An Analysis of SAM Pricing in the UK

by Austin Murphy*

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Abstract

This paper investigates the pricing and valuation of Shared Appreciation Mortgages (SAMs) issued in 1997 in the UK. The analysis indicates high expected returns to the lenders, that were clearly predictable ex-ante, with even higher upside potential and virtually no material risk of loss to the investors. Since SAMs had been invented decades before, the high returns to the UK lenders do not represent pay for financial engineering a new, innovative product. Instead, the high effective interest rates on the SAMs appear to represent compensation for misleading repackaging of an existing product.

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I. Introduction

Investment into shares of pooled individual houses/homes represents one very interesting source of potential diversification for investors. However, to date, this potential means of risk reduction and transfer has remained impossible for most. There are in fact a few investment companies in the United Kingdom (UK) that were created in the 1997-98 period for the very purpose of participating in home appreciation there. However, shares of these pools are closely held by a few institutions, and there has been no known attempt to make the shares in the pools available to the public.

The pooled investments that participate in home appreciation in the UK actually invest into Shared Appreciation Mortgages (SAMs) which provide cash to homeowners in return for a promise to repay principal and a percentage of the appreciation of the homes subsequent to the origination of the mortgage. Although a few of the issued SAMs pay explicit interest on the mortgage principal as well, most in the UK are 0% coupon rate mortgages. While seemingly attractive to both homeowners and investors, these UK SAMs have been marred by allegations of fraud and extortionate interest charges.

This research is undertaken in order to objectively examine the UK SAMs which had some very unique features compared to prior SAMs that led to both their attractiveness and to subsequent problems/complaints (Sanders and Slawson, 2005). One of the major complaints with the UK SAMs is that the participation in the home appreciation was far too high. This allegation will be investigated by computing a participation rate that is appraised to have allowed the SAMs to sell at equilibrium prices

in an efficient market at their principal value. The UK SAMs are valued using the Murphy (1990a) model, although a simpler framework is also provided to illustrate the intuition behind the model.

II. Background on SAMs

SAMs had been previously developed in the United States (US) in the 1970s during periods of very high double-digit interest rates in order to permit home buyers to purchase houses with a significantly lower interest charge. SAMs thereby allowed some people to buy homes that they might not otherwise have been able to afford at the high interest rates prevailing at the time. SAMs also gave homeowners the ability to reduce their concentrated investment in their own houses by transferring shares of the appreciation in those homes to lenders/investors, who potentially could enjoy diversification benefits to their portfolios thereby. At the same time, the SAMs provided lenders with a reasonable rate of expected return that could be extracted from the home appreciation which had been expected to continue from the inflationary 1970s.

However, the US SAM market largely collapsed when both inflation and interest rates fell in the mid-1980s. The lower inflation had an especially negative effect on the market. In particular, inflation lower than expected decreased returns to lenders, who began to shy away from them due to past bad experiences. It also reduced the explicit interest savings to home owners/buyers, who could also now afford regular mortgages at lower interest rates. Securitisation of the SAMs for public investment (with all its potential advantages) never got off the ground.

The UK SAM market exploded in the mid-1990s amidst an environment of increasing securitisation of many different assets. Real estate was being especially targeted for securitisation in order to reduce the illiquidity of such investments that normally entailed large transaction costs to trade. By enabling investors to take positions in real estate at lower transaction costs, the number of real estate buyers could be increased, thereby raising real estate prices through increasing demand and lowering the premium returns required by investors for buying illiquid assets (Murphy, 2000b). Much of the worldwide boom in real estate prices in the late 1990s was related to this securitisation.

Within this environment, UK lenders began offering SAMs of two major types in November 1996: those that paid explicit interest (typically 5.75%) and those which did not. The former usually gave the lender a share in the appreciation of the mortgaged home in an amount that exactly equaled the ratio of the mortgage loan to the appraised value of the home, thus giving the lender 100% participation in the appreciation of the portion of the home covered by the mortgage. The latter 0% SAMs offered 300% participation, insofar as the lender was due to receive a share of the appreciation of the home price equal to three times the ratio of the mortgage loan's value was to the original appraised value of the home.

Houses/homes represented one of the last classes of investment assets to be securitized. The UK SAMs, the first of which were offered in late 1996, were fairly standardized, thereby facilitating their packaging into pools in which investors to could take positions (*Euroweek,* 1996).

However, as opposed to being made available for individual investors through a public offering, much of the securitisation in debt instruments in Europe is designed to transfer risk from one lender/bank to another and thereby allow lenders to diversify across the lending/banking markets that had historically been highly segmented by country. The UK SAM pools do not appear to have been an exception. In fact, the extreme secrecy with respect to their pricing alone leads to questions of either pricing far above the principal value of the loans or special deals (such as a buyers in the pools offering compensation to the SAM pool originators in the form of great deals on some of their own asset-backed securities).

