FX SWAPS & OUTRIGHT FORWARDS VALIDATION

MASTER IN FINANCE

DRI – Risk Management Department, S.A.

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INDEX

INTRODUCTION

Company

Caixa Geral de Depósitos (CGD), S.A. is a State-owned public limited company with registered office in no.63, Avenida João XXI, in Lisbon; the object of the company is to engage in banking activity as widely as permitted by the law. CGD's share capital is divided into 1,180,000,000 shares with the nominal value of five euros each; CGD's shares may only belong to the state.

CGD's mission and strategy are built on five pillars: International Expansion Vectors; Solid Financial Position; Global Guidelines; Innovation; and, an integrated approach to banking. The first and very important, International Expansion Vectors, is based on the fact that CGD stands out in the Portuguese financial market by its geographic diversification which is founded in a prudent policy of internationalization based on defined profitability criteria. CGD group is present in 23 countries, specifically and with an active presence in Brail, Cape Verde, Mozambique, India, East Timor, China and the United States.

Caixa Geral de Depósitos group operates in the following sectors: Commercial Banking, Investment banking and Venture capital, Asset Management, Specialized credit, Insurance, Health Care, Real Estate, and Communication Technologies and Management of cultural spaces and events. Operating in the Commercial and Investment Banking sectors, CGS trades and manages financial instruments, such as equities, bonds, forex instruments (spot transactions), and derivative instruments (options, swaps, forward and future contracts). Derivatives play a

very important role in the economy and also in CGD's investment portfolio, however, this category of financial instruments is associated with risks.

From the EMIR (European Market Infrastructure Regulation – Regulation on OTC Derivatives, Central Counterparties and Trade Repositories), it was created the need, inside CGD group, for a validation of the valuation of the derivative instruments part of CGD's investment portfolio. For that purpose, two main solutions existed: the first, lied on an external consulting firm; the second, in the creation of an internal department that would validate those same financial instruments. CGD chose the one that would retain the knowledge inside the group and, for that, a Validation department was created inside the Risk Management Department group. Internships in that area were made available with the purpose of validating the valuations of CGD's software for valuating derivatives, the Reuters Kondor+.

Derivative Products & Markets

Financial instruments, including derivatives, can either be traded in the OTC (Over-The-Counter) market or in the Stock Exchange market. The Stock Exchange is the primary form of exchange of stocks, bonds and derivative products; the OTC market, is a market in which thousands of brokers register with the SEC as security dealers, dealers quote prices at which they are willing to buy or sell securities, then a broker executes a trade by contacting a dealer listing an attractive quote.

EMIR

The 2008 crisis highlighted that the risks originated from the derivative products traded in the OTC market were not sufficiently mitigated, specifically for the Credit Default Swaps. Since the beginning of the financial crisis that the European Commission is working to address these risks. The need to establish a safer and sounder regulatory framework for European financial markets had been accepted and, on February 09th 2012, an agreement was reached on a Regulation that would bring more stability, transparency and efficiency to derivative markets. The European Parliament and the Council adopted then, on July 4th 2012, the EMIR (European Market Infrastructure Regulation) – Regulation on OTC Derivatives, Central Counterparties and Trade Repositories. The entering into force of EMIR only occurred on August 16th 2012.

"The Regulation ensures that information on all European derivative transactions will be reported to trade repositories and be accessible to supervisory authorities, including the European Securities and Markets Authority (ESMA), to give policy makers and supervisors a clear overview of what is going on in the markets. The regulation also requires standard derivative contracts to be cleared through Central Counterparties (CCPs) as well as margins for uncleared trades and establishes stringent organizational, business conduct and prudential requirements for these CCPs."[1]

[1] http://ec.europa.eu/finance/financial-markets/derivatives/index_en.htm#

METHODOLOGY, DATABASE & PROCESS

The applied methodology was proposed by CGD and it consisted in the creation of Excel models, capable of replicating the valuation of FX Swaps and Outright Forwards from Kondor+, at the date of July 09th 2014. Reuters Kondor+ 2.6 manuals were used as basis to the replication, together with theory. The valuation of FX Swaps and Outright Forwards is performed through the NPV (Net Present Value) methodology. For such method to be implemented, forward discount rates were estimated, in order to discount the future cash flows and/or inflows of each instrument. At the date of July 9th 2014, all these forward discount rates needed to be estimated via the swap-curves of the day.

The data used to the entire process was extracted from Kondor+ database and it consisted in excel tables, with all the information used in the valuation of such products by the software. All this for the date of July 9th 2014. Therefore, tables with respect to the FX Swaps and Outright Forwards components used in the calculations were extracted via query to the Kondor+; a table with the NPV values of each FX Swap and Outright Forward, for July 9th 2014, was also extracted; together with all the swap-curves at July 9th 2014, namely: AUD-SWAP; CAD-SWAP; CHF-SWAP; EUR-SWAP; GBP-SWAP; HKD-SWAP; JPY-SWAP; MOP-SWAP; NOK-SWAP; SEK-SWAP; USD-SWAP; and ZAR-SWAP.

Forward Discount Factors, at July 09th 2014

The forward discount rates were estimated through these swap curves, at the date of July 9th 2014. In order to calculate the rates that were not present at the curves, the linear

interpolation method was used and the missing rates obtained. Also, the discount factor methodology calculation applied is the Compound Interest: $DF = \frac{1}{1+\frac{Zero\ Coupon\ Rate^{Yf}}{100}}$

Investment Portfolio Composition

At the date of July 9th 2014, the investment portfolio of CGD, for FX Swaps and Outright Forwards, was composed as follows:

	Investment		Trading		*Total*
	Non-Round	**Round**	**Non-Round**	**Round**	
FX Swap	10	126	1	15	
Total	136		16		152

Table 1. Amount of FX swaps in CGD's investment portfolio at July 9th 2014.

	Investment	**Trading**	***Total***
Outright Forward	152	34	186

Table 2. Amount of Outright Forwards in CGD's investment portfolio at July 9th 2014.

FX SWAPS

Image 1: Example of FX Swap, exchanging Euro for US dollar.[2]

An FX swap can be of three types: Round; Non-round; and Forward-Forward Round. A **Round FX Swap Deal** is an agreement to exchange an amount of one currency for another at a given rate on the spot date (the near transaction) and to re-exchange the same amount on a later date (far transaction) at another agreed-upon rate. A **Non-Round FX Swap Deal** is an agreement to exchange an amount of one currency for another at a given rate (the near transaction) and then to re-exchange an amount that is not the same as the first amount on a later date (the far transaction). A **Forward-Forward Round FX Swap Deal** is similar to the Round FX Swap deal, with the difference in the value dates that take place on a defined date in the future, for both the near and far transactions.

