

## Course Structure and Standard Syllabus

### Course Topic: Inclusive Growth and Structural Policies

### Course Title: Vulnerability Diagnostics (VDS)

**Course Description:** This advanced course, presented by the IMF Institute for Capacity Development (ICD), complements the Macroeconomic Diagnostics (MDS) course by enhancing participants' ability to assess fiscal, financial, external, and real vulnerabilities in an integrated fashion using lectures, analytical tools, hands-on workshops, and case studies to measure tail (as opposed to central) risks.

**Course Objectives:** Upon completion of this course, participants should be able to:

- Identify appropriate measures of fiscal, financial, external, and real vulnerabilities.
- Describe how vulnerabilities can morph into distress leading to crises as a result of adverse shocks or flawed policies.
- Use diagnostic tools to track measures of vulnerabilities and predict indicators of tail risks, including tools currently employed in IMF surveillance.
- Adapt over time diagnostic tools to their country data.

**Target Audience:** Officials of all levels in central banks and ministries of finance or other relevant agencies who monitor and assess country and regional vulnerabilities and risks.

**Pre-requisites:** Participants should have an advanced degree in economics or equivalent experience, a basic background in econometrics, and some familiarity with the use of software for econometric applications. In addition, some e-learning modules prior to the start of the course will be required—unless one of the following face-to-face or online EdX courses have been taken: Financial Programming and Policies (or FPPx); Macroeconomic Diagnostics (or MDSx); or and Macroeconomic Forecasting (MFx).

**Performance Evaluation:** Two multiple-choice tests will be given, one at the beginning of the course and another at the end to ascertain participants' backgrounds and progress.

### **Topics (*Core Units*)**

1. Vulnerabilities and Crises
2. Forecasting Methods for Tail Risks
3. Fiscal Vulnerabilities I: Assessing Debt Sustainability
4. Financial Vulnerabilities I: Taxonomy and Measurement of Financial Risks
5. External Vulnerabilities I: Bond Yields and Sovereign Default Risk
6. Financial Vulnerabilities II: Detecting Financial Fragility
7. Fiscal Vulnerability II: Short-term risks
8. External Vulnerabilities II: Current Account Imbalances
9. Financial Vulnerabilities III: Financial Cycles, Business Cycles and Systemic Risk
10. External Vulnerability III: Reserve Adequacy
11. The IMF's Vulnerability Exercise
12. Three Crises: Case Studies

### **Topics (*Auxiliary units*): Regional customization and more advanced tools**

The core units are designed to be offered in all regions. Auxiliary units should be customized to regions and perhaps expanding the core units with country specific examples from the region and/or offering more advanced toolkits. These variations can often be accommodated on days 6 and 7 of a two-week course, leaving day 8 and 9 for item 12, the breakout case studies. Day ten is usually reserved for testing, evaluation and course wrap up.

13. Fiscal Vulnerability III: Stochastic DSA
14. Financial Vulnerability IV: Spillovers and Contagion
15. Fiscal Vulnerabilities IV: Long-term Risks
16. Real Sector Vulnerabilities I: Financial Conditions

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## **PROGRAM OUTLINE FOR VDS COURSE**

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### **DAY 1**

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### **UNIT 1: INTRODUCTION TO VULNERABILITIES AND CRISES, AND THE COURSE OVERVIEW**

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#### **Lecture (1.5 hour)**

This lecture explains how vulnerability to adverse shocks in an economy or sets of economies can lead to crises, and how best to analyse the sources of fiscal, external, real and financial vulnerabilities and their impact of some on key macro variables. In addition, the structure of the course and its teaching modalities will be introduced.

- Theoretical overview
- Vulnerabilities and crises
- Structure of the course

## References

Claessens S., M.A. Kose, 2014, “Financial Crises: Explanations, Types, and Implications”, Chapter 1, in S. Claessens, M.A. Kose, L. Laeven, and F. Valencia Eds., *Financial Crises: Causes, Consequences, and Policy Responses*”, Washington DC. Available at a course website

Reinhart, C. M., and K. S. Rogoff, 2014, “Financial and Sovereign Debt Crises: Some Lessons Learned and Those Forgotten,” Chapter 3, in S. Claessens, M.A. Kose, L. Laeven, and F. Valencia Eds., *Financial Crises: Causes, Consequences, and Policy Responses*, Washington DC. Available at a course website

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## UNIT 2: FORECASTING METHODS FOR TAIL RISKS

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### Lecture (1.5 hours)

This lecture introduces the key methods to predict tail risks and vulnerabilities; namely VaR-type measures, Logit models, and ROC analysis. Several workshops in this course will focus on applications of these methods, considering different measures of stress/crises and different sets of predictors capturing vulnerabilities.

