Interest-rate Risk Management and the usage of Interest-rate Swap Derivatives in State Owned Enterprises:
A Portuguese Case Study

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Biographic Note

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Abstract: The main object of this study is the usage of derivatives to manage risk within the scope of State Owned Enterprises. This research intends to analyse good practices in terms of interest-rate risk management for state companies, particularly in terms of swap contracts, and taking into account some regulatory framework regarding UK regulation and OECD guidelines. With such analysis, it is intended to point a set of Good Practices to apply, particularly in the Portuguese case, concerning both a firm level and a more general level (Governmental, Regulative level). It is also presented a case study with an elucidative example of how things can go very wrong when using derivatives for hedging purposes that end up assuming huge speculative contours.

Resumo: O principal objectivo deste estudo centra-se na utilização de derivados na gestão de risco, no âmbito de empresas detidas pelo Estado. Esta pesquisa pretende fazer uma análise de boas práticas em termos de gestão de risco de taxa de juro nestas empresas, particularmente no que concerne ao uso de contratos swap, tendo em conta algum enquadramento regulatório encontrado no Reino Unido e algumas orientações da OCDE. Com esta análise, é pretendido identificar um conjunto de Boas Práticas a aplicar, particularmente no caso Português, quer ao nível das empresas, quer a um nível mais geral (Governamental, ou Regulatório). É também apresentado um caso de estudo, com um exemplo elucidativo de como as coisas podem correr bastante mal quando se usam derivados para cobertura de risco que acabam por assumir grandes contornos especulativos.

JEL Codes: G23; G28; G32; G38; K22; M48

Keywords: Interest-rate Swaps; Speculation; State Owned Enterprises; Financial Regulation; Hedging.

Palavras-Chave: Swaps de taxa de juro; Especulação; Empresas Estatais; Regulação Financeira; Hedging; Cobertura de risco.
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1. Introduction

“Derivatives are Financial weapons of mass destruction.”

- Warren Buffett, 2003 Berkshire Hathaway Annual Report

Being a strong statement, and somehow inflated, it can also be true in some occasions when these derivatives instruments are not used properly. They play a very important economic role in the financial market but their misuse can be disastrous as too many examples in the past have shown. Such could have been the case of a number of Portuguese State Owned Enterprises (SOE) throughout what became publicly known as the “Swaps case”. In this case, several companies owned by the Portuguese State contracted structured interest-rate swap contracts with a number of bank institutions, and ended up having huge losses, leading to an intervention by the State, which motivated the discussion about risk management within SOEs approached in this study.

Derivatives are useful tools to hedge the financial risks faced by any company, particularly in what concerns to interest rate risk, which is the most relevant one in the current case of analysis. There is a wide variety of swap derivatives available for trading, with various degrees of complexity, raising the question of whether all of them are equally adequate for hedging purposes. Additionally, in the context of SOEs and because of the impact in the public finances what should be the best practices in terms of risk management and of supervision by the competent authorities in order to prevent inadequate decisions to be taken at the SOE level.

The present study intends to bring additional insights to the few literature on the topic of risk management applied in SOEs, , by putting together the scarce regulative framework in the Portuguese case making it obvious the road that needs to be trailed, by reviewing the Organisation for Economic Co-operation and Development (OECD) and Her Majesty’s
Treasury\(^1\) (HM Treasury) guidelines on the matter and by suggesting an improved approach to the Best Practices applicable to these companies and to the role of the authorities in these matters. This study also analyses the case of a specific hedging strategy implemented by Metro do Porto, a Portuguese SOE, as the perfect example of a wrong hedging strategy even in the light of the available information at the time the decision was taken.

One of the limitations of this paper, is the scarce information about the specific contracts that were traded in the “Swaps Case”, as it remains confidential information, not provided by the companies nor by the authorities. Nevertheless, the details of one specific contract were published in the press and which illustrates a small but significant part of the problem. Using a simple Cox Ingersoll and Ross stochastic model in order to model the behaviour of the interest rate, and applying a Monte Carlo simulation it was price the contract to analyse its profits and losses profile and finally to assess the adequateness of the decision.

This paper presents an example of what can go wrong when companies assume a speculative approach to hedging when dealing with (swap) derivatives, focusing on the special case of the SOEs. In some cases, these strategies can put into question the overall financial soundness of the companies and impose an additional burden to the public finances. The main point in this paper is that despite the incentives or the pressures to lower the overall interest costs of the firms cannot justify these firms to enter into more speculative/complex contracts. The simple recommendations of good practices at a firm level might not be enough, and therefore, it might be necessary to build a regulative mechanism for the approval of the decisions related to risk management and the contracting of derivatives in SOEs. The approach that seems to be the most beneficial is the one taken by the HM Treasury, which tends to give some degree of freedom to counterparties in Public-Private Partnerships, but acts as a regulator, reserving the right of approval of the usage of derivatives and the overall risk management strategy.

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\(^1\) The HM Treasury, or Her Majesty’s Treasury, or sometimes referred to as the Exchequer is the United Kingdom government department responsible for developing and executing the British government’s public finance policy and economic policy.
This study starts by reviewing the literature in chapter 2 concerning the creation of value regarding the management of risk, and the legal framework in which derivatives are dealt. In chapter 3 the Portuguese case is presented in more detail. It also includes some considerations at a firm level motivated by an analogous case occurred in Chicago. This part also presents the changes in the Portuguese the legal framework, and the different international frameworks proposed by the OECD and the HM Treasury, ending with a description of the central role played by the Portuguese Treasury and Debt Management Agency (IGCP) in Portugal in the case that motivated this study. Finally, chapter 4 presents the case study of Metro do Porto (MdP), which is a public transportation utility company that, among many others, has celebrated complex swap contracts to hedge the risk associated to a long term floating rate loan. This case intends to exemplify how the misuse of derivatives can turn into an enormous liability to the firm.
2. Reviewing Literature

This study reviews the literature in three main areas including Risk Management and Value Creation, OTC Derivatives and Regulation and Best Hedging Practices in SOEs. The relevance of the latter justified a more thorough analysis of the topic, presented in chapter 3.

2.1 Risk Management and Value Creation

Several important papers in the literature argue for the worthiness of managing the risks of a company. The approaches are diverse and present different perspectives on how hedging can create value to a firm. For instance, Adam and Fernando (2006) studies gold mining firms that got significant gains from trading derivatives, due to the fact that future realised spot prices were systematically smaller than forward prices, and thus firms got profits from selling gold forward. Perhaps one of the most important aspects to retain through from the paper is the way value is created by means of the derivatives market, as mining companies are in fact exploiting an inefficiency of the gold market. So, specific conditions and inefficiencies of a particular market can be very important for hedging to create value.

This leaves the question of whether Hedging can create value regardless of specific market conditions and imperfections. Panaretou (2013) studies 350 large FTSE non-financial firms and concludes for the existence of a premium in the firm value of those doing risk management, with especially significant results for currency hedging. In terms of interest-rate hedging this study found slightly inferior impact in terms of value creation, but with less statistical significance, which may put into question such positive impact, whereas in terms of commodity hedging there are no significant results. This can also point in the direction that hedging can create value, in this case, independently of specific market conditions and imperfections. Furthermore, this unveils the fact that value creation through hedging depends on what is the firm hedging against.
Taking a step back, in the first paragraph is mentioned an example of market imperfections. Aretz and Bartram (2010) reviews and compiles a number of articles, and addresses this issue, having a perspective that such imperfections or inefficiencies can contradict the classic Modigliani and Miller (1958) model, and so, it is possible that Hedging creates value. Derivatives can, at a firm level, have therefore a role of fine-tuning in the presence of such real-world capital market imperfections, such as taxes or costs of financial distress. However, with such compilation of articles the authors find that most proxies used throughout the studies can lead to mixed results, as several studies point to different conclusions, and so, a simple answer to whether hedging creates value is not so easy to find.

But on a different angle, the article from Aretz and Bartram (2010) also unveil another aspect to which the present study is sensitive - the fact that most proxies used throughout the literature may not describe all the dimensions of risk management. For instance, a number of articles take the use of financial derivatives as a proxy for hedging, and this is problematic, as it only takes into account one of the dimensions for which derivatives can be used, and one might not know if other intentions are implied, such as earnings smoothing or simply speculation. Faulkender (2005) has an initial approach to the subject, trying to study possible market timing behaviour from firms, regarding their debt issuances. This article found evidence that firms are more probable to have floating rate debt in periods when the yield curve steepens (normal yield curve, i.e. the longer, the higher the interest), raising debt funds at a fixed interest rate otherwise. In addition, the author also finds that newly issued debt has a higher probability of being locked in at a fixed rate, if the expectations of recession increase. This attests to some degree of short-termism from managers, which as the author mentions may induce myopia or speculation. Chernenko and Faulkender (2011) address speculation more directly, with a focus on interest-rate swaps, decomposing risk management activities in cross-sectional and time series components. The argument used is that “assuming that the optimal hedge ratio is stable over time, the cross-sectional component identifies which firm characteristics are associated with hedging, while the time-series variation is more likely to result from speculation”. Indeed, the results point to firms simply hedging in the cross-section analysis, but the authors also find evidence on their time-series analysis that firms
change their floating rate debt over time, altering the use given for interest-rate swaps over time, which is more consistent with speculation. This can be a relevant problem when managers have high incentives to meet market expectations (analyst earnings forecasts), as derivatives can also enable the manipulation of cash flows over time. This can be described as a moral hazard issue.

Still regarding this hedging/speculation issue, Bartram et al. (2011) clearly separate a large sample of highly internationalised companies between hedgers and non-hedgers, finding that firms that use derivatives tend to have lower estimated values of total and systematic risk, despite their usual higher exposure. This can be an indicator that firms are effectively using derivatives to hedge rather than speculate. In fact, the study also reveals that derivatives users have both less cash flow and idiosyncratic volatilities. Generally, stability can be taken as a good sign which would potentially materialise in a premium value. Nevertheless, this study finds weak statistical significance for such premium, and once more it is not so clear whether hedging activities create value.

The latter idea of creating stability through the usage of derivatives (for hedging purposes), especially in terms of cash flows, is possibly the strongest argument for a firm to hedge its risks, as it works out approximately to an insurance policy, should anything go wrong. However, the idea that such stability is rewarded with a value premium in a firm’s valuation is a different matter, and answers in terms of value creation can therefore be somehow ambiguous regarding different approaches as it is a complex question to answer, potentially with a great number of variables to account for. Still, the analysis of this topic allowed unveiling some important issues to which the present study is sensitive, namely the fact that derivatives can be used by firms for speculative purposes, and there might exist occasional incentives for that. Within the scope of SOEs, it is especially important to prevent that from happening as public funds should not be used for speculating for the risk it involves, and so, there should be a strong regulation in this specific case.
2.2 OTC Derivatives and Regulation

Given the need for regulation, it is important to present a blueprint of how derivatives markets function and their regulation in general, before entering into the specific case of the SOE. Firstly, it is relevant to make a distinction between derivatives that are exchange traded, and the ones traded Over-the-Counter (OTC). The first ones are subject to specific legal framework of the country in which they are traded, and therefore they tend to have a very specific pattern (such as futures), which makes them much more transparent and less uncertain, especially in cases of legal litigation. Such concerns are more susceptible to arise in the case of derivatives traded OTC, such as Options and Swaps.

Having so, it is important to understand how these OTC markets work. In this sense, Duffie (2011) presents in its first chapter a good general approach to the subject. Briefly describing, in this market buyers and sellers negotiate terms privately, and as there is usually not any structured exchange market or index, there are restrictions of information about prices available from other potential counterparties. This means that OTC markets usually have higher levels of opacity, which opens a good starting ground for intermediating brokers and dealers. In fact, in a market with such characteristics, prices and allocation of financial derivatives will tend to be increasingly influenced by these intermediaries as opacity increases. The rationale implicit in this case is that intermediaries, for instance investment banks, negotiate trades more frequently, which gives them an advantage in terms of information and therefore, they will also have an advantage when dealing a transaction, possibly profiting from a higher bid-ask spread. This clearly presents an issue of asymmetric information.

