



НАЦИОНАЛЬНЫЙ ИССЛЕДОВАТЕЛЬСКИЙ
УНИВЕРСИТЕТ

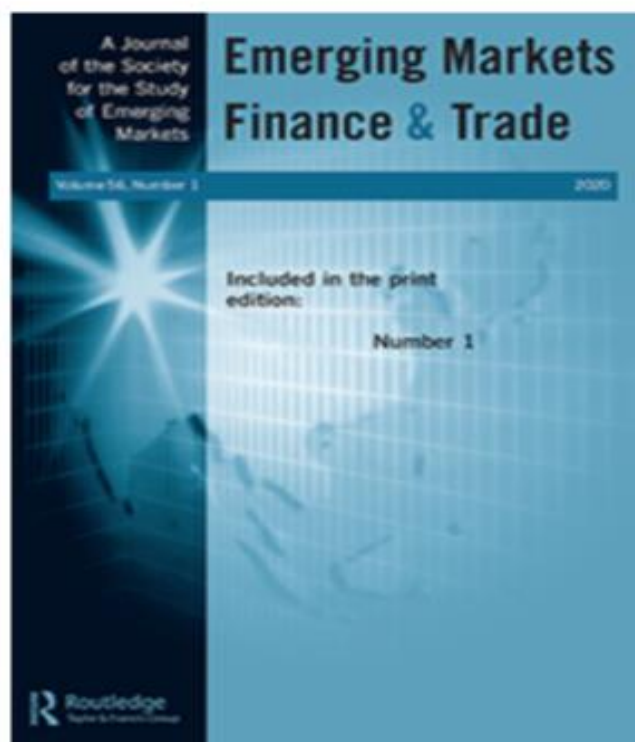
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PUZZLING PREMIUMS ON FX MARKETS: CARRY TRADE, MOMENTUM, AND VALUE ALONE AND STRATEGY DIVERSIFICATION

Спикер: Старший преподаватель,
к.э.н., Микова Евгения

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Puzzling Premiums on FX Markets: Carry Trade, Momentum, and Value Alone and Strategy Diversification

Evgeniya Mikova, Tamara Teplova & Qaiser Munir

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INTRODUCTION

Why FX market?

- Daily turnover in the global foreign exchange market has hit \$6.6t in 2020
- The foreign exchange (FX) market runs 24 hours a day
- The largest financial market in the world with high level of liquidity and low costs

Why Value, Momentum and Carry Trade?

- Well-known and a profitable strategy over several decades
- The failure of traditional asset pricing models to explain carry trade, momentum and value returns
- Negative correlation between value and momentum strategies

CONTRIBUTION TO THE LITERATURE

Study diversified currency portfolio employing three investment strategies simultaneously and optimizing strategies' weights depending on realized volatility.

Conduct a portfolio analysis from the perspective of the ruble, rather than the US dollar as the base currency.

Focus on emerging market currencies in our sample whereas the majority of papers examine the currencies of developed countries/G10 member countries, and include emerging markets in an additional sample without the consideration of ruble.



LITERATURE REVIEW

Carry trade

- Villanueva (2007) – 1981 – 1998, DEM, JPY, GBP, annualized return -4.4%, Sharpe ratio -0.7
- Burnside et al. (2011) - well-diversified across currencies carry trade strategy delivers a Sharpe ratio that is more than double that of the US stock market, peso problem
- Kojien et al. - carry trade going long high-carry assets and short low-carry assets earns significant returns in various asset classes, with an annualized Sharpe ratio, on average, of 0.7.