- Defining tail risks
- VaR measures of tail risks
- Logit/Probit models
- The signal approach: threshold methods

### References

Harper D., 2015, Introduction to Value at Risk (VaR), article at Investopedia <http://www.investopedia.com/articles/04/092904.asp>

Koenker, R. and K. Hallock. Quantile Regression: An Introduction, mimeo [www.econ.uiuc.edu/~roger/research/intro/rq.pdf](http://www.econ.uiuc.edu/~roger/research/intro/rq.pdf)

De Nicolo, G., and Lucchetta, M., 2016, Forecasting Tail Risks. *Journal of Applied Econometrics*, [http://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=2685707](http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2685707)

Basu, S., M. Chamon, and C. Crowe, 2017, “A Model to Assess the Probabilities of Growth, Fiscal, and the Financial Crises.” IMF working Paper 17/282. <https://www.imf.org/en/Publications/WP/Issues/2017/12/15/A-Model-to-Assess-the-Probabilities-of-Growth-Fiscal-and-Financial-Crises-45484>

**Workshop (1.5 hours):** Predicting Currency Crises via Probit/Logit Regressions

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## DAY 2

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### UNIT 3: FISCAL VULNERABILITIES I: ASSESSING DEBT SUSTAINABILITY

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#### Lecture (1.5 hour)

This lecture introduces the concept and mechanics of debt sustainability for the public sector in closed and open economy settings, including the rationale for borrowing, the IMF basic approach to DSA and limitations, and policy actions to ensure DS.

- Debt sustainability, debt crisis, and growth
- Deterministic DSA in closed and open economies

#### References

IMF, 2013, “Staff Guidance Note on Debt Sustainability Analysis for Market Access Countries” (Washington). <http://www.imf.org/external/pubs/ft/dsa/mac.htm>

IMF, 2015, “Public Debt Vulnerabilities in Low-Income Countries - The Evolving Landscape”, IMF Policy Paper <http://www.imf.org/external/pp/longres.aspx?id=5004>

**Workshop (1.5 hours):** Assessing debt sustainability: debt-stabilizing primary balance, IMF’s approach to DSA

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### UNIT 4: FINANCIAL VULNERABILITIES I: TAXONOMY AND MEASUREMENT OF FINANCIAL RISKS

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#### Lecture (1.5 hour)

The objective of this lecture is to introduce endogenous financial risks and their feedback loops, identify past banking crisis, and evaluate the risk of banking crisis at both the bank and system levels.

- Taxonomy of financial risks
- Measurement of financial risks

#### References

Laeven, Luc, and Valencia, Fabián, 2014, Chapter 2, in “Systemic Banking Crises,” in S. Claessens, M.A. Kose, L. Laeven, and F. Valencia Eds., *Financial Crises: Causes, Consequences, and Policy Responses*, Washington DC.

Laeven, Luc, and Valencia, Fabián, 2018, “Systemic Banking Crises Revisited.” IMF Working Paper 18/206.

<https://www.imf.org/en/Publications/WP/Issues/2018/09/14/Systemic-Banking-Crises-Revisited-46232>

Čihák, Martin, 2014, “Stress Tester: A Toolkit for Bank-by-Bank Analysis with Accounting Data,” Chapter 3, in A Guide to IMF Stress Testing (ed. by Li Lian Ong), Washington DC.

**Workshop (1.5 hours):** Measurement of risks and introduction to stress testing

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## DAY 3

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### UNIT 5: EXTERNAL VULNERABILITIES I: BOND YIELDS AND SOVEREIGN DEFAULT RISK

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#### Lecture (1.5 hour)

The objective of this lecture is to introduce the theory of sovereign default risk and the tight nexus between fiscal distress and external crises, focusing on rollover and refinancing risks, bond yields, CDS and RAS spreads and contagion.

- From fiscal distress to external crisis
- Theory of sovereign default risk
- Assessing risks in practice

#### References

IMF, 2010, “The IMF-FSB Early Warning Exercise: Design and Methodological Toolkit” (Washington), pp.22-23. <http://www.imf.org/external/pp/longres.aspx?id=4479>

Alper, E., L. Forni and M. Gerard, 2012, “Pricing of Sovereign Credit Risk: Evidence from Advanced Economies During the Financial Crisis,” IMF Working Paper 12/14. <http://www.imf.org/external/pubs/ft/wp/2012/wp1224.pdf>

**Auxiliary Workshop (1.5 hours):** Explaining Sovereign Bond Interest Rates

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### UNIT 6: FINANCIAL VULNERABILITIES II: DETECTING FINANCIAL FRAGILITY

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#### Lecture (1.5 hour)

This lecture gives an overview of bank balance sheet stress testing and its types, both single-factor sensitivity analysis, scenario stress testing and contagion analysis, including introducing key concepts of interest rate, exchange rate, credit and liquidity risks.

