Safe Asset Carry Trade

Universität St.Gallen

Benedikt Ballensiefen*, University of St. Gallen and World Bank Group
Angelo Ranaldo, University of St. Gallen and Swiss Finance Institute

Contact
Benedikt Ballensiefen
benedikt.ballensiefen@unisg.ch
+1(202) 848 4218

We provide the first systematic asset pricing analysis of one of the main safe asset categories, the repurchase agreement (repo). A standard, no-arbitrage model with a *market* and a *carry* factor prices these near-money assets. While the market factor determines the short-term interest rate level, the carry factor accounts for the cross-sectional dispersion providing for a remunerative carry. Consistent with the safe asset literature, the carry factor reflects heterogeneity in convenience yield and increases in safety and liquidity premia, and opportunity cost. Our carry factor helps explain the cross-section of long-term bond returns after accounting for standard bond pricing factors.

Paper in a Nutshell

We provide the first systematic asset pricing analysis of one of the main safe asset categories, the repurchase agreement (**repo**).

- Heterogeneity in repo rates allows for a remunerative **carry trade**. The return on this strategy is our carry factor.
- Standard, **no-arbitrage model** with a market factor (*level factor*) and a carry factor (*slope factor*) is able to price these near-money assets.
- Consistent with the **safe asset literature**, the carry factor reflects heterogeneity in convenience premia and increases in the safety and liquidity premia, and the opportunity cost.
- Our carry factor helps explain the cross-section of long-term **bond returns** after accounting for standard bond pricing factors.

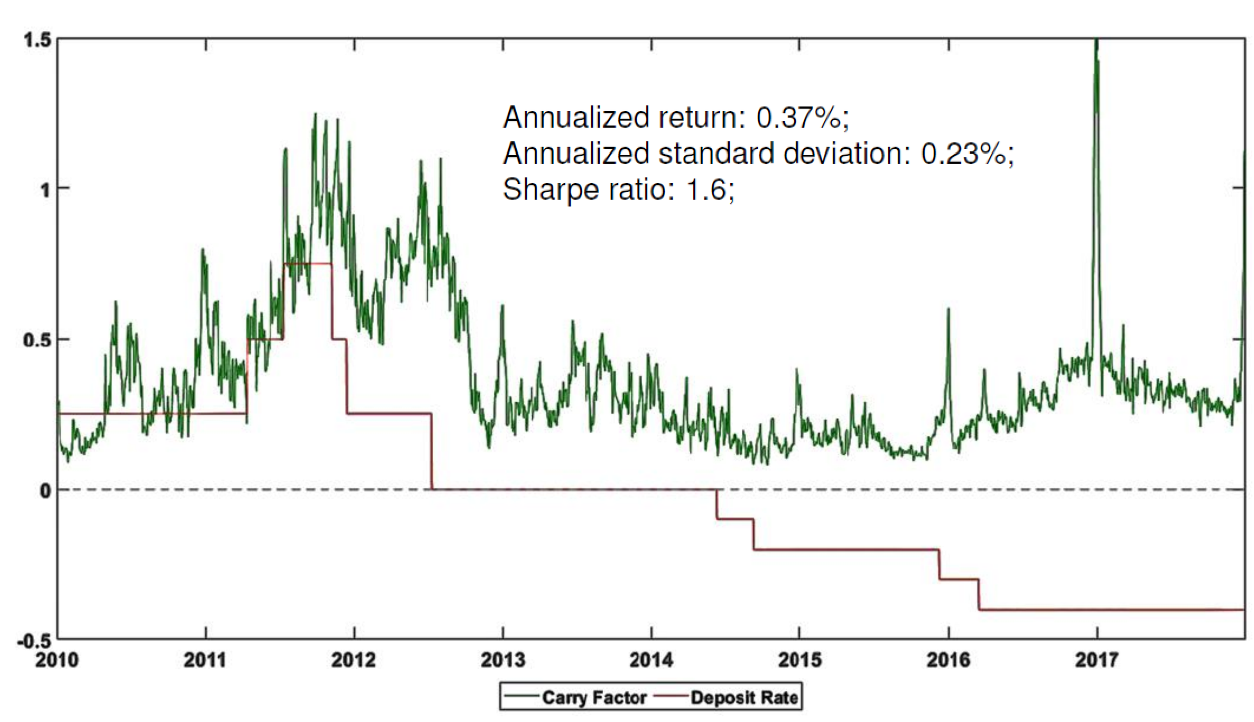

Figure: Development of the Safe Asset Carry Factor

We contribute to three strands of the literature:

(i) Short-term interest rates.