FX swap deals are inserted in Kondor+ with one of two purposes: Investment or Trading. A round FX Swap deal introduced in Kondor+ with the purpose of Investment, generates always two IAMs – Interest at Maturity – (one Deposit and the other Loan) and one spot transaction. An IAM is either a loan or a deposit, given for a certain period of time, involving only two exchanges of principal: one at the settlement date and the other at the maturity date. A round

[2] http://www.bis.org/img/qtrly/qt0803y.gif

FX swap deal inserted in Kondor+ with the purpose of Trading, generates two spot transactions, when the option Hedge is selected as 'yes'; with the option Hedge selected as 'no', the round FX swap deal does not generate any deal other than itself. A non-round FX swap deal introduced in Kondor+ with the purpose of Investment, generates the same instruments as a round FX swap deal with the same purpose, this is: two IAMs and one spot transaction. A non-round FX swap deal inserted with the purpose of Trading generates: one round FX swap deal and three spot transactions.

Based on these different valuation methodologies, five excel models were created to value each category of FX swap, which would also retrieve the amounts of each generated instrument, as well as the respective NPVs, given its existence. The first to value Round Investment FX Swap Deals; the second to value Non-Round Investment FX Swap Deals; the third to value Round Trading FX Swap Deals, with Hedge option selected as 'yes'; the forth to value Round Trading FX Swap Deals, with Hedge option selected as 'no'; and, the fifth to value Non-Round Trading FX Swap Deals.

The models were based on Kondor+ 2.5 Calculations Guide, provided by Reuters.

Round Investment FX Swaps

The cash flows of captured round investment FX swap are calculated as follows, assuming that the quotation mode of Currency 1/Currency 2 (Cur1/Cur2) is direct:

Date	Cur1	Cur2
Spot	$-Amount_{Cur1}$	$Amount_{Cur1} \times \frac{Spot\ Rate}{Quotation\ Unit}$
Maturity	$Amount_{Cur1}$	$-Amount_{Cur1} \times \frac{Forward\ Rate}{Quotation\ Unit}$

The cash flows of the generated deals will be equivalent to the cash flows of the original deal and are calculated as follows:

Generated Deal	Date	Cur1	Cur2
Spot in Spot Adj1 folder	Spot	$\frac{-Amount_{Cur1} \times \frac{n}{Basis_{Cur1}} \times \frac{Interest\ Rate_{Cur1}}{100}}{1 + \frac{n}{Basis_{Cur1}} \times \frac{Interest\ Rate_{Cur1}}{100}}$	$\frac{Amount_{Cur1} \times \frac{n}{Basis_{Cur1}} \times \frac{Interest\ Rate_{Cur1}}{100} \times \frac{Spot\ Rate}{Quotation\ Unit}}{1 + \frac{n}{Basis_{Cur1}} \times \frac{Interest\ Rate_{Cur1}1}{100}}$
Loan in Spot Adj2 folder	Spot	$\frac{-Amount_{Cur1}}{1 + \frac{n}{Basis_{Cur1}} \times \frac{Interest\ Rate_{Cur1}}{100}}$	
	Maturity	$Amount_{Cur1}$	
Deposit in Spot Adj3 folder	Spot		$\frac{Amount_{Cur1} \times \frac{Spot\ Rate}{Quot.\ Unit}}{1 + \frac{n}{Basis_{Cur1}} \times \frac{Int.\ Rate_{Cur1}}{100}} = \frac{Amount_{Cur1} \times \frac{Fwd\ Rate}{Quot.\ Unit}}{1 + \frac{n}{Basis_{Cur2}} \times \frac{Int.\ Rate_{Cur2}}{100}}$
	Maturity		$\frac{-Amount_{Cur1} \times Forward\ Rate}{Quotation\ Unit}$

Non-Round Investment FX Swaps

The only difference in the calculation of the cash flows of the captured deal lies in the relationship between Amount2 Cur1 (amount of currency 2 traded at the maturity date) and Interest Rate Cur1, which occurs as follows:

$$Amount2\ Cur1 = Amount1\ Cur1 \times (1 + (Interest\ Rate\ Cur1 \times Year\ Fraction))$$

Round Trading FX Swaps

The cash flows of a round trading FX Swap, with Cur1/Cur2 as the swap pair and a direct quotation mode, are calculated as follows:

Date	Cur1	Cur2
Spot	$-Amount_{Cur1}$	$Amount_{Cur1} \times \frac{Spot\ Rate}{Quotation\ Unit}$
Maturity	$Amount_{Cur1}$	$-Amount_{Cur1} \times \frac{Forward\ Rate_{Far\ Margin}}{Quotation\ Unit}$

- **Hedge = Yes**

Given the option Hedge to be selected as 'yes', two spot transactions are created with the respective amounts being calculated as follows:

AMOUNTS FOR SPOTS

SPOT 1 (NEAR TRANSACTION AMOUNTS)

$$Amount1\ Cur1 = -Amount_{Cur1} \times Spot\ Rate$$

$$Amount1\ Cur2 = Amount1_{Cur2} + \frac{Amount2\ Cur2}{(1+Interest\ Rate\ Cur2 \times \frac{n}{Basis\ Cur2})}$$

SPOT 2 (FAR TRANSACTION AMOUNTS)

$$Amount\ 2\ Cur1 = -Amount1\ Cur1$$

$$Amount2\ Cur2 = -Amount1\ Cur2$$

Non-Round Trading FX Swaps

Assuming that Cur1/Cur2 is a swap pair with direct quotation mode, the cash flows of the captured deal are calculated as follows:

Captured Deal	Amount Cur1	Amount Cur2
Spot date	$-Amount1_{Cur1}$	$Amount1_{Cur1} \times \frac{Spot\ Rate}{Quotation\ Unit}$
Maturity date	$Amount2_{Cur1}$	$-Amount2_{Cur1} \times \frac{Forward\ Rate_{Far\ Margin}}{Quotation\ Unit}$

The cash flows of the generated spot deal, can be calculated through the formulas below:

Spot1 Folder	Amount Cur1	Amount Cur2
SpotAdj1	$-(Amount1_{Cur1} - Amount2_{Cur1})$	$(Amount1_{Cur1} - Amount2_{Cur1}) \times \frac{Spot\ Rate}{Quotation\ Unit}$

