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INFLATION IN THE CAPITAL MARKET - A MONEY MACHINE?

Dr. Joachim Behrendt*

1. Introduction

A corporation which wants to calculate the net present value of an investion needs a discount rate. Typically, it takes the long-term capital market interest rate for this purpose. For financing the corporations investions, it has to decide which credit instruments cause which capital costs. This means it has to get informations about capital market interest rates as well. To manage the daily cash flows with a cash management system and to optimize cash balance, it needs capital market interest rates to know about his opportunity costs of cash balance a third time. Nearly every decision in financial management depends on capital market interest rates.

Table 1 shows a few rates of interest and of inflation for Turkey. It is easily to see that interest rates in Turkey exceed interest rates in countries with lower inflation; inflation seems to increase interest rates. But what is the exact relationship between interest rates and the rate of inflation? Does taxation have an influence on interest rates? What are the consequences of higher interest rates for financial decisions of corporations in high-inflation countries? This paper tries to show a few answers for this questions.

	CPI	WPI	P_{CPI} / month	P_{WPI} / month	P_{CPI} / year	P_{WPI} / year	i_o (Overn)	i_d (sight)	i_d (month)	i_d (year)
Jan 92	1046,70	893,80	9,37	11,03	78,50	69,02	60,39	12,10	57,40	72,20
Feb 92	1099,40	940,70	5,03	5,25	77,84	69,01	63,03	12,00	56,90	71,70
Mar 92	1152,90	981,00	4,87	4,28	78,69	68,09	63,76	11,90	56,90	71,70
Apr 92	1196,20	1002,50	3,76	2,19	73,99	63,01	65,83	11,70	58,00	74,00
May 92	1206,70	1009,50	0,88	0,70	69,86	59,50	67,63	11,80	58,40	74,50
Jun 92	1212,60	1012,00	0,49	0,25	65,79	57,76	68,49	11,90	58,40	74,70
Jul 92	1228,60	1030,60	1,32	1,84	65,80	57,13	66,72	11,70	57,90	74,70
Aug 92	1275,50	1080,40	3,82	4,83	65,54	57,29	64,91	11,00	57,10	74,10
Sep 92	1370,50	1148,10	7,45	6,27	67,67	60,13	63,31	10,80	57,10	73,90
Oct 92	1474,10	1211,80	7,56	5,55	69,18	63,27	65,73	10,70	57,10	73,80
Nov 92	1546,00	1254,10	4,88	3,49	68,59	62,70	66,68	10,60	57,50	74,20
Dec 92	1588,30	1299,30	2,74	3,60	65,97	61,40	67,77	10,60	57,60	74,20
Jan 93	1672,30	1364,80	5,29	5,04	59,77	52,70	65,19	10,90	57,70	74,20

(CPI / WPI = consumer price index / wholesale price index; p_{CPI} / month or / year and p_{WPI} / month or / year = change in consumer- or wholesale price index per month or per year; i_o = average overnight rate;, i_d (sight)/(month)/(year) = average deposit rate for sight/month/year. Source: Türkiye Cumhuriyet Merkez Bankasi, Aylik istatistik bülteni december 1993, own calculations)

Table 1: Rates of inflation and of interest in Turkey

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1) M.Ü. Almanca İşletme, Öğretim Görevlisi

2. Starting points: Fisher and Darby

Following common practice, the nominal rate of interest i_n can be calculated as sum of real rate of interest (after considering inflation) and the rate of inflation p:

$$i_n = i_r + p \qquad (1)$$

As an example, look for an investor who demands a rate of interest after inflation of i_r = 5% and expects a rate of inflation of p = 75% for the next year. Following (1), he claims a nominal rate of interest of i_n = 80%. Investing 1 million TL, he will get 1,8 million TL one year later. But in the same time, purchasing power has fallen: the purchasing power of 1,8 million TL in one year is equal the purchasing power of 1,8 million TL / (1+p) = 1,0286 million TL today. Therefore, his real rate of interest is 2,86% instead of 5% as calculated. The common practice, formula (1), ignores that not only the invested capital but interest too looses purchasing power. For a real rate of interest of 5% without any losses in purchasing power, the investor has to demand a nominal rate of interest of

$$i_n = i_r + p + i_r \cdot p \qquad (2)$$

Therefore, nominal rate of interest must raise to i_n = 83,75% in the example above to avoid a loss in purchasing power. The term $i_r \cdot p$ can only be ignored when inflation is relatively low or when interest is paid continuosly.

