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**Steffen Sebastian / Marcel Tyrell**

# Open-End Real Estate Funds: Danger or Diamond?

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**Steffen Sebastian[†] and Marcel Tyrell[*]**

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[†] Department of Finance, Goethe University Frankfurt, Mertonstr. 17-21, 60325 Frankfurt, Germany, E-mail: sebastian@finance.uni-frankfurt.de

[*] Department of Finance, Goethe University Frankfurt, Mertonstr. 17-21, 60325 Frankfurt, Germany, E-mail: tyrell@finance.uni-frankfurt.de

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# 1 Introduction

In the late 1980s the Dutch fund RODAMCO was one of the largest real estate funds in the world. Low interest rates made an investment in RODAMCOs shares particulary interesting, which offered a return of about 3 percent higher than a bank deposit. Due to the open structure the resulting flow of speculative capital into the fund could not be avoided. At this time the fund was with about three quarters of its assets invested in the US and UK. In the early 1990s the raise of interest rates caused a high outflow of capital. In the same time the US-American market - and thus RODAMCO's portfolio - was affected by a severe drop of real estate prices. In an open end structure, the unit price is determined by dividing the total assets of property and cash by the number of units. Therefore, as the value of the units redeemed is directly related to the value of the properties, and all the funds' properties are only appraised once at the end of the fiscal year, it was predictable that the redemption price was going to suffer a severe drop. In that situation it was thus optimal for all investors to redeem their parts and buy them back after the re-appraisal, i.e. free arbitrage was possible. In the end the liquidity problems forced the fund management to transform the fund into a stock quoted closed end fund. The fact that redemption and appraisals took place at different points in time represented a build-in danger of a bank run which had to come up after the first relevant decline of real estate prices (Boot, Greenbaum, and Thakor (1993); Helmer (1997), p. 126; Lee (2000)).

A similar crisis occurred about the same time with Australian open end real estate funds. The Australian real estate market was marked by huge inflow of capital, especially after the stock market crash of 1987, which caused a strong increase of real estate prices. This surge was even further supported by Australian bank credits at low interest rates. The central bank tried to limit the excess of the price bubble by an augmentation of the prime rate. The result was a sharp drop of the real estate prices by about two thirds which caused into a run on the redemption of open end real estate funds. To avoid a collapse of those investment vehicles the government decided to stop all redemption for a period of 12 months and forced all funds to quote on the stock exchange (see Little (1992)).

In Switzerland the first open end real estate fund was founded as early as in 1938. Switzerland was as well one of the first countries to introduce a regulation for open end real estate funds in 1967. Facing irregularities with redemption prices in 1991, the regulation authorities nevertheless adapted the regulations codified in the *"Anlagefondsgesetz"*(AFG). Among other chances, redemptions are now only possible after a notice of termination within a twelve months period before the end of the fiscal year (art. 42 AFG). This requirement ensures that the fund management has enough time to offer adequate liquidity, e.g. by selling parts of the funds assets. On the other hand, the depositary bank has to organize the continuous trade of the units, in general by trading on the stock exchange. As a result of the new regulations, most of the trading takes place at the stock exchange and Swiss open end real estate funds neither emit nor redeem units in relevant amounts. All in all, Swiss open end funds act comparable to stock quoted closed end funds with a limited redemption possibility.[1]

German open end real estate funds are internationally the only exception which have been for almost 50 years very successful. Since 2004, the whole sector suffers a crisis which is very close, if not already identical, to a bank run. Both phenomenon seek an explanation. The ongoing crisis let to the discussion how the current design of German real estate funds needs to be modified. In the beginning of 2006, several reform proposals were lanced, trying to slow down the number of unitholders asking for redemption. However, some reform proposals bear the intention to transform them towards closed end constructions and thereby diminish, in our opinion without need, the advantages of open end funds. We try to contribute to the reform discussion, first, by showing that open end structures may represent a stable solution like banks, and second, by examining the effect of the introduction of a secondary market. Furthermore, we show that the open end construction delivers a monitoring function with respect to the fund managers.

The article is organized as follow: Chapter 2 contains a description of the institutional design of German open end real estate funds and the development of the recent crisis. Chapter 3 describes the theoretical framework and chapter 4 the modifications of the basic model. Chapter 5 concludes.

# 2 Institutional Design

While setting up the German Investment Companies Act in 1969 ("*Investmentgesetz* (InvG)") the regulation contained a number of measures to avoid a liquidity crisis despite the obligation of daily redemption. Furthermore, different elements of the investment practice result in additional protection even if they were not initially implemented for that reason. German real estate funds have to hold at least 5% of their assets in cash, with a maximum of 50% allowed. Until the crisis of 2005/2006, the funds held 25-49% of their assets in cash or bonds. Furthermore, the funds are allowed to maintain a leverage up to 50% of a property's value. If even that does not allow to satisfy the outstanding redemptions, the fund can delay the repurchase of units for a period of up to two years. However, since 1959 this possibility of last resort was never used until 2005. A further important instrument to protect from unexpected withdrawals is an offering pre-

[1]As emissions only take place occasionally, Hoesli (1993), p. 29) called them "semi closed-end".

mium of usually 5%. In its origin raised to cover distribution cost these build-in transaction costs create an effective barrier to make frequent transactions with their units unattractive. Due to the offering premium the investment horizon to achieve a positive return is in general at least a year.[2]

All in all, the liquidity transformation of German real estate funds is to a large extend enabled by their hybrid character as a mix of cash and real estate investment. Furthermore, the liquidity of a unit is restricted in both dimensions of liquidity, price and time, thus limiting additionally the extend of liquidity transformation which the funds need to perform.

The appraisal of the funds' properties takes place at different dates during the fiscal year. As a result, value changes as well as changes of redemption prices are smoothed over the year. While originally introduced to facilitate administrative procedures, this appraisal praxis helps at least to avoid liquidity crisis similar to the RODAMCO case. The importance of that factor shows the development of the DEKA-crisis. In 2004, low performances of some funds which were predominately invested in Germany, led to demand on redemption in considerable amount. For example, Grundbesitz-Invest, one of the funds of Deutsche Bank, lost almost 800 million in the first half of 2004. In September 2004, the rumor came up that the DEKA fund might have overestimated the value of their property. In a few weeks the funds losses amounted more than 500 million Euro. The DEKA bank, the owner of the funds' management company, could only avoid the closing of the funds by buying back large amount of units. Ongoing mistakes in communication, ending in speculations of the bank director about closing the fund, led to the loss of capital of about 1,600 million Euro in less than a year. In the end, only the demission of the bank's director in combination with a renewed guarantee of redemption and a minimum return of 2% helped slowing down demand for redemption. Despite those efforts, a crisis of the sector of open end real estate funds could not be avoided. In December 2006, the Grundbesitz-Invest stopped redemption and emission until 1st of March 2006. In January, the KanAm was as well forced to stop redemption for the initial period of three month.[3]

[2]For a further description of the institutional framework of German open end funds see Maurer and Sebastian (2002); Maurer (2004) and Maurer, Reiner, and Rogalla (2005).

[3]See also Bannier, Fecht, and Tyrell (2006) for a detailed description of the development of the crisis.

# 3 Theoretical Framework

## 3.1 Overview and Description of the Model

In this section we will argue that open end real estate funds bear resemblance to banks and, accordingly, should be analyzed within a similar framework that proved to be useful in investigating banks' fragility. The classical approach to analyze bank fragility is that of Diamond and Dybvig (1983), where bank runs occur as a consequence of multiple equilibria. In a nutshell, these authors show that when the technological yield curve of real investments is upward sloping the banking system can provide efficient risk sharing to households (depositors) which face unobservable liquidity shocks. Thus, the *Diamond-Dybvig* model depicts the optimal contract between a financial intermediary and a consumer who faces uncertainty with respect to the timing of her consumption. Such a good *Nash* equilibrium, where banks offer depositors an insurance against liquidity shocks, exists even if the banks' asset side is composed mainly of illiquid long term assets. On the other hand, as a result of a coordination failure *Diamond/Dybvig* also show that a bad *Nash* equilibrium exists where all depositors, irrespective of their liquidity preference, withdraw early from the banks. This coordination failure is based on the notion that because of a certain illiquidity of the long term investment it becomes optimal for a depositor to withdraw early if he *believes* that other depositors will do likewise. Important assumptions of the model are that the yield of the deposit is invariant, and that the return on the illiquid long asset is riskless. Both assumptions constraint the usefulness of the approach to our research question because typically real estate assets exhibit some return variation and the yield of funds' shares are, even though at a smaller degree, uncertain as well.

Allen and Gale (1998) offer instead an alternative framework where the return of long term assets is risky, and the return of the deposit may vary with the demand for early redemption. We adopt and extend that approach in order to allow the yield of a fund‘s shares to be variant as well, while the variation of the shares' yield is a function of the long term real asset return. The smoothing function is captured by the model insofar as that the variation of the fund‘s share yield is lower than the variation of the long term real asset return.