Having so, one can question why a firm would deal in a market with such issues, but there are some arguments in favour of OTC markets. In fact, complexity and lack of transparency can be inherent to some underlying products, in which case they would be much less liquid and with low trade levels. Duffie (2011) gives the example of collateralised debt obligations. Such structured credit products can present such high complexity levels, that they can be analysed only by a narrower range of specialised investors. Another argument is
the fact that investment banks, for instance, are able to offer more tailor made (or custom made) financial products, that respond to the needs of customers, and for which product there is actually no active market. Finally, another argument found in the literature is that some financial products created in OTC markets may become increasingly traded and sufficiently standardised and popular so that their migration to an exchange could eventually happen.

Historically, as we can observe in Biggins and Scott (2012), OTC derivatives made their appearance in the 70’s, having developed a lot during the 80’s. They have been increasingly more important ever since, and had a great implication in the recent financial crisis. Actually, concerning derivatives before this crisis, the most relevant regulation reforms took place in the US and the UK, through the CFMA\textsuperscript{2} and the FSMA\textsuperscript{3}, respectively, in 2000. Being the British FSMA the most relevant in the scope of this study, it is relevant to refer that it created the Financial Services Authority\textsuperscript{4} (FSA) in order to regulate this derivatives market. Although, before the financial crisis, in practice this authority had a general policy of not interfering directly in the deals between sophisticated or qualified market participants, regarding OTC derivatives. In the US, the general policy had the same direction which led to a proliferation of derivatives throughout companies in both countries and around the world. After the accelerating mortgage defaults in the US in 2007, systemically important financial institutions such as the Lehman Brothers and American International Group (AIG) started to have losses on their derivatives portfolios, which triggered the whole liquidity crisis.

Accounting the latter paragraph, one can consider that the changes in legislation in 2000 were ineffective to regulate such proliferation of OTC derivatives. Regarding this issue, in Morgan (2008, 2012), the author describes the important role played by the International

\textsuperscript{2} CFMA stands for Commodity Futures and Modernisation Act
\textsuperscript{3} FSMA stands for Financial Services and Markets Act
\textsuperscript{4} The Financial Services Authority (FSA) was the centralized financial regulator in the UK, being in charge of both Prudential and Behavioural regulation. More recently, the UK adopted a Twin Peaks financial regulation model, which divided this central regulator in the Prudential Regulation Authority (PRA, within the Bank of England) and the Financial Conduct Authority (FCA).
Swaps and Derivatives Association (ISDA), founded in the 1980’s. This institution intervenes in the market to guarantee some degree of harmonisation of derivatives contracts across international partners, thus eliminating some uncertainty, and for which purpose it created its Master Agreement. The ISDA also acts on behalf of their associates (OTC Market participants, particularly some of the largest financial institutions) when regulations are designed. As mentioned in Morgan (2008), “these actors are concerned to develop a context where the market for derivatives is orderly and legal, but open to innovation and change”. In this sense, the ISDA also acts as lobbying power, being a powerful association. In fact, one concern that afflicts the author is the fact that, even though some steps were taken at the national level, and even internationally, private actors seem to move quicker and are proving to be more adaptable than national entities.

On another hand, after the financial crisis, attention was drawn to this subject. Both regulators and OTC market participants became aware of the concerns over systemic risk unveiled, being Credit Default Swaps (CDS) a central part on the initial discussion, and the OTC market landscape began to change. Ferrarini and Saguato (2013) address this issue, focusing mainly in Europe. In fact, the latter article also mentions a quicker response from private initiatives, as OTC participants began to report trading to central entities. Post-trade transparency in the case of CDS was enhanced through the creation of the ISDA Marketplace, which became the first entity to collect post-trade data on CDS transactions and disclosing such information in aggregate terms to the public. Other private initiatives began to take place since then, and especially after the creation of the Depository Trust and Clearing Corporation (DTCC), which is a private company that started to offer data collecting and clearing services for a wider range of OTC derivatives. This activity that started in the US and has been spreading around the globe. It has contributed for a better post-deal transparency in this market.

However, even if at a slower pace than private actors, regulators worldwide started to make some changes regarding derivatives markets as well, mainly grounded in the following pillars:
- “Promotion of OTC derivatives standardisation;”
- “Transparency through trade reporting to central trade repositories;”
- “Establishment of a central clearing system;”
- “Trading on exchanges and electronic platforms.”

Ferrarini and Saguato (2013) also describes the European Union changes, where it is proposed to adopt a “two peak system”, as mentioned in which the Markets in Financial Instruments Directive II (MiFID II) directive proposal sets out the authorisation and operating rules to be applied within the scope of investment firms and Regulated Markets (RMs). On the other hand, the Markets in Financial Instruments Regulation (MiFIR) proposal “address the transparency regime and focus on the trading of OTC derivatives on trading venues”. Being a way of creating a common standard between EU member states, these proposals intend to gradually transfer derivatives trading from OTC to Regulated Markets (RM), Multilateral Trading Facilities (MTF) and Organised Trading Facilities (OTF). The objective is to enhance both pre and post-trading transparency, as regulated and organised exchange markets enable participants to have less information asymmetry. At the same time, the OTC market would be used for the most complex and specific, or tailor made, derivative transactions.

The question to point is whether some of the derivatives traded acan be standardised and liquid enough to enter in a regulated market facility. In this sense, the authors point out that private agents have been remarkably fast to adapt and make some derivatives more standardised. In fact, Duffie (2011) also mentions that some of the OTC derivatives have high volumes of trade and are relatively standard, such as credit derivative index products and simple interest-rate swaps, which are at the centre of this research. So, having this transfer from OTC to RM, interest-rate swaps could be a natural candidate. Still, it is unclear if such transfer will actually take place, and the authors refer that only after the regulation changes such answers may be answered.
3. Best Hedging Practices in SOEs

This chapter approaches in more detail the literature with emphasis in SOEs. Describing the cases in Portugal and Chicago, it is presented a few ideas of best hedging practices in SOEs at firm level. Regarding regulation, are presented the changes in Portugal, the framework and guidelines of the OECD and HM Treasury, finishing with the role of the Portuguese IGCP, in order to have a view of best practices at a higher (regulatory) level. These best practices, at firm and regulatory levels, are synthesised at the end of the chapter, in subsection 3.3.

3.1. Swap Derivatives Misuse

The main motivation for this study is the recent cases of derivatives misuse, particularly interest-rate swaps, where public/state funds were involved. This study analyses the case of Portuguese SOEs, commonly known as the “Swaps Case”, in which a number of these companies contracted derivatives, Interest-rate Swaps, that resulted in a great deal of losses. This case, presented in next sub-section, has had a lot of scrutiny and opened the ground for debate about how risk management in SOEs is implemented.

The case of the City of Chicago is also presented for the relevant points and lessons that can be learned about public financial (risk) management, which are pertinent within the scope of this study.

3.1.1. The Portuguese case

The Portuguese case unveiled in recent years and consisted on the fact that a number of companies held by the Portuguese State celebrated swap contracts that proved to be very problematic and originated serious losses. These losses led to an intervention by the State,
and as a consequence, it had its impact in the state budget, which created a lot of public concerns. In this sense, a parliamentary enquiry commission was created in order to address the issue, regarding the period between 2003 and 2013, when these contracts were traded. The firms in question usually fall in the category of public utilities, such as water services and public transportation (a brief description of these companies can be found further ahead). The negotiated derivatives had as counterparties several banks\(^1\), being some of them renown international investment banks. A most relevant issue is that these contracts were allegedly traded for hedging purposes, despite the fact that most of them did not have the requiring conditions to be eligible for hedge accounting.

The commission’s report about this case can help us understand several dimensions of the problem, even if specific information about the contracts is still kept classified. Probably the first relevant aspect to take into account is that a number of these SOEs had complete autonomy in terms of risk management and for contracting derivatives. The second aspect is that several of these firms were highly indebted, with extremely high debt to equity ratios, and facing serious difficulties to finance their own operations and investments. The most problematic cases, were the examples of some public transportation companies, such as the underground (subway) companies, “Metro do Porto” (MdP) and “Metro de Lisboa” (MdL)\(^2\). In fact, there were several specific funding lines with governmental guarantees made available to these companies, but this funding soon became insufficient to finance all their operations and in some cases the huge infrastructural investments. For this reason the SOEs had to negotiate new loans without the governmental guarantees in a very poor negotiating position with the banking system.

This very precarious negotiation position of the SOEs was the consequence of i) the need for getting additional loans, as mentioned in some declarations at the parliamentary

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\(^1\) The list of the counterparty bank institutions, as described in the parliamentary commission report is as follows: Barclays, BBVA, Banco Comercial Português (BCP), Banco Espírito Santo (BES), BES Investimento (BESI), BNP Paribas, Banco Português de Investimento (BPI), Banco Português de Negócios (BPN), Bank of Tokyo-Mitsubishi (BTM), Caixa BI, Caixa Geral de Depósitos (CGD), Citi, Credit Suisse, DEPFA, Deutsche Bank, Goldman Sachs, JP Morgan, Merrill Lynch, Morgan Stanley, Nomura, Royal Bank of Scotland (RBS), Santander and Société Generale.

\(^2\) Metro do Porto (MdP) and Metro de Lisboa (MdL) are subway railway companies, created to manage and expand the Subway lines in the metropolitan areas of Porto and Lisbon, respectively.
commission; ii) the weak financial situation of the firms already too indebted, and iii) the impossibility to get the governmental guarantee for new loans as before. With almost any information about the contracts, and the negotiations of these contracts, as for most it remains unavailable, one can only wonder the impacts for the SOEs of such weak negotiation positions but certainly included greater complexity of the contracts and less advantageous offers, as mentioned in the report of the Commission. This is a much discussed issue throughout the inquiries of the Parliamentary Commission, particularly with a question made to several representatives of both the banks and the SOEs, concerning whether there were banks imposing swap contracts as a condition to finance these companies. Some state companies were approached by this subject, and later, the declarations of the Deutsche Bank representative can attest to the existence of such conditions for some SOEs to get financed. This presents nothing particularly illegal, as one might freely present the conditions at which is willing to negotiate, but also can be an indicator of a fragile negotiation position from the SOEs if they were willing to agree to such terms.

Given the pressure for these companies to lower their interest rate payments, related to their bank or bond loans, these swap contracts were offered as a way to alter the amount and the structure of the interest paid, which is quite different from hedging the interest rate risk involved.
In order to understand the scale of the problem in these swap contracts, the Commission’s report includes the following table:

<table>
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</thead>
<tbody>
<tr>
<td>CARRIS$^3$</td>
<td>4</td>
<td>2</td>
<td>-102.910</td>
<td>726.108</td>
<td>14.2%</td>
</tr>
<tr>
<td>CP$^4$</td>
<td>6</td>
<td>1</td>
<td>-141.744</td>
<td>3.593.136</td>
<td>3.9%</td>
</tr>
<tr>
<td>EGREP$^5$</td>
<td>1</td>
<td>1</td>
<td>-173.753</td>
<td>362.048</td>
<td>48.0%</td>
</tr>
<tr>
<td>EP$^6$</td>
<td>1</td>
<td>0</td>
<td>-13.909</td>
<td>2.934.709</td>
<td>0.5%</td>
</tr>
<tr>
<td>Metro de Lisboa (MdL)$^7$</td>
<td>66</td>
<td>39</td>
<td>-1.404.742</td>
<td>4.117.797</td>
<td>34.1%</td>
</tr>
<tr>
<td>Metro do Porto (MdP)$^8$</td>
<td>15</td>
<td>11</td>
<td>-1.063.453</td>
<td>2.724.849</td>
<td>39.0%</td>
</tr>
<tr>
<td>REFER$^9$</td>
<td>8</td>
<td>0</td>
<td>-37.871</td>
<td>6.929.730</td>
<td>0.5%</td>
</tr>
<tr>
<td>STCP$^{10}$</td>
<td>2</td>
<td>2</td>
<td>-105.656</td>
<td>364.678</td>
<td>29.0%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>103</strong></td>
<td><strong>56</strong></td>
<td><strong>-3.044.038</strong></td>
<td><strong>21.753.055</strong></td>
<td></td>
</tr>
</tbody>
</table>

It is important to notice that by the time of the swap portfolios valuation, all values were negative. This happened because most, if not all, of these contracts were celebrated in

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$^3$ CARRIS is a public transportation utility company that operates with buses in the Lisbon metropolitan area.

