SAPIENZA - UNIVERSITÀ DI ROMA

ANNALI DEL DIPARTIMENTO DI METODI E MODELLI PER L'ECONOMIA, IL TERRITORIO E LA FINANZA

2015

Perspectives on Behavioural Sciences

ISBN: 978-88-555-3333-1 ISSN: 2385-0825

PÀTRON EDITORE
Bologna 2015

PÀTRON Editore - Via Badini, 12
Quarto Inferiore, 40057 Granarolo dell'Emilia (BO)
Tel. 051.767003
Fax 051.768252
E-mail: info@patroneditore.com
http//www.patroneditore.com
Il catalogo generale è visibile nel sito web. Sono possibili ricerche per autore, titolo, materia e collana. Per ogni volume è presente il sommario, per le novità la copertina dell'opera e una breve descrizione del contenuto.

Stampa: Rabbi s.r.l., Bologna per conto di Pàtron editore, dicembre 2015.

Emilio Barone*, Gennaro Olivieri*

DERIVATIVES AND USURY: THE ROLE OF OPTIONS IN TRANSACTIONS USED TO ACT IN FRAUD OF THE LAW

Abstract: The search for derivative contracts with complex features can also be explained as the market's attempt to elude the restrictions imposed by the law on money loans. This is an undesirable effect of anti-usury rules. It can be added to the one mentioned by Montesquieu and Adam Smith, who pointed out that usury increases with the severity of the prohibition, since the lender indemnifies himself for the risk he runs of suffering the penalty. In this paper we look at some of the ways in which derivative contracts can be used to circumvent anti-usury provisions and conceal money loans made at exorbitant rates. After examining the simplest cases, we will consider more complex contracts, such as swaps with embedded options, which are often used in dealings between banks and municipalities. Our thesis is that, in all these cases, in order to detect usury, we have to calculate the contracts' option-adjusted yields.

Keywords: put-call parity, forwards, box spreads, strangles, interest-rate swaps, collars, caps, floors, flat volatility, spot volatility.

1. Introduction

Fear that the current crisis has caused a credit crunch, with a consequent increase in usury, makes the analysis of the ways in which usurious loans can be "masked" highly topical.

In this paper we look at some of the ways derivative contracts can be used to circumvent anti-usury provisions and conceal money loans made at exorbitant rates.

* Luiss - Guido Carli, Rome, Italy.

After examining the simplest cases, we consider more complex contracts, such as swaps with embedded options, which are often used in dealings between banks and municipalities. Our thesis is that, in all these cases, in order to detect usury, we have to calculate the contracts' option-adjusted yields.

The search for derivative contracts with complex features can also be explained as the market's attempt to elude the restrictions imposed by the law on money loans. This is an undesirable effect of anti-usury rules. It can be added to the one mentioned by Montesquieu and Adam Smith, who pointed out that usury increases with the severity of the prohibition, since the lender indemnifies himself for the risk he runs of suffering the penalty (for other critical comments see Masera, 1996 and Rocca, 1997).

> The borrower found himself under the necessity of paying for the interest of the money, and for the danger the creditor underwent of suffering the penalty of the law (Montesquieu, 1748, p. 398).

> This regulation, instead of preventing, has been found from experience to increase the evil of usury; the debtor being obliged to pay, not only for the use of the money, but for the risk which his creditor runs by accepting a compensation for that use. He is obliged, if one may say so, to insure his creditor from the penalties of usury (Smith, 1776, Chapter IV, p. 158).

2. In the footprints of Russell Sage

Derivatives were also used a long time ago to circumvent anti-usury law. This is the case, for instance, of Russell Sage (Figure 1), a U.S. financier (1816-1906) whose wealth at the end of 1800 amounted to $100 million, or more than $250 billion in today's terms. Russell Sage was charged with violations of the usury laws of the State of New York. Actually, he was accused of being the leader of the "Usury Ring." He was described as follows in the Encyclopedia Britannica (1963):

> SAGE, RUSSELL (1816-1906), U.S. financier, was born Aug. 4, 1816 in Oneida county, N. Y. He began his career in the grocery business. In 1853 he purchased the Troy an Schenectady railroad from the city of Troy, N. Y., and sold it to the New York Central railroad. He participated in the development and reorganization of railroads in the northwest. Sage moved to New York City in 1863, becoming a dealer in "puts" and "calls" and the "call money" market. He worked with Jay Gould, manipulating the stock of the Union Pacific and other companies,

Fig. 1 - Russell Sage at the age of 78, published by Mrs. Sage in New York, 1908.