Let us describe the basic framework of the model. We assume three time periods $t = 0, 1, 2$. A one-good-economy will be considered whereas this good can be used both for consumption and for investment. The open end fund can invest at $t_0$ into two types of assets, i.e. a liquid storage technology $L$ that just transfers the good without discount into the next time period, and in illiquid long term assets $X$ which can easily be interpreted as real estate assets. We assume for the latter asset class a stochastic production technology which transforms one unit of the invested good at $t_0$ into $R$ units at $t_2$, with $E[R] > 1$ and a density function $f(R)$, defined in the range $[0, R_1]$. In addition we suppose in this section that the illiquid long term assets cannot be sold in the short term. This should grasp in a stark way the fact that on short notice the real estate assets secondary market is relatively illiquid. In latter section we will weaken this assumption. In addition, we assume that shortly before $t_1$ all investors in the open end fund get a *perfect* public signal about the return realization of the long term asset class. As a consequence they can condition their decision to redeem their shares of the fund on this signal. With that assumption two reasons for withdrawing shares, i.e. low return prospects and consumption needs, will be interlinked. This adds realism to our model.

Consumers, i.e. households, by themselves can invest individually only in the liquid storage technology. Thus, one role of the real estate fund is to make investments on behalf of the consumers because funds' manager are specialists in doing that. This assumption should reflect the fact that real estate assets are extremely difficult to evaluate, and small investors typically lack the knowledge in this field. They can not distinguish valuable risky assets from nearly worthless assets. Accordingly, they face an extreme adverse selection problem when they try to buy and sell these assets directly and have to delegate such decisions.

Preferences of the risk-averse households[4] are modelled as follows. We assume the existence of a large number of ex ante, at $t_0$, identical investors of measure 1 which are, however, exposed to different liquidity shocks regarding their consumption needs at later time periods. We normalize the entire endowment of all the investors with investment good to 1 unit. A fraction $\lambda$ of the investors gets a liquidity shock so that it must consume at $t_1$, the fraction $(1-\lambda)$ has to consume instead at $t_2$. Shortly before $t_1$ every investor receives - in addition to the public information about the future return realization of the long term asset - a *private* information on whether he belongs to the early or late consumers, respective to a patient or impatient type. Thus ex ante all investors are identical with respect to the uncertainty about their liquidity needs but at $t_1$ they know individually if they belong to the so called early consumers or to the late ones. This means, we can define the following representative utility function:

$$U(c_1, c_2) = \begin{cases} u(c_1) & \textit{with probability} \quad \lambda \\ u(c_2) & \textit{with probability} \quad (1-\lambda), \end{cases} \tag{1}$$

with $c_t$ as consumption at $t = 1, 2$ and $u(\cdot)$ the neoclassical concave utility function. Because of the law of large numbers we have no aggregate uncertainty with respect to the liquidity needs of the entire investor base. The fund manager knows exactly the overall fraction of investors which have consumption needs at $t_1$ but he has no knowledge on the identity of the early consumers.

However, the fund has a double advantage over the small investors. First, in contrast to individual consumers it can hold a portfolio consisting of two asset classes, which will typically dominate a portfolio consisting of only the liquid

[4] We use the terms households, investors and consumers interchangeable.

asset. Secondly, the real estate fund can offer liquidity insurance to consumers with uncertain liquidity demands by pooling the endowments of a large number of investors, thereby giving early consumers some benefits of the high-yielding risky but illiquid long term real estate assets without subjecting them to the volatility of the asset market.

In the following we will describe in analogy to *Allen/Gale* the optimal incentive-compatible solution to this problem and show how it can be implemented by the redemption decision of the investors. This serves as a benchmark to the analysis in latter sections where we incorporate more realistic features of the open end real estate fund construction.

## 3.2 The Basic Model: Optimal Incentive-Compatible Solution and Its Implementation

We examine the problem from the perspective of a representative consumer. Free entry into the fund sector induces funds to maximize expected utility for the consumer. Then optimal risk sharing should allow the withdrawable amount at each date to be contingent on the long term return $R$. However, the incentive compatibility condition constraints the amount which can be withdrawn by impatient rsp. patient investors: in order that patient investors do not imitate impatient ones it must be guaranteed that for every value of $R$ the former are at least as well off as the impatient investors. Otherwise, a patient investor would for sure withdraw at $t_1$ and transfer the withdrawn amount by investing individually in the liquid asset to get his consumption in $t_2$. Thus, we should have $c_1(R) \leq c_2(R)$ for every value of $R$. Now we can formulate the optimal risk-sharing problem:

$$\begin{array}{ll} \max & E\left[\lambda u(c_1(R)) + (1-\lambda)u(c_2(R))\right] \\ \text{s.t.} & L + X \leq 1; \\ & \lambda c_1(R) \leq L; \\ & (1-\lambda)c_2(R) \leq L - \lambda c_1(R) + RX; \\ & c_1(R) \leq c_2(R). \end{array} \tag{2}$$

The first three constraints are budget constraints. First, the total invested amount must be less than or equal to the endowment of the investors. Second, holdings of the liquid asset $L$ must be sufficient for consumption provision to the early consumers $\lambda c_1$. Third, the value of the risky real estate assets $RX$ plus the amount of liquidity left over after withdrawal by the early consumers will be paid out to late consumers. The final constraint reflects the incentive compatibility condition.

In order to ensure that $L$ and $X$ are strictly positive, so we have an interior solution for the optimal portfolio containing both types of assets, we make two assumptions. The technology satisfies $E[R] > 1$ and the preferences and technology satisfy $u'(0) > E[u'(R)R]$. Thus, the risky illiquid asset $X$ is more productive than the safe liquid asset $L$, ensuring that even a risk averse investor will hold a positive amount of the former asset type. The second condition assures that the open end fund will not invest the entire amount in the risky long term real estate assets. Suppose the fund invest the entire endowment of 1 in the risky asset. In this case, early consumers cannot consume anything and the consumption of the late consumers would be $R$. Then the inequality states that an increase in $L$ and an equal reduction in $X$ will increase the utility of early consumers by more than it reduces the expected utility of late consumers. So the corner solution $L = 0$ and $X = 1$ cannot be optimal.

In solving problem (2), we can simplify it by removing the incentive compatibility constraint and examining the relaxed problem

$$\begin{array}{ll} \max & E\left[\lambda u(c_1(R)) + (1-\lambda)u(c_2(R))\right] \\ \text{s.t.} & L + X \leq 1; \\ & \lambda c_1(R) \leq L; \\ & (1-\lambda)c_2(R) \leq L - \lambda c_1(R) + RX. \end{array} \tag{3}$$

One can easily see, a necessary condition for a solution is that for each value of $R$, $c_1(R)$ and $c_2(R)$ must solve

$$\begin{array}{ll} \max & \lambda u(c_1(R)) + (1-\lambda)u(c_2(R)) \\ \text{s.t.} & \lambda c_1(R) \leq L; \\ & (1-\lambda)c_2(R) \leq L - \lambda c_1(R) + RX. \end{array} \tag{4}$$

The Kuhn-Tucker conditions of this optimization program (see Appendix A) imply $c_1(R) \leq c_2(R)$, resp. with concave utility functions $u'[c_1(R)] \geq u'[c_2(R)]$. From the Kuhn-Tucker conditions it also follows that the consumption of the two types is equal, unless the feasibility condition $\lambda c_1(R) \leq L$ is binding. In the latter case we have $\lambda c_1(R) = L$ and $(1-\lambda)c_2(R) = RX$, so that $c_1(R) < c_2(R)$. So the incentive compatibility constraint is automatically satisfied when we optimize subject to the budget constraints only, and for that reason can be skipped.

Notice that the critical value of the return of the risky long term asset at which the liquidity constraint begins to bind is

$$\overline{R} = \frac{(1-\lambda)L}{\lambda X}. \tag{5}$$

The following sequence of events will be presumed. At date 0 $L$ and $X$ will be chosen. At date 1 the return realization $R$ will be observed. For the given $L$ and $X$, then the optimal allocation of consumption $c_1(R)$ and $c_2(R)$ has to be derived. In case the signal indicates $R = 0$ so that the long term risky asset will pay off nothing at $t = 2$, both the impatient and patient investors will receive $L$. $L$ is all the output that will be available and it is efficient to equate consumption when possible given the form of $U(\cdot)$. The $\lambda$ impatient investors consume their share $\lambda L$ while the remaining $1-\lambda$ patient investors carry over $(1-\lambda)L$ to $t = 2$.

