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September 2012

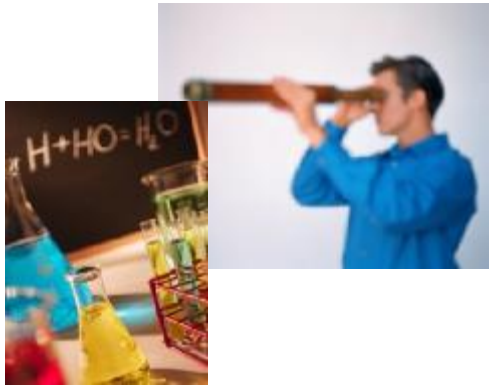
Valuation of R&D Intangibles – A Physicist's Approach

Chemistry/Physics and valuation : some similarities

- Chemical transformations
- Mass and Energy Flows
- Conservation Principles
  - Material/Energy balances
  - State Functions
- Forward-looking predictions
- Thermodynamics/Stat Mechanics
  - Probabilities
  - Sensitivity to initial conditions
  - Entropy
- Non-linear systems
  - Turbulence
  - Chaos

- Added value etc.
- Cash Flows
- « What goes in goes out or accumulates »
  - Cash balances/NPV
  - Compare « with deal » vs. « without deal »
- Future cash flows
- Uncertainty
  - Probabilities/**Discount rates**
  - First years hypothesis/growth rates
  - Money & Information
- e.g. Production Functions
  - Information & Money
  - Turbulence theory applied to Stock Price

A typical Company



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Functional Analysis : Customers, Business and R&D

Business Acquires Intangible

Business funds R&D

R&D generates Results

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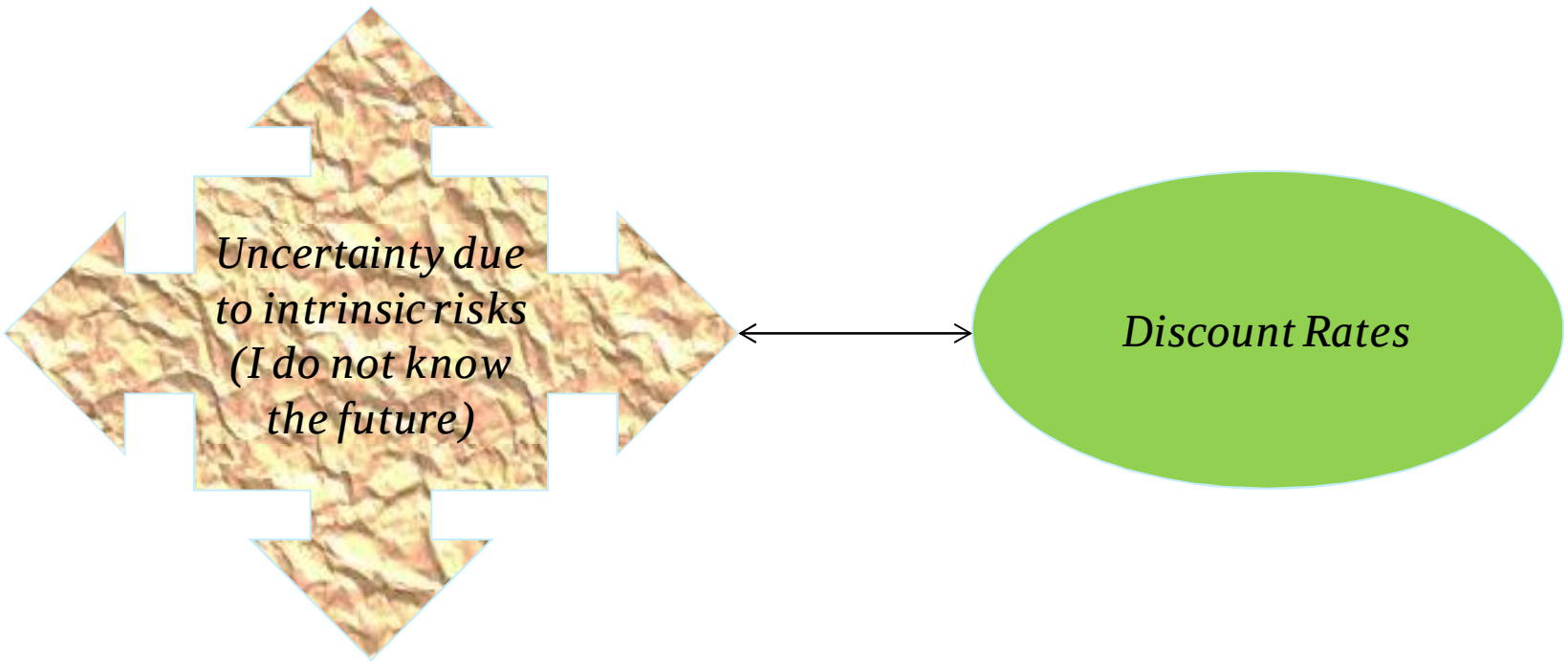
So what?

