



FX Transaction Cost Analysis

City of San Jose Police and Fire Department Retirement Plan

Reporting Period FY 2018/19

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Summary

Klarity FX has completed a FX transaction cost analysis for the San Jose Police and Fire Department Retirement Plan for transactions executed during the FY 2018/19 period. Analysis has been completed to measure the performance of each transaction compared to the day range¹, where the expectation is that each trade be completed within the trading prices available during the day. More importantly an analysis comparing the executed price of each transaction compared to the day average rate has been completed. In the absence of complete timestamp data, the day average performance measure allows the estimated USD cost of each transaction to be calculated, against the expectation that a large enough sample of transactions would be normally distributed compared to the day average price. The spread² from the day average allows reasonable conclusions to be drawn on transaction execution performance. Where timestamp data or benchmark data has been made available the executed price comparison has been completed.

- The plan completed 2110 transactions for a total transaction volume of \$611mln in FY 2018/19.
- Oberweis Intl Opportunities (05B0) was the largest investment manager by activity, accounting for 63% of the number of trades, and 23% of total volume.
- Russel Overlay Account initiated the most volume, accounting for 47% of the total.
- State Street completed 274 trades, for a total volume of \$82mln. Accounting for 13% of trades, and 13% of the total volume.
- Royal Bank of Canada completed the largest sum of volume, completing 25% of total volume over 5% of total trades.
- 97% of transactions fell within the day range, with 3% (69 transactions) falling outside the day range; a typical percentage.
 - 64 of the 69 were completed at a worse than day range, where volume totaled \$2,870,573 and an average spread of -0.33% was taken.
 - The four largest transactions accounted for \$2,412,142, over a spread of -0.21%. All four trades were initiated by Artisan, three were completed by State Street.
 - State Street completed 55 of the 64 total transactions outside of the day range, taking an average spread of -0.35% over \$2,602,939.
- Average rate analysis has been completed for all 2110 transactions. 54% of the transactions were completed at a rate inferior to the day average rate.
 - The spread from the day average is calculated to be -0.02%, a good³ result and minorly below the -0.01% average since 2015.
 - There was no major underperformance across investment manager, or counterparty.
 - The most significant underperformance came in transactions under \$5000, with an average spread of -0.10% taken; an acceptable outcome.
- State Street's performance for the year matched that of the 'Peer' Custodian group, at -0.11%.
 - The underperformance was isolated to the SSGM IndirectFX Air program. 98 transactions went through the program, with an average spread of -0.24% taken. The programs volume over the year totaled \$6,992,986. The remaining 176 transactions had a spread of -0.03% taken, from \$75,913,720 in trade volume.
 - It's important to note that the SSGM IndirectFX Air program largely deals with small repatriation trades; due to their nature, a wider spread is expected.
- The overall performance for 'All Other FX Counterparties' came in at a strong -0.01%. The combined overall spread came in at -0.02%; a good result.
- We continue to recommend that new accounts utilize the SSGM HPS program if they are unable to trade with their own FX partner.

¹ The available levels of analysis are explained in Appendix B&C

² An explanation of 'spread' vs. fee can be found in Appendix A

³ For guidance purposes outcomes may be described as follows: good outcome is -0.05% to positive | acceptable outcome is -0.15% to -0.05% | poor outcome is below -0.15%
These outcomes reference the spread taken on a transaction. EG, A -0.20% spread taken on \$1,000,000 = \$2,000 taken. Which is qualified as a poor outcome.

Overview of FX Transactions

No. Transactions	2110
Total Volume Transacted	\$610,793,637
Average Trade Size	\$289,476
Spot vs Forward	1520/590
FX Counterparties	16
FX Pairs	13
Investment Managers	8

