

# Sovereign wealth fund fully integrated risk and return management

Natural resource asset exposure and commodity price volatility

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- 1 Sovereign wealth funds
  - Overview
  - Exposure to commodity price volatility

# Overview

- 1 Do commodities have a risk premium analogous to equity? If not, our expected through-the-cycle (unconditional) excess returns (risk premia) would be zero.
- 2 Investigate whether or not commodity investments offer significant long term gains above the risk free rate. Do commodity investments grow faster than interest rates?
- 3 Volatility – Depends upon global underlying (use / no use / inventories).
- 4 Correlation with other asset classes and with other commodities – do commodities offer diversification benefit?
- 5 Downside risk and tail dependence – probability based stress testing?

# Fully integrated risk and return framework

We use a fully integrated risk and return framework to show how:

- commodities integrate into a SWF portfolio
- we best capture the interaction between asset classes in a SWF portfolio and manage risk and returns
- to conduct probability based stress testing

# Commodities in the context of sovereign wealth funds

- 1 Correlation with key asset classes (diversification) – We accept that commodity vehicles offer diversification benefits. But, on an unconditional basis we show that commodities did not provide diversification benefits in the 2008–2009 financial crisis.
- 2 We can extract excess returns from
  - Writing short calls (we are naturally long the underlying)
  - Writing short puts (we are naturally long the underlying)
- 3 Hedging and reducing volatility exposure
- 4 Projection horizon matters – Big difference between conditional (point in time) and unconditional (through the cycle) calibration. If investors are interested in commodities, they need appropriate calibration for assets given their projection horizon.

# Sovereign wealth fund – definition

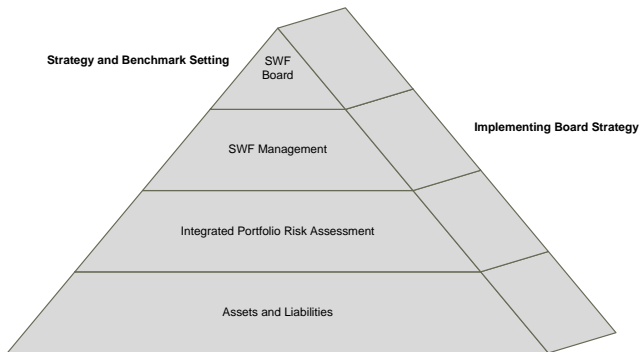
- 1 Investment vehicles typically set up by governments of resource-rich economies (some exceptions, e.g. China and Singapore).
- 2 Purpose:
  - Ensure control over the revenue from the country's strategic natural resource industries while smoothing and stabilising the effects of volatile commodity markets on the economy [Kaiser and Pulsipher, 2007].
  - Support state funded investment activities and provide economic stimulation [Kalyuzhnova and Nygaard, 2009].
- 3 Sovereign wealth funds (SWF) are naturally:
  - Long investors in commodities
  - Short investors in liabilities – typically longer dated social and infrastructure obligations of the state.

SWFs face additional and unique challenges regarding strategic focus, structure, governance, and capability.

# Example: National Oil Companies – characteristics and challenges:

- 1 **Focus:** Strategic focus on **maximising a country's resources** rather than on creating shareholder value.
- 2 **Mission:** NOCs to balance **national and enterprise considerations**. Competing objectives regarding local employment/ pipeline dependencies/ geopolitics and economic development considerations.
- 3 **Performance and governance:** Significant **barriers in achieving high performance levels** – NOCs need to overcome unclear long-term aspirations, organisational rigidity, complex governance models, and an underdeveloped performance culture.
- 4 **Relationships:** Managing **relationships with foreign partners** (not only in the initial phase) – granting concessions, structuring PSAs and JV agreements. Also: operational implications once agreement is signed.