- Many parameters and asumptions are needed for (R&D) Intangible Valuations
- Most commonly, future cash flows are deduced from (some) functional analysis



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How to analyze the discount rates?

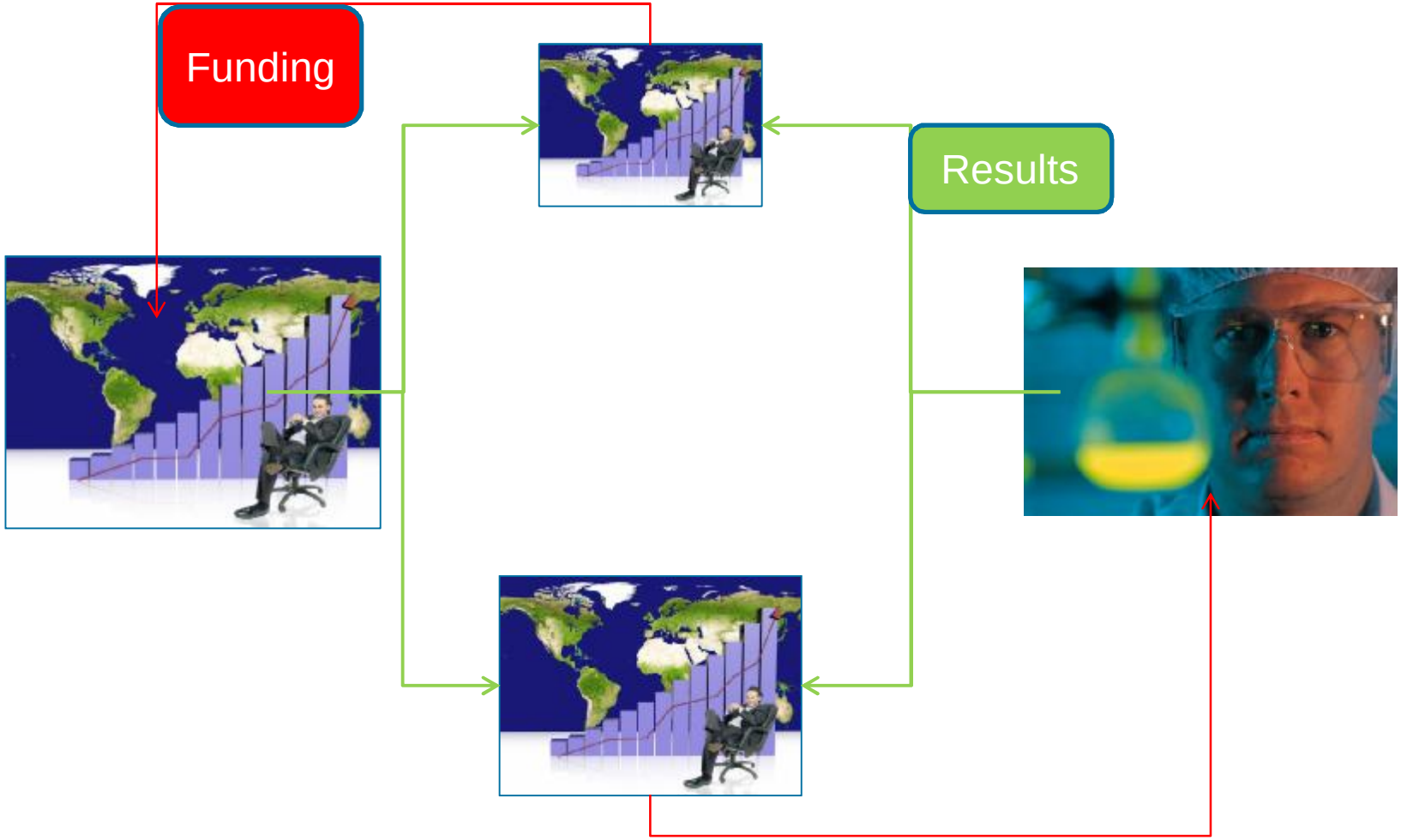
- Basic hypothesis: different risks (on cash flows) imply different discount rates
  - **Example 1: R&D costs cash flow:**
    - Decided by management
    - Bears a risk comparable to that of the whole business
    - Discount rate: $\mathbf{r_L}$ **- e.g. WACC or a little bit lower**
  - **Example 2: R&D-generated value creation**
    - Function of future markets behaviour
    - Function of the success of R&D (an Innovation Projects Portfolio's typical success probabiltty: is around 20-50%)
    - Discount rate : $\mathbf{r_H = r_L + \Delta r}$

