

ASX Equity Market Closing Price and Settlement Price Determination

CONSULTATION PAPER

JUNE 2017



Invitation to comment

ASX is seeking submissions on the matters canvassed in this paper by Friday 7 July 2017. Submissions should be sent to:

E regulatorypolicy@asx.com.au

Office of General Counsel ASX Limited
20 Bridge Street Sydney NSW 2000

Attention: Gary Hobourn

ASX prefers to receive submissions in electronic form. Submissions not marked as 'confidential' will be made publicly available on ASX's website.

If you would like your submission, or any part of it, to be treated as 'confidential', please indicate this clearly in your submission. ASX is available to meet with interested parties for bilateral discussions.

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Overview

The paper seeks feedback from stakeholders on the outcomes of an internal review into ASX's cash equity market closing price methodologies, particularly in a market outage scenario. The paper distinguishes between two separate, but related, concepts:

- the ASX **market** closing price – published daily by ASX to reflect the last traded price executed on the ASX market; and
- the ASX **settlement** price – used by ASX Clear (ASX's clearing house for equity securities) to determine daily margin calls and for derivative contracts (e.g. exchange-traded options) settlement pricing.

For cash equities, in all but a few exceptional circumstances, the market and settlement closing prices will be identical.

However, there may be scenarios where ASX Clear uses settlement prices that diverge from the ASX market closing price to value positions in order to effectively manage clearing house risks. The settlement price of exchange-traded options prices are also derived from the settlement price for the underlying security.

Given that ASX-listed securities now trade across more than one platform there are questions as to:

- the role that the ASX market closing price plays in a multi-market environment, including whether users have in place appropriate mechanisms to source alternative price data, if necessary, when there is a significant disruption to trading on the ASX market;
- whether the processes for calculating the ASX market and ASX settlement closing prices remain fit for purpose; and
- if these processes are sufficiently clear and transparent to allow users to make informed decisions.

ASX Trade (ASX's trading platform for equity and equity derivative securities) experienced a market outage in September 2016, which led to disrupted trading, including the early closing of the ASX market. Trading in ASX-listed securities continued, albeit in substantially lower volumes, including in some broker crossing networks. ASX did not conduct a Closing Single Price Auction (CSPA) on that day and used the last traded price as the closing price for that day. ASX Clear used existing protocols to determine the settlement prices for that day.

Following this event, and in response to a specific recommendation from an ASIC review, ASX has conducted an internal review of its methodology with respect to pricing under various market disruption scenarios.

This paper sets out the results of ASX's internal review of the determination, publication and use of closing prices. It aims to provide stakeholders with greater transparency and clarity into the process for calculating these closing prices to allow users to consider their own approaches to sourcing pricing information under different scenarios.

ASX's internal review concluded that the existing methodology for calculating the ASX market closing price remains fit for purpose. The review did identify that the market would benefit from the publication on ASX's website of what the ASX market closing price represents and the process that ASX Clear uses to establish the ASX settlement price.

Feedback from interested stakeholders is sought by 7 July 2017.



Background to the review

On Monday 19th of September 2016 the normal operation of the ASX market was interrupted (the ASX Trade outage). This resulted in the market not opening at 10am and closing prior to the normal CSPA process. ASX subsequently advised participants that the ASX market closing price would be calculated using the last traded price on ASX's market. The actual ASX market closing prices were distributed later that evening and the settlement prices for exchange-traded options were distributed a few hours after that.

ASIC published a review¹ of the ASX Trade outage in December 2016 and made recommendations, including two related to pricing matters:

ASIC recommendations to ASX

We recommend that ASX consider, formally map and report to ASIC on the dependencies that different stakeholders have on ASX's processes and decision-making, and determine what changes need to be made to mitigate the effect of ASX system failures on these stakeholders. This includes dependencies on:

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- c) Closing prices—ASX should review its methodology for determining closing prices in the absence of a CSPA and be transparent about its approach; and
- d) Security prices that may be used to price other products (e.g. derivatives).

This paper is the first in a series of public consultations over the course of 2017 in response to the matters raised in the ASIC review.

ASX market closing prices in a multi-market environment

Closing prices for cash market and equity derivative securities quoted and traded on ASX's trading platform are calculated by ASX at the end of every trading day and represent the most recent valuation for a security on the ASX market.

