Recent developments in portfolio insurance

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The aim of this article is to describe how portfolio insurance works, the main strategies employed and how these have evolved over recent years, and the possible links between their use and financial market stability. The key benefit of portfolio insurance is that it enables financial risk to be distributed among those agents most willing to absorb it. The downside is that it can possibly create conditions for greater fragility in financial markets and leaves issuers of portfolio insurance exposed to potential unexpectedly high losses. It seems unlikely that portfolio insurance-related investments contributed significantly to the financial market volatility that began in Summer 2007. Nonetheless, it is important to keep alert to situations when portfolio insurance could potentially work to amplify financial market instability.

Introduction

Portfolio insurance is a generic term for investment strategies that allow the investor to limit any downside risk to the value of a portfolio while retaining exposure to higher returns. For example, an investor with a basket of shares might additionally enter into a contract with a third party to guarantee, or insure, the total value of the basket should the price of the shares fall.

Such investment strategies are not especially new. Indeed, they have their roots in applications of the Black-Scholes-Merton option pricing theory that was developed in the early 1970s. But portfolio insurance has become increasingly commercially feasible over recent years as a result of the falling costs of trading and product innovation.

A key attraction of portfolio insurance is that it allows investors to move closer to the portfolios of assets they really want to hold, thereby facilitating a better allocation of their risk capital. In principle, this should help to support financial market stability. However, some have suggested that portfolio insurance can also affect financial markets in inefficient and destabilising ways, as those institutions who have sold the insurance seek to hedge their exposures.(1)

The potential association between portfolio insurance and financial market stability is not a new issue. Some commentators believe that the stock market crash of 1987 was exacerbated by the actions of institutional investors following automatic trading rules as part of their portfolio insurance strategies. Similarly, some commentators suggest that the collapse of Long Term Capital Management (LTCM) in 1998 and the ensuing market instability was, in part at least, linked to portfolio insurance. LTCM reportedly provided 'reinsurance' to many banks by selling financial options to offset the 'guaranteed' products these banks had sold (mostly) to retail investors.

It appears unlikely that portfolio insurance has played any significant part in the financial market volatility which began in Summer 2007. The Bank's market contacts have not cited it as a major contributory factor. The markets most closely associated with the recent turmoil and where prices have fallen most sharply have been structured credit markets. Although portfolio insurance products linked to credit had apparently been growing in popularity, the bulk of portfolio insurance has reportedly been linked to equities. But it remains possible that portfolio insurance-related investments could potentially be a more important influence on financial market dynamics in the face of more widespread and sharp falls in asset prices. And financial institutions could, having provided portfolio insurance to investors, be exposed to extreme moves in financial market asset prices.

More generally, portfolio insurance is an example of how financial innovations, which in most circumstances enable risk to be better managed, can also potentially accentuate market instability.(2) Importantly, as with the increased use of credit derivatives over recent years, the issue is not with such

(1) See for example, Jacobs (1999, 2004).
(2) This theme is explored further in the speech by Paul Tucker, 'Where are the risks?', reprinted in the *Financial Stability Review*, December 2005.

innovations *per se*, but with how they can interact with market frictions, such as illiquidity or imperfect information, to add to market volatility in certain circumstances.

The rest of the article is organised as follows. By way of technical background, the next section describes in more detail the mechanics of portfolio insurance, outlining how such products relate to the theory of financial options. The article then goes on to highlight some recent innovations in the market and reviews the implications for financial market stability. The final section offers some concluding remarks.

How does portfolio insurance work?

The theory

Portfolio insurance can be thought of as akin to an investment in a financial option. More formally, a simple option-based portfolio insurance (OBPI) strategy consists of an investment in a risky asset (usually a financial index such as the FTSE All-Share) plus a put option written on that asset — ie a contract that gives the holder the right to *sell* a certain quantity of the underlying asset to the writer of the option at a specified price, up to a specified date. This strategy enables the investor to put a floor under the value of the portfolio should the value of the risky asset fall.