Source: www.oldnewyork.blogspot.com/2008/11/russell-sage-millionaire-who-lived-like.html.

and was Whig representative in congress (1853-57). Sage died July 22, 1906, leaving his estate to his wife, MARGARET OLIVIA SLOCUM SAGE (1828-1918). Mrs. Sage established the Russell Sage foundation in 1907. During her life she made public gifts of $ 40,000,000, and when she died Nov. 4, 1918, she left $ 36,000,000 to be distributed to various public institutions. (J. R. Lt.)

Nobody played a more important role than Sage in the development of US railroads (he eventually acquired an interest in more than 40 railroads, serving as director or president of 20). He amassed part of his fortune not only by investment-banking operations on railroads but also by trading on the stock exchange (for instance, he used the technique of short selling – learnt from Jacob Little – to exploit the panic selling of 1857).

2.1. The Usury Ring

According to Paul Sarnoff – his “official” biographer – Russell Sage used to issue “short-term loans that bore rates of 40 to 80 per cent a year and long-term lendings at 14 to 20 per cent." (Sarnoff, 1965, p. 119). In 1867, Russell Sage was accused of being the gang leader of a usury group. He was convicted, together with nine other businessmen (see also Barone, 2012, Chapter 2):

> Sage had given a stockbroker a one month loan at an annual rate of 7 percent. When the stockholder was unable to repay the principal he asked Mr. Sage for a one month extension of the loan. Sage gladly granted the request – with the addition of a 1 per cent penalty charge. Unfortunately, the penalty charge put the loan rate above the legal maximum of 7 per cent and Sage was found guilty of violating the New York state usury law (Galai, Gould, 1974).

The episode was also described, with greater details, by Sarnoff:

> During the summer of 1869 Edward P. Scott, a stockbroker, applied to the Money-King for a one-month loan of $ 230,000 at 7 per cent, plus the customary service charge. When the time period for the loan expired, Scott, unable to meet his obligation, applied for a one-month extension. From the goodness of his heart (and pocketbook) Sage granted the extension and added a 1 per cent "late charge" to the 7 per cent rate, in addition to his "service charge". When the second month ran out the broker refused to pay back the principal. Sage took him to court, and Scott entered the defense of usury (Sarnoff, 1965, note 2, p. 131).

The penalty was a maximum fine of $ 1,000 and/or 6 months in jail. Justice Albert Cardozo imposed $ 250 fines and no jail terms with the exception of two defendants: Russell Sage and George Watts – a broker. They had to be imprisoned for 5 and 10 days, respectively, but a series of legal maneuvers convinced the judge to suspend the jail sentence.

2.2. Put-Call Parity

2.2.1. Options and Stocks

After the judgment, Russell Sage understood that several changes in his *modus operandi* were necessary for the continuation and betterment of his business. Given his know-how in options, which he developed on such a grand scale that he was known as the "father of puts and calls", Sage started to use options to mask loans at usurious rates. He invented an appropriate "conversion":

> To avoid such difficulties in the future, Sage devised a new strategy. In the

new strategy, if a customer wished to be long a stock, Sage would buy the stock, sell the customer a call and also obtain a put written by the customer (Galai, Gould, 1974, note 3, p. 106).

More clearly:

> Rather than lend the client the money to buy 100 shares of stock at usurious rates, Uncle Russell obtained from the client a put contract; bought the 100 shares of stock and was protected by the existing put. Then, he sold the client a call on the shares purchased (Sarnoff, Paul, note 2, p. 137).

It is easy to see that the portfolio built by Sage (where the purchases of the stock and the put were partially financed by the sale of the call) is equivalent to issuing a fixed-rate loan, i.e. to purchase a zero-coupon bond from the client. The simplest way to understand the equivalence is to represent the payoff in a table of both the portfolio and the zero-coupon bond as a function of the final value of the stock.

Consider, for instance, Table 1, where B_0 is the current price (at time 0) of a zero-coupon bond with face value K and maturity T, while S_0 is the current price of the stock. In addition, c_0 and p_0 indicate, respectively, the current values of a call and a put, with exercise price K and maturity T, written on the stock. Finally, S_T is the stock price at time T.

Tab. 1 - Put-call parity I (options and underlying asset).

