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Optimal Portfolio Choice with Absorbing Markov Chains

https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4494490

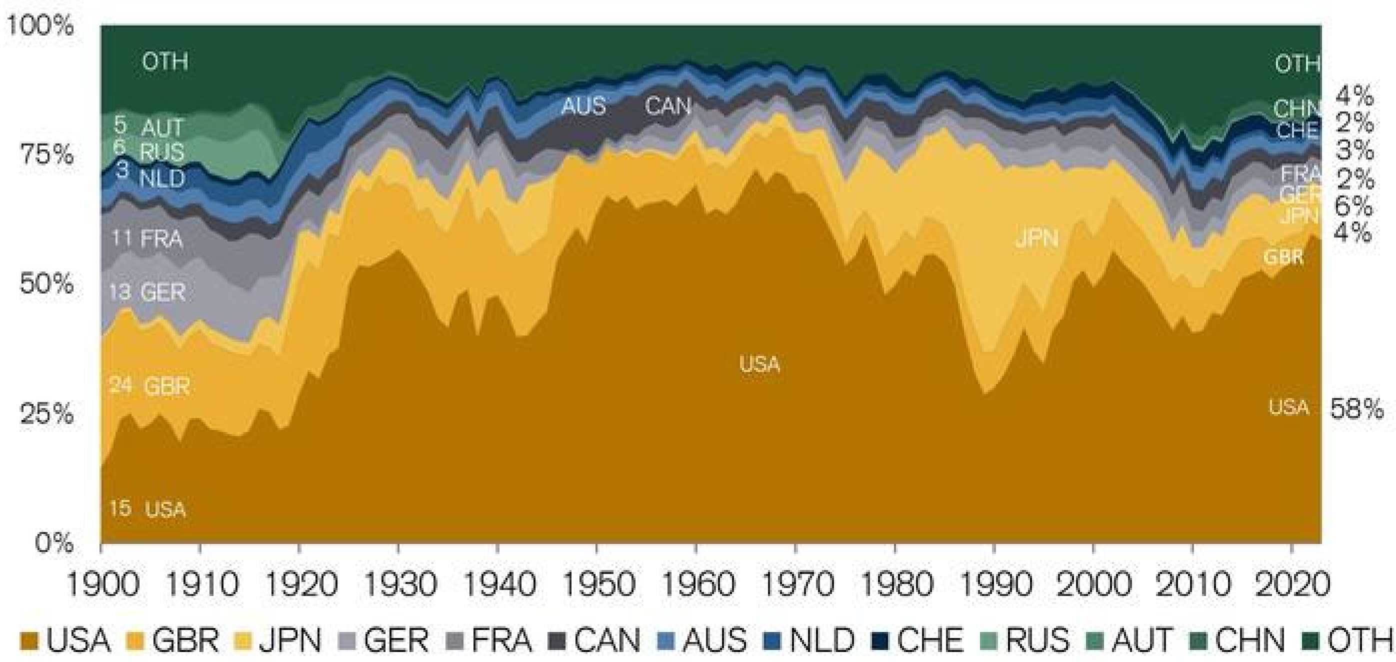
How can you allocate to markets that may potentially decouple?

Markets do decouple

In the 20th century, Austria, Russia, and China were large markets which ceased to exist

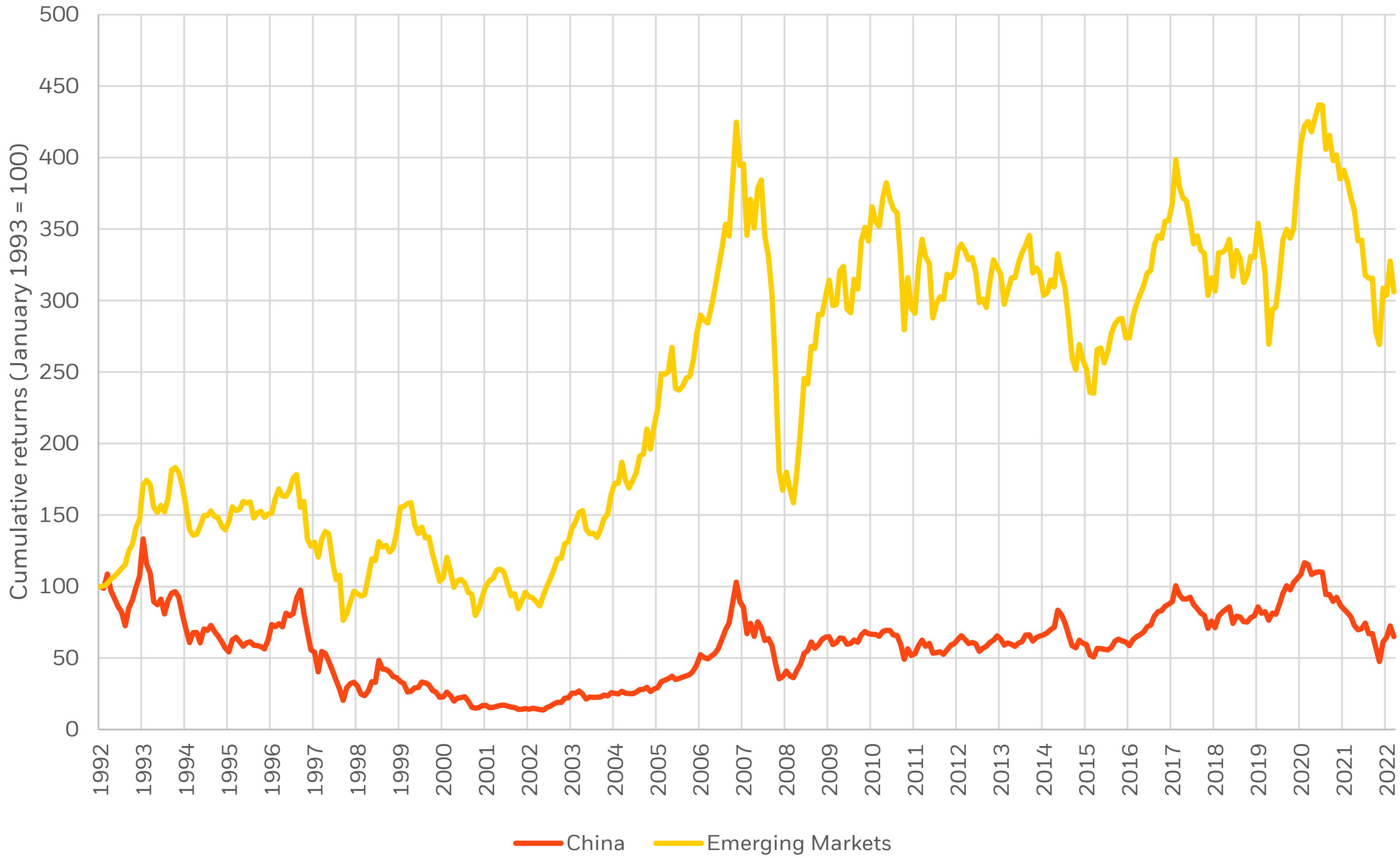
In the 21st century, Russia decoupled in March 2023

Evolution of capital markets since 1900



Source: Dimson, Marsh, and Staunton (2023) and Credit Suisse.