Figure 1 Profit at expiration to an investor in OBPI

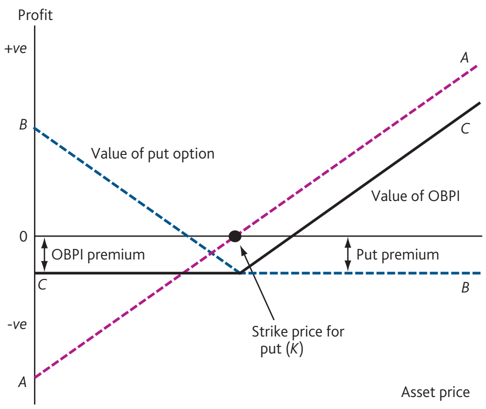


Figure 1 describes the net pay-off profile for an investor in an OBPI position at the expiry date of the put option. The dashed magenta line (*AA*) shows the pay-off to the investor, at different levels of the price of the underlying asset, from simply owning that asset. If the value of the risky asset is below the cost of purchase (*K*) the investor would be facing a loss. The dashed blue line (*BB*) shows the net pay-off from simply owning a put option on the underlying asset with the strike price for the option set at the initial capital investment, *K*. If at expiry of the option the value of the risky asset is below the strike price, the investor can profit by buying the asset in the open market and selling it to the writer of the option (say, a financial institution) at the agreed price (less the premium paid for the option itself). In contrast, if the price of the asset is above the strike price at expiration, the investor does not exercise the put option and it expires with no value.

As with all derivatives, an option transaction is a zero-sum game — for every person who gains on a contract, there is a counterparty that loses. So in this case, if the put option expires with positive value the investor gains but the writer of the option (ie the counterparty to the contract) loses.

By combining the two investments (the underlying risky asset and a put option) in a single strategy, the OBPI enables the investor to obtain the pay-off line *CC* which limits the potential downside risk — the pay-off on the option offsets any loss on holding the risky asset, thereby providing the capital protection.

In principle, the pay-off from an OBPI is identical to the pay-off from a call option on the underlying asset (a contract that gives the holder the right to *buy* the underlying asset at a specified price) and investing the remainder of the funds in a risk-free asset such as a government security. The maximum loss for the investor is the cost of the premium for the OBPI.

Cast in this light, there is an analogy with traditional types of insurance. The investor seeks an assured value for his investment in return for paying a premium for the option while the option writer hopes to make profits from these deals by charging premiums (typically across a range of options that he may have sold) that compensate for the risk taken.

Of course, some investors seeking portfolio insurance, for example retail investors, may not have direct access to options markets. And for some asset classes, an options market may not exist at all. However, in theory at least, it is possible to achieve the pay-off on an option without using options directly. Using the insights of Black-Scholes (1973), Leland and Rubenstein (1981) showed that it was possible to replicate the pay-off of an option by creating a dynamic portfolio of the underlying asset and a risk-free asset. By adjusting the holding of the underlying asset in response to changes in the underlying asset price over time (dynamic hedging), the returns to the portfolio mimic those of a call option.

The practice

The ability to replicate perfectly an option pay-off depends on certain key assumptions. These include the ability to trade continuously and at zero cost, and an absence of credit constraints on investors should they need to borrow funds to acquire more of the risky asset. In practice, these conditions are unlikely to hold and so this approach is not always practical. Consequently, a variant portfolio insurance strategy — constant proportion portfolio insurance (CPPI) — has become popular.

In a CPPI strategy, the investor seeks to approximate the pay-offs from a call option on the underlying asset (equivalent

The mechanics of CPPI

The basic structure of a CPPI is a portfolio that switches the investment mix dynamically between a risk-free and a risky asset according to a discrete trading rule. Each period the investor calculates how much needs to be invested in the risk-free asset in order to guarantee a given percentage of the initial investment — this is known as the cost of the guarantee or the 'floor' — as well as the value of the portfolio in excess of that floor (the 'cushion' or 'reserve'). A constant 'multiple' is then applied to the cushion to determine the amount to be invested in the risky asset in each period.

The multiple is typically chosen to reflect the expected performance of the risky asset as well as the risk preferences of the investor. In so doing, the multiple determines the potential leverage of the investment. A multiple of one implies no leverage; a multiple of zero is equivalent to a purely risk-free investment.

Table 1 provides an illustrative worked example of a simple CPPI strategy for a £100 investment over ten years where the price of the underlying asset is assumed to first rise and then fall over the investment period. At time zero, the guarantee of 100% of principal costs £74.4 (the present value of £100 received in ten years' time at a risk-free rate of 3%) so the initial cushion is £25.6 (£100–£74.4). With a multiple of 3 this implies an investment in the risky asset of £76.8 and £23.2 (£100–£76.8) in the risk-free asset.