$^4$ Comboios de Portugal (CP) is a railway utility company that operates trains across Portugal, both for public transportation and cargo purposes.

$^5$ Entidade Gestora de Reservas de Produtos Petrolíferos (EGREP) is a public corporate entity whose role is to build up and maintain the “strategic” portion of the emergency stocks of petroleum and petroleum-products in Portugal.

$^6$ Estradas de Portugal (EP) is the company in charge of conserving, expand and manage the Portuguese road network.

$^7$ Metro de Lisboa (MdL) is a railway company, in charge of managing and expand the subway network in the Lisbon metropolitan area.

$^8$ Metro do Porto (MdP) is a railway company, in charge of managing and expand the subway network in the Porto metropolitan area.

$^9$ Rede Ferroviária Nacional (REFER) is the company in charge of managing and developing the Portuguese railway network.

$^{10}$ Sociedade de Transportes Colectivos do Porto (STCP) is a public transportation utility company that operates with buses in the Porto metropolitan area.
order to hedge interest-rate risk, at least in principal. As the expectation before 2008 was of increasing interest rates, therefore firms hedged against this risk. However, after the financial crisis, the reference interest rates in the European Union fell sharply, which means that the previous strategy would incur in losses. Regarding this, it is important to present the graph in figure 1.

![Euribor Historic Rates](image)

*Figure 1 - EURIBOR Historic since 2000 until 2012*

We can easily observe that since 2005 EURIBOR rates were steadily increasing until October 2008. Actually, Lehman Brothers went bankrupt in September 15th 2008, but the European Central Bank (ECB) kept a high reference rate policy for a while longer and the reference rates reached their peak in October 9th, with a 6-month rate at 5.448%. After that, the reference rates fell abruptly, reaching 0.5% in 2012, and 0.25% just recently in 2014.

With these facts, one can understand that any simple hedging strategy designed before 2008 concerning increases in the interest rate would realise losses in the following years. Taking a step back to table 1, it can be observed that even companies without contracts classified as problematic have negative market value of their swap portfolio.

However, the problem resides in the magnitude of the losses, that is, in the magnitude of the market value of swap portfolios. In fact, since the sharp fall of reference rates, some companies suddenly have a hugely negative value of their swap portfolios. More importantly,
it is of a noticeable dimension the proportion of the losses in the swap portfolios relatively to
the overall debt, which in the cases of Metro companies, the most worrying ones, exceeds
one third of the overall debt. This can indicate an inadequate complexity of the swap contracts
traded, possibly with unfavourable clauses.

Observing Table 1 it is also possible to see that there is a great difference between
companies. Probably the best cases to mention is the discrepancy between both Metro SOEs
and REFER. A more conservative but adequate approach to interest rate risk management
would mean a company would fix or simply limit the interest rate related to its loans. In
which case it would incur in losses, given the sudden fall in interest rates, but relatively small
losses comparing to the size of overall debt, and that is the case of REFER. Looking to the
number of problematic contracts, we can observe that this railway company has none,
contrarily to both Metros. This raises the next question of what are the characteristics of these
problematic contracts and which was the criteria to make that contract classification.

One of the main constraints of this research is the limited information available
regarding the contracts traded by the SOEs, and their derivatives portfolios in general, as
such information remains classified. Although, even if the Parliamentary Commission does
not mention all the details of specific contracts, its report describes several types of contracts
that were in the companies portfolios. These are presented in the table provided in Annex 1,
which was originally elaborated by the IGCP11 (the role of this entity will be explored more
extensively ahead) in order to clarify the nature of the operations. Keeping in mind this table,
in Annex 2 is presented a classification of the swap operations, also elaborated by the IGCP
for the Parliamentary Commission, in terms of degrees of complexity. For such classification,
the IGCP took into consideration mainly four concepts: Opacity, Leverage, Toxicity and
Day-1 Present Value.

One can easily assess that the 1st and 2nd degree of swap contracts described in Annex
2 have simple structures, usually used in hedging or partial hedging strategies. These are the

11 IGCP is the Portuguese Treasury and Debt Management Agency
most acceptable structures in terms of interest-rate risk management, namely Plain Vanillas (Floating-for-fixed) and Caps, Floors or Collars, both with or without knock out\textsuperscript{12} clauses.

From the 3\textsuperscript{rd} degree of complexity and upwards, one can argue that these swap contracts have a more complex/speculative nature. For instance, Range Accruals imply a prediction that some specific market condition will be verified during a pre-determined period of time. Therefore, by signing such contract, one would have to rely on his expectations that all the conditions would become true, which is a more speculative approach. Actually, the report mentions a specific kind of clause in the contracts, the “rating triggers”, by which if the rating of the firm changes during the life of the contract, its payments suffer a pre-established alteration as well. From a simple hedging strategy standpoint, these contracts start making less sense.

While the 3\textsuperscript{rd} degree contracts are not so much complicated, although relatively more speculative than the previous, the 4\textsuperscript{th} degree includes increasingly complex and opaque contracts. The opacity refers to Index Linked contracts, as they are indexed to proprietary indexes of the banks, relatively unknown to the contracting firm. On the other hand, Snowball\textsuperscript{13} contracts are more related the aspect of toxicity, as they can reach very high coupon rates. These contracts can cause huge losses, should the companies predictions are proved wrong, which makes them a less adequate for risk management.

The difference in the Annex 2 scale between the 4\textsuperscript{th} and 5\textsuperscript{th} degree is the level of toxicity, as in the latter are included Snowball contracts with no restrictions or limits to their calculated spread, and so, the previous rationale stands in this case as well.

From the Commission’s report it is clear that the SOEs have traded several contracts of different degrees of complexity. After a thorough analysis of these contracts, the Portuguese government decided to assume the management of all SOEs swaps portfolios, early terminating the most complex ones. In some cases, the only contracts left active were

\textsuperscript{12} Knock out (KO) clauses establish an upward or downward barrier, from which the previously established limits cease effect.

\textsuperscript{13} These contracts take into account the spread paid in the previous payment period, and add an interest over that spread to the present payment, and so forth, depending on pre-determined conditions. Important further ahead.
plain vanilla, which represent a simple hedging strategy. Nevertheless, in a reduced number of cases the State was not able to reach an agreement with Santander Bank, the only bank that did not agree with terms proposed. These contracts are still open and the situation is currently in litigation at the London courts.

Precisely regarding the latter paragraph, throughout the Commission’s report there is mention of the case of Metro do Porto (MdP) and a Snowball contract dealt with Santander Bank, which corresponds to a 5th degree type of contract by the IGCP scale. That specific contract remains in litigation at the London High Court, as it was dealt in English jurisdiction. However, information about this contract was published by Osborn (2014) and later on by Levine (2014). Adding to this, details of another contract, also from MdP, came to appear in The Independent, Armitage (2014) corresponding to an Equity swap indexed to a proprietary index owned by the Nomura Bank. This three articles unveiled more detailed information about a few contracts traded by MdP and its based on this information that the case in chapter 4 is structured.

Regarding the Portuguese case, what is important to retain is that a number of SOEs contracted some incredibly complex and questionable swaps in terms of an interest-rate hedging strategy, that to put at risk the already fragile financial health of these companies.

3.1.2. City of Chicago

The case occurred in Chicago is important to exemplify that incidents with interest-rate swaps are not such an isolated case, though quite different from one another. This case is analysed by Luby (2012). The city of Chicago (local government) issued 500 Million Dollars “Second Lien Water Revenue Refunding Bonds” in order to refinance a number of previous issuances to fund a water utility project. These were floating-rate bonds. The municipality adopted a synthetic fixed rate strategy, trading an interest-rate swap, on the assumption that this strategy would pay a relatively lower interest than the fixed rate the City would get by issuing fixed-rate bonds. The City agreed on a receiving leg consisting of the
BMA bond index\textsuperscript{14} during an escrow\textsuperscript{15} period and 67\% of one-month USD LIBOR index after that, in exchange for a fixed rate paying leg. It seemed a reasonable enough strategy, as takes into account indexes usually close to the variable coupons of the bonds. Unfortunately, after the subprime crisis, through 2008, bond markets started having doubts about the financial health of bond insurers and many letters of credit issued by banks were put into question. So, as banks began to be downgraded, the floating rate of the bonds started to rise, while the SIFMA index (formerly BMA) remained relatively stable for a while. This created a basis mismatch between the floating coupons of the bond and the receiving leg of the swap, which were supposed to offset, causing the City to incur in losses, and pay much higher interest.

This case presents much less questions than the Portuguese case, as it seems a much less complicated strategy to stand for, in terms of hedging risk, comparing to the complex contracts celebrated in Portugal. Still, the reasons why the City of Chicago incurred into such Basis Risk are questionable. Regarding this, Luby (2012) presents some “lessons learned” that are relevant within the scope of this paper:

1. “Financial market Stability is not a given”
2. “Financial intermediary risk is real”
3. “Interest rate risk should be shifted permanently”
4. “Manager should stress test contracts and craft bond structures with reasonable flexibility”
5. “Managers should recognise that historical relationships between bond indices may not hold in the future”
6. “Up-front refinancing savings structures should be avoided”

\textsuperscript{14} The BMA (Bond Market Association) Municipal Swap Index is a 7-day high-grade market index comprised of tax exempt variable rate demand notes (VRDOs) produced by Municipal Market Data (MMD) in the US. It is reset weekly. Formerly known as the PSA Municipal Swap Index, and later on became SIFMA. This index is the shortest end of the municipal bond curve. It is usually around 65-70\% of the taxable equivalent (the 1-month USD LIBOR).
\textsuperscript{15} Escrow Period – Period between the bonds’ issuance date and the call date of the refunded bonds.
Most of these points are very straightforward, but it is important to retain them within the scope of this study. The 1st lesson clearly refers to the fact that markets won’t be stable forever, as shocks will always happen from time to time. To assume stability in a long term deal such as 10 to 20 years is questionable. The 2nd lesson refers to the fact that intermediaries with whom we deal can affect our own business. In the case of Chicago, the banks started to have problems, and their letters of credit started to lose credibility, which ultimately influenced the interest of the bonds paid by the City.

The 3rd lesson refers to the view that interest-rate risk in terms of this bond refinancing should be thoroughly eliminated, which can only be accomplished through a fixed rate bond issue. The 4th lesson refers to the need to study and analyse financial instruments before executing them. Stress testing, analyse the distribution of simulated cash flows through expected and worst case scenarios is important to make well-grounded decisions.

The 5th lesson is in some degree linked to the first. Meaning that in periods of unstable markets historical relationships may not hold. In the case of Chicago the historical relationship between SIFMA and LIBOR (on the dollar) was broken after a long period (roughly a decade). Finally, the 6th lesson refers to a certain short-termism, as the refinancing savings were designed to occur more in the first years of the contract, postponing somehow the amortisation of the principal, making the deal more vulnerable to extreme changes in the interest rate, which ended up happening.