As $R$ increases between 0 and $\overline{R}$, both groups can consume more of $RX + L$ in proportion to their share $\lambda$ respectively $1-\lambda$. However, when the signal indicates that $R$ will be high (i.e above $\overline{R}$), then impatient types consume the maximum amount of liquidity $L$ available to them at that time, so they each receive $\frac{L}{\lambda}$. Since $R$ is high the consumption possibilities for the patient types will be high as well, leading to consumption of $\frac{RX}{1-\lambda}$ for each of them. Even if ideally for insurance reasons the high output in $t = 2$ was shared with the early consumers at date 1, this is not technologically feasible. One cannot bring consumption back from the future. Summarizing, from the analysis of the Kuhn-Tucker conditions the optimal risk-sharing contract $\{c_1(\cdot), c_2(\cdot)\}$ is uniquely characterized by:

$$\begin{aligned} c_1(R) = c_2(R) &= RX + L \quad \text{if} \quad R \leq \overline{R}, \\ c_1(R) = \frac{L}{\lambda}, \quad c_2(R) &= \frac{RX}{1-\lambda} \quad \text{if} \quad R > \overline{R}, \\ L + X &= 1. \end{aligned} \tag{6}$$

So far we discussed the optimal risk-sharing problem given a certain portfolio distribution of liquid and illiquid assets, $L$ and $X$. We still have to derive the optimal values of $L$ and $X$ chosen at $t = 0$, that, in turn, determine $\overline{R}$, $c_1(R)$, and $c_2(R)$. Necessary for optimality is the condition that the expected marginal utilities of consumption at both dates are equal:

$$E[u'(c_1(R)] = E[u'(c_2(R)R]. \tag{7}$$

As shown above, the optimal risk-sharing problem can be written as

$$\begin{array}{c} \max \ \int_0^{\overline{R}} u(RX + L)f(R)dR + \int_{\overline{R}}^{\infty} (\lambda u(\frac{L}{\lambda}) + (1-\lambda)u(\frac{RX}{1-\lambda}))f(R)dR \\ \text{s.t.} \ \ X + L \leq 1, \end{array} \tag{8}$$

which gives the associated first-order conditions for an interior solution:

$$\int u'(c_1(R))f(R)dR = \mu \tag{9}$$

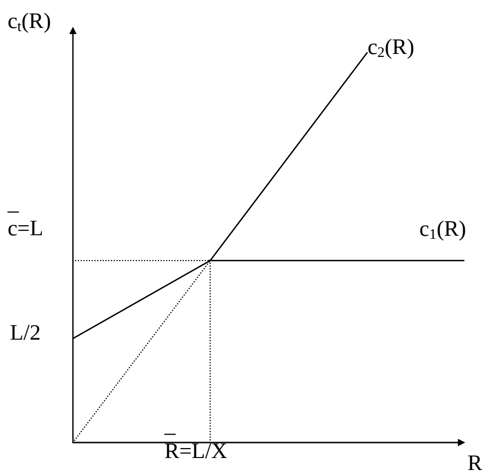
and

$$\int u'(c_2(R))Rf(R)dR = \mu, \tag{10}$$

with $\mu$ as the Lagrange multiplier for the budget restriction. Under the maintained assumptions, the optimal portfolio must satisfy $L > 0$ and $X > 0$, and these first-order conditions determine the optimal values of $L$ and $X$ and therefore $\overline{R}$, $c_1(R)$, and $c_2(R)$. The optimal contract is illustrated in Figure 1.

The question now is how can the optimal contract be implemented? One possibility is to think about a contract where the financial intermediary, i.e. the open end fund, makes a promise to pay out a fixed amount at each date $t = 1, 2$

Figure 1: Optimal Risk-Sharing Contract



and, in the event that the intermediary is unable to meet its obligations, to share out the available liquid assets equally among all withdrawing investors. This means, in case the fund cannot make the promised payment, it has to pay out all the liquidity, divided on an equal basis among those withdrawing. To be more specific, let denote $d_1$ the payment promised to impatient investors and $d_2$ the promised payments to patient investors. Without loss of generality, we can put $d_2 = \infty$ because competition between funds will assure that the funds do not want to have anything left over. Thus, the contract promises impatient investors either $d_1 \equiv d$ or, if that is infeasible, an equal share of the liquid assets, $X$, in the event of a crisis. In the latter case, not only the impatient investors but also some of the patient investors may want to withdraw early, with the consequence that impatient and patient investors will have the same consumption. Then the patient investors who stay with the bank are the residual claimants at date 2.

With this contract in mind, we can formulate the constrained optimal risk-sharing problem as:

$$\begin{array}{ll} \max & E\left[\lambda u(c_1(R)) + (1-\lambda)u(c_2(R))\right] \\ \text{s.t.} & L + X \leq 1; \\ & \lambda c_1(R) \leq L; \\ & (1-\lambda)c_2(R) \leq L - \lambda c_1(R) + RX; \\ & c_1(R) \leq c_2(R); \\ & c_1(R) \leq d \quad \text{and} \quad c_1(R) = c_2(R) \quad \text{if} \quad c_1(R) < d. \end{array} \tag{11}$$

It is easy to see that the solution to this problem is the same as the solution to the unconstrained optimal risk-sharing problem (2). Hence, the expected utility of both solution is the same and an open end fund, which is subject to runs, can achieve incentive efficiency by using this type of contract. To prove this, one only has to compare the optimal consumption functions from the two problems. From (6) we get for the unconstrained problem the form of the consumption profile

$$\begin{aligned} c_1(R) &= \min\{RX + L, L/\lambda\} \\ c_2(R) &= \max\{RX + L, RX/(1-\lambda)\}. \end{aligned}$$

By applying the Kuhn-Tucker conditions, the consumption profile from the constrained risk-sharing problem is in analogy to (6)

$$\begin{aligned} c_1(R) &= \min\{RX + L, d\} \\ c_2(R) &= \max\{RX + L, RX + L - \lambda d/(1-\lambda)\}. \end{aligned}$$

Both consumption profiles are identical if we set $d = L/\lambda$.

The interesting point is that the extra constraint captures the equilibrium conditions imposed by the possibility of runs. We need (partial) runs by patient investors on the open end fund for optimal risk-sharing reasons in case of low return realization $R$ of the long term asset. The proportion of the patient investors who withdraw early denoted $\omega(R)$ will adjust to equalize the consumption of the impatient investors $c_1(R)$, the consumption of the $e$arly withdrawing patient investors $c_{2,e}(R)$, and the $l$ate withdrawing patient investors $c_{2,l}(R)$. Because impatient and patient withdrawing investors are treated the same way in a run by sharing the liquid assets of the fund equally, we have in equilibrium

$$c_1(R) = c_{2,e}(R) = \frac{L}{\lambda + (1-\lambda)\omega(R)} = c_{2,l} = \frac{RX}{(1-\lambda)(1-\omega(R))}. \tag{12}$$

Risk-sharing is achieved here by increasing $\omega(R)$ to one as $R$ falls to zero. This is the optimal arrangement for $R < \overline{R}$. The lower the signal about the return realization $R$ the more patient investors who withdraw their funds at date 1 and the less each person withdrawing then receives. The severity of the run will equate the consumption profiles of all investors. Hence, in equilibrium patient investors are indifferent between joining the run and waiting, and the return for patient investors is equal to the return for impatient investors. Patient investors who withdraw early hold the safe liquid assets individually between date 1 and date 2, thereby getting a return that is exactly the same as the return on safe assets held by the intermediary. In the range $[\overline{R}, R_1]$ the impatient investors will get the promised payment $d$ whereas the patient investors get a proportionally with return realization $R$ increasing payment $c_2$. Also in this case, optimal risk-sharing will be the result.

The total illiquidity of the risky asset plays a very important role in this model. Because of our assumption that risky assets cannot be liquidated at date 1, the risky asset will be held by the fund until date 2. It makes no sense to give up the risky assets to someone else. As a consequence, there is always something left over which can be paid out to patient, not withdrawing investors at date 2. Provided there is a positive value of the risky asset, $RX > 0$, there must be a positive fraction of patient investors who do not flee. Only for this reason, bank runs can be partial. Accordingly, an increase in $\omega(R)$, the proportion of patient investors who join the run at date 1, must raise consumption at date 2 and lower it at date 1. In equilibrium with runs on the fund, we have a unique value of $\omega(R) < 1$ that equates the consumption of different investor types. Hence, with this type of financial intermediary the same level of efficiency is possible as in the unconstrained optimal risk-sharing problem. The first-best outcome in terms of consumption and portfolio allocation can be achieved by means of a contract that promises a fixed amount together with the possibility of runs that introduce the optimal degree of contingency. In contrast to the *Diamond-Dybvig*-panic model, where bank runs are bad and lower welfare, in this simple model structure runs are good.

But is such a model structure really adequate in analyzing open end real estate funds? We discuss that issue in the following by regressing on the experience made with open end real estate funds in Germany and to a lesser extent elsewhere. This should also help us to point on modifications of the model which should be made in order to grasp the most important characteristics of these funds. The analysis of these modifications in Section 4 therefore allows us the first assessment of whether open end real estate funds are an useful financial instrument or, express it in another way, are they diamonds or danger?