The cash flows of the generated round FX swap deal, follow the below formulas:

Deal Folder	FX Swap Cur1/Cur2 Folder	Date	Amount Cur1	Amount Cur2
Folder of captured deal	FX swap Cur1/Cur2 of captured deal	25/10/1994	$-Amount2_{Cur1}$	$Amount2_{Cur1} \times \frac{Spot\ Rate}{Quotation\ Unit}$
		10/11/1994	$Amount2_{Cur1}$	$-Amount2_{Cur1} \times \frac{Forward\ Rate_{Far\ Margin}}{Quotation\ Unit}$

From the generated round FX swap, two spot deals are generated, which cash flows can be achieved through the application of the formulas below:

AMOUNTS FOR SPOTS

SPOT 1 (NEAR TRANSACTION AMOUNTS)

$$Amount1\ Cur1 = -Amount_{Cur1} \times Spot\ Rate$$

$$Amount1\ Cur2 = Amount1_{Cur2} + \frac{Amount2\ Cur2}{(1+Interest\ Rate\ Cur2 \times \frac{n}{Basis\ Cur2})}$$

SPOT 2 (FAR TRANSACTION AMOUNTS)

$$Amount\ 2\ Cur1 = -Amount1\ Cur1$$

$$Amount2\ Cur2 = -Amount1\ Cur2$$

OUTRIGHT FORWARDS

Image 2: Example of an Outright Forward, exchanging Euros for US Dollars.[3]

Outright Forwards are deals that are a purchase or sale of a foreign currency on either a specific date or at any time between two dates and at an agreed rate of exchange. Outright Forwards can serve one of two purposes: Investment or Trading.

An Outright Forward introduced in Kondor+ with the purpose of Investment generates, at the date of its insertion, two IAM (Interest at Maturity) deals, one Deposit and the other Loan, and one Spot deal. An Outright Forward introduced in Kondor+ with the purpose of Trading generates three spot deals and one round FX swap, considering that the option Hedge is selected as a 'yes'; if the option Hedge is selected as 'no' then only one spot deal and one round FX swap are generated.

Based on the different valuation methodologies, four excel models were created. The first to valuate Investment Outright Forwards; the second to value Trading Outright Forwards with Hedge option selected as 'yes'; the third to value Trading Outright Forwards with the

[3] Adaptation of image from the following hyperlink: http://www.bis.org/img/qtrly/qt0803y.gif

Hedge option selected as 'no'; and, the forth to value Investment Outright Forwards which Value Date was bigger than the valuation date, July 9th 2014 (Value Date = July 10th 2014).

The models were based on Kondor+ 2.5 Calculations Guide, provided by Reuters.

Investment Outright Forwards

There exist two ways to calculate Forward Exchange Rates for Outright Forwards. Outright Forwards use two Forward Rates in the calculation of its amounts as follows:

FORWARD RATE - Client

$$\text{Forward Rate} = \text{Spot Rate} + \frac{Client\ Points}{10^{Points\ Digit}}$$

FORWARD RATE - Local

$$\text{Forward Rate} = \text{Spot Rate} + \frac{Local\ Points}{10^{Points\ Digit}}$$

For Investment Outright Forwards, the amounts for the captured deal and for the generated ones were calculated as follows:

CASH FLOWS - INVESTMENT OUTRIGHT FORWARDS

OUTRIGHT FORWARD

$$Amount1\ Cur1 = 0$$

$$Amount1\ Cur2 = 0$$

$$Amount2\ Cur1 = Amount_{Cur1}$$

$$Amount2\ Cur2 = \frac{-Amount_{Cur1} \times Forward\ Rate\ Client}{Quotation\ Unit}$$

SPOT:

$$Amount\ Cur1 = \frac{Amount_{Cur1}}{1+\frac{n}{Basis_{Cur1}} \times \frac{Interest\ Rate_{Cur1}}{100}}$$

$$Amount\ Cur2 = \frac{Amount_{Cur1} \times Spot\ Rate}{Quotation\ Unit \times (1+\frac{n}{Basis_{Cur1}} \times \frac{Interest\ Rate_{Cur1}}{100})}$$

GENERATED DEPOSIT:

$$Amount1\ Cur1 = \frac{Amount_{Cur1}}{1+\frac{n}{Basis_{Cur1}} \times \frac{Interest\ Rate_{Cur1}}{100}}$$

$$Amount2\ Cur1 = -Amount\ Cur1$$

GENERATED LOAN:

$$Amount1\ Cur2 = \frac{Amount_{Cur1} \times Spot\ Rate}{Quot.Unit \times (1+\frac{n}{Basis_{Cur2}} \times \frac{Interest\ Rate_{Cur1}}{100})} = \frac{Amount_{Cur1} \times Fwd\ Rate}{Quot.Unit \times (1+\frac{n}{Basis_{Cur2}} \times \frac{Interest\ Rate_{Cur2}}{100})}$$

$$Amount2\ Cur2 = -Amount_{Cur1} \times \frac{Forward\ Rate\ Local}{Quotation\ Unit}$$

Trading Outright Forwards

In the case of Trading Outright Forwards, only the Forward Rate – Client is used. The cash flows of the captured deal and generated ones are calculated as follows:

Generated Deals	Date	Cur1	Cur2
Outright forward	Spot	0	0
	Maturity	$Amount_{Cur1}$	$\frac{-Amount_{Cur1} \times Forward\ Rate}{Quotation\ Unit}$
Spot	Spot	$Amount_{Cur1}$	$-\frac{Amount_{Cur1} \times Spot\ Rate}{Quotation\ Unit}$
FX swap	Spot	$-Amount_{Cur1}$	$\frac{Amount_{Cur1} \times Spot\ Rate}{Quotation\ Unit}$
	Maturity	$Amount_{Cur1}$	$-\frac{Amount_{Cur1} \times Forward\ Rate}{Quotation\ Unit}$

- **Hedge = Yes**

  If the Trading Outright Forward is hedged, then two more spot transactions are generated. The amounts for one of the spot transactions is calculated as bellow, the amounts for the other spot, are simply the inverse of the ones calculated bellow.

