Introduction to Early Warning System of Korea

October 2013

Korea Center for International Finance

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I. **Background of EWS Establishment**

II. Early Warning System in Korea

III. Lessons Learned through Experience

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Why do we need EWS?

❑ **Korea experienced a number of crisis episodes.**

❑ **Prevention is always better than cure!**
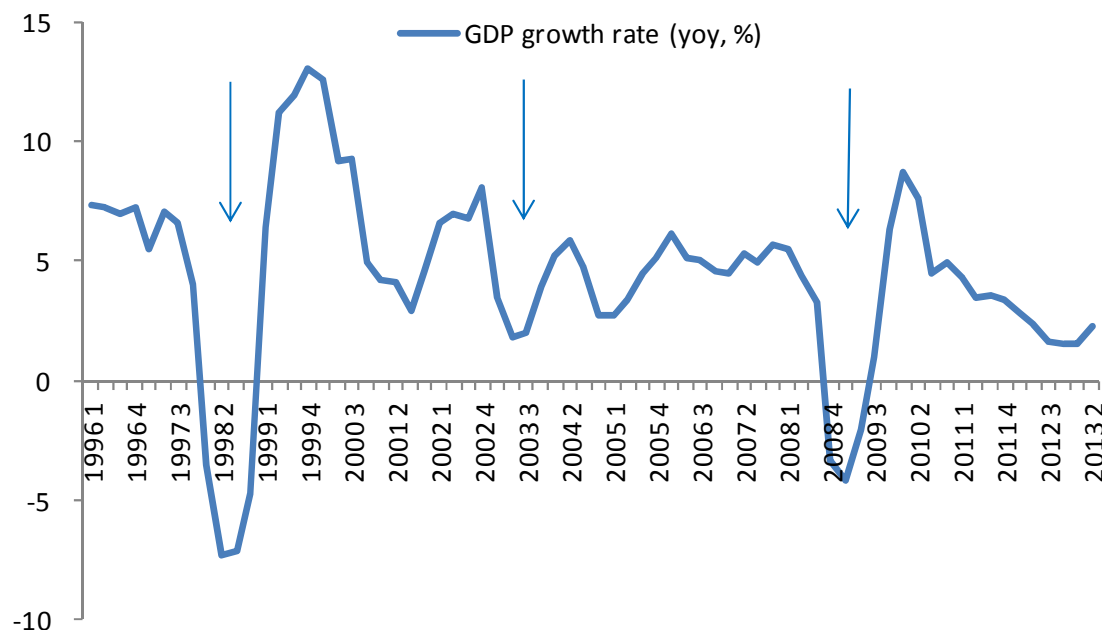
- **It takes enormous national pain to recover from a crisis.**

- **Compared with such pain, EWS operation costs nothing.**

GDP growth rate (yoy, %)

Korea's History of External Liberalization

< When Entered into Negative List System>

	Original Transaction	FX Settlement
Current Account Transaction	Goods : Late 1960's	1992
	Services : Early 1980's	1992
Capital Account Transaction	Almost open in 1997 & Negative List System in 1999	Inbound FDI : 1984 Outbound FDI : 1994 Others : 1999

* Accepted IMF Article 8 in 1988
& Acquired OECD membership in 1996.

Expansion of FX Transactions
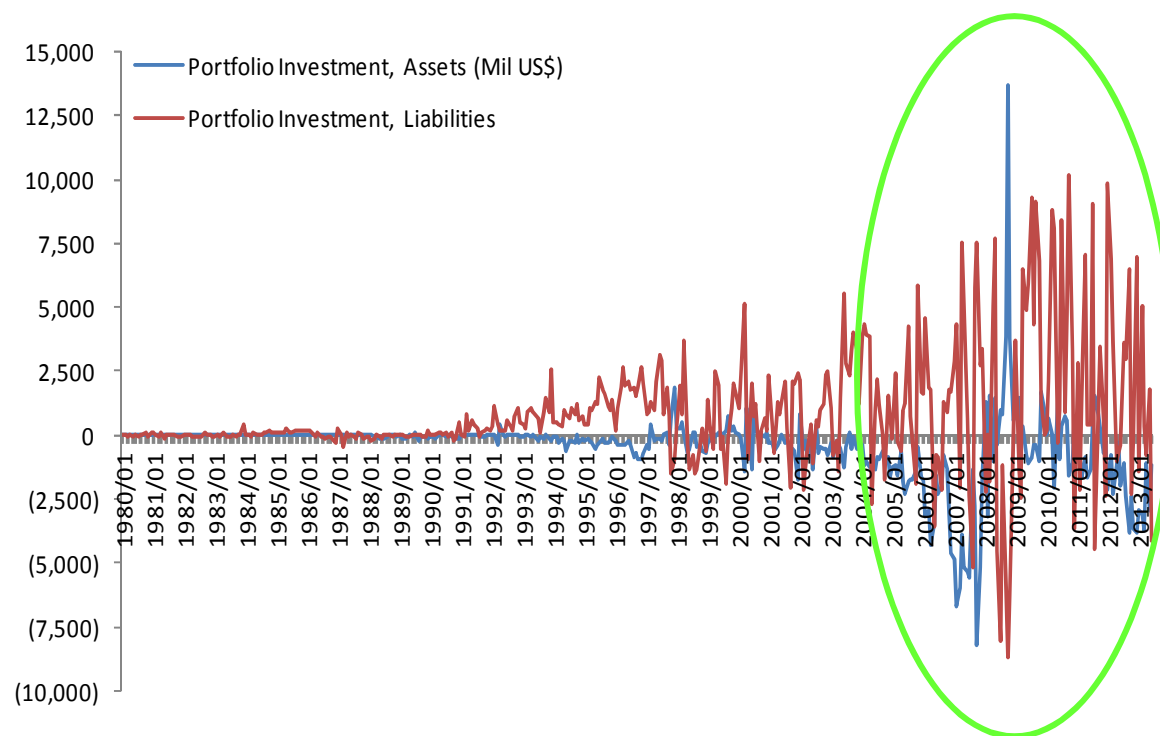
❑ **Liberalization precipitated since the currency crisis**

  ▪ Free float exchange rate system ('97.12)

  ▪ Foreigners' investment freed: listed bonds('97.12), listed stocks, short-term financial instruments ('98.5)

< FX commodity transaction (Domestic interbank, 100Mil$) >

	2001	2004	2007	2010
Spot	27.3	40.0	82.5	76.6
Forward	-	0.2	7.5	1.5
FX Swap	8.8	15.3	67.0	101.9
Other Derivatives	0.6	2.8	40.1	14.3
Total	36.7	57.3	197.1	194.6

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Liberalization Necessitates Monitoring

❑ **Volatility Surged after Liberalization**

Legend:
- Portfolio Investment, Assets (Mil US$)
- Portfolio Investment, Liabilities