ASX market closing prices are used by a range of internal and external users for a diverse range of purposes. These users include: third-party data vendors; index providers; fund managers; trading and clearing participants; listed companies; retail and institutional investors; alternative market operators, post-trade facilities; and regulators.

Historically, when trading of ASX-listed securities occurred only through the ASX trading platform the ASX closing price was the only 'market' closing price for users. The introduction of an alternative trading venue in 2011 meant that this was no longer necessarily the case as prices are formed in other trading venues. The ASX market price may no longer be the most recent available trading price for a particular security on a given day.

There is currently no single 'Australian market' closing price produced which combines prices across multiple trading venues on a given day.

¹ <http://www.asic.gov.au/regulatory-resources/find-a-document/reports/rep-509-review-of-the-asx-equity-market-outage-on-19-september-2016/>



The ASX market is the primary listing market and most liquid trading venue for price formation of Australian listed equity securities. The CSPA remains the most effective mechanism to determine the ASX market closing price.

A closing price auction is a practice adopted by almost all major securities exchanges in the world. The CSPA used by ASX generates a consensus price reflecting the interaction of market supply and demand, and importantly allows trades to be executed at the closing price, an ability that many market participants have indicated they value. It is common, even in large dispersed trading markets, for the closing price auction to occur on a single primary listing market (like the NYSE) as liquidity significantly impacts the stability of auction pricing. For these reasons, ASX considers that the CSPA remains the optimal method for determining the ASX closing price.

The Closing Single Price Auction (CSPA)

The CSPA is conducted after the completion of ASX’s continuous trading session at 4:00pm. Bids and offers are allowed to be entered, amended or cancelled in the order book during the pre-CSPA period up to 4:10pm. No overlapping bids or offers are matched during the pre-CSPA period.

The closing auction’s matching algorithm, based on a series of rules (see below), operates at a random point between 4:10pm and 4:11pm. The algorithm’s primary purpose is to ensure the maximum amount of trades are settled at the most competitive level to produce the closing auction price.

The auction algorithm uses four sequential decision rules to determine the auction price. If a clear result cannot be achieved when the first decision rule is applied, the model progresses to the next decision rule and so on. A high level illustration of this process follows:



The ASX market closing price is a factual statement of the last price recorded in the ASX trading platform following the CSPA (either an on-market trade or an off-market crossing reported to ASX between the national best bid and offer (NBBO)).

Alternative market operators are responsible for the calculation of closing prices for all securities traded on their market.



ASX does not take account of prices for ASX-listed securities traded on alternative licensed markets in calculating the official ASX market closing price.

Users are able to access price information directly from the any other market or through third-party data vendors if necessary.

In a multi-market trading environment users should have in place appropriate arrangements to source equity prices to satisfy their needs. In particular, users need to consider the appropriate approach they should adopt in the event that trading on one (or more) trading platform is disrupted.

For example, in circumstances where there is no CSPA process at all on the ASX market, or where a security does not trade during a CSPA process, users are best placed to consider if the published ASX market closing price (reflecting the last traded price) is the most appropriate and accurate price for their intended use or whether they should consider prices from other sources. A user would need to consider if the prices from other sources satisfy the purpose for which they intend to use that price. It may be that the most 'recent' price is not always the 'best' price for that purpose. For example, they would need to assess if the quality of the price formation process (e.g. liquidity) in an alternative market generates the best price to reflect the prevailing market value of that security.

ASX market closing prices (normal market operation)

Under normal market conditions, ASX calculates market closing prices for cash market equity securities through its daily CSPA process. This is similar to practice in nearly all major global markets, as the mechanism minimises the risk of manipulation of the closing price.

Where there are no trades completed in the daily CSPA, the market closing price reflects the last trade executed on ASX during the continuous trading window or reported to ASX as an NBBO crossing. Where there were no trades in a security that day, the ASX market closing price will be the last traded price recorded on the ASX trading platform.

Closing prices for equity derivative securities are calculated from the published settlement price and an implied volatility level derived from observed market activity. Theoretical pricing uses the globally accepted Cox-Rubinstein binomial option pricing model. Theoretical pricing is required as the last traded price of a derivative may not reflect the most recent changes in the underlying cash market security, implied volatility, expected dividends or interest rates.