Generated Deal	Date	Cur1	Cur2
Spot in Spot Adj1 folder	Spot	$\frac{-Amount_{Cur1} \times \frac{n}{Basis_{Cur1}} \times \frac{Interest\ Rate_{Cur1}}{100}}{1 + \frac{n}{Basis_{Cur1}} \times \frac{Interest\ Rate_{Cur1}}{100}}$	$\frac{Amount_{Cur1} \times \frac{n}{Basis_{Cur1}} \times \frac{Interest\ Rate_{Cur1}}{100} \times \frac{Spot\ Rate}{Quotation\ Unit}}{1 + \frac{n}{Basis_{Cur1}} \times \frac{Interest\ Rate_{Cur11}}{100}}$

COMMON TO BOTH

FX swap deals and Outright Forwards have a Trade Date, a Capture Date, a Value Date and a Maturity Date. The Trade Date is the date in which the deal was traded; the capture date is the date in which the deal was inserted in Kondor+, which most of the times is the same as the respective trade date; the Value Date, usually one to three days after the capture date, is

the date in which the deal effectively starts; and the Maturity Date, is the date at which the deal ends.

Given that the valuation date was stated as July 9th 2014, only spot transactions happening on this day possess a NPV different from zero. IAMs only have an NPV if their capture date (date in which they were inserted in Kondor+) is posterior to July 9th 2014.

RESULTS

Applying the formulas presented in the previous section, together with the estimated discount factors, the result was that all the FX Swaps and Outright Forwards were valued with a maximum difference of 0.01%, as required by CGD.

Example of Round Investment FX Swap

	Amount 1 KONDOR+	*Amount 1 MODEL*	*Amount 2 KONDOR+*	*Amount 2 MODEL*	*NPV KONDOR+*	*NPV MODEL*
Currency 1 (CAD)	870.000,00	870.000,00	-870.000,00	-870.000,00	-869.950,70	-869.950,70
Currency 2 (EUR)	-598.678,78	-598.678,78	598.563,45	598.563,45	598.563,11	598.563,12

Table 3. Round FX Swap amounts and NPVs, as calculated by Kondor+ and by the Excel Model.

IAM amounts are presented below:

	Principal KONDOR+	*Principal MODEL*	*Principal + Int KONDOR+*	*Principal + Int MODEL*	*NPV KONDOR+*	*NPV MODEL*
IAM Depo (CAD)	869.578,78	869.578,78	870.000,00	870.000,00	-869.950,70	-869.950,70
IAM Loan (EUR)	598.388,92	598.388,92	598.563,45	598.563,45	598.563,11	598.557,30

Table 4. Generated IAMs amounts and respective NPVs, as calculated by Kondor+ and by the Excel Model.

Spot amounts are presented below:

	Amount KONDOR+	*Amount MODEL*
Currency 1 (CAD)	421,22	421,22
Currency 2 (EUR)	-289,86	-289,86

Table 5. Generated Spot amounts, as calculated by Kondor+ and by the Excel Model.

Example of Round Trading FX Swap: Hedge = Yes

	Amount 1 KONDOR+	*Amount 1 MODEL*	*Amount 2 KONDOR+*	*Amount 2 MODEL*	*NPV KONDOR+*	*NPV MODEL*
HKD	567.000.000,00	567.000.000,00	567.000.000,00	-567.000.000,00	-566.136.650,45	-566.136.650,45
USD	-73.118.834,23	-73.118.834,23	73.177.342,13	73.177.342,13	73.114.052,81	73.114.052,81

Table 6. Non-Round FX Swap amounts and NPVs, as calculated by Kondor+ and by the Excel Model

	Amount Spot1 KONDOR+	*Amount Spot1 MODEL*	*Amount Spot2 KONDOR+*	*Amount Spot2 MODEL*
Currency 1 (HKD)	1.125.355,76	1.125.342,15	-1.125.355,76	-1.125.342,15
Currency 2 (USD)	-145.122,93	-145.121,17	145.122,93	145.121,17

Table 7. Generated Spots' amounts, as calculated by Kondor+ and by the Excel Model.

Example of Round Trading FX Swap: Hedge = No

	Amount 1 KONDOR+	*Amount 1 MODEL*	*Amount 2 KONDOR+*	*Amount 2 MODEL*	*NPV KONDOR+*	*NPV MODEL*
USD	-21.800.000,00	-21.800.000,00	21.800.000,00	21.800.000,00	21.796.555,06	21.796.555,07
EUR	17.748.268,97	17.748.268,97	-17.555.485,60	-17.555.485,60	-17.554.843,92	-17.554.843,93

Table 8. Non-Round FX Swap amounts and NPVs, as calculated by Kondor+ and by the Excel Model.

Example of Non-Round Trading FX Swap

	Amount 1 KONDOR+	*Amount 1 MODEL*	*Amount 2 KONDOR+*	*Amount 2 MODEL*	*NPV KONDOR+*	*NPV MODEL*
USD	-5.000.000,00	-5.000.000,00	5.081.111,11	5.081.111,11	5.078.460,25	5.078.460,26
EUR	3.707.089,51	3.707.089,51	-3.763.593,65	-3.763.593,65	-3.762.796,87	-3.762.796,88

Table 9. Non-Round FX Swap amounts and NPVs, as calculated by Kondor+ and by the Excel Model

	Amount 1 KONDOR+	*Amount 1 MODEL*	*Amount 2 KONDOR+*	*Amount 2 MODEL*
USD	-5.081.111,11	-5.081.111,11	5.081.111,11	5.081.111,11
EUR	3.767.226,74	3.767.226,74	-3.763.593,65	-3.763.593,65

Table 10. Generated Round FX Swap amounts, as calculated by Kondor+ and by the Excel Model

	Amount Spot1 KONDOR+	*Amount Spot1 MODEL*	*Amount Spot2 KONDOR+*	*Amount Spot2 MODEL*
USD	-23.872,01	-23.871,97	23.872,01	23.871,97
EUR	17.699,14	17.699,11	-17.699,14	-17.699,11

Table 11. Generated Spots' amounts, as calculated by Kondor+ and by the Excel Model; respective to the generated Round FX Swap.

	Amount Spot1 KONDOR+	*Amount Spot1 MODEL*
USD	81.111,11	81.111,11
EUR	-60.137,23	-60.137,23

Table 12. Generated Spot amounts, as calculated by Kondor+ and by the Excel Model; respective to the Non-Round FX Swap.

Example of Investment Outright Forward: Value Date < 2014/July/09

	Amount 1 KONDOR+	*Amount 1 MODEL*	*Amount 2 KONDOR+*	*Amount 2 MODEL*	*NPV KONDOR+*	*NPV MODEL*
USD	-	-	-73.456,66	-73.456,66	-73.451,86	-73.451,86
EUR	-	-	53.794,70	53.794,70	53.794,34	53.794,34

Table 13. Outright Forward amounts and NPVs, as calculated by Kondor+ and by the Excel Model.