# Sovereign wealth fund organisational structure



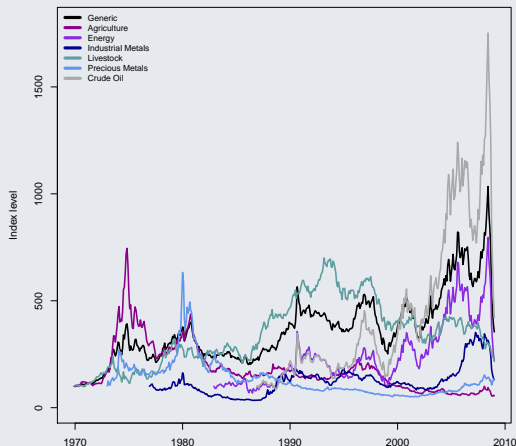
Assets					Liabilities	
Oil and Gas	Other Commodities	Banking / Financial Services – Equity	Energy / Nat. Resource Company - Equity	Other Equity	Bonds	SWF liabilities
<ul style="list-style-type: none"> <li>• Direct resource investment</li> <li>• Investment in international commodity markets</li> </ul>	<ul style="list-style-type: none"> <li>• Direct resource investment</li> <li>• Investment in international commodity markets</li> </ul>	<ul style="list-style-type: none"> <li>• Direct State participation</li> <li>• Investment in international equity markets</li> </ul>	<ul style="list-style-type: none"> <li>• Direct State participation</li> <li>• Investment in international equity markets</li> </ul>	<ul style="list-style-type: none"> <li>• Direct State participation</li> <li>• Investment in international equity markets</li> </ul>	<ul style="list-style-type: none"> <li>• Investment in international credit markets</li> </ul>	<ul style="list-style-type: none"> <li>• Healthcare</li> <li>• Pension</li> <li>• Education</li> <li>• Infrastructure</li> <li>• Transport</li> <li>• etc.</li> </ul>

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# Goldman Sachs Commodity Index (GSCI) level

Detailed analysis in [Kirchner et al., 2010], also see commodities study by [Erb and Harvey, 2006].

## Crash in 2008 and little evidence for (ex post) risk premia



## Historic events

1977	Middle east crisis
1987	Global markets collapse
1998	Dotcom crisis
2008	Financial crisis

- Excess returns peak before crises but diversification benefit collapses in times of crisis.
- This has implication on the level of portfolio diversification benefit.

# Commodity performance over decades

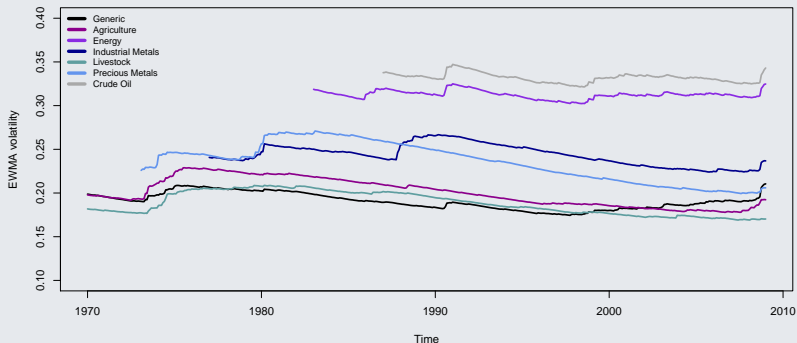
	Generic (all)	Agriculture	Energy	Ind. Met.	Livestock	Prec. Met.	Crude Oil
Jan. 1970 – Dec.1979							
Average return	13%	12%	n.a	9%	11%	23%	n.a
Volatility	21%	26%	n.a	26%	25%	33%	n.a
Sharpe Ratio	62%	45%		34%	42%	71%	
Jan. 1980 – Dec.1989							
Average return	1%	-6%	13%	0%	5%	-15%	24%
Volatility	14%	17%	30%	30%	17%	25%	26%
Sharpe Ratio	7%	-38%	43%	-1%	28%	-58%	90%
Jan. 1990 – Dec.1999							
Average return	-1%	-6%	-1%	-1%	-2%	-7%	4%
Volatility	17%	14%	31%	17%	13%	12%	33%
Sharpe Ratio	-7%	-40%	-2%	-3%	-12%	-57%	13%
Jan. 2000 – Jan 2009							
Average return	0%	-6%	1%	1%	-7%	9%	3%
Volatility	26%	20%	35%	23%	15%	17%	36%
Sharpe Ratio	0%	-32%	4%	4%	-43%	54%	9%
Full Sample Exp. Wtd.							
EW Mean	1%	-3%	2%	1%	0%	1%	5%
EW Volatility	21%	19%	33%	24%	17%	21%	34%
Sharpe Ratio	7%	-18%	7%	3%	-2%	7%	15%
Full Sample Equally Wtd.							
Average return	3%	-1%	4%	1%	2%	1%	6%
Volatility	20%	20%	32%	24%	18%	23%	34%
Sharpe Ratio	16%	-7%	12%	3%	11%	4%	19%

# GSCI Through-the-cycle volatility (annualised)

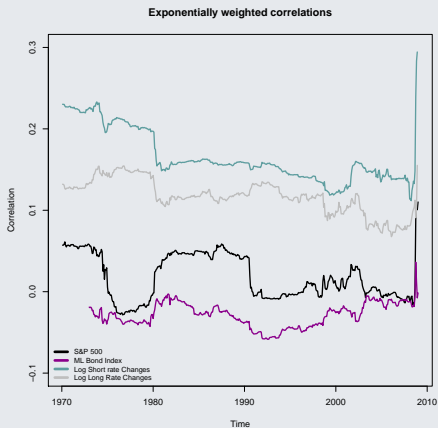
Through-the-cycle volatility – exponentially weighted moving average (EWMA).