Time 0	Time T	
	$S_T < K$	$K \leq S_T$
S_0	S_T	S_T
$-c_0$	0	$-(S_T - K)$
p_0	$K - S_T$	0
B_0	K	K

Table 1 shows that the value of the portfolio at time T is always equal to the face value, K, of the zero-coupon bond (if $S_T < K$ then $S_T + 0 + (K - S_T) = K$, otherwise if $S_T \geq K$ then $S_T - (S_T - K) + 0 = K$). As a consequence, in order to prevent arbitrage opportunities, the portfolio's current value should always be equal to the current value, B_0, of the zero-coupon bond.

The equivalence shown in the table is just the put-call parity, which was evidently well known to Russell Sage:

$$S_0 - c_0 + p_0 = B_0. \quad (1)$$

Sage used the put-call parity to circumvent anti-usury law: he bought a bond promising a very high yield from the client, at a very low price, B_0, and received its face value, K, at maturity. The bond was masked by using a portfolio made up of a long stock, a short call and a long put. The options' maturity was equal to the life of the loan and their strike was equal to the loan's par value.

2.2.2. Repurchase Agreements

The technique invented by Sage can also be seen as a reverse repurchase agreement: he bought the stock at the spot price S_0 and sold it at the forward price $F_0 = K$. This last operation (a forward sale, i.e. a short forward) was made synthetically by purchasing a put and selling a call. Actually, Relationship (1) can also be written as:

$$S_0 - f_0 = B_0 \quad (2)$$

where $-f_0$ is the current value of a short forward:

$$-f_0 = p_0 - c_0. \quad (3)$$

Table 2 proves Relationship (3), which is an alternative way of writing the put-call parity.

Tab. 2 - Put-call parity II (options and forward).

Time 0	Time T	
	$S_T < K$	$K \leq S_T$
p_0	$K - S_T$	0
$-c_0$	0	$-(S_T - K)$
$-f_0$	$K - S_T$	$K - S_T$

2.3. Box Spread

2.3.1. Four Options

There are other ways of masking a bond by using options (called "privileges" in Sage's time). One is the so-called box spread. Instead of buying a zero-coupon bond with face value $K_2 - K_1$ (K_1 <

K_2), one could buy a portfolio made up of four options, with the same maturity T, written on the same asset: a long call with strike K_1, a short call with strike K_2, a short put with strike K_1 and a long put with strike K_2.

In other words, if B_0 is the price of a zero-coupon bond with face value $K_2 - K_1$, we have:

$$c_1 - c_2 - p_1 + p_2 = B_0 \quad (4)$$

where the subscripts of c and p now indicate their respective strikes (K_1 or K_2).

As Table 3 shows, the portfolio's final value is always equal to $K_2 - K_1$, regardless of the evolution of the underlying asset price between time 0 and time T.

Tab. 3 - Final value of a box spread.

Option	$S_T < K_1$	$K_1 \leq S_T < K_2$	$K_2 \leq S_T$
long call with strike K_1	0	$S_T - K_1$	$S_T - K_1$
short call with strike K_2	0	0	$-(S_T - K_2)$
short put with strike K_1	$-(K_1 - S_T)$	0	0
long put with strike K_2	$K_2 - S_T$	$K_2 - S_T$	0
	$K_2 - K_1$	$K_2 - K_1$	$K_2 - K_1$

2.3.2. Two Strangles

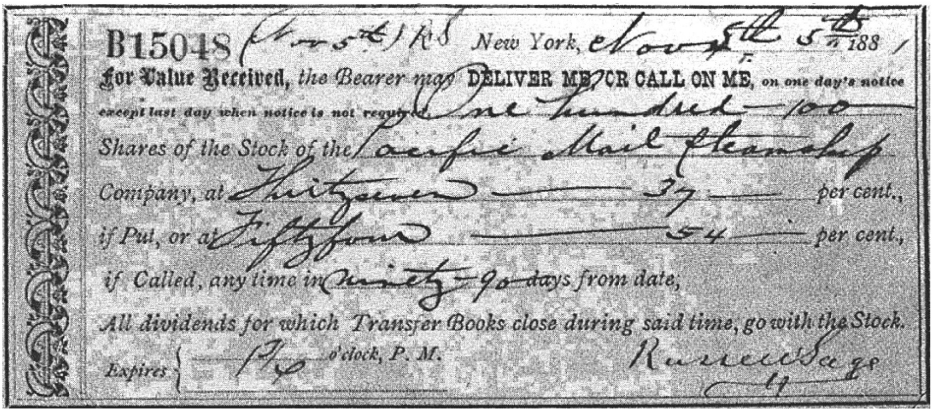
Another way to represent a box spread is to consider it as the combination of two strangles (a strangle is a portfolio made up of a call and a put with the same maturity but different strikes): a long in-the-money strangle and a short out-of-the-money strangle. In fact, by (4) we have:

$$(c_1 + p_2) - (c_2 + p_1) = B_0. \quad (5)$$

It is possible that Russell Sage also used the box spreads to mask his loans. It has also been claimed that he invented both strangles and straddles (Sarnoff, footnote 2, p. 238. "Strangle" is the current name for the term "spread" used by Sarnoff).