- Cross-sectional dispersion in repo rates in Europe (e.g., Mancini, Ranaldo, and Wrampelmeyer, 2016; Boissel et al., 2017) and the United States (e.g., Bartolini et al., 2011; Gorton and Metrick, 2012; Copeland, Martin, and Walker, 2014; Krishnamurthy, Nagel, and Orlov, 2014; Infante, 2020).

(ii) Asset pricing.

- Common risk factors in equity, fixed income (Fama and French, 1993) and foreign exchange (FX) markets (Lustig, Roussanov, and Verdelhan, 2011). Koijen et al. (2018) on different carries in equity, fixed income, and option markets.

(iii) Safe assets.

- On convenience yields (e.g., Krishnamurthy, 2002; Longstaff, 2004; Krishnamurthy and Vissing-Jorgensen, 2012; Greenwood and Vayanos, 2014; Nagel, 2016). On safe and quasi safe assets (e.g., Stein, 2012; Sunderam, 2015; Krishnamurthy, He, and Milbradt, 2019).

I. Carry Factor

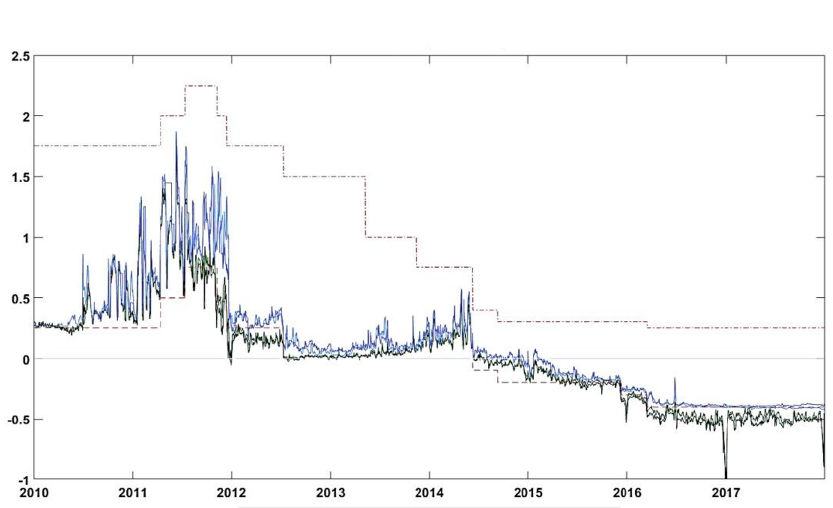

Figure: Repo Rate Development

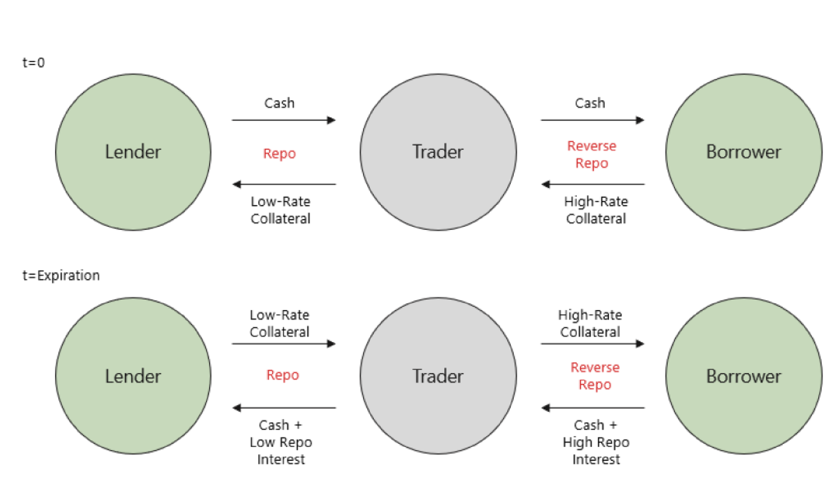

Figure: Carry Trade

We document the **cross-sectional dispersion** in near-money rates. The safe asset literature offers an explanation pointing to the time-dependent safety and liquidity premia.

- (i) Differences in the **safety premia** create an interest rate differential between truly (e.g., German collateral) and quasi-safe assets (e.g., Italian collateral).
- (ii) Differences in the **liquidity premia** refer to some collateral assets offering larger liquidity benefits (e.g., in terms of fungibility and (re-)pledgeability).

By going **long** repos with the highest rate (via a reverse repo) while **shorting** repos lowest rate (via a repo), our carry represents a self-financing trading strategy swapping assets with higher convenience premia for those with lower convenience premia.

II. Common Factors

Assume a **linear factor model** and employ two common asset pricing estimation techniques:

- Two-stage ordinary least squares (OLS) estimation following **Fama and MacBeth (1973)**.
- Generalized method of moments (GMM) estimation following **Hansen (1982)**.