ASX market closing prices (disrupted market operation)

In the event that ASX's usual market operations are disrupted and a CSPA process is not completed, the following methodologies are performed to determine the ASX market closing price for all quoted securities.



Product	Methodology
Cash market securities	<p>The closing price is the last valid on-market transaction executed on the ASX trading platform or reported to ASX as a NBBO crossing.</p> <p>In the event that a security has not traded on ASX during the day, the last trading day's closing price is used.</p>
Equity derivatives (ETOs)	<p>The closing price for equity derivative securities is calculated from the ASX market closing price of the underlying security and an implied volatility level calculated from the most recent of the last traded price or midpoint of the bid and offer quotes in the derivative security, observed on the ASX trading platform.</p> <p>Where no market data is available to calculate an implied volatility level, a theoretical value is determined through volatility modelling, using the last traded price of the underlying security and market data observed across all derivatives of the same maturity for that security.</p>

ASX believes the existing ASX market closing price methodologies for both cash equity and equity derivative products (under both normal market conditions and in the event of an outage) remain fit for purpose and should be maintained. These methodologies will be set out on the ASX website. A draft of the explanatory text is in Appendix A.

If a market outage precludes the holding of the daily CSPA, ASX would advise the market as soon as practicable and confirm the process under which the market and settlement closing prices will be determined.

While international comparisons of market practice are difficult given the different market structure that exists in each market, ASX notes that comparable global exchanges in countries such as Canada (TMX), Hong Kong (HKEX) and Singapore (SGX) also use last traded price on the main exchange's trading platform in circumstances where a closing auction does not occur. SGX also explicitly reserves the right to use an alternative formula or procedure to determine their closing prices if deemed necessary.

Approaches in a country such as the US, which operates a consolidated tape for market data, do not provide a suitable benchmark, given that the market there is based on trading activity being spread widely across a large number of trading venues as compared to Australia where it is largely concentrated in a single venue.

Consultation questions

1. Are there any scenarios where you think the ASX market closing price calculation methodologies set out above are not fit for purpose? Provide reasons why the current approach is not appropriate and any alternatives.
2. Is the explanatory text (Appendix A) a clear explanation of ASX's approach to determining the published market closing price? If not, what needs to be clarified?



ASX Clear as a user of market closing prices

The primary purpose of margining participants is to manage clearing house risks. In practice these risks are concentrated in large capitalisation stocks, so the focus of the settlement price policy is on ensuring the best possible pricing of these securities in the most efficient, transparent, and easy to calculate method. This will ensure that, when there is a disruption in the trading platform, clearing participants can be informed of the settlement prices of securities in a timely manner to enable them to meet any margin calls.

The settlement price used by ASX Clear to determine participant margin requirements will typically be the ASX market closing price. This practice has continued following the introduction of multiple platforms trading ASX-quoted securities, as the ASX generated prices are consistently based on a more liquid price determination process and are normally set during the end of day CSPA process.

ASX believes that the current practice of using prices from the ASX trading platform for margining purposes remains fit for purpose, except in very exceptional circumstances (see below). The closing prices for large capitalisation stocks, the focus of this policy, will almost always be set through the CSPA process.

In addition to the operation of the daily CSPA, around 85-90 per cent (on average) of on-market trading occurs through ASX Trade and drives price formation which facilitates trade execution in other venues, including broker crossing engines.

While it is possible that more intra-day trading volume in individual ASX-quoted equity securities could occur on a given day (or days) on another trading venue, it is not a regular occurrence, particularly in the most highly capitalised securities (e.g. those that comprise the S&P/ASX 200 index).

When that price formation is not available because of a disruption on ASX Trade, experience to date has been that there was no significant transfer of trading volume to another platform.

The risk of relatively thin trading combined with the absence of a closing auction, could create an environment for increased volatility or the potential for inappropriate trading to affect the final closing price on other trading venues.

ASX Clear will monitor the Australian market structure to ensure that its settlement price policy reflects any changes in the nature of equity market price formation and the opportunity to source alternative closing price data.

Under a market outage scenario, where a CSPA cannot occur, the settlement price may need to differ from the ASX closing price to ensure ASX Clear holds adequate margin in the event of a participant default or on days of high market activity or volatility. In such circumstances accurate pricing is even more critical as inaccurate or stale pricing may lead to ASX Clear holding insufficient initial margin and not adequately covering its market exposure, increasing the risk of losses to the clearing house.