Figure 2 shows a 90-day out-of the-money strangle signed by Sage in 1881. The strangle was written on 100 shares of the Pacific Mail Steamship Company. The strikes of the put and the call were equal to 37 and 54 per cent, respectively.

Fig. 2 - A strangle written by Russell Sage.


B15048 New York, Nov 5th 1881

For Value Received, the Bearer may DELIVER ME, OR CALL ON ME, on one day's notice except last day when notice is not required, One hundred 100

Shares of the Stock of the Pacific Mail Steamship

Company, at Thirty seven 37 per cent.,

if Put, or at Fifty four 54 per cent.,

if Called, any time in ninety 90 days from date,

All dividends for which Transfer Books close during said time, go with the Stock.

Expires o'clock, P. M.

Russell Sage

Source: New York Historical Society, Edwin Denison Morgan Papers.

2.3.3. Two Forwards

The box spread is also equivalent to a portfolio made up of two forward contracts: a long forward with delivery price K_1 and a short forward with delivery price K_2. In fact, by (4) we have:

$$(c_1 - p_1) - (c_2 - p_2) = B_0. \tag{6}$$

Besides, by put-call parity (1), we obtain:

$$(c_1 - p_1) = f_1 \text{ and } (c_2 - p_2) = f_2 \tag{7}$$

where f_1 and f_2 indicate the value of two forward contracts with delivery price equal to K_1 and K_2, respectively.

Therefore, substituting (7) into (6) gives:

$$f_1 - f_2 = B_0. \tag{8}$$

Relationship (8) shows that a money loan with current value B_0 is equivalent to a portfolio made up of two forward contracts: a long forward with delivery price K_1 and a short forward with delivery price K_2.

2.4. Swaps, Caps and Floors

Anti-usury laws can also be circumvented by using swaps, caps and floors. Sometimes, the standard fixed-rate loan, with current value B_{fx}, is split into two distinct transactions: a common floating-rate loan, with current value B_{fl}, and an interest-rate swap, with current value V_{swap}, where the client pays the fixed rate and receives the variable rate (in other cases, it is the variable-rate loan that is split into two different transactions: a common fixed-rate loan and an interest-rate swap in which the borrower pays the variable rate and receives the fixed rate):

$$B_{fl} - V_{swap} = B_{fx}. \qquad (9)$$

The variable rate that the client receives in the swap compensates the variable rate he has to pay on the original floating-rate loan. Therefore he is left with the fixed-rate payments agreed in the swap.

It is difficult for this kind of transaction to make it possible to charge the client a usurious rate. The transaction is fairly transparent, so that it is difficult for the fixed rate of the swap, i.e. the swap rate to diverge excessively from market quotes. Sometimes, however, the contracts contain covenants with an option content, such as caps and floors, that add "opacity" to the product.

The technique used is similar to that invented by Russell Sage: a fixed-rate money loan can be masked by a portfolio made up of a floating rate loan and a collar. The collar is made up of a long floor and a short cap. The cap is a portfolio of caplets, i.e. call options on an interest rate, while the floor is a portfolio of floorlets, i.e. put options on an interest rate. If V_{cap} and V_{floor} indicate the value of a cap and a floor with the same strike, the relationship equivalent to put-call parity (3) is (Hull, 2014, Chapter 29, p. 680):

$$-V_{swap} = V_{floor} - V_{cap} \qquad (10)$$

Substituting (10) into (9) gives:

$$B_{fl} + V_{floor} - V_{cap} = B_{fx}. \qquad (11)$$

Relationship (11) shows that a fixed-rate loan can be replicated by a portfolio made up of a floating-rate loan and a collar.

3. A few examples

A few examples can be used to illustrate what was discussed in the last section.

The first example shows the technique applied by Russell Sage, who made use of the put-call parity (1).