III. Valuing the UK SAMs

The fair value of the UK SAMs to knowledgeable investors can be appraised using the Murphy (1990a) model of SAMs. This modeling framework, which continues to be state-of-the-art compared to alternatives, in terms of efficiency and accuracy in appraising market values (Murphy, 2000a), is based conceptually on valuing SAMs like convertible bonds (Murphy, 1989). Such debts can be divided into a fixed income component (the promised principal and interest) and an option component (the participation in the house appreciation).

While Sanders and Slawson (2005) have developed an alternative model of SAMs where the borrowers are assumed to be "rational" and "forward-looking", they failed to deduce the fact that mortgagors would have needed advisors with substantial financial expertise to figure out optimal prepayment times[1] and the authors' assumed resulting underinvestment rates. Such advisors would have been prohibitively expensive to the

mortgagors. Regardless, it is unclear whether underinvestment rates of the magnitude assumed by the authors were motivated, probable, or even possible under the UK SAM contract terms. In particular, the SAM contracts provided for home improvements above 10,000 British pounds to be considered for at least partial payment by the lender, so that incentives do exist to improve the property.[2]

Since Sanders and Slawson (2005) provided absolutely no empirical data indicating home appreciation was significantly (or at all) related to minor home improvements with a value less than 10,000 pounds (that itself represents an amount less than $20,000), it is likely such minor improvements (below 10,000 pounds) have a negligible effect on house prices. In addition, because any such minor improvements might generally be undertaken largely for personal consumption purposes regardless of whether the home is mortgaged by a SAM or not, there might actually be absolutely no effect on the appreciation of houses subject to a SAM.[3]

However, a modest impact of the latter factor is implicitly incorporated into the valuation model employed in this study by using an expected appreciation rate for UK houses that is slightly less than the average past real appreciation rate of homes. Expected home appreciation is assumed to be 2% above inflation rates, since this rate was estimated by one SAM issuer at the time, and since this estimate was below the past annual 2.2% real home appreciation in the UK (*Euroweek*, 1999). A figure above that average could certainly be justified given the liquidification of worldwide real estate investments, including homes in the UK through the securitisation of the SAMs.[4] Inflation in the UK itself can be objectively estimated to equal the difference between the market yield on long-term UK government bonds (or gilts) that are not indexed to

inflation and the real market yield on long-term gilts that are indexed to inflation (Murphy, 2000b).

Aggregate UK housing price data available from the Council of Mortgage Lenders, the Nationwide Building Society, and the UK Deputy Prime Minister indicates a standard deviation of about 10% over the last few decades for the time-series average house price in the UK. Given cross-sectional variation in home prices, a time-series standard deviation for individual home prices of 20% seems reasonable (since the aggregate average home price smoothes out the unsystematic variation in individual home prices). A 20% estimate is consistent with the Sanders and Slawson (2005) findings that, for a sample of SAMs that prepaid within 27 months of origination, the cross-sectional standard deviation of annualized return equaled 21.12% and 14.27% for individual mortgages with 300% and 100% participation rates, respectively. While cross-sectional variation in housing prices combined with time-series price volatility in the aggregate might make the true standard deviation in excess of 20%, that figure is utilized to ensure a conservative (or minimum) estimate of value for the SAM.

Public Securities Association (PSA) prepayment rates, which are standardized rates of autonomous mortgage prepayments/redemptions that have historically occurred in an environment without refinancings related to mortgage rate declines, are assumed for SAM redemptions. The PSA figures, which begin with a 1% annual prepayment rate and have the rate rise 1% each year until it stabilizes at 5%, are roughly consistent with early data on UK SAM prepayments published by Sanders and Slawson (2005). They are also consistent with the longer-term data on prepayments implied from the annual reports of the SAM pools.[5]

The average age of the borrowers, cited by Sanders and Slawson (2005) to be 69, would indicate the PSA prepayment rates could have reasonably been forecasted ex-ante as a conservative minimum. In particular, complete mortgage prepayment or redemption is automatically required on the SAMs upon the death(s) of the mortgagor(s), and death rates were reported in the *Annual Abstract for Statistics* for the UK to be over 2% for people in the 65-74 age group and to rise to over 6% after 5 years in the next age group 75-84.

Traditional refinancings above PSA frequencies due to lower interest rates that occur on both conventional mortgages (Murphy, 2000a) and convertibles (Murphy, 1989) would not apply in the same fashion for the UK SAMs whose own coupon rate never did fall (and could not fall in the case of the 0% SAMs). The questionable value of a prepayment option is therefore not incorporated into the model, although such voluntary repayments and their effects are discussed later.

To value the components of a convertible or SAM, various risk parameters must be estimated (Murphy, 1989). Because the UK SAMs required the initial loan-to-value ratios to be at or below 25%, they clearly have very minimal default risk (*Euroweek*, 1999). An assumption of a Aaa rating, with a 0.10% chance of default and a 60% recovery in default net of legal fees (Murphy, 2000b) is therefore appropriate, as is a beta of 0.1 for the underlying home price.[6]

Discount rates in the Murphy model are estimated using Sharpe's (1964) widely-employed Capital Asset Pricing Model (CAPM). Risk-free rates available on government bonds denominated in the domestic currency are added to a premium required for bearing risk. An assumption of a 5% risk premium per unit of beta risk is fairly standard based on

past returns (Murphy, 2000b) and is consistent with recent findings in the bond markets (Elton, Gruber, Agrawal, and Mann, 2001). The required return on the home therefore equals 0.1x5%=0.5% above the risk-free interest rates on government bonds that are called gilts in the UK.