Momentum effect

- Okunev and White (2003) - 8 currencies, from 1980 to 2000, positive currency momentum effect, with investment returns of 6% a year
- Burnside et al. (2011) - 20 currencies, 1976 - 2010, from 4.5% to 4.9% a year with a Sharpe ratio of 0.62–0.98
- Asness, et al. (2013) - 10 currencies, January 1972 - July 2011 across Australia, Canada, Germany (spliced with the euro), Japan, New Zealand, Norway, Sweden, Switzerland, the United Kingdom, and the United States, currency momentum strategy yields excess returns of 3.5% a year with a Sharpe ratio of 0.34

Value effect

- Rafferty (2012) - 37 currencies (15 of them are currencies of developed countries) for the period January 1976– August 2011- annual return of 2.8% for the entire sample and 4.1% for developed countries with a Sharpe ratio of 0.38 for the entire sample and 0.53 for the currencies of developed countries.
- Copeland and Lu (2013) - 48 countries were considered for the period from November 1983 to September 2011. The authors receive an average return of 6.8% a year using a value strategy.

Portfolio optimization

- Menkhoff et al. (2012) find no correlation between the HML momentum and carry trade portfolios.
- Asness et al. (2013) report a negative correlation between momentum and value across different asset classes and different markets



DATA

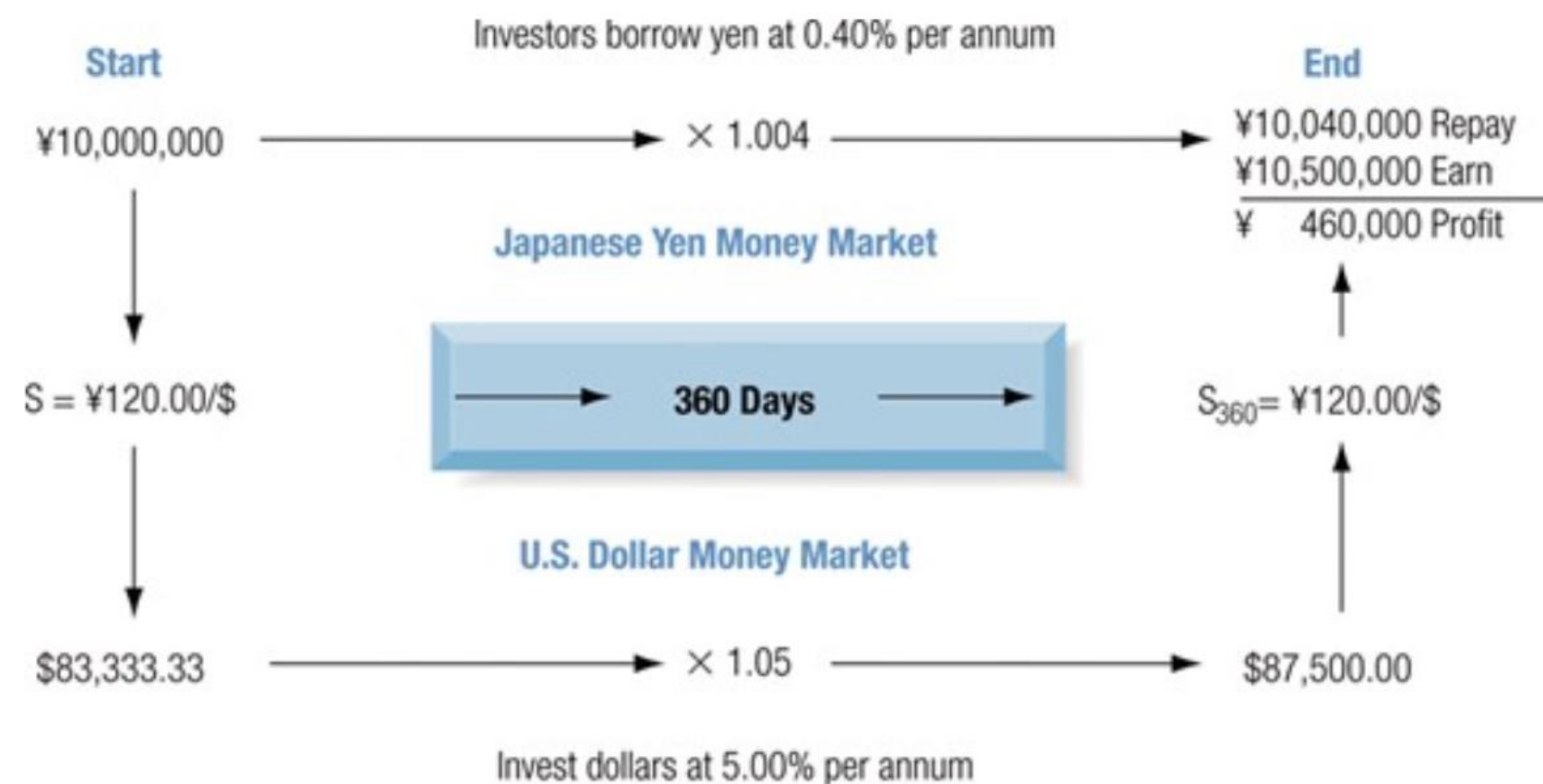
- **Object** - spot cross-rates of various currencies against the ruble
- **Frequency** – monthly
- **Period** - July 31, 2003 - March 31, 2018
- **Currencies of major developed countries**
US dollar (USD), euro (EUR), pound sterling (GBP), Australian dollar (AUD), New Zealand dollar (NZD), Swiss franc (CHF), Canadian dollar (CAD), Swedish krona (SEK), Danish krona (DKK), and Japanese yen (JPY).
- **Currencies of major emerging countries**
Argentine peso (ARS), Chinese renminbi (RMB), Hong Kong dollar (HKD), Indian rupee (INR), Polish zloty (PLN), Saudi Arabian riyal (SAR), Singapore dollar (SGD), new Taiwan dollar (TWD), Thai baht (THB), Turkish lira (TRY), Kuwaiti dinar (KWD), and Mexican peso (MXN), Hungary Forint (HUF), Latvian Lat (LVL), Korean Republic Won (KRW), and Malaysian Ringgit (MYR).