ASX Clear pricing methodology for calculating margin payments

The table below outlines ASX Clear's approach for the determination of settlement prices used for margining purposes where there is a disruption in the ASX trading platform. These methodologies will be set out on the ASX website. A draft of the explanatory text is set out in Appendix A.



Market outage	ASX approach
Partial closure²	<p>ASX Clear would use the ASX market closing price, in this case the last traded price for the day on ASX Trade prior to the disruption, as the settlement price unless there was evidence that there had been a material market movement between the time of outage and the normal closing time.</p> <p>In the event that the futures market remains open, ASX Clear may use the movement in the Share Price Index (SPI) futures as a proxy for the absolute movement in the universe of S&P/ASX 200 index stocks.</p> <p>If the absolute movement in the most active SPI Futures contract during the period of the outage (from the time of the outage until the normal market closing time) is greater than 1 per cent, ASX Clear will apply an equivalent price shift to all cash equities in the S&P/ASX 200 index. This is in line with the current materiality threshold applied to determine if an ad hoc intraday margin run is required.</p> <p>Other cash equities securities outside of the S&P/ASX 200 universe will retain the last trade price as the settlement price given their lesser correlation to broader market movements and given that these securities do not have a material impact on the overall clearing house risks.</p>
Market closed (ASX)³	<p>If no data is available from any ASX source (including futures) and there is evidence of a material market movement occurring during the period of the ASX outage, alternative sources may be considered in exceptional instances.</p> <p>This may include observed price movements in other licensed markets trading ASX securities where there is sufficient liquidity to provide confidence in the quality of price formation.</p> <p>Where no domestic prices are available, market movements in other global market indices averaging more than 2 per cent will be considered. During the Asian time zone, ASX Clear would monitor price movements in the major regional markets in Tokyo, Hong Kong and Singapore for this purpose. In the case of overnight movements, markets in the US, UK and Europe would be monitored.</p>
Market closed (all)⁴	<p>ASX will determine settlement prices under its current methodologies using last traded price for cash equity securities, and theoretical option pricing based on last measured implied volatilities for equity derivatives.</p>

² An event which causes ASX to cease market operations mid-way through a trading day. This may affect a section of or all securities available for trade.

³ An event which renders ASX unable to open the market for an entire session. Other markets, either domestic or international, are open.

⁴ An event which renders ASX unable to open the market for an entire session. All other markets are also closed.



Consultation questions

3. Are there superior approaches for ASX Clear to determine its settlement price calculations? If yes, please explain your reasons.
4. Is the explanatory text (Appendix A) a clear explanation of ASX Clear's approach to determining the settlement closing price? If not, what needs to be clarified?

Appendix A: Draft text for the ASX website

What the ASX market price represents and how ASX Clear calculates settlement prices

Introduction

There are two closing price measures published and used by ASX:

- The ASX **market** closing price – published daily by ASX to reflect the last traded price executed on the ASX market; and
- The ASX **settlement** price – used by ASX Clear (the clearing house for equity securities) to determine daily margin calls and for derivative contracts (e.g. exchange-traded options) settlement pricing.

For cash equities, in all but a few exceptional circumstances, the market and settlement closing prices will be identical.

However, there may be scenarios where ASX Clear uses settlement prices that diverge from the ASX market closing price to value positions in order to effectively manage clearing house risks. The settlement price for exchange-traded options is derived from the underlying cash equity closing price, i.e. the settlement price for the underlying equity.

This document sets out ASX's determination, publication and use of closing prices. It aims to provide stakeholders with greater transparency and clarity into the process for calculating these closing prices to allow users to consider their own approaches to sourcing pricing information under different scenarios.

Calculation of ASX market closing prices

Closing prices for cash market and equity derivative securities quoted and traded on ASX's trading platform are calculated by ASX at the end of every trading day and represent the most recent valuation for a security on the ASX market. The ASX market is the primary and most liquid trading venue for price formation of Australian listed equity securities.

Under normal market conditions, ASX uses a Closing Single Price Auction (CSPA), to generate a consensus price reflecting the interaction between market supply and demand.

