

Baisse «surprise» des prix du pétrole? du bon usage de modèles prospectifs ‘hybrides’

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D’après :

- Les travaux de H. WAISMAN, J. ROZENBERG, O. SASSI, JC HOURCADE

(*Peak oil profiles through the lens of a general equilibrium assessment. Energy policy – 48, 2012*)

- Travaux complémentaires de F. Leblanc sur les ressources non-conventionnelles (en cours de révision)

A field of vibrant red poppies with green stems and leaves, serving as a background for the text.

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A challenge: framing public debates in a structurally uncertain context

- Experts at risk of disqualification?
 - Peak Oil, inexorable rise of oil prices: a new mantra after (IEA 2008)
 - Emergence of shale oil & gaz + recent drop in oil prices
- Or misuse of scientific analysis?
 - Not only a communication problem
 - A demand of “best guess” by fear of radical uncertainty
- What good use of models if prospective is not prediction?
 - Illustration based on published (2012) and recent works
 - Understanding the interplays between geological, technical, economic and geopolitical parameters and the links between Long Term and Short Term signals



Why (and how) modeling oil markets and technical change within a hybrid CGE model ?



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Fossil fuel markets and macroeconomy: integrating engineers' and economists' views



- Three disconnected strands of literature:
 - Technical and Geological-based analyses; Hubbert bell-shaped production curves + Energy systems modeling (demand addressed to fossil fuels)
 - Economic analysis of short term effects of oil shocks (Hamilton etc ...)
 - Long-term analysis of exhaustible resources, no peak oil (Hotelling)

- The modeling agenda
 - Endogenizing fossil fuels markets through the interplay between:
 - Technical inertia and imperfect expectation
 - Induced technical change (non fossil energies, infrastructures)
 - Strategic choices by OPEC (and other regions)

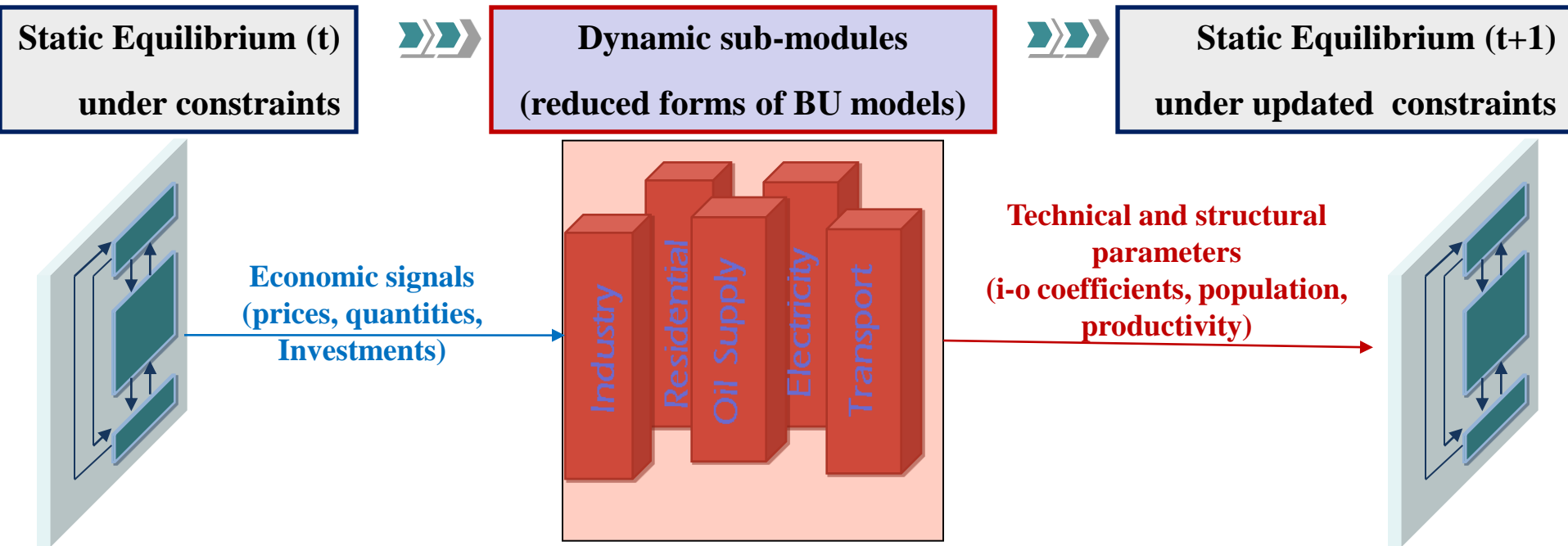
 - Representing the impact of the macroeconomy on oil markets: demand dynamics, profitability prospects and capital availability