CARRY TRADE ON FX MARKET

Carry trade - borrowing (or going short) a low yielding asset and investing (or going long) an asset that provides a higher rate of return.

The classic application is in currencies — specifically, going long currencies of countries with the highest interest rates and short those with the lowest.

Example:



$$\text{Курс } ¥/\$^* = \frac{10040000}{87500} \sim 115$$

Доллар должен обесцениться, чтобы UIP выполнялся



CARRY TRADE – FREE LUNCH?

Uncovered interest parity (UIP) - difference in interest rates between two countries is equal to the expected change in exchange rates between the countries' currencies and so it is an equilibrium condition in the spot market.

$$UIP: E \frac{S_{t+1}}{S_t} = \frac{1+i_t^d}{1+i_t^f} \quad \frac{1.004}{1.05} = \frac{x}{120} \quad x = 115$$

Crash risk - high yielding currencies go up by the stairs and down by the elevator

Violating UIP and “Forward premium puzzle”

- slope coefficient in UIP regression is significantly less than zero -> high-yielding currencies tend to appreciate further

Source: Fama (1984)
$$\frac{S_{t+1} - S_t}{S_t} = \alpha + \beta \frac{F_t - S_t}{S_t}$$

Covered interest parity (CIP) - difference in interest rates between two countries is equal to the difference between the spot and forward currency values of the two countries and so it is an equilibrium condition between the spot and forward market.

$$CIP: E \frac{F_t}{S_t} = \frac{1+i_t^d}{1+i_t^f}$$



CARRY PORTFOLIO CONSTRUCTION

Portfolio currency excess returns (CER) $CER = (1 + i_t^*) \frac{S_{t+1}}{S_t} - (1 + i_t)$ CER=1.05*120/120-1.004=4.6%

We switch to currency portfolios that combine developed and emerging countries, we use CER, in order to fulfill CIP

$$1.004 = 1.05 * 115 / 120$$

$$(1 + i_t) = (1 + i_t^*) \frac{F_t}{S_t}$$

$$CER = (1 + i_t) \cdot \left(\frac{S_{t+1} - F_t}{F_t} \right)$$

$$1.004 * (120 - 115) / 115 = 4.6\%$$

Four different ways of portfolio weighting approaches :

- Equally Weighted Strategy (EW)
- Rank-Weighted Portfolio (RW)
- Basket Strategy (P5-P1)
- High- Minus-Low (HML)

buy with forward discount -> funding currency should appreciate : if NO we will get money



INDIVIDUAL CARRY TRADE STRATEGIES FOR MAJOR CURRENCIES AGAINST THE RUBLE FOR 2003-2014

Table 1. Performance of different carry trade strategies vs. benchmarks, July 2003–November 2014.

