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AN APPLICATION OF THE RISK-SHARING PARADIGM

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153/2001

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WIFO Working Papers, No. 153
August 2001

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2001/258/W/

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AN APPLICATION OF THE RISK-SHARING PARADIGM

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August 2001

Abstract

The paper argues that if the standard assumption of (approximately) risk-neutral banks holds only two kinds of loan rate covenants in standard debt contracts are optimal. If the borrower is risk-averse – no matter how much – then it is optimal that the interest rate risk is fully borne by the bank (i. e., fixed-rate loan). If the borrower herself is (approximately) risk-neutral as well, then a fifty-fifty division of the interest rate risk between the bank and the borrower is the optimal loan rate covenant in an adjustable-rate loan contract. Both findings can be nicely motivated by axiomatic bargaining theory and by traditional risk-sharing analysis. In addition, these results square well with the common-sense intuition that more risk-averse agents bear less of the risk than agents who are less risk-averse. Importantly, these results have some practical meaning too, for the fifty-fifty rule has become the standard rate covenant for adjustable-rate loans granted by Austrian banks to natural persons since 1997. The latter coincides with the introduction of an amendment to the Austrian consumer protection laws in 1997 which explicitly states that rate-adjustment covenants, in general, have to be based on 'objective and fair criteria'.

1. Introduction

Standard debt contracts are typically characterized by a repayment function such as $P(y) = \min(y,P)$, y denotes an observable, but basically stochastic cash flow and P a fixed repayment. In adjustable-rate loan contracts, for instance, the repayment in any period is calculated so that the loan will be retired at the maturity date, under the assumption that the interest rate will remain constant until then (*Luenberger*, 1998). Thus, the standard debt contract consists of (a) a promise of the borrower to pay the lender (i. e., the bank) a constant amount P and (b) an entitlement given to the lender to seize the borrower's entire cash flow y if the borrower reneges (that is, if she goes back on the promise). This is why under standard assumptions (i. e., risk-neutrality of banks vis-à-vis individual credits) optimal risk-sharing contracts fall short of providing a sound rationale for standard debt contracts. Contrary to the latter, optimal risk-sharing contracts involve a high sensitivity of the repayment P(y) to y, usually close to one when assuming that borrowers are considerably more risk-averse than lenders. This is almost always the case since banks behave almost always (approximately) risk-neutral (a rationale for neutral risk-behavior of banks is given in *Allen – Santomero*, 1998 and in *Scholtens – van Wensvee*, 2000).

Even though it remains valid that the risk-sharing approach cannot explain the wide-spread use of standard loan contracts, risk-sharing analysis has nevertheless something to say when it comes to the design of the covenant aimed to settle whether and how the interest rate agreed upon beforehand between the agents is to be adjusted in case observable changes of the bank's cost of funds occur before the credit retires. That is to say, rate clauses in standard debt contracts are supposed to fix in advance the allocation of possible (windfall-)revenues or costs due to unforeseeable (but basically observable) deviations of the cost of funds from the very set of costs that formed the calculation basis for the (pre-fixed) interest rate agreed upon between the lender and the borrower at date 0. In the case of fixed-rate loan contracts this clause, of course, states that the interest rate as contracted at date 0 remains unchanged until the loan expires. The practical importance of clauses like these is self-evident because, mainly due to costly state verification, unclearly and inaccurately specified rate-adjustment arrangements in loan contracts often give rise to very costly and tiresome litigation between borrowers and lenders.

