Auto-Callables

Understanding the products, the issuer hedging and the risks.

Equity Derivative Strategy

Gerry Fowler* CFA
+44 20 7986 0224
gerry.fowler@citigroup.com

Lamia Outgenza*
+44 20 7986 0244
lamia.outgenza@citigroup.com

* for non-US investors only

- **Auto-callable products have been traded on baskets and indices for several years and are now being quoted and traded on single stocks.**
- **While there is no product that could be considered generic, most involve a large coupon payment if the underlying is above a reference level on particular "auto-call" dates. If so, the coupon is paid and the structure terminated. If not, the coupon often steps up for the next period.**
- **The high coupon paid in a potentially short period of time makes the product attractive to yield-hungry investors but also to issuing banks that have previously only issued long-term structures. When an auto-callable is terminated early, the issuer has an opportunity to encourage the investor to make a new auto-callable purchase.**
- **There are a variety of vanilla and exotic risks involved in buying and issuing auto-callables including:**
  - **For clients:**
    - **Early Maturity Risk**
    - **Interest Rates**
    - **Credit Risk**
    - **Liquidity Risk**
    - **Event Risk**
    - **Tax Risk**
  - **For issuers:**
    - **The most important is "pin risk". That is, the potentially significant change in value of an auto-callable product when the underlying trades near a barrier approaching auto-call dates or expiry. This can create discontinuous delta and gamma profiles.**
    - **Volatility risk – Issuers are generally long volatility but this is a very dynamic exposure due to an indeterminate expected time to expiry (fugit) affecting skew and term structure exposure. Vega convexity issues can also arise (January 2004 for example).**
    - **Another significant risk that it is difficult to quantify is correlation risk between bonds and equities (cega).**

An introduction to Auto-callables

Auto-callables have been actively traded in European markets for several years. Initially, they were issued on baskets of stocks, then on indices and now increasingly on single stocks.

An Auto Call product is a structured product that has an automatic call feature on pre-prescribed dates (the “auto-call dates”). These are usually from monthly to bi-annual intervals. In essence, the investor purchases a bond with an embedded long forward and/or short put struck at the money.

While few auto-callables are exactly the same, most share common characteristics:

A large coupon is payable if an auto-call level is triggered (when on an auto-call date the underlying is above the strike). If not auto-called, the coupon escalates (often the next multiple) for the next auto-call date.

A sold knock-in put is embedded to reduce the structure cost. This is often referred to as “soft” protection as the product is usually capital guaranteed unless this knock-in put is triggered.

For illustrative purposes in this piece we assume the following:

- 3-yr maturity with annual auto-call dates and 100% strike.
- 10% coupon escalating to 20% and 30% in years two and three if not auto-called.
- 70% downside knock-in put with continuous barrier (can knock-in any time).

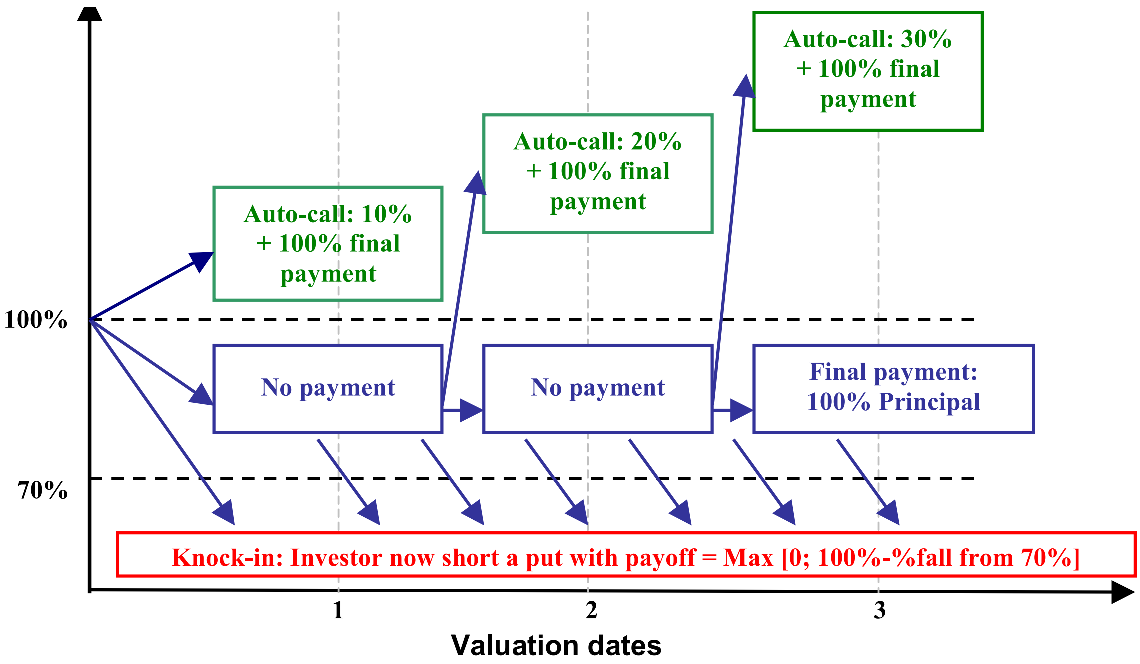
At each auto-call date there are two possibilities that determine if the product will be auto-called or will pay no coupon but continue to the next period:

1. If the underlying is above the strike (100%), accumulated coupons are paid (10% per year of life) and the whole structure is terminated.
2. If the underlying is below the strike (100%) the structure remains “alive” and the potential coupon escalates (by a further 10%) for the next auto-call date.

If at any time, the underlying is below the knock-in put strike (70%), the autocallable holder becomes short-the put and this “soft” capital protection is removed.

Technically speaking, in an auto-call product the client is short an out-of-the-money knock-in put and long a strip of contingent ATM digital options, which pay coupons and knock out the whole product if in the money at auto-call dates.

Index level vs. Strike Level



Product popularity

The most common explanation for auto-callable popularity amongst investors is that the potential for a very high coupon is attractive in the current low yield environment for bonds, property and equities.

Investors who buy Auto-Call products are looking for a long-term equity-linked investment providing a conditional 100% principal protection at maturity and a potential for a large return on investment from coupons. The investor has a view that the underlying will have a moderate increase over the life of the product and will not trade below the knock-in level.

Another source of popularity arises from the fact that auto-callable products may have a shorter lifespan than other structure products. It is hoped that in these situations, investors flush with new cash from the coupon paid, might invest in further auto-call products. Many other structured products lock-in an investor's money for a long duration (5-10yrs is common) so for issuers, the prospect of a seemingly long-term product expiring early may provide the chance to issue another product to the same investor.

Auto-call risks

From an investor's perspective:

- Early Maturity Risk
- Credit Risk
- Tax Risk
- Performance of the underlying with full capital exposure to falls in the underlying below the sold knock-in strike.
- A rise in interest rates during the investment period may result in mark-to-market losses.
- Liquidity risk and spread costs if an investor seeks to sell their notes prior to the maturity date.
- Event risk due to some adjustments to the terms of the contract like mergers, trading suspension…

From an issuer's perspective:

- A discontinuous valuation pattern near auto-call dates where delta hedging may require a theoretically infinite multiple of the notional to be traded rapidly.
- An indeterminate time to maturity. Vega and gamma exposure is highly dynamic. As the underlying rallies, vega exposure gravitates toward the next auto-call date.
- Correlation exposure between bonds and the underlying. The sensitivity of the fair value of an auto-call product to this "hybrid correlation" is negative. This stems from the risk to the issuer that as the underlying rallies, the value of the auto-call increases but if bonds are also rallying, the discount rate falls and will also serve to increase the product fair value (the present value of the coupon payment will be higher). In this situation, high correlation has a double negative effect for the issuer.

