FX SWAPS & OUTRIGHT FORWARDS VALIDATION

MASTER IN FINANCE

DRI – Risk Management Department, S.A.

A Project carried out under the supervision of:
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CGD Coordinator – João Braga

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Student number: 792
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 Brazil, 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.
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 09\textsuperscript{th} 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 4\textsuperscript{th} 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 16\textsuperscript{th} 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.”\textsuperscript{1}

\textsuperscript{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: \( DF = \frac{1}{1 + \frac{\text{Zero Coupon Rate}}{100}^{YF}} \)

**Investment Portfolio Composition**

At the date of July 9\(^{th}\) 2014, the investment portfolio of CGD, for FX Swaps and Outright Forwards, was composed as follows:

<table>
<thead>
<tr>
<th></th>
<th>Non-Round</th>
<th>Round</th>
<th>Non-Round</th>
<th>Round</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FX Swap</strong></td>
<td>10</td>
<td>126</td>
<td>1</td>
<td>15</td>
<td>152</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>136</td>
<td>16</td>
<td></td>
<td></td>
<td>152</td>
</tr>
</tbody>
</table>

*Table 1. Amount of FX swaps in CGD’s investment portfolio at July 9\(^{th}\) 2014.*

<table>
<thead>
<tr>
<th></th>
<th>Investment</th>
<th>Trading</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Outright Forward</strong></td>
<td>152</td>
<td>34</td>
<td>186</td>
</tr>
</tbody>
</table>

*Table 2. Amount of Outright Forwards in CGD’s investment portfolio at July 9\(^{th}\) 2014.*
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

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

2. [http://www.bis.org/img/qtrly/qt0803y.gif](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:
The cash flows of the generated deals will be equivalent to the cash flows of the original deal and are calculated as follows:

### Non-Round Investment FX Swaps

The only difference in the calculation of the cash flows of the captured deal lies in the relationship between $\text{Amount}_2\text{ Cur}_1$ (amount of currency 2 traded at the maturity date) and Interest Rate $\text{Cur}_1$, which occurs as follows:

\[
\text{Amount}_2\text{ Cur}_1 = \text{Amount}_1\text{ Cur}_1 \times (1 \times (\text{Interest Rate }\text{Cur}_1 \times \text{Year Fraction}))
\]

### 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:
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)**

\[
\text{Amount1 Cur1} = -\text{Amount_{Cur1}} \times \text{Spot Rate}
\]

\[
\text{Amount1 Cur2} = \text{Amount_{Cur1}} + \frac{\text{Amount_{Cur2}}}{(1+\text{Interest Rate Cur2} \times \text{m Basis Cur2})}
\]

**SPOT 2 (FAR TRANSACTION AMOUNTS)**

\[
\text{Amount 2 Cur1} = -\text{Amount1 Cur1}
\]

\[
\text{Amount2 Cur2} = -\text{Amount1 Cur2}
\]

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

<table>
<thead>
<tr>
<th>Captured Deal</th>
<th>Amount Cur1</th>
<th>Amount Cur2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spot date</td>
<td>(-\text{Amount}_1\text{Cur1})</td>
<td>(\text{Amount}_1\text{Cur1} \times \frac{\text{Spot Rate}}{\text{Quotation Unit}})</td>
</tr>
<tr>
<td>Maturity date</td>
<td>(\text{Amount}_2\text{Cur1})</td>
<td>(-\text{Amount}<em>2\text{Cur1} \times \frac{\text{Forward Rate}</em>{\text{Far Margin}}}{\text{Quotation Unit}})</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Deal Folder</th>
<th>Amount Cur1</th>
<th>Amount Cur2</th>
</tr>
</thead>
<tbody>
<tr>
<td>SpotAdj1</td>
<td>(-\text{(Amount}_1\text{Cur1} - \text{Amount}_2\text{Cur1}))</td>
<td>(\text{(Amount}_1\text{Cur1} - \text{Amount}_2\text{Cur1}) \times \frac{\text{Spot Rate}}{\text{Quotation Unit}})</td>
</tr>
</tbody>
</table>

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)**

\[
\text{Amount}_1\text{Cur1} = -\text{Amount}_1\text{Cur1} \times \text{Spot Rate}
\]

\[
\text{Amount}_1\text{Cur2} = \text{Amount}_1\text{Cur1} + \frac{\text{Amount}_2\text{Cur2}}{\left(1 + \text{Interest Rate}_{\text{Cur2}} \times \frac{n}{\text{Basis Cur2}}\right)}
\]