Formula (2) was evolved by Irving Fisher even 100 years ago. Fisher assumed in his theoretical and empirical investigations rational behaviour - which means the absence of financial illusions in this context - and identical expectations regarding inflation of all participants of capital markets. Moreover, he made the assumption that capital markets are perfect. Following the condition of the absence of financial illusions as assumed in (2), there could be no impact of inflation on the real rate of interest; a raise in the rate of inflation will be compensated by a raise of the nominal rate of interest (**Fisher-effect**)[1].

Results change when taxation is considered. Interest earned is taxed by income or corporation tax, interest paid for credits by corporations reducts income or corporation tax. Therefore, the net interest rate after taxes i_s can be calculated as

$$i_s = i_n.(1-s) \qquad (3)$$

with s as marginal tax rate for interest earned or paid, respectively. Thus, a marginal tax rate of s = 25%, applied on a nominal interest rate of i_n = 5%, leads to an interest rate after taxes of i_s = 3,75%[2].

In case of inflation, application of (3) on the Fisher-condition (2) leads to a rate of inflation of

$$i_s = (i_r + p + i_r.p).(1-s) \qquad (4)$$

which means a interest rate after taxes of i_s = 62,8125% for our example mentioned above. If an investor invests 1 million TL, he will get 1,628125 million TL one year later. Considering the loss of purchasing power, this amount equals a capital of 0,93004 million TL, measured with the purchasing power at the time of investing. That means his real rate of interest is -6,96%.

This negative real rate of interest is caused by taxation of the rate of inflation p itself by taxing the whole nominal rate of interest: The term p in (4) is like the "real" interest taxed with s. To obtain a constant real rate of return after taxes in case of inflation, the rate of inflation p ought not to be taxed. In this case, nominal rate of interest after taxes has to be

$$i_s = (i_r + i_r.p).(1-s) + p \qquad (5)$$

Together with (3), the nominal rate of interest before taxes can be calculated as

$$i_n = \frac{i_s}{(1-s)} = i_r + i_r \cdot p + \frac{p}{(1-s)} \qquad (6)$$

In the example, nominal rate of interest has to raise to i_n = 108,75% in case of taxation to obtain a real rate of interest after taxes of i_s = 3,75%. This condition, evolved for the first time from Michael R. Darby in 1975, is named **Darby-effect**[3].

Since there is no reliable statistical material, it is much more difficult to look into interest rate for credits than to investigate in real interest rates for deposits. A possible way is the examination of the average overnight rates which are published by the Türkiye Cumhuriyet Merkez Bankasi regulary. The overnight rate is the rate for short-time credits between commercial banks. Normally, credit rates from commercial banks for corporations tend to be a few per cent above the overnight rates which means that they follow the same trends as the overnight rate. Credit rates below the overnight rate are economic irrational. In such a case, corporations would try to get credit as much as possible to invest them in capital markets[6]. To test the Fisher-effect, the overnight rate as a short-time interest rate has to be compared with a short-time rate of inflation. Simplifying, we can use the rate of inflation for the same month. A monthly rate of inflation, e.g. for january 1992 (consumer price index) of 9,37%, equals an annual rate of inflation - when this lost in purchasing power will continue for one year - of $(1 + 0{,}0937)^{12} - 1 = 192{,}94\%$.

In the following, we abstain from showing the results for the real overnight rates. Even in the "quiet" time from january 1992 to december 1993, real overnight rates fluctuate between -54% and +63%. In april 1994, real overnight rates of more than 100% are realized. So we can conclude as following:

3.In the short run, the real interest rate for credits is not constant but fluctuates with sometimes extreme oscillations.

