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DERIVATIVE LOGIC AND THE BANKING SYSTEM

1. Introduction

This paper tries to develop a fresh view of what it means to analyze the banking system. We use modern finance theory to disentangle the obvious. The view we put forward is suggestive and the idea is that by disentangling the language and transforming it into a language of finance, we realize what the liability side of a banks balance sheet consists of. In order to get going, we have to review both, the Merton model and the put-call parity. The technical details are less important than the general idea of what they convey [Merton, 1974].

2. The put-call parity revisited¹

An option starts off with a positive value. The buyer must pay a premium and the seller receives this premium. This reflects that the buyer acquires a "right" and the seller has an "obligation". The terminology of "premiums" reflects that we have an insurance-type contract. It remains to be discussed how far this analogy should be taken. Before we start, we have to develop our notation. Remember that time 0 is today and time T is the expiration of the option contract. Furthermore, remember that European calls are only exer-

¹ Any textbook in finance will give you such an exposition. See, for example, Kolb [2000] or Chance [2003].

cisable at expiry, while American options can be exercised during the whole tenure of the option contract.

S_0, S_T = price of the underlying asset at time 0 (today) and time T (expiration),

X = exercise price,

r = risk-free rate,

T = time to expiration, equal to number of days to expiration divided by 365,

c_0, c_T = price of European call today and at expiration,

p_0, p_T = price of European put today and at expiration.

At expiration, a call option is worth either zero or the difference between the underlying price and the exercise price, whichever is greater.

$$c_T = \text{Max}(0, S_T - X)$$

At expiration, a put option is worth either zero or the difference between the exercise price and the underlying price, whichever is greater.

$$p_T = \text{Max}(0, X - S_T)$$

If we buy a call we talk of being long a call. If we sell a call, we are short a call. Similarly, if we buy a put we talk of being long a put. If we sell a put, we are short a put.

Example:

Let us look at the profit and payout diagram on the exercise date, assuming that the exercise price of the share under consideration is \$30 and the option