China and EM returns



Past performance is not a reliable indicator of current or future results. Index performance returns do not reflect any management fees, transaction costs or expenses. Indices are unmanaged and one cannot invest directly in an index.

Source: Bloomberg, as of 28 February 2023. The charts show cumulated returns of the MSCI China Index and the MSCI EM Index from January 1993 to February 2023 rebased to 100. Indexes are unmanaged and index performance is shown for illustrative purposes only. It is not possible to invest directly in an index. The figures shown relate to past performance. Past performance is not a reliable indicator of current or future results.

Bull and bear markets

One regime ("bull") has historically been characterized by positive returns and lower volatility. The other regime ("bear") has been characterized by negative returns and higher volatility

Positive returns China 8.5%

Low volatility China 20% volatility

Negative returns China -20%

High volatility China 45% volatility

Source: Ang, Shen, Shen, and Zhao (2023). The figures shown relate to past performance. Past performance is not a reliable indicator of current or future results.

Two-state Markov model

The first regime corresponds to a "bull" market, with high means and low volatilities

The second regime corresponds to a "bear" market, with low means and high volatilities

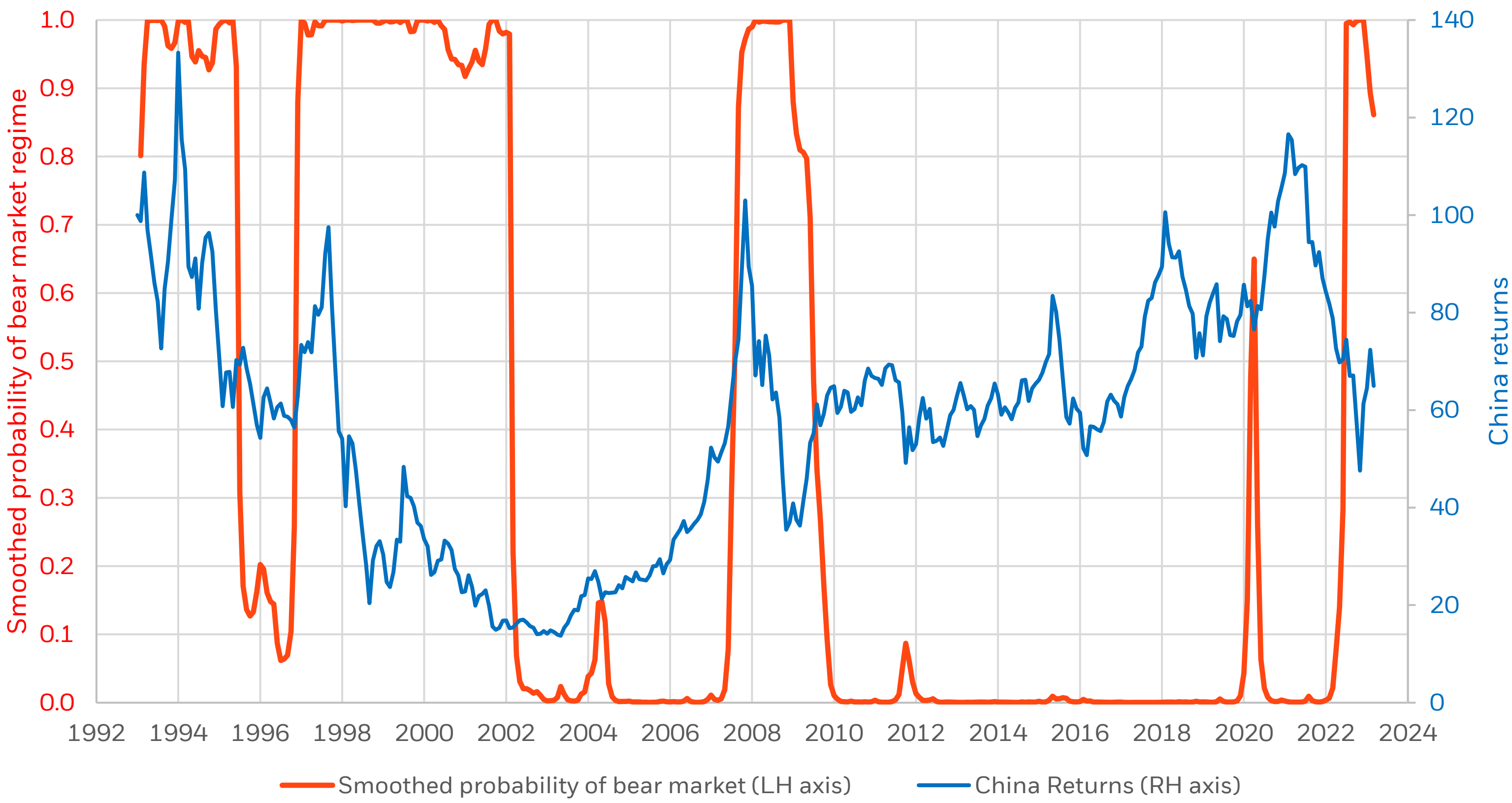
Both regimes are very persistent

Parameters	$s_t = 1$	$s_t = 2$
μ China	0.085	-0.195
μ EM	0.087	-0.054
σ China	0.206	0.451
σ EM	0.172	0.294
Correlation	0.822	0.672
	P	Q
Transition probabilities	0.980	0.963

Source: BlackRock, 28 February 2023. For illustrative purposes only.