To some extent, a regulatory can be seen by comparing the overnight rate with the rate of inflation, measured by the consumer price index, of the last 12 months (see fig.2)[7]. Apart from a few oscillations during the economic crisis in spring 1994, rate of inflation and real interest rate have an approximately reverse trend: a raise in the rate of inflation leads to a fall in the real interest rate. Constant real interest rates as assumed by Fisher cannot be observed in this case, too. This leads to two further conclusions:

4.Credit rates are adapted to rate of inflation not in the short, but in the long run. For adapting credit rates to inflation, commercial banks seems to use the rate of inflation of the last 12 months, measured by the consumer price index.

5.Rising rates of inflation result in sinking real interest rates and therefore in cheaper credits[8].

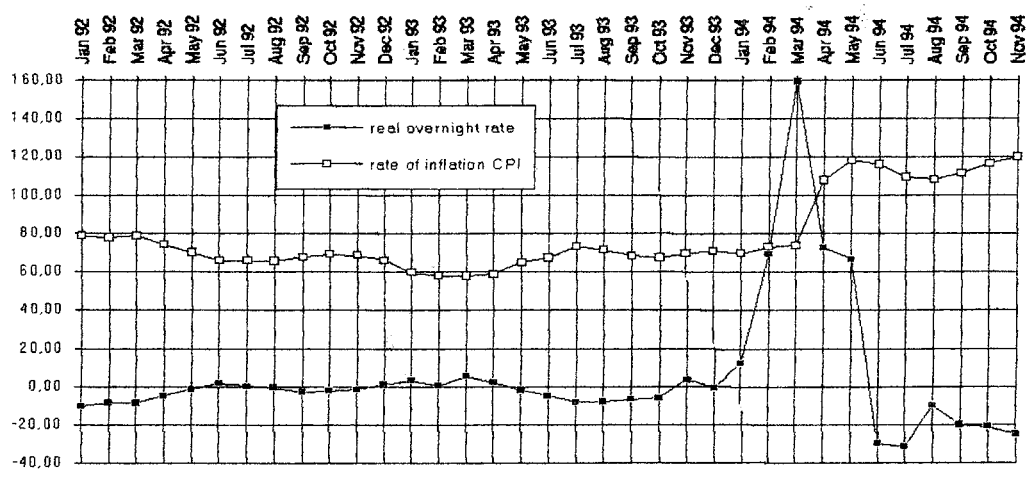

Fig. 2: Real overnight rate

Looking on fig. 2, it is interesting to see that the real overnight rate is sometimes below zero without considering taxation. After taxes, the real overnight rate is always negative: From

3. Interest rates and rates of inflation in Turkey

It is difficult to test the Fisher- and the Darby-effect. Fisher did not maintain a constant **realized** but a constant **expected** real interest rate. Since the real interest rates, expected by market participants, are not observable, it is impossible to test the ex-ante-version of the Fisher-effect or the Darby-effect empirically[4]. Only the ex-post-versions of this effects which measure the realized real interest rates are testable.

Table 1 shows without long calculations that the interest rate for sight- or one-month-deposits is lower than the rate of inflation, measured either with the consumer price index or the wholesale price index. Therefore, our first result can be formulated as following:

1.Sight- or one-month-deposits in commercial banks leads to real capital losses in all probability.

Judgement of one-year-deposits is a little bit more complicated. If investor and bank agree about a nominal interest rate of 72,20% in january of 1992 (see table 1), questions about the real interest rate can be answered not until january 1993 by comparing the rate of inflation from january 1992 to january 1993 with the nominal interest rate fixed in january 1992. Using (2), the ex-post interest real rate before taxes can be calculated as

$$i_r = \frac{i_n - p^*}{1 + p^*} \qquad (7)$$

with p^* as the rate of inflation - in this case, using the consumer price index - one year later[5]. The ex-post real interest rate after taxes can be calculated in the same way.

Fig. 1 shows the ex-post real interest rate before and after taxes (s = 25%) for one-year-deposits from january 1992 to june 1993. It can be seen easily that the real interest rate is by no means constant and very often negative. Especially from march to june 1993, real interest rates are strong negative due to the economic crisis and the resulting raise in the rate of inflation in spring 1994. The real interest rate after taxes is negative in any case. So we can fix a second result

2.One-year-deposits in commercial banks leads to uncertain and - in case of taxation - negative real interest rates and therefore to income losses.