The paper is divided as follows. In Section 2 the standard risk-sharing model is applied to show how systematic, and thus observable changes of a bank's fund costs are optimally allocated between the lender and the borrower under standard assumptions. The model also provides a rationale for why it is optimal that under information symmetry conditions (even slightly) risk-averse borrowers and (approximately) risk-neutral banks are to go for a fixed-rate loan contract rather than an adjustable-rate one. Section 3 discusses the major implications of the model against the background of an amendment to the Austrian consumer protection laws introduced in 1997 giving rise to what has now become the standard rate-covenant in adjustable-rate loan contracts offered by Austrian banks to natural persons seeking credit for private use (i. e., personal or consumer loans). The standard 'Austrian rate-adjustment covenant' is as follows: Loan rates are to be adjusted according to the rule that systematic changes of the bank's cost of funds as approximated by changes of the sum of two leading domestic interest-rate indicators (the 3-month Euro Interbank Offered Rate, in short 3-month EURIBOR, and the volume-weighted average of the yields of the quoted Federal government bonds of various maturities) be equally divided between the lender and the borrower. The paper argues that this fifty-fifty rule is a first-best solution under standard symmetry conditions (i. e., symmetric information, symmetric preferences) and when analyzed as a bargaining problem a Nash solution under the idealized assumption of equally distributed bargaining strength between the borrower and the lender. Section 4 concludes.

2. The Model

Suppose that all what is left to complete an otherwise optimal standard debt contract between a bank and a borrower is to specify whether the loan rate is fix or adjustable according to a rule. For simplicity, we assume that the loan starts at date 0 and retires at date 1 (note that multi-period loan contracts can be viewed as a sequence of one-period loans). Further, we take that both agents agree that only the systematic result x of a stochastic change of the bank's cost of funds is the subject matter of the covenant (i. e., the agents share the same rational expectations as to the development of the general interest rate level but are undecided yet as to the question how to deal with unforeseeable general interest rate shocks contractually). Obviously, the reason for the latter is that only systematic rate changes of a bank's funds (i. e., macroeconomic shocks to prevailing money market and capital market rates) are equally observable by the lender and the borrower and, importantly, these very risks cannot be avoided by holding a diversified portfolio (note also, there is a situation of complete and symmetric contracting, rendering a direct revelation mechanism needless). This is why the agents specify in advance, by means of a rate covenant, how they will share the nondiversifiable risk x.

Without loss of generality, we define x as the cash flow at date 1 generated by stochastic changes of the very interest-rates, to be denoted as r, that co-formed the calculation basis for the loan rate g at date 0, $g(0) \geq r(0)$, and, in addition, are symmetrically observable by the agents involved. We assume that the amount of the loan L be 1, hence $x \equiv -\Delta r$. Of course, x can be positive, negative or zero, but it is reasonable, indeed, to assume that x is bounded in order to ensure a meaningful support.

What we are up to in the following is to search for a procedure that specifies an optimal sharing rule for x with the bank's share R as a function of x, $0 \leq R(x) \leq x$ when $x \geq 0$, and $-x \leq R(x) \leq 0$ when $x < 0$. Obviously, (x-R(x)) will go to the borrower leading, when $R(x) \neq x$, to a change of her, at date 0 pre-fixed interest payment at date 1, accordingly. In other words, we are looking for the optimal formula for g at date 1, that is, $g(1) = g(0) + (x-R^*(x))$ for all x, fixed in advance at date 0.

If we assume that the risk preferences of both agents are described by Von Neumann-Morgenstern utility functions u_L (for the bank) and u_B (for the borrower) with the usual properties (i. e., both are twice continuously differentiable, concave, and strictly increasing), then, it is easy to see that the optimal rate covenant can be obtained as the solution of the following optimization program (*), that is, by applying the standard risk-sharing paradigm (see, for example, *Freixas – Rochet*, 1997, p. 93):

$$(*) \qquad \max Eu_B(x - R(x))$$

$$s.t.\ Eu_L(R(x)) \geq U_L \qquad (2.1)$$

$$0 \leq R(x) \leq x,\ iff\ x \geq 0 \qquad (2.2a)$$

$$-x \leq R(x) \leq 0,\ iff\ x < 0 \qquad (2.2b)$$

where the parameter U_L, in following *Freixas – Rochet* (1997), denotes the expected utility demanded by the bank (individual rationality level). Since the lender and the borrower play completely symmetric roles in the given context, as does the sharing rule with regard to x, that is, the same sharing rule is supposed to hold either way, $x < 0$ and $x \geq 0$, it suffices to solve the program (*) for $x \geq 0$. That is to say, our model is formally the same as the standard risk-sharing model as discussed, for example, in *Freixas – Rochet* (1997).

