

OPINION

Is the repo a derivative?

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Abstract

An explanation of a derivative instrument (forward, future, swap, option, etc) generally encompasses that the instrument is derived from, i.e. is based on, certain, or aspects of certain, financial market instruments, and takes its value largely from these or other instruments or markets. Explanations also refer to the underlying instrument. No textbooks regard the repurchase agreement (repo) as a derivative instrument. This article argues that the repo is derived from an existing financial market instrument (the underlying instrument) and takes its value from another segment of the financial market. As such, it should be regarded as a derivative instrument. In addition, the use of the word repo is often misrepresented, and the mathematics involved in repos is not readily available in the literature. This article endeavours to address these issues.

1. Introduction

The literature on the derivative markets and the spot (cash) financial markets do not treat the celebrated repo as a derivative instrument. It is regarded by the authors as a money market instrument, similar in nature to *normal* money market instruments such as the treasury bill (TB) and the negotiable certificate of deposit (NCD). It is our opinion that the repo should be classified as a derivative instrument.

The term repo is often used erroneously and is therefore confusing to students and others. The mathematics pertaining to repos undertaken in money market instruments is straightforward; however, when bonds are the underlying instruments of repos the mathematics is not straightforward.

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The purpose of this brief article is to attempt to make a case for the repo to be regarded as a derivative instrument, as well as to address the terminology and mathematics issues. Section 2 defines a repo, elucidates its elements, and provides an example. Section 3 describes the various terms used in the past and present to describe this instrument, and the motivation underlying repos. Section 4 provides an analysis: the “for and against” arguments. Section 5 presents the mathematics of the repo market, and section 6 concludes.

2. Definition and description

(a) Introduction

A repo may be defined as a contractual obligation in terms of which an existing security is sold spot at a price that approximates its market value, coupled with an agreement to repurchase the same security on a specified or unspecified date in the future at an agreed price that reflects the price of money for the period of the repo. A repo is therefore a simultaneous spot sale and forward purchase of the same instrument. The two parties to the repo are called the *seller* (sometimes called the *maker*) and the *buyer*.

There are two repo types: the fixed-rate repo and the floating-rate repo. The latter may be categorised into two sub-types: the floating-rate open repo and the floating-rate fixed-term repo. Both these carry a rate linked to an agreed benchmark rate (in South Africa usually one of the JIBAR rates), but the floating rate open repo has no termination date, whereas the floating-rate fixed-term repo has a fixed termination date. The floating rate open repo terminates when the seller or the buyer exercises the free option which both have to terminate with one day’s notice.

The repo that we focus on here, which we regard as a derivative, is the fixed-rate repo and this means that the definition given above applies but excludes the words “or unspecified” (date). To recap:

A repo is a contractual obligation in terms of which an existing security is sold spot at a price that approximates its market value, coupled with an agreement to repurchase the same security on a specified date in the future at an agreed price that reflects the price of money for the period of the repo.

The definition perhaps requires further elaboration. For this purpose we dissect the definition as follows.

(b) Contractual obligation

The transaction note of a broker-dealer confirming the sale of the security can include a note stipulating the agreement to repurchase. Alternatively (and usually), two transaction notes can be issued, ie a sale note together with a purchase note dated for the agreed repurchase date. It is market practice that underlying all repos is the ISDA Master Repurchase Agreement, an internationally recognised repo contract [drawn up by the International Securities and Derivatives Association (ISDA)].

(c) Existing security

The seller of the repo sells a security already in issue to the buyer. The securities that underlie repos are usually fixed-rate interest rate instruments, such as bonds and money market securities. In order to eliminate credit risk in the repo deal, the securities used are usually government securities (treasury bills and government bonds). The securities have a maturity date beyond the termination date of the repo.⁷

(d) Market value

The security underlying a repo is sold at its market value. However, in some cases (usually in the case where money market securities are involved and the buyer insists on a “comfort margin”) the securities are sold at a lower price (higher rate) than market value. If the seller fails to repurchase the security at termination of the repo, the holder acquires title to it and has the right to sell it in the market. For example, if the value of TBs sold under repo is R9 500 000, the repo is done at a value of R9 450 000, and the interest factor for the period of the repo is R35 000 (total = R9 485 000), the buyer is protected should the maker default.