Table 7: First Stage GMM: Factor Loadings

Portfolio	1	2	3	4	5	6	7	8
a	−0.01	0.02***	0.02***	0.02***	0.02***	0.02**	0.02***	0.02***
	(−1.45)	(4.25)	(5.13)	(6.89)	(7.08)	(2.38)	(6.53)	(5.91)
β^{Market}	0.97***	1.06***	1.05***	1.03***	1.00***	0.98***	0.98***	0.99***
	(81.32)	(89.20)	(120.23)	(169.88)	(227.14)	(81.38)	(87.01)	(85.60)
β^{HML}	−0.89***	−0.11***	0.03***	0.09***	0.13***	0.20***	0.28***	0.37***
	(−41.53)	(−11.61)	(3.30)	(8.63)	(12.00)	(9.69)	(28.65)	(30.58)

The table reports the factor loadings for the eight portfolios estimated via the GMM approach. The GMM results depicted in Tables 7 and 8 are estimated jointly as part of a single, overidentified estimation. ***, **, and * represent significance at a 1, 5, and 10% level, respectively; t-statistics are in parentheses. Error terms are adjusted according to Newey and West (1987) with the optimal number of lags chosen using the Bartlett kernel. Data are daily for the period 2010–2017.

Table 8: Second Stage: Risk Premium

	FMB	GMM
λ^{Market}	−0.07	−0.07
	(−1.41)	(−1.64)
λ^{HML}	0.40***	0.39***
	(13.28)	(15.94)
N	16,392	16,392
Time Periods	2,049	2,049
adj. R^2	98.15%	97.73%
χ^2	-	28.59%

The table reports estimates of the risk premia for the market factor and the carry factor obtained using the FMB and GMM approaches. The GMM results depicted in Tables 7 and 8 are estimated jointly as part of a single, overidentified estimation. ***, **, and * represent significance at a 1, 5, and 10% level, respectively; t-statistics are in parentheses. Error terms are adjusted according to Newey and West (1987) with the optimal number of lags chosen using the Bartlett kernel. For the GMM estimation, p-values of χ^2 tests are reported in percentage points. Data are daily for the period 2010–2017.

III. Safe Asset Determination

Carry factor reflects a **differential in convenience yield** as truly safe assets (in the low-rate portfolio) carry higher safety and liquidity benefits than quasi-safe assets (in the high-rate portfolio).

- Carry return increases in the **safety premium** (i.e., difference in ten-year CDS spreads between the countries in the high- and low-rate portfolio).
- Carry return increases in the **liquidity premium** (i.e., difference in the short-term debt to GDP ratio between the countries in the high- and low-rate portfolio).
- Carry return increases with the **opportunity cost** (i.e., main Euro-area short-term interest rate benchmark Eonia).

Control for market frictions and **arbitrage deviations** by accounting for the U.S. Dollar Euro covered interest parity (CIP) basis.

Table 9: Economic Analysis: Safe Asset Dimensions

	(1) Carry b/t	(2) Carry b/t	(3) Carry b/t	(4) Carry b/t	(5) Carry b/t	(6) Carry b/t
Risk	0.545***				0.396***	0.396***
	(6.63)				(5.84)	(5.20)
Asset Supply		0.545**			0.249**	0.242*
		(3.02)			(2.22)	(2.02)
Opportunity Cost			0.319**		0.366***	0.357***
			(2.35)		(5.70)	(5.25)
Arbitrage Deviation				0.361***	0.166**	0.159**
				(3.35)	(2.49)	(2.31)
Carry Lag1						0.019
						(0.21)
Constant	−0.035	0.131	0.372***	0.264**	−0.091	−0.097
	(−0.32)	(0.62)	(5.02)	(2.16)	(−1.62)	(−1.55)
N	31	31	31	31	31	30
adj. R^2	0.589	0.213	0.131	0.254	0.803	0.791

The table reports the results of the time-series regressions of our carry factor on a constant, the static weighted CDS price difference between portfolios 8 and 1 ("Risk"), the dynamic weighted difference in the log of the ratio of short-term debt to GDP between portfolios 8 and 1 ("Asset Supply"), the Eonia rate ("Opportunity Cost"), the absolute U.S. dollar Euro CIP deviations ("Arbitrage Deviation"), and the lagged carry factor ("Carry Lag1"). ***, **, and * represent significance at a 1, 5, and 10% level, respectively; t-statistics are in parentheses. Error terms are adjusted according to Cochrane and Orcutt (1949), following Wooldridge (2015). Data are quarterly for the period 2010–2017.