❑ **Major Monitoring Tools**

- ▪ *KCIF* with Currency Crisis EWS, Since April 1999
- ▪ *On-line FX Flow Monitoring System*, Since April 1999
- ▪ *Korea Financial Intelligence Unit (FIU)*, Since November 2001
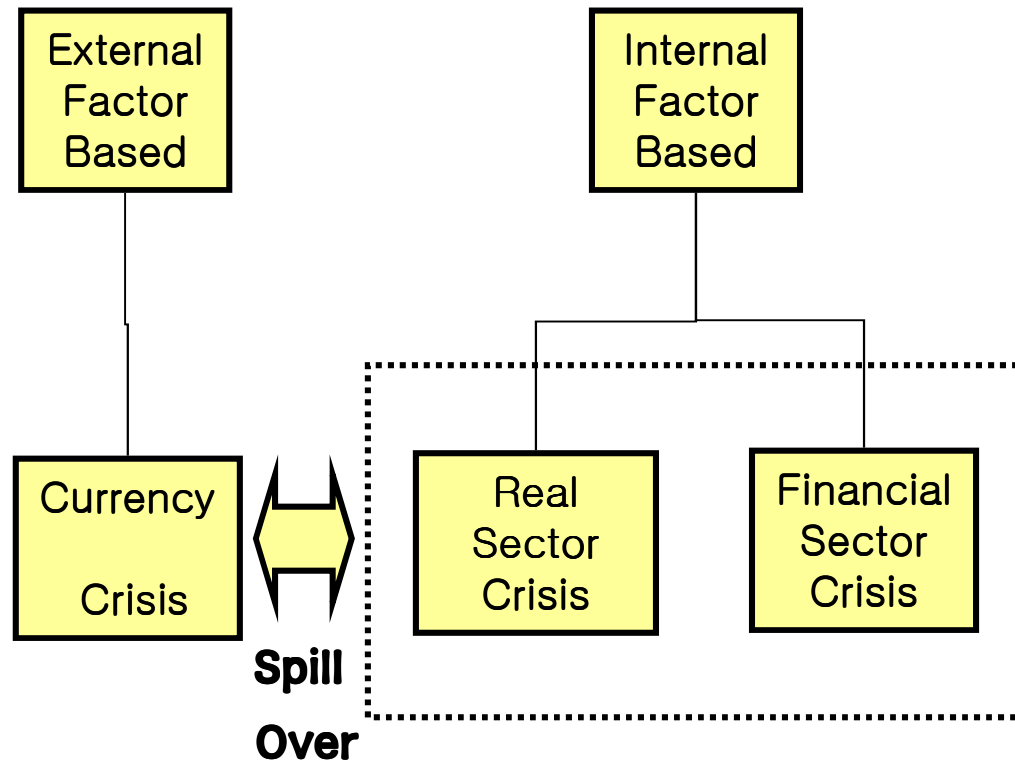- ▪ Strengthened FX Soundness Surveillance, by FSS

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Need for National EWS

❑ **Risks are more and more interrelated.**

External Factor Based

Internal Factor Based

Currency Crisis

Real Sector Crisis

Financial Sector Crisis
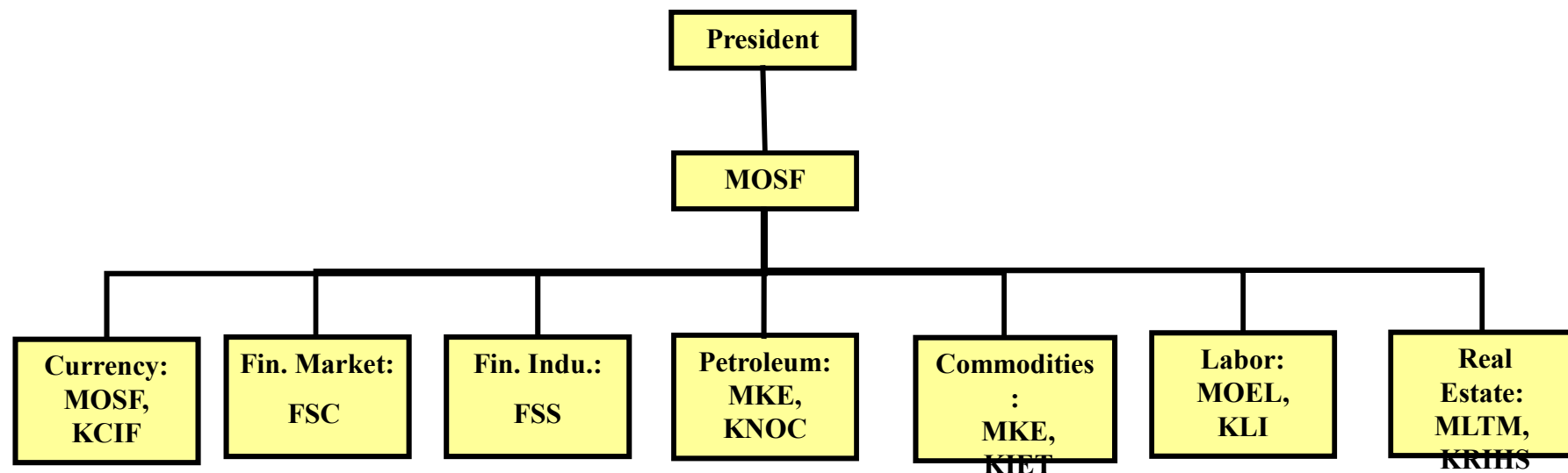
Spill Over

- 1997 currency crisis

  : External → Domestic

- 2003~04 credit card bubble burst

  : Domestic → External

- 2008~09 global financial crisis

  : Overseas → Domestic

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National EWS since 2005

❑ National EWS is built & in operation since 2005

- ▪ 7 sectors : Own model in each sector
- ▪ Korea has the KCIF for currency crisis related risks

< Korea's Monitoring System >

```
                      ┌─────────────┐
                      │  President  │
                      └──────┬──────┘
                             │
                      ┌──────┴──────┐
                      │    MOSF     │
                      └──────┬──────┘
```

| Currency: MOSF, KCIF | Fin. Market: FSC | Fin. Indu.: FSS | Petroleum: MKE, KNOC | Commodities : MKE, KIET | Labor: MOEL, KLI | Real Estate: MLTM, KRIHS |

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# Currency EWS mandated by KCIF

❑ **Establishment**

- **Established on April 1, 1999 under the auspices of the Government and the Bank of Korea**

❑ **History**

- **98.11.3 : Task Force for KCIF Establishment started**
- **99.2.23 : 1st Standing Committee & President designated**
- **99.4.1 : KCIF began its operation**
- **13.5 : Current president, Mr. IkJoo Kim, took his position as 7th president of KCIF**

Qualitative & Quantitative EWS

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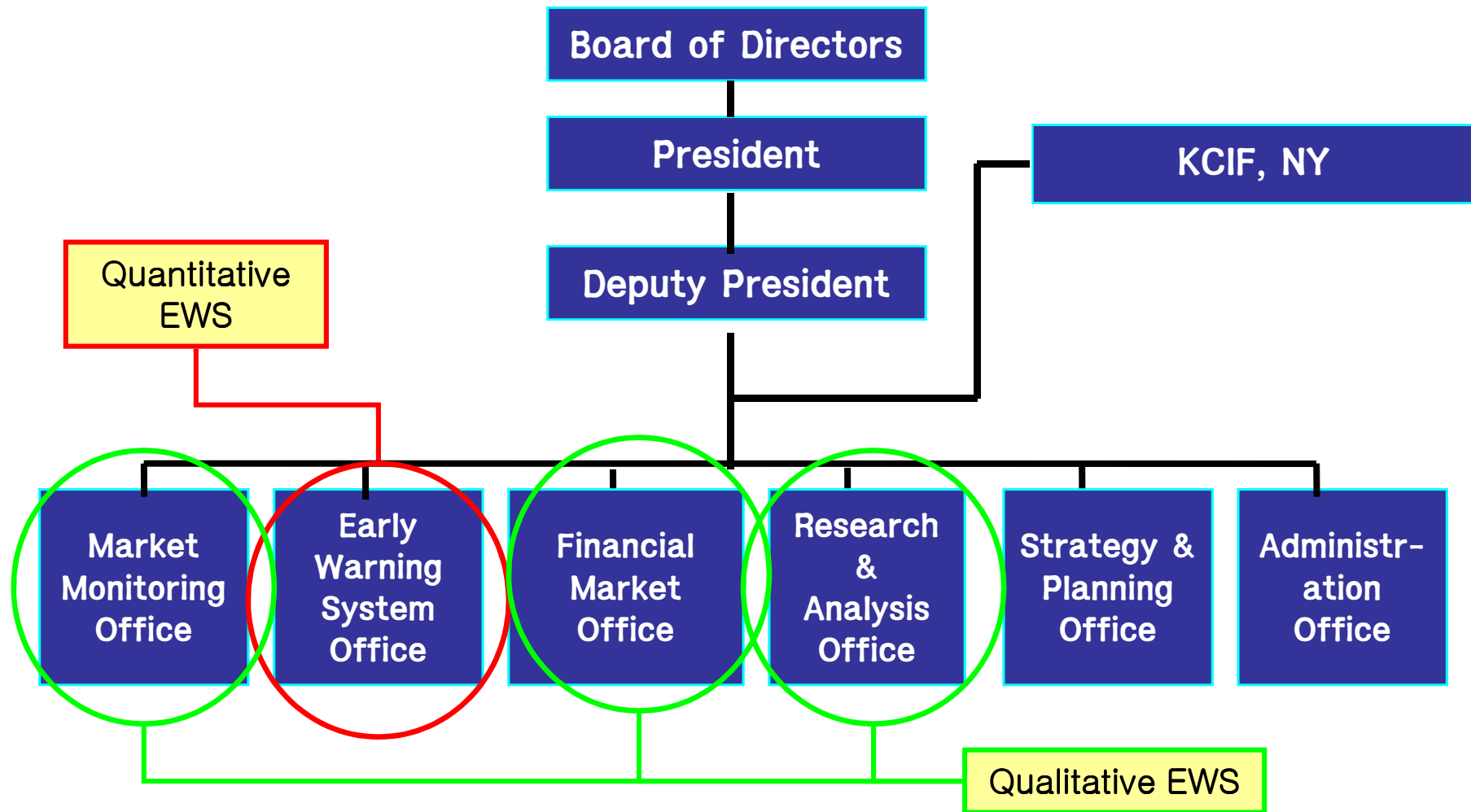
Qualitative EWS is Needed