In order to get the classical result on optimal risk-sharing between two parties in a symmetric situation, we have to assume that the constraints (2.2) are not binding. Though stated for technical reasons only in the given context, this assumption brings out the full flavor of the risk-sharing paradigm. Translated into our setting the central result of the risk-sharing approach is as follows (for formal details, see *Freixas – Rochet*, 1997, Chapter 4):

Result: In standard loan contracts, optimal rate covenants under symmetric information are characterized by the following first-order condition

$$R(x)' = I_B(x-R(x))/[I_B(x-R(x))+I_L(R(x))]$$

where I_i, i=L, B, denotes the Arrow-Pratt absolute risk aversion coefficient, defined as

$$I_i(x) = -[u_i''(x)/u_i'(x)]$$

Note, $I_B(x)$ larger than $I_L(x)$ means the borrower is more risk-averse than the lender, and $I_L(x)$ close to 0 is equivalent to saying the bank is (approximately) risk-neutral.

The implications of this result for the optimal design of rate covenants can best be grasped when utilities u_i, $i = B, L$, are assumed to be exponential. In this case the risk aversion coefficients are constant ($I_i \equiv \rho_i$) for all x. The optimal sharing rule $R^*(x)$ has then the simple form (by ignoring the constants of integration)

$$R^*(x) = \alpha x, \quad with\ \alpha=[\rho_B/(\rho_B+\rho_L)]$$

It is easy to see that, under the standard assumption of 'near risk-neutrality' on the part of banks, the optimal sharing rule $R^*(x)$ translates into the following statement:

Optimal Rate Covenant: When the bank is (approximately) risk-neutral, the optimal formula for g at date 1, $g(1)=g(0)+(1-\alpha)\,\Delta r$, fixed in advance at date 0, is

(a) $g(1) \cong g(0)$, if the borrower is risk-averse, and

(b) $g(1) \cong g(0)+(1/2)\Delta r$, if the borrower is (approximately) risk-neutral.

The proof of this proposition is trivial. Implication (a) follows directly from $R^*(x) \cong x$, since $\alpha \cong 1$, and (b) from $R^*(x) \cong (1/2)x$, since $\rho_B \cong \rho_L$.

From a practical point of view, this proposition says something interesting (for financial economists, however, something quite familiar), namely given the bank is approximately risk-neutral 'genuine' risk-sharing considerations with respect to the interest rate risk as discussed above are irrelevant. If a borrower is risk-averse – no matter how much – and a lender is approximately risk-neutral, then it is optimal for both to go for a fixed-rate loan. If both agents are approximately risk-neutral, then an adjustable-rate loan with a fifty-fifty rate adjustment rule is the optimal choice.

This result squares well with the common-sense intuition that, as put by *Allen – Gale* (2000, p. 155), "more risk-averse people bear less of the risk than people who are less risk-averse" and, in addition, with the idea of a bank as an intermediary who takes and manages interest rate risks (hopefully efficiently) by issuing liquid deposits guaranteed by illiquid loans. This particularly holds when a fixed-rate loan contract turns out to be optimal for both agents. However, an adjustable-rate loan contract with a fifty-fifty rule for the division of ex post gains and losses due to stochastic changes of the bank's observable cost of funds to be the only optimal solution if both agents are risk-neutral cannot be viewed as an outright unexpected or perverse finding either. The point is that if a situation is symmetric as in the given context it seems to be quite natural to find a symmetric equilibrium very intuitive.

The fact that the fifty-fifty rule has become the standard rate covenant in adjustable-rate loan contracts between banks and individuals (i. e., personal loans for private use) in Austria since 1997 underlines forcefully the practical importance of this symmetric result. We will come back to the Austrian version of the fifty-fifty sharing rule in greater detail in the following section.