**SPOT 2 (FAR TRANSACTION AMOUNTS)**

\[
\text{Amount}_2\text{Cur1} = -\text{Amount}_1\text{Cur1}
\]

\[
\text{Amount}_2\text{Cur2} = -\text{Amount}_1\text{Cur2}
\]
OUTRIGHT FORWARDS

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

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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 9\textsuperscript{th} 2014 (Value Date = July 10\textsuperscript{th} 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:

\[
\text{Forward Rate} = \text{Spot Rate} + \frac{\text{Client Points}}{100\text{Points Digit}}
\]

\[
\text{FORWARD RATE - Client}
\]

\[
\text{Forward Rate} = \text{Spot Rate} + \frac{\text{Local Points}}{100\text{Points Digit}}
\]

\[
\text{FORWARD RATE - Local}
\]

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

\[
\text{Amount1 Cur1} = 0
\]

\[
\text{Amount1 Cur2} = 0
\]

\[
\text{Amount2 Cur1} = \text{Amount Cur1}
\]

\[
\text{Amount2 Cur2} = -\frac{\text{Amount Cur1} \times \text{Forward Rate Client}}{\text{Quotation Unit}}
\]

SPOT:

\[
\text{Amount Cur1} = \frac{\text{Amount Cur1}}{1 + \frac{n}{\text{Basis Cur1}} \times \frac{\text{Interest Rate Cur1}}{100}}
\]

\[
\text{Amount Cur2} = \frac{\text{Amount Cur1} \times \text{Spot Rate}}{\text{Quotation Unit} \times (1 + \frac{n}{\text{Basis Cur1}} \times \frac{\text{Interest Rate Cur1}}{100})}
\]

GENERATED DEPOSIT:

\[
\text{Amount1 Cur1} = \frac{\text{Amount Cur1}}{1 + \frac{n}{\text{Basis Cur1}} \times \frac{\text{Interest Rate Cur1}}{100}}
\]

\[
\text{Amount2 Cur1} = -\text{Amount Cur1}
\]

GENERATED LOAN:

\[
\text{Amount1 Cur2} = \frac{\text{Amount Cur1} \times \text{Spot Rate}}{\text{Quotation Unit} \times (1 + \frac{n}{\text{Basis Cur1}} \times \frac{\text{Interest Rate Cur1}}{100})} = \frac{\text{Amount Cur1} \times \text{Fwd Rate}}{\text{Quotation Unit} \times (1 + \frac{n}{\text{Basis Cur2}} \times \frac{\text{Interest Rate Cur2}}{100})}
\]

\[
\text{Amount2 Cur2} = -\text{Amount Cur1} \times \frac{\text{Forward Rate Local}}{\text{Quotation Unit}}
\]

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:
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.

<table>
<thead>
<tr>
<th>Generated Deals</th>
<th>Date</th>
<th>Cur1</th>
<th>Cur2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outright forward</td>
<td>Spot</td>
<td>0</td>
<td>Amount_{Cur1} - \frac{Amount_{Cur1} \times Forward Rate}{Quotation Unit}</td>
</tr>
<tr>
<td></td>
<td>Maturity</td>
<td>Amount_{Cur1}</td>
<td>Amount_{Cur1} \times Spot Rate \times Quotation Unit</td>
</tr>
<tr>
<td>Spot</td>
<td>Spot</td>
<td>Amount_{Cur1}</td>
<td>Amount_{Cur1} \times Spot Rate \times Quotation Unit</td>
</tr>
<tr>
<td>FX swap</td>
<td>Spot</td>
<td>-Amount_{Cur1}</td>
<td>Amount_{Cur1} \times Spot Rate \times Quotation Unit</td>
</tr>
<tr>
<td></td>
<td>Maturity</td>
<td>Amount_{Cur1}</td>
<td>Amount_{Cur1} \times Forward Rate \times Quotation Unit</td>
</tr>
</tbody>
</table>

**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 9\textsuperscript{th} 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 9\textsuperscript{th} 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

<table>
<thead>
<tr>
<th></th>
<th>Amount 1 KONDOR+</th>
<th>Amount 1 MODEL</th>
<th>Amount 2 KONDOR+</th>
<th>Amount 2 MODEL</th>
<th>NPV KONDOR+</th>
<th>NPV MODEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Currency 1 (CAD)</td>
<td>870.000,00</td>
<td>870.000,00</td>
<td>-870.000,00</td>
<td>-870.000,00</td>
<td>-869.950,70</td>
<td>-869.950,70</td>
</tr>
<tr>
<td>Currency 2 (EUR)</td>
<td>-598.678,78</td>
<td>-598.678,78</td>
<td>598.563,45</td>
<td>598.563,45</td>
<td>598.563,11</td>
<td>598.563,12</td>
</tr>
</tbody>
</table>