3.1.3. Considerations about Best Practices of Risk Management in SOEs at firm level

It is important to stress that the two cases presented are very different. In the case of Chicago a simple basis mismatch created the problem, while in Portugal the contracts traded had great complexity. However, in both cases, there is a fundamental aspect that cannot be ignored in this paper, which is the fact that there was a pursuit of a lower interest rate, by contracting several types of interest-rate swaps. In terms of managing public funds, this can
be a very dubious position, as essentially, these contracts should be used in order to hedge and minimize interest-rate risk. This pursuit of a lower interest-rate contradicts this rationale, as essentially, if a company’s (or state office’s) objective is to lower its paying interest-rate due through these derivatives, it can incur in complex contracts for very large periods of time, and in fact, this would mean that they would be taking risk, instead of minimizing it.

The focus of the present study is mainly bonded to the Portuguese case, but the lessons presented in the Chicago case are useful in terms good practices at a firm level. In fact, in this Portuguese case many of these lessons have been neglected. The connection of some of these contracts to the risk management of the related loan contract is only tenuous at best. Particularly, the 1st and the 5th lessons of Chicago are of great importance within the scope of SOEs, as usually some contracts last for decades, making it very probable that some of our assumptions will go wrong at some point.

Nevertheless, whatever the good practices we take into account at a firm level, there will always be a pressure to lower the interest paid, whether it is a matter of political will, more in the case of Chicago, or simply a pressure to finance operations in an environment of financial constraints, such as in the case of Portuguese SOEs. Therefore, on the top of this best practices there should exist regulation and some degree of control by higher and more independent institutions. The next section approaches this discussion, presenting the changes in the Portuguese regulation, and the recommendations of the OECD and the legislation in the UK.

3.2. Legislation, Regulation and Control Mechanisms

In this section it is considered a higher level than firms. The role of regulators and authorities is approached into more detail, in order to design a possible control mechanism, so that problems described above can be avoided. The changes in Portugal are approached more closely, as it is the case in focus on the study, describing the key role of the IGCP in
the process. This section also frames other views from the HM Treasury and the OECD (the latter, can also complement some points at firm level).

3.2.1. Chronology of changes in Portuguese legislation

Before January 2009, there were no orientations of any kind, and SOEs were independent to contract derivatives. Authorisation by a superior chain of command was only required in order to obtain approval for loan financing. Adding to this, the accounting standards did not include hedge accounting until 2010, which could difficult the detection of problems in these contracts.

Even so, during 2003 and 2013, the Portuguese Tribunal de Contas\textsuperscript{16} did several audits to some of these SOEs detecting problems in some of the swap contracts. Moreover, in 2007 and 2008 the IGF\textsuperscript{17} has done an analysis on the financial liabilities of a number of state owned companies, and concluded for a significant and systemic increase on their financial expenditures. As previously mentioned, the current international accounting standards were not in practice at that time in Portugal, and so, comparison between companies could be difficult. More importantly, it was not mandatory to present detailed information about the hedging strategies (Hedge Accounting) or the derivatives portfolio in the annual reports. The study revealed that 52.1\% of the SOEs debt was guaranteed debt, 84\% of which was guaranteed by the State. Moreover, 57.6\% of these State guaranteed loans were being used as underlying for risk management instruments, most of them interest-rate swaps.

There are 3 chronologically relevant changes in the course of action following the problems detected previously:

\begin{footnotesize}
\begin{itemize}
  \item Tribunal de Contas is the Portuguese Court of Auditors (literal translation)
  \item IGF is the General Financial Inspection committee
\end{itemize}
\end{footnotesize}
1. In January of 2009, the Direcção-Geral de Tesouro e Finanças (DGTF)\textsuperscript{18}, Public entity that manages State Companies, ruled that the SOEs had to report in their annual accounts the fair value and the variations in fair value of their swaps portfolio.

2. In June of 2009, the DGTF ruled that the SOEs had submit for authorization the contract they intended to trade, and it became required to report and ask for the opinion of the IGCP. This was (is) the most qualified public entity to analyse a possible trade of a derivative contract. At the same time, it was decreed that SOEs should report to DGTF information about the open contracts, in order to monitor their positions and have a better view of their Marked-to-Market evolution over time.

3. In August of 2012, the statutes of IGCP were changed, enabling it to manage the derivatives portfolios of the SOEs.

   It is important to point that these changes were made after a lot of traded contracts since 2003. In this way, the changes in regulation were more reactive, in order to respond to a scaling problem, than proactive.

### 3.2.2. Framing OECD Recommendations

In the Organisation for Economic and Development (2010) report we can find a number of recommendations and guidelines in terms of accountability and transparency for corporate governance of SOEs. Being the report related to the overall corporate governance, it has some relevant recommendations with respect to risk management.

\textsuperscript{18} DGTF stands for General Directorate of Treasury and Finance, or Head Office of Treasury and Finance.
The OECD report, considers the growing deregulation and internationalisation of the derivatives market, and presents recommendations in terms of best practices, mainly set on the following three pillars:

- The role of internal auditors is important as they should “(...) contribute to the improvement of risk management and control systems, which tend to be in some cases underdeveloped in comparison with the private sector.”

- In terms of financial reporting standards, it refers clearly that “SOEs, especially large ones, should be subject an annual independent external audit based on international standards” and they should “be subject to at least the same level of transparency and disclosure requirements as listed companies”.

- The role of the ownership entity is also addressed, as it “it should also encourage internal auditors to focus not only on compliance but on risk, i.e. on ensuring that the risk management policy is properly implemented”, and more importantly and specifically, after a risk assessment is carried out by the internal audition, “risk assessment plan should be discussed and approved by the entire board or the supervisory board.”

In a first look at these points, it is possible to consider the 1st and 3rd points as related to firm level recommendations, while the 2nd stands on a more regulative level.

In practice, the most relevant issue, taking these points into account, is the fact that reporting standards in Portugal were normalised according to a common European system just in 2010, which takes into consideration the International Financial Reporting Standards (IFRS), and more importantly takes into consideration the IAS 39, which relates to Hedge Accounting standards. In this sense, Portuguese companies in general were not obliged to report derivatives contracts and their fair value (unless they were publicly traded in other markets, such as some companies do through instruments such as ADRs\(^{19}\)). In the case of the Portuguese SOEs, such reporting was not mandatory until 2009 by direct action of the DGTF (ownership authority) and later until 2010 by general law. This created a situation of

\(^{19}\) ADR – American Depository Receipts
information asymmetry between the individual companies and the internal and state auditors (mainly the IGF), who were only able to identify the problems after some discrepancies in the companies accounts were unveiled in 2007 and 2008. A faster implementation of such reporting standards would have been important to help detect some of the problems sooner as the fair value and the variations in fair value of derivatives contracts would have to be discriminated accordingly. In this matter, one can say that before the implementation of accounting standards, the lack of transparency was an issue.

One idea to retain from the other OECD recommendations is that they are not strong enough in order to prevent the contracting of problematic derivatives, as we can argue that the remaining points were being followed. In fact, the internal audits occurred normally, and reserves were expressed. Despite that, the derivatives contracted were approved by the boards of the SOEs. In this sense, we can argue that, in these recommendations, best practices can lack enforcement, i.e., there is lack of a supervising entity who could approve or not the contracting of derivatives.

We should also consider that the report is from 2010, and some of the developments, especially the contracting of interest-rate swaps, took place ex ante, which makes these OECD recommendations seem as late.

### 3.2.3. Framing HM Treasury Guidelines and Experience

The UK is one of the pioneers in terms of Public-Private Partnership (PPP) contracting. These partnerships were designed with the rationale of risk sharing between the public and private sectors, thus resulting in a better resource allocation. In this sense, the UK government, through the HM Treasury, established one specific type of PPPs, long-term and relatively standardized contractual agreement, named Private Finance Initiative (PFI) contracts.

As Demirag et al. (2012) describes these contracts, “In PFI the private sector designs, builds, finances and operates assets such as roads, hospitals, and schools, in return for a
revenue stream in the form of an annual unitary charge paid by the procurer, that is used to repay debt, fund construction and operations, and provide a return to investors”.

An application note from the HM Treasury in May of 2006 was released in order to address the issue of interest-rate and inflation risks in PFI contracts. This application note is a statement of best practices, reflecting the experience acquired by the public sector while dealing with such contracts, and addressed very specifically the issue of Interest-rate and Hedging. In this note, there are a set of options on how to deal with interest-rate risk, and it is important to highlight the following two:

1. “The contractor’s parent company absorbs the risk within its corporate treasury function, which manages a full portfolio of funding arrangements supporting all of its business operations. In such cases Authorities should have no involvement in interest-rate (…)”

2. “The contractor raises variable-rate finance, typically adjusted 6-monthly based on LIBOR, but passes on this risk to financial institutions through long-term interest-rate hedging (e.g. interest-rate swaps)”

These points can express the concerns about risk management in this type of partnerships. Starting by the 2nd point, the application note also highlights that, even with the frequent usage of derivatives, and particularly Swaps, they usually have large breakage costs in the case of early termination, in which scenario there is a high probability that an Authority would incur in more expenses. Another aspect frequently presented is the complexity of some derivatives, and the possible and probable lack of expertise both from the companies and from the authorities, for which reason it is recommended the possibility of resort to consulting experts. For such reasons mentioned above, “the Authority should reserve the right of approval of all hedging instruments proposed by the contractor and their execution”. In fact, of this particular approval is very important, and is mentioned especially in the case of early
terminations in the Standardisation of PF2 Contracts\textsuperscript{20} document by the HM Treasury from 2012, with some technical exceptions mentioned in its point 28.4.4.

Regarding the 1\textsuperscript{st} point, it is important to introduce some valid ideas taken into consideration and presented in another report from the HM Treasury, in July of 2003, in which is argued that interest-rate risk management lying primarily with the PFI contractor raises two issues:

- “where it is necessary to terminate a PFI contract to ensure flexibility for delivery of public services in the circumstances described above, the cost of breaking the hedging contracts put in place by the PFI contractor are typically passed back to the Government”;
- “it is also difficult to ensure that the process of agreeing a fixed interest rate at financial close is sufficiently transparent and cost effective.”

These two arguments lead the UK Government to consider whether it should treat its exposure to interest-rate risk regarding PFI contracts in terms of the PFI programme as a whole, thus securing better value for money, or continuing to put in the hands of the private sector such hedging.

We can therefore observe, through the documents published by the HM Treasury, that this sector was relatively more developed in the UK, and relatively standardised through PFIs. Some of the UK’s expertise could have been important in preventing some problematic contracts in the Portuguese case, particularly the reservation of right of approval by an Authority, which can establish a “chain of approval and control” outside the scope of the SOE by its own.

\textsuperscript{20} “Standardisation of PF2 Contracts” from 2012 recently replaced the 4\textsuperscript{th} version of “Standardisation of PFI contracts” from 2007.
3.2.4. The role of the IGCP

As described before, the succession of events regarding the problems in Portuguese SOEs on Swaps case, the Government appointed the IGCP to act as an approving and controlling Authority in matters of risk management of such companies following the alteration in its statues, described in the Portuguese Decree-Law 133 of 2013, more specifically in its 29th article.

One of the reasons for such change, mentioned in the parliamentary enquiry commission’s report, was the fact that some of the types of contracts described in that document may be used in order to manage the expectations of future moves in the interest rate. This means they can be used for speculative reasons rather than for hedging risk. Such behaviour would be a clear deviation from the core business of such non-financial companies, which evidently also lack of expertise themselves to incur in such complex contracts.

The IGCP is the most capable public institution in this matter, and quite conservative in terms of risk-taking decisions. From IGCP perspective simple risk management strategies use simpler derivatives contracts (such as plain vanilla, or caps), and so, speculative strategies would imply the use of complex derivatives. Adopting a conservative approach towards risk, such complex contracts are not likely to be approved. Even so, it was necessary to outsource technical advisory due to the complexity and the amount of contracts at stake. Unfortunately, the report produced by the advisory firm remains confidential, and so, more technically detailed information about these contracts remains inaccessible.