- **The present approach to compute Δr**
  - **Analyze two comparable settings (Material/Cash Balances)**
  - **Equate the relative NPVs (Conservation Equation)**
  - **Deduce a first-order approximation (Asymptotic behaviour)**

Analysis scheme

- Arbitrarily split the R&D/Business model in two separate components
  - Each R&D component operates in close relationship with the other
  - Each R&D component generates results for each of the separate Business components
- Compare two situations (I) vs (II)
  - (I) : Dual-licensor/licensee:
    - Each Business ([A] resp. [B]) licenses the results of its' controlled R&D operation [A] resp. [B])
    - Each Business is licensed by the other ([B] resp. [A]) for the results generated by the other R&D component ([B] resp. [A])
  - (II) : [A] fully finances the whole [A]+[B] R&D operation, and licenses [B] for the results
  - The R&D and Business people do not notice the difference between (i and (II) on a day-to-day basis (management and operation unchanged)

Analysis: let us split arbitrarily the activities



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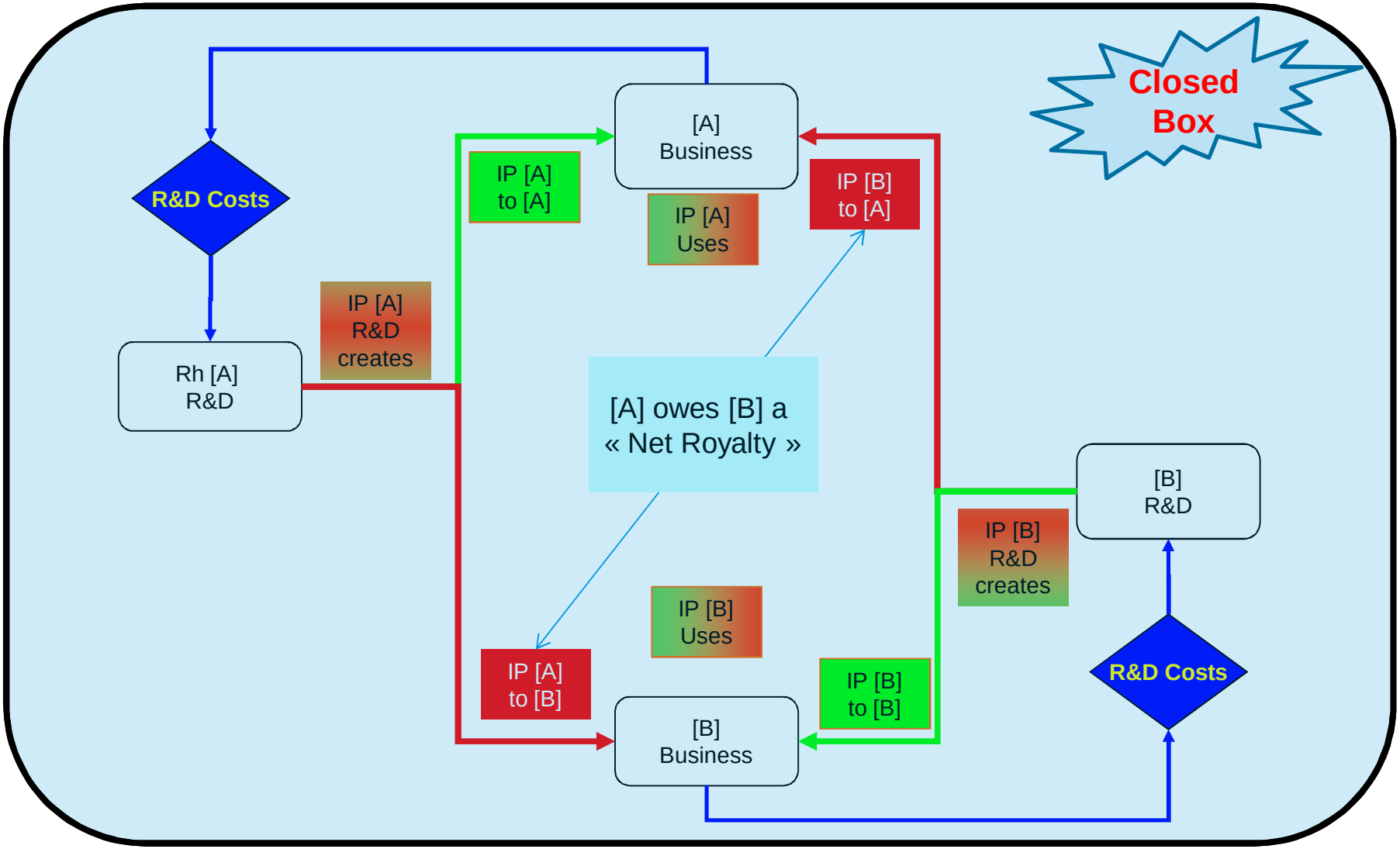
The IP & R&D costs cash flows in situation (I): dual licensor



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“Net IP” brought into [A] from [B]

- The total IP generated in [A] R&D benefits both [A] and [B]

  IP [A] R&D generates = IP [A] to [A] + IP [A] to [B]

