Amundi
ASSET MANAGEMENT

Optimal Asset Allocation for Sovereign Wealth Funds

Z. Bodie, *Boston University*

M. Brière, *Amundi, Paris Dauphine University and Université Libre de Bruxelles*

SWF Workshop Nanterre **24/1/2014**

Amundi
ASSET MANAGEMENT

Sovereign Wealth and Risk Management

- "Sovereign Wealth and Risk Management: A Framework for Optimal Asset Allocation of Sovereign Wealth", *Journal of Investment Management*, Q4 2013.

- "Optimal Asset Allocation for Sovereign Wealth Funds: Theory and Practice", *Bankers, Markets and Investors*, Jan-Feb 2014.

Amundi
ASSET MANAGEMENT

Motivation

- SWFs are special
  - State vehicles used to transfer wealth to future generations
  - Collect and manage tax revenues from natural resources / exports

- They serve financial but also economic, social and political objectives
  - Maximizing return/risk
  - Stabilizing the budget
  - Saving for future pensions
  - Controlling sensitive industries, supporting domestic economy
  - Etc.

- They cannot be managed like traditional private sector investment vehicles

Amundi
ASSET MANAGEMENT

Our questions

- How could Sovereigns design a framework to allocate their wealth allowing various State objectives to be taken into account?

- How can Sovereigns implement that framework in practice ?

Amundi
ASSET MANAGEMENT

How is sovereign wealth allocated?

- Central Bank FX reserves: mainly allocated in developed countries government bonds
- SWFs: publicly disclosed equity stakes in listed firms (Chhaochharia and Laeven (2009), Dyck and Morse (2011), Bernstein et al. (2013), Bortolotti et al. (2013))
  - large foreign firms
  - politically sensitive industries: finance, energy, telecom
  - firms with financial difficulties (investors of last resort)
- Diversification is low

Amundi
ASSET MANAGEMENT

How do academics advise them to allocate?

- Central bank FX reserves: hedging against sudden slowdown in capital inflows (sudden “stops”)
  - Reserves are used to repay short term foreign debt
  - Bernardell et al. (2004), Caballero and Panageas (2005), Beck and Rahbari (2008), Beck and Weber (2011)

- SWFs: various objectives
  - Pure return objective : Brown et al. (2010)
  - Fiscal smoothing : Brown et al. (2010)
  - Diversification with natural resources : Scherer (2009)
  - Hedging against inflation : Martellini and Milhau (2010)

Amundi
ASSET MANAGEMENT

Challenges with traditional approaches

- Segregating the different entities might be misleading: assets are fungible
  - When a government is short of liquidity, SWFs' or public pension funds' assets are used (E.g. Russia, Ireland, Kazakhstan and Qatar)
  - If good institutional reasons to consider separate entities, the asset allocation could be defined more broadly

Amundi
ASSET MANAGEMENT

Challenges with traditional approaches

- All sovereign assets and liabilities should be taken into account

  – Liabilities: Expenses linked to economic and social objectives, debt servicing, contingent liabilities to the private sector, etc.

  – Assets: Financial assets, taxes coming from natural resources, human capital, etc.

- Managing sovereign wealth should not be so different from managing an individual's wealth

  – Hedge the risks on the liability side of the sovereign balance sheet and diversify with other assets

Amundi
ASSET MANAGEMENT

The conceptual framework

- We propose an analytical framework for sovereign wealth and risk management

- Sovereign entity: government + monetary authorities
  - Objective to maximize Social Welfare (function of level and volatility of present and future consumption)
  - Subject to the constraint of not falling into default

- The optimal asset allocation problem of the Sovereign can be viewed as an ALM exercise
  - Takes into account (1) the financial wealth + assets generating sources of revenues for the sovereign, (2) future expenses
  - Considers all sources of risks affecting assets and liabilities (macro and financial)

Optimal asset allocation in practice

- Step 1: estimate the whole sovereign's economic balance sheet

- Step 2: define an objective function for the sovereign and optimize the balance sheet using an ALM approach

Amundi
ASSET MANAGEMENT

Step 1 : Estimation of the sovereign economic balance sheet

Simplified economic balance sheet

– Assets and liabilities at current market values, sensitivities to “shocks” in underlying market or economic risk factors

	ASSETS ($Bn)		LIABILITIES ($Bn)		
	Foreign Reserves, Gold, Special drawing rights		**Base Money** **Local and Foreign Currency Debt**		**Debt payments, Benefits**
	Pension Fund assets		**Pension Fund liabilities**		**Pension Fund payments…**
Other Sovereign Revenues	**SWF**		**Contingent Claims: Implicit guarantees (to banks etc.)**		
	Other public sector assets (state-owned companies, real estate, etc.)		**Present value of expenses on economic and social development, security, government administration, etc.**		
Taxes	**Present value of future taxes, fees, seignoriage**		**Present value of target wealth to be left to future generations**		
	TOTAL		TOTAL		