It is also important to mention that there are two types of SOEs that the IGCP hast to consider. Some companies have been reclassified (EPR\textsuperscript{22}), which means that their accounts are consolidated within the Annual State Budget, and some other were not (EPNR\textsuperscript{23}). Regarding the swaps case, a list of reclassified and non-reclassified companies is described.

\textsuperscript{21} IGCP hired the financial boutique Storm Harbour for this purpose.
\textsuperscript{22} EPR, the acronym in Portuguese for “Empresa Pública Reclassificada”. In English, Reclassified Public Enterprise.
\textsuperscript{23} EPNR, the acronym in Portuguese for “Empresa Pública Não Reclassificada”. In English, Non-Reclassified Public Enterprise.
in the parliamentary commission’s report, and such information is provided in Annex 3. The main difference, in terms of the IGCP action, is that the institute was mandated to manage the entire portfolio of the reclassified companies, and so, the EPRs interest-rate risk management is centralised. Meanwhile, the non-reclassified companies have more freedom in terms of risk management, but the contracting of derivatives always needs a positive and binding report from the IGCP, which tends to be a more approximate scenario regarding the HM Treasury recommendations described above.

The Portuguese government centralized the management of the whole swaps portfolio in one single institution - the IGCP, putting this institution in a better negotiating position than the firms to deal with the banks a solution for the problem. The renegotiations of swap contracts led to the closing of most of the contracts (the complex that went beyond the hedging goals) and overall there was a 30% reduction in potential losses, according with the commission’s report. This means that generally banks agreed to assume these losses into their accounts. In fact, the declarations of Barclays Bank’s representative in the parliamentary commission’s report can be particularly enlightening, stating in his own words – “We accepted because we are, since January of 2004, a specialised operator of treasury vehicles, which in practice is designated as primary dealer of Portuguese public debt, and so we have a special responsibility with the Portuguese State. (...) It wouldn’t make any sense to have a dispute with the State, being a Republic’s primary dealer”. This is indicative that IGCP stands on a more favourable position to negotiate these contracts than the companies by themselves, as the institute is also mandated to manage public debt, which is of a larger business that banks may be reluctant to loose.

However, methodology found to deal with the situation was just a second best because of the conflicting interests sitting at the same table. The IGCP was at that moment arguing for the best conditions to early resolve the swaps contracts with the same investment banks that a few months after would manage the issuance of Government bonds after a long period outside the market. This is a delicate situation that most certainly influenced the negotiations. Therefore, there are pros and cons related to the centralization of the risk management of the SOEs in this institution and it remains an open topic for discussion.
After the changes in terms of regulation, IGCP powers were reinforced, but there has not been much activity in terms of derivatives contracts and risk management in the SOEs ever since. As expressed before, the derivatives market suffered profound changes, and it is the institute’s view that the market is simply not the same. One strong argument is the fact that it may be unattractive to contract derivatives such as interest-rate swaps at the moment, especially with a low interest rate conjecture. However, it is important to find out if it is ideal to maintain for the future the centralization of the risk management in the IGCP or if its role in this matter should come to an end with the closing of the contracts. In our opinion it can have an active supervising role but the execution of the risk management policy has to be done at firm level.

3.3. Suggestions of Best Practices of Risk Management in SOEs

In this last section of chapter 3 we summarise the information above into a brief set of recommendations in terms of best practices, both at firm and regulatory/supervision levels. In our opinion, respecting this best practices is a way to ensure that SOEs follow healthy risk management strategies, reducing the probability of events such as the ones occurred in Portugal.

3.3.1. Firm Level

The best practices of risk management in SOEs at firm level can therefore be summarized as follows:

1. Derivatives are useful instruments tools to hedge risk, not speculate – these companies usually fall in categories of public utilities, they are not investment banks. Speculating is a clear deviation from their core business. Furthermore,
the struggle to reduce financial costs should not press a firm to take additional risks.

2. *The hedging strategy should be simple* – the “Swaps Case” in Portugal is, among other reasons, a consequence of complex strategies undertaken by companies that do not have sufficient know-how to manage those strategies. Simple contracts such as vanilla swaps or caps are the adequate ones to hedge risks such as interest-rate risk.

3. *Transparency is important* – accounting standards and compliance play an important role in the way auditors (internal or external) do their analysis.

4. *Financial stability is not a given and historical data will not always useful to predict the future* – this lesson from Chicago is valid anywhere. It was evident in the Portuguese case that abrupt changes in market values or interest rates can always happen. On the other hand, historical relationships, between indices for instance, may not hold constantly forever.

5. “*Financial intermediary risk is real*” – if we rely on bank credit notes, our investments rely on the capacity of the bank to provide liquidity. This was evident in Chicago. The intermediaries with whom a firm deals can affect a firm’s business, or investments.

6. *Managers should shift risk permanently or at least stress test their risk management strategy* – sometimes the ideal way to fix interest rates is to issue fixed-rate bonds. Although, when such does not happen stress testing should be done frequently, in order to attest the soundness of the strategy.

7. “*Up-front refinancing savings structures should be avoided*” – One might read short-termism should be avoided. Realising savings on the first periods of a financial operation at the cost of postponing other problems can create difficulties to the firm in the future.

8. *Internal auditors contribute to improve the effectiveness of a firm’s risk management strategy* – it is important for a firm to frequently assess its needs in terms of risk management, as well as adjust and improve strategies already undertaken.
9. **The ownership entities should be aware and approve a risk management strategy** – ensuring a proper evaluation about the strategy is important. The discussion and approval by the board, or the supervisory board, should therefore be a requirement.

### 3.3.2. Regulatory/Supervision Level

Having considered the best practices at a firm level, which can be valid for firms in general, it is no less important to ensure that SOEs in particular follow these good practices. As discussed before, sometimes there can be incentives and pressure to deviate from these standards. Therefore, these recommendations in a regulatory and supervision level come as another step to enforce good hedging practices within SOEs.

In this sense, authorities should consider best practices in terms in SOEs at a regulatory level grounded on the following 4 pillars:

1. **Transparency must be a requirement**\(^{24}\) – reporting standards must be clear and assure at least a minimum degree of transparency in a firm’s accounts. In the Portuguese case, relatively outdated accounting standards made it very difficult to detect the problems in SOEs at first.

2. **Periodic supervision and monitoring by State auditors** – external auditing can be crucial to detect problems. In the Portuguese case, the IGF and Tribunal de Contas (Court of Auditors) proved to be essential in unveiling problematic swap contracts.

3. **Establish a standardised ground in which SOEs can propose a risk management strategy** – firms should be able to assess the risks they face, and they should have the flexibility to develop a simple hedging strategy.

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\(^{24}\) The topic of transparency appears in both levels, but in different ways. A firm should adopt transparent criteria. But at a regulatory level authorities must obligate firms to adopt transparent reporting standards at least to some degree.
4. *Proposed risk management strategies in SOEs should require analysis and approval by authorities* – the most important point, as it guarantees that any proposed strategy would have to be evaluated by a competent authority. In Portugal this role came to fall in the IGCP hands.

These points materialise our view that the best regulatory approach is one more approximate to the HM Treasury. The general concept is that individual SOEs would have enough flexibility to develop an adequate hedging strategy to its individual needs, while on the other hand authorities would have a role of overseeing and approval.

Observing the changes in Portugal, what happened is close to this view, especially when considering the role of the IGCP towards non-reclassified SOEs (EPNRs), as expressed before. However, regarding reclassified SOEs (EPRs), in which are included some of the most problematic in the “Swaps Case”, the management of their swap portfolio is centralised in the IGCP. Such centralisation is understandable as a short-term measure, *i.e.* in terms of problem resolution, being this authority in charge of closing problematic contracts. To sustain this centralised policy over the long term clearly deviates from the view of this study.
4. Case study analysis of Metro do Porto (MdP)

Metro do Porto is a transport utility company, created to manage and develop the subway network in the metropolitan area of Porto, operating since 2002. Table 2 summarizes the evolution of relevant accounting data from the company’s annual reports since 1 2006.

Table 2 - Accounting data from MdP, taken from the annual reports for 2006-2013.

<table>
<thead>
<tr>
<th>Years</th>
<th>Equity</th>
<th>Total Liabilities</th>
<th>Total Assets (Equity + Liabilities)</th>
<th>Funding (Long term)</th>
<th>Derivatives</th>
</tr>
</thead>
<tbody>
<tr>
<td>(POC) 2006</td>
<td>207,668,676</td>
<td>1,811,018,897</td>
<td>2,018,687,573</td>
<td>1,341,245,894</td>
<td>-</td>
</tr>
<tr>
<td>(POC) 2007</td>
<td>70,418,021</td>
<td>1,941,801,540</td>
<td>2,012,219,560</td>
<td>1,453,090,087</td>
<td>-</td>
</tr>
<tr>
<td>(POC) 2008</td>
<td>-68,301,179</td>
<td>2,129,309,299</td>
<td>2,061,008,120</td>
<td>1,917,956,881</td>
<td>-</td>
</tr>
<tr>
<td>(POC) 2009</td>
<td>-154,578,767</td>
<td>2,337,217,926</td>
<td>2,182,639,159</td>
<td>2,114,561,555</td>
<td>-</td>
</tr>
<tr>
<td>(SNC) 2009</td>
<td>-805,199,596</td>
<td>3,038,337,552</td>
<td>2,233,137,956</td>
<td>2,150,333,653</td>
<td>608,461,109</td>
</tr>
<tr>
<td>(SNC) 2010</td>
<td>-1,157,678,433</td>
<td>3,434,537,164</td>
<td>2,276,858,731</td>
<td>2,159,451,641</td>
<td>767,986,267</td>
</tr>
<tr>
<td>(SNC) 2011</td>
<td>-1,269,268,614</td>
<td>3,664,645,912</td>
<td>2,395,377,298</td>
<td>2,414,539,204</td>
<td>684,940,911</td>
</tr>
<tr>
<td>(SNC) 2012</td>
<td>-1,738,559,397</td>
<td>4,079,290,283</td>
<td>2,340,730,886</td>
<td>2,520,925,574</td>
<td>914,402,629</td>
</tr>
<tr>
<td>(SNC) 2013</td>
<td>-1,788,576,729</td>
<td>4,075,184,890</td>
<td>2,286,608,161</td>
<td>2,720,740,757</td>
<td>16,437,615</td>
</tr>
</tbody>
</table>

The accounting standards changed in 2010 becoming mandatory the discrimination of the derivatives portfolio in the Cash Flow Statement. The impact of the adoption of the new accounting standards is clear from the comparison of the accounting values for 2009 according the two standards.

The equity of MdP becomes increasingly negative after 2008 which corresponds to a technical bankruptcy, still surviving because it is an SOE in the utilities sector. The main source of funding is debt. In the first four years, the Funding column values, which represent

---

2 POC is the former accounting standard in Portugal, before the adoption of the new standards in 2010.
3 SNC is the present accounting standard, adopted since 2010 in order to respond to international standards and a harmonisation among European Union Member States. It also made obligatory to present in annual reports the Marked-to-Market value of financial derivative instruments, relatively to hedging activities, commonly known as Hedge Accounting, accordingly to IAS 39.
mostly long term bank loans, tend to accompany the Total Liabilities values, representing 75% to 90% of them. These values were regarded as normal not only because it is a very recent state company but also because it needed vast quantities of liquidity in order to finance its operations, which includes building new railways. Some of these loans were given by the European Investment Bank (EIB), and some of them with governmental guarantees. With such high debt levels, there might exist some incentives in terms of lowering the amount of interests paid. However, in an environment of financial constraints, in which the Government is not able to provide additional loan guarantees and also demands for less expenses, such incentives might turn into real pressure.