IV. Data and Analysis

Data on risk-free gilt interest rates were obtained from the *Financial Times* for the last day of the month for each of the 12 months of 1997 during which time originations in UK SAMs were concentrated. Yields to maturity on 1-, 2-, 3-, 5-, 7-, 10-, and 20-year gilts for each of those days are interpolated in order to compute necessary risk-free discount rates for each year in the future using the Murphy (1991) method.

A. SAM Values and Fair Appreciation Rates

The results of valuing the mortgages over the 12 months of 1997 are shown in Table 1. Columns 4 and 5 indicate the valuations are fairly stable for both the 0% and 5.75% SAMs,. The 0% SAMs were the best deals for the lenders, whose present value of expected excess profits above those that would be available in an efficient market averaged 59.8% of the principal (ranging between 54.0% and 69.2% over the sample). The lower present value of excess profits for the 5.75% SAMs averaging 28.7% of principal (ranging between 23.9% and 35.8% over the sample). The latter profit margin implies a lower difference between the actual SAM appreciation participation rate and the rate that would exist with fair pricing of the SAMs.

While columns 4 and 5 of Table 1 show that the homeowners with SAMs were overcharged by a substantial amount, columns 6 and 7 of Table 1 indicate how much of the home appreciation the mortgagors should have had to pay if they had only been charged enough to make the SAMs worth their principal value upon issue. In an efficient market (Fama, 1970) with fully informed borrowers and lenders, columns 6 and 7 indicate the true participation rates should have been 143% and 25% for the 0% and 5.75% SAMs, respectively. While less profitable, the 5.75% SAMs with their 100% participation in the appreciation of the homes underlying the mortgages exceed an estimate that would value the SAMs at their principal value by a huge 100%-25%=75%. That actually compares modestly to the 300%-143%=157% overcharging on the 0% SAMs.

Since many of the SAMs were sold by the mortgage originators in asset-backed pools to institutional investors, the present value of the profit to the lenders from overcharging the borrowers may have been realized fairly quickly. In fact, since the sale at fair value would generate a return of over 50% on the 0% SAMs and over 20% on the 5.75% SAMs in the short period it might take to sell them, the annualized return would be astronomical.

In fact, the size of the profit from sale of the SAMs in pools may have been partially split with the buyers of the SAM pools, possibly in return for unspecified benefits such as special access to offerings of their own lucrative pools of other sorts. The incredible returns to the SAM pools were publicly disguised by combining the SAMs with assets that pay an interest rate which varies with the London Interbank Interest Rate

(LIBOR) and that made up 60% of the pools (Salmon, 1996), leading to an assertion of expected returns of only 7.8% (*Euroweek,* 1999).

B. Decomposing SAM Values

An analysis of the relative portion of the value to the lenders created by the 0% SAMs is provided in Table 2 for the approximate midpoint in the sample, July 1997. This table supplies an estimate (in column 4) of the component of the SAM value to the lender created by the final principal payment, while a separate component value for the lender's share in the home appreciation is provided in column 3. The appreciation component value estimate is based on the assumption inherent in the Murphy (1990a) model that a SAM is really just a bond convertible into the house (with cash settlement), where the conversion or participation feature of SAMs therefore is like a call option on the house price.

For modeling purposes, the house is assumed to have a net marginal effective yield to the homeowner equal to the difference between the expected appreciation on the house and the required return on asset with the same risk as that of the home. This effective yield includes the psychic and other benefits of home ownership to the homeowner (not available to the mortgage lender) net of any costs/headaches (none of which are assumed to accrue to a lender). Houses can therefore be expected to appreciate at rates different from a market rate of return due to this net effective yield to the homeowner (where, once again, this effective yield is in excess of the required return on the house that has been assumed to equal to 0.5% above the risk-free rate).

For July 1997, the expected annual inflation rate over the next 20 years (as incorporated into nominal and real yields on 20-year gilts) was 6.93%-3.53%=3.40% (equaling the difference between the yields on gilts that are not and are indexed to inflation), making the expected house price appreciation equal 3.40%+2%=5.40% (assuming the 2% appreciation rate above inflation rates). Assets with similar betas or relevant risk would have an expected rate of return over 20 years equal to 6.93%+{5%x0.1}=7.43% (given the assumed beta of 0.1 and the 5% premium return required for such relevant risk). The net effective yield on the home accruing only to the homeowner at the end of July 1997 was therefore 7.43%-5.40%=2.03%. The latter figure represents the difference between the required return and the actual appreciation expected on the house that would have to exist at the margin in equilibrium.