Team	Major Function
Financial Market Office	Monitors FX, Fixed Income, Equity, Derivatives Mkt
Research & Analysis Office	Monitors Regional Economies including China, Japan, EU, US, EM's and Commodities Mkt
Market Monitoring Office	Monitors Korea-related agenda, changes in global players' view
Part of EWS Office	Final call for sovereign risk, Contact point with rating agencies, Coordinate IFPF

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Monitoring Source

❑ **Monitoring Source**
  - 20 IB & CB Reports including Goldman Sachs, JP Morgan, etc.
  - Rating Agency DB including S&P, Moody's and Fitch
  - Proprietary Info. Source including Bloomberg, Reuters, Dow Jones
  - Research Institutes including Oxford Analytica, Global Insight, IIF
  - Specialized Periodicals including FT, WSJ, Economist, Euromoney
  - N.Y. Office – contacts local economists, analysts

Major Outcome of Quali. EWS : Reports Produced

❑ **Quick Report**
  - Daily, Special Monitoring Report
    (Surge in Market Volatility, North Korean Nuke, etc.)
  - Distribution : Public

❑ **General Report**
  - most of 'Issue Analysis', Monthly, Quarterly
  - Distribution : Public

❑ **Premium Report**
  - selected 'Issue Analysis'
  - Distribution : Presidential Office, Government, FSC, BOK, FSS
    Members & Sponsors

❑ **VIP Report**
  - Issue Analysis (Confidential), EWS Report
  - Distribution : VIP in Presidential Office, Government, FSC, BOK, FSS

Major Periodical Reports

❑ **Major IBs' Exchange Rate Survey (weekly)**

❑ **International Financial Market Monthly**

❑ **Foreigners' Derivative Position (monthly)**

❑ **Non-residents' equity transaction in Asian Market**

❑ **Emerging Market Risk (Monthly)**

❑ **Commodity Market Trends (Monthly)**

❑ **Fund Flow into US (Monthly)**

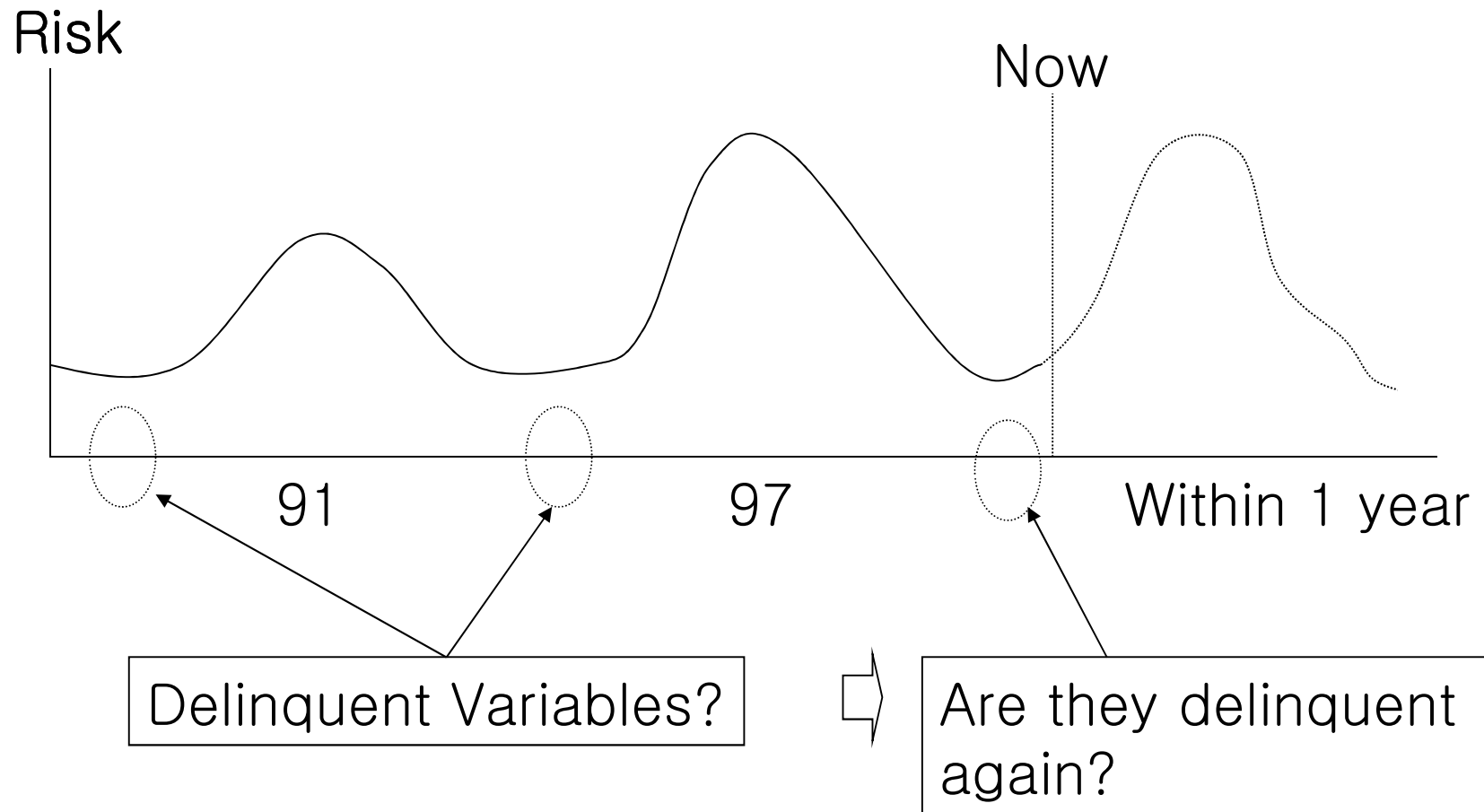Some 2000 reports a year!

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Quantitative EWS for Currency Crisis : FCI

❑ Every month, FCI (Fundamental based Crisis Index) Model, an econometric black box, takes macroeconomic indicators as input and spit out three kinds of risk indicators — composite indicator, sector indicators, and individual indicators.