Table 1. Data Summary

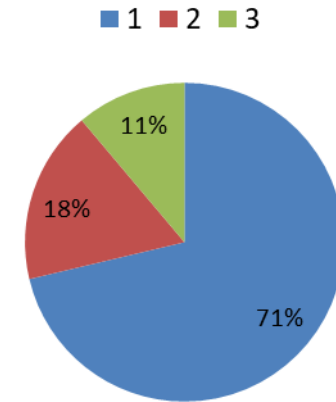


Figure 1. Transactions by currency tier

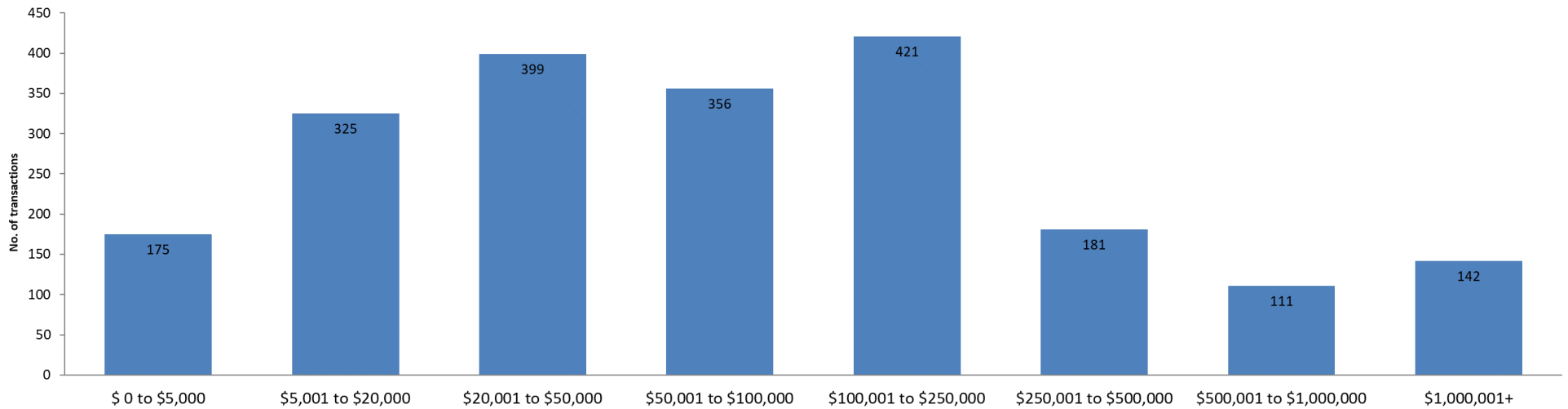


Figure 2. Transaction size distribution (\$)

Investment Manager Breakdown

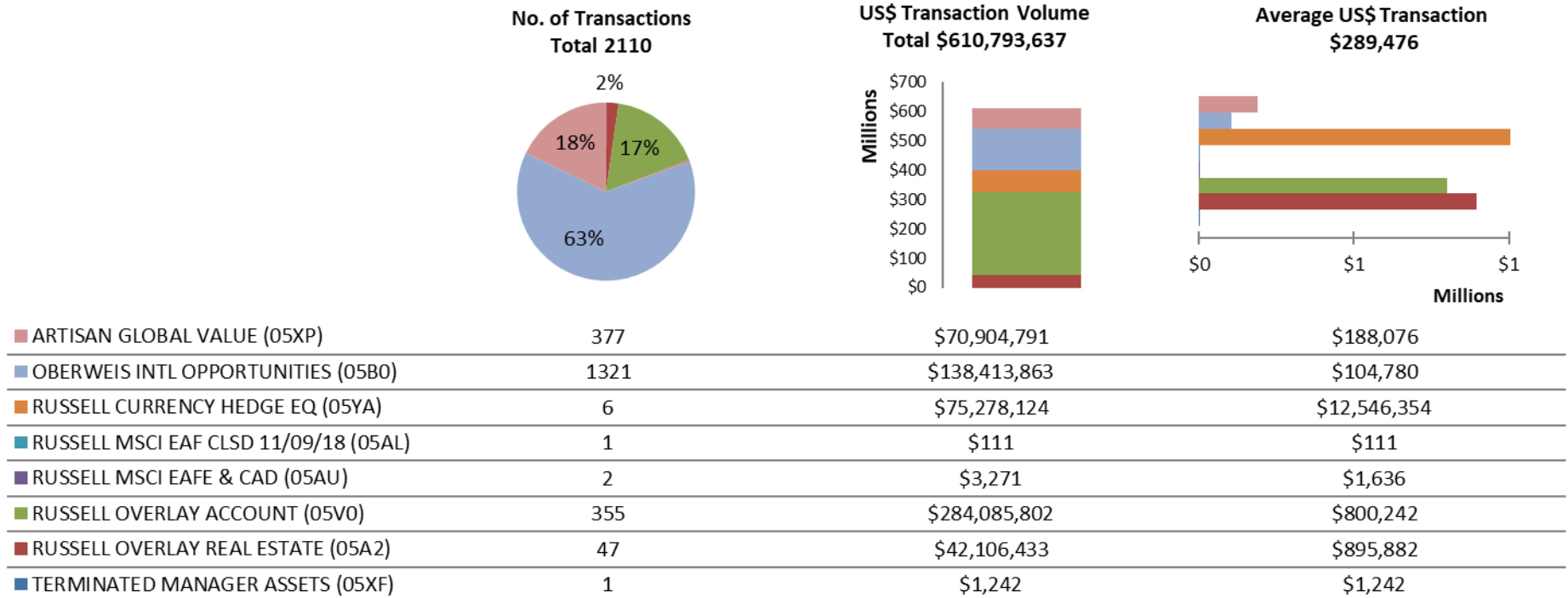
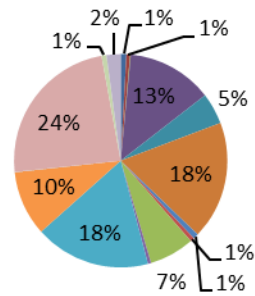