The weighted summed value in Table 2 is slightly different from the July 1997 appraised value in Table 1 (160.9 vs. 158.1) for two reasons. The Table 2 option values are computed with the Rubinstein (1976) option pricing model that essentially adjusts the widely employed Black and Scholes (1973) model for the effective yield on the underlying asset. The effective yield on the house to the homeowner (and therefore the yield parameter in the option pricing model) was kept constant across all maturities for simplicity in illustration in Table 2, whereas it automatically varied with the yield to maturity at each maturity for the Table 1 value (i.e., it varied with the difference between the expected home appreciation of 5.40% in July 1997 and the yields on gilts of different maturities). In addition, the Black-Scholes model assumes a normal distribution for home prices that leads to slightly different figures than the Table 1 values which come from the Murphy (1990a) model that utilizes an assumption of a truncated normal distribution.

Because the differences in value estimates are not material,[7] and because the Black-Scholes model is widely recognized and available for those seeking to verify these results, only the latter separated results are reported for the illustration of the component values of SAMs.

Table 2 indicates that the present value of the excess profits to the lenders increases for every extra year that the SAMs are owned for 18 years before stabilizing at a very high level. With a present value to the lender of over 123% of principal (if the homeowner prepaid in a year), and with the present value of the expected payoff to the lender rising to over 168% of principal in 19 years, before leveling off, the mortgages would optimally be prepaid on the day they were taken out. However, if the homeowners had known this fact, they would of course never have taken out the loans, thereby possibly proving fraud and deception from the start (since the sophisticated lenders, who must have been well aware of these financial facts, did not reveal this information to the borrowers prior to signing).

By the definition of present value, the Table 2 illustration indicates that the average *abnormal* return to the lender above market rates equals between $1.675^{1/22}$-1=2.4% (for prepayment/death in 22 years) and $1.237^{1/1}$-1=23.7% (for prepayment/death in 1 year).[8] Given interest rates of 6.9% on long-term gilts and 7.1% on short-term risk-free UK bonds, and assuming an expected premium return of 0.5% for the beta risk of the SAMs, the expected cost of the loans to the homeowners ranged between 6.9%+0.5%+2.4%=9.8% and 7.1%+0.5%+23.7%=31.3%. Obviously, the lenders expect to earn a higher rate of abnormal profit with early prepayments but generate high

abnormal rates of return regardless. Using the PSA prepayment rates to weight the returns, the average expected return would be 7.0%+0.5%+5.2%=12.7%.

Homeowners (once having made the mistake of entering into the SAMs and not redeeming them immediately) could, in some circumstances, minimize the expected value of the exorbitant interest rate, which they effectively are forced to pay, by waiting as long as possible to prepay.[9] However, their average age of 69 gives them little flexibility in delaying the mortgage redemptions that are mandated upon death.

C. Risks to SAM Lenders?

There was very little risk on these investments for lenders. For instance, the risk of cross-sectional variation in house price appreciation was diversified away in the pools of SAMs, and this component of house price volatility merely increased the value of the investor's participation right (as volatility increases the value of any option).[10]

In addition, the time-series risk of inflation being lower than expected could be hedged in the UK with short positions on gilts indexed to inflation combined with long positions on unindexed gilts if the SAM investors chose to do so. However, such hedges were likely not made. In particular, inflation and inflationary expectations incorporated into gilt prices were already very low. Moreover, the SAMs provided protection against deflation with their claim on the fixed principal. Thus, there was very little downside risk to hedge.[11]

The risk of house prices being below the inflation rate over an extended period was also probably quite limited. Even in a country like the US with its substantial tracts of vacant and unused land, real estate prices tend to rise at least with inflation rates over

the long-term (Shiller, 2005). Using home price appreciation equal to expected inflation to reflect this minimum rate that is feasible, the 0% SAMs still provided values (not shown) that ranged between 112.7% and 125.9% of the principal over the sample (and averaged 117.6%). Thus, even in a worst case, the SAMs offered sizeable abnormal profits to the lenders/investors.

On the other hand, the upside potential return on the SAMs to the lenders/investors, and the potential costs to the homeowners, was enormous. Column 7 of Table 2 shows the maximum return to the lender on an individual SAM if the house price rises by 3.09 standard deviations above the mean expected appreciation. Given that return distributions tend to be fat-tailed, there may actually be a greater than a 0.1% probability of such a high return estimate that is based on an assumption of normality in housing prices. It was entirely feasible that the lender would earn between 17.8% (on the SAMs that prepaid in 22 years) and 211.6% (on the SAMs that prepaid in one year). While the lenders should have been well aware of these statistical facts ex-ante, it is very unlikely the SAM borrowers had any idea the cost of the loans could resemble (and even exceed) extortionate rates.

D. Reasons Homeowners May Have Agreed to the Possibly Extortionate SAM Rates

It is worthwhile to speculate on why the homeowners entered into the SAM contracts. They were clearly unaware of the risks of the loans to themselves that column 7 of Table 2 now illustrates. Some form/variant of the information in the latter table should have been revealed to them by the lenders prior to signing.

In addition, homeowners apparently were not informed of even the expected cost to themselves of the loans. SAM promotional material typically showed only a 4.5% annual appreciation rate, which was even lower than the 2% real rate publicly estimated by one SAM issuer (given the objective market forecasted inflation rate listed in Table 1). The promotional materials also did not indicate that, even with only a 4.5% annual home appreciation, the annual effective cost of the loans would be higher than for the illustrated case of redemption in 20 years, if the mortgagor(s) died before then.