3.1. Put-Call Parity

Let's suppose we want to lend \$1 to a client who wishes to buy a no-dividend stock, whose current price, S_0, is \$1 and whose volatility, σ, is 20 percent. The (continuously compounded) interest rate, *r*, we want to charge the client is 8 percent, a level much higher than the market rate, r_{mkt}, which is – for instance – 5 percent. In such a case, the current value, B_0, of the zero-coupon bond we purchase from the client is \$1 and its par value, *K*, is:

$$K = B_0\, e^{rT} = \$1 \times e^{0{,}08 \times 1} = \$1.08329.$$

To circumvent anti-usury law we can mask the loan by making use of options. The values, c_0 and p_0, of a call and a put, with maturity $T = 1$ year and exercise price $K = \$1.08329$ (= \$1 $e^{0.08 \times 1}$), written on the stock, are both equal to \$ 0.07966 if r = 8 percent [against \$ 0.06655 if – for instance – r_{mkt} is 5 percent]. Instead of buying the zero-coupon bond from the client, we buy the stock at \$1 and the put at \$ 0.07966, while we sell the call at \$ 0.07966. The amount paid to the client (i.e. the loan) is clearly \$1 (= \$1 for the stock + \$ 0.07966 for the put – \$ 0.07966 for the call). At maturity, if the stock price, S_T, is lower than or equal to *K*, we exercise the put. Therefore, we deliver the stock and receive $K = \$1.08329$ from the client (who abandons the call, whose exercise is not advantageous). Instead, if the stock price, S_T, is greater than *K*, the client exercises the call and we (who abandon the put) deliver him the stock and receive the exercise price, $K = \$1.08329$. Therefore, whatever the final stock price ($S_T \leq K$ or $S_T > K$), we receive $K = \$1.08329$ against the initial loan of \$1. As a consequence, the (continuously compounded) interest rate is 8 percent, regardless of the evolution of the stock price during the life of the options.

The second example illustrates the reverse repurchase agreement (2).

3.2. Reverse Repurchase Agreement

Let's suppose we want to lend \$1 to a client, at a (continuously compounded) rate, r, equal to 8 percent, a level much higher than the market rate, r_{mkt}, which is – for instance – 5 percent. Let S_0 = \$1 be the current price of a no-dividend stock. To circumvent anti-usury law we can mask the loan by buying the stock spot from the client at \$1 and selling it back forward at \$1.08329 (= \$1 $e^{0.08 \times 1}$) after 1 year. The agreed forward price is much higher than the market price, which is equal to \$1.0513 (= \$1 $e^{0.05 \times 1}$) if r_{mkt} = 0.05. Instead of buying a zero-coupon bond from the client, we buy the stock spot at \$1 and sell it back forward at \$1.08329. The amount paid to the client (i.e. the loan) is \$1 (= \$1 for the stock + \$0 for the forward). At maturity – after 1 year – we deliver the stock to the client and receive the agreed forward price (F_0 = \$1.08329). Therefore, the implied (continuously compounded) interest rate is 8 percent (= ln(\$1.0833/\$1)).

The third example illustrates the box spread (4).

3.3. Box Spread

Let's suppose we want to lend \$1 to a client, at a (continuously compounded) rate, r, equal to 8 percent. Let S_0 = \$1 be the current price of a no-dividend stock and let σ = 20 percent be its volatility. To circumvent anti-usury law, we buy a portfolio made up of 4 options with a 1-year maturity from the client for \$1: a long call with strike K_1 = \$1.058883; a short call with strike K_2 = \$1.069716; a short put with strike K_1 = \$1.058883 and a long put with strike K_2 = \$1.069716. The value of the options, calculated using the Black-Scholes formula – on the basis of a (continuously compounded) interest rate of 8 percent – is as follows:

$$c_1 = \$\ 9.0531;\ c_2 = \$\ 8.5577;\ p_1 = \$\ 6.8003 \text{ and } p_2 = \$\ 7.3050.$$

Therefore, the portfolio's current value is \$ 1 (= \$ 9,0531 – \$ 8,5577 – \$ 6,8003 + \$ 7,3050). As Table 3 shows, the portfolio's value at maturity is always equal to $K_2 - K_1$ = \$ 1.08329 (= \$ 106.9716 – \$ 105.8883). Therefore, the implied (continuously compounded) interest rate is equal to 8 percent (= ln(\$ 1.08329/ \$ 1)).

4. Option-Adjusted Yields

According to Sarnoff, the method invented by Sage protected him from any legal risk:

In this way Sage could not lose any money if the stock declined (thanks to his client's put) nor could he make any money if the stock rose by virtue of having sold his client a call! And there was no law in New York State which dictated how much Mr. Sage should charge for a call.