The above will become clearer in the section covering the mathematics of repos.

(e) Price of money

The price of money applicable to the repo is the current market rate of interest for the period of the repo, for example 14 days. Let’s call it the market repo rate (*mrr*) to differentiate it from the central bank’s repo rate. It bears no relevance to the current rate of interest that applies to the underlying instrument. The *mrr* does however affect the price of the security at which it is sold back to the

⁷ In some repos the seller has the right to switch securities, but the substituted security is stipulated and is usually of the same type (credit rating).

original seller.

It will be evident that the *mrr* is regarded as a borrowing rate for the seller of the repo and as a lending rate for the buyer of the repo. The *mrr* for the term of the repo is agreed between the seller and the buyer at the time of making the agreement.

(f) Specified maturity date

The specified maturity date is the date when the repo is terminated. The buyer sells the security / securities underlying the repo back to the seller at a price that takes into account the *mrr* agreed. In the case of money market securities the mathematics is simple and in the case of bonds a little less simple.

An example of a repo is presented in Figure 1.

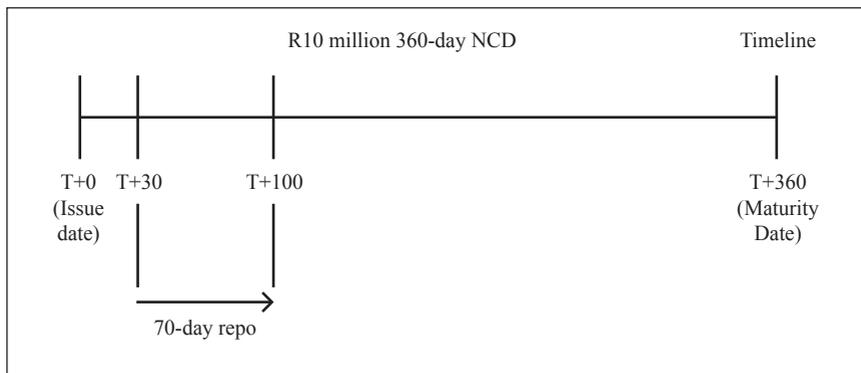


Figure 1. Repo example.

A bank has in its portfolio a R10 million NCD of another bank (it may not hold its own liabilities) that it is holding in order to make a capital profit when rates fall. The NCD had 360 days to maturity when it was purchased. It is now day T+30 in the life of the NCD (ie it has 330 days to run – to maturity), and the bank needs funding for a particular deal that has 70 days to run. The bank sells the NCD to a party that has funds available for 70 days under agreement to repurchase the same NCD after 70 days. The rate agreed is the current market interest rate for loans / borrowing for 70 days.

Before presenting an analysis of this type of repo deal, we present a section on the terminology of the repo market.

3. Terminology pertaining to repos

The terminology related to the repo is often confusing. The term *repurchase* agreement applies to the seller of the agreement. S/he sells the security spot and agrees to *repurchase* the security on the termination date in the future (forward purchase). The buyer of the agreement, on the other hand, does a *resale agreement*. He agrees to buy the security spot and to *resell* the security to the maker of the agreement on termination date (forward sale).

Synonyms for the repurchase agreement are:

- *Buy-back agreement* (point of view of the maker) and *sell-back agreement* (point of view of the buyer).
- *Warehousing transaction*. The seller is doing a *warehousing transaction* and the buyer is *warehousing* an asset.
- *Repo-in* and *repo-out*. The former is a *resale or sell-back agreement* and the latter a *repurchase or buy-back agreement*.
- *Carry*. The maker would say he is having securities *carried*, while the buyer would say he is *carrying* securities. Notable in this regard is the fact that the *JSE Interest Rate Exchange* (Yield-X) embraces this terminology: it has a repo product called “j-Carries: buy-sell back transactions”.