Two-state Markov model

Smoothed probabilities of Regime $s_t = 2$



Source: BlackRock, February 2023. Graph shows smoothed probabilities of the estimation of a bear market conditioning on full sample information from 1993 – 2023. The charts show cumulated returns of the MSCI China Index from January 1993 to February 2023 rebased to 100. **The figures shown relate to past performance. Past performance is not a reliable indicator of current or future results.**

Two-state Markov model

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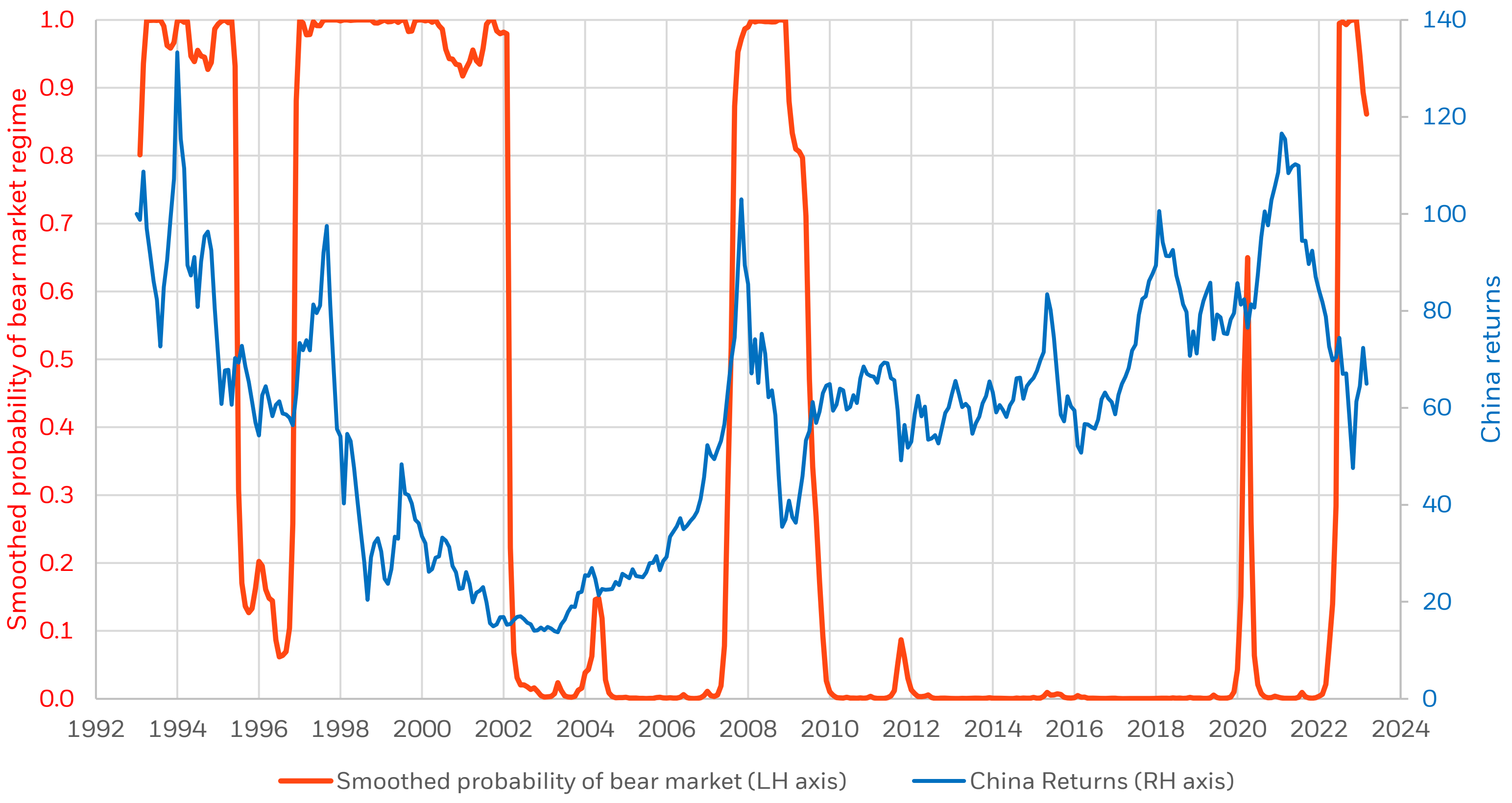

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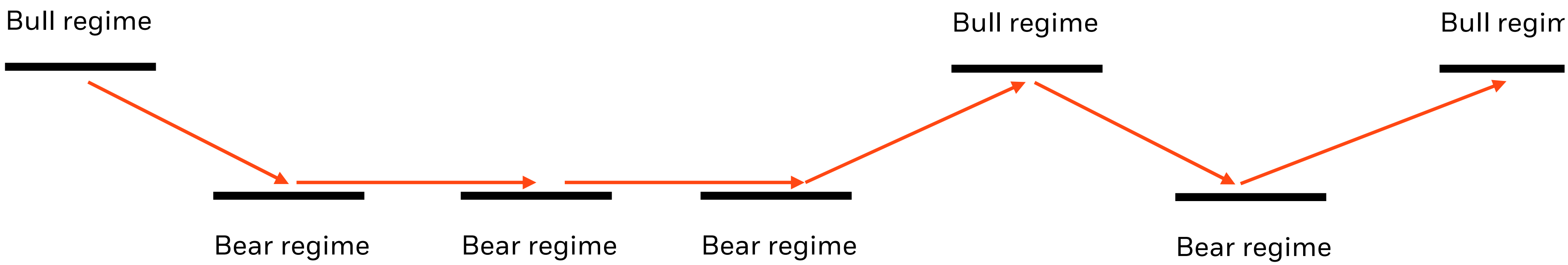
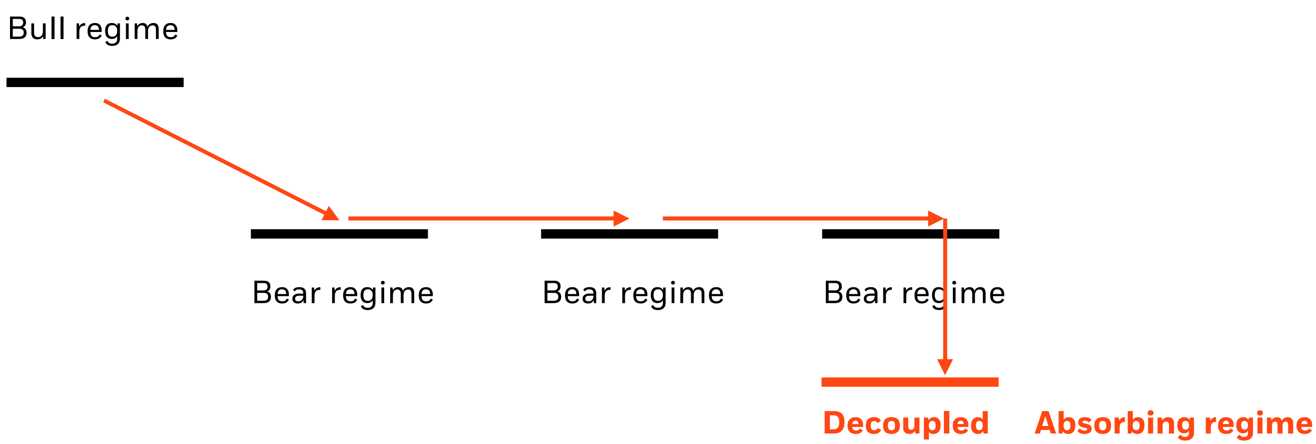
Introducing uninvestability