	Principal KONDOR+	*Principal MODEL*	*Principal + Int KONDOR+*	*Principal + Int MODEL*	*NPV KONDOR+*	*NPV MODEL*
IAM Depo (USD)	73.206,13	73.206,13	73.456,66	73.456,66	-73.451,86	-73.451,86
IAM Loan (EUR)	53.513,25	53.513,25	53.708,17	53.708,17	53.707,81	53.707,81

Table 14. Generated IAMs amounts and respective NPVs, as calculated by Kondor+ and by the Excel Model.

	Amount KONDOR+	*Amount MODEL*
USD	-73.206,13	-73.206,13
EUR	53.513,25	53.513,25

Table 15. Generated Spot amounts, as calculated by Kondor+ and by the Excel Model.

Example of Investment Outright Forward: Value Date = 2014/July/10

	Amount 1 KONDOR+	*Amount 1 MODEL*	*Amount 2 KONDOR+*	*Amount 2 MODEL*	*NPV KONDOR+*	*NPV MODEL*
USD	-	-	-250.000,00	-250.000,00	-249.790,41	-249.790,42
EUR	-	-	183.823,53	183.823,53	183.728,63	183.728,63

Table 16. Outright Forward amounts and NPVs, as calculated by Kondor+ and by the Excel Model.

	Principal KONDOR+	*Principal MODEL*	*Principal + Int KONDOR+*	*Principal + Int MODEL*	*NPV KONDOR+*	*NPV MODEL*
IAM Depo (USD)	249.658,80	249.658,80	250.000,00	250.000,00	-132,93	-132,87
IAM Loan (EUR)	183.478,21	183.478,21	183.661,48	183.661,48	88,50	88,50

Table 17. Generated IAMs amounts and respective NPVs, as calculated by Kondor+ and by the Excel Model.

	Amount KONDOR+	*Amount MODEL*
USD	-249.658,80	-249.658,80
EUR	183.478,21	183.478,21

Table 18. Generated Spot amounts, as calculated by Kondor+ and by the Excel Model.

Example of Trading Outright Forward: Hedge = Yes

	Amount 1 KONDOR+	*Amount 1 MODEL*	*Amount 2 KONDOR+*	*Amount 2 MODEL*	*NPV KONDOR+*	*NPV MODEL*
USD	-	-	300.000,00	300.000,00	299.832,81	299.832,81
EUR	-	-	-215.903,91	-215.903,91	-215.852,44	-215.852,45

Table 19. Outright Forward amounts and NPVs, as calculated by Kondor+ and by the Excel Model.

	Amount 1 KONDOR+	*Amount 1 MODEL*	*Amount 2 KONDOR+*	*Amount 2 MODEL*
USD	-300.000,00	-300.000,00	300.000,00	300.000,00
EUR	215.886,36	215.886,36	-215.903,91	-215.903,91

Table 20. Generated Round FX Swap amounts, as calculated by Kondor+ and by the Excel Model

	Amount Spot1 KONDOR+	*Amount Spot1 MODEL*	*Amount Spot2 KONDOR+*	*Amount Spot2 MODEL*
USD	-572,70	-572,70	572,70	572,70
EUR	412,13	412,13	-412,13	-412,13

Table 21. Generated Spots' amounts, as calculated by Kondor+ and by the Excel Model.

	Amount Spot1 KONDOR+	*Amount Spot1 MODEL*
USD	300.000,00	300.000,00
EUR	-215.886,36	-215.886,36

Table 22. Generated Spot amounts, as calculated by Kondor+ and by the Excel Model.

Example of Trading Outright Forward: Hedge = No

	Amount 1 KONDOR+	*Amount 1 MODEL*	*Amount 2 KONDOR+*	*Amount 2 MODEL*	*NPV KONDOR+*	*NPV MODEL*
USD	-	-	106.000,00	106.000,00	105.940,92	105.940,93
EUR	-	-	-79.759,22	-79.759,22	-79.740,20	-79.740,21

Table 23. Outright Forward amounts and NPVs, as calculated by Kondor+ and by the Excel Model.

	Amount 1 KONDOR+	*Amount 1 MODEL*	*Amount 2 KONDOR+*	*Amount 2 MODEL*
USD	-106.000,00	-106.000,00	106.000,00	106.000,00
EUR	79.627,40	79.627,40	-79.759,22	-79.759,22

Table 24. Generated Round FX Swap amounts, as calculated by Kondor+ and by the Excel Model

	Amount Spot1 KONDOR+	*Amount Spot1 MODEL*
USD	106.000,00	106.000,00
EUR	-79.627,40	-79.627,40

Table 25. Generated Spot amounts, as calculated by Kondor+ and by the Excel Model.

CONCLUSIONS

The purpose of the internship in the Validation Department of CGD was to create an internal and controlled tool that would replicate the calculations performed by the software Kondor+. The idea was never to create an alternative form to value FX Swaps and Outright Forwards, but rather to validate and replicate the software results in the context of EMIR implementation.

The goal proposed by CGD was a difference of, at most, 0.01% between the valuations performed by the new Excel model and the ones provided by Kondor+. The goal was achieved and all the FX Swaps and Outright Forwards' instruments, with an existent Net Present Value at the date of July 09th 2014, were valued with a difference equal or lower than the 0.01% proposed by the financial institution.

The Validation department was created with the goal of retaining the knowledge created from the process inside de organization and, this same goal, was achieved. A final report was written detailing all the process of replication and the way the Excel model, as well as Kondor+, performs the calculations. The knowledge is, therefore, retained inside the institution.