 - Capturing the feedback of oil markets on macro-economy: energy trade and rents, structural change, effect on growth, employment and welfare

The IMACLIM-R model

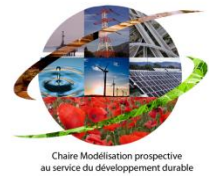


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- *Hybrid matrixes in values, energy and « physical » content (Mtoe, pkm)*
 - Secure the consistency of the engineering based and economic analyses
 - Explicit accounting of inertias on equipment stocks
 - Endogenous and exogenous TC, technical asymptotes, basic needs
- *Solowian growth engine in the long run but transitory disequilibrium*
 - Unemployment, excess capacities
 - Investments under imperfect foresight (informed by sectoral models)
 - Trade and capital flows under exogenous assumption about debts

Modeling geological constraints & producers' decisions



- Resource : 12 oil categories (conventional and unconventional)
 - **Maximum rate of increase of production** capacity for each category, given geological constraints

$$\frac{\Delta Cap_{\max}(t, i)}{Cap(t, i)} = \frac{b_i \cdot (e^{-b_i(t-t_{0,i})} - 1)}{(1 + e^{-b_i(t-t_{0,i})})}$$

$Q_{\infty, i}$: size of the reservoir (ultimate reserves, including past production)

$p_i^{(0)}$: breakeven price (exploration/exploitation and accessibility)

b_i : steepness of the bell-shape profile (default value: $b=0.061$)

$t_{0,i}$: expected date of the maximum for oil category i , given past production

- Producers' behavior

- All regions except Middle-East = “Fatal producers”
 - Maximum ΔCap_{\max} if profitable ($p_{oil} > p_i^{(0)}$)
- Middle-East = “Swing producers”
 - Fill the gap between demand and other suppliers
 - World price depends on the utilization rate of production capacities
 - Deployment of production capacities in function of their price objective

Endogenizing alternative liquids fuel & oil demand

- Alternatives to oil
 - Biofuels
 - Competition over oil-based fuels: supply curves increasing with oil price
 - Asymptotes on BF production at a given year (competition of land uses)
 - Evolve in time to represent induced technical progress
 - Coal-To-Liquid
 - backstop technology with capacity constraints
 - enter the market at high oil price
 - production costs governed by the cumulated past investments
- Demand for liquid fuels (residential, industry, transport)
 - Utility and profit maximization under constraints
 - Short-term : inertia in the renewal of equipments and LBD
 - Long-term : consumption styles (preferences), technical potentials (technology availability, asymptotes), location patterns