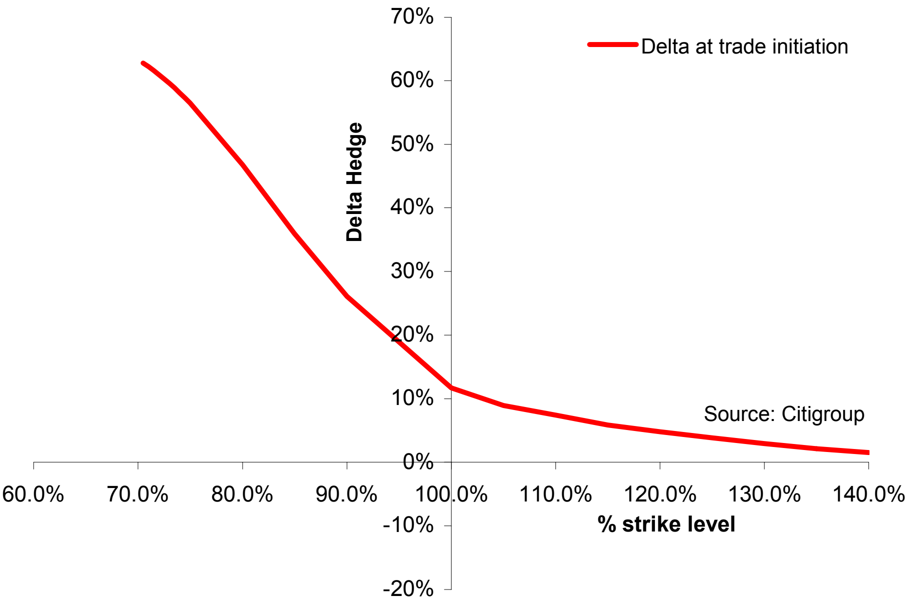
Auto-call effect on derivative markets

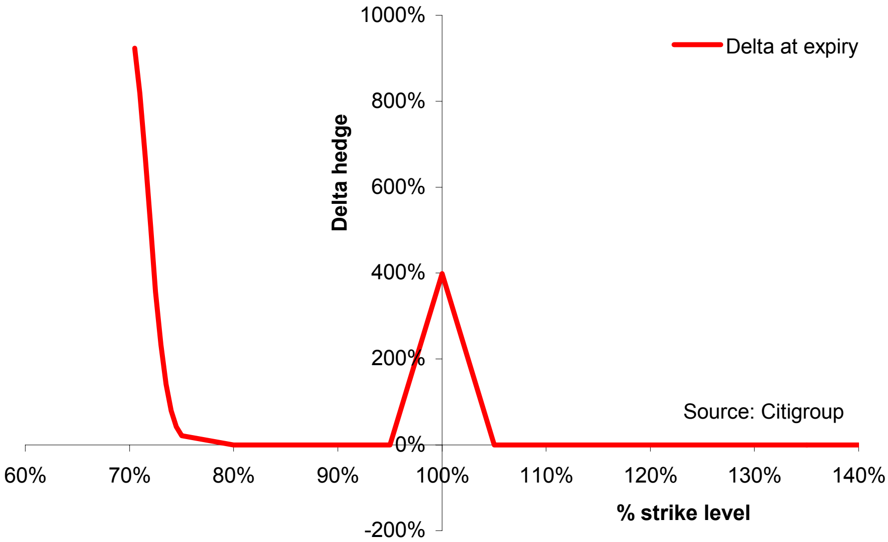
Delta

The delta changes can be significant and irregular for auto-call products particularly when the underlying is trading near a knock-in or knock-out level close to expiry.

- The auto-call product experiences a fair value "jump" when a knock-in or knock-out occurs. In our example, at the 70% level, the issuer requires a large hedge position so that profit/loss on minor underlying movements are sufficient to offset the large fair value changes in the auto-callable.

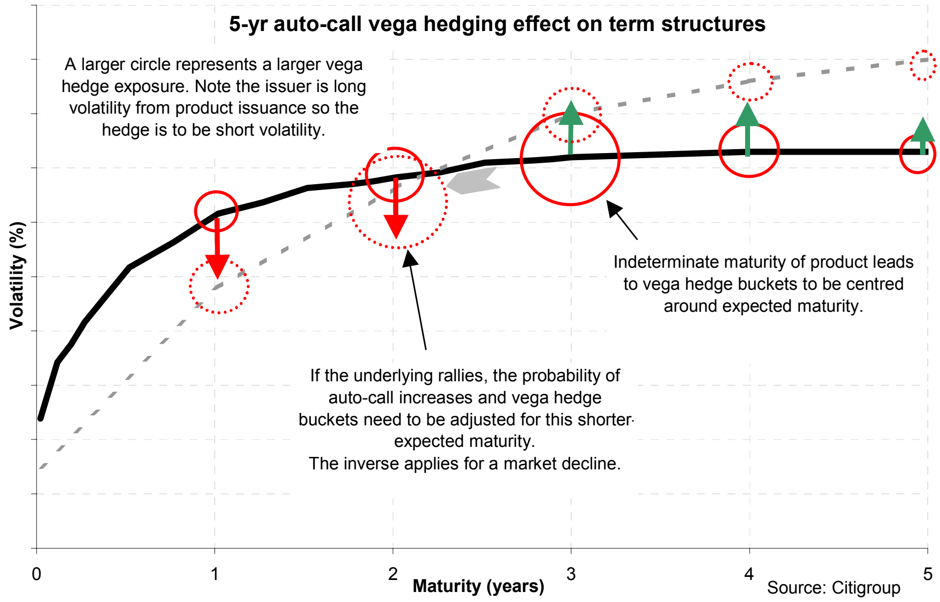
The first chart below shows the delta position of our illustrative auto-callable at trade initiation. The second shows the massive change in delta position required when the underlying of an auto-callable trades close to a knock-in or knock-out level near an auto-call date or expiry.