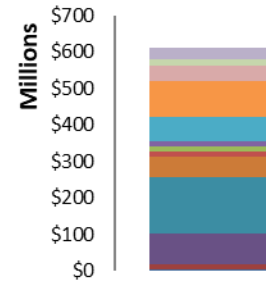
Table 2. Investment manager data summary

FX Counterparties

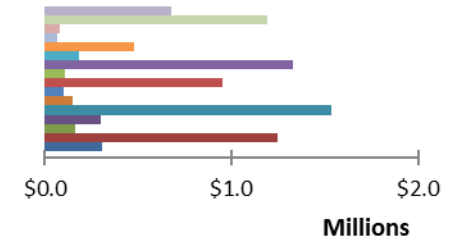
**No. of Transactions
Total 2110**



**US\$ Transaction Volume
Total \$610,793,637**



**Average US\$ Transaction
\$289,476**



BANK OF AMERICA, N.A.	45	\$30,393,013	\$675,400
BANK OF MONTREAL	16	\$19,112,374	\$1,194,523
BANK OF NEW YORK	502	\$40,232,597	\$80,145
BARCLAYS BANK PLC WHOLESALE	1	\$69,175	\$69,175
BROWN BROTHERS HARRIMAN + CO	208	\$99,719,146	\$479,419
CITIBANK N.A.	370	\$66,687,224	\$180,236
COMMONWEALTH BANK OF AUSTRALIA SYDNEY	10	\$13,287,880	\$1,328,788
DEUTSCHE BANK AG	144	\$15,293,927	\$106,208
GOLDMAN SACHS BANK USA	13	\$12,351,433	\$950,110
HSBC BANK USA	17	\$1,670,555	\$98,268
JPMORGAN CHASE BANK	378	\$55,261,065	\$146,193
ROYAL BANK OF CANADA	100	\$153,711,948	\$1,537,119
SSGM	274	\$82,265,092	\$300,238
STANDARD CHARTERED BANK	2	\$320,181	\$160,091
UBS AG	12	\$14,919,298	\$1,243,275
WESTPAC BANKING CORPORATION	18	\$5,498,730	\$305,485

Table 3. FX counterparty data summary

Day Range Analysis

■ In Range ■ Out of Range

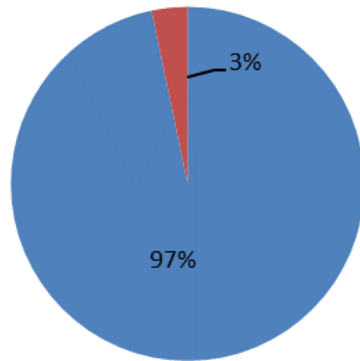


Figure 3. Day range results overall

■ Tier 1 ■ Tier 2 ■ Tier 3

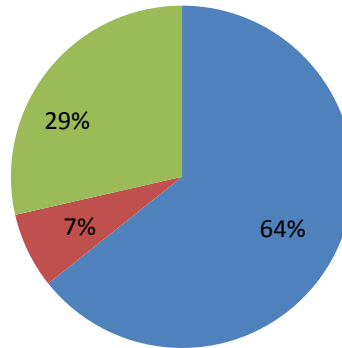


Figure 4. Day range results by currency tier (% worse)

\$ Transaction	Worse Than Range	Total Transactions
0-5,000	29	175
5,001-20,000	26	325
20,001-50,000	5	399
50,001-100,000	-	356
100,001-250,000	1	421
250,001-500,000	1	181
500,001-1,000,000	1	111
1,000,001+	1	142
Total	64	2110

Table 4. Day range results by transaction size

	Total Transactions	Worse than Range	% of Transactions by Manager
OBERWEIS INTL OPPORTUNITIES (05B0)	1321	58	16%
OTHER	789	6	<1%
Grand Total	2110	64	2%

Table 5. Day range results by Manager

50 of Oberweis trades were small trades that went through the SSGM Indirect FX Air Program.

	Total Transactions	Worse than Range	% of Transactions by Counterparty
SSGM	274	55	20%
OTHER	1836	9	<1%
Grand Total	2110	64	2%

Table 6. Day range results by Counterparty

Average Rate Analysis

- Average rate analysis has been completed for all 2110 transactions.