- FCI model has 4 sectors — domestic real, domestic financial, external real, external financial.

```
                                    Individual
                                    Indicators

Macro           FCI Engine          Composite
indicators                          Indicator

                                    Sector
                                    Indicators
```
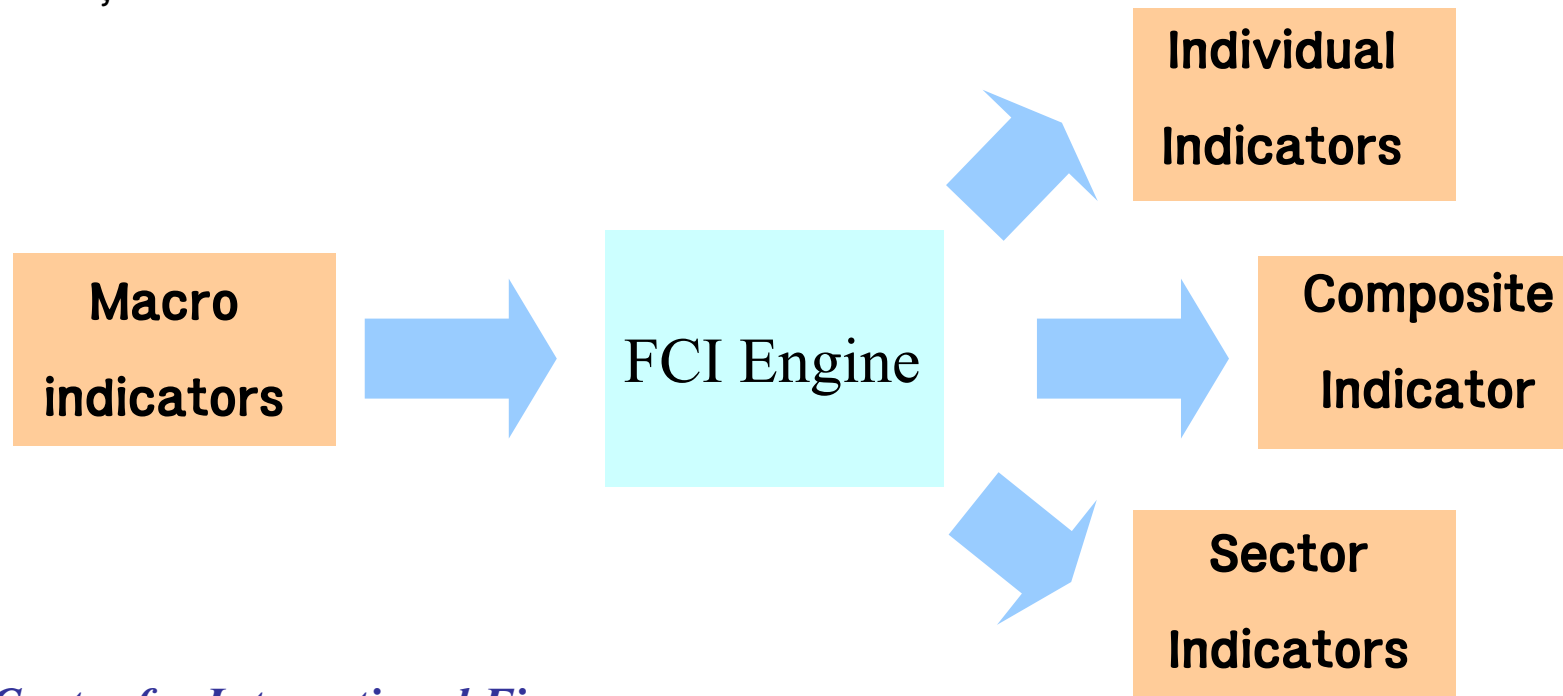
Concept of EWS : Once criminal, delinquent again

Risk

Now

91   97   Within 1 year

Delinquent Variables? ⇨ Are they delinquent again?

Signaling Approach (Kaminsky & Reinhart, '98)

❑ **Detect the recurrence of crisis by tracking those indicators that sent signals before the previous crises**

❑ **Set a critical value for each indicator and form an index as a weighted average of risk signals from indicators**

   ▪ **A signal is issued: if the indicator passes threshold**

❑ **Critical values are set to minimize Noise/Signal ratio**

   ▪ **Noise($\frac{B}{B+D}$): signal issued when the economy is in peace**

   ▪ **Signal($\frac{A}{A+C}$): signal issued when the economy is in crisis**

	Crisis (within 12 mos)	No Crisis (within 12 mos)
Signal issued	A	B
No Signal issued	C	D

FCI Reporting

❑ **Composite Indicator**

- ▪ **Five levels from "normal" to "emergency"**

- ▪ **Each level matches specific policy action guideline**

❑ **Sector Indicator and Individual Indicators**

- ▪ **Even though composite indicator stands in green zone, KCIF analyzes in depth the indicators which trespasses own threshold.**

Policy actions responding each FCI level

FCI Level	Policy Action
Normal	-
Caution	• Tighter monitoring on domestic/global market, and Cross border short term capital flow • Increase quantity & quality of information shared inside and outside of government for the risk factors identified
Warning	• Strengthen monitoring function on illegal FX transaction • Higher requirement on FX liquidity soundness of financial institutions • Prepare policy action plans on risk factors identified • Active sovereign IR
Quasi-emergency	• Prepare contingency plans on short term FX liquidity shortage • Activate pan-government daily checking system and crisis management entity • Double check SAFEGUARD trigger conditions.
Emergency	• Activate SAFEGUARD following predetermined trigger conditions

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Meaning of FCI Indicators : A Caveat

❑ FCI indicator implies the probability of another currency crisis within upcoming 12 months, not tomorrow nor next month.

❑ FCI captures primarily ''currency crisis.'' The other forms of crisis are captured at contagion phase.

❑ FCI is designed to be sensitive to any kinds of symptom, so that it is doomed to be emit false signal as well as true signal.

➔ Examination needed before policy action.

Renovation of FCI

❑ **Renovated N/S ratio, critical values, forecasting models**

  ▪ N/S ratio, critical values are re-adjusted to reflect the recent changes in behavior of indicators

  ▪ Forecast variables are estimated on extended time series

❑ **Responsiveness & forecasting ability of FCI enhanced**

Additional Models

❑ **FCI + Additional Models**

- ▪ **International Financial Market Risk Index: Stock, Bond, FX, Interbank funding, Investment sentiment**
- ▪ **Domestic Financial Market Risk Index: Stock, Bond, FX**
- ▪ **Proximate Risk Index: Recent risk factors − Eurozone fiscal crisis, Global business cycle slowdown**

❑ **Qualitative judgment by Committee**

- ▪ **Held every month to review model operations and determine final index**

Other Quantitative Tools

❑ **Quantitative monitoring on other country**
  - Try to expand the scope of monitoring
  - China model development