Over time, if the growth in the value of the risky asset exceeds the risk-free rate of interest, the cushion will rise and more of the portfolio should be switched into the risky and away from the risk-free asset. In the example, by period 2 the CPPI strategy involves a negative position in the risk-free asset (ie borrowing funds to invest more in the risky asset than the value of the portfolio). When in period 3 the risky asset performs less well the portfolio is rebalanced towards the risk-free asset in order to provide the protection of principal at maturity. As the risky asset price continues to fall, more of the portfolio is reallocated away from the risky asset. In the second half of the investment period, the portfolio is switched mostly into the risk-free asset. If developments in the risky asset require that the CPPI portfolio be entirely reallocated to the risk-free asset this is a situation known as 'close-out' or 'knock-out'.

Table 1 Possible evolution of a CPPI strategy for a £100 investment — example 1[(a)]

Period	Cost of guarantee (£)	Risky asset price (£)	Cushion (£)	Risky asset exposure (£)	Risk-free asset exposure (£)	Portfolio value (£)
	A	*B*	*C=F–A*	*D=C x multiple*	*E=F–D*	$F=E_{t-1}(A_t/A_{t-1})+D_{t-1}(B_t/B_{t-1})$
0	74.4	100.0	25.6	76.8	23.2	100.0
1	76.6	110.0	31.7	95.2	13.2	108.4
2	78.9	130.0	47.1	141.4	-15.3	126.1
3	81.3	110.0	22.6	67.7	36.2	103.9
4	83.7	102.0	16.3	48.8	51.2	100.0
5	86.3	100.0	14.3	43.0	57.6	100.6
6	88.8	95.0	11.3	34.0	66.2	100.2
7	91.5	90.0	8.9	26.6	73.8	100.4
8	94.3	80.0	5.4	16.1	83.5	99.6
9	97.1	85.0	6.1	18.2	85.0	103.1
10	100.0	85.0	5.7	17.1	88.6	105.7

Source: Bank calculations.

(a) Ten-year instrument with multiple = 3; risk-free rate = 3%.

to the pay-off to an OBPI) by switching his portfolio between the risk-free asset and a risky asset according to a mechanical decision rule.

The box above describes the mechanics of CPPI, including a worked example. In summary, the trading rule results in the investor increasing exposure to the risky asset after it has performed well and switching out of the risky asset following poor performance (switching completely into a risk-free asset or 'guarantee' if the value of the risky asset falls sufficiently). Typically CPPI strategies also incorporate some form of gearing whereby the investor is allowed to borrow funds to invest more in the risky asset than the value of the portfolio.

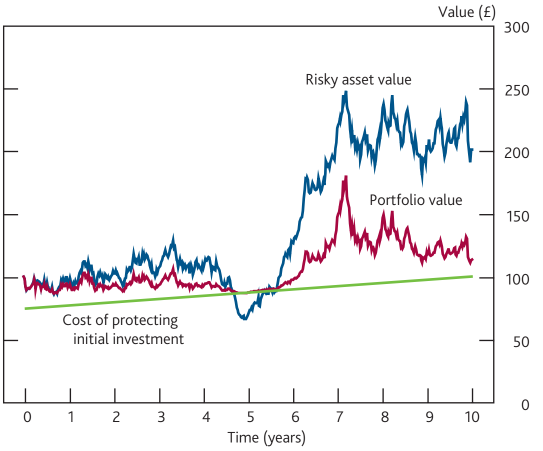
As an illustration, **Chart 1** shows how a second example CPPI strategy might evolve over a ten-year investment horizon. The price of the risky asset is assumed to develop over time in a random fashion[(1)] and the CPPI incorporates features typical of those seen in the market. The chart demonstrates that the CPPI captures some of the upside performance and its value always remains sufficient to switch into the risk-free asset if required, thereby enabling the investor to protect his initial capital.

However, **Chart 1** also shows that, if the price of the risky asset appreciates significantly towards the end of the investment horizon, the value of the CPPI will typically share only partially in this recovery. This is because by the end of the investment horizon the CPPI strategy needs to hold sufficient funds in the risk-free asset to provide the guarantee and so the investor cannot switch heavily into the risky asset.

The final return to a CPPI is said to be 'path dependent' — it depends on the whole history of prices of the underlying asset throughout the term and not just the terminal value. As a

(1) More formally, the asset price is assumed to evolve as a geometric Brownian motion with a drift of 10% per annum and with volatility of 20%.