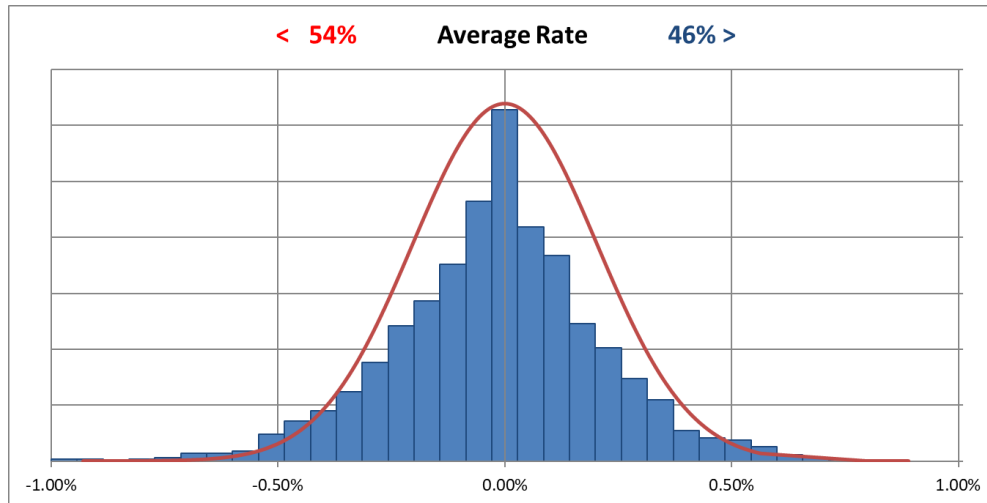


Figure 5. Average rate performance for all transactions

% Spread from Avg ⁴	
Tier 1	-0.01%
Tier 2	-0.03%
Tier 3	-0.02%
	-0.02%

Table 7. Average rate performance by currency tier

\$ Transaction	% Spread from Avg
0-5,000	-0.10%
5,001-25,000	-0.03%
25,001-50,000	0.00%
50,001-100,000	-0.02%
100,001-250,000	-0.02%
250,001-500,000	0.00%
500,001-1,000,000	0.01%
1,000,001+	0.01%
Total	-0.02%

Table 8. Average rate performance by transaction size

	% Spread from Avg	Average US\$ Transaction	Worse than Avg	No. of Transactions
ARTISAN GLOBAL VALUE (05XP)	-0.03%	\$188,076	56%	377
OBERWEIS INTL OPPORTUNITIES (05B0)	-0.02%	\$104,780	54%	1321
RUSSELL CURRENCY HEDGE EQ (05YA)	-0.02%	\$12,546,354	50%	6
RUSSELL MSCI EAF CLSD 11/09/18 (05AL)	0.17%	\$111	0%	1
RUSSELL MSCI EAFE & CAD (05AU)	-0.16%	\$1,636	100%	2
RUSSELL OVERLAY ACCOUNT (05V0)	-0.01%	\$800,242	53%	355
RUSSELL OVERLAY REAL ESTATE (05A2)	-0.01%	\$895,882	51%	47
TERMINATED MANAGER ASSETS (05XF)	-0.10%	\$1,242	0%	1
Grand Total	-0.02%	\$289,476	54%	2110

Table 9. Average rate performance by investment manager

⁴ For guidance purposes outcomes may be described as follows: good outcome is -0.05% to positive | acceptable outcome is -0.15% to -0.05% | poor outcome is below -0.15%

	% Spread from Avg	Average US\$ Transaction	Worse than Avg	No. of Transactions
BANK OF AMERICA, N.A.	0.02%	\$675,400	53%	45
BANK OF MONTREAL	-0.02%	\$1,194,523	50%	16
BANK OF NEW YORK	0.01%	\$80,145	49%	502
BARCLAYS BANK PLC WHOLESALE	-0.03%	\$69,175	100%	1
BROWN BROTHERS HARRIMAN + CO	-0.03%	\$479,419	56%	208
CITIBANK N.A.	-0.02%	\$180,236	51%	370
COMMONWEALTH BANK OF AUSTRALIA SYDNEY	0.00%	\$1,328,788	50%	10
DEUTSCHE BANK AG	0.02%	\$106,208	51%	144
GOLDMAN SACHS BANK USA	0.08%	\$950,110	31%	13
HSBC BANK USA	-0.02%	\$98,268	53%	17
JPMORGAN CHASE BANK	-0.02%	\$146,193	54%	378
ROYAL BANK OF CANADA	-0.01%	\$1,537,119	56%	100
SSGM	-0.10%	\$300,238	68%	274
STANDARD CHARTERED BANK	-0.16%	\$160,091	100%	2
UBS AG	-0.01%	\$1,243,275	50%	12
WESTPAC BANKING CORPORATION	-0.02%	\$305,485	56%	18
Grand Total	-0.02%	\$289,476	54%	2110