❑ **IB Risk Indicators**
  - Cost-efficient ways to increase surveillance capability
  - ex. GS FCI, GLI, UBS Risk index…
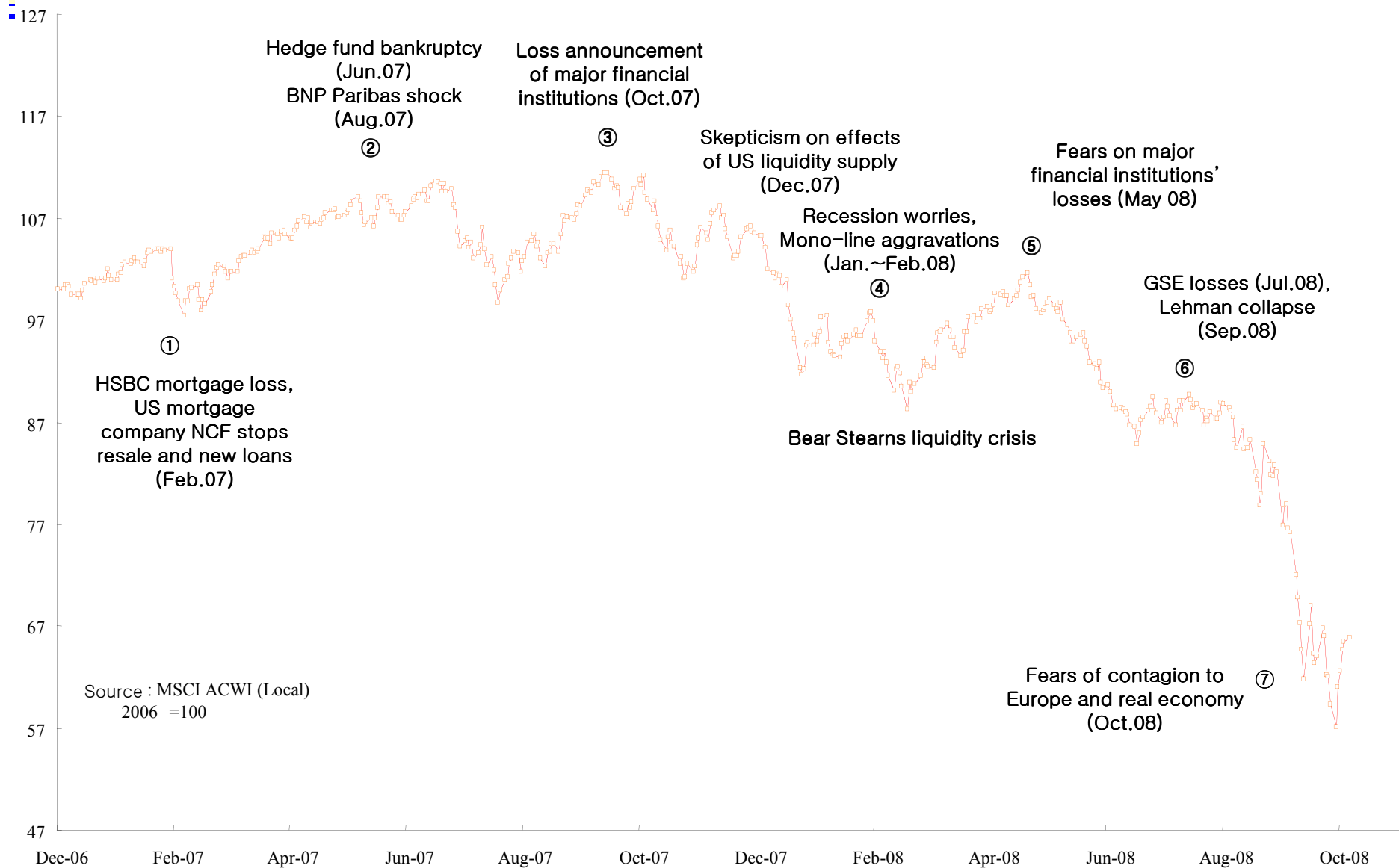
Currency EWS – Performance

❏ **Qualitative EWS**

- ▪ **Warnings on major financial institutions' failure**
  - The possibility of similar event such as Bear Sterns to other IBs (Mar. '08)
  - Aggravation of credit crunch due to de-leveraging and write-offs (Jun. '08)
  - The possibility of collapse of Lehman Brothers (Jul. '08)
  - Relayed the worries on KDBs acquisition on LM (Aug.29.08)
- ▪ **Continued monitoring efforts on Recovery phase**
  - Risks in Eastern European economies, US commercial mortgages, Deteriorations in public finance of advanced countries⋯
  - Market condition for Korean bond issues overseas⋯

Currency EWS – Performance

Hedge fund bankruptcy
(Jun.07)
BNP Paribas shock
(Aug.07)
②

Loss announcement
of major financial
institutions (Oct.07)
③

Skepticism on effects
of US liquidity supply
(Dec.07)

Fears on major
financial institutions'
losses (May 08)

Recession worries,
Mono−line aggravations
(Jan.~Feb.08)
④

⑤

GSE losses (Jul.08),
Lehman collapse
(Sep.08)

①

HSBC mortgage loss,
US mortgage
company NCF stops
resale and new loans
(Feb.07)

Bear Stearns liquidity crisis

⑥

Source : MSCI ACWI (Local)
2006 =100

Fears of contagion to
Europe and real economy
(Oct.08)
⑦

Currency EWS – Performance

List of Issue Analysis and Reports: Example

Title	Date
The response of major financial institutions since subprime crisis	Feb.5.2008
Recession worries in the midst of credit crunch	Mar.4.2008
The possibility of further aggravations of subprime mortgages	Mar.6.2008
Rescue on Bear Sterns and Future Outlook	Mar.17.2008
The outlook on global credit crunch spill-over	Mar.28.2008
Major IBs' write-offs and their effects	Apr.21.2008
The 2nd quarter major IBs performance and outlook	Jun.17.2008
Global banks' bad asset accumulations and their effects	Jun.20.2008
Reemergence of credit crisis and international financial market turmoil	Jul.1.2008
Risk factors in domestic financial market and policy measures	Jul.14.2008
Risks on US banks' bankruptcy	Jul.28.2008
Local views on US housing market, oil prices and dollars	Aug.29.2008

⋮

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Currency EWS – Performance

❑ **Quantitative EWS**

  ▪ **Limits and difficulties**

   • Composed of domestic indicators → hard to capture crisis from abroad

   • Sound operations of domestic economy

  ▪ **Some important risk factors captured**

   • The model emitted signals in some important indicators related with the crisis : short-term external debt, banks' position on external asset/liability

   • Reported especially with sectoral indicators and qualitative analysis

Financial Industry/Market EWS

❑ **Objective: Sound supervision and pre-emptive response to financial sector crises (financial industry and market)**

- ▪ **Responsible authority: FSS, FSC**
- ▪ **Models: Handy Assessment System + Early Warning Models (Ordered Probit, Logit, Statistical CAEL, etc.)**
- ▪ **Key variables**
  - • **Financial market: 30 variables, including stock price index, interest rate, ratio of dishonored bill, spread, etc.**
  - • **Financial industry: Approximately 360 variables, including capital adequacy, asset soundness, profitability, liquidity, etc.**

Financial Industry/Market EWS

Early Warning Model & Handy Indicators

	Early Warning Model	Handy Indicators
Objective	Assess/forecast the crisis possibility of financial industry and individual financial institutions	Real time check the crisis possibility of financial industry and individual financial institutions
Assessment	Using 6 econometric models	Grading a few handy indicators
Data	Balance sheet information of financial institutions, macroeconomic variables, etc.	Soundness, profitability, liquidity indicators, etc.
Frequency	Quarterly	Monthly (Checked Daily)

* Monitoring 9 financial segments: Bank, life insurance, liability insurance, securities, asset management, credit card, installment financing, savings bank, credit union

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Financial Industry/Market EWS – Performance

❑ **Complement the supervision on financial institutions' health and market stability**

- ▪ BIS capital adequacy ratio, NPL ratio maintained sound level
- ▪ Difficulty in lacking sample of crisis experience
- ▪ Stability of financial market & indicators

BIS ratio of banks in Korea

Asset Soundness

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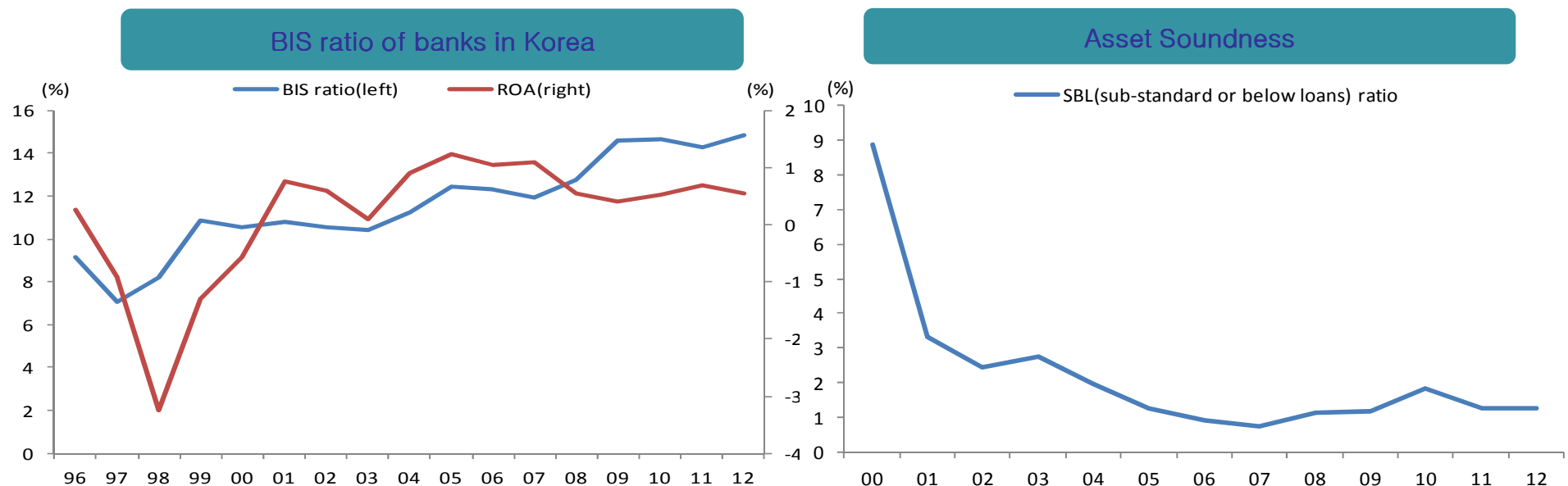
Real Estate EWS