- The total IP used by [A] comes from [A] R&D and [B] R&D

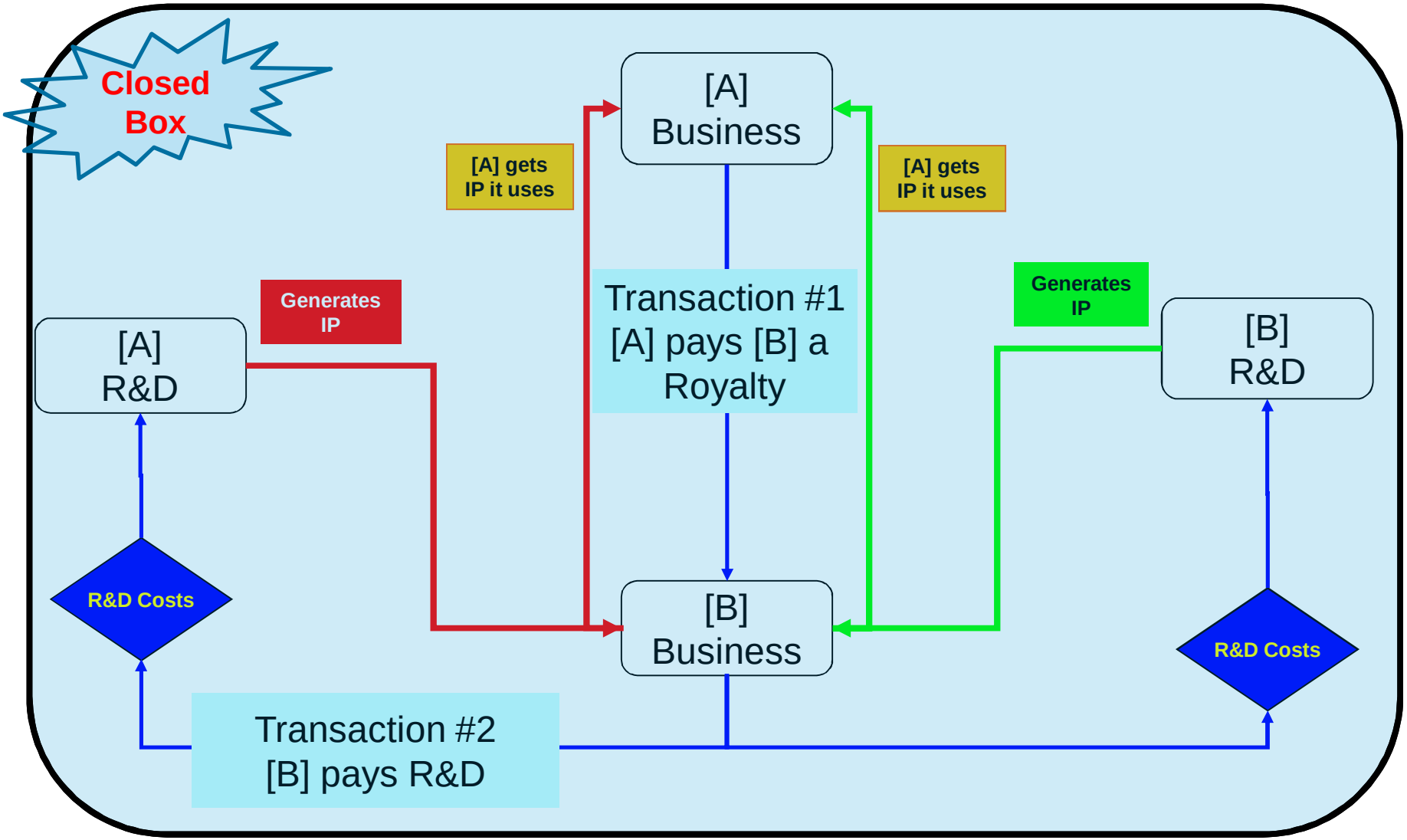
  IP [A] uses = IP [A] to [A] + IP [B] to [A]

- Taking the difference :

  The net IP flow to [A] is equal to the difference between the total IP used by [A] and the total IP generated by its R&D

This relationship allows to compute the “Net Royalty Due by [A] to [B]” (>0 or <0) without having to compute the individual IP flows, which is generally very difficult

The R&D costs and IP flows under situation (II): single licensor



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Comparison of the two situations for [A]

- Situation (I) : double Licensor
  - [A]'s R&D creates a value V
  - [A] fully funds its R&D
  - [A] owes to [B] the « Net Royalty Due » = IP used by [A] – IP created by [A]'s R&D

Ebitda [A]= X – (IP used by [A] – IP created by [A]'s R&D)