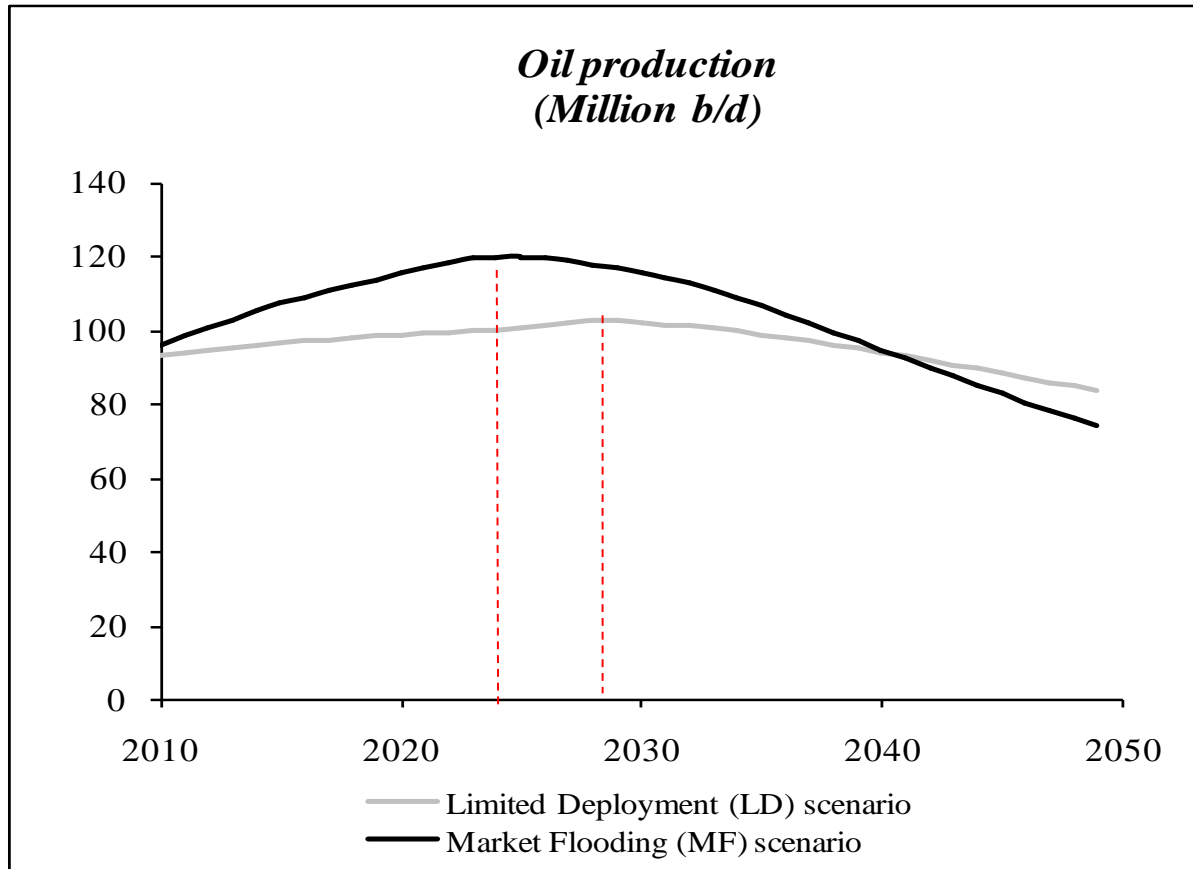
Modeling monopolistic behaviors

Two counterfactual scenarios of the world economy over 2010-2050

- different production capacity expansion in the short term
- Market Flooding scenario (1980 – 1986 strategy)
 - ME expands production capacities to maintain oil price at 2009 level
 - Supports high demand for oil in the short-term
 - Slows down low carbon technical change
- Limited Deployment scenario
 - ME restricts capacity expansion to maximize short-term rents
 - Induces a moderation of oil demand and a biased technical change towards non fossil energies



Moderate effect on the date of peak oil



- Level
- Date
- Post-PO decrease

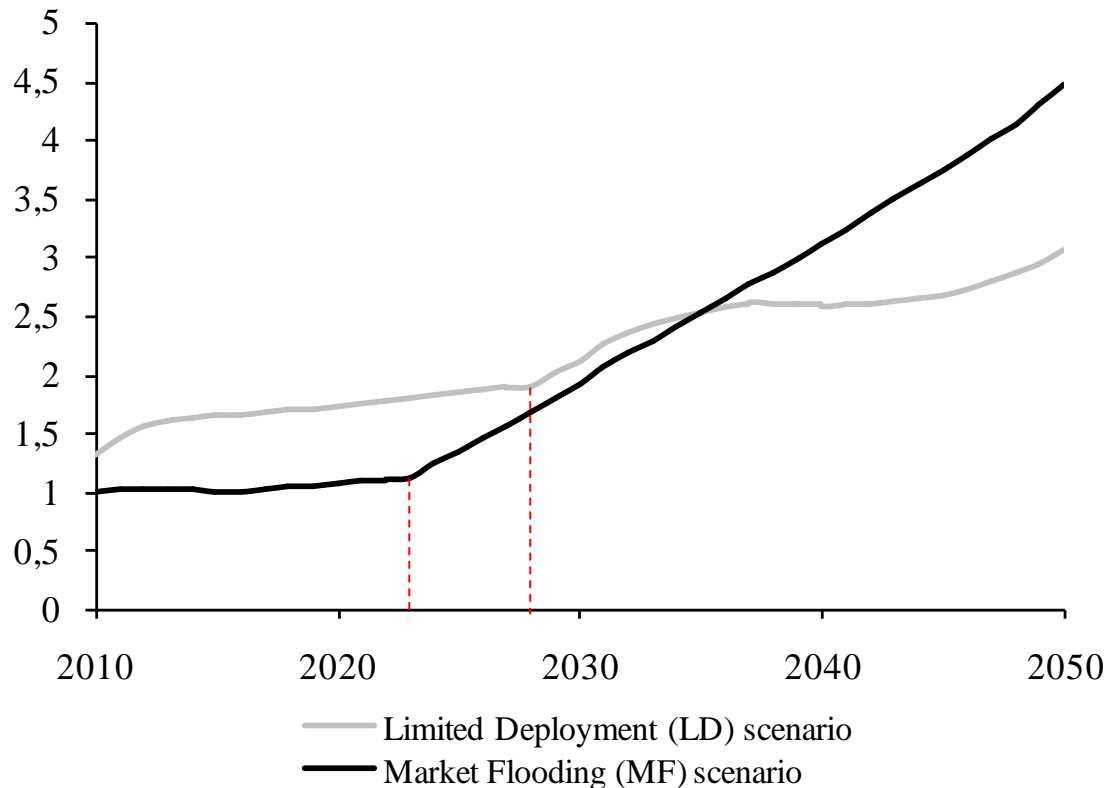
Close dates but very different time profiles!