The terminology used by many central banks in their accommodation procedures and open market operations is a little confusing. The central banks usually say that they accommodate the banks by doing *repos* at the *repo rate*, and at times when it “mops up” liquidity it calls these transactions *reverse repos*. As we now know, the normal use of the word is:

Repo = repurchase agreement = sale of security with undertaking to repurchase it on a date in the future.

Derived from this:

Reverse repo = resale agreement = purchase of security with undertaking to resell it on a date in the future.

When a central bank accommodates the banking system it *purchases* eligible securities from the banks and has the obligation to sell the same securities back to them in the future. In our opinion this is a *reverse repo* and *not a repo* as the central states. *The banks being accommodated by the central bank are doing repos with the central bank.*

The converse is also true: when the central bank does what it calls a reverse

repo, it is actually doing a repo. We suggest that the central bank switches use of the words repo and reverse repo or amends its repo terminology to:

Accommodates banks = buys securities from banks under repo = repo-in.

Destroys cash reserves = sells securities to banks under repo = repo-out.

4. Motivation for repos

There are many participants in the repo market and many motivations for the creation of this instrument. Most central banks around the world accommodate the banks with repos-in and make the market short (destroy cash reserves) with repos-out. In addition to the bank-central bank repos, the banks are involved with many parties in the repo market, such as pension funds, foreign investors and speculators (which includes the banks themselves).

The majority of repos are effected with bonds as the underlying instrument, and the pursuit of extraordinary profit in a brief period in this market (ie speculation) is a major genesis-factor in bond repos. It involves the taking of a *position* in a bond and financing it in the money market, ie buying a bond outright, selling it under repo, repurchasing it on the termination date of the repo and selling it outright on that date. Many repos are also done in NCDs.

A simple example is perhaps useful: a wealthy speculator who believes that NCD rates are about to fall sharply (say in the next 7 days) buy a new⁸ 1-year NCD to the value of R10 million at the spot market rate of 10.0%. The consideration (amount of the deposit) is R10 million (= present value - PV) and the maturity value (= future value - FV) is R11 000 000 [$10\,000\,000 \times (1 + 0.1 \times 365 / 365)$].

S/he does not have the funds to undertake this transaction, but has the creditworthiness to borrow this amount in the view of a broker-dealer in repos. The speculator immediately sells the R10 million NCD to the broker-dealer for 7 days at 10.2% pa (the rate for 7-day money). The broker-dealer in turn on-sells the NCD to a pension fund for 7 days at 10.0% pa.

Assume now that the 1-year NCD rate falls to 9.0% pa on day seven. The broker-dealer unwinds the repo deal and pays the pension fund R10 million plus interest at 10% pa for 7 days ($R10\,000\,000 \times 0.10 \times 7 / 365 = R19\,178.08$), ie R10 019 178.08. The broker-dealer then sells the NCD back to the speculator

⁸ Above we said that repos are done with existing (i.e. secondary market) securities. In real life this is so, but this deal-type also occurs (i.e. where a speculator takes a position in a primary market issue).

for R10 million plus interest at 10.2% pa ($R10\,000\,000 \times 0.102 \times 7 / 365 = R19\,561.64$), ie R10 019 561.64. The broker-dealer's profit is 0.2% on R10 million for 7 days ($R10\,000\,000 \times 0.002 \times 7 / 365 = R383.56$) = the difference between the two above amounts (R383.56).

The speculator sells the NCD in the money market at the market rate of 9.0% (remember he bought it at 10.0%). The consideration (PV) = $FV / (1 + 0.09 \times 358 / 365) = R11\,000\,000 / (1 + 0.09 \times 358 / 365) = R10\,107\,748.85$). His profit on the 1-year-less-7-days NCD is this consideration less the amount he paid the broker-dealer = $R10\,107\,748.85 - R10\,019\,561.64 = R88\,187.21$.