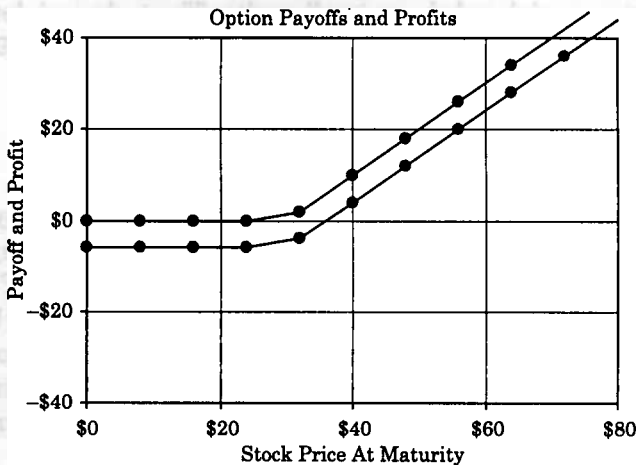


Fig. 1. Long Call

Source: authors' own elaboration

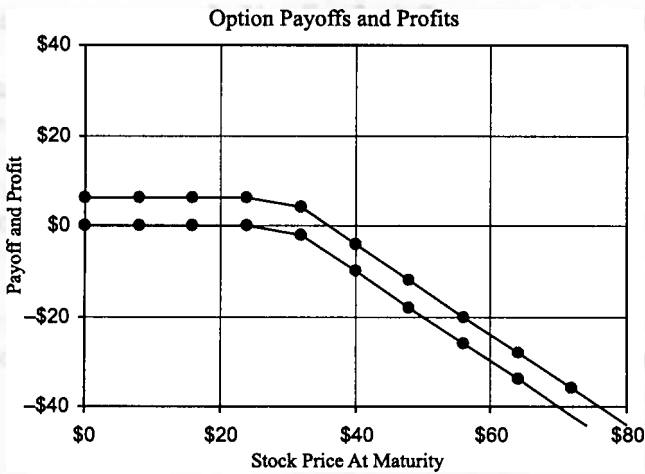


Fig. 2. Short Call

Source: authors' own elaboration

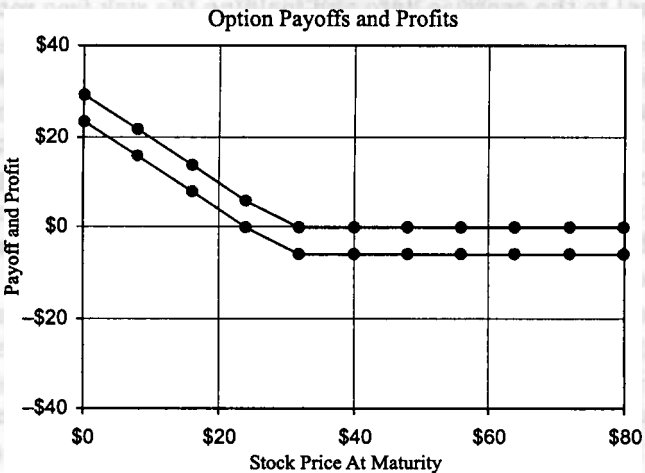


Fig. 3. Long Put

Source: authors' own elaboration

price is \$6. Note that the profit line includes the cost of the option, while the payoff line ignores it.

It is important to realize at this stage, that the long call has the upside potential of the underlying asset, but not the downside potential. The downside potential is found in the short put. Buying a call and selling a put would thus mimic a long position in the asset. It is not the same, however, as we did not invest in the underlying. Only if we invest the underlying in zero bond with

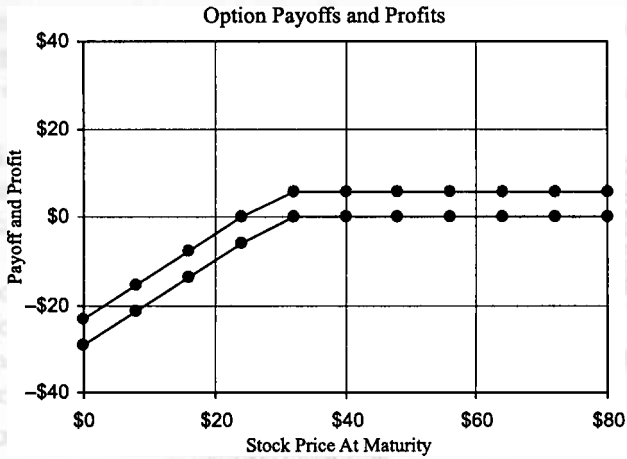


Fig. 4. Short Put

Source: authors' own elaboration

maturity equal to the exercise date and yielding the risk free rate, both positions become equivalent.

We now assume that we buy a call and a risk free bond, which matures on the option expiration day and has a face value equal to the exercise value of the call. Chance [2003] calls this position a “fiduciary call”, as this strategy allows protection against downside losses and thus, preserves capital. Hence, at expiration, if the price of the underlying is below X , the call expires worthless and the bond is worth X . If the price of the underlying is above X , the call expires in the money at the underlying price S_T .

We now want to construct what is known as a “protective put” strategy. Here we buy the underlying asset and we also buy a put. Again, we participate on the upside of the underlying, but the downside is now protected by the put we bought. If the price of the underlying is below X at expiry, the put is worth $X - S_T$ and the underlying is worth S_T . If the price of the underlying is above X , the put expires worthless and the underlying is worth S_T .

What we have seen is, that both strategies, the fiduciary call and the protective put, end up with the same value. In an efficient market, without arbitrage, their value must be the same. Hence, we can write that the cost of the call plus the cost of the bond equals the cost of the put plus the cost of the underlying.

$$c_0 + X/(1 + r) T = p_0 + S_0$$

This equation is called the put-call parity. It shows you how calls, puts, the bond and the underlying are related. The equation is also the basis for financial engineering. We can now construct a call by using a put, the underlying

and the bond. Or we can construct the underlying by using a call, a put and a bond.

Thus, a call is simply constructed by being long a put, long the underlying and short the bond.

$$c_0 = p_0 + S_0 - X/(1+r)T$$

A put is constructed by being long a call, long a bond and short the underlying.

$$p_0 = c_0 + X/(1+r)T - S_0$$

The bond can be constructed by being long the put, long the underlying and short a call.

$$X/(1+r)T = p_0 + S_0 - c_0$$

And finally, we construct the underlying by being long the call, long the bond and short the put.

$$S_0 = c_0 + X/(1+r)T - p_0$$

These synthetic positions allow us to price options, they also allow us to find mis-pricings and thus to arbitrage. For our purposes in this paper, it is important to know these relationships and be familiar with the terminology employed.