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Stronger influence on long-term prices

*World oil price
(index 1=2009 level)*

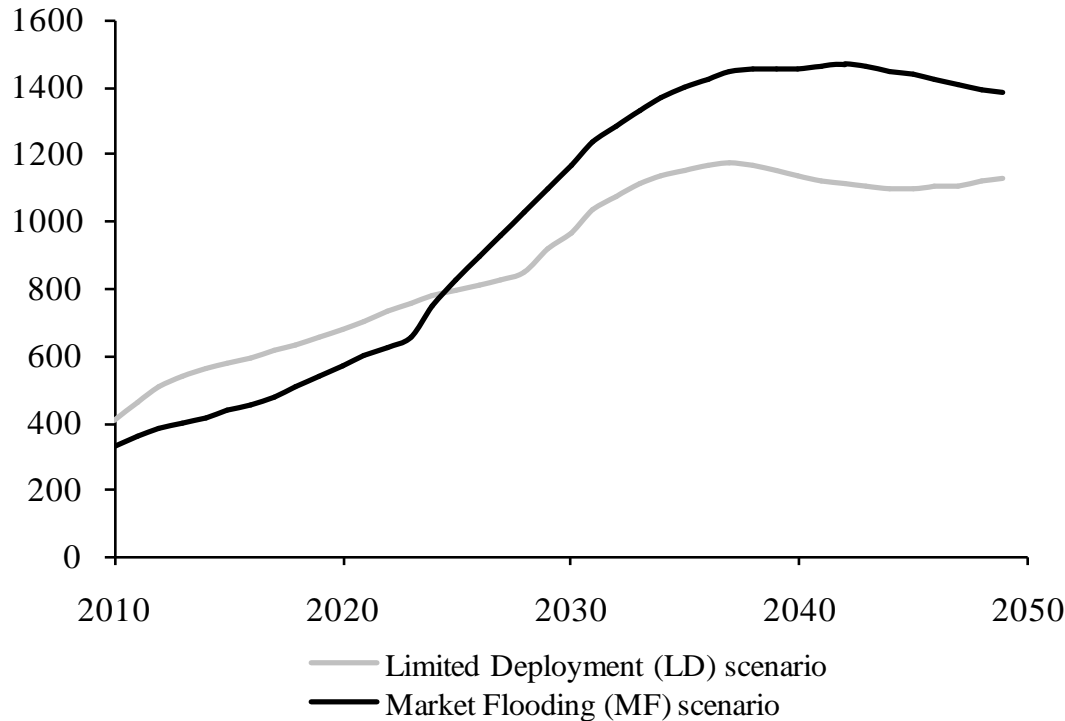


- Controlled by OPEC in the short-term
- Sudden rise at the Peak Oil date
- Continuous increase in long term due to constraints on CTL



Oil revenues as a short-term/long-term tradeoff

*Middle-East annual oil profits
(Billion \$)*



- ❑ Short-term revenues controlled by price targets
- ❑ Bubble of long-term profits triggered by price increase after PO

Room for Short-term vs. Long-term tradeoff!



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The underlying economic and political rationale is then crucial

<i>Discount rate</i>	<i>Limited Deployment Scenario</i>	<i>Market Flooding Scenario</i>
0%	38.9	43.6
1%	28.9	31.8
2%	21.9	23.6
5%	10.6	10.8
6%	8.7	8.6
7%	7.2	7.0
15%	2.4	2.2

MF scenario profitable for oil producers at discount rates lower than 6%



Hedging strategy of short-term high prices against scarcity (for oil importers)

OECD average growth rate

		Average (2010-2050)	Short-term Period (2010- 2025)	Peak Oil Period (2025- 2040)	Long-term Period (2040- 2050)
Natural growth rates		1.42%	1.69%	1.30%	1.19%
Effective growth rates	Limited Deployment scenario	1.57%	1.93%	1.43%	1.24%
	Market Flooding scenario	1.53%	2.00%	1.29%	1.18%

Close average growth but different time profiles: good indicator of tensions, when effective growth rates are below the natural one



Light tight oil as a game changer ?