## 3.3 The Usefulness of the Modelling Structure in Analyzing Open End Real Estate Funds

As already mentioned in the introduction, the experiences made with open end real estate funds are mixed at best. In Germany for instance, real estate funds showed a remarkable stability and performance until very recently. In other countries like Australia, Switzerland or the Netherlands, open end real estate funds could not survive. Their institutional design was changed either by purpose or in the sequence of crisis situations caused by runs of investors who wanted to redeem their shares. As a matter of fact, the latest crisis developments in Germany also question the stability and survivability of this asset class.[5] In consequence, the German Investment Management Association (BVI) wants to implement self-regulatory measures for the funds in order to make them less vulnerable to runs which on the other side would alter their design fundamentally. However, what can we learn from the crisis events and characteristics of the real estate market for the adequateness of our model structure?

First of all, real estate assets are risky, however open end real estate funds want to smooth out, at least to a certain degree, the return variability of the underlying real estate assets. This can be seen most clearly from the empirical analysis in Maurer, Reiner, and Rogalla (2005). They show, using a data sample from Germany, that in the last 30 years the risk profile of this investment vehicle was at the same level as the real return variability of a money market investment, but, at least for longer holding periods, the real mean return of an investment in open end real estate funds was higher. However, we know that by no means the real estate assets in Germany exhibited lower return variability than the respective money market assets. Accordingly, the shares of open end real estate funds offer investors intertemporally smoothed returns. This feature is clearly reflected in our model structure.

What about the assumption that an open end real estate fund in case of a run shares its liquid assets equally among investors who want to withdraw at the interim stage? Again, in our opinion, this is a realistic assumption, especially viewed from the perspective of the recent crisis events. In a certain run state, open end real estate funds do not follow a first-come, first-served policy but tend to distribute their funds pro-rata among those withdrawing. From a theoretical point of view, they follow an equilibrium state-contingent suspension of convertibility rule.

[5]See, for instance, the article in Economist (2006), p. 195.

However, at least three crucial assumptions of the modelling structure concern us so far. First, it is really unrealistic to assume that runs on open end real estate funds do not reduce the returns of the assets and are therefore optimal. Typically, a default by an open end fund can generate deadweight losses. It might be that premature liquidation of assets is costly. One possibility for inefficiencies that directly comes into mind is the following. One can analyze what happens if the liquid asset can generate a higher return if it is held by the fund instead of by the investors themselves. Thus, there is a cost of holding the liquid asset outside the fund system. This can be interpreted in a way that especially small investors cannot realize the same return on their investment in liquidity as funds. It also reflects the discount investors have to incur when redeeming their shares, and insofar such a modification grasps an important characteristic of open end real estate funds. As a consequence of assuming that the liquidation of the safe asset at date 1 comes with a cost, there is a trade-off between the optimal risk-sharing and the return realized on the fund's portfolio. We will analyze this trade-off in analogy to Allen and Gale (1998) in Section 4.1.

Second, in the basic structure of the model the long-term assets are completely illiquid. However, could a secondary market for the assets resolve the problem of deadweight losses associated with foreclosure? If it is possible to sell assets during a run, there is just a transfer of value but not necessarily an economic cost. And, of course, also for real estate assets there exists a secondary market, even if this market is not very liquid and transparent. The introduction of an asset market in which the risky long-term asset can be traded will be analyzed in Section 4.2.[6]

Third, we want to start to investigate if the open end fund structure could also provide a monitoring function with respect to the fund's manager. This aspect of the open end form has already been informally discussed by Fama and Jensen (1983). Their argument can be understood in the manner that if a fund is set up on a closed-end basis, then dispersed investors do not have a recourse in the case of managerial misbehavior. As a consequence, their entire investment could be slowly eaten away. On the other hand, if they invested in an open end fund, they can liquidate at the first sign of trouble, avoiding large losses due to mismanagement.[7] By augmenting the basic model in Section 4.3, we will show in a moral hazard context that the possibility of runs can have nice incentive characteristics.

[6]This analysis also follows Allen and Gale (1998).

[7]In similar vein one can understand the argument made in Stein (2005). In his model, however, closed end funds should be set up when the underlying assets of the fund are relatively illiquid. In contrast, Diamond and Rajan (2001) and Diamond (2004) argue that especially for banks that have illiquid loans on their balance sheet's asset side the threat of runs on the short-term demand deposits serves as a commitment device for the bank manager not to misbehave.

# 4 Modifications of the Basic Model

## 4.1 Costly Liquidation and the Efficiency of the Run Mechanism

The result that runs on open end real estate funds can be optimal is a special one. It presumes that a default by the funds does not generate any deadweight losses. In the following we will relax this assumption and consider the case where premature liquidation causes costs. Let $r > 1$ denote the value of the safe asset held by the funds between $t_1$ and $t_2$. Thus, if one unit of consumption stored by a consumer at $t_1$ produces one unit at $t_2$, the costs of premature liquidation are $r - 1 > 0$. As already mentioned in the last section, this modelling assumption could be interpreted as a shortcut for the discount one has to incur in selling shares of the fund prematurely. However, we will, as in the basic model, assume that the risky asset is, on average, more productive than the safe asset, that is

$$E\left[R\right] > r.$$

The optimal incentive-efficient risk-sharing contract is characterized by the following optimization problem, in which the fund's manager chooses the investment portfolio of a liquid asset $L$ and a long-term real estate asset $X$, thereby offering the early and late investors a consumption level $c_1(R)$ rsp.$c_2(R)$:

$$\begin{array}{llll} \max & & E\left[\lambda u(c_1(R)) + (1-\lambda)u(c_2(R))\right] & \\ & \text{(i)} & L + X \leq 1; & \\ \text{s.t.} & \text{(ii)} & \lambda c_1(R) \leq L; & \\ & \text{(iii)} & (1-\lambda)c_2(R) \leq r(L - \lambda c_1(R)) + RX; & \\ & \text{(iv)} & c_1(R) \leq c_2(R). & \end{array} \tag{13}$$

One can see from the comparison with the original problem (2) that only constraint (iii) differs. In that constraint it is depicted that the safe asset produces a return of $r$ if it is held by a fund between $t_1$ and $t_2$. In solving this problem one can follow the same procedure as in Section 3.2. Again the incentive-compatibility constraint (iv) is not binding and can be removed. Thus, the Kuhn-Tucker conditions imply

$$u'(c_1(R)) \geq ru'(c_2(R)). \tag{14}$$

These first-order conditions must hold as an equality if $\lambda c_1(R) < L$. Accordingly there exists a critical value $\overline{R}$ such that $\lambda c_1(R) < L$ if $R < \overline{R}$. For a given portfolio allocation $(L, X)$, we get the following consumption profile

$$\begin{aligned} u'(c_1(R)) = ru'(c_2(R)) \text{ if } R < \overline{R} \\ c_1(R) = L/\lambda, c_2(R) = RX/(1-\lambda) \text{ if } R \geq \overline{R}, \end{aligned} \tag{15}$$

where $\overline{R}$ is chosen to satisfy $u'(L/\lambda) = ru'(RX/(1-\lambda)$. Given this consumption allocation and obeying the budget constraint $L + X = 1$, the optimal portfolio choice $(L, X)$ has to satisfy the following first-order condition

$$E\left[u'(c_1(R))\right] = E\left[u'(c_2(R))R\right]. \tag{16}$$

Figure 2 illustrates the form of the optimal risk-sharing contract.

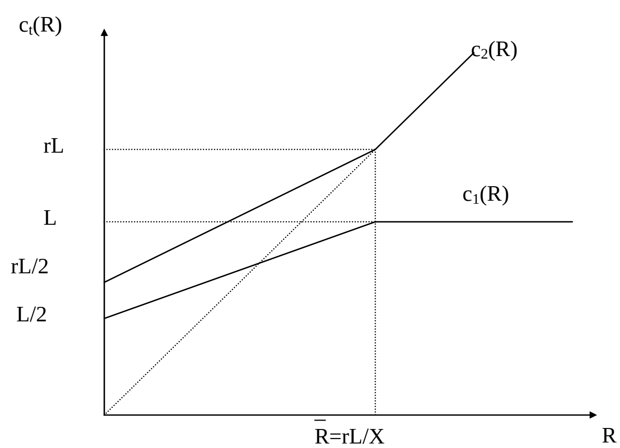
Comparing this to figure 1, which illustrates the optimal risk-sharing contract without costly liquidation, one can see one big difference: even for $R < \overline{R}$ the consumption of late consumers should be higher than the consumption of the early consumers. This is due to the fact that by maximizing date $t_0$ expected utility the ratio of the marginal utilities of consumption for the early and late consumers has to be equated to the marginal rate of transformation $r$. Only if the consumption of late consumers is higher for $R < \overline{R}$, it is possible to satisfy the condition $u'(c_1(R)) = ru'(c_2(R))$ for concave utility functions.