In particular, if the mortgagor(s) died in a year (thereby forcing redemption/prepayment according to the SAM terms), the effective annual cost of the 0% SAMs would have been 13.5% even with only a 4.5% rise in the value of the home. This 13.5% rate is 4.8% above the annual cost of 8.7% widely promoted by SAM lenders that was only valid in the single scenario cited in much of the SAM promotional materials. That scenario assumed the unlikely case of homeowners living (and not moving) for 20 years as well as property values increasing only 4.5% annually. Given the advanced age of most SAM borrowers, the loan cost of only 8.7% quoted in the typical SAM promotional materials was extremely unlikely (and extremely deceptive as an illustration).

Even assuming prepayment probabilities as low as the very conservative PSA rates would indicate approximately a 50% chance of a mortgage redemption within 15 years. Using this median figure and the 5.4% expected house appreciation at the end of July 1997, it is possible to compute a more likely annual cost for the 0% SAMs as $[\{(1.054^{15}-1)3\}+1]^{1/15}=10.7\%$. It is unclear why the SAM lenders would choose parameter values that have a very low probability of occurrence and that imply far lower

costs, unless of course they were deliberately trying to mislead the homeowners into mortgages that the lenders most assuredly knew had abnormally high expected returns with little investment risk.

Prior to 1997, the UK housing market had just been through a protracted period of price deflation. Most of the homeowners, lacking sufficient financial expertise to even find the inflation-indexed yields in the *Financial Times*, probably were expecting more price declines that would have resulted in a 0% cost for the loan. Many homeowners may have seen the lenders' promotional illustrations and the 4.5% annual rise in home prices as a worst possible case (especially those who saw the promotional material illustrating no other possibility).[12] In any event, in the environment of falling housing prices, most probably perceived the SAM cost would be far below the widely promoted 8.7% effective rate for the 0% SAMs.

The latter promoted cost was competitive with long-term mortgage rates in the UK that were at or above that cost in the initial four months of 1997 and that averaged (at 8.39%) only slightly less than the 8.7% over the entire year (as shown in column 3 of Table 1). The fact that the annualized rate on the 0% SAMs would more likely be several percent higher than the 8.7% was not explained to the homeowners. Within this "promotional" environment, many homeowners may have perceived a scenario of an extremely low interest cost (even 0%) that had only a very slight chance of happening to be the most likely case. On the other hand, since the possibility of an extreme in the opposite direction (i.e., of costs well above expectations as illustrated in column 7 of Table 2) was not disclosed, homeowners could not possibly have been aware of the risks.

It therefore can be concluded that the lenders were quite successful in deceiving the homeowners.[13]

The deception was made easier by the fact that people may be less diligent with respect to analyzing or investigating risks of post-mortem events or cash flows (such as payoffs on SAM redemptions), which they cannot experience, and over which they may feel they have little control. In addition, at least some homeowners may not have perceived any payoffs upon redemption of the SAMs at death were as important or valuable as mortgage payments prior to death (i.e., a pound to their heirs might be worth less than a pound to the mortgagors while still living). In the latter case, the lenders may have only defrauded the children or other heirs of the homeowners.

Further contributing to the motivation to sign the SAM contracts was the lack of viable fixed-rate mortgage alternatives in the UK. In particular, most mortgages in the UK are variable-rate in nature, with even the fixed-rate ones listed in column 3 of Table 1 switching to a variable rate after 10 years. With UK interest rates having risen to very high double-digit levels in the recent past, many homeowners may have more clearly seen (and experienced) the risks of high costs on alternative mortgages. Without experience or expertise with SAMs, homeowners could only rely on lender counseling and examples on SAMs (that were misleadingly made to appear much more attractive than the possibility of eventual double-digit rates on the standard variable-rate loans). The fact that, unlike with variable-rate mortgages, any higher cost to the homeowners resulting from home appreciation in the case of SAMs would also be simultaneously increasing the net worth of the homeowner was no doubt a very attractive feature.

V. Conclusion

The SAMs offered during the 1996-98 period in the UK benefited the lenders/investors enormously to the detriment of the home owners persuaded to sign up for them. To the sophisticated financial institutions making or investing in the SAM loans, the expected return would have been clearly recognized ex-ante to be extremely high relative to risk. The fact that the annualized loan costs could exceed over 100% (and did in some instances) would also have been clear to the lenders/investors prior to the mortgage originations. It remains for future research to determine the exact magnitude of the actual returns on these loans and the extent to which they might have exceeded even the highest interest rates charged by loan sharks and other extortionate lenders.[14]

SAMs have extraordinary potential for homeowners and investors. However, the price gorging by the UK lenders, who were apparently motivated to maximize just short-term profits, may have created an atmosphere of mistrust that will take a great deal of effort to overcome. One possible route for doing so might be to retroactively reprice the mortgages based on the fair value appreciation shares listed in columns 6 and 7 of Table 1.[15]