3. Applying the Language of the Merton Model

In this part we want to present the basics of Merton's 1974 model of a firm's debt. We follow the common exposition by Crouhy et al. [2001].

The firm's asset value V_T is assumed to follow a standard geometric Brownian motion.

$$V_t = V_0 \exp \left\{ \left(\mu - \frac{\sigma^2}{2} \right) t + \sigma \sqrt{t} Z_t \right\}$$

with $Z_t \sim N(0,1)$.

The μ denotes the mean and σ^2 the variance of the instantaneous rate of return on the asset of the firm. Merton also assumes that the firm has a simple capital structure. It is financed by equity S_t and a single zero-coupon debt, maturing at time T , with a face value of F and a market value of B_t . Thus, the value of the assets of the firm is denoted by V_t .

He then shows that if the value of the assets falls below B_t , the firm goes into default and S_t is worthless. Thinking back to our options, above, holding

Assets	Liabilities
<ul style="list-style-type: none"> • Assets of the firm, such as inventory, fixed assests, etc. 	<ul style="list-style-type: none"> • B_1 – a zero-coupon debt instrument • S_1 – equity

Fig. 5. The balance sheet of a firm under the Merton Model (1974)

Source: authors' own elaboration on the basis of [Merton, 1974]

St is like holding a call on the assets of the firm. It has upward potential with when the value of the assets is above B_t and otherwise, in the case of default, St expires worthless. Being long B_t is similar to selling a put or being short a put: The premium is the interest on the debt, while the value is determined by the value of the assets of the firm.

Merton goes on to calculate the critical asset value below default occurs. Credit risk in this framework is a function of the financial structure of the firm. Thus, the higher the leverage of a firm turns out to be, the higher the probability that this firm will default.

Consequences

Thus, holding a share of a company can be compared with being long a call in that company. Similarly, a bank loan is from the perspective of the bank nothing but a short put. The loan book of a bank or the loan portfolio is thus a portfolio of short puts. From the perspective of an investor of a bank this would imply that buying a share of a bank is being long a call written on a portfolio of short puts. Before we move on, however, we should take a look at the different banking systems. Economies of transition reflect the continental banking system And this not by coincidence, simply because there is a lack of functioning capital markets.

4. Stylized differences of the continental and Anglo-Saxon banking systems

This part of the paper attempts to look at the stylized differences in the two banking systems. The emphasis lies on stylized. The continental banking system is usually called the "German" banking system. This terminology is misleading, however, as most countries on the continent – including the CEE countries – display the same characteristics. We think about France, Italy, Spain, but also Poland and Austria. If we define the financial market as being the sum of the capital markets, the banking system and other financial

intermediaries, such as insurance companies, then it seems fair to say that (traditionally) the financial markets in continental Europe are bank-driven or bank-based. The economies finance themselves largely via bank debt and only to some extent via the capital market (corporate bonds or the issuance of equity). Continental banks used to earn their money by the spread between interest paid on deposits and earned on the issuance of corporate loans. Only in recent years did we witness a move towards commission income. Companies tended to have one or more “house banks”, which would issue long-term loans and would involve themselves in the companies, usually by sitting in supervisory committees. These loans would carry a fixed interest rate, rather than a floating one. Furthermore, banks would assume equity stakes in companies and be engaged and bound together in what seemed to be a long-run relationship. Companies were thus able to avoid the capital market and so there was less need for transparency, corporate governance codes. Interest rates on loans were usually set at a specific rate above the interest paid on deposits and they were seldom linked to the actual risk associated with a particular loan. Thus, especially in Austria and Germany, the economies displayed and still display a large number of small and medium-sized companies (SME's), the so-called *Mittelstand*, a phenomenon which has vanished almost in the Anglo-Saxon world. Does this banking system cross-subsidize the SME's? Given the debate about Basel II, it would seem so, as loans – not being related to the underlying risks – were too cheap. Note also that the system is rather built on long-term issues: the interest rate is fixed, loans are long-term, etc. Is this system better prepared to weather storms compared to the more short-term approach of the Anglo-Saxon system? The answer seems to depend on the length of the storm. If the storm is rather short, the banking system helps to stabilize the economy, as the refinancing of the economy is assured. However, if the storm turns out to be prolonged, as it does currently, long-term loan after long-term loan goes into default, the mis-pricing of loans becomes apparent and the whole banking system seems to falter, as it currently does in Germany, especially those banks with the highest credit exposures such as the HVB Group. The stylized balance sheet of this form of bank-based financial market summarizes this story.