- Overview of stress testing
- Single-factor sensitivity analysis
- Identifying stress-testing scenarios: Case study

## References

IMF, 2012, “Macrofinancial Stress Testing: Principles and Practices,” IMF Paper on Policy (Washington: International Monetary Fund).

<http://www.imf.org/external/np/pp/eng/2012/082212.pdf>

**Workshop (1.5 hours):** Measurement of risks and introduction to bank stress testing

## DAY 4

### UNIT 7: FISCAL VULNERABILITY II: SHORT-TERM RISKS

#### Lecture (1.5 hour)

This lecture adds more structure to the basic DSA framework by introducing risk identification and analysis (distinguishing between advanced, emerging and developing economy frameworks of the IMF), the vulnerability of the debt profile to shocks and its sensitivity, as well as standard methods of reporting used in the IMF.

- Risk-based DSA
- Interest rate growth differential and public debt
- Refined analysis of growth and interest rate shocks

#### References

IMF, 2010, “The IMF-FSB Early Warning Exercise: Design and Methodological Toolkit” (Washington), pp.22-23.

<http://www.imf.org/external/pp/longres.aspx?id=4479>

Schaechter, Andrea, and others, 2012, “A Toolkit for Assessing Fiscal Vulnerabilities and Risks in Advanced Economies,” IMF Working Paper No. 12/11.

<http://www.imf.org/external/pubs/ft/wp/2012/wp1211.pdf>

**Workshop (1.5 hours):** Risk-based DSA, refined analysis of growth and interest rate shocks

### UNIT 8: EXTERNAL VULNERABILITIES II: CURRENT ACCOUNT IMBALANCES

#### Lecture (1.5 hour)

The objective of this lecture is to develop an understanding the importance of exchange rate assessments in IMF surveillance and the link between national accounts, CA imbalances and REER misalignments; to use and possibly adapt the External Balance Assessment (EBA) or EBA-lite framework to assess the degree of misalignment of the REER through the *flow, price, and stock* approaches.

- Current account imbalances
- External balance assessment (EBA)

### References

IMF External Sector Report and EBA methodology and refinements:  
<https://www.imf.org/en/Publications/SPROLLs/External-Sector-Reports>

**Workshop (1.5 hours):** External Balance Assessment (EBA) and EBA-Lite applications

## DAY 5

### UNIT 9: FINANCIAL VULNERABILITIES III: FINANCIAL CYCLES, BUSINESS CYCLES AND SYSTEMIC RISK

#### Lecture (1.5 hour)

The objective of this lecture is to further develop the risks of the financial system, examine how systemic risk is an endogenous risk, with its realizations impacting real activity. It will focus on the cyclical behavior of asset prices, credit and leverage, and thus how financial cycles are used to identify vulnerabilities in the banking system.

- Business cycles and financial cycles
- Systemic risk

### References

Benoit, S., Colliard, J.-E., Hurlin, C., and Pérignon, C., 2017, Where the Risks Lie: A Survey on Systemic Risk. *Review of Finance*, forthcoming.  
[https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=2577961](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2577961)

Classens, Stijn, and M Ayhan Kose, 2018, Frontiers of macro-financial linkages, BIS Paper No 95, January. <https://www.bis.org/publ/bppdf/bispap95.htm>

Drehmann, Mathias, and others, 2012, “Characterizing the Financial Cycle: Don’t Lose Sight of the Medium Term!” BIS Working Paper No 380, June.  
<http://www.bis.org/publ/work380.htm>

**Workshop (1.5 hours):** Financial cycles and banking distress

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## UNIT 10: EXTERNAL VULNERABILITY III: RESERVE ADEQUACY

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### Lecture (1.5 hour)

This lecture introduces how to measure foreign reserves, and their costs and benefits, and how to model reserve adequacy—focusing mainly on the IMF ARA metric.