Original: transition between bull and bear regimes



Introduce a new absorbing state regime where returns decouple permanently



Source: BlackRock, April 2024

Introducing uninvestability

Regime 1 = Fully Investable

Regime 2 = Potentially Decouple

Regime 3 = Decoupled (absorbing state)

Transition Probability Matrix

$$\begin{bmatrix} P & 1-P & 0 \\ 1-Q-\psi & Q & \psi \\ 0 & 0 & 1 \end{bmatrix}$$

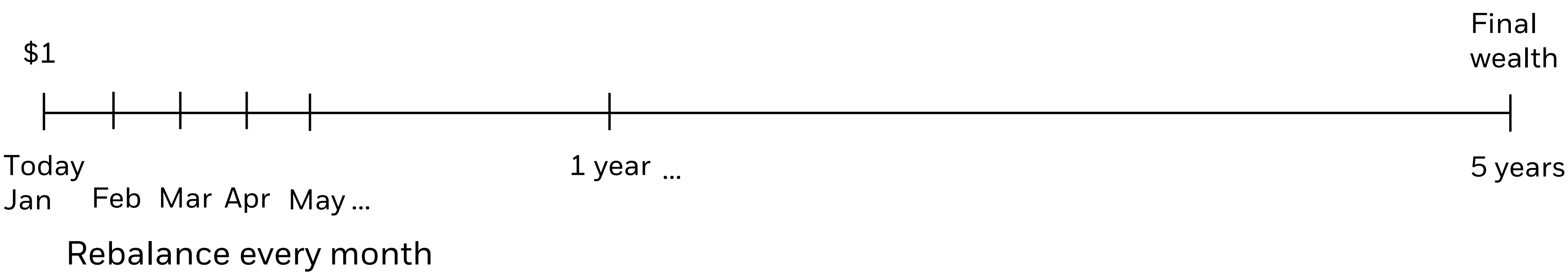
ψ is the probability of transitioning from the Potentially Decouple regime to the Decoupled regime

In the Fully Investable regime, there is no probability of becoming decoupled

Source: BlackRock, 30 April 2023.

Investing

Put in $1 today and invest over T years. Rebalance every month



Final wealth is uncertain, and investors are risk averse

Source: BlackRock, April 2024. For illustrative purposes only.

Utility

Power (Constant Relative Risk Aversion) utility with intermediate consumption

Horizon *T* with monthly rebalancing

Consumption rate (payout) is exogenous

Two assets = asset that may potentially decouple + MSCI Emerging Markets Index

Compute certainty equivalents (or willingness-to-pay)—the sure amount of wealth a risk-averse investor expects to receive to compensate them for not being able to invest in the potentially decoupling market

Calibrate risk aversion to a myopic (single period) target allocation

Source: BlackRock, 30 April 2023.

Adjusting the Potentially Decouple mean

A non-zero probability of decoupling, ψ, changes the moments of the second Potentially Decouple regime

We adjust the mean of the Potentially Decouple regime to be held constant as we change the probability of decoupling

(Note the higher moments of the Potentially Decouple regime change)

$$\bar{R}_1(s_t = 2) = (1 - Q - \psi)\exp\left(\mu_1(s_t = 1) + \frac{1}{2}\sigma_1^2(s_t = 1)\right) + \mathrm{Q}\exp\left(\mu_1(s_t = 2) + \frac{1}{2}\sigma_1^2(s_t = 2)\right) + \psi \times 0$$

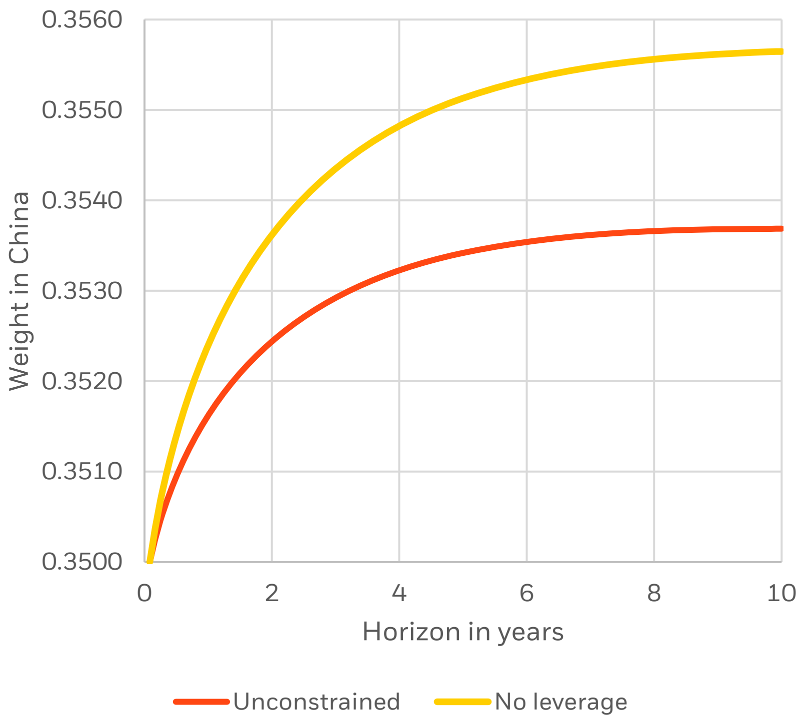
Source: BlackRock, 30 April 2023.