Table 10. Average rate performance by FX counterparty

State Street Focus

	ARTISAN GLOBAL VALUE (05XP)	OBERWEIS INTL OPPORTUNITIES (05B0)	RUSSELL MSCI EAF CLSD 11/09/18 (05AL)	RUSSELL MSCI EAFE & CAD (05AU)	RUSSELL OVERLAY ACCOUNT (05V0)	RUSSELL OVERLAY REAL ESTATE (05A2)	TERMINATED MANAGER ASSETS (05XF)	Total Transactions/ %Spread from Day Average
SSGM DIRECTFX	102 0.00%	1 -0.01%		1 -0.21%	61 -0.08%	5 0.08%		170 -0.03%
SSGM INDIRECTFX AIR		97 -0.24%					1 -0.10%	98 -0.24%
SSGM INDIRECTFX SSH			1 0.01%	1 -0.10%				2 -0.06%
SSGM SUBCUSTODIAN	4 -0.20%							4 -0.20%
Total Transactions/ % Spread	106 -0.01%	98 -0.24%	1 0.01%	2 -0.16%	61 -0.08%	5 0.08%	1 -0.10%	274 -0.11%

Table 11. Breakdown of State Street transactions by execution method (Count & Average Spread)

	State Street		All Other FX Counterparties		All
	% Spread from Avg	Count	% Spread from Avg	Count	% Spread from Avg
\$0-5,000	-0.26%	63	-0.02%	112	-0.10%
\$5,001-25,000	-0.18%	48	-0.01%	277	-0.03%
\$25,001 -50,000	-0.11%	22	0.00%	377	0.00%
\$50,001-100,000	-0.02%	30	-0.01%	326	-0.02%
\$100,001-250,000	-0.04%	49	-0.02%	372	-0.02%
\$250,001-500,000	-0.02%	24	0.00%	157	0.00%
\$500,001-1,000,000	0.02%	21	0.01%	90	0.01%
\$1,000,001+	0.08%	17	0.00%	125	0.01%
	-0.11%	274	-0.01%	1836	-0.02%

Table 12. Comparison of State Street vs. All Other across transaction size

	% Spread from Avg	Average Transaction size	No. of Transactions
Tier 1	-0.14%	\$216,062	192
Tier 2	-0.05%	\$298,930	36
Tier 3	-0.02%	\$652,600	46
	-0.11%	\$300,238	274

Table 13. State Street performance by Tier Group

	SJPF (SS)	Peer Group	Performance ⁵
	% Spread from Avg	% Spread from Avg	SJPF/Peer
Grand Total	-0.11%	-0.11%	EQUAL

Table 14. SJPF (State Street) performance compared to Peer Group

⁵ For guidance purposes outcomes may be described as follows: good outcome is -0.05% to positive | acceptable outcome is -0.15% to -0.05% | poor outcome is below -0.15%