Amundi
ASSET MANAGEMENT

Step 1 : Estimation of the sovereign economic balance sheet

- Theory of contingent claims analysis (Merton, 1974)
- Total value of sovereign assets derived from senior/junior claims (Gray, Merton Bodie, 2007)

ASSETS ($Bn)	LIABILITIES ($Bn)
Foreign Reserves, Gold, Special drawing rights	**Base money + local currency debt ('equity')**
Pension Fund assets – liabilities	**Foreign currency debt ('debt')**
SWF	
Other public sector assets (state-owned companies, real estate, etc.)	
Present value of future taxes, fees, seignoriage – Present value of expenses – Present value of target wealth for future generations – Contingent liabilities	

Step 1: Estimation of the sovereign economic balance sheet

- Assuming the value of sovereign assets follows a lognormal diffusion process
- Local currency liabilities are the sum of base money and local debt, expressed in foreign currency

$$LCL_{\$} = \frac{(M_{LC}e^{r_d T} + B_d)e^{-r_f T}}{X_F}$$

- local currency liabilities can be seen as a **call option on the value of sovereign assets**, with a strike price equal to the default barrier, derived from foreign debt

$$LCL_{\$} = V_{\$Sov}N(d_1) - B_f e^{-r_f T}N(d_2)$$

$$d_1 = \frac{\ln(\frac{V_{\$Sov}}{B_f}) + (\mu_{\$Sov} + \frac{\sigma^2_{\$Sov}}{2})}{\sigma_{\$Sov}\sqrt{T}} \qquad d_2 = d_1 - \sigma_{\$Sov}\sqrt{T}$$

Amundi
ASSET MANAGEMENT

Step 1: Estimation of the sovereign economic balance sheet

- To solve the problem and find the values of the two unknowns *V$Sov* and its volatility, we use a second equation, linking the volatility of the sovereign asset to that of the junior claim (local currency debt):

$$LCL_{\$}\sigma_{\$LCL} = V_{\$Sov}\sigma_{\$Sov}N(d_1)$$

- The present value of the fiscal surplus can be deduced from the total value of assets

Step 2: Optimal asset allocation

Objective function for the sovereign

- We assume that the sovereign has a CRRA utility function of the present value of future spending on public consumption
- Maximizes the expected utility of the Global Sovereign Surplus (GSS)

$$GSS_f = FA_f + FS_f - FL_f - DL_f$$

With *FA* the financial assets, *FS* the fiscal surplus, *FL* the foreign liabilities and *DL* the domestic liabilities (domestic debt+base money)

Amundi
ASSET MANAGEMENT

Step 2: Optimal asset allocation

- The sovereign's optimization problem is:

$$Max_w \left[\mu_{GSS} + \frac{1}{2}(1-\rho)\sigma^2_{GSS} \right]$$

- Its optimal portfolio:

$$w^* = \frac{1}{(\rho-1)\alpha}\Omega^{-1}_{FA}\mu_{FA,t} - \frac{(1-\alpha)}{\alpha}\Omega^{-1}_{FA}\Omega_{FA,FS} + \frac{\beta}{\alpha}\Omega^{-1}_{FA}\Omega_{FA,FL} + \frac{(1-\beta)}{\alpha}\Omega^{-1}_{FA}\Omega_{FA,DL}$$

4 components: a speculative portfolio and 3 hedging demands to protect against the variability of **fiscal surplus**, **domestic and foreign liabilities**

- Generalizes previous results on SWFs asset allocation to more exhaustive sources of risk affecting the sovereign balance sheet

Amundi
ASSET MANAGEMENT

The example of Chile

- Simplifying hypotheses :
  - Horizon : 50 years
  - No contingent liabilities
  - Fiscal surplus proxied by receipts indexed on inflation, copper prices and equities and spending indexed on inflation
  - Extrapolation of past 10 years

$$P_{fiscalsurplus} = \left[\sum_{i=1}^{\infty} \frac{R_i}{(1+r)^i}\right] - \left[\sum_{i=1}^{\infty} \frac{E_i}{(1+r)^i}\right]$$