As long as the asset has not yet decoupled, it can offer diversification and a source of potential returns

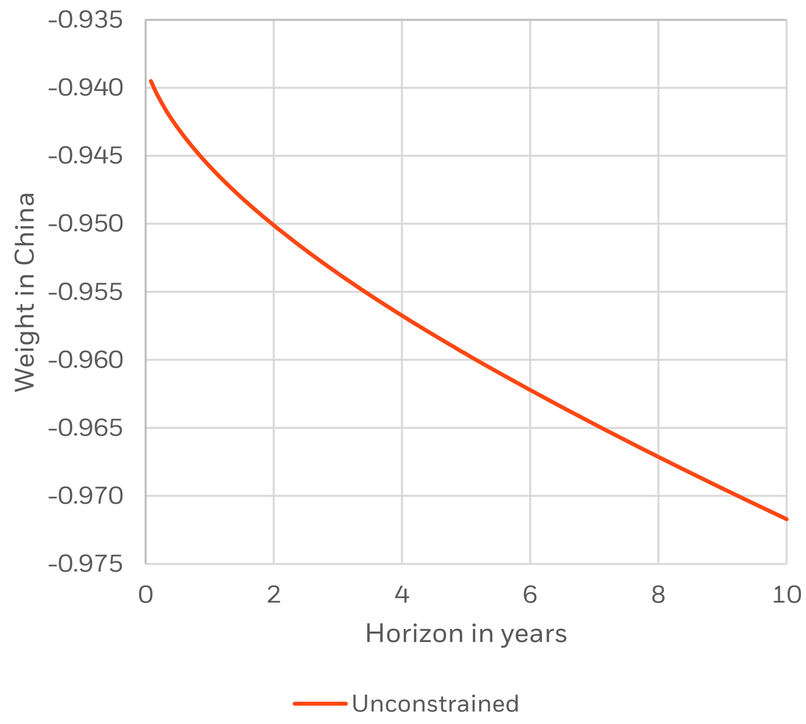
Diversification does not assure a profit and may not protect against loss of principal. Diversification among investment options and asset classes may help to reduce overall volatility.

Optimal holdings of potentially decoupling asset

Fully investable regime $s_t = 1$



Potentially decouple regime $s_t = 2$



Source: BlackRock, 31 May 2023. Ang, Shen, Shen, and Zhao (2023). For Illustrative purposes only.

Certainty equivalent costs

Certainty equivalent costs are enormous if the investor is allowed to take leverage

Costs are non-zero even when the holdings of the potentially decoupling asset is zero

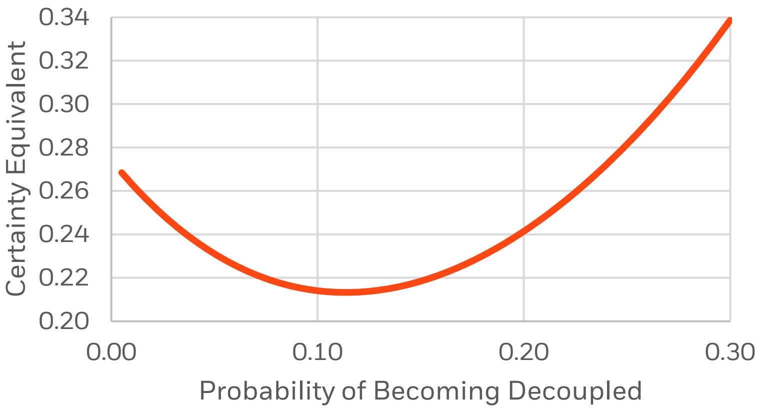
	Unconstrained		No-Leverage	
	Fully Investable Regime	Potentially Decouple Regime	Fully Investable Regime	Potentially Decouple Regime
1 month	0.0046	0.2893	0.0046	0.0000
2 months	0.0136	0.5412	0.0086	0.0001
6 months	0.0790	1.3420	0.0220	0.0015
1 year	0.2311	2.2550	0.0383	0.0053
3 years	1.1564	4.8247	0.0911	0.0296
5 years	2.3142	6.7547	0.1369	0.0604
10 years	5.4910	10.7410	0.2383	0.1422

Source: BlackRock, 31 May 2023. Ang, Shen, Shen, and Zhao (2023). For Illustrative purposes only.

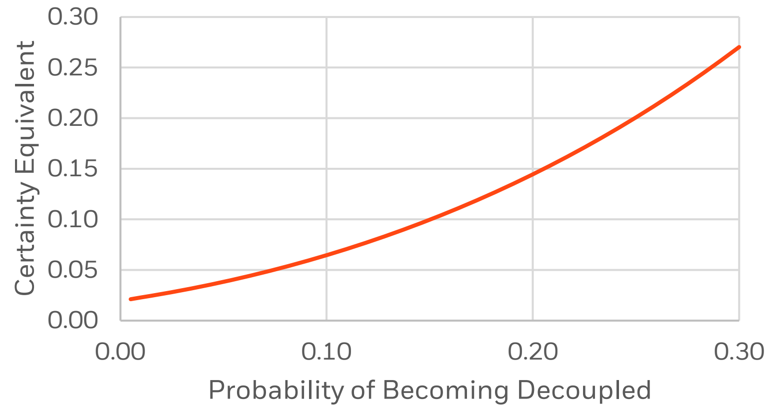
Certainty equivalent costs varying probability of decoupling