Chart 1 Possible evolution of a CPPI strategy — example 2



Source: Bank calculations.

result it is not possible to know in advance the precise pay-offs to the strategy at expiry of the investment.

However, simulations of the possible paths for the price of the underlying asset can provide a guide. The box on page 41 describes in more detail the typical factors that influence CPPI performance. It shows that the possible overall returns to CPPI look broadly similar to the pay-off structure for a call option, as the theory of portfolio insurance would suggest. However, the pay-off line for the CPPI is more convex (ie more curved) than for an options-based approach which reflects the effect of gearing on the returns to the strategy.

Recent market developments

Type of investment

Although portfolio insurance has been around for some time, it has experienced something of a re-emergence over the past few years. This appears to stem from lower structuring and trading costs and a broadening in, and growth of, asset classes on which investors find the idea of principal protection attractive. Many of the developments in principal-protected products are common to structured products more generally. Structured notes are securities that can be specifically created to meet needs that cannot be met from standard financial instruments. They typically embed some form of derivative, with characteristics that adjust the security's risk/return profile.(1)

Market contacts report that traditional OBPI investments have not been particularly common over recent years. In part, this reflects the difficulty in explaining options to investors. But CPPI products have become much more prevalent and over time have been designed with additional features (see box on page 42).

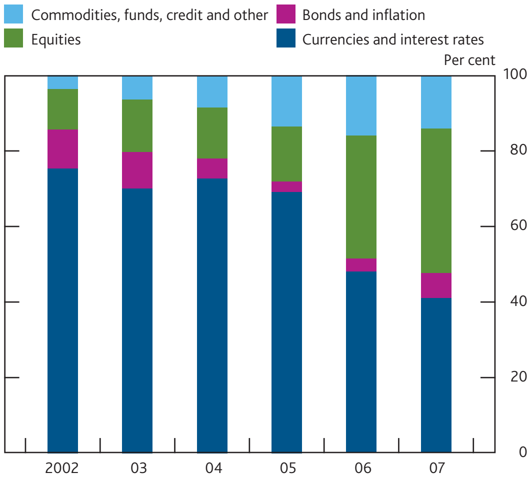
An important development has been the broadening of asset classes associated with CPPI. This includes investment in hedge funds and funds of hedge funds (ie investment funds that consist of a portfolio of other investment funds rather than investing directly in shares, bonds or other securities). But CPPI has also been written on corporate bonds and credit derivatives such as credit default swaps (so-called credit CPPI), property and private equity. In early 2007, a CPPI investment linked to a basket of water, renewable energy, solar energy and bio-fuel commodity indices was also issued, giving investors exposure to growth in sustainable energy industries.

Market size

It is difficult to be precise about the size and the rate of growth of CPPI (or portfolio insurance more generally). What data are available do not always isolate portfolio insurance products from other structured products. However, market contacts indicate that CPPI has been an important element in the expansion of structured products more generally.

The bulk of structured notes are not related to portfolio insurance. But the share of notes linked to equity and 'alternative' assets, such as commodities and credit (some of which could be related to CPPI) have become increasingly significant. In 2005, those sorts of assets were referenced in around 28% of structured notes (by value), but in 2007 this share had risen to over 50% (**Chart 2**).

Chart 2 Share of structured note issuance by type of underlying asset



Source: MTN-i.

Issuance of structured notes linked to credit and funds have increased in particular, although in aggregate terms they remain relatively small in value (**Chart 3**). Consistent with this, funds under management with financial institutions with specialist arms in portfolio insurance products have reportedly risen sharply over the past few years.

Market participants

The market for portfolio insurance investments has reportedly been more prevalent in Europe than in the United States. In

(1) For more details about structured products see Rule, Garratt and Rummel (2004).

The performance of CPPI

Table 1 reports summary statistics for pay-offs on CPPI portfolios with different multiples and compares them with a pure investment in the risky asset (with no portfolio insurance) and with a basic OBPI strategy. Leverage in the CPPI strategy is constrained at 250% and portfolio rebalancing is undertaken weekly.(1)

Table 1 Comparison of the pay-offs to different portfolio insurance strategies under variable multiples(a)

	Strategy				
	Risky asset	OBPI	CPPI	CPPI	CPPI
Multiple			2	4	6
Mean (£)	271.6	257.5	234.0	462.0	580.0
Standard deviation	57.0	54.0	59.1	275.0	356.8
Skew	0.8	0.8	1.6	2.1	2.0
Number of knock-outs(b)			2	37	106

(a) Assumes a risk-free rate of 3% and volatility of 10%. The underlying price process is also assigned a 10% per annum upward drift.
(b) Defined as returns less than risk-free rate.