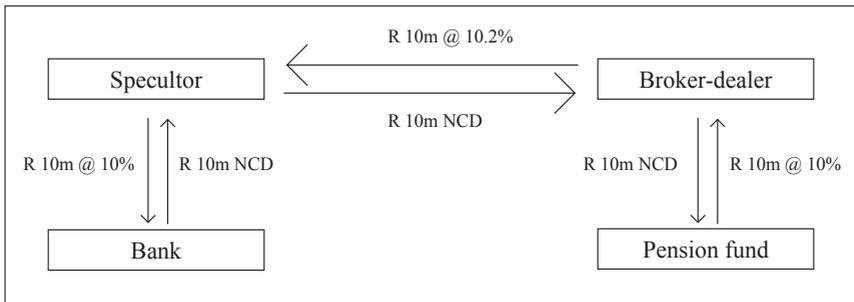


Figure 2. Onset of repo deal.

This deal may be depicted as in Figure 2 and Figure 3.

It will be evident that the speculator sold the NCDs to the broker-dealer under *repurchase agreement* for 7 days (or had them *carried / warehoused*) for this period). The broker-dealer did a *resale agreement* for 7 days with the speculator (or *carried* the NCDs), and a *repurchase agreement* with the pension fund (or had the NCDs *carried* by the pension fund). The pension fund did a *resale agreement* with the broker, or *carried* the NCDs for 7 days.

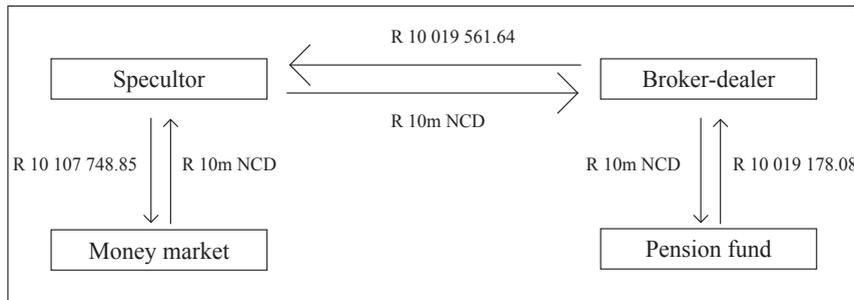


Figure 2. Termination of repo deal.

5. Analysis: is the repo a derivative?

In the above example the NCD speculator sold the NCD spot and purchased it forward at a fixed amount (= original consideration + the money market rate for 7 days applied to the consideration). The broker-dealer bought the NCD spot from the speculator and sold it forward. For the same dates the broker-dealer sold the NCD spot and bought it forward. The pension fund also bought the NCD spot and sold it forward.

The repo may thus be seen as a combination of a spot and a forward transaction, specifically a spot sale / purchase and a simultaneous forward purchase / sale of the same instrument. The applicable rate of interest on the repo is not the current market rate of the NCD, but the current market rate for a money loan for 7 days. This rate is applied to the consideration (at the market rate) of the NCD on the date the repo is made in order to determine the price at which the instrument “arrives” back in the books of the seller. From this information we can say the following:

- The repo is a separate instrument; it can be traded in the money market.
- It is derived from a specific NCD; i.e. the NCD is the underlying instrument.
- The rate of interest applicable on the repo is the price of money for the period of the repo.
- It is bought at a price and terminates at a price that reflects the original price and the *mrr*.

Compare this to a forward or future on a specific NCD:

- The future is a separate instrument; it can be traded (by doing an opposite deal - with the exchange in the case of the future).
- It is derived from a specific NCD; i.e. the NCD is the underlying instrument.
- The fair value of the future at any point in its life is the spot price enhanced by the rate of interest for the remaining period of the future (the money market rate – in this case the risk-free rate), less the income accruing in the period of the repo.

Surely this is a strong case for regarding the repo as a derivative. However, we feel obliged to present possible “arguments against”.