Summary Results

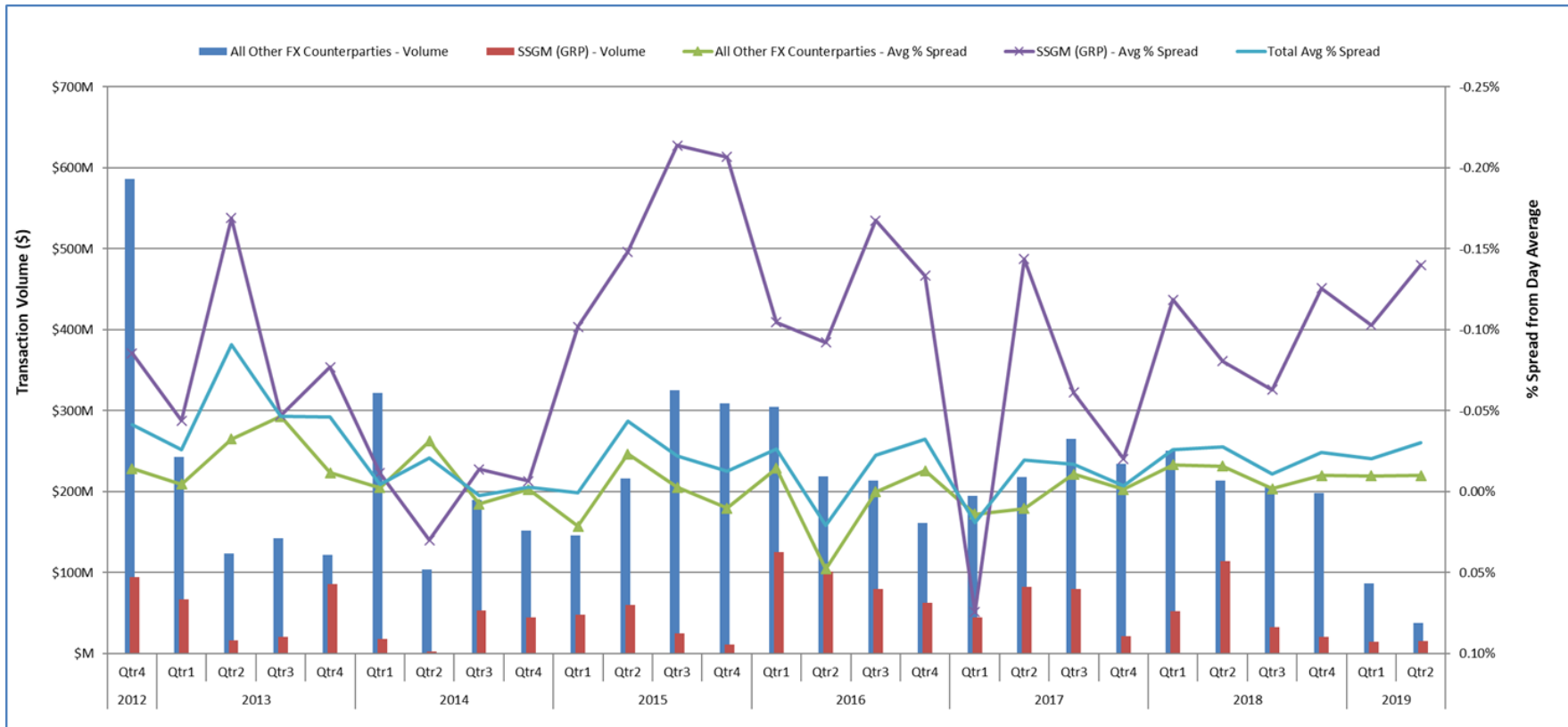


Figure 6. Avg % spread performance compared to transaction volume for SSGM vs. All Other FX counterparties

	2012	2013	2014	2015	2016	2017	2018	2019	Grand Total
All Other FX Counterparties - Volume	\$587M	\$631M	\$767M	\$996M	\$898M	\$911M	\$869M	\$123M	\$5783M
SSGM (GRP) - Volume)	\$94M	\$189M	\$118M	\$144M	\$368M	\$228M	\$220M	\$39M	\$1390M
All Other FX Counterparties - Avg % Spread	-0.01%	-0.03%	-0.01%	0.00%	0.01%	0.00%	-0.01%	-0.01%	0.00%
SSGM (GRP) - Avg % Spread	-0.09%	-0.08%	0.00%	-0.17%	-0.12%	-0.06%	-0.09%	-0.10%	-0.09%
Grand Total	-0.04%	-0.05%	-0.01%	-0.02%	-0.01%	-0.01%	-0.02%	-0.02%	-0.02%

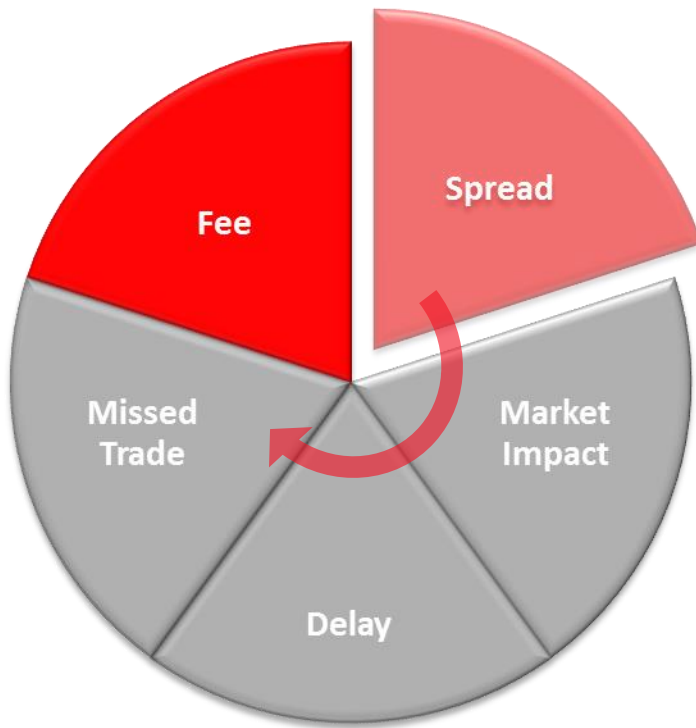
Table 15: Summary of Avg % spread performance compared to transaction volume for SSGM vs All Other FX Counterparties