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

IAM amounts are presented below:

<table>
<thead>
<tr>
<th></th>
<th>Principal KONDOR+</th>
<th>Principal MODEL</th>
<th>Principal + Int KONDOR+</th>
<th>Principal + Int MODEL</th>
<th>NPV KONDOR+</th>
<th>NPV MODEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>IAM Depo (CAD)</td>
<td>869.578,78</td>
<td>869.578,78</td>
<td>870.000,00</td>
<td>870.000,00</td>
<td>-869.950,70</td>
<td>-869.950,70</td>
</tr>
<tr>
<td>IAM Loan (EUR)</td>
<td>598.388,92</td>
<td>598.388,92</td>
<td>598.563,45</td>
<td>598.563,45</td>
<td>598.563,11</td>
<td>598.557,30</td>
</tr>
</tbody>
</table>

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

Spot amounts are presented below:

<table>
<thead>
<tr>
<th></th>
<th>Amount KONDOR+</th>
<th>Amount MODEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Currency 1 (CAD)</td>
<td>421.22</td>
<td>421.22</td>
</tr>
<tr>
<td>Currency 2 (EUR)</td>
<td>-289.86</td>
<td>-289.86</td>
</tr>
</tbody>
</table>
Table 5. Generated Spot amounts, as calculated by Kondor+ and by the Excel Model.

**Example of Round Trading FX Swap: Hedge = Yes**

<table>
<thead>
<tr>
<th>Currency</th>
<th>Amount 1 KONDOR+</th>
<th>Amount 1 MODEL</th>
<th>Amount 2 KONDOR+</th>
<th>Amount 2 MODEL</th>
<th>NPV KONDOR+</th>
<th>NPV MODEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>HKD</td>
<td>567.000.000,00</td>
<td>567.000.000,00</td>
<td>567.000.000,00</td>
<td>-567.000.000,00</td>
<td>-566.136.650,45</td>
<td>-566.136.650,45</td>
</tr>
<tr>
<td>USD</td>
<td>-73.118.834,23</td>
<td>-73.118.834,23</td>
<td>73.177.342,13</td>
<td>73.177.342,13</td>
<td>73.114.052,81</td>
<td>73.114.052,81</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Currency</th>
<th>Amount Spot1 KONDOR+</th>
<th>Amount Spot1 MODEL</th>
<th>Amount Spot2 KONDOR+</th>
<th>Amount Spot2 MODEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Currency 1 (HKD)</td>
<td>1.125.355,76</td>
<td>1.125.342,15</td>
<td>-1.125.355,76</td>
<td>-1.125.342,15</td>
</tr>
<tr>
<td>Currency 2 (USD)</td>
<td>-145.122,93</td>
<td>-145.121,17</td>
<td>145.122,93</td>
<td>145.121,17</td>
</tr>
</tbody>
</table>

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

**Example of Round Trading FX Swap: Hedge = No**

<table>
<thead>
<tr>
<th>Currency</th>
<th>Amount 1 KONDOR+</th>
<th>Amount 1 MODEL</th>
<th>Amount 2 KONDOR+</th>
<th>Amount 2 MODEL</th>
<th>NPV KONDOR+</th>
<th>NPV MODEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>USD</td>
<td>-21.800.000,00</td>
<td>-21.800.000,00</td>
<td>21.800.000,00</td>
<td>21.800.000,00</td>
<td>21.796.555,06</td>
<td>21.796.555,07</td>
</tr>
<tr>
<td>EUR</td>
<td>17.748.268,97</td>
<td>17.748.268,97</td>
<td>-17.555.485,60</td>
<td>-17.555.485,60</td>
<td>-17.554.843,92</td>
<td>-17.554.843,93</td>
</tr>
</tbody>
</table>

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**

<table>
<thead>
<tr>
<th>Currency</th>
<th>Amount 1 KONDOR+</th>
<th>Amount 1 MODEL</th>
<th>Amount 2 KONDOR+</th>
<th>Amount 2 MODEL</th>
<th>NPV KONDOR+</th>
<th>NPV MODEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>USD</td>
<td>-5.000.000,00</td>
<td>-5.000.000,00</td>
<td>5.081.111,11</td>
<td>5.081.111,11</td>
<td>5.078.460,25</td>
<td>5.078.460,26</td>
</tr>
</tbody>
</table>
Table 9. Non-Round FX Swap amounts and NPVs, as calculated by Kondor+ and by the Excel Model