Obviously, the risk-sharing approach as presented here does not provide an explanation for the wide-spread use of adjustable-rate loans with an interest rate equaling, for instance, the 3-month EURIBOR plus, say, 200 basis points in any period. In adjustable-rate loan contracts like these, the interest rate risk involved as measured by the changes of standard rate indicators is shifted fully to the borrower. As a result, the bank enjoys a constant net-interest income with no interest rate risk at all when it funds the loan by issuing deposits that pay an interest rate equal to the 3-month EURIBOR. This is a very convenient (and, I must say, rather easy) way for banks indeed to cope with interest rate risks associated with transforming short-term debts into long-term assets. Our model motivates such a 'sharing rule' as optimal only when we assume that the bank is considerably more risk-averse than the borrower (note if both agents are similarly risk-averse then the fifty-fifty rule holds). By all means, this is, in general, a 'turning-the-world-upside-down' kind of assumption and thus a not reasonable one to make in the context of a standard bank-individual borrower relationship as discussed here (for example, *Allen – Gale*, 2000, argue that banks are capable of averaging risks over time that cannot be diversified at a given point in time and, more importantly, they are able to do it in a way that reduces the impact on individual welfare). Thus, there have to be other forces at work than optimal risk-sharing considerations that motivate rate covenants like these. Likely candidates for those contingent rate clauses are, indeed, asymmetries such as the usually far bigger market power of banks vis-à-vis individual borrowers, binding liquidity constraints on the part of borrowers, strong but opposing beliefs as to how the level of prevailing interest rates develops or in the more complex set-up of structured investment financing, the use of adjustable-rate loans as interest rate derivatives to enhance (or control) the performance of portfolios (i. e., floating-rate debt instruments issued by non-financial companies).

3. The Fifty-Fifty Rule as Applied by Austrian Banks

In Austria as in any other industrialized country, agents are basically free to sign contracts at will as long as the laws of the land are not violated. Of course, this also applies to lenders and borrowers when signing contracts, though the legal restrictions in loan contracting are much tighter than elsewhere mainly due to the fact that consumer protection issues traditionally matter quite strongly in this particular strand of contracting. Consumer protection concerns also played a central role in the introduction of a supplement to the Austrian consumer protection laws in 1997 that, since then, has led to a substantial change as to the design of the usual rate-adjustment rule in adjustable-rate loan contracts signed between banks and natural persons. This very piece of law states implicitly that adjustable-rate loan contracts between banks and individual borrowers (i. e., natural persons) have to specify sufficiently clearly how to adjust the respective loan rate 'fairly and objectively' until the credit expires. As a result, and without going into contractual (and other) details here, the following rule has finally emerged as the standard rate-adjustment covenant

$$\Delta g = (1/2)\,[\Delta\, EURIBOR3 + \Delta\, SMRB]$$

where EURIBOR3 denotes the 3-month EURIBOR and SMRB the volume-weighted average of the yields of the quoted Austrian Federal government bonds. This formula refers to two major domestic interest rate indices, both of which are symmetrically observable (i. e., both are published on a regular basis by third parties), and, importantly, meets the requirement to capture the systematic (and thus macro-stochastic) changes of the Austrian banks' cost of funds sufficiently well (Figure 1). Standard correlation analysis corroborates this visual impression (Table 1).

