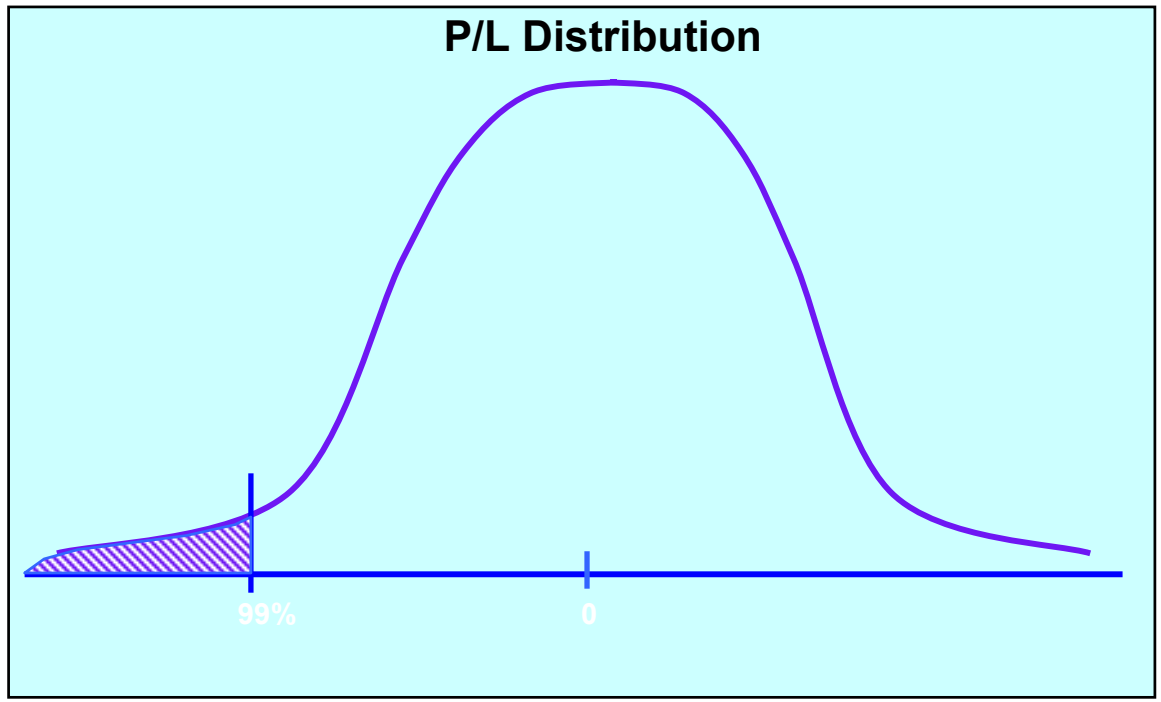
1. Reprice the current portfolio for each of the preceding 265 business days (the look-back period) using hypothetical market data based on today's markets and the markets' changes that occurred on that day.
2. Calculate the daily market value change of the portfolio.

   You now have a hypothetical P&L for each day.
3. Rank the portfolio's daily P&L in descending order.
4. Calculate the average of the worst seven days. Multiply the result by –1 to produce a positive number.

THE RESULT = VAR

VAR - The Concept

- VAR - Estimate P/L of unlikely event in normal market



The Appeal of VAR

The main attraction of VAR is that it is easy to understand and produces one number which provides banks with a concrete method to measure risk. VAR works on multiple levels, it can be calculated for a specific position, portfolio, business unit or legal entity.

VAR has become the common language for discussions inside the bank or with regulators, rating agencies or shareholders.

Calculating Market Value changes

At JPMorganChase, two approaches are used to calculate market values.

- The Sensitivity Method, otherwise referred to as the ***Greeks***.

- **A full revaluation method.**

Calculating Market Value - Sensitivity Method

Sensitivities are used to approximate the set of hypothetical P&L.

Market Value Change (i) for day (i) =

Delta x (ДS) + ½ x gamma (ДS)^2 + vega x (ДV) + rho x (ДI)

Where: S = equity cash price

V = implied volatility

I = interest rate

Д represents daily change

Sensitivity Method - Benefits & Drawbacks

- They are easy to understand and can be used across a range of instruments.
- Relatively fast to run as it is not computationally intensive
- This calculation can also be used to find the VAR for one component of an outstanding trade. For example short term near-the-money options have high gamma. Under certain market conditions, one risk factor may be more significant than the others.

- The sensitivities are local measures, which means they are valid only for small changes. Thus, if there are dramatic market moves, P&L figures may be distorted. This is why they can not be used for stress testing.
- They approximate non-linear instrument behavior. Therefore, they are less accurate.

Full Revaluation Method

This method revalues the entire portfolio by revaluing each instrument individually using actual market rates.

Benefits	Drawbacks
• Most accurate method since it uses actual pricing models. • Captures all non-linear risk.	• Computationally intensive. • Some combinations of hypothetical markets can cause models to fail.