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- http://www.fca.org.uk/firms/markets/international-markets/emir

GLOSSARY

Currencies

- AUD: Australian Dollar
- CAD: Canadian Dollar
- CHF: Swiss Franc
- EUR: Euro
- GBP: Pound Sterling
- HKD: Hong Kong Dollar
- JPY: Japanese Yen
- MOP: Macanese Pataca
- NOK: Norwegian Krone
- SEK: Swedish Krona
- USD: American Dollar
- ZAR: South African Rand

APPENDIX 1. Kondor+ prints of a Round Investment FX Swap

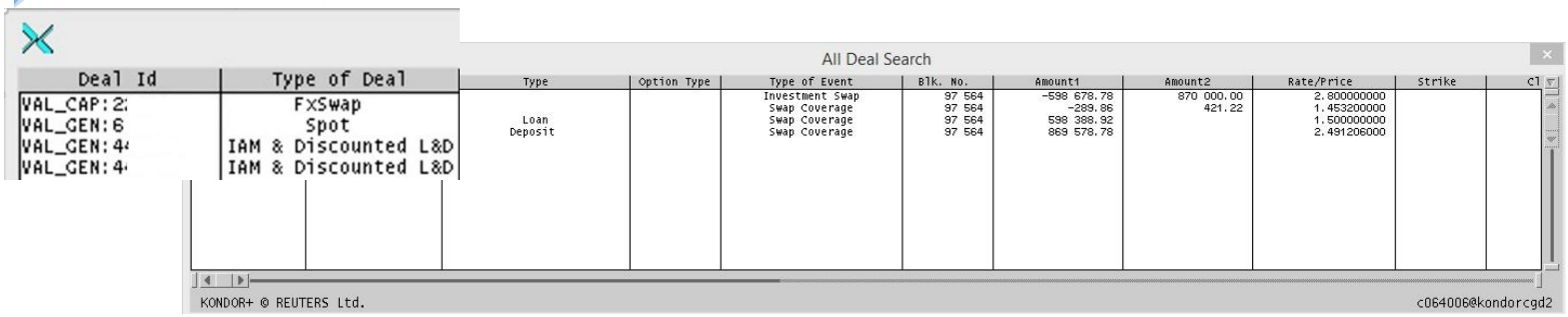

Figure 1. Block composition

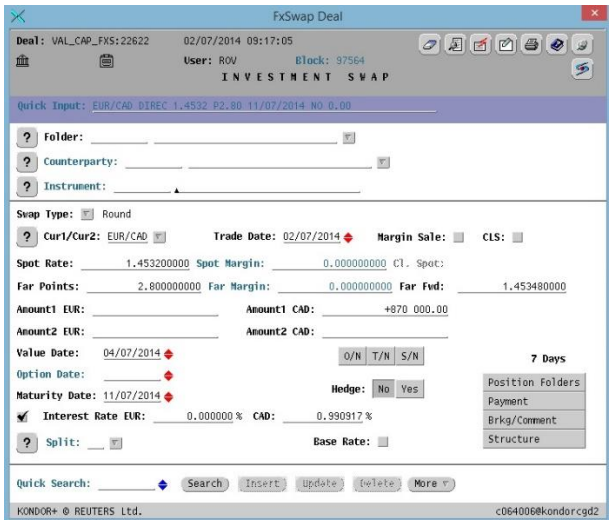

Figure 2. Round Investment FX Swap in Kondor+ (Hedge = No)

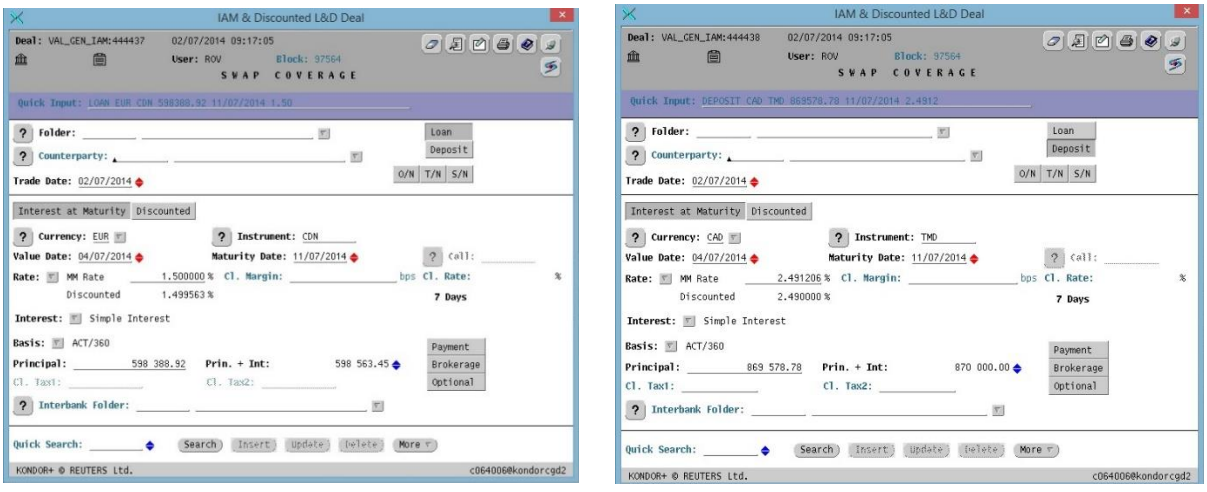

Figure 3. IAMs – Generated by the Round FX Investment Swap

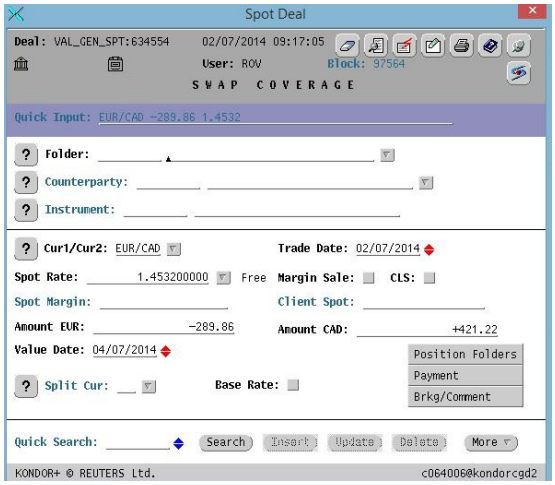

Figure 4. Spot – Generated by the Round FX Investment Swap

APPENDIX 1.1. Excel Model prints of a Round Investment FX Swap

BLOCK NUMBER	97564
Valuation Date	2014-07-09

FX SWAP	
Deal Number	22622
Currency Pair	EUR/CAD
Points Digit	4
Quotation Mode	D
Quotation Unit	1
Quotation Order	Y
Curr1	CAD
Curr2	EUR
Trade Date	2014-07-02
Capture Date	2014-07-02
Value Date	2014-07-04
Maturity Date	2014-07-11
Amount1 Curr1	870.000,00 CAD
Amount2 Curr1	- 870.000,00 CAD
Amount1 Curr2	- 598.678,78 EUR
Amount2 Curr2	598.563,45 EUR
Interest Rate Curr1	2,491206 CAD
Interest Rate Curr2	1,5 EUR