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Are current low prices such a surprise ?

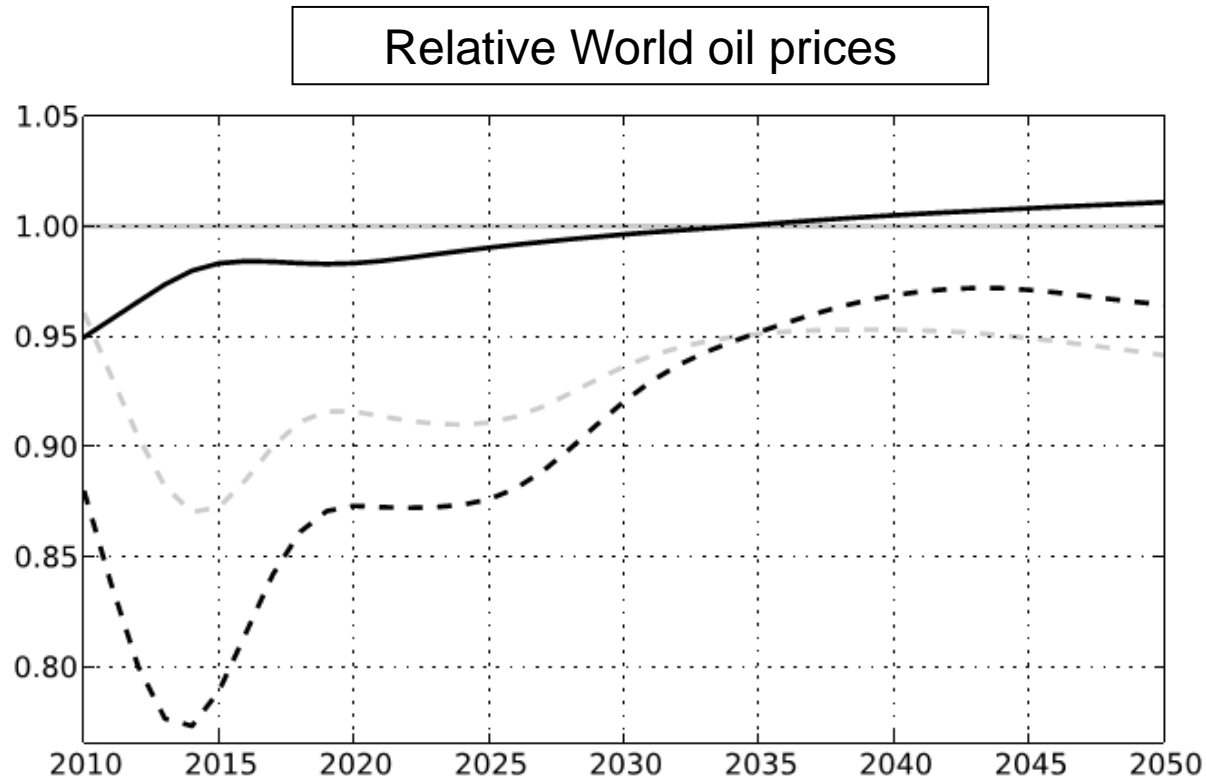
- Shocks in production :
 - + 4 mb/d from U.S. Light tight oil since 2009
 - + 0.7 mb/d from Libya between June and October 2014
- Normal cyclical price of the oil commodity
 - Long period of high price :
 - Fuelling growth in supply
 - Discriminate demand growth not meeting supply
(efficiency in transport, substitutions, lower economic activity)

Sources : Khalid Al-Falih, chief executive of Saudi Aramco
World Economic Forum on 21 January 2015
(from Oil price war, John Kemp – Reuters – 5th February 2015)