- Situation [(II): single licensor
  - [A]'s R&D creates a value V
  - [A] gest reimbursed by [B] of its R&D Costs RD[A]
  - [A] pays to [B] a royalty R, which value is determined by [A]'s IP usage

Ebitda A = X – R + RD[A]

- Both situations are equivalent when, on an NPV basis;

X-R+RD[A] = X - (IP used by [A] – IP created by [A]'s R&D)

Since R = IP used by [A], this simplifies to **IP Created by [A] = RD[A]**

Since the original split was arbitrary; this should hold for any split; in particular, for the whole initial business

IP Created by the whole business is commensurate with Total R&D costs

Some mathematical considerations

- Closed box
- Equality sign is a leading order approximation of « real world » values
  - Integration in time form a given date has to be done: all values are NPVs
  - The situation being analyzed supposed stationary cash flows
- To compute the value of an asset at a given time, the relationship holds only at times when all pre-existing IP has been replaced by a new one

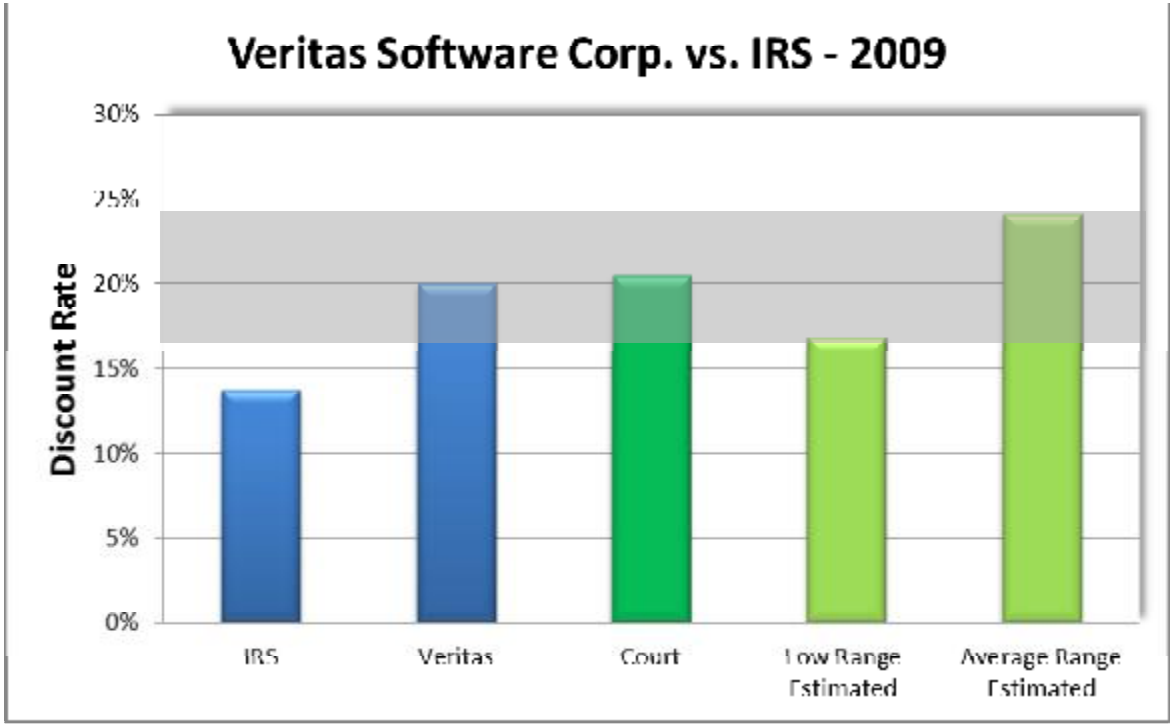
- Practically, simple situation:
  - A constant % R Royalty vs Sales represents value creation
  - Value creation lasts M years after stop of R&D spendings
  - Cash flows are growing at a constant rate g from t > N years
  - Several g's can be assumed; for simplicity, only one is used here

$$\frac{\%R}{r_L+\Delta r-g}\left[1-\left(\frac{1+g}{1+r_L+\Delta r}\right)^{N+M}\right]=\frac{R\&D/Sales}{r_L-g}\left[1-\left(\frac{1+g}{1+r_L}\right)^{N}\right]$$

$$N \to +\infty \Leftrightarrow \Delta r \sim (r_L - g)\left[\frac{\%R}{R\&D/Sales} - 1\right]$$