<table>
<thead>
<tr>
<th></th>
<th>Amount 1 KONDOR+</th>
<th>Amount 1 MODEL</th>
<th>Amount 2 KONDOR+</th>
<th>Amount 2 MODEL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>USD</strong></td>
<td>-5.081.111,11</td>
<td>-5.081.111,11</td>
<td>5.081.111,11</td>
<td>5.081.111,11</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th></th>
<th>Amount Spot1 KONDOR+</th>
<th>Amount Spot1 MODEL</th>
<th>Amount Spot2 KONDOR+</th>
<th>Amount Spot2 MODEL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>USD</strong></td>
<td>-23.872,01</td>
<td>-23.871,97</td>
<td>23.872,01</td>
<td>23.871,97</td>
</tr>
<tr>
<td><strong>EUR</strong></td>
<td>17.699,14</td>
<td>17.699,11</td>
<td>-17.699,14</td>
<td>-17.699,11</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th></th>
<th>Amount Spot1 KONDOR+</th>
<th>Amount Spot1 MODEL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>USD</strong></td>
<td>81.111,11</td>
<td>81.111,11</td>
</tr>
<tr>
<td><strong>EUR</strong></td>
<td>-60.137,23</td>
<td>-60.137,23</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th></th>
<th>Amount 1 KONDOR+</th>
<th>Amount 1 MODEL</th>
<th>Amount 2 KONDOR+</th>
<th>Amount 2 MODEL</th>
<th>NPV KONDOR+</th>
<th>NPV MODEL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>USD</strong></td>
<td>-</td>
<td>-</td>
<td>-73.456,66</td>
<td>-73.451,86</td>
<td>-73.451,86</td>
<td>-73.451,34</td>
</tr>
<tr>
<td><strong>EUR</strong></td>
<td>-</td>
<td>-</td>
<td>53.794,70</td>
<td>53.794,34</td>
<td>53.794,34</td>
<td>53.794,34</td>
</tr>
</tbody>
</table>

Table 13. Outright Forward amounts and NPVs, as calculated by Kondor+ and by the Excel Model.
Table 14. Generated IAMs amounts and respective NPVs, as calculated by Kondor+ and by the Excel Model.

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

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

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

Table 17. Generated IAMs amounts and respective NPVs, as calculated by Kondor+ and by the Excel Model.
Table 18. Generated Spot amounts, as calculated by Kondor+ and by the Excel Model.

Example of Trading Outright Forward: Hedge = Yes

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

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

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

Table 22. Generated Spot amounts, as calculated by Kondor+ and by the Excel Model.
Example of Trading Outright Forward: Hedge = No

<table>
<thead>
<tr>
<th></th>
<th>Amount 1 KONDOR+</th>
<th>Amount 1 MODEL</th>
<th>Amount 2 KONDOR+</th>
<th>Amount 2 MODEL</th>
<th>NPV KONDOR+</th>
<th>NPV MODEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>USD</td>
<td>-</td>
<td>-</td>
<td>106.000,00</td>
<td>106.000,00</td>
<td>105.940,92</td>
<td>105.940,93</td>
</tr>
<tr>
<td>EUR</td>
<td>-</td>
<td>-</td>
<td>-79.759,22</td>
<td>-79.759,22</td>
<td>-79.740,20</td>
<td>-79.740,21</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th></th>
<th>Amount 1 KONDOR+</th>
<th>Amount 1 MODEL</th>
<th>Amount 2 KONDOR+</th>
<th>Amount 2 MODEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>USD</td>
<td>-106.000,00</td>
<td>-106.000,00</td>
<td>106.000,00</td>
<td>106.000,00</td>
</tr>
<tr>
<td>EUR</td>
<td>79.627,40</td>
<td>79.627,40</td>
<td>-79.759,22</td>
<td>-79.759,22</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th></th>
<th>Amount Spot1 KONDOR+</th>
<th>Amount Spot1 MODEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>USD</td>
<td>106.000,00</td>
<td>106.000,00</td>
</tr>
<tr>
<td>EUR</td>
<td>-79.627,40</td>
<td>-79.627,40</td>
</tr>
</tbody>
</table>

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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- *Reuters*, Kondor+ 2.6 Curves, Document Number 260007.4, 4 February 2009

- http://www.bis.org/publ/qtrpdf/r_qt0803z.htm


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

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

Figure 5. Print of Round FX Swap Excel Model – Amounts and NPVs of Round FX Swap
Figure 6. Print of Round FX Swap Excel Model – Amounts and NPVs of Generated IAMs.

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

Figure 34. Amounts and NPVs of Outright Forward.
Figure 35. Amounts and NPVs of generated IAMs.

Figure 36. Amounts and NPVs of generated Spot deal.