❑ **Objective: Detect volatilities/instabilities of real estate (housing & land) market and minimize their effect on national economy**

- Responsible authority: Ministry of Land, Transport, Maritime Affairs
- Models:
  - National: Signaling approach
  - Regional: Probit model
- Feature: Real Estate Market Monitoring Committee meeting (monthly)
  - composed of experts in academia and research institutes, market experts, civil servants
- Key variables: Sales price, housing lease price, land price, and home mortgage loan, etc.

Real Estate EWS – Performance

❑ **Contributed to the stabilization of real estate market**

- Helped alert policy makers to counter housing market overheating : LTV, DTI
- Alerted weakness in construction business during recent crisis
- Regarded to be effective in policy contribution – Qualitative judgment process

House Prices (yoy)

Unsold housing units (thousands)
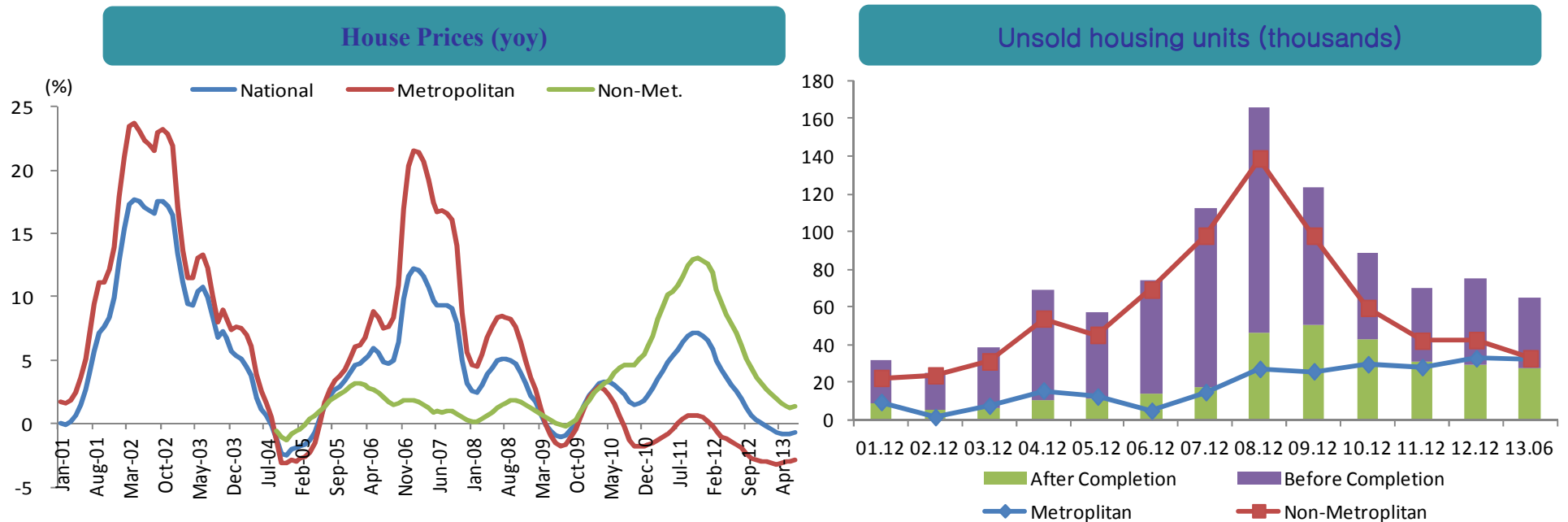
Energy/Commodity EWS

❑ **Objective: Detect the possibility of price surge and supply shortage of oil and commodities**

- Responsible authority: Ministry of Knowledge and Economy
- Operation:
  - Oil: Korea National Oil Corporation
  - Commodity: Korea institute for industrial economics and trade
- Models:
  - Oil: Artificial Neural Network model
  - Commodity: Signaling approach
- Key variables:
  - Oil: U.S. oil inventories, OPEC output, global oil demand, etc.
  - Commodity: commodity output, commodity inventories, commodity futures price, etc.

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Labor EWS

❑ **Objective: Respond to instabilities in the national economy and people's livelihood caused by employment crises and labor disputes**

- ▪ Responsible authority: Ministry of Labor
- ▪ Models:
  - Employment: Forecast the employment rates and evaluate the stress level in labor market
  - Labor management relation: Forecast labor disputes in 1 month ahead, based on previous year's labor disputes
- ▪ Key variables:
  - Employment: unemployment rate, index of industrial product, wage, etc.
  - Labor management relation: number of industrial, regional and annual labor dispute, etc.

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Funding/Manpower for independent NSU Can Be Shared

❑ **Outputs from NSU also can be shared**

Central Bank	**MOSF**	**Related Private Associations**

Independent NSU
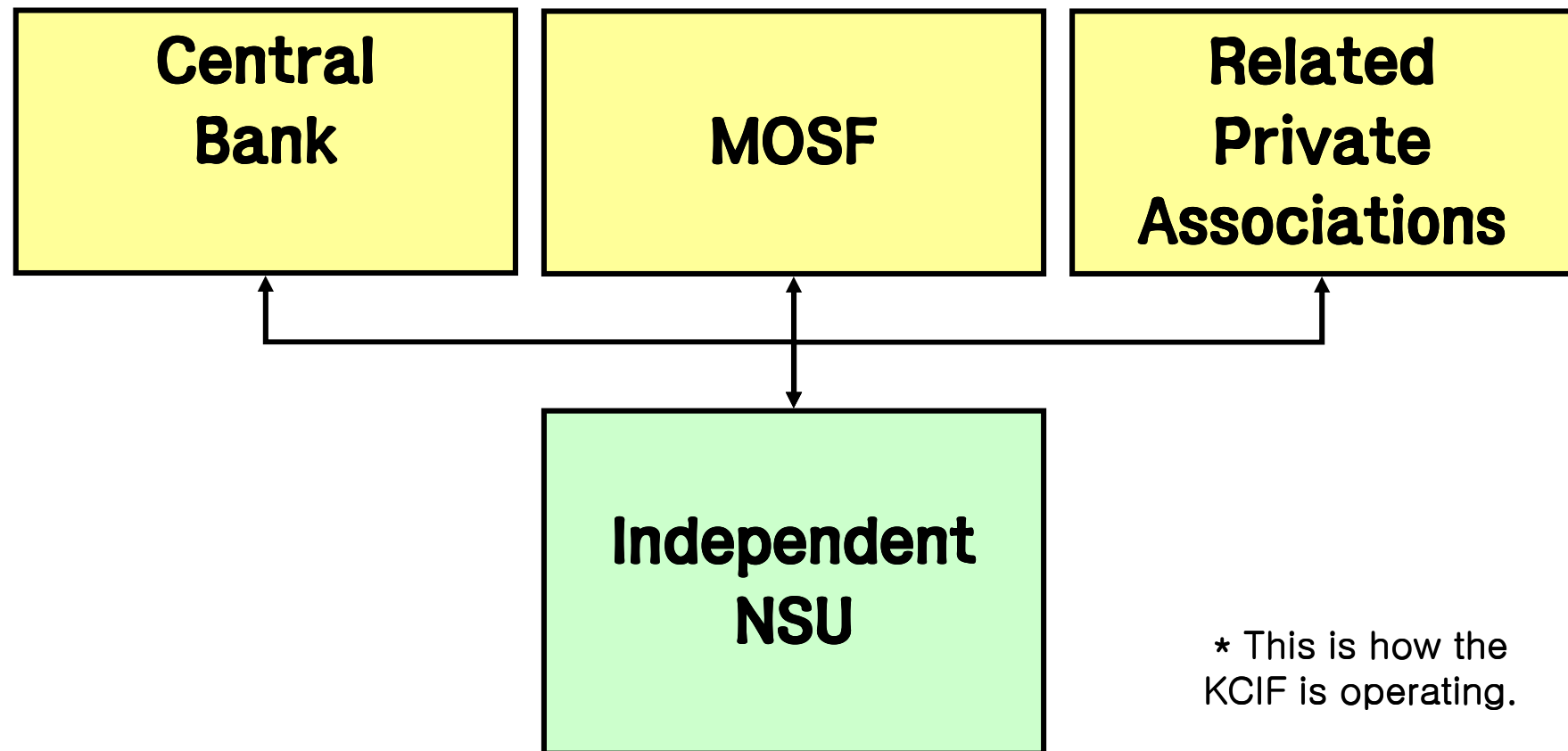
* This is how the KCIF is operating.