Figure 1: Fifty-Fifty-Rule versus Average Cost of Funds for Austrian Banks

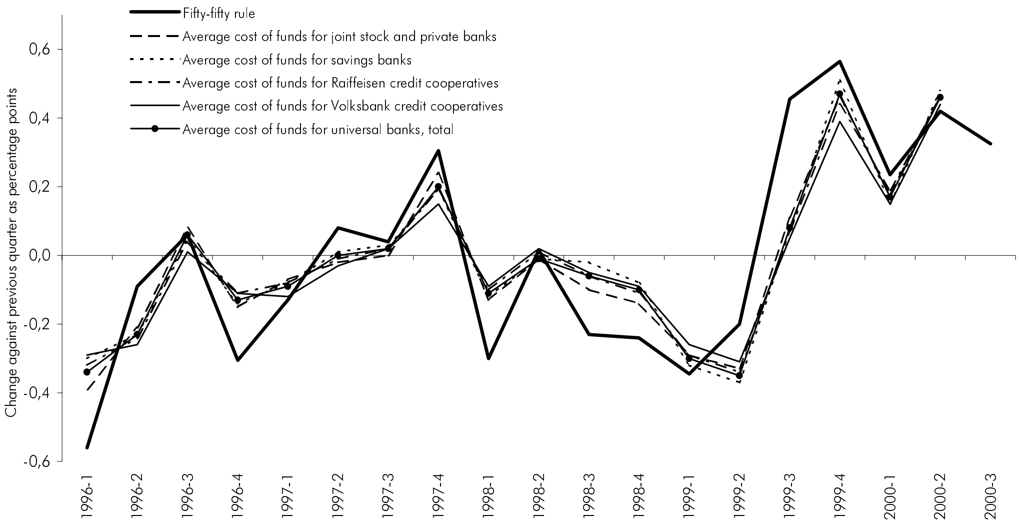


Table 1: Correlations between Fifty-Fifty Rule and Average Cost of Funds for Austrian Banks

	Dgraq	Dgrsq	Dgrlq	Dgrgq	Dgrtq	Dzgklq
Quarterly						
Dgraq	1,0000					
Dgrsq	0,9843 *	1,0000				
Dgrlq	0,9920 *	0,9940 *	1,0000			
Dgrgq	0,9817 *	0,9906 *	0,9961 *	1,0000		
Dgrtq	0,9943 *	0,9965 *	0,9984 *	0,9931 *	1,0000	
Dzgklq	0,9164 *	0,8652 *	0,8758 *	0,8553 *	0,8861 *	1,0000

Period: I. quarter 1996 to II. quarter 2000.

	Dgra	Dgrs	Dgrl	Dgrg	Dgrt	Dzgkl
Monthly						
Dgra	1,0000					
Dgrs	0,9680 *	1,0000				
Dgrl	0,9739 *	0,9830 *	1,0000			
Dgrg	0,9541 *	0,9640 *	0,9839 *	1,0000		
Dgrt	0,9854 *	0,9929 *	0,9930 *	0,9772 *	1,0000	
Dzgkl	0,8910 *	0,8567 *	0,8544 *	0,8344 *	0,8693 *	1,0000

Period: January 1996 to August 2000.
Source: Data are from the Austrian Institute of Economic Research and the Austrian Central Bank, own computation.
* ... significant at 1%-level.
For all banking sectors, average cost of funds correspond to the volume-weighted average of the interest rates payed by Austrian banks for domestic deposits and of the issuing yields of domestic bonds issued by Austrian banks.

Changes of average cost of funds against previous period in percentage points for
Dgra(q) ... joint stock and private banks
Dgrs(q) ... savings banks
Dgrl(q) ... Raiffeisen credit cooperatives
Dgrg(q) ... Volksbank credit cooperatives
Dgrt(q) ... universal banks
Dzgkl(q) ... Fifty-fifty rule as defined in Section 3.

Of course, standard risk-sharing analysis as carried out in Section 2 does provide an excellent rationale for the 'Austrian formula' under plausible (viz. standard) presumptions, but though caressing common sense intuition a formal analysis like that is not very likely to have been the core motivation for the implementation of this rule in the first place. In my opinion, what comes closest to the truth is a rationalization of this rule on the basis of the axiomatic bargaining theory. To be sure, the parties involved (i. e., bankers and loan applicants) most probably don't know a thing about this approach (and therefore can't apply it explicitly to underpin this formula), but this offspring of cooperative game theory is often remarkably useful in revealing and illustrating the underlying (formal) structure of explicit (and complete) contracts that can be enforced by third parties such as the courts. Because axiomatic bargaining theory is aimed to formulate and analyze the determination of reasonable social compromises, its logic resembles, to a high degree, the mode of argumentation that usually guides the finding of justice in a court of law (at least in the legal systems of Europe and the USA). Put differently, solutions of standard (bilateral) bargaining problems often correspond one-to-one to resolutions of (implicit) arbitrators whose task is to distribute the gains (and losses) from trade or, more generally, from cooperation in a manner that reflects 'fairly' the bargaining strength of the different agents (*Mas-Colell – Whinston – Green*, 1995, p. 838).