$$\sigma_{X,n}^2 = \lambda(X_n - \bar{X})^2 + (1 - \lambda)\sigma_{X,n-1}^2$$

EWMA volatility, 25y mean data age



# GSCI Generic through-the-cycle correlations with other asset classes



# Dynamic / integrated portfolio strategy

A multi asset class econometric analysis of risk and return

- Equities
- Bonds
- Commodities
- Correlation
- Volatility

The sovereign wealth fund board need to review the following:

- Assumptions
- Dependencies
- Surplus/Deficit
- Stress tests
- Hedging

- 2 Risk management strategy
  - Strategy overview
  - Fully integrated risk management

# Strategy overview for SWF

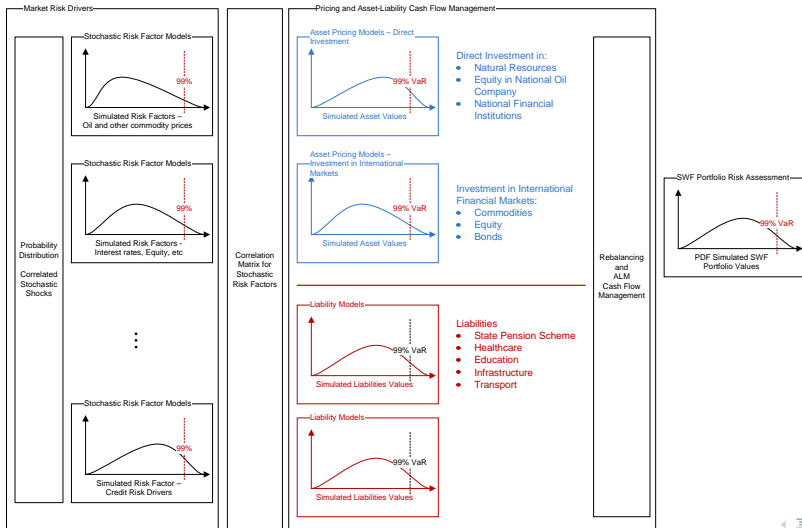
A transparent strategic framework that integrates:

- Management assumptions and estimates with regards to portfolio positions and cash flows.
- Link core (asset) cash flows with market risk drivers – identifying key dependencies and risks
- Link core liability profiles with assets in the fund (taking account of duration matching and liquidity requirement).
- Manage asset and liabilities in a manner which enables the portfolio to be re-balanced to take advantage of correlation / diversification opportunities
- Benchmark setting, tracking error monitoring and probability based stress testing

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# Fully integrated portfolio risk modelling

Based on the model proposed by [Kretzschmar et al., 2010].



## Ex-ante conclusions

- Fully integrated approach avoids theoretical pitfalls and practical limitations of more modular approaches (e.g. correlation matrix applied to loss distributions).
- Opens the door to **capital allocation, risk-adjusted performance comparison and risk-based SWF steering**, as is the ultimate goal of enterprise risk management.
- Provides a framework for **rational (probability-based) stress testing**. Our analyses show how we can identify risk factors that “correlate” highly with asset value losses and reveal the factors that are particularly influential in the tail, i.e. we can get a proper handle on **tail dependence**.
- Of course the quality of the results is model dependent and this entails a process of continual refinement and back-testing. **In practice, model requires regular calibration and regular stress testing**.
- **Systematic commodity risk** is a very important driver of results.

# For Further Reading



Erb, C. B. and Harvey, C. R. (2006).

The strategic and tactical value of commodity futures.

*Financial Analysts Journal*, 62(2):69–97.



Kaiser, M. J. and Pulsipher, A. G. (2007).

A review of the oil and gas sector in Kazakhstan.

*Energy Policy*, 25:1300–1314.



Kalyuzhnova, Y. and Nygaard, C. (2009).

Resource nationalism and credit growth in FSU countries.

*Energy Policy*, 37:4700–4710.



Kirchner, A., Kretschmar, G. L., and Akdeniz, A. (2010).

Sovereign wealth fund fully integrated risk and return management – natural resource asset exposure and commodity price volatility.

Working paper.



Kretschmar, G. L., McNeil, A. J., and Kirchner, A. (2010).

Integrated models of capital adequacy – why banks are undercapitalised.

*Journal of Banking and Finance*, In Press, Corrected Proof.