Direct reporting line is critical

❏ **If considered important, KCIF report is delivered to all the necessary parts of the public sector at once with minimum time spent.**

▪ **Those reports sometimes disregard official format requirement ➜ Only content & freshness are important.**

❏ **NSU's reporting lines are recommended to be 'hot lines' which can bypass the bureaucratic ladder.**

Qualitative Analysis Crucial

❑ **Countries tend to focus on model development.**

❑ **Models are generally useful for experienced crisis.**
- However, the nature of crisis changes all the time.
- 1997 currency crisis vs. Recent crisis in 2008
- Hard to change or build a model in a short period of time

❑ **Qualitative analysis flexible for various monitoring tasks**
- Directly look into the sector/market in trouble

Qualitative Side First

❑ **What is needed is the manpower/organization**

  ▪ who supplies good information so that policy makers can make appropriate decisions.

  ▪ who operates the model, analyze the outcome, filter out false signals and finally produce reports.

❑ **If research power is available after quali., it's recommended to develop models which look at different aspects of the elephant.**

  ▪ For example, stress tests, market monitoring system...

Emitting signals is important

❑ **Despite all the monitoring efforts, there's a tendency qualitative warnings are not treated seriously.**

- Regarded as one of those numerous economic reports···
- Both handed economic analysis: One the one hand normal, on the other hand crisis···
- No explicit links or guidelines connecting the seriousness of situation to policy actions

❑ **Desirable to incorporate qualitative judgment process on final warning signals**

- Quantitative analysis suggests objective numerical results.
- Qualitative judgment supplements quant. results by making explicit choices on final signal.

Persistent maintenance efforts required

❑ **For proper operations, EWS requires constant efforts and attentions.**

❑ **A tendency of insufficient maintenance and upgrade once a model is built**
  - EWS on economy is very different from EWS on engineering objects
  - Economic behavior changing and evolving : cannot be mechanical

Data is far more important than technology.

❑ **It has been observed that some department of the government tries to develop EWS model without sufficient accumulation of data.**

  ▪ However wonderful the machine is, one cannot extract sesame oil out of "no sesame".

❑ **In the case of financial sector EWS, soundness distribution of individuals and corporations were not identified ➜ Failed to capture "credit card risk" & "SME risk."**

  ▪ Once distribution data ready, it is expected to function well.

Overcome the hesitance to release signal

❑ **People have tendency to hide risk factors rising within the area of which they are in charge.**

- ▪ It is burdensome to take policy actions based on crisis warning that may not be realized.

- ▪ It is probable that risk factors are exposed only after they grow beyond control.

❑ **Warning signals are better interpreted as warning on vulnerabilities of the economy to be cautioned, not the fortune telling.**

- ▪ Model output needs to be reported to rather wider group of policy leaders → more difficult to conceal
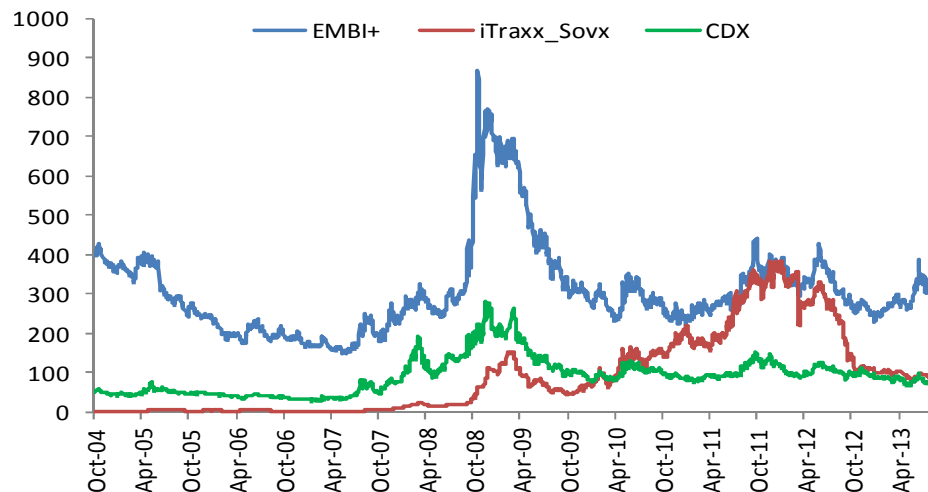
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Expand surveillance coverage

❑ **What happens in a country has rapid and significant influence on others.**

- ▪ Trade and financial linkages are increasing in the world economy.

- ▪ If confined to domestic variables only, one captures crisis only at contagion phase.

- ▪ Utilize financial indicators that respond swiftly to market situations

- ▪ Again, qualitative first, then quantitative monitoring

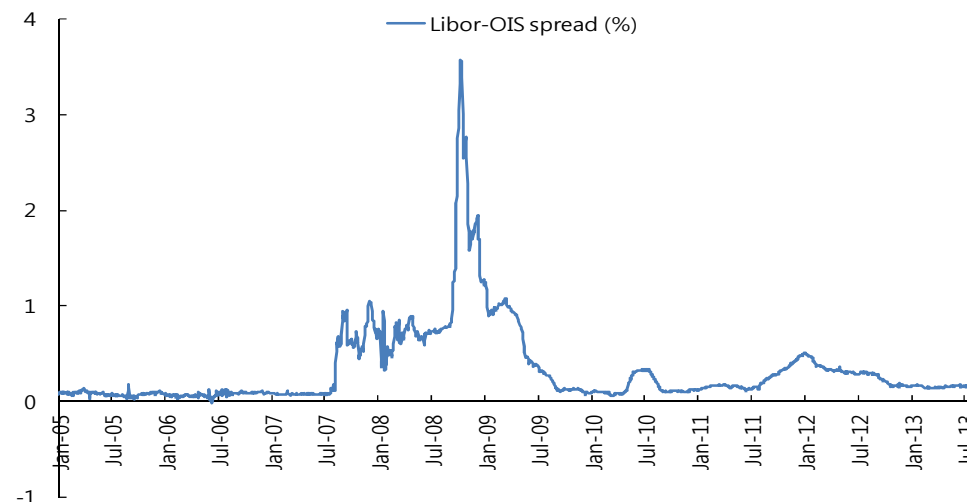- ▪ Concentration and parsimony of models desirable

Indicators of global financial market

Bond market

EMBI+ — iTraxx_Sovx — CDX

Interbank funding

Libor-OIS spread (%)

