Valuation of mineral and energy resources

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Outline of the presentation

- **Definition of the asset boundary**
  - Position of the 2008 SNA
  - Example 1: Australian balance sheets
  - Example 2: Canadian balance sheets
  - Rely on SEEA-2012 classes for statistical reporting

- **Practical issues for valuation**
  - Key reference for national accountants: Nature's Numbers (1999)
  - Heterogeneity of deposits across space
  - Constraints imposed on mineral production by associated capital
  - Volatility in the value of mineral assets introduced by short-run price fluctuations

Definition of the asset boundary

Position of the 2008 SNA

- For the sake of international comparability, need to be explicit about which resource categories are valued in the accounts.

- 2008 SNA, §10.179: only those resources that are « economically exploitable given current technology and relative prices » should be included in national accounts' balance sheets.

  -> Main problem here: the asset boundary is not defined with reference to a precise classification of resources.

  -> Countries valuing mineral and energy resources in their national accounts' balance sheets may consider different types of resources, e.g.: Australia, Canada.

Definition of the asset boundary

Example 1: Australian balance sheets

Coverage of mineral and energy resources in the Australian balance sheets

Fundamental Characterization	CRIRSCO Template for Solid Mineral Classes	SPE-PRMS Classes	SPE-PRMS Sub-Classes	UNFC Class	UNFC Sub-class	UNFC E axis	UNFC F axis	UNFC G axis: Proved Measured	Probable Indicated	Possible Inferred
								IP/IC Low Estimate		
								2P/2C Best Estimate		
								3P/3C High Estimate		
Discovered and Commercially Recoverable	Mineral Reserves	*Reserves*	*On Production*	Commercial Projects	On Production	1	1.1	1	2	3
			Approved for Development		Approved for Development	1	1.2	1	2	3
			Justified for Development		Justified for Development	1	1.3	1	2	3
Discovered and Not Commercially Recoverable	Mineral Resources	*Contingent Resources*	*Development Pending*	Potentially Commercial Projects	Development Pending	1.1	2.1	1	2	3
						2	1.3	1	2	3
						2	2.1	1	2	3
			Development Unclarified or on Hold — *On Hold*		Development On Hold	2	2.2	1	2	3
	Inventory (not defined in template)		*Development Unclarified or on Hold* — *Unclarified*	Non-Commercial Projects	Development Unclarified	3.2	1.3	1	2	3
						3.2	2.1	1	2	3
						3.2	2.2	1	2	3
			Development not Viable		Development Not Viable	3.3	1.3	1	2	3
						3.3	2.1	1	2	3
						3.3	2.2	1	2	3
						3.3	2.3	1	2	3
		Unrecoverable	*Unrecoverable*	Additional Quantities in Place		3.3	4	1	2	3
Undiscovered	Exploration Results	*Prospective Resources*	*Prospect*	Exploration Projects	(No sub-classes defined)	3.2	3.1	4.1	4.2	4.3
			Lead			3.2	3.2	4.1	4.2	4.3
			Play			3.2	3.3	4.1	4.2	4.3
	Unrecoverable					3.3	4	4.1	4.2	4.3

SEEA-2012 Class A

SEEA-2012 Class B

SEEA-2012 Class C

Australia's Natural Resource System

Economically Demonstrated Resources (EDRs)