It may be said that the repo for the buyer is just an interest bearing instrument: the buyer lays out a sum of money and earns a stipulated interest rate on the sum (the *mrr*). This is true, but for the maker of the repo it is a different story (as already described).

It may also be said that derivatives are created as hedging instruments. This

is true, but they may also be used as investments. For example, a person who wants an exposure to the share market can buy the future on an index of his choice and simply roll it over (i.e. renew it) on the termination date of the future.

While the repo is not created as a hedging instrument, it can in fact be used to hedge certain derivatives, such as FRAs and the floating rate in a swap.

In our view the “arguments against” are insignificant when pitted against the “arguments for”. Conclusion: the repo should be regarded as a derivative instrument. It is notable in this regard that the JSE’s interest rate derivatives exchange, Yield-X, has chosen to include in its list of products the repo called “j-Carries”.

6. Mathematics of the repo market

Repos are dealt on a yield basis: the interest rate is quoted and paid on an interest add-on basis. With money market instruments as the underlying assets there are two repo deal-types:

- Where a consideration of a rounded amount is agreed and interest at the agreed *mrr* for the period is simply added to this amount to determine the termination amount.
- Same as above, but the interest is applied to the market-determined consideration.

Here we discuss the former and the instrument we use is the NCD.

The time value of money applies, i.e. the present value-future value (PV-FV) formulae apply:

$$TC = C \times [1 + (ir \times t)]$$

where

$$TC = FV = \text{termination consideration}$$

$$C = PV = \text{consideration (ie rounded amount)}$$

$$ir = \text{agreed } mrr \text{ expressed as a fraction of 1}$$

$$t = \text{term of the repo expressed as number of days / 365.}$$

We assume the following:

$$\text{Original term to maturity of the NCD} = 334 \text{ days}$$

$$\text{Issue rate} = 7.25\% \text{ pa}$$

$$\text{Deposit amount (consideration – C)} = R10\,000\,000.00$$

$$\text{Maturity value (MV = FV)} = R10\,663\,424.66.$$

$$\text{Remaining term to maturity (when repo is done)} = 210 \text{ days}$$

$$\text{Repo term} = 7 \text{ days}$$

$$\text{Market rate} = 6.75\% \text{ pa}$$

mrr

= 6.50% pa.

The MV (= FV) of the NCD is calculated according to the PV-FV formula:

$$\begin{aligned} \text{MV} &= C \times [1 + (ir \times t)] \\ &= R10\,000\,000 \times [1 + (0.0725 \times 334 / 365)] \\ &= R10\,000\,000 \times 1.06634247 \\ &= R10\,663\,424.66. \end{aligned}$$

The fair value price (FVP) (= C = PV) of the NCD during its life (210 days to maturity) is determined according to:

$$\begin{aligned} \text{FVP} &= \text{MV} / [1 + (ir \times t)] \\ &= R10\,663\,424.66 / [1 + (0.0675 \times 210 / 365)] \\ &= R10\,663\,424.66 / 1.03883562 \\ &= R10\,264\,785.40. \end{aligned}$$

The buyer and seller of the repo agree to round the amount of the repo to R10 265 000. In this example the repo TC is:

$$\begin{aligned} \text{TC} &= R10\,265\,000 + [R10\,265\,000 \times (0.065 \times 7 / 365)] \\ &= R10\,265\,000 \times [1 + (0.065 \times 7 / 365)] \\ &= R10\,265\,000 \times 1.00124658 \\ &= R10\,277\,796.09. \end{aligned}$$

If this repo deal is done at the precise market value, then the FVP (= R10 264 785.40) is used in the TC formula instead of the rounded amount.

In the case of repos that have long-term bonds as the underlying instruments the principle as applied above is the same, except that⁹:

- Only the market consideration is used in the calculation.
- The termination price is affected by the changed clean price because the term to maturity is shorter by 7 days.
- The interest factor is affected by the difference between the coupon rate and the *mrr*.

⁹A calculator for repo transactions in bonds can be found at: <http://calculator.bondexchange.co.za/BondComparitive.aspx?calc=Repo>