IV. Convenience Premium and Asset Prices

- Our results provide a **bridge between short-term and long-term safe assets**.
- Our two repo factors help explain the **cross-section of bond returns** after accounting for the standard bond pricing factors and measures of bond safety and liquidity.
- The unexplained yield component of long-term bonds increases with our repo carry factor, suggesting that it captures additional **convenience attributes**.

Table 11: Convenience Premium and Bond Prices

	(1) Bond Return b/t	(2) Bond Return b/t	(3) Bond Return b/t	(4) Bond Return b/t
Nelson-Siegel Implied Bond Return	1.239***	0.918***	0.949***	0.838***
	(14.495)	(28.124)	(37.366)	(23.087)
Bond Safety		0.013***	0.013***	0.012***
		(4.188)	(4.818)	(4.738)
Bond Liquidity		0.004***	0.003***	0.003***
		(4.625)	(6.012)	(5.978)
Repo Carry Factor *				
Germany			−0.017***	−0.017***
			(−5.527)	(−5.515)
Netherlands			−0.015***	−0.015***
			(−4.956)	(−4.935)
Austria			−0.014***	−0.014***
			(−3.774)	(−3.737)
Finland			−0.012***	−0.011***
			(−4.243)	(−4.118)
Belgium			−0.008*	−0.008*
			(−2.000)	(−1.951)
Spain			0.008*	0.008**
			(1.963)	(2.063)
Italy			0.010***	0.010***
			(2.806)	(2.941)
Ireland			0.024***	0.024***
			(3.941)	(4.105)
Portugal			0.066***	0.066***
			(9.071)	(9.140)
Repo Market Factor				0.004***
				(3.167)
N	614,667	614,665	614,665	614,665
adj. R^2	0.741	0.863	0.909	0.910
Bond FE	Yes	Yes	Yes	Yes

The table reports the results explaining the return on a cross-section of European sovereign bonds. The dependent variable is the log return of bond i at time t. The Nelson-Siegel implied return is the log return of bond i at time t implied by the Nelson-Siegel model estimated via German government bonds. Bond safety denotes the log of the CDS spread, bond liquidity the log of the relative bid-ask spread. The market and carry factor are the two repo pricing factors. ***, **, and * represent significance at a 1, 5, and 10% level, respectively; t-statistics are in parentheses. All regressions include bond fixed effects and standard errors clustered at the maturity bucket-country level. Data are daily for zero and fixed-coupon bonds for the period 2010–2017.

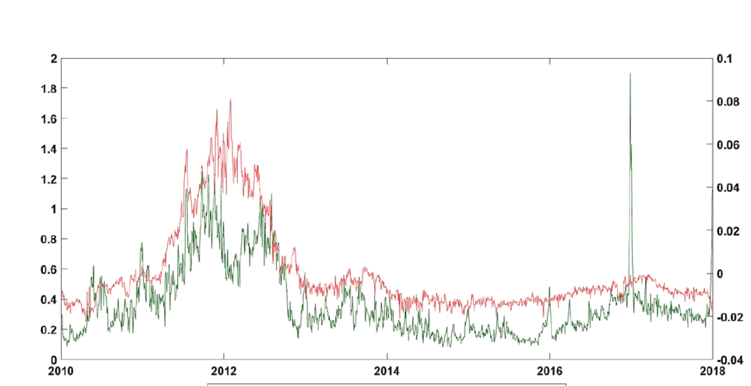

Figure: Carry Factor and First PCA of Unexplained Bond Return

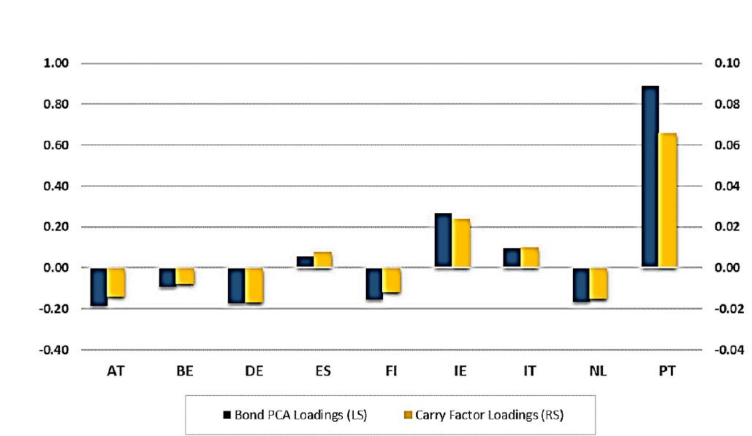

Figure: Country Loadings on Carry Factor and Bond PCA

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