	2012	2013	2014	2015	2016	2017	2018	2019	Running Total Average % Spread
ARTISAN PARTNERS, LP (05XP)		-0.02%	0.00%	0.01%	0.00%	-0.02%	-0.03%	-0.03%	-0.02%
BRANDES INVESTMENT PARTNERS (05VZ)					0.21%				0.21%
CALAMOS (trmd) / FIXED TRANSITION	0.02%								0.02%
EQUITY TRANSITION ACCOUNT	0.00%	0.04%							0.01%
MACKAY SHIELDS		-0.15%							-0.15%
OBERWEIS INTL OPPORTUNITIES (05B0)				-0.03%	-0.02%	-0.02%	-0.02%	-0.02%	-0.02%
RS INVESTMENT MANAGEMENT, L.P. (05WJ)	-0.10%	-0.09%	-0.06%						-0.09%
RUSSELL CURRENCY HEDGING ACCT (05YA)				0.08%	0.00%	0.06%	-0.01%		0.03%
RUSSELL INVESTMENT MANAGER RUSSELL 3000		-0.26%							-0.26%
RUSSELL INVESTMENT MANAGERS EAFE & CAD (05AU)		-0.31%	0.05%	-0.47%	-0.03%	-0.12%	0.00%	-0.16%	-0.19%
RUSSELL INVESTMENTS MSCI ACWI (trmd 11/2012)	-0.62%	0.15%	0.03%						0.06%
RUSSELL INVESTMENTS MSCI ACWI VALUE (trmd 11/2012)	-0.85%	-0.07%	0.16%						-0.17%
RUSSELL INVESTMENTS OVERLAY ACCOUNT (05V0)	-0.02%	-0.02%	0.01%	-0.02%	-0.01%	0.03%	-0.02%	0.01%	-0.01%
RUSSELL INVST MSCI EAFE + CAD SMALL CAP (05AL)	-0.35%			-0.70%		-0.14%	-0.07%		-0.29%
RUSSELL OVERLAY-GAA	-0.02%	-0.06%							-0.05%
RUSSELL OVERLAY-HEDGE FUNDS (05AZ)	-0.05%	0.01%	0.00%	-0.04%					-0.01%
RUSSELL OVERLAY-REAL ESTATE (05A2)	-0.04%	-0.01%	0.03%	0.00%	0.04%	0.00%	-0.01%	0.23%	0.01%
TERMINATED MANAGER ACCOUNT (05WE)					-0.20%		-0.10%		-0.17%
TRANSITION ACCOUNT (05WE)		-0.05%	0.01%		0.10%				-0.02%
TRISTAN CAPITAL PARTNERS (05BX)				-0.01%	-0.22%	0.17%	-0.13%		-0.01%
WILLIAM BLAIR & COMPANY (05VY)			0.05%	-0.51%	0.40%	-0.20%			0.07%
Grand Total	-0.04%	-0.05%	0.01%	0.00%	-0.01%	-0.01%	-0.02%	-0.01%	-0.02%

Table 16. Investment Manager spread from day average by quarter

Appendix A – FX Costs(Spread vs Fee)

- FX Transaction Cost Analysis investigates the true cost to the client when executing a deal.
- FX component implicit in international transactions adds a layer of opacity; FX TCA is a means of adding transparency.



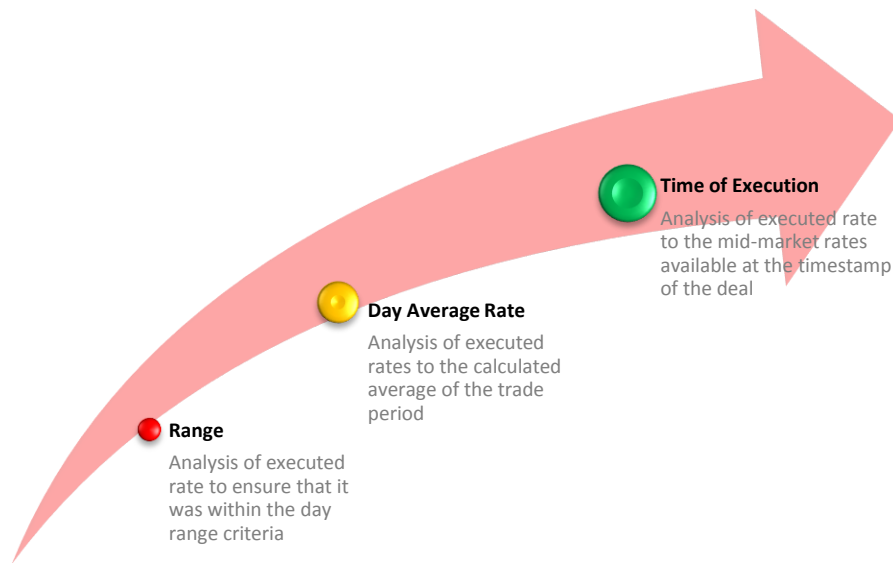
Explicit costs

Should be reasonably transparent, consisting of the agent fee plus the spread on the asset. What if the spreads are not readily available and reported, as is the case in currency markets? Quantifying the spread is an Achilles heel for managers

Implicit costs

Are generally accepted to be more difficult to ascertain and are generally broken into three areas: market impact, delayed execution, and missed trades. Often used to mask excessive spreads.