- FX Reserves: definition, composition and trends
- Analytics of reserve holdings
- Normative assessments of reserve holdings

### References

IMF, 2011, “Assessing Reserve Adequacy”  
<http://www.imf.org/external/np/pp/eng/2011/021411b.pdf>

IMF, 2013, “Assessing Reserve Adequacy – Further Considerations”  
<http://www.imf.org/external/np/pp/eng/2013/111313d.pdf>

IMF, 2014, “Assessing Reserve Adequacy – Specific Proposals”  
<http://www.imf.org/external/np/pp/eng/2014/121914.pdf>

**Workshop (1.5 hours):** International Reserves Adequacy

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## DAY 6

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## UNIT 11: THE IMF’S VULNERABILITY EXERCISES

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### Lecture (1.5 hour)

This lecture builds on the first lecture, by introducing the concept and uses of early warning systems, their modelling and in and out of sample performance. It then groups several sectors into one index and illustrates the approach of the IMF VE exercise.

- Overview of the VEE
- Key indicators and methodologies
- Putting it all together and cross sectoral linkages

### References

IMF, 2017, “Assessing Country Risks: Selected Approaches”.  
<https://www.imf.org/en/Publications/TNM/Issues/2017/06/01/Assessing-Country-Risk-Selected-Approaches-44959>

IMF, 2016, “Factsheet: The IMF-FSB Early Warning Exercise,” (Washington).  
<http://www.imf.org/external/np/exr/facts/ewe.htm>



**Workshop (1.5 hours):** Putting all Sectors Together and Constructing a Vulnerability Index

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## **UNIT 12: PREPARATION FOR PARTICIPANTS’ PRESENTATIONS**

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### **Breakout workshop groups (3 hours)**

The objective of this (10.5-hour session in total) is to gain more in-depth analysis of classic or regional crises cases, the build-up of sectoral vulnerabilities and crises triggers and policy remedies.

Preparation for this unit takes 9 hours in total in the breakout workshop format, whereby counsellors provide a handout of the chose case study the evening prior and guides their groups on detecting fiscal, financial, external and real vulnerabilities—quantifying them using terminology/graphs/techniques/spreadsheets learned during the course (e.g., reserve adequacy, EBA, DSA, Stressing testing, etc). The group must explain schematically how these vulnerabilities were inter-related pre and/or post the shocks that hit the economy and highlight policy measures that should or were taken to address each sector’s vulnerability build up. Approximately 15 slides should be produced, and following dry runs within each group, the participants return the plenary session to present their work (1.5 hours). Hence, if there are three groups, each would have 30 minutes to present, including Q&A.

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## **DAY 7**

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## **UNIT 12: PREPARATION FOR PARTICIPANTS’ PRESENTATIONS (CONTINUED)**

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### **Breakout workshop groups (6 hours)**

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## **DAY 8**

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## **UNIT 12: PARTICIPANTS’ PRESENTATIONS: (CONCLUDED)**

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### **Plenary presentations (1.5 hours)**

*Course wrap up (test, evaluation and closing) or*

*Continue with Auxiliary units*

**A.1 For the JVI prior to Unit 12 add from the following Units depending on interests (ending with Unit 12 and course wrap up):**

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## UNIT 13: FISCAL VULNERABILITY III: STOCHASTIC DSA

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**Lecture (1.5 hour)**

- Stochastic DSA vs. deterministic DSA
- Main steps of stochastic DSA: estimating relationship between DSA inputs, fiscal reaction function, simulations

**References**

IMF, 2013, “Staff Guidance Note on Debt Sustainability Analysis for Market Access Countries” (Washington). <http://www.imf.org/external/np/pp/eng/2013/050913.pdf>

Celasun O., X. Debrun, and J.D. Ostry, 2006, “Primary Surplus Behavior and Risks to Fiscal Sustainability in Emerging Market Countries: A “Fan-Chart” Approach”, IMF Working Paper 06/67 <https://www.imf.org/external/pubs/ft/wp/2006/wp0667.pdf>

**Workshop (1.5 hours):** Stochastic DSA

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## DAY 9

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## UNIT 14: FINANCIAL VULNERABILITY IV: SPILLOVERS AND CONTAGION

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**Lecture (1.5 hour)**

- Indicators of spillovers
- Network analysis
- Systemic risk measurement: VaR, CoVaR

**References**

Adrian, Tobias, and Markus K. Brunnermeier. 2016. "CoVaR." *American Economic Review*, 106 (7): 1705-41. DOI: 10.1257/aer.20120555  
<https://scholar.princeton.edu/markus/publications>

Espinosa-Vega, Marco A., and Juan Solé (2014), “Cross-Border Financial Surveillance: A Network Perspective,” IMF Working Paper WP/10/105  
<https://www.imf.org/external/pubs/ft/wp/2010/wp10105.pdf>

**Workshop (1.5 hours):** VaR, CoVaR, and  $\Delta$ CoVaR

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## UNIT 15: FISCAL VULNERABILITIES IV: LONG-TERM RISKS

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### Lecture (1.5 hour)

- Debt level and fiscal space
- Fiscal gaps: full account of government assets and liabilities
- Medium- and long-term fiscal adjustment needs

### References

IMF, 2017, “Assessing Country Risks: Selected Approaches”.