Is it really possible to elude anti-usury rules by making use of derivatives? According to us, derivatives are only portfolios of elementary assets (Barone, 2004). They must be decomposed into these elements for their features and economic functions to emerge.

To be effective and to avoid elusive conduct, anti-usury rules should cover not only traditional loans, but also "synthetic" loans, i.e. transactions that – substantially, even if not apparently – are equivalent to usurious loans (Knoll, 2002).

If this interpretation is correct, the contractual terms of swaps should also be consistent with anti-usury law. According to Italian law no. 108 of 7 March 1996, interest rates should not be greater than the "average global" yields measured quarterly by the Bank of Italy (Table 4).

Tab. 4 - Yields calculated according to Italian usury law (first quarter 2009).

Mortgages	*Average yields (per annum)*	*Average yields increased by 50 percent*
– fixed rate	5.39	8.085
– floating rate	5.45	8.175

Source: Banca d'Italia, *Comunicato Stampa*, December 29, 2008.

Checking for violation of anti-usury law is simple in the case of plain-vanilla swaps, where a floater is exchanged with a fixed-rate bond, but it is more complex in the case of swaps with embedded options. In such cases, we should calculate the option-adjusted yield. This is the yield that should be considered to check whether the bounds imposed by the anti-usury laws have been respected.

To determine the option-adjusted yield (OAY) it is necessary to use a recursive algorithm:

(a) to estimate the zero curve and the volatility curve;

(b) to determine the swap's expected payments, including those of the embedded options, consistently with the zero curve and the volatility curve;

(c) to determine the swap's current value by discounting its expected payments consistently with the zero curve;

(d) to repeat steps (b) and (c), by making a parallel shift of the zero curve, until the swap's value is null (or equal to the up-front, if that is the case);

(e) to calculate the swap's option-adjusted yield as the interest rate which makes null (or equal to the up-front, if that is the case) the present value of the last iteration's expected payments.

Without discussing technical issues which are beyond the scope of this paper, it is sufficient here to mention that the expected payments of interest-rate options depend not only on the current and forward level of interest rates but also on their expected volatilities. It is difficult to measure expected volatilities. The standard method is to use volatilities consistent with the flat volatilities of caps (or, equivalently, floors) quoted by traders on the basis of Black's model (these volatilities, which change with caps' maturity, are called "flat" because the same volatility is used to value all the caplets comprising any particular cap. From flat volatilities it is possible to calculate the spot volatilities valid for the individual caplets, which are necessary to evaluate options with nonstandard features. On this subject, see Hull, footnote 2, Chapter 29, p. 681.

5. Conclusions

The use of financial engineering to circumvent the anti-usury laws is not new, as the case of Russell Sage shows. To safeguard the efficacy of the rules, it would be desirable to check that derivatives, and in particular swaps, are not used for goals in contrast with the aims of the law.

In particular, in the case of swaps, a check should be made as to whether the value of the embedded options is consistent with market conditions and, as a final point, to avoid options being used to obscure the actual cost of loans.

References

BARONE E. (2004), Derivati complessi come portafogli di attività elementari, in Di Giorgio G., Di Noia C., *Intermediari e mercati finanziari*, Il Mulino.

BARONE G. (2012), *Arbitraggi e Algebra di Garman*, USA: CreateSpace.

DE SECONDAT C.-L. - Baron de La Brède e de Montesquieu (1748), *The Spirit of Laws*, Genève. Translation by T. Nugent (2005), Kessinger Publishing Co.

GALAI D., GOULD J.P. (1974), Transaction Costs and the Relationship between Put and Call Prices, *Journal of Financial Economics* **1**, pp. 105-129.

HULL J.C. (2014), *Options, Futures, and Other Derivatives*, 9th ed., Pearson Prentice Hall.

KNOLL M.S. (2002), Put-Call Parity and the Law, *Cardozo Law Review* **24**, 1, pp. 61-91.

MASERA R. (1996), Attenti a non favorire l'usura, *Corriere della Sera*, December 13th, 1996, p. 21.

ROCCA C. (1997), Difesa dell'usura, *Il Foglio*, April 22nd, 1997.

SARNOFF P. (1965), *Russell Sage: the Money King*, Ivan Obololensky, Inc., New York.

SMITH A. (1776), *An Inquiry into the Nature and Causes of the Wealth of Nations*, Book Two ("Of the Nature, Accumulation, and Employment of Stock").