By applying the bargaining approach to our problem how, then, has the story to run to motivate the fifty-fifty-sharing rule? To cut a possibly long story short, I suppose both bankers (say, represented by their legal counselors) and borrowers (say, represented by seasoned consumer protectionists) have (intuitively) sensed the similarity between negotiating a standard loan rate covenant subject to a legal constraint as imposed by the Austrian consumer protection laws since 1997 and finding a unique (and efficient) solution for a stylized 'bargaining game' with the structure of letting two parties of equal standing negotiate a split of, say, ATS 100 with both getting nothing if no agreement is reached. To be a bit more concrete, in a symmetric situation like this (i. e., the parties involved are taken to have basically the same bargaining strength and the same risk preferences, which is, by the way, a reasonable assumption to make in this very context) it seems to be quite natural to expect a split into half shares for each (that is, ATS 50) to be the efficient (and symmetric) outcome (see, *Kreps*, 1990, p. 106).

This 'natural equilibrium' holds good as an efficient (and a unique) solution under the given assumptions when looked at from the more formal viewpoint of the axiomatic bargaining theory (note what J. Nash, who established this framework, used to say: "One states as axioms several properties that it would seem natural for the solution to have and then discovers that the axioms actually determine the solution uniquely.", quoted in *Osborne – Rubinstein*, 1990, p. 11).

Without going into formal details of the axiomatic bargaining theory (for an excellent treatment of Nash's approach of deriving a unique solution from some simple axioms such as, for example, symmetry and Pareto-efficiency – to mention just those needed for solving our problem – see, *Osborne – Rubinstein*, 1990, or *Roth*, 1979), we simply state that there is an efficient and a unique bargaining solution, a so-called Nash solution, for the loan rate-adjustment problem between a bank and an individual borrower as discussed in Section 2, and this solution is given by

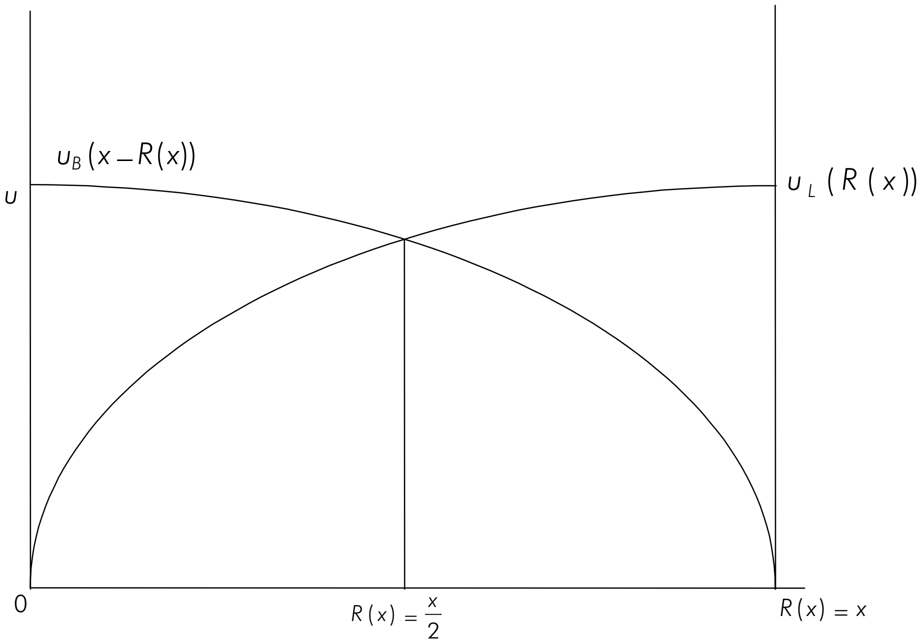
$$(**) \qquad \max E[u_B(x - R(x))\, u_L(R(x))]$$