Now the following question arises. Is it again possible to implement such an optimal risk allocation through a contract offered by open end funds that in equilibrium allows for runs on the funds assets? To answer this question one has to reformulate the optimization problem in the following way:

$$\begin{array}{lll}
\max & & E\left[\lambda u(c_1(R)) + (1-\lambda)u(c_2(R))\right] \\
\text{s.t.} & \text{(i)} & L + X \leq 1; \\
 & \text{(ii)} & \lambda c_1(R) + \alpha(R)(1-\lambda)c_2(R) \leq L; \\
 & \text{(iii)} & (1-\alpha(R))(1-\lambda)c_2(R) \leq r(L - \lambda c_1(R) - \alpha(R)(1-\lambda)c_2(R)) + RX; \\
 & \text{(iv)} & c_1(R) \leq \overline{c}_1; \\
 & \text{(v)} & \lambda c_1(R) + \alpha(R)(1-\lambda)c_2(R) = L \text{ if } c_1(R) < \overline{c}_1; \\
 & \text{(vi)} & c_1(R) \leq c_2(R); \\
 & \text{(vii)} & c_1(R) = c_2(R) \text{ if } \alpha(R) > 0.
\end{array} \tag{17}$$

How should one read this formulation of the optimization problem? The first three constraints are budget ones. Constraint (i) is familiar. In budget constraints (ii) and (iii) one has to take $\alpha(R)$ into account, the proportion of patient investors who choose to withdraw early, because this has an impact on the total consumption possibilities at both dates. One unit withdrawn at $t_1$ reduces consumption at $t_2$ by $r - 1$. Constraint (iv) says that the actual payment made by the fund may not exceed the payment $\overline{c}_1$ (implicitly) promised by the fund to anyone withdrawing at date $t_1$. The payment is smaller than $\overline{c}_1$ if the total demand for liquidity by impatient and patient investors early exceeds the liquidity amount $L$ held by the fund (constraint (v)). Constraint (vi) depicts the familiar incentive-compatibility condition and constraint (vii) is an equal-treatment condition for investors in case of a run. In essence, the contract offered by a fund in $t_0$ is structured so that the fund pays investors who withdraw early either the fixed amount $d = \overline{c}_1$ or share the liquid assets out.

Figure 2: Optimal Risk-Sharing Contract with Costly Liquidation



The problem is simplified by noting, as discussed above, that patient and impatient investors share the assets when there is a run, that is, when $R$ falls below a critical liquidity threshold $R^*$. Since runs occur if and only if $c_1(R) < d$, $R^*$ is implicitly defined by

$$(1-\lambda)d = r(L-\lambda d) + R^* X. \tag{18}$$

This equations says that if there are no runs and impatient investors are paid the promised amount, there is just enough left to provide patient investors with the level of consumption that satisfies the incentive compatibility constraint. Hence, if $R < R^*$ we should have a (partial) run of patient investors on the assets of the fund. The return on the risky long-term asset $R$ is too small to provide impatient investors with the consumption level $d$ *and* to allow patient investors at $t_2$ at least the same level. Thus, without a run it would not be possible to take something away from the impatient investors. The equilibrium condition $c_1(R) \leq c_2(R)$ can only be satisfied if we have a run, because that allows for an equal treatment of all investors. In addition, one can see from condition (18) that, for the case $R > R^*$, it is always possible to avoid a run. And such an avoidance is optimal because it allows the fund to utilize the relatively high return on the risky asset. This said, the optimization problem for the fund becomes

$$\begin{array}{ll} \max & \int_0^{R^*} u(RX+L)f(R)dR + \int_{R^*}^{\infty} \left[\lambda u(d + (1-\lambda)u(\frac{r(L-\lambda d)+RX}{1-\lambda})\right] f(R)dR \\ \text{s.t.} & \text{(i)}L + X \leq 1; \\ & \text{(ii)}R^* = \frac{[(1-\lambda+r\lambda)d - rL]}{X}. \end{array} \tag{19}$$

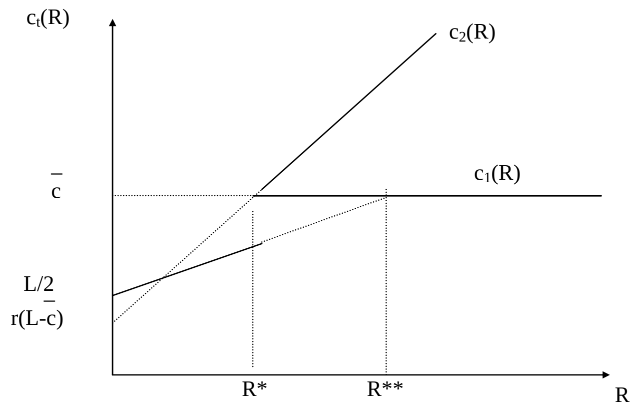
Basically, there are two possible types of solutions to this problem. First, $\lambda d = L$ and the solution is the same as the one considered in Section 3.2. In that case, the amount $L$ invested in liquidity will paid out to the impatient investors in total at $t_1$ unless we have a run by patient investors. Hence, according to that solution we will not see any transfer of liquidity done by the fund until date $t_2$. Correspondingly, costly liquidations will not happen. The consumption functions comply with the functions illustrated in Figure 1.

Second, $\lambda d < L$ and an amount $L - d$ will be held over by the fund until date $t_2$ so that there is a loss of $(r-1)(L-\lambda d)$ from premature liquidation in the event of a run. This is illustrated in Figure 3. From $\lambda d < L$ it also follows that $d > R^* X + L$.[8] Thus, at the point $R^*$ the corresponding consumption functions display a discontinuity caused by liquidation costs.

However, which one of both solution possibilities is optimal depends on the return differential between both asset types $E[R] - r$ and the costs of premature liquidation, $r - 1$. If the costs are relatively low and the return differential is not too high as well, then the amount optimally invested ex ante by the fund in

[8]Solving the equilibrium condition $R^* = \frac{[(1-\lambda+r\lambda)d-rL]}{X}$ for $d$ and taking into account that $\lambda d < L$ leads to that result.

Figure 3: Open End Funds Contract with Costly Liquidation



the liquid asset is higher than the liquidity demand of the impatient investors. In that case, the opportunity cost of investing in liquidity is quite low. The risk premium commanded by the long-term real estate asset is not high enough to attract a large amount of investment. Furthermore, investment in liquidity is in particular high when the cost of premature liquidation are enormous and the return differential is modest. In that case, the fund finds it optimal to voluntarily prevent runs and invest an accordingly high amount in the short-term asset. In addition, the optimal portfolio investment in the risky long-term asset increases with the probability that no premature liquidity demand arises and with lower risk aversion on the part of investors.

These comparative static results throw some light on the recent situation in Germany. It is reasonable to suspect that short-term-oriented institutional investors, who in particular invested large amount in open end real estate funds in the last years, have a higher preference for liquidity than households which in the past typically invested long-term into open end real estate funds. And demanding market conditions for the German real estate market presumably resulted in lower returns for real estate assets. Paying attention to our model analysis, both developments point the direction of increasing instability of the open end real estate fund sector, something which can readily be observed at the moment in Germany.

However, both types of solution for the optimal contract with a run mechanism are inefficient in comparison to the optimal risk-sharing contract with costly liquidation. The first-order conditions of the optimal incentive-efficient consumption allocation $u'(c_1(R)) = ru'(c_2(R))$ are not satisfied for $R < R^*$ in both cases. This is also directly observable by comparing Figure 1 and 3 with Figure 2. The inefficiency arises from the fact that liquidating the safe asset and storing the proceeds until date $t_2$ is less productive than keeping the safe asset within the fund.

## 4.2 Trading of Real Estate Assets and the Efficiency of the Run Mechanism

Until now we assumed that real estate assets are completely illiquid. This illiquidity is a crucial assumption of the model. Solely because of this assumption, runs are typically partial, thereby involving only a fraction of the patient investors who will redeem their shares. In the following we want to investigate what happens if we integrate a secondary market for real estate assets into the analysis. Accordingly, we assume the existence of an asset market at date $t_1$ in which real estate assets can be traded. The analysis builds again on the basic model in Section 3.2. Thus, we do not consider premature liquidation costs of the type analyzed in the last section.

Introducing an asset market has no impact in the states of the world which are characterized by no (partial) run in the optimal contract, but quite a lot of influence in the other states. To substantiate this statement, we consider a fund which chooses a portfolio $(X, L)$ at date $t_0$ and offers investors a contract which requires that it pays $d$ early withdrawers in $t_1$, if that is possible, and liquidates its assets otherwise. In states characterized by relatively high values for $R$, the early withdrawers receive $d$ and patient investors what is left, that is, $c_2(R) = (L - \lambda d + RX)/(1 - \lambda)$. Accordingly, the fund can make its promised payments.