Reported Categories

JORC Reserves and JORC Resources (measured and indicated) Development

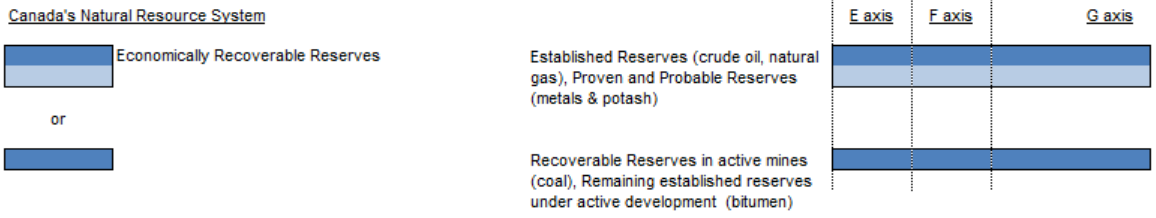
E axis | F axis | G axis

Definition of the asset boundary

Example 2: Canadian balance sheets

Coverage of mineral and energy resources in the Canadian balance sheets

Fundamental Characterization	CRIRSCO Template for Solid Mineral Classes	SPE-PRMS Classes	SPE-PRMS Sub-Classes	UNFC Class	UNFC Sub-class	UNFC E axis	UNFC F axis	UNFC G axis: Proved Measured	UNFC G axis: Probable Indicated	UNFC G axis: Possible Inferred	
								1P/1C Low Estimate			
								2P/2C Best Estimate			
								3P/3C High Estimate			
Discovered and Commercially Recoverable	Mineral Reserves	Reserves	On Production	Commercial Projects	On Production	1	1.1	1	2	3	SEEA-2012 Class A
			Approved for Development		Approved for Development	1	1.2	1	2	3	
			Justified for Development		Justified for Development	1	1.3	1	2	3	
Discovered and Not Commercially Recoverable	Mineral Resources	Contingent Resources	Development Pending	Potentially Commercial Projects	Development Pending	1.1	2.1	1	2	3	SEEA-2012 Class B
						2	1.3	1	2	3	
						2	2.1	1	2	3	
			Development Unclarified or on Hold: On Hold		Development On Hold	2	2.2	1	2	3	
	Inventory (not defined in template)		Development Unclarified or on Hold: Unclarified	Non-Commercial Projects	Development Unclarified	3.2	1.3	1	2	3	SEEA-2012 Class C
						3.2	2.1	1	2	3	
						3.2	2.2	1	2	3	
			Development not Viable		Development Not Viable	3.3	1.3	1	2	3	
						3.3	2.1	1	2	3	
						3.3	2.2	1	2	3	
						3.3	2.3	1	2	3	
		Unrecoverable	Unrecoverable	Additional Quantities in Place		3.3	4	1	2	3	
Undiscovered	Exploration Results	Prospective Resources	Prospect	Exploration Projects	(No sub-classes defined)	3.2	3.1	4.1	4.2	4.3	
			Lead			3.2	3.2	4.1	4.2	4.3	
			Play			3.2	3.3	4.1	4.2	4.3	
	Unrecoverable					3.3	4	4.1	4.2	4.3	



Definition of the asset boundary

Rely on SEEA-2012 classes for statistical reporting

- The SEEA 2012 offers a convenient way to delineate mineral and energy resources:
  - Class A: Commercially recoverable resources
  - Class B: Potentially commercially recoverable resources
  - Class C: Non-commercial and other known deposits
- SEEA-2012 classes are based on the UNFC-2009 classification.
- Main advantages of the UNFC-2009 classification:
  - Resource types are precisely defined based on 3 dimensions: socio-economic viability, project feasibility and geological knowledge.
  - It applies to both mineral and energy resources.
  - It can be mapped with other classifications used by countries (e.g. with CRIRSCO template for minerals, with SPE-PRMS for oil and gas, and soon with Russian classifications).
- Note that the AEG supports the SEEA distinction between 3 classes of resources and recommends to focus on Class A in national accounts' balance sheets (April 2016 meeting).

Practical issues for valuation

Key reference: Nature's Numbers (1999)

- Key reference for national accountants: Nature's numbers (1999)

  See Chapter 3 on subsoil assets:
  http://www.bea.gov/scb/pdf/national/niparel/2000/0200srm.pdf