Appendix B – Analysis Classification



Range:

Quick snapshot to identify major issues with fee models. Results are only indicative of trading performance within the day range. It is not possible to assess or make strong conclusions on the transaction costs for the portfolio, but it is possible to identify strongly inferior practices.

Day Average Rate:

Trading behavior modeling to identify transaction costs, based on average rate performance as the benchmark. Results are dependent upon a significant sample/population size to justify the assumed average rate distribution.

Time of Execution:

Detailed cost modeling to identify transaction costs based on actual vs. traded as the benchmark. Results from this analysis draw strong conclusions on actual transaction costs but the ability to complete this analysis is limited to the availability of timestamp data from the FX counterparties and custodian.

Appendix C - Analysis Methodology



In this illustration the client is selling Euro's and receiving US Dollar's. The higher the EUR/USD FX rate the more US Dollar's received.

Day Range

- If the exchange rate achieved is greater than 1.2640 then the transaction was executed "Better than the Day Range"
- If the exchange rate achieved is lower than 1.2540 then the transaction was executed "Worse than the Day Range"

Day Average Rate

- Calculated as the average of the high and low exchange rates available on the day. In this example this is the average of 1.2640, 1.2540, is 1.2590.
- If the exchange rate achieved is greater than 1.2590 then the transaction was executed "Better/superior than the Day Average Rate"
- If the exchange rate achieved is lower than 1.2590 then the transaction was executed "Worse/inferior than the Day Average Rate"

Appendix D - Tier Groups, currency classification

Tier 1	High Liquidity	Currency	RIC
		US dollar	USD
		Euro	EUR
		Japanese yen	JPY
		Pound sterling	GBP
		Australian dollar	AUD
		Swiss franc	CHF
		Canadian dollar	CAD
Tier 2	Medium Liquidity	Hong Kong dollar	HKD
		Swedish krona	SEK
		New Zealand dollar	NZD
		Korean won	KRW
		Singapore dollar	SGD
		Norwegian krone	NOK
		Mexican peso	MXN
Tier 3	Low Liquidity	Indian rupee	INR
		Russian rouble	RUB
		Chinese renminbi	CNY
		Polish zloty	PLN
		Turkish lira	TRY
		South African rand	ZAR
		Brazilian real	BRL
		Danish krone	DKK
		New Taiwan dollar	TWD
		Hungarian forint	HUF
		Malaysian ringgit	MYR
		Thai baht	THB
		Czech koruna	CZK
		Philippine peso	PHP
		Chilean peso	CLP
		Indonesian rupiah	IDR
		Israeli new shekel	ILS
		Colombian peso	COP
		Romanian leu	RON
		Saudi riyal	SAR
		Argentine peso	ARS
		Peruvian Nuevo sol	PEN
		Lithuanian litas	LTL

Appendix E – State Street Execution Models

METHOD	SSGM FXS	Indirect FX Services	The foreign exchange request is made indirectly to SSGM, by email or fax, initiated by the investment manager.
	SSGM FXC	Direct FX Services: FX Connect	The foreign exchange request is made through the online dealing platform (fxconnect).
	SSGM REP	Indirect FX Services; Income Repatriation	The foreign exchange request is automated, typically tax reclaims, dividends, standing instructions.
	SSGM SUBCUSTODIAN	SSGM preferred counterparties	For currencies not traded by SSGM, the foreign exchange request will be sent to the local sub-custodian for execution.
	SSGM P	Direct FX Services; Phone	The foreign exchange request is made directly to SSGM, by phone, initiated by the investment manager.
	SSGM BTB	Direct FX Services	The foreign exchange request is made directly to the custodian, typically through peer to peer networks, or online dealing systems.
TYPE (Hourly/Daily/Restricted)	SSGM HPS (Direct/Indirect)	Hourly Price Service	FX rates are established every hour on the hour between 9am and 4pm in each region. Rates constrained by session Hi-Lo for trading region.
	SSGM SSH	Security Settlements & Holdings	FX rates are generally established at the end of the trading day in the region, with the exception of same day value activity and restricted currencies. Rates constrained by session Hi-Lo for trading region.
	SSGM AIR	Automated Dividend & Interest Income Repatriation Service	FX Rates are established at the beginning of the HK trading day (or at the beginning of trading session for restricted currencies) for all funds regardless of the location of the custody client or SSGM trading desk. Rates established without reference to the hi/lo trading range.