However, for lower values of $R$ the fund cannot assure that. To show this, we first have to derive a critical value $R^*$ determined by the condition that the fund can just afford to give *everyone*, i.e. impatient and patient investors, $d$, that is,

$$d = R^* X + L. \tag{20}$$

By signals $R < R^*$ the investors know that the fund cannot pay everyone at least $d$ and patient investors also will try to redeem their shares. Accordingly, a run will result; but in contrast to the analysis in the sections above, this run cannot be partial anymore. The reason is that with a secondary market for the long-term real estate assets it is possible to liquidate these assets. Patient investors will anticipate that the fund will start to liquidate assets in order to meet its obligation $d$. But then less and less is left over for patient investors at date $t_2$. However, the incentive compatibility constraint says that late withdrawers always receive as much as early withdrawers. Hence the fund has to pay all investors the same amount in such a situation where $R < R^*$, and the only alternative is to liquidate all the long-term real estate assets by selling them on the secondary market and paying all investors less than $d$. Since a late withdrawer knows that he will receive nothing, he will join the run. Accordingly, all investors will redeem their shares at $t_1$. As a result, for $R < R^*$ we observe *complete* runs, with the respective fund selling all its assets on the secondary market, while for $R > R^*$ no run will occur. Here we again have an all-or-nothing characteristic of runs that is familiar from Diamond and Dybvig (1983).

What determines the pricing of the risky long-term asset on the secondary market? Allen and Gale (1998) distinguishes two different regimes. To understand the price dynamics on the market we will present just the basic argument. Let us assume that besides the open end real estate funds there exists another large group of market participants, who are risk-neutral and maximize given an initial endowment of $W_s$ their expected wealth at date $t_2$. Initially at $t_0$ these speculators choose a portfolio $(L_s, X_s)$ of the two assets such that $(L_s, X_s) > 0$ is subject to the budget constraint $L_s + X_s = W_s$. Hence, it will be presumed that holdings of both assets are positive. As Allen and Gale (1994) has been shown in an earlier work, such an assumption reflects short sale restrictions.[9] Especially

[9]Allen and Gale (1994) also discuss in detail why short sale restrictions are plausible assumption.

since the safe asset cannot be shorted, speculators can not buy as much of the risky long-term asset as they would like to. As a consequence, we have restricted liquidity on the market. In particular, it follows that the price for such an asset on the secondary market will not always be equal to its expected present value. The price is determined by the amount of cash instead, i.e. the safe asset the speculators supply in exchange for it.

With such "cash-in-the-market"-pricing at hand two different price regimes should be distinguished. In the intermediate range of $R$, i.e. ($R_0 < R < R^*$), the price is determined by the speculators' holding of cash $L_s$. There will not be paid the fair value $RX$ for the asset, instead the price is determined by the ratio of the speculators' cash to the fund's holding of real estate assets. In that range of $R$ the price of the asset is independent of $R$ and accordingly the consumption level of late and early investors is constant and amounts to the sum of $L$ and $L_s$. Since in that range we will have a run on the fund, this amount will be split between all investors. Interestingly for small values of $R$, i.e ($R < R_0$), the asset price is again equal to the fair value. In that range, the amount of cash is sufficient to pay the expected present value of the asset. Accordingly, $R_0$ is determined by the condition

$$L_s = R_0 X. \tag{21}$$

Taking all this into account, the following price relation $P(R)$ will persist on the market for the long-term asset:

$$P(R) = \begin{cases} R \text{ for } R < R_0 \text{ or } R \geq R^* \\ L_s/X \text{ for } R_0 < R < R^*. \end{cases} \tag{22}$$

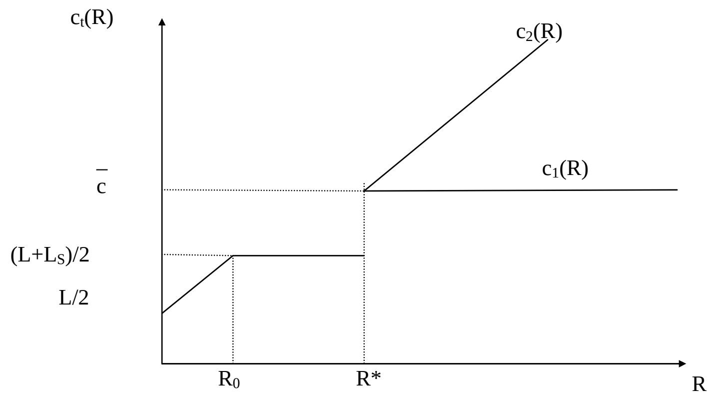
Thus, the price on the real estate market collapses only if the return is low enough to provoke a run, but not too low, so that the cash is sufficient to pay the fair value.

The resulting consumption profile in Figure 4 again illustrate a discontinuity at $R^*$. Here it is a consequence of the asset sales caused by a run. This will drive the price of the assets on the market down. The consumption possibilities of all investors shrink and are determined by the condition $c_1(R) = c_2(R) = P(R)X + L$. Speculators make a windfall profit and consumers experience a windfall loss.

## 4.3 Moral Hazard Problems and the Efficiency of the Run Mechanism

To analyze the incentive aspects of the open end construction with respect to fund managers, we have to introduce the possibility of moral hazard on their side into our model. We will do that along the lines of Gale and Vives (2002) by assuming that the effort of a fund manager influences the probability distribution of returns to the long-term asset. To be concrete, we suppose that the effort by a fund

Figure 4: Open End Funds Contract with Asset Sales on Secondary Market



manager can take two values, $e \in \{0, 1\}$. This effort decision will have an impact on the random variable $R$ via its probability density function $f(R, e)$, which, as in the basic model in section 3.2, has a support $[0, R_1]$. To model this effect in a stark way, we assume that $f(R, 0)/f(R, 1)$ is decreasing in $R$ which means that the monotone likelihood ratio (MLRP) holds. As a consequence, the cumulative distribution function $F(R, 1)$ of the first order stochastically dominates $F(R, 0)$. Thus we presume that the performance of the fund depends, for instance, on the carefulness of choices the manager makes in selecting properties, which the fund has to invest in. Hence, he screens and monitors the properties carefully. However, high effort in order to select successful properties causes costs which the manager privately has to bear. Within our two-point-structure this has the meaning that the cost of effort to the manager is $C$ if he chooses $e = 1$ and zero otherwise. Undertaking no effort can here be interpreted as just choosing investment projects offered to him by good friends or business partners for prices which might be too high, or making not enough market analysis before investing, or just straight embezzlement. Furthermore, we assume that the manager receives a private benefit $B > 0$ if there will be no dismantling of the fund at $t_1$, i.e., in our fund interpretation, no run on the fund will occur. A premature dismantling of the fund would be considered by the investing public as a bad signal of the quality of the manager,it will therefore hurt his reputation and accordingly his future business possibilities are seriously negative affected. Hence the manager always prefer to continue the fund at $t_1$. It follows that the manager's expected payoff is $-Ce + pB$, with $p$ as the probability that the fund is continued at date 1.[10] The effort decision of the manager is not observable, consequently the only way to give the manager the right incentives to provide effort is by linking his effort to the probability that the fund survives the first period.

By formulating the management incentive problem in this way, we implicitly made some assumptions concerning the return structure of long-term assets. First, the long-term asset can be prematurely liquidated, even though this might be costly. In contrast, if the long-term assets couldn't be liquidated prematurely at all, partial runs on the fund as exemplified in 3.2 would be possible and accordingly the assumption that, with certain probability $p$, the fund will be totally dismantled would make no sense. Second, we have to assume that it is impossible to liquidate a fraction of the fund's long-term asset, since otherwise again a

[10]Thus we do not allow a direct dependence of the manager's compensation on the return realization of the fund. Of course, in reality such a dependence is also one (minor) element of his compensation package. Since here we are interested in analyzing the effect of financial instability on management decisions, we are ruling that element out. Insofar, we are considering low powered incentive systems within the company managing the open end fund. Since we know that, at least in Germany, the variable compensation component is strongly positively affected by the fund's size, we are not too far away from reality with this assumption. Furthermore, a high-powered incentive system with rewards, that are positively associated with return realizations over the whole range of $R$, might create another, here however unmodelled, risk incentive problem of choosing properties with unfavorable high risk characteristics.

partial survival of the fund would be possible. Of course, the latter assumption is not realistic but it will simplify the analysis and help us to clarify our argument.

Hence, in accordance with these assumptions we are considering a situation where premature liquidation of the long-term real estate assets is costly, yielding a payoff of $\delta R$ at $t_1$, with $0 < \delta < 1$. The lower $\delta$, the costlier the liquidation of long-term real estate assets is only with these assumptions the all-or-nothing characteristics of runs can be preserved and we can focus the attention on the disciplining function in quite an easily to handle framework. Besides these assumptions concerning the return structure of the long-term assets, the basic structure of the model, as depicted in section 3.2, is unchanged.

In order to analyze incentive effects on runs we proceed as follows: first, we will make an argument, under which conditions not only the fund manager, who always wants to continue with the fund, but also the investors, at least in principle, want to continue the fund ex post, i.e. after getting information on the return realization to the property assets. Second, we will derive the incentive-efficient solution to the problem, given it is optimal to induce high effort, $e = 1$, on side of the fund management. And third, we will show that, given our assumptions concerning the observability of the investor type, management effort decision and the non-contractibility of return realizations, an open end fund structure can implement the so-called third-best solution.