Footnotes

1. Even for much simpler conventional mortgages in the US, homeowners on average make rather suboptimal prepayment decisions (Murphy, 2000a), and to assume otherwise for the complex UK SAMs could only defy reality.
2. Lender participation in home appreciation can also reduce monetary incentives for the homeowner to maintain and insure the home. However, the SAM contracts indicate any failure to do so can lead to the lender engaging in these tasks and adding the resulting costs and damages to the lender's share of the appreciation in the home. In addition, the homeowner does still retain a portion of the home appreciation and is financially motivated (even without the maintenance clauses) to keep up and improve the home as long as the costs of maintenance and insurance don't exceed the homeowner's share of any lost appraised value resulting from the failure to invest into the home. Moreover, the fact that the homeowner lives in the house certainly provides many nonfinancial incentives to both keep up and improve the house.
3. It should also be mentioned that Sanders and Slawson (2005), who failed to even cite prior research on SAM modeling and pricing, didn't seem to allow for forced mortgage redemptions/prepayments in their model, which have enormous effects on value and returns to the lender(s), especially given the average age of the SAM borrowers of nearly 70. The authors' model actually leads to the bizarre conclusion that the interest rate charged on a SAM in "equilibrium" would be only trivially impacted by the appreciation share granted to the lender(s), and it

would not be affected at all by appreciation shares above 20%. Under these circumstances, it is unclear why "rational" mortgagors would consent to appreciation shares over 20%. It is especially unclear why a "rational" mortgagor would take out a SAM with the extreme appreciation participation rates charged in the UK. The authors' model appears to be totally inconsistent with and inapplicable to the UK SAMs.

4. A reduction in asset illiquidity reduces required returns and thereby increases asset prices (Murphy, 2000b). While investors could always purchase residential real estate directly (and then rent the houses, as many do), buying shares in a SAM pool permits investment at much lower transaction costs (and with greater diversification), thereby potentially lowering required returns on house investments and raising home prices. The increase in the securitisation of regular mortgages in the UK might also have contributed to a later boom in housing prices since the liquidification of traditional UK mortgages might have reduced the mortgage rates investors required on such loans (once again, via a resulting reduction in illiquidity premiums), thereby increasing demand for UK housing by making it more affordable to more people.
5. As explained later in footnote 9, voluntary prepayments would not optimally occur in the housing price scenario that unfolded, so that the actual prepayment/redemption rates close to PSA rates long-term would reflect autonomous ones forced by the death or moving of the homeowner(s), or by their ignorance.

6. Betas measure the average percentage movement of the home price with any given percentage movement in the market portfolio of investment assets (Sharpe, 1964). A home beta of 0.1 indicates the house price moves on average by 1/10 of the amount of the market portfolio here, as may be typical for unlevered real estate returns (Murphy, 2000b). The debt beta of .03, as well as the other debt parameters, are estimated from past data (Murphy, 1988). A beta is important because it represent the contribution of an asset to the risk of a diversified portfolio for which investors require compensation in the form of a higher return, and market prices should reflect this risk premium via the discount rate employed to compute present value of cash flows from the assets (Sharpe, 1964).
7. See Murphy (1990b) for a general comparison of the two modeling assumptions. Murphy (2000a) has shown the Murphy modeling framework and its assumed truncated normal distribution to be more efficient and accurate in valuing debt securities with embedded options.
8. Note that the expected return on the 0% SAMs (and the effective cost of the loans to the borrowers) exceeds the return that would exist if the actual home appreciation equaled the expected or average value of the appreciation on the homes. In particular, as shown in column 5 of Table 2, if the 0% SAMs prepay in 1 year, the lender receives an average abnormal return of 23.71% above the required return of 7.09%+0.5%=7.59%, or 23.71%+7.59%=31.30%. Those average returns would be across an entire portfolio of SAMs redeemed in one year (with most providing more or less than this average). In contrast, on those homes appreciating at the expected or average appreciation rate of

3.40%+2%=5.40% (from Table 1) and being prepaid in full in 1 year, the return to the SAM lenders/investors is 16.20% (=3x5.40%}. The reason for the difference between the actual average return to the lender and the return in the case of the average home appreciation rate of 5.40% reflects the option value of the appreciation rights that prevent the lender from suffering any loss of principal claim on any individual SAM whose underlying home declines in price.

9. Because of a housing boom in the UK in the late 1990s, something very close to a worst case for the homeowners actually happened on many SAMs. In particular, there was enormous appreciation in the homes underlying the SAMs, with the house values "usually" being asserted to have doubled just a few years after mortgage origination (Sanders and Slawson, 2005). Under such conditions, it might currently be optimal to never voluntarily prepay the mortgages, resulting in the SAMs being redeemed only upon the death of the mortgagor(s). While the Murphy (1989) model of convertibles would indicate that sophisticated borrowers (such as corporations that have access to employees or advisors with a high level of financial sophistication) might also consider prepaying at other times, such as when interest rates have dropped significantly to permit refinancing the convertible at a lower rate, interest rates can't fall below the 0% on SAMs. Interest rates below expected home appreciation rates could also motivate redemption before death (that might objectively happen if real interest rates fell below 1.5%), but once again homeowners would need access to advanced financial software or rocket scientist advisors to be unaware of that fact (and prepayment at such times would only inhibit the already excessive cost from

getting even more excessive over more time periods—given normal death rates, it would not keep the lenders/investors from earning an abnormal profit that might appear to be "obscene" by some moral standards).