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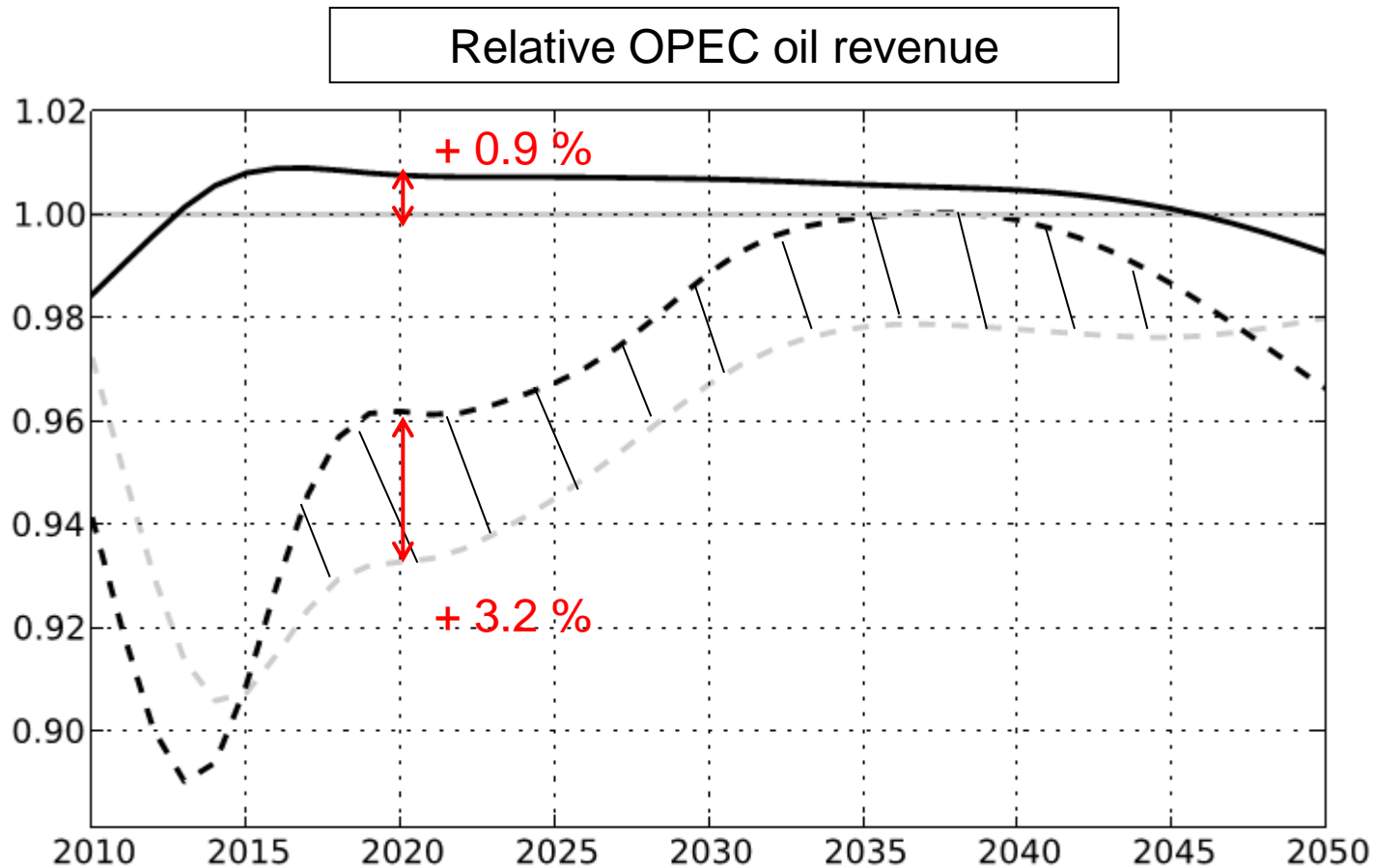
Shifting oil prices downwards



- US : Tight oil - MDE : Limited development
- - US : Tight oil - MDE : Market flooding
- US : no tight oil - MDE : Limited development
- US : no tight oil - MDE : Market flooding



Larger differences between strategy in oil revenue



- US : Tight oil - MDE : Limited development
- - US : Tight oil - MDE : Market flooding
- US : no tight oil - MDE : Limited development
- US : no tight oil - MDE : Market flooding

Projection is not prediction

- Energy prospective models are not expected to :
 - Give best guess of future energy and economic values
 - Predict future geopolitical and energy context
 - Light tight oil boom in US
 - Conflicts in Middle East
- The « good use » of ‘hybrid’ energy prospective model :
 - Confront contrasted views of the future under uncertainty :
 - Geological uncertainties
 - Potential behavior of Middle East
 - Understand the Short-term / Long-term interplay :
 - Economical part of geopolitical context for producers
 - Short-term low price may impact long-term growth of oil importing countries
 - Use and enhancement of prospective models when information is given :
 - Reasons for the Middle East response to US light tight oil production





Thank you for your attention !

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