	Quotation Order=N	Quotation Order=Y
Spot Rate	1,4532	0,688136526
Spot Margin	0	
Client Spot	1,4532	0,688136526
Far Margin	0	
Far Points	2,8	
Client Far Forward	1,45348	0,688003963

Amount1 Cur1	870.000,00	CAD	-
Amount2 Cur1	- 870.000,00	CAD	-
Amount1 Cur2	- 598.678,78	EUR	- 0,002
Amount2 Cur2	598.563,45	EUR	0,002

Discount Factor (Curr1)	0,999943336	CAD
Discount Factor (Curr2)	0,999999444	EUR
NPV (Curr1)	- 869.950,70	CAD
NPV (Curr2)	598.563,12	EUR
NPV Kondor (Curr1)	- 869.950,70	CAD
NPV Kondor (Curr2)	598.563,11	EUR
Variação (Curr1)	0,0000000024084	CAD
Variação (Curr2)	0,0000000086713	EUR

Figure 5. Print of Round FX Swap Excel Model – Amounts and NPVs of Round FX Swap

IAM - LOAN			
Deal Number		444438	
Curr1		CAD	
Basis		2	M
Trade Date		2014-07-02	
Value Date		2014-07-04	
Maturity Date		2014-07-11	
Days		7	
Principal	-	869.578,78	
Rate		2,491206	
Principal + Interest	-	870.000,00	
Discount Factor		0,999943336	
NPV	**-**	**869.950,70**	
NPV Kondor (Curr1)	**-**	**869.950,70**	
Variação		**0,00000024084%**	

Principal	**869.578,78**	**CAD**	**1.739.157,555**
Rate	**2,49**	**CAD**	
Principal + Interest	**870.000,00**	**CAD**	**1.740.000,000**

IAM - DEPO			
Deal Number		444437	
Curr2		EUR	
Basis		2	M
Trade Date		2014-07-02	
Value Date		2014-07-04	
Maturity Date		2014-07-11	
Days		7	
Principal	-	598.388,92	
Rate		1,5	
Principal+Interest	-	598.563,45	
Discount Factor		0,999989722	
NPV		**598.557,30**	
NPV Kondor (Curr2)		**598.563,11**	
Variação		**0,00097135717%**	

Principal	**598.388,92**	**EUR**	**1.196.777,838**
Rate	**1,50**	**EUR**	
Principal + Interest	**598.563,45**	**EUR**	**1.197.126,898**

Figure 6. Print of Round FX Swap Excel Model – Amounts and NPVs of Generated IAMs.

SPOT			
Deal Number		634554	
Currency Pair		EUR/CAD	
Curr1		CAD	
Curr2		EUR	
Trade Date		2014-07-02	
Capture Date		2014-07-02	
Value Date		2014-07-04	
Basis Curr1		2	CAD
Basis Curr2		2	EUR
Amount Curr1		421,22	CAD
Amount Curr2	-	289,86	EUR

	Quotation Order=N	Quotation Order=Y
SPOT RATE	1,4532	0,688136526

NPV	**0**
NPV Kondor	**#N/A**

Amount Cur1	**421,22**	**CAD**	**- 0,005**
Amount Cur2	**- 289,86**	**EUR**	**0,000**

Figure 7. Print of Round FX Swap Excel Model – Amounts and NPVs of Generated Spot.