	P1	P5	P5-P1	Low	High	HML	RW	EW	MICEX	Buy FX
Annualized mean	5.90	8.12	2.11	5.35	7.95	2.47	1.10	2.53	16.30	8.97
Monthly arithmetic mean	0.48	0.65**	0.17	0.44	0.64**	0.2	0.09	0.21	1.32*	0.74***
<i>P</i> -value mean	0.15	0.03	0.33	0.22	0.04	0.35	0.37	0.19	0.06	0.01
Monthly geometric mean	0.41	0.6**	0.11	0.33	0.58*	0.09	0.05	0.19	0.97	0.69**
<i>P</i> -value mean	0.19	0.05	0.37	0.28	0.07	0.39	0.39	0.22	0.16	0.02
Skewness	1.98	1.47	-1.07	2.87	1.33	-1.69	-1.33	0.95	-0.53	2.74
Kurtosis	6.01	5.96	3.87	15.78	5.01	6.95	4.73	3.40	1.25	9.17
Annualized st. dev.	13.83	11.78	12.03	16.48	12.43	16.37	9.49	6.99	28.17	11.25
Sortino ratio	0.26	0.39	0.07	0.20	0.35	0.05	0.04	0.18	0.23	0.69
Sharpe ratio	0.43	0.69	0.18	0.32	0.64	0.15	0.12	0.36	0.58	0.80

*/**/*** indicates that the parameter is significantly different from zero at 10%/5%/1% level of significance.



INDIVIDUAL CARRY TRADE STRATEGIES FOR MAJOR CURRENCIES AGAINST THE RUBLE FOR 2014-2018

Table 2. Performance of different carry trade strategies vs. benchmarks, January 2015–March 2018.

	P1	P5	P5-P1	Low	High	HML	RW	EW	MICEX	Buy FX
Annualized mean	-14.20	-10.48	4.28	-15.49	-9.65	6.82	1.68	4.46	11.83	-1.86
Monthly arithmetic mean	-1.28	-0.93	0.35	-1.39*	-0.84	0.55	0.14	0.36	0.94	-0.15
<i>P</i> -value mean	0.11	0.18	0.26	0.09	0.23	0.22	0.36	0.32	0.13	0.83
Monthly geometric mean	-1.41*	-1.04	0.32	-1.53*	-0.97	0.50	0.12	0.30	0.87	-0.26
<i>P</i> -value mean	0.08	0.15	0.28	0.07	0.19	0.24	0.36	0.34	0.16	0.73
Skewness	-0.23	0.36	0.39	-0.66	0.47	0.75	0.51	-0.19	-0.54	0.08
Kurtosis	2.03	0.51	0.45	3.79	0.5	2.51	0.79	0.04	0.39	0.69
Annualized st. dev.	17.70	16.47	8.55	17.75	17.86	11.12	6.81	12.34	13.00	16.10
Sortino ratio	-0.29	-0.25	0.24	-0.31	-0.22	0.31	0.11	0.15	0.39	-0.05
Sharpe ratio	-0.80	-0.64	0.50	-0.87	-0.54	0.61	0.25	0.36	0.91	-0.12

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IMPACT OF CHANGES IN EXCHANGE RATE REGIMES ON THE INVESTMENT RESULTS

Table 3. Time-series regression analysis with time dummy variables of carry trade strategy.