When the underlying asset performs strongly, a CPPI strategy will tend to underperform a pure investment in the risky asset since it does not generally allocate 100% of funds to the risky asset from the start. But on weak performance in the underlying asset, CPPI will limit the downside. The results of the simulations confirm this, as indicated by the much more positive skew of the distribution of CPPI pay-offs (with a skew of around 2, compared to a skew of 0.8 for the pure risky asset investment).

Moreover, higher levels of leverage (as defined by the multiple) tend to increase the upside to a CPPI strategy but also result in more frequent underperformance and hence more variable returns. **Chart A** illustrates this graphically. The higher the multiple, the larger the upside pay-off from a CPPI but the higher the incidence of low pay-off outcomes (shown in the inset chart). Put another way, the greater the multiple, the higher the convexity of the pay-off profile.

Chart A Distribution of portfolio insurance approaches under variable multiples

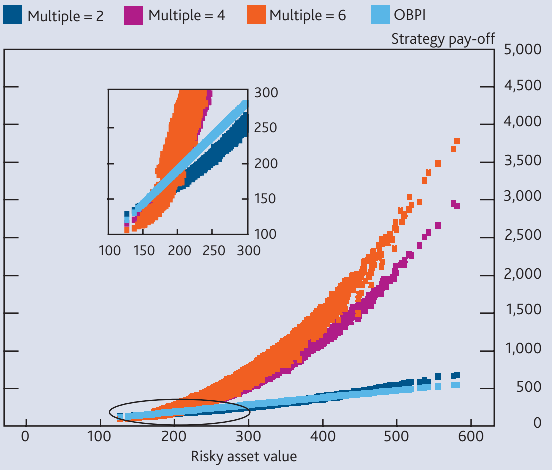


Table 2 shows simulation results under different assumptions about the volatility of the risky asset price process. Higher realised volatility in the underlying price process results in weaker performance for CPPI. This is because, since the strategy involves buying after a price rise and *vice versa*, the number of knock-outs rises as asset price volatility increases.

The impact of volatility on the pay-off to different portfolio insurance strategies can be linked to their option-like characteristics. This is intuitively most obvious for an OBPI strategy in which the investor has explicitly bought options — options cost more if volatility is expected to be high.

Developments in risk-free rates also influence the performance of CPPI. They determine the initial value of the floor, and hence the cushion, with higher risk-free rates permitting a greater investment in the risky asset (since the price of the risk-free bond is lower). Given the path dependence of CPPI, it is not only the initial level of risk-free rates that is important, but also the level at each rebalancing point. These simulations assume constant risk-free interest rates. However, if risk-free rates were to fall between rebalancing points, the cost of principal protection would increase by more than otherwise; and the cushion would be lower, requiring a rebalancing out of the risky asset even in the absence of poor performance.

Table 2 Comparison of the pay-offs to different portfolio insurance strategies under different assumptions about volatility(a)

	Strategy			Strategy			Strategy		
	Risky asset	OBPI	CPPI	Risky asset	OBPI	CPPI	Risky asset	OBPI	CPPI
Volatility		10%			20%			30%	
Mean (£)	271.6	257.5	462.0	271.6	238.3	270.0	269.5	215.1	178.7
Standard deviation	57.0	54.0	275.0	120.6	105.6	471.6	203.7	159.6	1109.9
Skew	0.8	0.8	2.1	1.8	1.8	13.0	4.1	4.2	44.1
Number of knock-outs(b)			37			4959			9034

(a) Assumes a risk-free rate of 3%, and a multiple of 4. The underlying price process is also assigned a 10% per annum upward drift.
(b) Defined as returns less than risk-free rate.

(1) Given the path dependence feature of CPPI, there exists no closed-form solution for valuing the portfolio. Simulations are therefore required to assess the terminal value of the product. This is undertaken using a Monte Carlo technique with 10,000 simulations for three investment strategies on a CPPI with a ten-year maturity.

Popular features in CPPI investments

Over time, CPPI investments have evolved to incorporate various different features. Of particular note are the following:

Constraints on the investment level

In the event that the underlying asset price falls, the allocation to the risky asset can potentially fall to zero. Once that happens there is no chance for the strategy to recover. To counter this, some products have been developed that incorporate a minimum level of investment in the risky asset. Equally, to avoid unbounded investment in the risky asset as its price rises, a maximum investment level is sometimes imposed.