In 2009 the Total Liabilities values diverge significantly according to the two standards. In the new accounting standards, Total Liabilities are much higher and more importantly, in the proportion of roughly the same value accounted for Derivatives. In the following years, this increasingly greater gap between Funding and Total Liabilities can be mostly attributed to an increasingly higher value of Derivatives, until the 2013, when the IGCP took charge of the MdP derivatives portfolio. This can attest that the accounting standards were a relevant issue, and if SNC were to be implemented quicker, it would have been possible to make a clear picture before 2010. A note in 2007’s report from Ernst & Young, MdP’s external auditor at the time, emphasises exactly that, noticing that there were 5 active Swap contracts and that they should be presented according with IAS 39\(^4\), even if the legal framework did not require such at the time.

The fair value of the derivatives portfolio is known only since 2009 (and even this year’s numbers were only published according to the IAS 39 in the 2010 report). Even so, the general expectations about the evolution of the interest rates were broken in late 2008 after the default of Lehmann Brothers, which means that derivatives traded with previous expectations concerning interest-rate, either for hedging or speculative reasons should be realising losses from 2009 onward. That is what happened in MdP, as it is observable in the following table:

\(^4\) IAS refers to International Accounting Standards, and the 39\(^{th}\) article is relative to Hedge Accounting.
Table 3 - Fair Value of MdP’s Derivatives from 2009 to 2013. Values taken from MdP’s annual reports.

<table>
<thead>
<tr>
<th>Years</th>
<th>Fair Value of Hedge Instruments for Accounting Purposes</th>
<th>Fair Value of Non Hedge Instruments for Accounting Purposes</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>-8,631,131</td>
<td>-569,539,572</td>
<td>-578,170,703</td>
</tr>
<tr>
<td>2010</td>
<td>-10,442,274</td>
<td>-736,638,623</td>
<td>-747,080,897</td>
</tr>
<tr>
<td>2011</td>
<td>-15,957,689</td>
<td>-640,542,078</td>
<td>-656,499,767</td>
</tr>
<tr>
<td>2012</td>
<td>-20,361,276</td>
<td>-869,296,756</td>
<td>-889,658,032</td>
</tr>
</tbody>
</table>

The fair value of the derivative contracts generally decreased over time, during which the reference Euribor rate fell to approximately 0.5% and remained low now. In 2013 the IGCP closed most of the non-hedge contracts, which explains the drastic change in the numbers.

For accounting purposes the contracts are categorised in Hedge and Non-Hedge instruments. The annual reports since 2012 mention the contracts do not meet the necessary conditions to be considered as hedge accounting except for one. From the table 3 it is clear that these Non-Hedge contracts made the most damage to MdP’s accounts and the magnitude of their losses can actually endanger the financial soundness of the company.

Moreover, the annual reports mention repeatedly that the company has a “proactive - not a reactive” position in the presence of movements in the interest rate markets, making a permanent monitoring of these markets. Such monitoring needs a great deal of know-how and attention on a daily basis, and clearly deviates from the core business of the company, contradicting the overall approach of good practices mentioned throughout this study.

One important issue that deserves special analysis is the types of the contracts traded by MdP. Specific information about these contracts remains classified, but some of these contracts were unveiled by the international press, namely the Snowball with Santander presented with more detail in the next section, and the Index Swap renegotiated with Goldman Sachs and later on renegotiated with Nomura with highly complex structures.
4.1. The Snowball case

As mentioned before, the information about the swap contracts is limited, as it remains confidential for the most part. Most of problematic the contracts were renegotiated or simply terminated by the IGCP, as most of the banks agreed to the proposed terms. However, some contracts remain in litigation in the London courts. One of these contracts came to public knowledge through Osborn (2014) and later on also referred by Levine (2014), which was a Snowball Swap traded by Medtro do Porto (MdP) in 2007.

According to the original article, the author had access to the defense documents, and it is described that in 2005 the company was urged to reduce its fixed-rate of 4.76% semi-annually relative to a straightforward 20-year fixed-for-floating swap. This contract, traded with Banco Comercial Português (BCP), was initially designed to cover a floating 20-year loan, which was an adequate hedging strategy considering interest-rate risk. After considering the proposals from various banks, MdP entered in another swap with Banco Santader Totta (BST), with an underlying of 89 Million euros, in which the bank agreed to pay a fixed coupon of 4.76% semi-annually. In the opposite direction, MdP agreed not only to pay the bank a semi-annual coupon of 1.76%, but also a quarterly floating rate coupon with a calculated spread tied to the 3-month Euribor that responded to the following conditions that would only become active after the first two years:

- Previous quarter spread, plus:
  - 2 times the difference between 2% and 3-month Euribor at the payment period of the coupon, if 3-month Euribor is below 2%;
  - Or, 2 times the difference between 3-month Euribor, at the payment period of the coupon, and 6%, if 3-month Euribor is above 6%
- Or, Previous quarter spread, minus:
  - 0.5% if 3-month Euribor at the payment of the coupon was between 2% and 6%, but the spread would never go negative.
In a simpler way, we can explain that, after two years, for every quarter that 3-month Euribor would be outside the interval of 2% and 6%, the clause would be activated, having a memory effect, i.e. taking into account the previous spread. The calculated spread would successively decrease in 0.5% for each time the 3-month Euribor was in the interval of 2% and 6%, but never going below zero.

Considering the characteristics of this contract, as it does not have any reset clauses or caps (as the bank safeguarded itself against the calculated spread going negative), it fits in the 5th category of the complexity scale proposed by the IGCP.

Assembled this information about the Snowball contract, the following analysis intends to assess the decision taken by MdP, taking into account the structure of future cash flows in different scenarios for the 3-month Euribor and the adequacy of such derivative.

4.2. Methodology and Results

4.2.1 Day-1 Present Value

In order to calculate the Day-1 Present Value (Day-1 PV) of the contract we took into account the 9th of March 2007, as the starting date of the contract, before the Subprime crisis.

The Cox-Ingersoll-Ross model (CIR) due to Cox et al. (1985), is used to simulate of possible future paths of interest rates only using the data available at the described periods in time, and which can be described as in Kladivko (2007):

\[ dr_t = \alpha (\mu - r_t) dt + \sqrt{r_t} \sigma dW_t \]  

(1)

5 Explicit information about the exact emission date of the contract was not given. However, through the articles researched, it is known that the first time that the calculated spread was activated was in the 11th of March 2009. The contract was explicitly celebrated in 2007, and the calculated spread was not to be activated in the first two years of the contract. So, the Snowball contract must have been traded in the roughly two years before the calculated spread was activated. As the 11th of January 2007 is a Sunday, we assumed the date immediately before.
Where \( r_t \) is the interest rate and \( \Theta \equiv (\alpha, \mu, \sigma) \) are model parameters. The drift function \( \mu(r_t, \Theta) = \alpha(\mu - r_t) \) is linear and possesses a mean reverting property, i.e. interest rate \( r_t \) moves in the direction of its mean \( \mu \) at speed \( \alpha \). The diffusion function \( \sigma^2(r_t, \Theta) = r_t \sigma^2 \) is proportional to the interest rate \( r_t \) and ensures that the process stays on a positive domain. The term \( W_t \) is a standard Brownian motion. If \( \alpha, \mu \) and \( \sigma \) are all positive and \( 2\alpha\mu \geq \sigma^2 \) holds, the CIR process is well defined, having a steady state distribution, while the density is gamma distributed.

The estimation of the CIR model’s parameters \((\alpha, \mu, \sigma)\), follows the methodology presented in (Kladivo (2007)), consisting of the estimation by Maximum Likelihood, using Matlab. For such, it is necessary to define the probability density function. So, given \( r_t \) at time \( t \), the density of \( r_{t+\Delta t} \) at time \( t + \Delta t \) is as follows:

\[
p(r_{t+\Delta t} | r_t; \Theta, \Delta t) = c e^{-u-v} \left( \frac{v}{u} \right)^q I_q(2\sqrt{uv}), \tag{2}
\]

Where,

\[
c = \frac{2\alpha}{\sigma^2(1-e^{-\alpha\Delta t})} \tag{3}
\]

\[
u = cr_t e^{-\alpha\Delta t} \tag{4}
\]

\[
v = cr_{t+\Delta t} \tag{5}
\]

\[
q = \frac{2\alpha\mu}{\sigma^2} - 1 \tag{6}
\]

And \( I_q(2\sqrt{uv}) \) is a modified Bessel function of the first kind and order \( q \). Having so, it is possible to derive the log-likelihood function of the CIR process as follows:

\[
\ln L(\Theta) = (N-1) \ln c + \sum_{t=1}^N \left\{ -u_t - v_{t+1} + 0.5q \ln \left( \frac{v_{t+1}}{u_t} \right) + \ln \left[ I_q \left( 2\sqrt{u_{t+1}v_t} \right) \right] \right\} \tag{7}
\]
Where \( u_t = e^{-\alpha \Delta t} \) and \( v_{t+1} = c r_{t+1} \). The maximum likelihood estimates \( \hat{\theta} \) of parameter vector \( \theta \) can be found by maximizing the log likelihood function\(^6\), considering the parameter space:

\[
\hat{\theta} \equiv (\hat{\alpha}, \hat{\mu}, \hat{\sigma}) = \arg \max_{\theta} \ln L(\theta) \tag{8}
\]

The data used to estimate the parameters of the model was the daily 3-month Euribor\(^7\) rates, for every business day, between January of 2001, until 9th of March of 2007. The Matlab computations can be found in Annex 3, and the time step considered was of 1/250, or 0.004, as the data provided consists in business days values.

The estimates until 2007 were the following:

\[\begin{array}{|c|c|}
\hline
\text{Parameter} & \text{Estimate} \\
\hline
\alpha & 0.330598 \\
\mu & 0.024581 \\
\sigma & 0.014274 \\
\hline
\end{array}\]

With this data, and attributing random values to the white noise process \( dW \) following \( N \sim (0,1) \), it is possible to make a prediction using this stochastic model, in equation 1, for the daily 3-month Euribor over the next 14 years, until the maturity of the Snowball contract. However, concerns arise assuming such extended period of time, as we can argue how accurate can predictions be for this timeframe.

After having built the complex structure of possible cash flows of the Snowball contract on Excel, we inputted this prediction of 3-month Euribor in order to observe the possible changes in the calculated spread for every future quarter, which enabled me to make a forecast of the Day-1 PV of the swap contract. Obviously, one cannot only assume one

\(^6\) Such maximisation can be done using the “fminsearch” function, which is a standard feature of Matlab.

series of values for the random noise process, for which reason we did a Monte Carlo simulation, using Crystal Ball\textsuperscript{8} software, having set this \(dW\) as a variable following \(N\sim(0,1)\) for every day of the forecast, running a thousand trials. The forecast results are presented in Figure 2.

![Figure 2 - Monte Carlo Simulation of Day-1 Present Value for the Snowball contract using the Cox-Ingersoll-Ross model, with data until March 9\textsuperscript{th} of 2007](image)

What we observe with this simulation is that, there is more than a 90\% probability (y axis, on the left) that the contract’s Day-1 PV reaches over 57 Million euros (x axis), with a 95\% degree of confidence. Actually, the values would most certainly be comprised roughly between 52 and 58 Million euros.

Normally, the Day-1 Present Value should be null, or at least very close to zero. This is an essential condition for both sides to be interested in negotiating the trade. Automatically, such value raises questions about the contract, and what clauses are implied.

\textsuperscript{8} Crystal Ball is a software that works as an add-in for Excel
A possible explanation is the fact that information in use might not be perfect, meaning that access to the contract itself was not granted, and so, there might be some clauses outside of our knowledge.