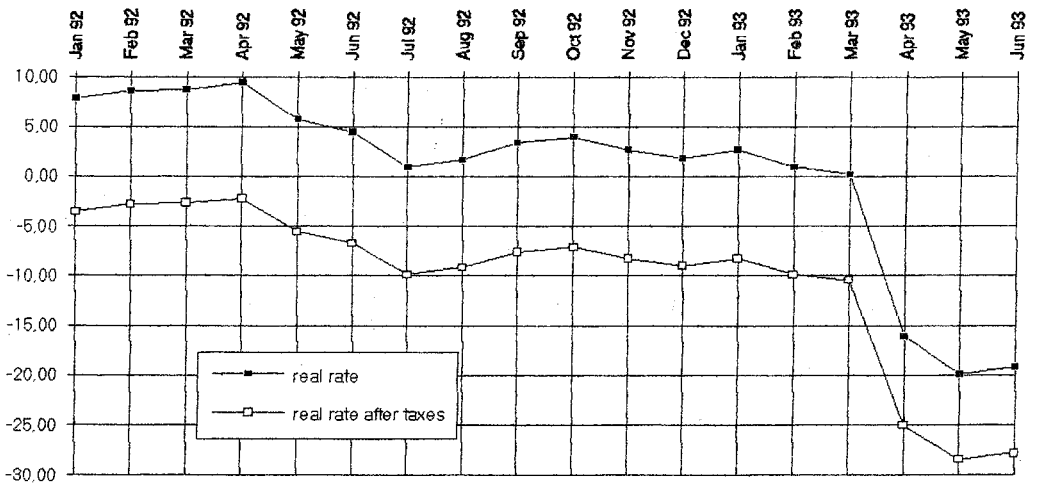

Fig. 1: Real interest rates for one-year-deposits

january 1991 to november 1994, the average real overnight rate after 25% taxes is -7,5%. After 55% taxes, it is in the average -21,11%. That means that, depending on the difference between overnight rate and credit rates for corporations and on the marginal tax rate of the borrower, real credit rates after taxes can be negative, too. As mentioned above, this is first and foremost caused by deducting inflation rate (included in the nominal interest rate) from taxable income - a small compensation for financial problems for corporations caused by the economic policy from government. So we get the last and - as it seems to us - most urgent conclusion:

6. Especially in times with high inflation, there are good chances to get credits with a negative real interest rate. In this case, it is possible to earn money only by borrowing and paying back credits.

4.Open questions and new research

It seems surprising that real credit rates fall - sometimes below zero - when inflation rises, because in this case, investors shift real money to borrowers. But empirical results for other countries show that Turkey is no single case - real interest rates tend to fall when inflation rises[9].

The question why the real interest rate tends to fall when inflation rises is investigated relatively detailed. The problem of formation of interest rates in an economy is being examined in detail from macro economics[10]. Mundell, for example, argues as following: In times of inflation, real cash balance of households falls. This leads to a lower demand for consumption and, therefore, higher savings. Higher savings means higher capital supply, which leads, together with a constant capital demand, to sinking capital costs and - after all - falling real interest rates (**Mundell-effect**)[11]. But until today, there is no model explaining these falling real interest rates in times of high inflation which is complete and which is broadly accepted.

Another way of explaining the facts dealt with in this paper could be research in modern capital market theory. Until now, there are only a few attempts to explain the formation of interest rates considering inflation within capital market theory. The most interesting starting points are developments of the **CAPM (Capital Asset Pricing Model)**, a model explaining the equilibrium of the capital market. Basis of the CAPM is the explanation of the rate of interest as riskless basic rate of interest plus a supplementary charge for risk. For evaluating risk, the CAPM shows a few ways, partly useful for practical purposes. The developments of the CAPM regarding inflation see inflation as a special risk and investigate in the relationship between inflation risk and other risks[12]. But in this research area, there is much more to do, and models are far away from common acceptance and - particularly due to measurement problems - further away from practical usability.