One-year horizon

Unconstrained case

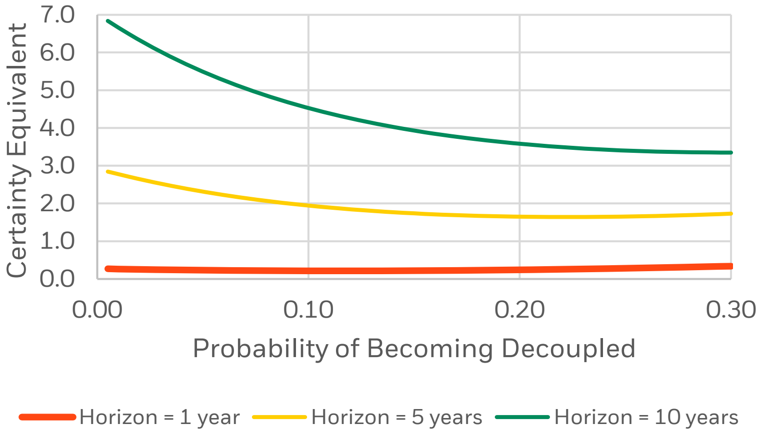


No-leverage case

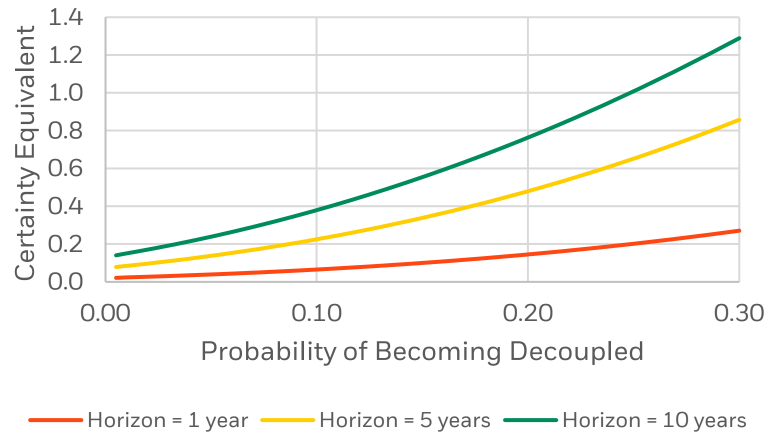


One-year, 5-year, 10-year horizons

Unconstrained case



No-leverage case

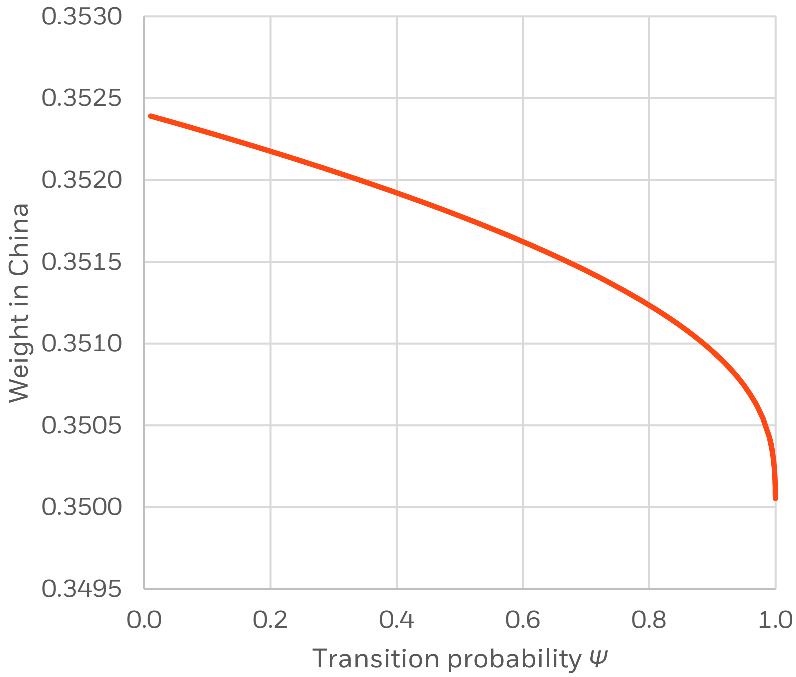


Source: BlackRock, 31 May 2023. Ang, Shen, Shen, and Zhao (2023). For Illustrative purposes only.

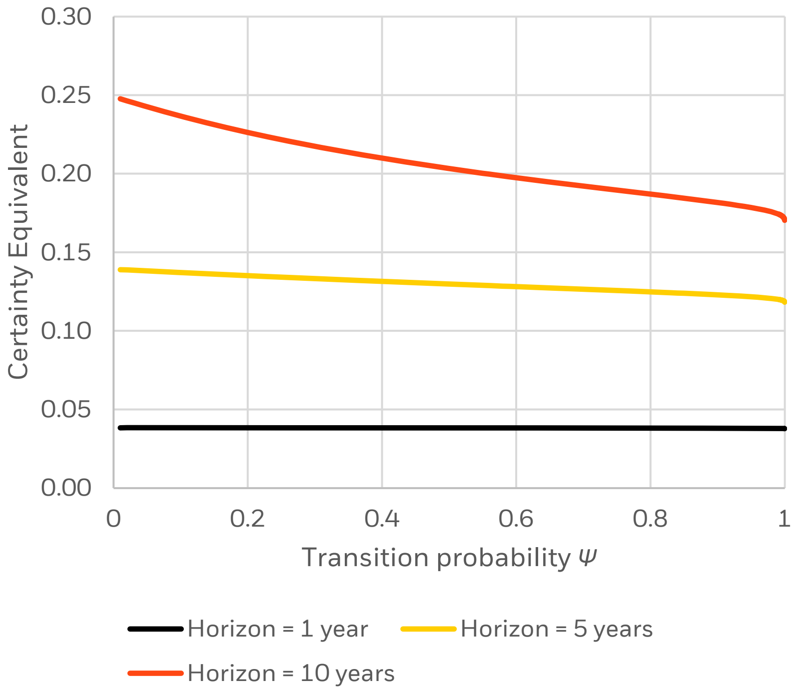
Changing ψ it affects both risk and return

Transition Probability Matrix = $\begin{bmatrix} P & 1-P & 0 \\ (1-\psi)(1-Q) & (1-\psi)Q & \psi \\ 0 & 0 & 1 \end{bmatrix}$

Weight of potentially decoupling asset



Certainty equivalents in Fully Investable regime



Source: BlackRock, 31 May 2023. Ang, Shen, Shen, and Zhao (2023). For Illustrative purposes only.