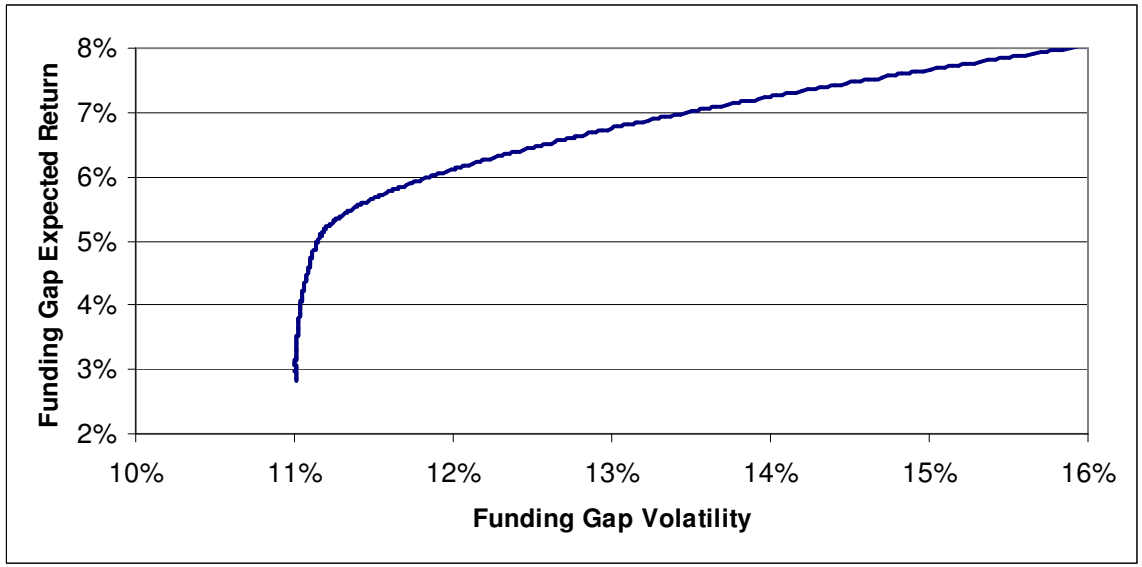
$$E_i = RR_i(1+\pi_i)$$

$$R_i = RR_i(1+\beta_{inflation} * \pi_i + \beta_{copper} * r_i^{copper} + \beta_{equity} * r_i^{equity})$$

Amundi
ASSET MANAGEMENT

The example of Chile

- Efficient Frontier: Chile's Global Sovereign Surplus, Expected Return and Volatility Tradeoff, 2010



Sample period: Aug 2000 – Dec 2010

Amundi
ASSET MANAGEMENT

The example of Chile

Optimal Portfolios

	Min Vol	GSS return 5%	GSS return 8.1%
Mean	0.24%	0.42%	0.67%
Ann. Mean	2.83%	5.00%	8.07%
Median	0.32%	0.41%	0.81%
Maximum	9.01%	9.49%	13.32%
Minimum	-9.07%	-8.90%	-12.78%
Std. Dev.	3.18%	3.22%	4.64%
Volatility	11.01%	11.15%	16.07%
Skewness	-0.05	-0.01	-0.05
Kurtosis	3.41	3.53	3.29
		Weights	
USD	7%	0%	0%
EUR	30%	31%	0%
JPY	0%	0%	0%
Emg Eqty	6%	24%	100%
Dvp Eqty	28%	0%	0%
Emg Bond	27%	42%	0%
Dvp Bond	0%	2%	0%
World IL Bonds	2%	0%	0%

Estimation on Aug 2000 – Dec 2010

Amundi
ASSET MANAGEMENT

Concluding remarks

- The unit of analysis for SWF asset allocation should be the national risk balance sheet (Gray Merton Bodie 2007).
  - Working with economic balance sheets rather than flow of funds
- Efficient management of the SWF in an ALM framework, in accordance with the sovereign objectives
  - The starting point for asset allocation should be the minimum risk strategy, equivalent to asset-liability matching
- Practical application in the case of Chile shows that Chile's sovereign assets are underdiversified

Amundi
ASSET MANAGEMENT

Concluding remarks

- A simplified framework !
  - Concentrates on asset allocation
  - Considers macro variables exogenous
  - Tax intensity, inflation, debt repudiation are also decision variables
- Challenges for practical implementation
  - Public finance data
    - Low frequency, accounting based
    - Intangibles, natural capital, etc. (World Bank, 2006, 2011)
  - The need for central coordination
    - CB, DMO, treasury, ministry of finance
    - Optimal organization? (Das et al., IMF 2012 ; Bodie and Brière, BMI 2014)

Amundi

ASSET MANAGEMENT

A joint stock company (Société anonyme) with registered capital of 546,162,915 euros

An investment management company approved by the French Securities Authority (Autorité des marchés financiers) under no. GP 04000036

Registered office: 90 boulevard Pasteur 75015, RCS Paris no. 437 574 452