On another hand, the results mean that the forecast of the interest rates through CIR rarely, or even never, fell below the barrier of 2% or rose above the 6% barrier in the simulation. In fact, the CIR model used, given the parameter estimates, might have a very stable behaviour around the long term mean (estimated around 2.5%). In order to illustrate this we present figure 3:

![3-month Euribor prediction using CIR](image)

*Figure 3 - Example of a prediction of 3-month Euribor using CIR*

It is important to stress the fact that figure 3 represents a mere example of one random prediction (the Monte Carlo simulation ran a thousand random trials for each day), being just a simple illustration. Nevertheless, the blue line represents the prediction of the 3-month Euribor (y axis) for each day after the celebration of the contract (x axis), while the flat orange line is the estimated long term mean. Evidently, the behaviour of the predicted 3-month Euribor is stable enough around its long term mean (mostly above) so that it never leaves the 2%-6% interval. This means that the behaviour of our predictions is favourable to the structure of the Snowball contract, and so, this is a plausible explanation for the highly positive Day-1 Present Value.

Although, the main aspect to retain from this analysis is that our day-1 present value is far from being null, which is a reason against the trade.
4.2.2. Adequacy of the Strategy

The initial contract traded with BCP was a simple fixed-for-floating swap contract, with an agreed 4.76% semi-annual fixed rate coupon. The purpose of the contract was very straightforward, hedging MdP against increases in the interest rate over the fixed rate. After the renegotiation with Santander it is not so simple to identify what is the contract hedging against. Given the terms of the contract described in section 4.1, one might say that MdP would be hedging against fluctuations in the interest rate, as long as these fluctuations did not exceed the barriers of 2% and 6%. Historically, since the introduction of the euro, Euribor rates had never left this interval (recall figure 1), which might be a reason why MdP agreed the terms. Nevertheless, for such an extended period of time as 14 years, to assume interest rates would continue to be relatively stable between this range is questionable.

Relatively to the cash flows, it is simple to observe that if the 2% and 6% barriers are not transposed, the firm would receive a constant stream of 1,566,400 euros semi-annually until maturity (4.76% minus 1.765%, times the notional of 89 Million euros). However, reading the conditions of the calculated spread, some concerns can arise, and one might ask what happens if one of the established barriers is broken. Table 5 illustrates such scenario, using realised values of the 3-month Euribor in 2009, as a mere example.

<table>
<thead>
<tr>
<th>t</th>
<th>3-month Euribor</th>
<th>Discount Factor(^9)</th>
<th>Discounted Receiving leg CF(^{10})</th>
<th>Discounted Fixed Paying Leg CF</th>
<th>Discounted Variable Paying Leg CF</th>
<th>Sum of the Discounted Cash Flows</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1.663%</td>
<td>1</td>
<td>0.00</td>
<td>0.00</td>
<td>599,860.00</td>
<td>-599,860.00</td>
</tr>
<tr>
<td>0.25</td>
<td>1.277%</td>
<td>0.995851</td>
<td>4,218,823.73</td>
<td>1,559,901.21</td>
<td>1,878,971.91</td>
<td>779,950.61</td>
</tr>
<tr>
<td>0.5</td>
<td>0.773%</td>
<td>0.991719</td>
<td>0.00</td>
<td>0.00</td>
<td>4,037,151.14</td>
<td>-4,037,151.14</td>
</tr>
<tr>
<td>0.75</td>
<td>0.714%</td>
<td>0.987605</td>
<td>4,183,889.65</td>
<td>1,546,984.41</td>
<td>6,281,108.28</td>
<td>-3,644,203.04</td>
</tr>
<tr>
<td>1</td>
<td>0.650%</td>
<td>0.983508</td>
<td>0.00</td>
<td>0.00</td>
<td>8,618,417.34</td>
<td>-8,618,417.34</td>
</tr>
<tr>
<td>1.25</td>
<td>0.719%</td>
<td>0.979427</td>
<td>4,149,244.84</td>
<td>1,534,174.56</td>
<td>10,815,930.67</td>
<td>-8,200,860.39</td>
</tr>
</tbody>
</table>

\(^{9}\) The discount rate used was the first realized rate, 1.663%. Naturally the discount factors are adjusted in time.  
\(^{10}\) CF in this context means Cash Flows.
The table presents a sequence of rates clearly not favourable, considering the terms of the contract. In such context is observable is that the variable cash flows rapidly escalate and more than compensate the positive cash flow streams of the contract. In addition, the variable cash flows are paid quarterly, while the receiving leg only pays semi-annually. This means that we have a more frequent stream of negative cash flows.

In fact, this Snowball contract has an implied memory effect. If things go wrong, to the previous spread is added an additional calculation to form the following spread, and so forth. As there is no reset clause, this dynamic continues until the end of the contract unless the reference rate steps back in the 2%-6% interval. Even so, the pace at which the calculated spread is reduced is very small (0.5% per quarter). All this, allied to the fact that the calculated spread is due to quarterly, are components that can make this contract have great levels of toxicity.

Actually, in order to have a better illustration of how much toxic the contract can be we applied the same methodology as for the Day-1 Present Value, but using data of 3-month Euribor until the middle of January 2009\textsuperscript{11}. The point is simply to present a less favourable scenario in order to observe the reaction of the cash flows. The CIR parameter estimates in this case are presented in table 6.

\begin{table}[h]
\centering
\begin{tabular}{|c|c|}
\hline
Parameter & Estimate \\
\hline
\text{\(\alpha\)} & 0.19051 \\
\hline
\text{\(\mu\)} & 0.01802 \\
\hline
\text{\(\sigma\)} & 0.01552 \\
\hline
\end{tabular}
\caption{Cox-Ingersoll-Ross Parameters, using data until January of 2009}
\end{table}

In such case, an example of how would the 3-month Euribor behave can be found in figure 4.

\textsuperscript{11} The most logical path would be to use data until the 11\textsuperscript{th} of March of 2009, exactly 2 years after the trading of the contract. However, as 3-month Euribor reaches extremely low values, and the CIR model estimates start to present increasingly less plausible values shortly after the 15\textsuperscript{th} of January. Again, the point here is to simply present a less favorable scenario.
As we can observe, in this example 3-month Euribor would stay under the 2% barrier for an extended period of time. The Monte Carlo simulation for such conditions would be the following:
In this hypothetical case it is observable that the probability of having positive present value for the contract decreases drastically, comparing with the simulation for Day-1 Present Value. Not only that, but also the graph presents a long tail towards increasingly negative present values. In such scenario there is a great chance that the snowball would reach incredibly negative present values, up until 11 times the notional of 89 Million euros, with a degree of confidence of 95%. In this case, it would be a serious liability.

This happens, because there is a complete disproportion between the upside and the downside of the contract, meaning that when the 3-month Euribor steps outside the 2%-6% interval, the calculated spread is very fast to increase, and relatively slow to decrease, and so, if one of the barriers is transposed for more than 2 or 3 consecutive quarters it will result in losses that will take much beyond another 2 or 3 quarters to recover from, resulting in a fast decrease in the contract’s value.

In terms of a risk management strategy, one has to consider the profile of the contract as well, and in this case the relevant question to ask is if this Snowball contract is adequate for hedging purposes.

The original loan was had floating rate, so it would be exposed to increases in the interest rate, which is the risk an adequate strategy should hedge against. By the time this snowball swap, the 3 and 6-month Euribor rates were 3.885% and 3.986%, respectively. At this time, the reference rate was within the 2%-6% range, but the contract does not hedge against the rise of the interest rates above 6%. Adding to this, a floating rate loan is naturally hedged against any decreases in the interest rates, but the contract limits this, hedging only until the reference rate reaches 2%. Outside this range, the due periodic variable payments can grow exponentially, without any reset clause. So the adequacy of this contract is very questionable, in terms of simple hedging.
4.2.3. Alternative Plain Vanilla Strategy

In order to illustrate a profile of a simpler risk management strategy, we performed the same Monte Carlo simulations using the data from the BCP contract that preceded the snowball, in order to observe how this simple floating-for-fixed Vanilla swap would have hypothetically behaved, considering present value of future cash flows. In this case, the interest rate paid would still be fixed at 4.76% semi-annually. Considering similar scenarios as the ones illustrated in figures 3 and 4 for the prediction of the interest rate, but in this case relatively to the 6-month Euribor the results were the following:

Figure 6 – Monte Carlo simulation of Present Value of future Cash Flows of the Vanilla contract using the Cox-Ingersoll-Ross Model, in 2007
This represents a simple hedging strategy, in which the firm would keep its payments locked to 4.76%, and thus the contract’s worth would depend if the interest rate would rise above or decrease under that reference. In such a simple contract structure, the firm would neither have huge profits from the contract, nor huge losses, which in essence dictates the mitigation of risk.

From the 2007 to the 2009 scenario, we have an alteration of the paradigm, and the long term average interest rate is lower, thus the becoming the Vanilla contract subject to more losses, but not anything that would endanger the financial soundness of a company greatly. Certainly very different than the snowball profile presented previously.
4.2.4. Case Conclusions

Through this technical analysis it is possible to approach in more detail the characteristics of this contract. In a first approach, the highly positive Day-1 Present Value (around 57 Million euros) is an important indicator that there might be some problems in this contract. Analysing its structure into more detail it is possible to put into question the adequacy of such contract to hedge interest-rate risk. Especially considering the fact that hedging coverage is limited to the interval of 2%-6%. In fact, if the reference rate leaves this interval the losses are very quick to escalate, which raises the point of whether this contract might be adding more risk instead of minimising it.

The difference between the Snowball and the Vanilla swaps profiles is drastic. There is no way that the latter would endanger the financial soundness of the firm. In an adverse environment, it would comprise losses, but there is no disproportion between the way it might create value or generate these losses. That is the reason the snowball contract is inadequate. Its disproportion between upside and downside lead to the question of whether is our belief that interest rates will be stable (2%-6%) so strong that we are predisposed to assume the risk of such not happening. But this is a speculating position, not hedging.

It is important to mention that this final analysis has its limitations. The Day-1 PV, among other present values calculated are valid admitting that the interest rates considered follow a CIR process. Other processes potentially more flexible and adequate might exist, but a comparison between processes and their adequacy is not the within the scope of this study.
4.2.5. Shortcomings in terms of Best Practices Compliance

Regarding the Best Practices comprised within this study it is relatively simple to observe some shortcomings, both a firm and regulatory levels.

At firm level, this snowball case there is a clear deviation from hedging and keeping simple hedging strategies/structures as the contract revealed to have a certain degree of complexity and potential toxicity (5th degree by the IGCP scale). Transparency was also an issue, at firm and regulatory levels, as the accounting standards were not clear in presenting the derivatives portfolio before the SNC, and when the new standards were adopted, it was too late. On another hand, the firm may have relied too much in the fact that historically had never left the 2-6% range before, but when the money market suffered a shock all the assumptions no longer hold. Adding to this, it also seemed that a certain short-termism from managers might have been present, due to the fact that the contract enabled certain refinancing savings for the first 2 years, during which the calculated spread was not to be activated.

Considering the points at a regulatory level, in section 3.3.2, it is clear to observe difficulties in compliance. State auditors (IGF and Tribunal de Contas) had a role in unveiling problems (1st point) in MdP and other SOEs as well, but clearly there was a certain lag between the detecting problems and adopting measures to solve them, which transpires some degree of inefficiency. More importantly, there was a clear lack of supervision (4th point). It is doubtful that the IGCP would approve such complex, toxic and opaque contracts as the Santander’s Snowball or the Nomura’s index swap. Clearly, the risk management flexibility (freedom) in some SOEs, including MdP, was not beneficial.
5. Conclusions

This article addresses some of the aspects of the problems that can occur when dealing with interest-rate swap derivatives within the scope of State Owned Enterprises, especially taking into account the problems faced in Portugal. Derivatives can be useful to hedge risk, but can also be a vehicle to speculate, in which case, being proven the worst case scenarios, they can result in significant losses. That is very much present in the case of the Portuguese SOEs, or more generally when companies try to use derivatives, in this case interest-rate swaps, in order to reduce the cost of their finance instead of managing risk.