Furthermore, we might want to highlight the structure of the financial system by using the concept of the financing box. The financing box shows the structure of the financial system and the comparative importance of its parts. One of the crucial sectors of the economy is the structure of the financial intermediaries. Financial intermediaries link the monetary and the real sphere. Depending on how these institutions are structured, monetary policies trickle through to the real sphere. Note that theoretical economics has not much to say about the institutions of the financial sector. Beyond the link between the monetary and the real sphere of the economy, financial intermediaries finance the economy. Economic growth has to be financed and this role lies on the shoulders

Assets	Liabilities
<ul style="list-style-type: none"> • Long term loan facilities, often unquoted and unrated companies • Shareholdings and cross-holdings • Fixed rate debt • Limited securitization 	<ul style="list-style-type: none"> • Deposits • Debt • Equity

Fig. 6. Bank based financial system: Continental banking system

Source: authors' own elaboration

of financial institutions. They are the source of growth. One of the lessons we can draw from the transition experience in Central Europe is the dependence of economic policies on the financial system of a country. Consider the following example: an interest rate drop in the UK has a completely different effect on the economy than a decline in interest rates in the Euro zone. The reason can be found in the different financial systems of the two countries, or what we call the workings of the "financing box". British consumers are to a large extent home-owners, financed via a flexible rate mortgage. Thus, a decrease or increase of interest rates by the Bank of England has an immediate effect on consumer spending. Thus, the effects of monetary policy are different from the continent, for example. This example also questions the viability of one monetary exchange rate for countries with completely different financing boxes.

The financing box describes the financial system: capital markets, banking system and other financial markets and sits in between the monetary policies and the microeconomic policies of a country. The effectiveness of these policies should be seen as dependent on the financing box. The following questions drop out of the visualization:

- What effects do monetary policies have depending on the structure of the financing box?
- What type of monetary policy is possible (OMO versus reserve requirement)?
- How important are capital markets in financing the economy?
- How important is the banking system in financing the economy?
- How important are other financial institutions in shaping the capital market and in financing the economy?
- Depending on these three elements of the box, how should we effectively regulate the financial system?
- If regulation or legislation is exogenously imposed (EU or Basel II), how does it affect and change the three parts of the box?

- What effects do microeconomic policies have depending on the structure of the financing box?
- Given the above, what does this imply for the risk management of financial institutions?