To see under which conditions the investors want to continue the fund irrespective of the return realization $R$, first, one has to compare the maximum utility for a representative investor from discontinuing the fund at $t_1$ with the maximum utility of continuing the fund. As was already shown in section 3.2, the only efficient solution in case of a run is the consumption allocation $c_t(R)$ that splits the aggregate wealth of the fund equally among early and late investors. Applied to the problem description in this section, that means the following maximization problem

$$\begin{array}{ll} \max & E\left[\lambda u(c_1(R)) + (1-\lambda)u(c_2(R))\right] \\ \text{s.t.} & L + X \leq 1; \\ & \lambda c_1(R) + (1-\lambda)c_2(R) \leq \delta R X + L; \\ & c_1(R) \leq c_2(R). \end{array} \tag{23}$$

has to be solved for the given first-date decisions regarding $X$ and $L$ and a certain return realization $R$, with $\delta RX + L$ as the aggregate wealth of the fund in case of premature liquidation of the long-term assets. Hence, as already proved in section 3.2, the efficient consumption profile in that case is $c_1(R) = c_2(R) = \delta RX + L$. Accordingly, the maximum utility from prematurely liquidating the long-term asset and discontinuing the fund at $t_1$ is

$$W(R, X, L) = u(\delta RX + L). \tag{24}$$

For deriving the ex ante expected utility for a representative investor in case of continuing the fund we can also refer to the analysis in section 3.2. We have to slightly reformulate the optimal risk-sharing problem as done in (2), i.e.

$$\begin{aligned} \max \quad & E\left[\lambda u(c_1(R)) + (1-\lambda)u(c_2(R))\right] \\ \text{s.t.} \quad & L + X \leq 1; \\ & \lambda c_1(R) \leq L; \\ & (1-\lambda)c_2(R) \leq L - \lambda c_1(R) + RX; \\ & c_1(R) \leq c_2(R). \end{aligned} \tag{25}$$

Hence, we already know the solution to this problem from section 3.2: $c_1(R) = \min\{RX + L, L/\lambda\}, c_2(R) = \max\{RX + L, RX/(1-\lambda)\}$, and, accordingly, the maximum utility from continuing the fund at $t_1$ is

$$U(R, X, L) = \lambda u(\min\{RX + L, L/\lambda\}) + (1-\lambda)u(\max\{RX + L, RX/(1-\lambda)\}). \tag{26}$$

To make the problem interesting, we want to assume that on average the investors are better off if the fund is continued ex post, i.e. at $t_1$, but from the welfare point of view the high effort choice should be implemented ex ante. Only then we are in a situation with the *time consistency* problem, where it might be ex ante important to give the manager the right incentives to work hard in order to increase the return prospects of the fund but ex post, i.e. after getting the information signal on return realization, the investors want to continue with the fund. Anticipating such a decision from the investors, the manager being rational wouldn't take the high effort choice.

Investors are, on average, better off continuing the fund ex post if

$$U(R, X, L) \geq W(R, X, L), \ \forall \ (X, L, R). \tag{27}$$

This inequality is fulfilled if it is satisfied for very small values of R near zero, and if $U(R, X, L) - W(R, X, L)$ is increasing in $R$. However, for the latter condition to be true, $\lambda$, the liquidity preference of investors, and/or $\delta$, the liquidity of the fund's properties, have to be small and, in addition, the risk aversion of the investors has to be relatively moderate (see the appendix for a proof). All these conditions are likely to be met in the case of real estate open end funds.

Implementing the high effort $e = 1$, one has to choose the default probability $p(R)$, that maximizes the expected utility for a representative investor, subject to the incentive compatibility constraint, that insures a high effort choice of the fund management. The high effort choice should increase the expected benefits of the manager so that it is worthwhile for him to cover his effort costs. Because higher effort is associated with higher return realizations, ones should reward the manager for high outcomes and sanction him for bad outcomes. This can be done by choosing an appropriate continuation rule. However, given our assumptions on the return structure, i.e. $F(R, 1)$ of the first order stochastically dominates $F(R, 0)$, and given the fact that partial dismantling of the fund is not possible, and that we do not want to consider a randomized discontinuation of the fund, the continuation decision should follow the cutoff rule in the sense that the optimal continuation probability is, for some constant $R^c$, given by

$$p^c(R) = \begin{cases} 1 & for\ R \geq R^c \\ 0 & for\ R < R^c, \end{cases} \tag{28}$$

For the incentive constraint it must be that

$$B(F(R^c, 0) - F(R^c, 1) \geq C. \tag{29}$$

How can we explain this central result?[11] Under the supposed conditions, especially $U(R, X, L) - W(R, X, L)$ and $f(R, 1)/f(R, 0)$ increasing in $R$, it is optimal to have a continuation of the fund as often as possible. However, we have to give the management incentives to choose the high effort. From taking into account these incentives, it follows that we have to dismantle the fund in order to punish the manager for low return realizations. But discontinuing the fund is associated with an ex post social welfare loss because of the liquidation cost $\delta$. Thus we want to hold the range, in which we have to liquidate the fund, as small as possible. Hence, we choose the lowest possible $R^c$, so that the incentive constraint of the manager is binding. It follows that, for certain plausible parameter values $R^c$ is lower than $\bar{R} = \frac{(1-\lambda)L}{\lambda X}$, the threshold value that defines from the optimal risk sharing perspective the point beyond which we should have equal consumption of impatient and patient investors (see Figure 5 for an illustration of a typical solution).

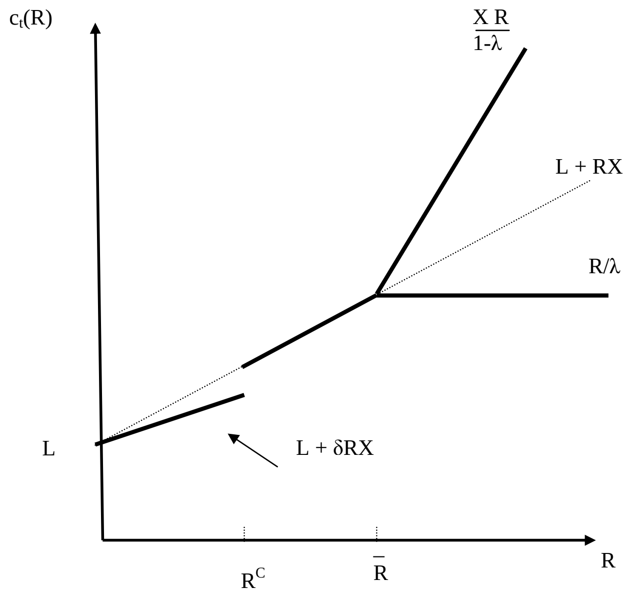
More formally, one has to choose a portfolio $(L, X)$ and a cutoff point $R^c$ that solve

$$\begin{array}{ll} \max & \int_{R^c}^{R_1} U(R, X, L) f(R, 1) dR + \int_0^{R^c} W(R, X, L) f(R, 1) dR \\ \text{s.t.} & L + X \leq 1; \\ & (F(R^c, 0) - F(R^c, 1) \geq C/B. \end{array} \tag{30}$$

Denote the solution by $(X^c, L^c, R^c)$. As was noted above, the cutoff point $R^c$ should be as low as possible. In addition, one can see from the incentive constraint that $R^c$ tends to zero as $C/B$ approaches zero and is increasing in $C/B$. After determining the threshold value $R^c$from the incentive constraint, we can choose the portfolio composition $(X, L)$ to maximize (30) subjects only to the first period budget constraint. In that manner we derive the consumption profile and determine optimally the threshold value $\bar{R}$ at which the consumption profile of patient and impatient investors are divided from each other (see Figure 5). In summary, we can distinguish three regions: if $R$ is in the lowest range $[0, R^c]$, both investor types will get $c_1(R) = c_2(R) = \delta RX + L$ and the fund will be discontinued; for return realizations in the range $[R^c, \bar{R}]$ they can expect both $c_1(R) = c_2(R) = RX + L$, and above $\bar{R}$ the impatient investor will earn the constant $c_1 = L/\lambda$ and patient investors $c_2(R) = RX/(1 - \lambda)$.

[11] For a proof, see the appendix.