<https://www.imf.org/en/Publications/TNM/Issues/2017/06/01/Assessing-Country-Risk-Selected-Approaches-44959>

Ostry, Jonathan D., and others, 2010, “Fiscal Space”, IMF Staff Position Note 10/11.

<http://www.imf.org/external/pubs/ft/spn/2010/spn1011.pdf>

**Workshop (1.5 hours):** Debt level thresholds; arithmetic of fiscal gaps and long-term adjustment needs

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## DAY 10

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## UNIT 16: REAL SECTOR VULNERABILITIES I: FROM DOMESTIC AND EXTERNAL FINANCIAL CONDITIONS

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### Lecture (1.5 hour)

- Tail risk impact on the real economy
- Estimating growth at risk from financial prices
- Construction of financial conditions index
- Aggregating macro financial vulnerabilities

### References

Adrian, T., N. Boyarchenko, D. Giannone, 2017, “Vulnerable Growth,” Federal Reserve Bank of New York Staff Papers.

[https://www.newyorkfed.org/medialibrary/media/research/staff\\_reports/sr794.pdf](https://www.newyorkfed.org/medialibrary/media/research/staff_reports/sr794.pdf)

IMF, 2017, Is Growth at Risk, GFSR Oct 2017:

[https://www.imf.org/en/Publications/GFSR/Issues/2017/09/27/global-financial-stability-report-october-2017#Chapter Three](https://www.imf.org/en/Publications/GFSR/Issues/2017/09/27/global-financial-stability-report-october-2017#Chapter%20Three)

**Workshop (1.5 hours):** Growth at Risk Toolkit applied to an emerging European economy

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**A.2 For the CEF or STI (or shorter VDS courses), add regional outlook or pertinent analytical topics (e.g., from REOs) and/or consider other options as per recent offerings.**

<b>Summary of Instructional Time</b>		
<b>Topics</b>	<b>Lectures</b>	<b>Workshops/Case Studies</b>
<i>Core units:</i>		
1. Vulnerabilities and Crises	1.5	
2. Forecasting Methods for Tail Risks	1.5	1.5
3. Fiscal Vulnerabilities I: Assessing Debt Sustainability	1.5	1.5
4.a. Financial Vulnerabilities I: Taxonomy and Measurement of Financial Risks	1.5	
5. External Vulnerabilities I: Bond Yields and Sovereign Default Risk	1.5	1.5
6. Financial Vulnerabilities II: Detecting Financial Fragility	1.5	1.5
7. Fiscal Vulnerability II: Short-term risks	1.5	1.5
8. External Vulnerabilities II: Current Account Imbalances	1.5	1.5
9. Financial Vulnerabilities III: Financial Cycles, Business Cycles and Systemic Risk	1.5	1.5
10. External Vulnerability III: Reserve Adequacy	1.5	1.5
11. The IMF's Vulnerability Exercise	1.5	1.5
12. Three Crises Cases: Classic Crises cases/regional customization		9.5
<i>Subtotal of core units</i>	<i>16.5</i>	<i>23</i>
<i>Auxiliary units:</i>		
<i>A.1 for JVI:</i>		
4.b. Financial Vulnerabilities I: Taxonomy and Measurement of Financial Risks		1.5
13. Fiscal Vulnerability III: Stochastic DSA	1.5	1.5
14. Financial Vulnerability IV: Spillovers and Contagion	1.5	1.5
15. Fiscal Vulnerabilities IV: Long-term Risks	1.5	1.5
16. Real Sector Vulnerabilities I: Financial Conditions	1.5	1.5
<i>A.2 for CEF or STI:</i>		
Other materials relevant for region/customization		
<i>Subtotal of auxiliary units</i>	<i>6</i>	<i>7.5</i>
<i>Other:</i>		
Administration (opening brief, evaluation, closing):	1.5	
Tests	1	
<i>Subtotal of other</i>	<i>2.5</i>	
<b>Total</b>	<b>25</b>	<b>30.5</b>