	α_0	β_{FX}	β_{D1}	β_{D2}	R^2
P5-P1	0.34 [0.22]	-0.15** [0.03]	-6.78** [0.05]	-0.02 [0.98]	0.26
HML	0.40 [0.26]	-0.04 [0.68]	-23.10*** [0.00]	0.14 [0.85]	0.40
RW	0.25 [0.25]	-0.13** [0.02]	-7.21*** [0.01]	-0.13 [0.78]	0.31
EW	0.31 [0.13]	-0.18*** [0.00]	3.58 [0.15]	0.02 [0.96]	0.25

$$R_{it} = \alpha_0 + \beta_{fx}FX + \beta_{D1}D_1 + \beta_{D2}D_2 + e_i$$

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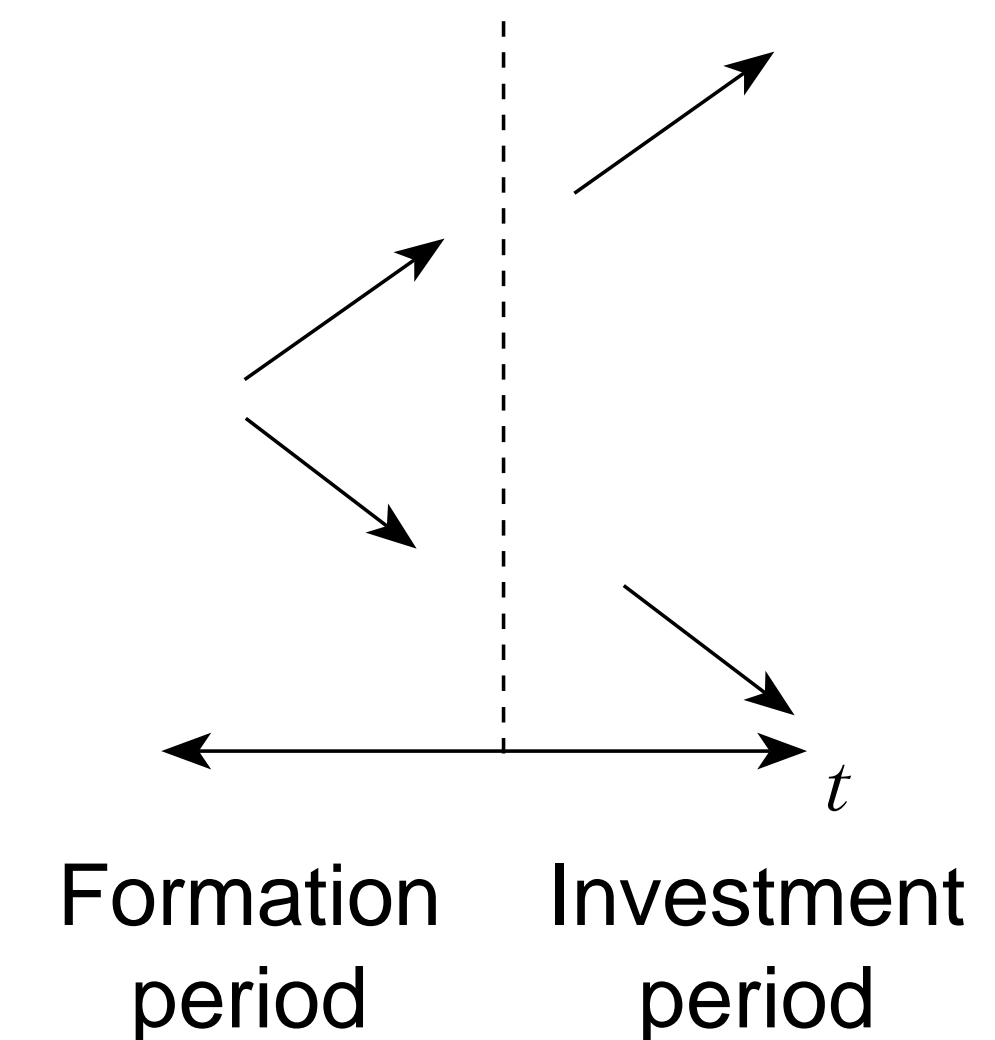
MOMENTUM EFFECT IN GENERAL AND ON FX MARKET

MOMENTUM EFFECT

- The most provocative anomaly EVER
- Not the result of data-snooping - empirical evidence that momentum effect is observed on the different markets, in different historical periods and even on different underlying assets.