Constraints on leverage

Exposure to the risky asset of more than the initial available funds can be achieved by allowing borrowing. But often there will be limits on how much can be borrowed, depending on collateral or margin limits.

Variable and 'straight-line' floors

When the price of the underlying asset increases, any gains made by the CPPI strategy can still be lost if prices subsequently fall. To address this, products with so-called 'ratcheting' are available which allow the investor to lock-in gains made from upward movements in the risky asset price. More specifically, the floor is increased if the cushion exceeds some agreed threshold, with the trigger typically set as a percentage of the highest portfolio value or as a percentage of any gains achieved.

The floor in a conventional CPPI is sensitive to the level of interest rates (since it affects the present value of the pay-off on the risk-free asset). As interest rates fall, the floor would rise and the investment switches away from the risky asset. This in turn would limit the potential upside from the CPPI, which could be significant (if interest rates and the risky asset are negatively correlated for example). However, this sensitivity can be removed and the floor can be allowed to vary linearly with time, a feature sometimes known as a 'straight-line' floor.

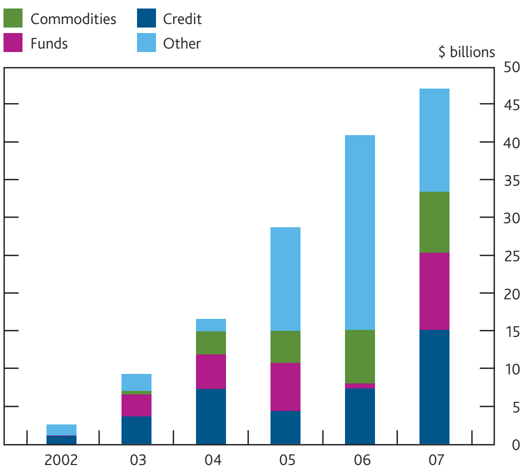
Variable multiples

Rather than having a fixed multiple, some product structures allow for the multiple to vary over time in relation to the volatility of the risky asset and reflecting investors' appetite for risk. This is sometimes referred to as dynamic portfolio insurance (DPI). There is often a maximum level for the multiple, which is often based on the results of stress tests performed on the risky asset.

Volatility caps

Some CPPI products include mechanisms that allow the percentage exposure to the risky asset to be reduced if its realised volatility exceeds a certain level.

Chart 3 Issuance of structured notes linked to 'alternative' assets



Source: MTN-i.

terms of participants in the market, the key issuers (ie sellers) are typically large banks that can provide the necessary structuring and marketing expertise. The scale of their balance sheets also means that they can extend loans to clients who leverage their investments within CPPI strategies. Access to a distribution network to both retail and wholesale clients is also said to be important.

According to market contacts, the main investors in portfolio insurance products are high net worth individuals; private banks who purchase products for onward sale to their clients; and institutional investors such as pension funds. The latter have reportedly been especially important in continental Europe.

Implications for financial market stability

To the extent that portfolio insurance enables individuals and firms to match their exposures better to their risk preferences, such products should in theory result in risks being better distributed among agents most willing to absorb them and hence benefit financial stability. However, in practice markets are imperfect and portfolio insurance could potentially contribute to market instability.

This article highlights three (interrelated) ways in which portfolio insurance might add to market instability: the impact of dynamic hedging on illiquid markets; imperfect information and the potential for 'gap risk' (ie the risk that the value of the investment drops sharply without trades taking place); and the limited available instruments to hedge this exposure to gap risk.

Dynamic hedging and illiquid markets

The issuers of portfolio insurance products have essentially sold or written options to the buyers of these products. This is most obvious for issuers of OBPI. But it is also typically true for CPPI strategies if the issuer provides a guaranteed minimum return and takes on the possible shortfall between the return from the CPPI strategy and the guarantee (ie implicitly writes an option on the CPPI strategy).

Issuers will typically look to hedge their exposures. One way they can do this is to replicate the pay-offs that they might have to make to investors by dynamically hedging the option they have sold to investors. Broadly speaking, this entails buying the underlying asset as prices rise, and selling it as prices fall. In this way however, the hedging actions of portfolio insurance providers can potentially generate feedback effects in markets which work to reinforce and amplify market price developments.