subject to the constraints *(2.2a)* and *(2.2b)*, respectively. If the utility functions are exponential, as assumed above for simplicity reasons, it is easy to see that in case the agents share the same attitude toward risk, meaning their risk preferences can be represented by the same utility function (that is, both are either approximately risk-neutral or similarly risk-averse) the Nash bargaining solution is

$$[1 - R(x)'] = R(x)'$$

Obviously, this implies that, within the frame of this theory, the fifty-fifty sharing rule is an efficient and a unique bargaining solution when the bank and the borrower are approximately risk-neutral or similarly risk-averse (see Figure 2 for an illustration of the latter). Not surprisingly, given these very assumptions the bargaining solution is the same as the egalitarian solution derived in Section 2.

Figure 2: Nash-bargaining solution when lender and borrower are identically risk-averse



Likewise, it can be shown that in case both agents have exponential, but different utility functions, $R^*(x) = \alpha x$, with $\alpha = [\rho_B/(\rho_B + \rho_L)]$, is an efficient and a unique bargaining solution according to Nash's theory.

Thus, the optimal rate covenant as presented in Section 2 can be nicely motivated either way, by axiomatic bargaining theory and traditional risk-sharing analysis.

The fifty-fifty rule even holds, at least in a practical sense as discussed throughout, if one enriches the structure of our bilateral bargaining game along the line of alternating-offer bargaining (see, for example, *Kreps*, 1990). In a nutshell, this approach analyzes bargaining games as outlined above (i. e., splitting a sum of money) under the assumption that the bargaining process itself is costly. That is to say, the lender and the borrower have an incentive not to bargain endlessly. *Rubinstein* (1982) shows that such bargaining games provided both agents are risk-neutral have indeed a single equilibrium that, as put by *Kreps* (1990), "does not involve any incredible threats of any sort, one in which the first player to make an offer offers to take a little bit more than 50 per cent of the pie, and the second player agrees immediately".

Bargaining costs of any sort may be one, if not the most important part of the explanation for the wide-spread use of the fifty-fifty-rule in adjustable-rate loan contracts signed between Austrian banks and natural persons since 1997. As an aside, it may have been particularly costly for Austrian banks in recent years to explain their clientele why their favored rate-adjustment clauses before 1997 deviated from that applied ever since. After all, what the very amendment to the Austrian consumer protection laws requires is, apparently, no more than Austrian banks insist to have done all the years anyway, namely treating clients 'objectively and fairly'.

4. Final Remarks

The paper argues that if the standard assumption of (approximately) risk-neutral banks holds only two kinds of loan rate covenants in standard debt contracts are optimal. If the borrower is risk-averse – no matter how much – then it is optimal that the interest rate risk is fully borne by the bank (i. e., fixed-rate loan). If the borrower herself is (approximately) risk-neutral as well, then a fifty-fifty division of the interest rate risk between the bank and the borrower is the optimal loan rate covenant in an adjustable-rate loan contract. Both findings can be nicely motivated by axiomatic bargaining theory and by traditional risk-sharing analysis. Importantly, the fifty-fifty rule has become the standard rate covenant for adjustable-rate loans granted by Austrian banks to individual borrowers (i. e., consumers) since 1997. The latter coincides with the introduction of an amendment to the Austrian consumer protection laws in 1997 which explicitly states that rate-adjustment covenants, in general, have to be based on 'objective and fair criteria'.

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Verkaufspreis: ATS 100,– bzw. EUR 7,27