CURRENCY MOMENTUM EFFECT

- Academic literature focuses generally on the stock momentum effect.
- The foreign exchange market is associated with lower transaction costs, higher liquidity, and no constraints on short-selling.





INDIVIDUAL CROSS-SECTIONAL MOMENTUM STRATEGIES ON FX MARKET FOR 2003-2014

Table 4. Performance of different momentum strategies vs. Benchmarks, July 2003–November 2014.

	P1	P5	P5-P1	Low	High	HML	RW	EW	MICEX	Buy FX
Annualized mean	3.77	3.86	0.09	2.59	4.27	1.64	0.41	10.39	16.30	8.97
Monthly arithmetic mean	0.31	0.32	0.01	0.21	0.35	0.14	0.03	0.83***	1.32*	0.74***
<i>P</i> -value mean	0.24	0.21	0.40	0.33	0.23	0.37	0.39	0.00	0.06	0.01
Monthly geometric mean	0.24	0.26	-0.03	0.13	0.27	0.05	0.00	0.81***	0.97	0.69**
<i>P</i> -value mean	0.29	0.25	0.39	0.37	0.28	0.39	0.4	0.00	0.16	0.02
Skewness	1.84	1.44	-0.01	1.08	1.39	1.57	0.22	0.06	-0.53	2.74
Kurtosis	6.39	4.30	2.47	3.45	3.45	8.01	5.90	9.6	1.25	9.17
Annualized std. dev.	12.78	11.27	10.11	14.01	13.67	14.44	8.48	6.74	28.17	11.25
Sortino ratio	0.17	0.18	0.00	0.09	0.17	0.06	0.02	0.84	0.23	0.69
Sharpe ratio	0.29	0.34	0.01	0.18	0.31	0.11	0.05	1.54	0.58	0.80



INDIVIDUAL CROSS-SECTIONAL MOMENTUM STRATEGIES ON FX MARKET FOR 2015-2018

**Table 5. Performance of different momentum strategies vs. Benchmarks, January 2015–
March 2018.**

	P1	P5	P5-P1	Low	High	HML	RW	EW	MICEX	Buy FX
Annualized mean	-12.72	-17.46	-5.37	-12.9	-16.03	-3.55	-1.38	7.32	11.83	-1.86
Monthly arithmetic mean	-1.13	-1.59*	-0.46	-1.14	-1.45*	-0.30	-0.12	0.59***	0.94	-0.15
<i>P</i> -value mean	0.11	0.07	0.19	0.11	0.10	0.29	0.36	0.00	0.13	0.83
Monthly geometric mean	-1.23*	-1.73*	-0.49	-1.25*	-1.60*	-0.33	-0.13	0.58***	0.87	-0.26
<i>P</i> -value mean	0.09	0.05	0.17	0.09	0.08	0.28	0.36	0.00	0.16	0.73
Skewness	-0.10	-0.61	-0.99	-0.07	-0.69	0.27	-0.66	-0.10	-0.54	0.08
Kurtosis	2.02	1.74	2.73	1.66	2.38	0.07	1.09	-0.57	0.39	0.69
Annualized std. dev.	15.47	18.20	8.37	15.75	19.13	8.60	5.94	3.98	13.00	16.10
Sortino ratio	-0.30	-0.33	-0.22	-0.30	-0.30	-0.16	-0.08	1.15	0.39	-0.05
Sharpe ratio	-0.82	-0.96	-0.64	-0.82	-0.84	-0.41	-0.23	1.84	0.91	-0.12



CURRENCY REGIME DOES NOT HAVE IMPACT ON MOMENTUM STRATEGY RESULTS ON FX MARKET

Table 6. Time-series regression analysis with time dummy variables of momentum strategy.