The actions of final investors following their own CPPI strategies could also conceivably have feedback effects on asset markets since they too would buy following price rises in the risky asset and sell when prices fall. But in practice the larger transactions are undertaken by the issuers of CPPI.

Under normal circumstances, where the underlying asset markets are generally deep and liquid, dynamic hedging of portfolio insurance products should have a limited impact on prices. However, amplifying feedback effects can become significant if markets are, or become, illiquid, so that small changes in demand relative to supply prompt large changes in the price (which in turn could trigger more hedging flows).

Given the paucity of aggregate data on portfolio insurance sold, it is difficult to gauge the impact of hedging by issuers on market dynamics. However, according to market contacts, the amount of portfolio insurance-related dynamic hedging flows still remain modest relative to the size of the corresponding underlying asset markets. Moreover, contacts do not generally perceive dynamic hedging as having been a significant factor in the period of financial market turmoil which began in the summer of 2007, even in those new asset classes that had increasingly become referenced in CPPI strategies during recent years.

In particular, as noted above, credit securities had become popular as assets underlying CPPI. And, as prices of these assets fell, these instruments would in some cases have needed to be sold as part of a rebalancing/hedging of CPPI exposures. When credit markets became unusually illiquid in August 2007, contacts noted that this deleveraging process was not always easy to undertake. But, on the whole, the aggregate size of rebalancing required was not thought sufficient to have generated any significant feedback effects.

Likewise, issuers of CPPI that reference mutual funds, hedge funds and funds of hedge funds reported that they have not noticed particular problems hedging their exposures over the past few months. Such asset classes are not always actively traded and when they are, the frequency of trading is typically restricted. For example, for most hedge funds, invested monies in the fund can only be withdrawn at fixed intervals, (usually at least a month) and some have much longer lock-in periods. The inability to disinvest quickly makes it more difficult to hedge these investments compared with those in more traditional financial assets, such as equities, and means that the impact of dynamic hedging on these markets could potentially be greater.

In the event, returns to diversified portfolios of hedge funds were relatively stable during the second half of 2007. And initiatives taken by hedge fund managers to mitigate large drawdowns were also thought to have been helpful in breaking any feedback loop before it took effect.

Furthermore, in seeking to rebalance their portfolios in response to changing market conditions, market contacts report that issuers exercise discretion over how and when this is achieved in order to minimise the impact on the price of the underlying asset. For example, CPPI providers often only rebalance their portfolios when the value of the portfolio breaches some pre-agreed tolerance levels. This avoids the potential for feedback effects, at least for relatively small moves in the price of the referenced asset. However, it conceivably might result in a need to trade in larger size if tolerance levels were eventually breached.

Imperfect information and gap risk

Even if the dynamic hedging flows are relatively small compared with the overall trading volume of the underlying asset, these dynamic investment strategies may potentially reduce the information available from market prices. Because other investors cannot distinguish dynamic hedging flows, they may misread such trades as containing information about more fundamental factors.(1)

More generally, imperfect information surrounding the possible values that some insured assets may take can mean that portfolio insurance strategies are particularly vulnerable to sudden jumps in asset prices. In particular, if the price of the risky asset falls sharply before the portfolio can be rebalanced, the value of the CPPI strategy may fall below the floor.

In practice, such exposure to gap risk is often underwritten by the issuer of the CPPI because of the hard guarantee on returns

(1) Gennotte and Leland (1990) showed that information asymmetry between market players can mean that the impact of portfolio insurance strategies can potentially trigger relatively illiquid conditions in markets. Likewise, Frey and Stremme (1997) showed that the strength of feedback effects depends not only on hedging demand but also significantly on the heterogeneity of views about the distribution of hedged pay-offs.

they typically provide. In the first instance, the issuer will look to build the cost of this implicit option into the premiums and fees charged to the investor. But the pricing of an option on a CPPI can be quite complex, especially when bespoke features are added.

Furthermore, in much the same way that a financial option is more (less) valuable to the investor (issuer) if the price of the asset is expected to be volatile, the returns on a CPPI strategy are also affected by asset market volatility. But given the path dependence feature, the parties to a CPPI are exposed to *actual* market fluctuations — ie realised volatility — rather than future expected volatility (see the box on page 41). If realised volatility turned out to be higher than expected at the time the guarantee on the CPPI was sold, the issuer could incur unanticipated losses which might potentially prompt further unwinds of positions.