Examples - 1

- Veritas Corp. Vs IRS – Dec 10, 2009
- Cost Sharing Agreement – Initial Buy-in Payment
  - IRS : $2,5 Billion then $1,7 Billion
  - Taxpayer : $100-$200 Million ($94M - $315M)
- Contested asumptions
  - Royalty Rate
  - Discount Rate (IRS=14%)
  - Terminal Value
  - Trademarks Value



Rapid evaluation from asymptotic formula:

- **IRS is wrong (14% DR)**
- **An even higher Discount Rate (24%) makes sense**

Examples - 2

- Real Purchase Price Allocation exercises
  - Valuations by external assessors
  - Compute pre-existing and in-development IP
  - Discount rates computed from CAPM models (*)
  - This model based on
    - Before/after purchase comparison and asymptotic discount rate formula
    - Assumes purchaser continues to fund R&D forever (simple perpetuity formulas)

Acquisitions	1	2	3
Accounting value	100±10	100	100±10
Computed here	99,9	87,1	114,9

- CAPM uses Beta to compute the « risk premium » Δr
  - Beta = covariance of rate of return « asset » vs « portfolio »

Conclusion and Path Forward

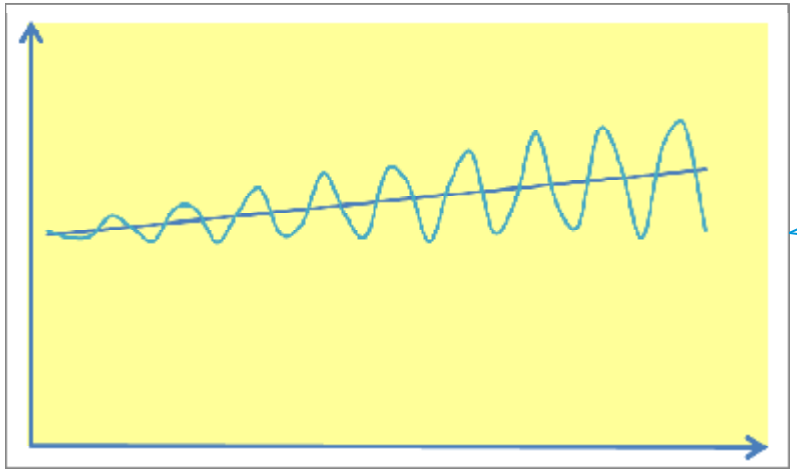
- *Conclusions*
  - *Simple model to determine discount rates of risk-carrying assets*
    - *Based on few asumptions, mainly conservation of value*
    - *Ab-initio (mostly analytical) computations give results analogous to more detailed models*
  - *Allows short-cut rapid order-of magnitude assessments*
  - *Critical issue is assessment of value creation*
    - *Residual Profit Methods*
    - *Direct assessment of R&D portfolio*
  - ***Other examples welcome***

- *Path forward*
  - *Study consequences*
    - *Quick tests on %Royalties etc.*
  - *Release stationnarity*
    - *Time-lag between spendings and IP usage*
    - *In-service ramp-ups*
  - ***Introduce risk-assessment***
    - ***Insurance-type risk premiums for R&D***
    - ***Monte-Carlo simulations***
  - *Etc….*

Example of Monte-Carlo simulation

- *Non-decided cash flows (example: revenues) are random*
- *Monte-Carlo simulations*

Cash Flow



Time

Physicist's NPV distribution for a given (WACC) Discount Rate

Finance's Discount Rate for a given NPV