Figure 5: Optimal Risk-Sharing Contract with Moral Hazard



The question is wether we can implement such a solution within an open end fund structure, thereby giving the fund manager the incentive to choose the high effort? The problem is that an open end fund mechanism does not allow us to write contracts directly contingent on the state of nature, i.e. the signal about the return realization. The fund promises instead, as in section 3.2, to pay out $d$ at $t_1$ to investors who want to redeem their shares and the residual units to patient investors. If the fund can repay to all investors who want to withdraw at $t_1$, the fund is solvent and the fund's properties will not be liquidated. However, if the fund cannot repay all withdrawing investors, the fund must be liquidated and its liquidation revenues distributed to the agents. As already noted in section 4.2, the fund is only solvent if it can pay impatient investors $d$ the promised amount $d$ *and* in addition, given this promise, potentially patient investors do not withdraw early but are willing to wait until $t_2$. Hence we have two necessary conditions for solvency of the fund. First, the amount of the liquidity of the fund, $L$, is high enough so that impatient investors can redeem their shares at face value $d$, i.e. $\lambda d \leq L$, and, second, the aggregate consumption of the patient investors $(1-\lambda)c_2 = RX + L - \lambda d$ is high enough so that they do not want to withdraw early, i.e.

$$d \leq c_2(R) = \frac{RX + L - \lambda d}{1-\lambda}. \tag{31}$$

In this case, it is rational for patient investors to wait until $t_2$. However, there also exists the second equilibrium, in which all investors, also the late ones, withdraw early. We will exclude that equilibrium in the following.[12]

Having said this, we will analyze how $d$, the (implicit) payment promise of funds to early withdrawing investors, will be determined, bearing in mind that the incentive constraint of the manager should be met. Therefore, given a certain $d$, which will later on be derived to maximize the expected utility of investors, one has first to define the critical return realization, $R^F$, such that the fund can just meet its obligations to the early investors, i.e. (31) is fulfilled as an equality leading to $d = R^F X + L$. This means, for $R \geq R^F$ impatient investors will get $c_1 = d$ and patient ones $c_2(R) = (RX + L - \lambda d)/(1-\lambda)$, whereas for $R < R^F$ all investors will redeem their shares early and split the liquidation revenues equally, leading to $c_1(R) = c_2(R) = \delta RX + L$. Hence, with the choice of $R^F$ the fund will also determine the insolvency point. Secondly, the fund has to choose the optimal portfolio (L,X) and the insolvency point $R^F$ simultaneously. That makes out the difference to the optimal incentive efficient solution derived above and depicted in Figure 5. In the fund solution one determines by choosing the insolvency point the range in which the consumption profile of patient and impatient investors

[12]That means in addition to the "good" equilibrium there also exists a sunspot equilibrium in which all investors withdraw early. We do not consider the latter equilibrium, which can be avoided by the fund management if it is allowed to suspend the convertibility of shares in such a case. However, giving the fund's management discretionary power in this respect, one can undermine the disciplinary role of the open end fund construction.

are equal (see Figure 6) is also unavailable. The reason is that, given the fund construction, the consumption profiles can only be identical when it comes to a run. In contrast, in the optimal incentive efficient solution, as illustrated in Figure 5, there exists a range $[R^c, \bar{R}]$ where the fund will be continued and nevertheless the consumption profiles are equal to each other. This range is not possible within the fund solution since fund contracts cannot be written conditionally on the return realization. Because of this risk-sharing inefficiency induced by the fund solution, the optimal $R^F$ will tend to be higher than $R^c$. Accordingly, we will have a higher probability of default in equilibrium. In the incentive efficient solution one chooses the smallest $R^c$, which is just compatible with preserving incentives for the manager without affecting the optimal risk-sharing threshold $\bar{R}$ that will be determined independently by the portfolio choice $X^c, L^c$. In contrast, by selecting $R^F$ in the fund solution, one directly determines the level of $d$ for a given portfolio choice $(X, L)$. Accordingly, a low $R^F$ induces a low consumption level $d$ for impatient investors, which from a risk sharing perspective can be suboptimal. More fundamentally, the problem is that one cannot separate the incentive from the risk-sharing aspect in the fund solution.

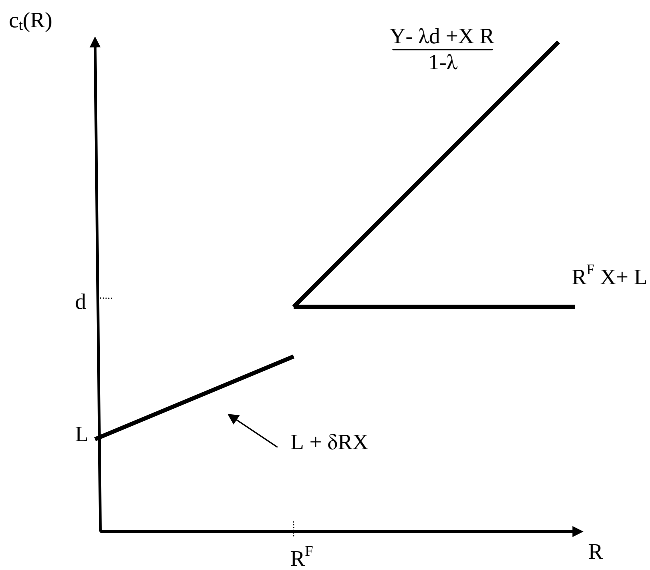
More formally, the fund chooses $(X^F, L^F, R^F)$ to maximize

$$\begin{array}{ll} \max & \int_{R^F}^{R_1}(\lambda u(d) + (1-\lambda)u(\frac{R^F X + L - \lambda d}{1-\lambda}))f(R,1)dR + \int_0^{R^F} u(\delta R^F X + L)f(R,1)dR \\ \text{s.t.} & L + X \leq 1; \\ & (F(R^F,0) - F(R^F,1) \geq C/B. \end{array} \tag{32}$$

Hence, it is likely that $R^F > R^c$. This will happen, independently on the liquidation costs $1-\delta$ which also tend to raise $R^F$, in particular in situations which are characterized by high uncertainty about the return on the risky asset. Then at $t_0$ the fund will, from the risk-sharing perspective, optimally invest a high fraction of its received contributions in the liquid asset, which accordingly induce a relatively high $d$. However, to implement such a high $d$, $R^F$ must be also high. And this might lead to a probability of default for the fund which is too high viewed from the incentive perspective. The incentive constraint will therefore not be binding. In general, because of the higher $R^F$ we have, compared to the second-best incentive efficient solution, a third-best solution will be implemented by the fund. This can also be easily observed by comparing Figure 5 with Figure 6, which illustrates the typical fund solution.

In summary, the optimal fund solution depicts nice incentive effects. The possibility of a run induces the fund manager to choose high effort despite unobservability of effort decisions and non-contractibility of return signals. This is particularly important in situations which are characterized by the time consistency problem, as in the case formulated in this section, where it was ex post optimal to avoid costly liquidation and one would prefer to continue the fund at $t_1$. Anticipating this behavior ex post, fund managers would not make sufficient effort to screen and monitor the real estate projects. A mechanism, which, as the

Figure 6: Open End Funds Contract with Moral Hazard



open end fund construction, is based on a run as the individually optimal chosen action of investors in certain situations, makes the disciplining role effective, even though it might be socially not optimal. In this respect, the monitoring function is irrevocably tied to the run mechanism. Furthermore, the existence of such a disciplining device that does not presuppose individually high information requirements on the part of investors might be especially important for investment vehicles that invest to a large amount in illiquid long-term assets like properties.[13] Hence, the explanation given here that open end real estate funds should be understood as intermediaries that deliberately combine illiquid assets and liquid liabilities under one roof in order to induce incentive compatibility is very similar to the arguments made in Diamond and Rajan (2001). Financial fragility might have positive side effects.

[13]What is important regarding the information requirements of this mechanism is the existence of a reliable public signal concerning the future performance of funds. This signal could also be the behavior observation of certain investors.

# 5 Conclusions

Both banks and open end real estate funds effectuate liquidity transformation in large amounts and high scales. Because of this similarity the latter should be analyzed using the same methodologies as usually applied for banks. We show that the work in the tradition of Diamond and Dybvig (1983), especially Allen and Gale (1998) and Diamond and Rajan (2001), provides an applicable theoretical framework. We used this as the basis for our model for open end real estate funds. We then examined the usefulness of the modeling structure in analyzing open end real estate funds.

First, we could show that withdrawing of capital resulting in a run is not always inefficient. Instead, withdrawing can as well be referred to the situation where the low return of an open end fund unit in comparison to other opportunities makes, (partial) withdrawal viewed from the risk-sharing perspective optimal. Even with costly liquidation, this result will hold, though we will have deadweight losses in such a situation.

Second, introducing a secondary market in our model does, not in general, resolve the problem of deadweight losses associated with foreclosure. If assets are sold during a run, we do not only have a transfer of value but it can also create an economic cost. Because funds are forced to liquidate the illiquid asset in order to fulfill their obligations, the price of the real estate asset is forced down making the crisis worse. Rather than providing insurance, such that investors receive a transfer in negative outcomes, the secondary market does the opposite. It provides a negative insurance instead.

Third, our model proves that the open end structure provides a monitoring function which serves as an efficient instrument to discipline the funds management. Therefore, we argue that an open end structure can represent a more adequate solution to securitize real estate or other illiquid assets. Instead of transforming open end in closed end structures, fund runs should be accepted as a normal phenomenon to clear the market from funds with mismanagement.

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