To assess and manage the gap risk, the issuer needs to model the likely 'worst-case' move in the risky asset price before the next rebalancing opportunity. But in practice, issuers do not know perfectly the underlying processes generating asset prices and may not have sufficient data to estimate gap risk accurately. In particular, given the limited trading history of some of the referenced underlying assets, as is the case for many hedge funds, assessing the degree of correlation across assets, and hence any potential diversification benefits, may be especially difficult.

More specifically, those assets that appear uncorrelated in normal trading conditions may become much more correlated in stressed conditions when investors in less traditional asset classes may all look to exit their trades simultaneously. Taken together with the inherently less liquid nature of the markets for certain underlying assets, these factors mean that issuers could underestimate the scale of potential losses.

In fact, during the period of heightened market volatility that began in Summer 2007, contacts believed that only a very few CPPI investments experienced such large falls in the prices of their underlying assets that gap risk would have crystallised. To the extent that some portfolios have suffered significant losses over recent months, contacts highlighted vulnerable investments as those most exposed to structured credit portfolios with a relatively low level of diversification between assets (for example, CPPI written on single hedge funds specialising in structured credit).

Some issuers employ scenario analysis to help calibrate gap risk. Others employ due diligence procedures to interrogate the structure and management of the selected funds, in a bid to understand the risks being taken by a hedge fund and, in particular, ensure that assets offer genuine diversification benefits. These procedures remain relatively untested, though contacts noted that the events of recent months will be useful in the future stress testing of their exposures.

Limited hedging instruments and gap risk

Rather than dynamically hedging their option exposures, issuers of CPPI might look to offset the gap risk they face by using options markets directly. In particular, institutions may look to purchase put options, where the strike prices would typically be set so that they would only become valuable if the underlying asset price fell very sharply. These option positions would not typically be changed over time and as such would represent a static hedge.

However, in practice, those who have sold tailored options may find that there are few available financial options on the underlying asset through which to hedge their exposures. This might be especially true for the recent popular types of referenced assets in CPPI deals, such as structured credit, hedge funds and funds of funds. And even if suitable hedging options did exist, dealers and market makers may find buying them is uneconomical in market environments in which there was a marked preference for buying over selling options.

Anecdotal evidence suggests that insurers and reinsurers may have taken on some of the gap risk associated with portfolio insurance products. Some contacts have also reported that issuers of CPPI sometimes create securities that package up the gap risk and these have been sold to investors, including private banks and funds. But these structured notes are not thought to be that prevalent, in part because the level of documentation necessary to understand the nature of the risk transferred can be significant.

As a result, issuing banks may alternatively seek to limit their exposure to gap risk through other (albeit imprecise) hedging strategies. For example, financial institutions faced with short option positions from structured notes based on commodities have reportedly issued collateralised commodity obligations in an attempt to offset some of their gap risk exposures.

The imprecise nature of the available hedges may itself create potential problems. Such hedging exposes the portfolio insurance issuer to so-called basis risk (ie the risk that offsetting investments in a hedging strategy will not experience price changes in entirely opposite directions from each other).

Concluding remarks

Portfolio insurance strategies enable investors to unbundle financial risks and tailor their investments to their risk preferences. In this way, they facilitate a better allocation of risk and so potentially provide broader welfare benefits. However, the existence of financial market imperfections means that portfolio insurance and the associated hedging flows could potentially have destabilising feedback effects on financial markets. Further, the issuers of portfolio insurance also expose themselves to significant gap risk, which if it crystallised, could lead to significant unexpected losses that might potentially trigger disorderly unwinds of positions.

Most of the arrangers of CPPI have so far tended to be large international banks. These types of institutions might be better placed than smaller institutions to absorb large unexpected losses. However, in environments in which the appetite for risk among product providers is strong, there is a danger that strategies such as portfolio insurance transfer financial risk to financial institutions who may have limited capacity to provide protection in the event of severe financial market stress. In this way, risk avoidance on the part of end-investors can lead to the development of investment products that, while intended to reduce risk, have the potential to increase the fragility of financial markets.

Overall, it seems unlikely that portfolio insurance-related investments contributed significantly to the latest bout of financial market volatility that began in Summer 2007. And, in all but a handful of cases, market contacts observe that the gap risk in CPPI products has not crystallised. Nonetheless, financial markets currently remain fragile and vulnerable to further shocks. It is therefore important that market participants and policymakers alike are alert to situations when portfolio insurance could potentially work to amplify financial market instability.

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