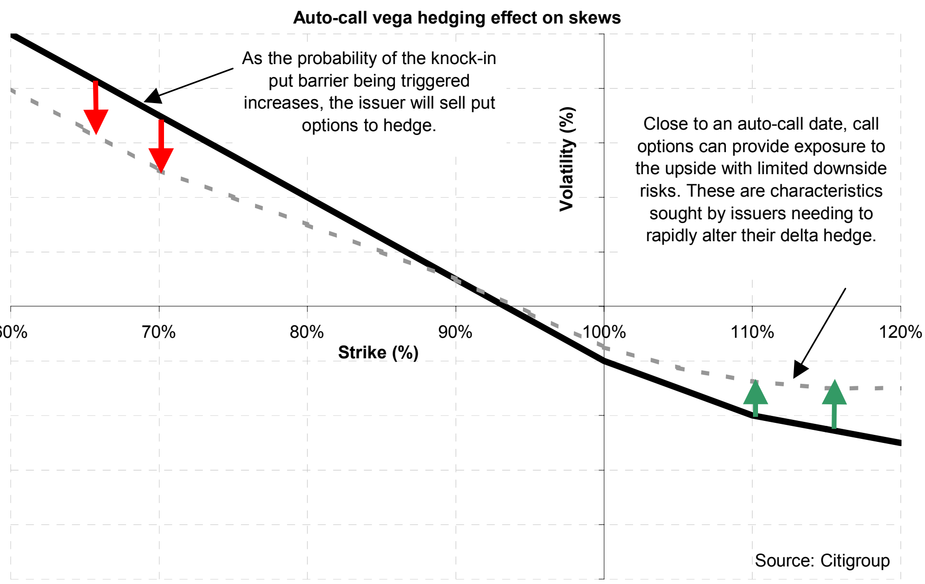
Vega

- The auto-callable issuer is buying volatility. When the underlying is near a level where a coupon would be payable, the issuer would prefer the stock to be highly volatile to provide a greater probable distance from the barrier.
- If the underlying declines, the issuer still prefers high volatility to provide a greater probability of hitting the knock-in level (where the issuer becomes long a put option).
- This long volatility exposure is hedged in the market by issuers selling volatility. The indeterminate maturity however, makes this hedge highly dynamic and pressures the term structure and skew when flows are significant.
- **Term structure** – As the underlying rallies, an auto-call becomes more probable and the expected maturity of the product shortens. Longer dated vega hedges are bought back to sell more shorter dated vega hedges. The opposite applies for a decline below the strike. The chart below graphically represents this pressure on term structures for a rise in the underlying.



Source: Citigroup

- **Skews** – Similar to the effect on term structures, as the probability of auto-call increases, the demand from issuers increases for upside calls to hedge the large coupon. Similarly, as the probability of the knock-in put being triggered increases, the issuer would look to sell downside puts in advance to hedge. Both of these effects serve to pressure the volatility skew at the barriers as represented in the graph below.



Source: Citigroup

- These changes are very difficult to quantify and the above examples are an illustration of the direction pressure would be applied but not the size. An important note however is that these flows at the moment appear to be relatively insignificant compared to normal market supply and demand. At certain times and especially when a large issue is close to a strike approaching an auto-call date, these effects can be much more significant.
- Issuer's long volatility positions from similar products (snow-balls in particular – the coupon part of an auto-callable) are also believed to have contributed to the "vega convexity" issue that saw significant selling of volatility in January 2004.

Gamma

- "Gamma wells" are an interesting effect experienced by issuers of auto-callables. These are created when one or more institutions hold large derivatives positions and the required hedging activity on the underlying asset begin to influence its price movements.
- Long gamma means delta hedging pressure tends to dampen volatility and sometimes supports the share price near or above the strike price near maturity.
- At the knock-in level and especially close to an auto-call date or expiry, the gamma becomes very large which means dealers buy more and more of the underlying on the way down, providing support for the market.
- The caveat is that at some point, the issuer will consider the release of their delta position to be more important than delta hedging profits and gamma becomes irrelevant as the issuing bank sells their hedge. In practice, few dealers will fully hedge themselves as the market approaches the barrier and will often sell off the delta before the barrier is breached in an attempt to achieve the anticipated correct hedge ratio.

Important added notes

- Auto-callables are significant but vary widely in maturity and strikes making event risk at any particular underlying level or on any particular date relatively minor at this stage in our view.
- Auto-callables are minor in the scheme of volatility selling by investors when compared to overwriting, which we believe remains a much larger impact on volatility markets currently.
- At the current very low implied volatility levels, even auto-callables are hard to price with significant yield. Demand may subside if the current environment continues. Equity, bond and property returns also remain subdued however so yield enhancing products do still maintain attractiveness.

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