	α_0	β_{FX}	β_{D1}	β_{D2}	R^2
P5-P1	0.03 [0.90]	-0.03 [0.61]	1.51 [0.61]	-0.51 [0.31]	0.01
HML	0.12 [0.72]	0.00 [0.97]	0.89 [0.83]	-0.40 [0.57]	0.40
RW	0.11 [0.59]	-0.05 [0.29]	1.85 [0.45]	-0.39 [0.35]	0.01
EW	0.72* [0.00]	0.09** [0.02]	-0.53 [0.78]	0.04 [0.89]	0.03

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VALUE PORTFOLIO FORMATION

Value portfolio is based on measuring undervaluation/overvaluation:

$$value = \frac{S_t}{PPP_t^{adj}}$$

The ratio of foreign currency against the ruble:

$$PPP_{RUB/FCU} = \frac{PPP_{RUB/USD}}{PPP_{FCU/USD}}$$

PPP is calculated on an annual basis whereas our strategy implies monthly rebalancing, so we interpolate its value for the next few months in the calendar year using the following equation:

$$PPP_t^{adj} = PPP_t \frac{CPI_t^{RUB} / CPI_{bop}^{RUB}}{CPI_t^{FCU} / CPI_{bop}^{FCU}}$$



INDIVIDUAL VALUE STRATEGIES ON FX MARKET FOR 2003-2014

Table 7. Performance of different value strategies vs. Benchmarks, July 2003–November 2014.

	P1	P5	P5-P1	Low	High	HML	RW	EW	MICEX	Buy FX
Annualized mean	7.03	0.59	-6.05	-0.21	8.01	-8.23	-4.12	-0.12	16.30	8.97
Monthly arithmetic mean	0.57*	0.05	-0.52**	0.64*	-0.02	-0.66*	-0.35**	-0.01	1.32*	0.74***
<i>P</i> -value mean	0.09	0.39	0.03	0.09	0.40	0.05	0.04	0.40	0.06	0.01
Monthly geometric mean	0.50	0.00	-0.55**	0.56	-0.08	-0.74**	-0.37**	-0.03	0.97	0.69**
<i>P</i> -value mean	0.13	0.40	0.02	0.13	0.39	0.03	0.03	0.39	0.16	0.02
Skewness	3.00	1.72	-0.97	3.83	1.22	-2.00	-0.85	0.24	-0.53	2.74
Kurtosis	12.71	5.74	2.20	23.06	3.74	14.76	2.82	9.47	1.25	9.17
Annualized std. dev.	11.52	13.58	9.09	12.06	15.19	13.50	6.50	6.14	28.17	11.25
Sortino ratio	0.03	0.39	-0.23	-0.01	0.41	-0.32	-0.22	-0.01	0.23	0.69
Sharpe ratio	0.52	0.05	-0.67	-0.02	0.53	-0.61	-0.63	-0.02	0.58	0.80

antivalue effect

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INDIVIDUAL VALUE STRATEGIES ON FX MARKET FOR 2015-2018

Table 8. Performance of different value trade strategies vs. Benchmarks, January 2015–March 2018.

	P1	P5	P5-P1	Low	High	HML	RW	EW	MICEX	Buy FX
Annualized mean	-12.63	-14.03	-1.58	-13.54	-17.18	-4.32	-1.26	-4.72	11.83	-1.86
Monthly arithmetic mean	-1.12	-1.25	-0.13	-1.21	-1.56*	-0.35	-0.11	-0.27	0.94	-0.15
<i>P</i> -value mean	0.13	0.12	0.36	0.13	0.06	0.16	0.34	0.32	0.13	0.83
Monthly geometric mean	-1.28*	-1.38*	-0.15	-1.33*	-1.69**	-0.37	-0.11	-0.3	0.87	-0.26
<i>P</i> -value mean	0.09	0.1	0.35	0.1	0.04	0.15	0.33	0.3	0.16	0.73
Skewness	-0.24	-0.12	-1.06	0.12	-0.68	-1.33	-0.33	-0.59	-0.54	0.08
Kurtosis	2.01	0.88	3.35	0.66	4.33	3.44	0.8	3.29	0.39	0.69
Annualized std. dev.	16.43	17.85	6.37	17.40	17.30	5.74	3.96	8.22	13.00	16.10
Sortino ratio	-0.28	-0.29	-0.09	-0.29	-0.35	-0.47	-0.12	-0.2	0.39	-0.05
Sharpe ratio	-0.77	-0.79	-0.25	-0.78	-0.99	-0.75	-0.32	-0.57	0.91	-0.12

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CURRENCY REGIME HAS IMPACT ON VALUE STRATEGY RESULTS ON FX MARKET

Table 9. Time-series regression analysis with time dummy variables of value strategy.