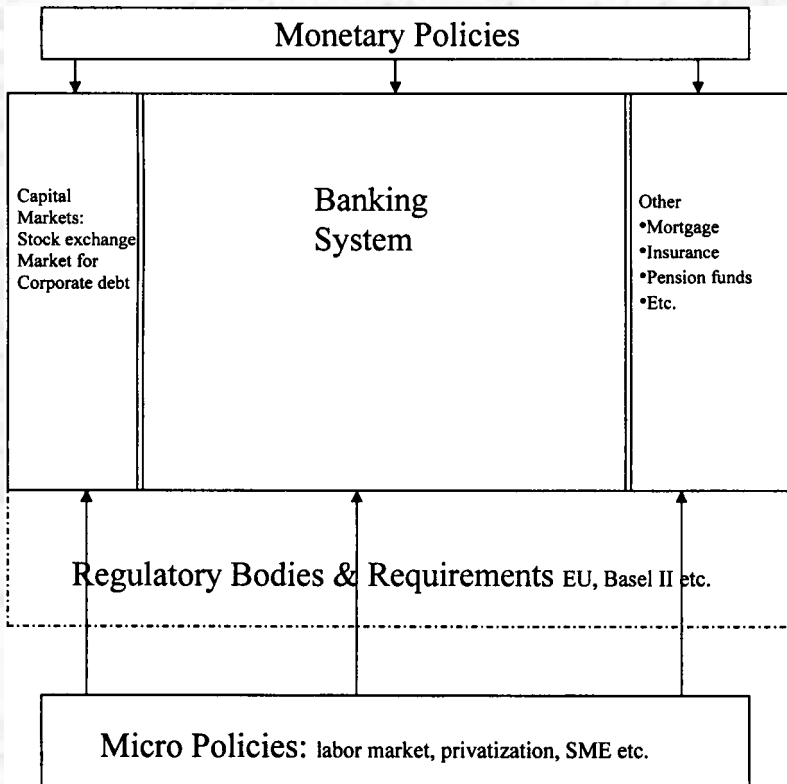


Fig. 7. Capital market based financial system: Anglo-Saxon system

Source: authors' own elaboration

Let's now move on to the stylized Anglo-Saxon banking system. Here we would include countries such as the United States, Great Britain, but also to some extent The Netherlands. Commission income dominates the earnings of banks. Banks act as intermediaries between corporate clients and the capital market. Thus, they take on risks for a short time, being an underwriter of equity or debt issues. They charge a commission for taking on that risk. Companies finance themselves via the capital market and demand investment banking services. Furthermore, companies demand credit lines, but these often only act as a form of collateral or security for capital market debt instruments, such as commercial paper. The credit lines are usually structured as revolvers

(short-term revolving or automatic revolvers), and the interest rates are thus flexible. In general, loans tend to be short-term. The clients – as they rely on the capital markets – tend to be quoted companies and are often rated by rating agencies. Banks have few long-term equity holdings and try to use securitization to trim down their balance sheet. The Anglo-Saxon banking system is summarized in the balance sheet and financing box below.

Assets	Liabilities
<ul style="list-style-type: none"> • Short term loan facilities, often revolvers • Often quoted and rated companies • Few long-term equity holdings • Floating rate debt • High level of securitization 	<ul style="list-style-type: none"> • Deposits • Debt • Equity

Fig. 8. Financing Box for a bank-based financial system

Source: authors' own elaboration

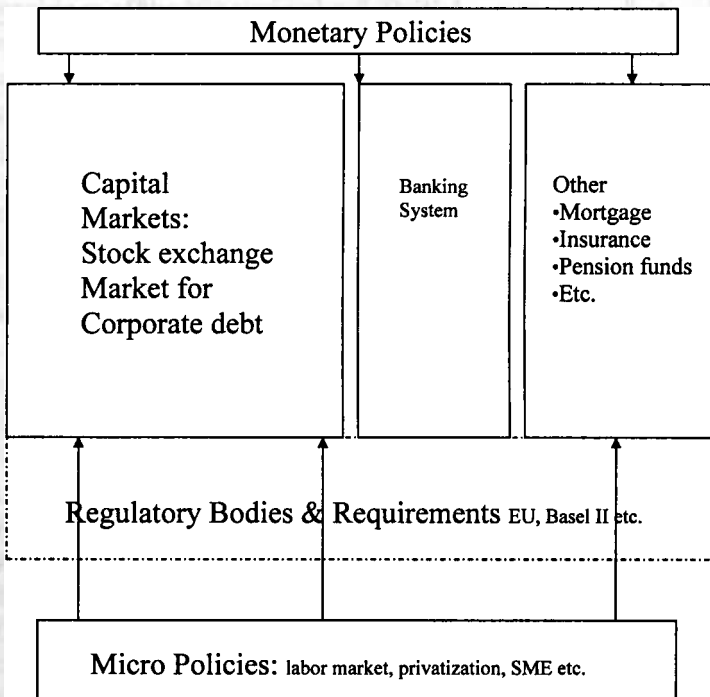


Fig. 9. Financing Box for a capital market-based financial system

Source: authors' own elaboration

5. Conclusion

In this paper, we discussed the structure of stylized banking systems. We have distinguished between the Continental or German banking system and the Anglo-Saxon banking system. We have argued that the banking systems in CEE resemble the continental banking system and we have shown, that there are many institutional reasons, why the existence of continental banking systems is no random occurrence. In fact, given the structure, legal system and information inefficiencies, plus the non-existing strength of the local investors, it seems optimal to finance an emerging economy in such a way. Given the capital structure and needs of international regulation, this will put pressure on the balance sheets of the CEE banks. It remains for another paper to discuss the alternative ways of risk transfer and to argue, that asset backed securities seem especially suited to transfer risk out of local markets and local banks to the international investor. This would take advantage of the Anglo-Saxon banking system, which dominates the developed financial systems. Indeed, an international investor, holding a portfolio of CEE banks is in an ideal position to structure CEE asset backed securities to intermediate risk of his portfolio of short puts. Thus, the comparative advantages of both financial systems are optimized.

Literature

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