10. Appraisal error, for which Sanders and Slawson (2005) observed some evidence, including possibly with respect to one home that was appraised to have appreciated at an annualized rate of 88% three weeks after origination, would add to the volatility that increases option values. In addition, the fact that the SAM contracts permit the lenders to choose the appraiser upon mortgage redemption adds further value to the lenders. Appraisal bias in favor of the lenders could easily occur if the mortgagees chose appraisers with a reputation for conservative valuations for the initial appraisal and, upon redemption, selected appraisers with a history of providing relatively high valuations. The same appraisers might also be motivated to bias the valuations in the direction clearly known to be preferred by the lender if further appraisal business with the lender was desired. Given the range of possible values that can result from an appraisal, even "honest" appraisers would, at least subconsciously, have clear incentives to bias the appraisals to provide maximum return to the lender. Note that such additional value (which can be very significant) has not been included into the model, values, and returns estimated in Tables 1 and 2. Such additional value to the lender would likely more than offset any possible underestimation of the effect of homeowners' incentives to underinvest in their homes, as well as any self-selection agency problem hypothesized by Sanders and Slawson (2005) whereby homeowners expecting their houses to appreciate less than others would be the

ones more likely to engage in SAMs (especially since the hypothesis that the SAM homeowners had any expert knowledge or forecasting skill in predicting home prices seems to be discredited by the actual huge appreciation in their homes ex-post—see footnote 9).

11. For instance, if the lenders/investors decided not to hedge the inflation risk, and inflationary expectations fell to 0%, the 0% SAMs would still have been worth (not shown) between 68.0% and 86.3% of principal in present value terms over the sample interval (for an average of 74.9%). However, if predicted inflation actually fell to 0%, interest rates on unindexed gilts would undoubtedly fall, causing the discount rate on the cash flows to the lenders/investors in the SAMs to decline and thus likely keeping the present value of the expected cash flows far above the principal value (thereby permitting sale at a sizeable profit at any time regardless). In particular, in case of actual deflation, interest rates would likely fall close to 0% (as they have been in Japan for the last decade), thus making the principal payments upon redemption of the SAMs being scarcely discounted in present value terms. In the latter case, the equilibrium values of the SAMs would probably remain well above their amount because the option values of the appreciation rights would continue to have significant value due to the cross-sectional variation in home prices (i.e., even though some SAMs would only be worth their principal value because of home price declines, others would be worth above that amount because at least a few homes would rise in price even within a deflationary environment).

12. One UK lender even formerly capped the participation in the home appreciation at 5% (Sanders and Slawson, 2005), perhaps reflecting homeowners' widespread expectation of this rate as an attractive worst case. SAM originations collapsed after 1997, however, as mortgage rates fell (thereby making especially the SAMs with the 5.75% coupon rate to be clearly extortionate) and as the dramatic rise in house prices made homeowners aware of the actual worst possible cases which became real facts for many.
13. Of course, deceptive methods of earning abnormally high profits open up the lenders to civil suits for fraud. In addition, the fact that the high appreciation shares were fixed across time and lender may imply some form of collusion, price-fixing, and restraint of trade that could be illegal in the UK. Future research could test (perhaps using end-of-week data) whether the abnormal profits to the lenders from the sale of SAMs in the first 4 months of 1998 (when the lenders, at the very latest, should have dropped their appreciation shares to reflect the 1997 drop in interest rates, which actually fell further in 1998, as well as the prior year's SAM performance) were significantly higher than in the first 4 months of 1997.
14. As previously mentioned, Sanders and Slawson (2005) have already measured the initial returns to one group of SAM loans within 27 months of origination. Annualized returns ranged between 0% and 88%, with an average of 23.21%. These returns are very close to those that would have been expected ex-ante, as implied by column 5 of Table 2 (see footnote 8). In addition, they all remain within the range implied by column 7 of Table 2, and so the actual exorbitant

rates that appear to be occurring on the SAMs are not an anomaly or outside the realm of ex-ante feasible predictions. Future researchers who are able to obtain more data from the lenders/investors might compare actual returns in subsequent years not only with the expected returns and ranges computed in Table 2 but also test whether the effective costs of the loans were significantly higher than the rates that have been found in the UK Courts to be usurious or extortionate.

15. One of the reasons the lenders may have sold the SAMs to other investors (through the SAM pools) may have been to make it more difficult to sue the banks themselves for price gouging and other legal violations (see footnote 13). However, whether the mortgages were sold, traded, or held, the lenders had the opportunity to earn the abnormal profits listed in columns 4 and 5 of Table 1. This amount (plus interest at the relevant bond rates for corporations with the same ratings as the lending institutions) should equitably be returned to the SAM mortgagors or their heirs (in either cash, bank stock, or as a prepayment in the case of SAMs still outstanding, at the lender's choice), along with an apology for the pricing mistake (these things happen).