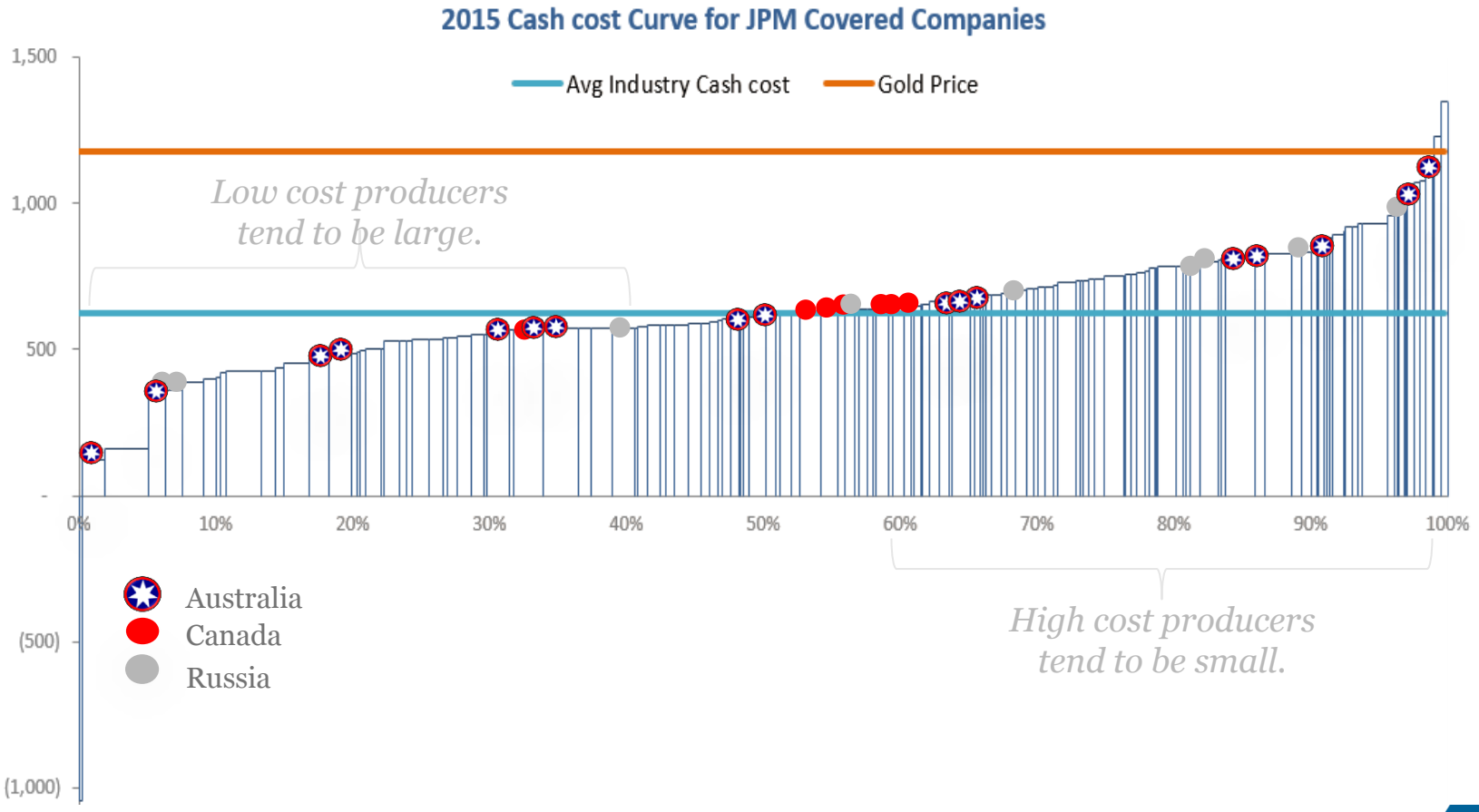
- 5 research priorities for NPV computations were identified in this book:

  1. Value of mineral resources that are not reserves;
  2. Impact of ore-reserve [and extraction cost] heterogeneity on valuation calculations;
  3. Distorsions resulting from the constraints imposed on mineral production by associated capital;
  4. Volatility in the value of mineral assets introduced by short-run price fluctuations;
  5. *Difference between the market and social values of subsoil mineral assets.*

Practical issues for valuation

Heterogeneity of deposits across space

- For a given commodity, extraction costs vary globally and also within countries, by a large extent. Example of gold:



Practical issues for valuation

Constraints imposed on mineral production by associated capital

- Cairns-Davis (1998) and Cairns (2001):
  - They emphasize that output at mine level is constrained by initial investments in physical capital.
  - They encourage economists to follow mining engineers and assume that output at mine level remains constant over a mine's service life.
- Advantages related to the constant output assumption:
  - NPV computations are easier.
  - Based on market transaction data, Cairns and Davis (1998) show empirically that this assumption works better than the Hotelling assumption.
- Main difficulty:
  - This assumption only makes sense at the mine level.
  - Accountants would have to collect data at the mine (establishment) level. But the heterogeneity of deposits is another reason for doing this…

    -> Feasibility needs to be further assessed with NSOs (OECD SEEA Task Force).

Practical issues for valuation

Volatility in the value of mineral assets introduced by short-run price fluctuations

- Techniques for valuation of deposits under uncertainty exist in the financial literature and have been reviewed by the OECD SEEA Task Force. No need for national accountants to reinvent them.
- Main advantages of these techniques:
  - They are actually used by mining firms to value their own deposits.
  - They allow to understand why currently unprofitable deposits may have a significant market value (volatile prices => probability that future prices are higher than current prices).
  - If a significant part of the volatility in the accounts comes from the fact that deposits switch from outside to inside the asset boundary, they have the potential to reduce it.
- Main difficulty:
  - They require high-quality data on how mining profits are generated and, in particular, on extraction costs.
- Recommendation: As a priority, NSOs should concentrate on data quality improvements and try to dampen NPV volatility by relying on long-term averages of resource prices.

Thank you for your attention!