APPENDIX 5. Kondor+ prints of an Investment Outright Forward

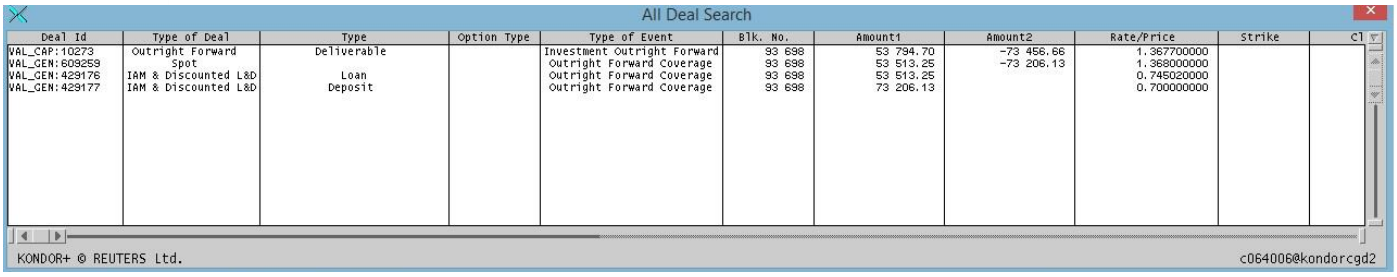

Figure 8. Block Composition

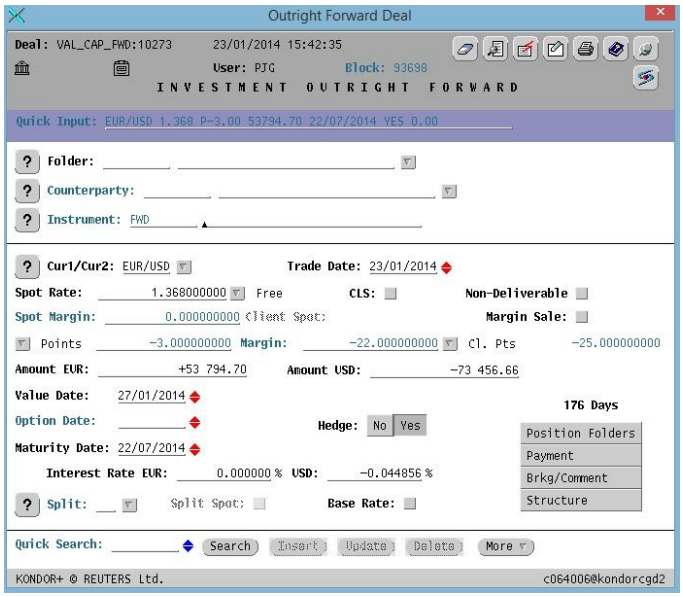

Figure 9. Investment Outright Forward in Kondor+

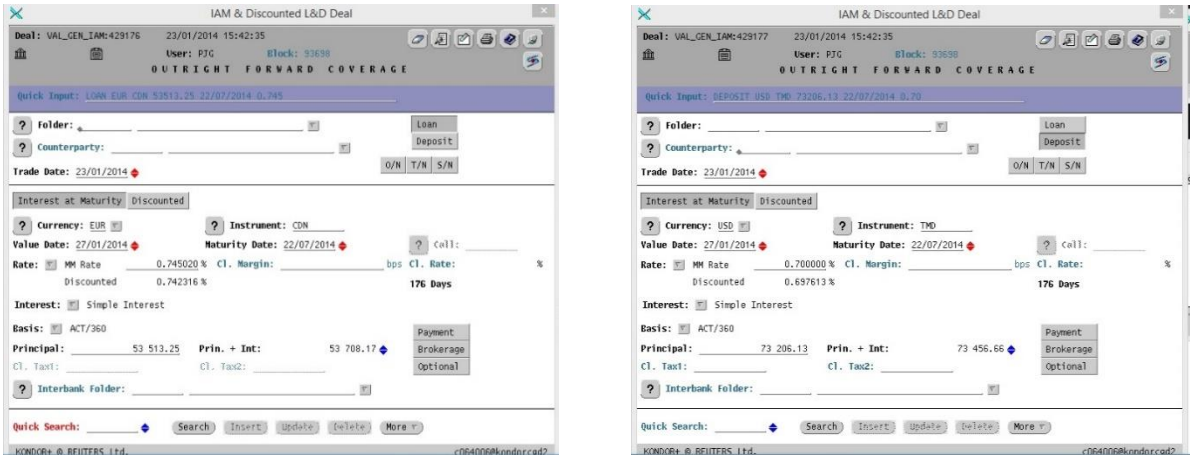

Figure 10. IAMs – Generated by the Investment Outright Forward.

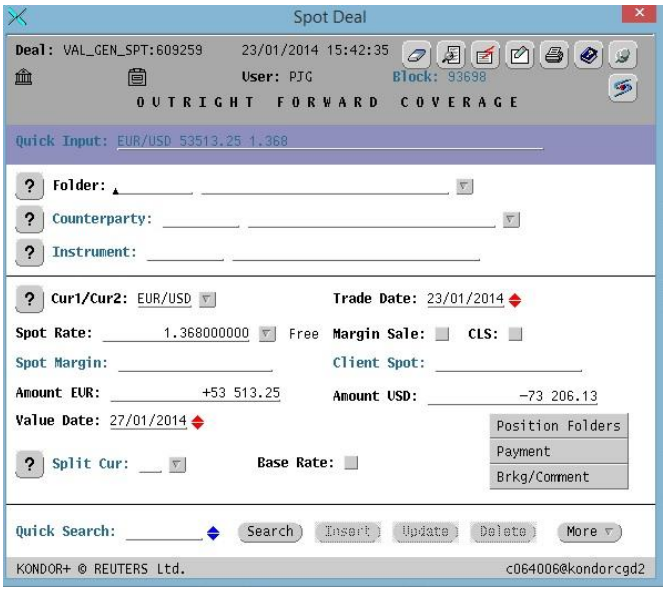

Figure 11. Spot Deal generated by the Investment Outright Forward.

APPENDIX 5.1. Excel Model prints of an Investment Outright Forward

BLOCK NUMBER	93698
Valuation Date	2014-07-09

FX FORWARD	
Deal Number	10273
Currency Pair	EUR/USD
Points Digit	4
Quotation Mode	D
Quotation Unit	1
Quotation Order	Y
Curr1	USD
Curr2	EUR
Interest Hedging	Y
Trade Date	2014-01-23
Capture Date	2014-01-23
Value Date	2014-01-27
Maturity Date	2014-07-22

Amount1 Curr1		-	USD
Amount2 Curr1	-	73.456,66	USD
Amount1 Curr2		-	EUR
Amount2 Curr2		53.794,70	EUR
Interest Rate Curr1		0,7	USD
Interest Rate Curr2		0,74502	EUR

	Quotation Order=N	Quotation Order=Y
Spot Rate	1,368	0,730994152
Spot Margin	0	
Local Points	-3	
Client Points	-25	
Forward Rate (Local)	1,368	0,731154493
Forward Rate (Client)	1,366	0,732332479

Amount1 Curr1		-	-
Amount2 Curr1	-	73.456,66	-
Amount1 Curr2		-	-
Amount2 Curr2		53.794,70	0,0021

Discount Factor (Curr1)		0,9999347	USD
Discount Factor (Curr2)		0,9999934	EUR
NPV (Curr1)	-	73.451,86	USD
NPV (Curr2)		53.794,34	EUR
NPV Kondor (Curr1)	-	73.451,86	USD
NPV Kondor (Curr2)		53.794,34	EUR
Variação (Curr1)		0,00000004741	USD
Variação (Curr2)		0,00000003298	EUR

Figure 34. Amounts and NPVs of Outright Forward.

IAM - DEPO		
Deal Number	429177	
Curr1	USD	
Basis	2	M
Trade Date	2014-01-23	
Value Date	2014-01-27	
Maturity Date	2014-07-22	
Days	176	
Principal	73.206,13	
Rate	0,7	
Principal+Interest	73.456,66	
Discount Factor	0,9999347	
NPV	**73.451,86**	
NPV Kondor (Curr1) -	**73.451,86**	
Variação	**0,00000474078%**	

IAM - LOAN		
Deal Number	429176	
Curr2	EUR	
Basis	2	M
Trade Date	2014-01-23	
Value Date	2014-01-27	
Maturity Date	2014-07-22	
Days	176	
Principal	53.513,25	
Rate	0,74502	
Principal+Interest	53.708,17	
Discount Factor	0,9999934	
NPV	**53.707,81**	
NPV Kondor (Curr2)	**53.707,81**	
Variação	**0,00000266235%**	

Principal	**53.513,25**	**- 0,0046**
Principal + Interest	**53.708,17**	**0,00**

Principal	**73.206,13**	**- 0,0023**
Principal + Interest	**73.456,66**	**-**

Figure 35. Amounts and NPVs of generated IAMs.

SPOT		
Deal Number	609259	
Currency Pair	EUR/USD	
Curr1	USD	
Curr2	EUR	
Trade Date	2014-01-23	
Capture Date	2014-01-23	
Value Date	2014-01-27	
Basis Curr1	2	USD
Basis Curr2	2	EUR
Amount Curr1 -	73.206,13	USD
Amount Curr2	53.513,25	EUR

	Quotation Order=N	Quotation Order=Y
SPOT RATE	1,368	0,730994152

NPV	**0**
NPV Kondor	**#N/A**

Amount Curr1	**- 73.206,13**	**- 0,0023**
Amount Curr2	**53.513,25**	**- 0,00**

Figure 36. Amounts and NPVs of generated Spot deal.