Where there are no trades completed in the daily CSPA, the closing price reflects the last trade executed on ASX during the continuous trading window or reported to ASX as a National Best Bid and Offer (NBBO) crossing. Where there were no trades in a security that day, the closing price will be the last traded price recorded on the ASX trading platform.

Closing prices for equity derivative securities are calculated from the published settlement price and an implied volatility level derived from observed market activity. Theoretical pricing uses the globally accepted Cox-Rubinstein binomial option pricing model. Theoretical pricing is required due to the fact the last traded price of a derivative may not reflect the most recent changes in the underlying cash market security, implied volatility, expected dividends or interest rates.

In the event that ASX's usual market operations are disrupted and a CSPA process is not completed, the following methodologies are performed to determine the ASX market closing price for all quoted securities.



Product	Methodology
Cash market securities	<p>The closing price is the last valid on-market transaction executed on the ASX trading platform or reported to ASX as a NBBO crossing.</p> <p>In the event that a security has not traded on ASX during the day, the last trading day's closing price is used.</p>
Equity derivatives (ETOs)	<p>The closing price for equity derivative securities is calculated from the ASX cash equity closing price of the underlying security and an implied volatility level calculated from the most recent of the last traded price or midpoint of the bid and offer quotes in the derivative security, observed on ASX Trade.</p> <p>Where no market data is available to calculate an implied volatility level, a theoretical value is determined through volatility modelling, using the last traded price of the underlying security and market data observed across all derivatives of the same maturity for that security.</p>

If a market outage precludes the holding of the daily CSPA, ASX would advise the market as soon as practicable and confirm the process under which the market closing prices will be determined.

ASX Clear pricing methodology for setting settlement prices for margin obligations

The settlement price used by ASX Clear to determine participant margin requirements will be the ASX market closing price generated from the ASX trading platform, except in exceptional circumstances.

Where the daily CSPA does not occur because of technical difficulties on the ASX Trade platform, the settlement price may need to differ from the ASX closing price to ensure ASX Clear holds adequate margin in the event of a participant default or on days of high market activity or volatility.

The table below outlines ASX Clear's approach for the determination of settlement prices used for margining purposes where normal trading and the CSPA are disrupted.

Market Outage	ASX approach
Partial closure⁵	<p>ASX Clear would use the ASX market closing price, in this case the last traded price for the day on ASX Trade prior to the disruption, as the settlement price unless there was evidence that there had been a material market movement between the time of outage and the normal closing time.</p> <p>In the event that the futures market remains open, ASX Clear may use the movement in the Share Price Index (SPI) futures as a proxy for the absolute movement in the universe of S&P/ASX 200 index stocks.</p> <p>If the absolute movement in the most active SPI futures contract during the period of the outage (from the time of the outage until the normal market closing time) is greater than 1 per cent, ASX Clear will apply an equivalent price shift to all cash equities in the S&P/ASX 200 index. This is in line with the</p>

⁵ An event which causes ASX to cease market operations mid-way through a trading day. This may affect a section of or all securities available for trade.



Market Outage	ASX approach
	<p>current materiality threshold applied to determine if an ad hoc intraday margin run is required.</p> <p>Other cash equities securities outside of the S&P/ASX 200 universe will retain the last trade price as the settlement price given their lesser correlation to broader market movements and given that these securities do not have a material impact on the overall clearing house risks.</p>
Market closed (ASX)⁶	<p>If no data is available from any ASX source (including futures) and there is evidence of a material market movement occurring during the period of the ASX outage, alternative sources will be considered.</p> <p>This may include observed price movements in other licensed markets trading ASX securities where there is sufficient liquidity to provide confidence in the quality of price formation.</p> <p>Where no domestic prices are available, market movements in other global market indices averaging more than 2 per cent will be considered. During the Asian time zone, ASX Clear would monitor price movements in the major regional markets in Tokyo, Hong Kong and Singapore for this purpose. In the case of overnight movements, markets in the US, UK and Europe would be monitored.</p>
Market closed (all)⁷	<p>ASX will determine settlement prices under its current methodologies using last traded price for cash equity securities, and theoretical option pricing based on last measured implied volatilities for equity derivatives.</p>

⁶ An event which renders ASX unable to open the market for an entire session. Other markets, either domestic or international, are open.

⁷ An event which renders ASX unable to open the market for an entire session. All other markets are closed.