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Table 1
Valuation Analysis of SAMs in the UK[a]
(End of the Month Data, 1997)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
		10-year	0%	5.75%	Participation to Price at Principal[e]	
Month	Forecasted Inflation[b]	Mortgage Rates[c]	SAM Value[d]	SAM Value[d]	0% SAM	5.75% SAM
January	3.97%	8.74%	158.0	125.0	151%	34%
February	3.90%	8.76%	159.3	127.1	146%	30%
March	4.09%	8.70%	155.9	123.9	152%	37%
April	3.95%	8.71%	156.1	125.0	151%	34%
May	3.53%	8.69%	154.0	125.6	152%	30%
June	3.46%	8.69%	155.6	126.7	149%	28%
July	3.40%	8.39%	158.1	128.3	145%	25%
August	3.44%	8.37%	156.8	127.3	147%	27%
September	3.20%	8.14%	162.6	132.4	136%	15%
October	3.36%	8.03%	167.5	133.9	130%	15%
November	3.22%	7.72%	165.4	133.3	132%	15%
December	3.20%	7.71%	169.2	135.8	127%	11%
AVERAGE	3.95%	8.39%	159.8	128.7	143%	25%

[a] Analysis of the 0% SAMs (with 300% participation) and the 5.75% coupon SAMs (with 100% participation) sold in the UK 1996-98.
[b]Estimated as the difference between the yields on fixed-rate 20-year gilts and 20-year inflation-indexed gilts.
[c]Average end-of-the-month mortgage rates on residential mortgages with 10-year fixed rates and 75% loan-to-value ratios issued by banks and building societies in the UK.
[d]Value as a percentage of mortgage principal estimated using the Murphy (1991) model.
[e]Estimated minimum participation in the appreciation of the home of the mortgagor in order for the mortgage to be worth the principal value.

Table 2
Approximate Decomposition of the Value of the 0% SAMs
(at the end of July 1997)

(1)	(2)	(3)			(4)		(5)	(6)	(7)
	0%	Component Value of :						Percent	
Years From Origination	SAM App. Rate	100% Appreciation Participation[a]		+	Fixed Principal[b]	=	Present Value[c]	Prepay This Year[d]	Max Future Value[e]
1	[3 x	10.19	]	+	93.14	=	123.7%	1%	311.6%
2	[3 x	15.41	]	+	86.86	=	133.1	2%	425.1
3	[3 x	19.63	]	+	81.00	=	139.9	3%	529.0
4	[3 x	23.23	]	+	75.50	=	145.2	4%	631.3
5	[3 x	26.34	]	+	70.41	=	149.4	5%	734.5
6	[3 x	28.99	]	+	65.90	=	152.9	5%	838.4
7	[3 x	31.31	]	+	61.74	=	155.7	5%	945.1
8	[3 x	33.46	]	+	57.74	=	158.1	5%	1059.1
9	[3 x	35.41	]	+	53.98	=	160.2	5%	11798
10	[3 x	37.13	]	+	50.52	=	161.9	5%	1305.8
11	[3 x	38.73	]	+	47.21	=	163.4	5%	1442.0
12	[3 x	40.18	]	+	44.12	=	164.7	5%	1586.9
13	[3 x	41.48	]	+	41.23	=	165.7	5%	1741.1
14	[3 x	42.64	]	+	38.54	=	166.5	5%	1905.7
15	[3 x	43.65	]	+	36.08	=	167.0	5%	2078.1
16	[3 x	44.59	]	+	33.73	=	167.5	5%	2265.1
17	[3 x	45.42	]	+	31.55	=	167.8	5%	2465.0
18	[3 x	46.16	]	+	29.50	=	168.0	5%	2678.6
19	[3 x	46.82	]	+	27.59	=	168.0	5%	2907.0
20	[3 x	47.35	]	+	25.86	=	167.9	5%	3145.1
21	[3 x	47.85	]	+	24.20	=	167.8	5%	3405.7
22	[3 x	48.28	]	+	22.65	=	167.5	5%	3684.6
Weighted Sum[d]	[3x	38.21	]	+	46.24		160.90		1821.7

[a]These values were computed using the Black and Scholes (1973) option pricing model using the Rubinstein (1976) adjustment for dividend yield that is assumed to equal the difference between the risk-free rate and the expected house appreciation.

[b]These values were computed using the Murphy (1988) model assuming a Aaa rating.

[c]Note that the weighted summed total value is slightly less than the 158.1 amount listed in Table 1 for reasons mentioned in the text.

[d]The weights are determined by the percent of the mortgage pool prepaid according to the standard historical PSA prepayment schedule (i.e., 1% for year 1, adding 1% for each year thereafter until the amounts stabilize at 5% in year 5 and thereafter), as denoted in column (6).

[e]The maximum feasible *future* value of the payoff (including principal and 300% appreciation rights) to the lender as a percentage of the original principal with a 99.9% confidence level (so that there is only a 0.1% chance of a larger payoff).