	α_0	β_{FX}	β_{D1}	β_{D2}	R^2
P5-P1	-0.40* [0.06]	-0.16*** [0.00]	6.35** [0.01]	0.08 [0.86]	0.06
HML	-0.37 [0.22]	-0.26*** [0.00]	6.26* [0.09]	0.10 [0.88]	0.07
RW	-0.27* [0.06]	-0.12*** [0.00]	6.60*** [0.00]	0.01 [0.97]	0.10
EW	-0.01 [0.97]	0.03 [0.48]	3.60* [0.07]	-0.56* [0.10]	0.04

*/**/*** indicates that the parameter is significantly different from zero at 10%/5%/1% level of significance.



COMBINATION OF CURRENCY CARRY, MOMENTUM, AND VALUE STRATEGIES

Table 10. Combination of carry trade, momentum, and value investment styles across currencies vs. benchmarks and individual strategies, June 2004–November 2014.

	Combination			EW individual strategies			Benchmark	
	EW	IV	LRV	Carry	MoM	Value	MICEX	Buy FX
Annualized mean	6.47	8.21	7.61	1.91	3.60	0.46	15.82	9.67
Annualized std. dev.	5.96	4.94	5.02	9.82	8.50	2.69	28.33	11.56
Skewness	0.44	1.36	1.30	-1.37	0.67	1.14	-0.50	2.68
Kurtosis	2.64	7.06	7.21	4.41	5.86	5.94	1.29	8.37
Sortino ratio	0.57	1.15	0.98	0.07	0.20	0.08	0.22	0.75
Sharpe ratio	1.09	1.66	1.52	0.19	0.42	0.17	0.56	0.84

Table 11. Combination of carry trade, momentum, and value investment styles across currencies vs. benchmarks and individual strategies, January 2015–March 2018.

	Combination			EW individual strategies			Benchmark	
	EW	IV	LRV	Carry	MoM	Value	MICEX	Buy FX
Annualized mean	5.30	5.45	5.70	4.29	-0.85	0.86	11.83	-1.86
Annualized std. dev.	3.65	3.44	3.09	6.51	5.65	3.80	13.00	16.10
Skewness	0.63	0.49	0.11	0.24	-0.19	0.35	-0.53	0.09
Kurtosis	2.44	1.78	1.27	0.53	-0.11	0.52	0.20	0.45
Sortino ratio	0.89	0.97	1.12	0.32	-0.06	0.09	0.39	-0.05
Sharpe ratio	1.45	1.59	1.85	0.66	-0.15	0.23	0.91	-0.12



CONCLUSION

- Carry trade strategy shows more impressive results across the broad sample of currencies than with the major currencies, and this is true in both periods.
- The results of testing the momentum strategy indicate the highest mean excess returns and risk-adjusted returns from taking an EW approach that allows investors to earn high abnormal returns during the different exchange rate regimes across major currencies.
- The “antivalue effect” on the analyzed currencies, indicating that overvalued currencies tend to outperform undervalued currencies for a 1-month holding period.
- Combining strategies, namely, carry trade, momentum, and value, based on volatility, offers significant improvement in risk-adjusted returns compared to either of the two strategies independently or to benchmarks



LIMITATIONS

- We do not focus on portfolio optimization and risk-control metrics for explanations of carry trade, momentum, and excess value returns in FX markets leaving this field for further development in our future investigation.
- We will develop portfolio optimization metrics including advanced approaches like Risk Parity, Downside risk control, ML, RL.

**THANK YOU FOR YOUR ATTENTION AND
INTEREST IN RESEARCH PAPER**



НАЦИОНАЛЬНЫЙ ИССЛЕДОВАТЕЛЬСКИЙ
УНИВЕРСИТЕТ

E-mail: emikova@hse.ru