VAR Example - Single Position

- Long $50mm 5 yr Bond X
  - Credit Spread BPV = 50mm * 4.1 yr duration / 10,000 = 20,500
  - Interest Rate BPV = 50mm * 4.1 yr duration / 10,000 = 20,500
  - CS BPV proxy to 5 yr Bond credit spread index
  - IR BPV proxy to 5 yr US Treasuries

CSBPV		20,500	
Day	**Date**	**Index Chg (bp)**	**MV Change (USD)**
1	8-Apr-02	3	$ (61,500)
2	5-Apr-02	2	$ (41,000)
3	4-Apr-02	(2)	$ 41,000
4	3-Apr-02	(6)	$ 123,000
5	2-Apr-02	4	$ (82,000)
6	1-Apr-02	(1)	$ 20,500
7	29-Mar-02	5	$ (102,500)
.	.	.	.
.	.	.	.
.	.	.	.
261	12-Apr-01	2	$ (41,000)
262	11-Apr-01	1	$ (20,500)
263	10-Apr-01	(3)	$ 61,500
264	9-Apr-01	(4)	$ 82,000

7 Worst Days			
Day	**Date**	**Index Chg (bp)**	**MV Change (USD)**
42	28-Mar-02	14	$ (287,000)
111	8-Mar-02	11	$ (225,500)
67	18-Mar-02	9	$ (184,500)
210	9-Feb-02	8	$ (164,000)
14	29-Mar-02	8	$ (164,000)
166	18-Feb-02	6	$ (123,000)
7	29-Mar-02	5	$ (102,500)
		VAR	**$ (178,643)**

VAR Example - Multiple Positions

- Long $50mm 5 yr Bond X & Short $50mm 5 yr Bond Y

CSBPV		20,500		-20,500		
		Ford		Xerox		Portfolio
Day	Date	Index Chg (bp)	MV Change (USD)	Index Chg (bp)	MV Change (USD)	MV Change (USD)
1	8-Apr-02	3	$ (61,500)	14	$ 287,000	$ 225,500
2	5-Apr-02	2	$ (41,000)	3	$ 61,500	$ 20,500
3	4-Apr-02	(2)	$ 41,000	(9)	$ (184,500)	$ (143,500)
4	3-Apr-02	(6)	$ 123,000	(21)	$ (430,500)	$ (307,500)
5	2-Apr-02	4	$ (82,000)	7	$ 143,500	$ 61,500
6	1-Apr-02	(1)	$ 20,500	3	$ 61,500	$ 82,000
7	29-Mar-02	5	$ (102,500)	14	$ 287,000	$ 184,500
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	.	.	.	.	.
261	12-Apr-01	2	$ (41,000)	(3)	$ (61,500)	$ (102,500)
262	11-Apr-01	1	$ (20,500)	3	$ 61,500	$ 41,000
263	10-Apr-01	(3)	$ 61,500	(9)	$ (184,500)	$ (123,000)
264	9-Apr-01	(4)	$ 82,000	2	$ 41,000	$ 123,000

Position	VAR
Ford	$ 178,643
Xerox	$ 321,557
Total Portfolio	$ 107,186

Corporate Stress Tests

- **Complement to VAR**
  - **P/L for positions given a certain scenario**
  - **Abnormal market conditions**

- **Economic scenarios - currently 3 scenarios**
  - **Effect corporate wide exposure**
  - **Plausible but unlikely**
  - **Longer time horizon**
  - **Monthly runs, at both corporate and business level**

Capital as Risk Management Tool

- **Affects decisions at level of trading decisions - align incentives to control risk**

Stress/VAR - Based Capital

Capital = 2 x {50% x Stress + 50% x Scaling x VAR}

Key Features

- **Results in capital ~ 2 x worst stress loss**
- **Based on 3 - month averages of VAR and stress tests**
- **Diversification benefit given to business**

Limit Process

- **Daily Monitoring**
- **Semi-annual review**
- **Limit types**
  - **At the corporate level: VAR and Stress test loss advisories**
  - **At the business level:**
    - **VAR (Total, IR, CS, FX and Equity VARS)**
    - **IR BPV (Total, Directional and Local USD)**
    - **CS BPV and Basis limits**
    - **FX Net Spot, Derivative greeks (Vega) and Equity concentration**

Limit Structure - Example

Global Emerging Markets: Statistical Limits

	STATISTICAL LIMITS						
	Total VAR	Interest Rate VAR			Credit Spread VaR	Foreign Exchange VAR	Equities VAR
		Total	Directional	Local USD			
TOTAL MTM							
Total Latin America							
Total Eastern Europe							
Total Middle East							
Total Africa							
Total Asia							
G7							
Global Trading							
Prop Trading							
Sovereign and Credit Spread (**)							
Derivatives							
Primary Book							
		Note: the Management Book to be used for overall risk reduction, only.					
Local Markets							
Latin Local Markets							
Eastern Europe/Africa/Middle East							

(**) includes Distressed Debt

	VAR	20 Day Loss Advisory
TOTAL ACCRUAL		
Total Latin America		
Total Eastern Europe		

Limit Structure - Example

Global Emerging Markets: Non-statistical Limits

	Stress Loss	Interest Rate				Credit Spread bpv		CDS / Bond basis			Foreign Exchange		Equity
		Total bpv(**)	Direct bpv	Local USD bpv	I/R Vega	I/R Vega (*)	CSBPV	CDS /Bond	CDS / Loan	Net Not	Net Spot (mm)	FX Vega	Gross Inven(mm)
TOTAL MTM													
Total Latin America													
Argentina													
Brazil													
Mexico													
Chile													
Venezuela													
Other Latin America (per country)													
Total Eastern Europe													
Russia													
Turkey													
Greece													
Poland													
Czech Republic													
Hungary, Slovakia (per country)													
Other Eastern Europe (per country)													
Total Middle East													
Israel													
Egypt													
ME Tier II (per country)													
Other Middle East (per country)													
Total Africa													
South Africa													
Morocco, Nigeria, Algeria													
Ivory Coast													
Other Africa (per country)													
Total Asia													
Philippines													
South Korea													
Asia Tier II													
Other (per country)													
G7													
Global Trading													
Prop Trading													
Sovereign and Credit Spread													
Derivatives													
Primary Book													
Distressed Debt (Market Value)													
Local Markets													
Latin Local Markets													
Eastern Europe/Africa/Middle East													