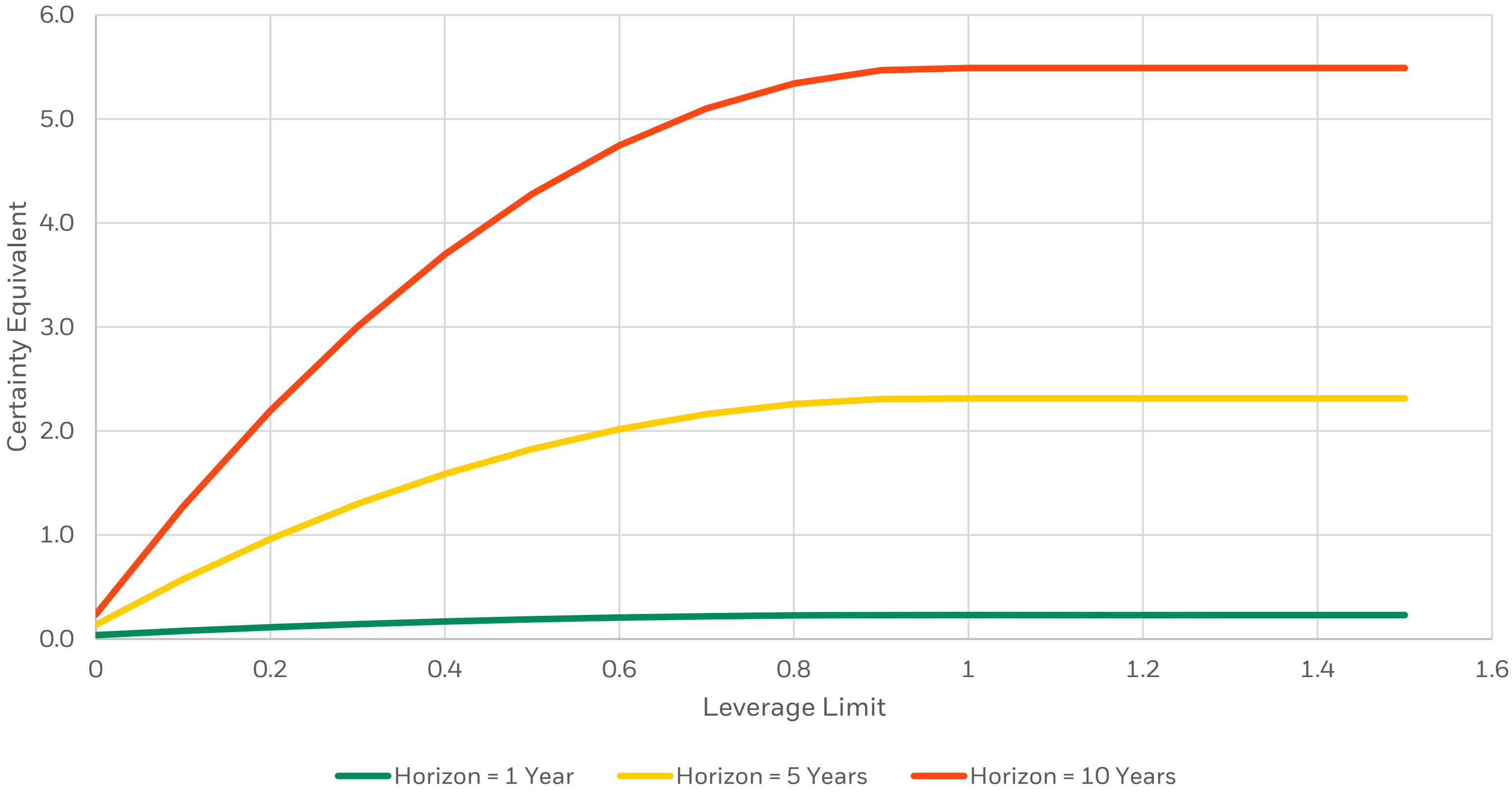
Payout or consumption ratio

Certainty equivalent costs changing the payout ratio

Source: BlackRock, 31 May 2023. Ang, Shen, Shen, and Zhao (2023). For Illustrative purposes only.

Changing leverage

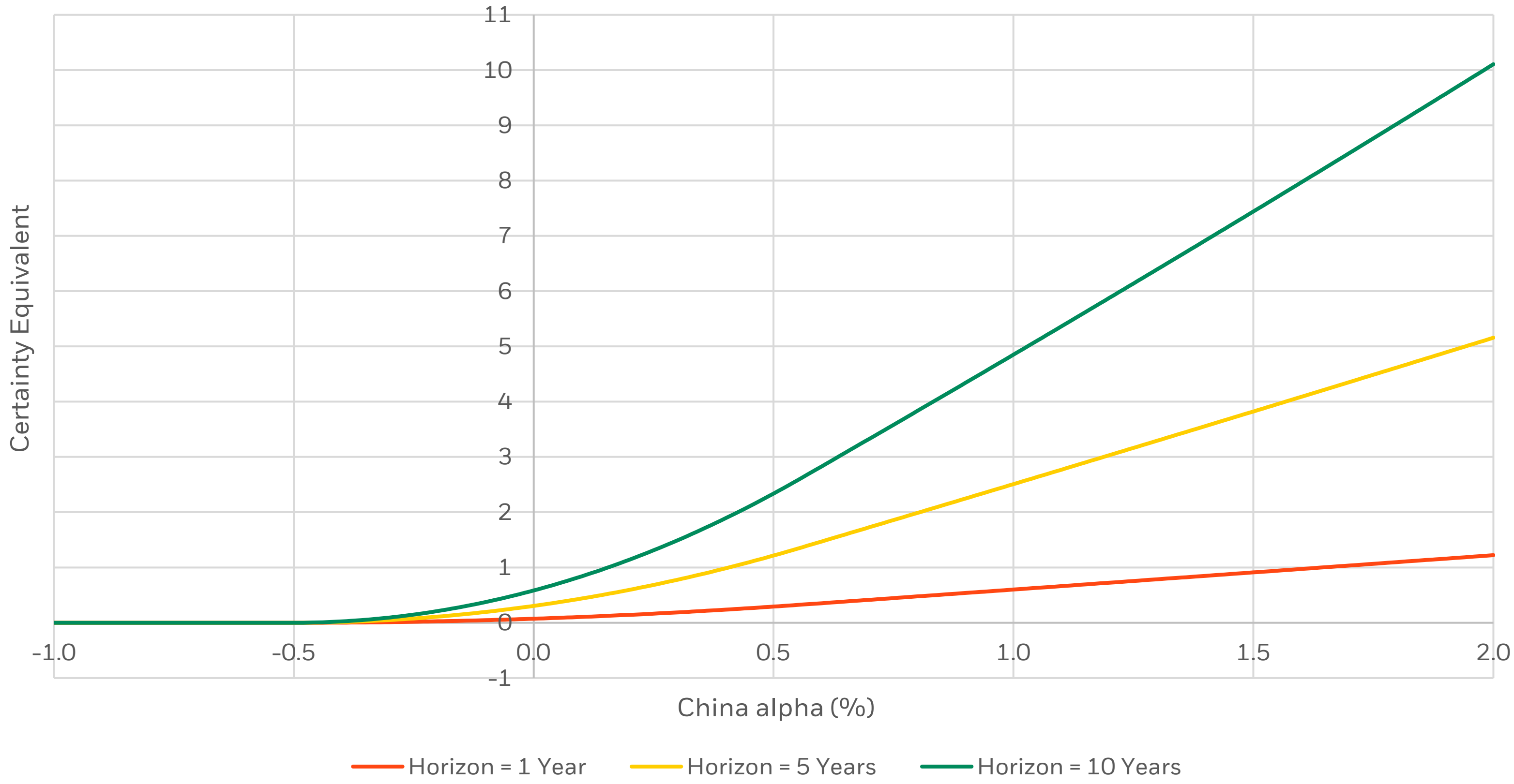
Certainty equivalent costs changing the leverage limit



Source: BlackRock, 31 May 2023. Ang, Shen, Shen, and Zhao (2023). For Illustrative purposes only.