The specific condition of SOEs dictates that when a great deal of losses takes place, it will lead to a governmental intervention, which can lead to important impacts on the state budget. Having so, it is important that good practices in terms of interest-rate risk management, not only having the companies coping healthy and strictly hedging strategies by themselves, but also having a system in which there are rules enforcing and assuring that good criteria for hedging purposes are being applied.

The cases in Portugal and Chicago were instrumental to understand inefficiencies that can exist regarding the compliance of good practices in risk management. Particularly in the Portuguese case it was possible to observe the damage that the lack of a supervising authority may induce. Considering both cases, it was possible to contribute to the literature with a synthesis of best practices to apply in SOEs at a firm level. Not neglecting the role of the auditing authorities, this study also emphasises that it is especially important that the approval of derivatives is attributed to a superior authority, who is able both in terms of knowhow and technical instruments to evaluate such contracts. In this regard this study also contributes at a supervision level with a view of a regulatory framework in which authorities are able to execute the enforcement and coping of good practices by SOEs.
In the Portugal, the designated authority came to be the IGCP, which is the institute in charge of handling the emissions of public debt. This institute is the one most able to be in charge of this derivatives approval. Still, one issue is the fact that the control cannot be so strict that SOEs are unable to hedge their risk properly and in due time, and such a worry may rise in a case such as the Portuguese, where the whole problem came strongly into public opinion as a scandal. In this sense, one might question the political will to simply terminate contracts and not pursue with an important aspect of the companies governance that is risk management, and so, it is also important that the approving authority is able to act with some degree of independence.

The analysis of the Snowball contract can be one strong example of how bad things can turn when a speculative approach is done using such financial instruments. Derivatives are useful and important instruments to hedge risk, but can also lead to disastrous consequences. This technical analysis of the case was important to understand how can complex, toxic and relatively opaque contracts may lead to great losses, possibly endanger a firm. Risk management, especially within the scope of SOEs should be simple and straightforward.
6. References


# 8. Annexes

## 8.1. Annex 1 – Types of Contracts

<table>
<thead>
<tr>
<th>Designation of the Instrument</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cancelable Swap</td>
<td>Vanilla Swap in which one of the parties has the option of cancelling the swap, in pre-established dates, during the contract’s life.</td>
</tr>
<tr>
<td>Cap</td>
<td>Option that allows the buyer, through paying a premium, to fix a maximum limit for a determined reference interest rate. Every time that the interest rate rises above the fixed level, the buyer receives the differential.</td>
</tr>
<tr>
<td>Collar</td>
<td>Option structure that consists in the combination of a cap purchase, with the selling of a floor (minimum limit for an interest rate), both with the same characteristics in terms of notional, reference rate and maturity. This structure allows the buyer to establish a maximum and a minimum limit of fluctuation of the reference rate.</td>
</tr>
<tr>
<td>Cross Currency Swap</td>
<td>Swap of cash flows expressed in different currencies and indexed to different interest rates</td>
</tr>
<tr>
<td>Digital Option</td>
<td>Or Binary Option. It is an option with a pre-determined payout and dependent on the level at which it fixes the reference rate in each period of interest regarding pre-established barriers.</td>
</tr>
<tr>
<td>Fixed/Fixed Swap</td>
<td>Swap in which both coupons are fixed</td>
</tr>
<tr>
<td>Floor</td>
<td>Option that allows the buyer, through the payment of a premium, to fix a minimum limit for the reference rate. Every time that the reference rate falls below that level, the buyer receives the differential.</td>
</tr>
<tr>
<td>Fly or Butterfly</td>
<td>Swap whose coupon is indexed to a (currency) yield curve</td>
</tr>
<tr>
<td>Index linked</td>
<td>Swap indexed to the performance of proprietary indexes of banks. The indexes consist in strategies of algorithms that try to capture market tendencies</td>
</tr>
<tr>
<td>Inflation Linked</td>
<td>Swap indexed to the performance of an inflation index</td>
</tr>
<tr>
<td>Inverse Floater</td>
<td>Swap in which the interest of one of the legs variates contrarily to a reference indexant</td>
</tr>
<tr>
<td><strong>Knock Out Cap</strong></td>
<td>Consists in a combination of a cap (maximum limit) with a “knock-out” barrier (level at which the cap is extinguished. The knock-out is above the cap level). The buyer of this option is protected against a rise of the interest rate above the cap, until the knock-out barrier.</td>
</tr>
<tr>
<td><strong>Plain Vanilla Swap</strong></td>
<td>Or simply vanilla swap. The simplest version of a swap contract, in which there is a trade of variable cash-flows for fixed, or vice-versa.</td>
</tr>
<tr>
<td><strong>Range Accrual</strong></td>
<td>Swap in which the value of the coupon depends on the proportion of days/weeks, in a given period, in which there are verified a determined condition, or set of conditions.</td>
</tr>
<tr>
<td><strong>Snowball</strong></td>
<td>Swap with memory effect. To each coupon is added the value fixed in the previous coupon</td>
</tr>
<tr>
<td><strong>Spread Option</strong></td>
<td>Option whose payout is dependent on the spread between two indexants</td>
</tr>
<tr>
<td><strong>Steepener</strong></td>
<td>Swap whose coupon depends on how steep is a yield curve (difference between rates of short and long terms)</td>
</tr>
<tr>
<td><strong>Step-up Swap</strong></td>
<td>Swap whose coupon is dependent to an interest rate that is increasingly higher during the lifetime of the contract</td>
</tr>
<tr>
<td><strong>Swap with Conditional Spread</strong></td>
<td>Swap whose coupon is dependent to the verification of one or several established conditions about market indexants</td>
</tr>
</tbody>
</table>
| **Swaption** | Option that allows the buyer to enter in an interest-rate swap. There are two types of Swaptions:  
  Payer Swaption – gives the owner the right to enter in an Interest-rate swap in which he pays fixed and receives variable interest  
  Receiver Swaption – gives the owner the right to enter in an Interest-rate swap in which he receives fixed and pays variable interest. |
| **Switchable Swap** | Swap in which the paying interest rate is usually inferior relatively to a vanilla swap, as a counterpart of the right given to the bank to switch the interest rate from fixed to variable, or vice-versa, in pre-established dates, during the lifetime of the swap contract. |
| **Volatility Swap** | Swap indexed to the volatility of an interest rate |
| **Worst of** | Swap whose coupon depends on the lowest value observed for a determined indexant, or for the spread between two indexants. |
### 8.2. Annex 2 – Degrees of complexity scale, by the IGCP

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Vanilla operations and Overlays (operations of hedging of other derivatives without the introduction of new risk factors)</td>
</tr>
<tr>
<td>2</td>
<td>Operations with simple structures that allow partial hedging of interest-rate risk, namely Cancellable Swaps, Collars and KO Collars in their most elementary versions</td>
</tr>
<tr>
<td>3</td>
<td>Operations with some degree of complexity, namely Range Accruals, with one or two conditions, and inverse Floaters.</td>
</tr>
<tr>
<td>4</td>
<td>Operations with complex structures particularly associated to the performance of proprietary indexes of banks, Snowballs with caps or resets, Snowballs over the steepness of the EUR curve and Range Accruals with more than three conditions.</td>
</tr>
<tr>
<td>5</td>
<td>Classification reserved to Snowballs without caps or resets (with the exception of snowballs over the steepness of the EUR curve) given its specificities, namely the high probability of reaching very costly coupons, capable of putting into question the financial viability of the company.</td>
</tr>
</tbody>
</table>
### 8.3. Annex 3 – List of Reclassified (EPR) and Non-Reclassified (EPNR) SOEs

<table>
<thead>
<tr>
<th>Reclassified (EPR)</th>
<th>Non-Reclassified (EPNR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estradas de Portugal (EP)</td>
<td>Águas de Portugal (AdP)&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td>Metro do Porto (MdP)</td>
<td>ANA Aeroportos de Portugal&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>Metro de Lisboa (MdL)</td>
<td>Carris</td>
</tr>
<tr>
<td>Rádio e Televisão Portuguesa (RTP)&lt;sup&gt;3&lt;/sup&gt;</td>
<td>CP</td>
</tr>
<tr>
<td>REFER</td>
<td>EGREP</td>
</tr>
<tr>
<td></td>
<td>Parpública&lt;sup&gt;4&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>STCP</td>
</tr>
<tr>
<td></td>
<td>Transportadora Aérea Portuguesa (TAP)&lt;sup&gt;5&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Transtejo&lt;sup&gt;6&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>1</sup> AdP is a water utility firm in charge of water distribution.
<sup>2</sup> ANA is the company that manages airports in Portugal.
<sup>3</sup> RTP is the national radio and television company.
<sup>4</sup> Parpública is the firm in charge of participations that the Portuguese State has in other companies.
<sup>5</sup> TAP is the national air transportation company in Portugal.
<sup>6</sup> Transtejo is a company that manages ferry-boat transportation across the river Tagus (Tejo) river.
8.4. Annex 4 – Matlab Computation

8.4.1. Initial estimates

% CIR initial parameters estimation
x = Model.Data(1:end-1); % Time series of interest rates observations
dx = diff(Model.Data);
dx = dx./x.^0.5;
regressors = [Model.TimeStep./x.^0.5, Model.TimeStep*x.^0.5];
drift = regressors
dx; % OLS regressors coefficients estimates
res = regressors*drift - dx;
alpha = -drift(2);
mu = -drift(1)/drift(2);
sigma = sqrt(var(res, 1)/Model.TimeStep);
InitialParams = [alpha mu sigma]; % Vector of initial parameters
8.4.2. The MATLAB code of the log-likelihood function
(Besseli command)

function lnL = CIRobjective1(Params, Model)

%======================================================================
% PURPOSE : Log-likelihood objective function (multiplied by -1) for the
% CIR process using the MATLAB besseli function
%
%======================================================================
% USAGE : Model.TimeStep = Delta t
% Model.Data = Time series of interest rates observations
% Params = Model parameters (alpha, mu, sigma)
%
%======================================================================
% RETURNS : lnL = Objective function value
%
%======================================================================

Data = Model.Data;
DataF = Data(2:end);
DataL = Data(1:end-1);
Nobs = length(Data);
TimeStep = Model.TimeStep;
alpha = Params(1);
mu = Params(2);
sigma = Params(3);
c = 2*alpha/(sigma^2*(1-exp(-alpha*TimeStep)));
q = 2*alpha*mu/sigma^2 - 1;
u = c*exp(-alpha*TimeStep)*DataL;
v = c*DataF;
z = 2*sqrt(u.*v);
bf = besseli(q,z,1);
lnL = -(Nobs-1)*log(c) + sum(u + v - 0.5*q*log(v./u) - log(bf) - z);
end
8.4.3. The MATLAB code of the log-likelihood function (using chi-square)

function lnL = CIRobjective2(Params, Model)

%===================================================================
% PURPOSE : Log-likelihood objective function (multiplied by -1) for the
% CIR process using MATLAB ncx2pdf function.
%
%===================================================================

% USAGE : Model.TimeStep = Delta t
% Model.Data = Time series of interest rates observations
% Params = Model parameters (alpha, mu, sigma)
%
%===================================================================

% RETURNS : lnL = Objective function value
%
%===================================================================

Data = Model.Data;
DataF = Data(2:end);
DataL = Data(1:end-1);
TimeStep = Model.TimeStep;
alpha = Params(1);
mu = Params(2);
sigma = Params(3);
c = 2*alpha/(sigma^2*(1-exp(-alpha*TimeStep)));
q = 2*alpha*mu/sigma^2-1;
u = c*exp(-alpha*TimeStep)*DataL;
v = c*DataF;
s = 2*c*DataF;
nc = 2*u; % noncentrality parameter
df = 2*q+2; % degrees of freedom
gpdf = ncx2pdf(s, df, nc);
ppdf = 2*c*gpdf;
lnL = sum(-log(ppdf));
end