Sentiment index

VIX

FX market

EURUSD volatility — USDJPY volatility
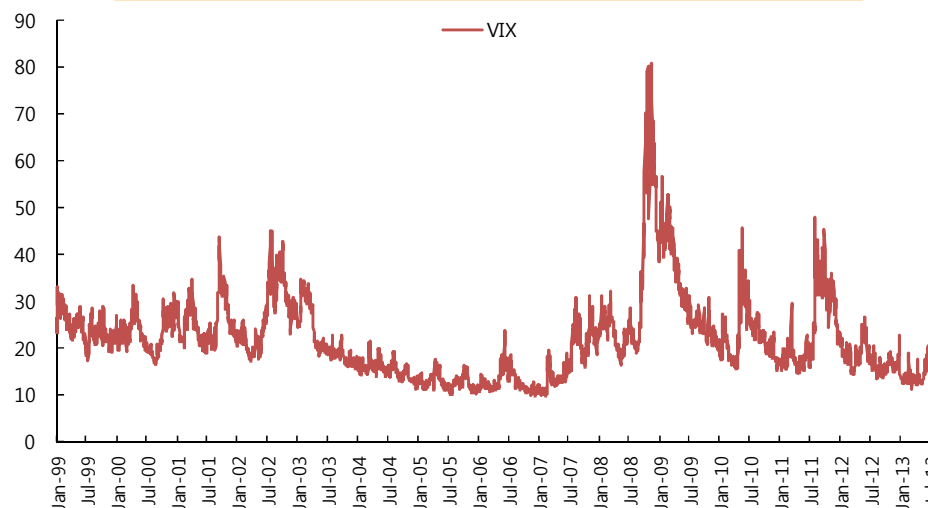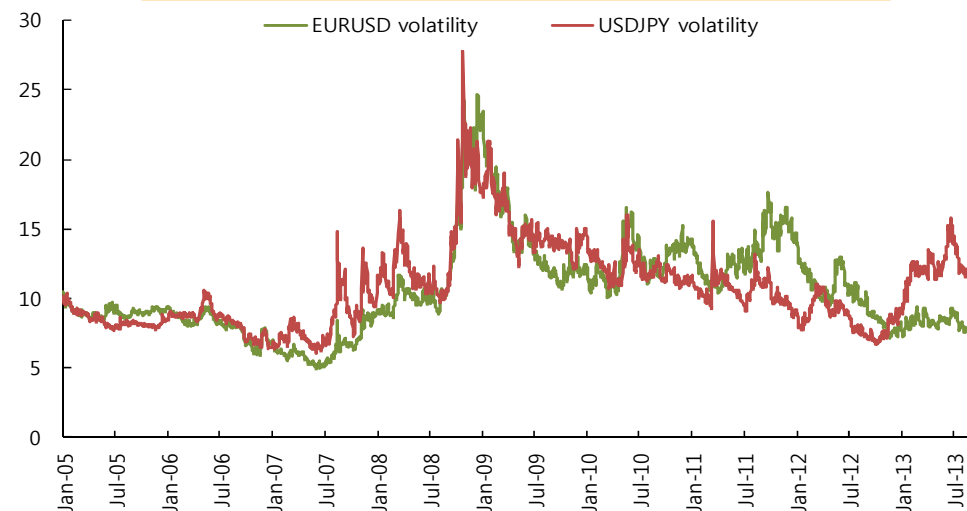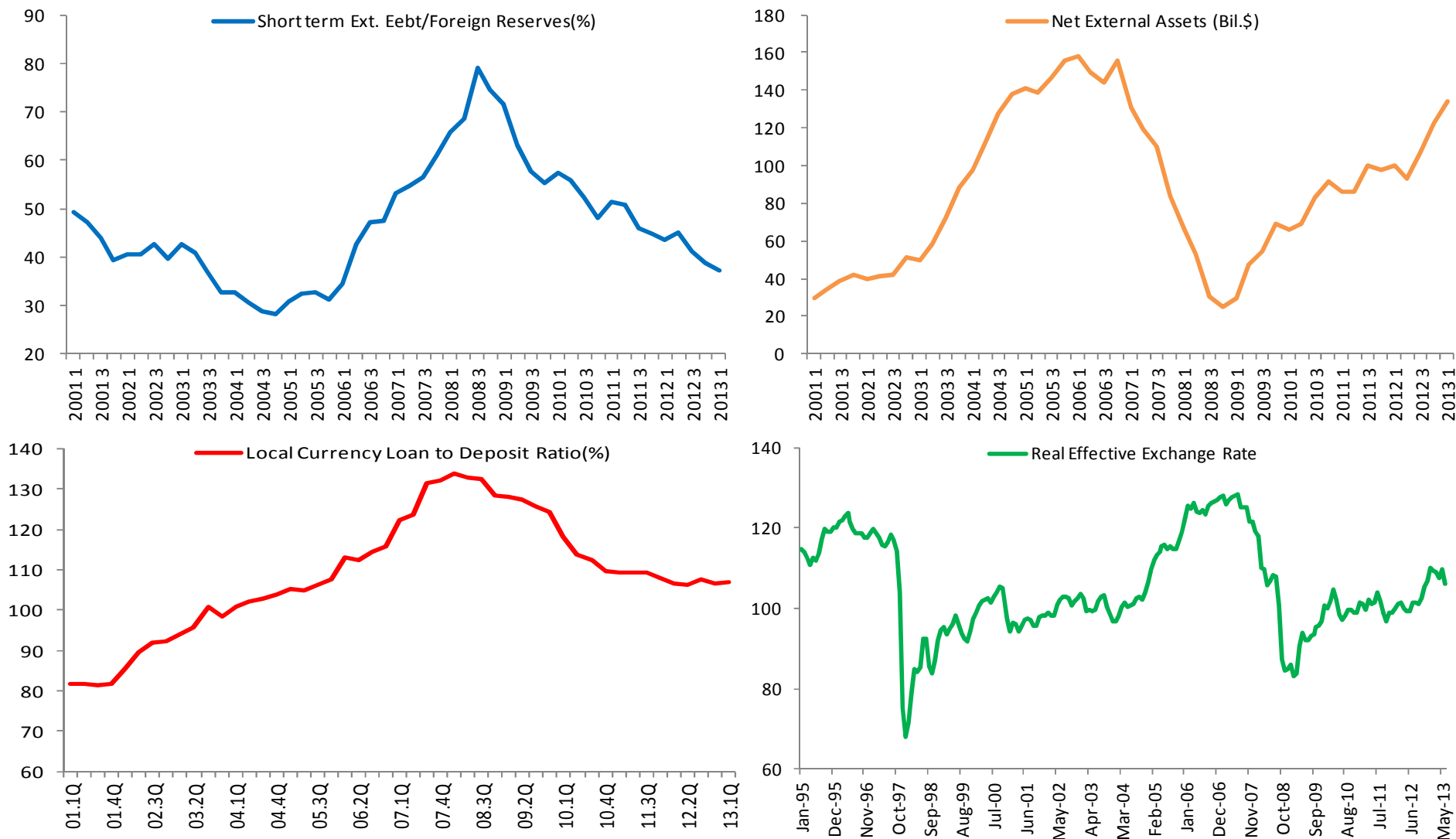
More attention on domestic vulnerabilities

❑ **Focus on preconditions of the economy to absorb shocks**

- Crisis occurs with accumulation of underlying vulnerabilities such as asset price bubbles, excessive borrowing of foreign currency, etc.
- Difficult to predict exactly when crisis occurs
- Vulnerabilities tend to be formed before the crisis since crisis is unlikely to occur without them.
- IMF's monitoring on emerging economies (VEE) largely based on identifying vulnerabilities

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Vulnerabilities of FX liquidity

Short term Ext. Eebt/Foreign Reserves(%)

Net External Assets (Bil.$)

Local Currency Loan to Deposit Ratio(%)

Real Effective Exchange Rate

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Other Lessons

❑ **Various methodologies applicable**

- Stress tests on EWS for worst case scenarios
- High frequency financial indicators such as premiums on interest rate, spreads, implied volatility of options⋯
- Trade and financial linkages among economies

❑ **Whether to publicize the EWS result?**

❑ **Critical statistics in risk monitoring can be found in the financial supervisory authorities, not in the National Statistics Office.**

Other Lessons

❑ Keep on listening and watching what other countries do. ➔ International cooperation is important as in ASEAN+3 framework.

Thanks for listening...