Changing alpha

Certainty equivalent costs changing the alpha of the decoupling asset



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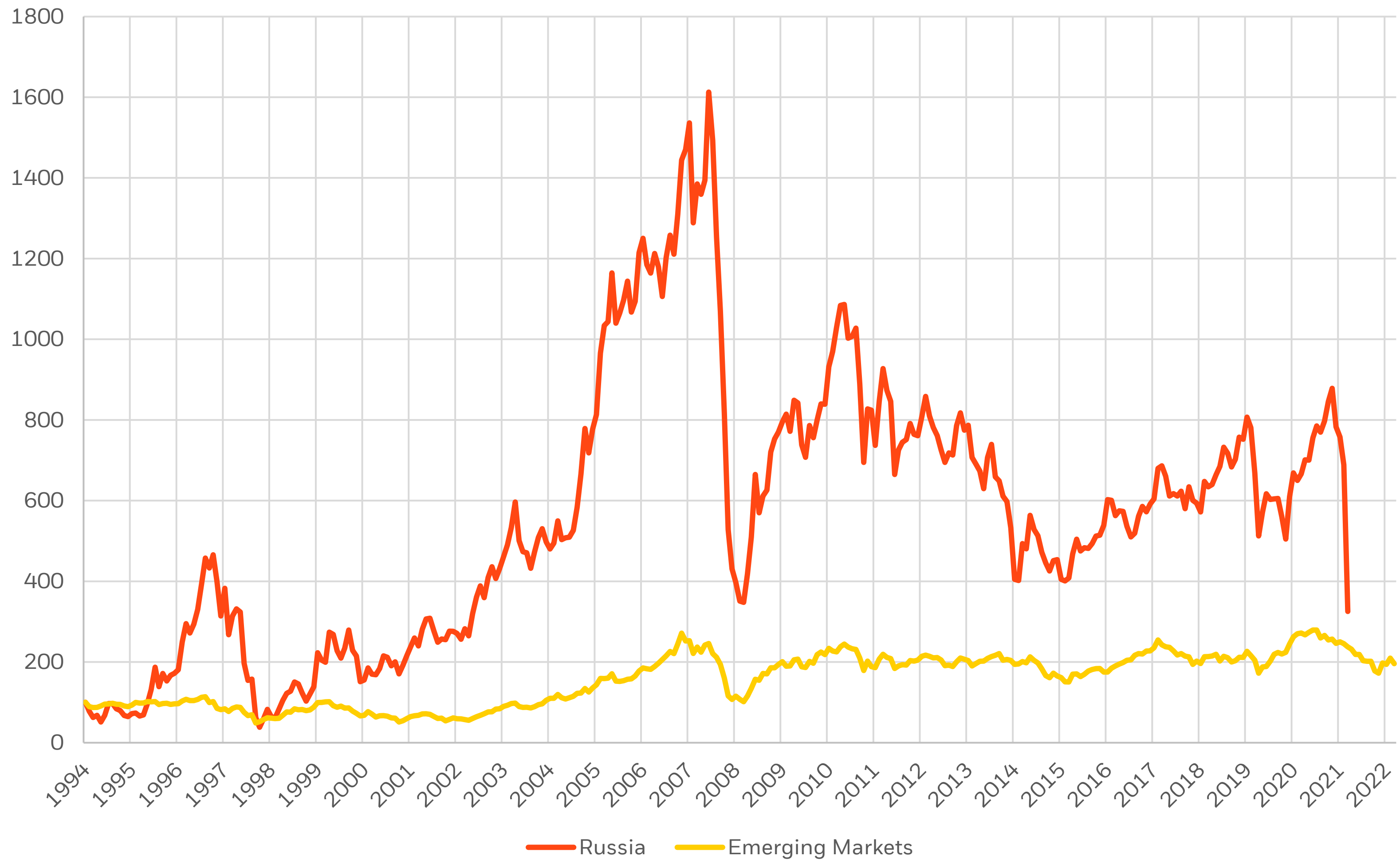
Calibration with Russia

Russia and EM returns



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Source: Bloomberg, as of 28 February 2023. The charts show cumulated returns of the MSCI Russia Index and the MSCI EM Index from January 1993 to February 2023. Russia becomes a standalone market on March 9, 2022. Indexes are unmanaged and index performance is shown for illustrative purposes only. It is not possible to invest directly in an index. The figures shown relate to past performance. Past performance is not a reliable indicator of current or future results.

Certainty equivalent costs

Hedging demands are negative

Certainty equivalent costs are approximately the same across the Fully Investable and Potentially Decouple regimes

	Portfolio Weights		Certainty Equivalent Costs	
	Fully Investable Regime	Potentially Decouple Regime	Fully Investable Regime	Potentially Decouple Regime
1 month	0.0500	-0.0772	0.0000	0.0000
2 months	0.0500	-0.0772	0.0028	0.1020
6 months	0.0260	-0.0697	0.0441	0.4960
1 year	-0.0102	-0.0606	0.3847	0.9963
3 years	-0.0276	-0.0504	2.2383	2.4117
5 years	-0.0276	-0.0498	3.5256	3.6962
10 years	-0.0276	-0.0498	6.7914	6.9673

Source: BlackRock, 31 May 2023. Ang, Shen, Shen, and Zhao (2023). For Illustrative purposes only.

Extensions

Although probabilities of decoupling are time varying (because the probability of decoupling is only non-zero in the second Potentially Decouple regime), the decoupling probability may be state-dependent. This introduces a new state variable

There is a possibility that a previously decoupled market re-integrates into world markets. In this case, the absorbing state regime is no longer absorbing

The power utility function is locally mean-variance, but it is likely the disutility of decoupling is greater than the utility gain of the return

The decoupling regime could be interpreted as a regime where certain assets become “stranded”

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