Therefore, our summary is not motivating for practicians: Until today, economics and business administration give little help in handling problems with financial decisions and financial risks in an inflationary world with strong oscillations of normal and real interest rates. The greatest hope for financial managers may be that the scientific community of countries with high inflation rates, affected with these problems nearly every day, one day will give satisfying explanations and models which will help financial managers to do their job. Another way may be to get a better control over budget and inflation by the economic policy of governments. Today, it seems hard to say which way is more difficult for Turkey.

Joachim BEHRENDT

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1) For details, see *Fisher*, Appreciation and Interest, New York 1896 (reprint 1970) chapter II; *Gebauer*, Realzins, Inflation und Kapitalzins, Berlin et al 1982, p.2 f.

2) Corporate tax rate in turkey is 25%, marginal income tax rate is between 25% and 55% depending on taxable income. For private investors, tax duties for capital income are often fulfilled by paying a tax at source of 10%. Since this paper deals with financial decisions of corporations, tax rate is assumed as s = 25% in the following.

3) *Darby*, The Financial and Tax Effects of Monetary Policy on Interest Rates, in: Economic Inquiry 1975, p.266 f. See also *Thiemer*, Der Zusammenhang zwischen Realzins und Inflationserwartung, Bergisch Gladbach / Köln 1987, p.11 f.

4) See *Thiemer*, loc.cit., p.6 f.

5) It depends on the situation which price index should be preferred for measuring inflation. In this case, we have a private consumer who invests and defers his consumption for one year. Therefore, measuring the rate of inflation with the consumer price index is correct. Has, in comparison, a corporation to decide about borrowing for buying mining material now instead of buying them later, inflation should be measured with the wholesale price index for mining.

6) We had to learn that - in Turkey - some credit rates are lower than the overnight rate. In most cases, this credits are credits for special purposes, for example credits for exports or imports.

7) This comparison supposed that investors build their inflationary expectations from past rates of inflation which means that inflationary expectations are built adaptive. Although this seems to be possible in reality - e.g., for the turkish overnight rates -, it is not consistent with rational behaviour. See, for example, *Schlotthauer*, Inflationserwartungen, Hamburg 1981, p.20 f., for a discussion in detail.

8) Please notice that these statements are not the results of statistical tests; they are only plausible estimations.

9) See, for example, the empirical investigations of *Nelson/Schwert,* Short-Term Interest Rates as Predictors of Inflation: On Testing the Hypothesis that the Real Rate of Interest is Constant, in: American Economic Review 1977, p.478 f.; *Fama/Gibbons,* Inflation, Real Returns and Capital Investment, in: Journal of Monetary Economics 1982, p.297 f.; *Barsky,* The Fisher Hypothesis and the Forecastability and Persistence of Inflation, in: Journal of Monetary Economics 1987, p.3 f. For the German case see *Thiemer* , loc.cit., p.61 f.

10) See *Thiemer*, loc. cit., p.18f.; *Thiemer*, Zinseffekte von Inflationserwartungen - Ein Überblick, in: das wirtschaftsstudium 1994, p.117 f.

11) See *Mundell*, Inflation and Real Interest, in: Journal of Political Economy 1963, p.280 f.

12) See *Roll*, Assets, Money and Commodity Price Inflation under Uncertainty: Demand Theory, in: Journal of Money, Credit and Banking 1973, p.903 f.; *Long*, Stock Prices, Inflation, ant the Term Structure of Interest Rates, in: Journal of Financial Economics 1974, p.131 f.; *Chen/Boness,* Effects of Uncertain Inflation on the Investment and Financing Decisions of a Firm, in: Journal of Finance 1975, p.1975 f. For a more sophisticated approach with less assumptions, see *Friend/Landskroner/Losq*, The Demand for Risky Assets under Uncertain Inflation, in: Journal of Finance 1976, p.1287; for newer attempts *Solnik*, Inflation and Optimal Portfolio Choices, in: Journal of Financial and Quantitative Analysis, p.903 f.; *Levy/Levy*, Equilibrium under Uncertain Inflation: A Discrete Time Approach, in: Journal of Financial and Quantitative Analysis, p.285 f.