

## **Information regarding The Bank of Nova Scotia’s (“Scotiabank”) Foreign Exchange Algorithms Strategy Products**

### **Overview**

The Bank of Nova Scotia and its affiliates (“Scotiabank”) through its Global Foreign Exchange (“Global FX”) business, which is part of its wholesale banking division, Global Banking and Markets (“GBM”), offers FX Algorithms (“Algos”) that intelligently work orders with the overall objective of improving execution performance. Scotiabank Algos are designed for the highest quality execution performance and focus on reducing market impact of transactions.

The purpose of this notice is to outline some of the key services provided in Scotiabank’s suite of FX Algos, which are designed to provide access to liquidity, mitigate market impact and optimize performance, by reacting rapidly to market dynamics. Scotiabank’s algorithms can also be customized in line with its Clients’ execution goals. This notice is designed to inform Clients of Scotiabank’s suite of FX Algos and provides an overview of each FX Algo and the associated parameter controls that Clients may customize to meet their execution goals.

This notice is intended to supplement other disclosures, including Scotiabank’s Foreign Exchange Terms of Dealing available at: <https://www.gbm.scotiabank.com/en/legal.html> under Foreign Exchange Terms of Dealing. This notice does not alter or eliminate Scotiabank’s legal or regulatory duty to its Clients. This notice is subject to change, and the latest version of this notice is available at: <https://www.gbm.scotiabank.com/en/legal.html>.

### **Algo Design**

The suite of FX Algos provides a comprehensive range of execution methods including schedule-based and opportunistic. The algos leverage third party proprietary quantitative analysis of market behaviors across many factors including price, volatility, liquidity and other inputs to determine how and when to place orders. Advanced logic, under-pinned by machine learning, enables the FX Algos to anticipate and react to changes in market dynamics.

### **Technological Platform in Use and/or In Development**

The Scotiabank GFX platform leverages algorithms from a third-party technology provider to deliver a full suite of liquidity seeking and benchmark algorithms, with customization available.

### **Internal Algorithm Use**

Internal Scotiabank desks leverage the same platform and algorithm suite as its Clients.

## **Algo Risk**

Client is responsible for making its own independent decision to use FX Algos and is responsible for ensuring the FX Algos it elect to use is appropriate or proper for its needs based upon its own judgement and upon advice from such advisors deemed necessary. Client shall not rely on any communication (written or oral) of FX Algos as investment advice or as a recommendation to use Scotiabank FX Algos. Client understands that information and explanations related to the FX Algos shall not be considered investment advice or a recommendation to use FX Algos. Client further understands that algorithmic trading can be affected by risks inherent in computer-based operations generally, such as authentication protocols and internet connectivity issues, stability of data connections, hardware failures, usage loads and bandwidth limitations, any of which may result in delays or failures in order execution, incorrect order execution or other issues.

## **Customization**

Algorithms and smart order routing are highly customizable at the Client and strategy level – including adding and removing specific venues from our routing table. Scotiabank frequently analyzes venues by measuring fill rates, reversion, participation rates, opportunity costs, and parent-level performance metrics.

## **Accessing Liquidity**

Algo child orders are sent to liquidity sources via a sophisticated Smart Order Router (“SOR”). The SOR accesses liquidity from multiple Electronic Communication Networks (ECNs), direct liquidity partners & correlated futures instruments providing access to sweepable, firm and full amount streams.

Clients have the option to include or exclude certain liquidity sources from their order flow. Leveraging machine learning techniques, the SOR not only assesses price when routing child orders but also historical fill rates and other observable factors. The SOR also contains a dynamic order synchronization algorithm to lower the risk of latency arbitrage when executing across multiple liquidity sources.

## **Confidentiality of Client Information**

Access to client order information is limited to account coverage, personnel handling Client orders, and supervisors, as well as certain other support personnel in the performance of their

responsibilities. Protecting the confidentiality and security of order, execution, position, revenue, and related information is an important part of how Scotiabank conducts business. Scotiabank may use such information for a variety of purposes, including client coverage, supervision, risk management, liquidity provision, and business strategy, and may disclose such information in connection with our regulatory obligations, client instructions, and normal course business functions. To the extent that third party technology is involved in the handling or analysis of an order, information about the underlying client is anonymized. In the event that client trade data is disseminated or published, it will always be done on an aggregated and anonymous basis.

## **Execution and Venue Transparency**

Scotiabank leverages a sophisticated analytics platform to evaluate Algo and smart order router performance. Scotiabank's Execution Service team provides execution quality reporting as well as actionable product recommendations and market structure commentary to its Clients.

Bespoke Transaction Cost Analysis (TCA) reporting capabilities include:

- Detailed analysis of performance by algo and urgency
- Order-level trade review
- Venue-specific analysis.

## **Risk Limits**

Scotiabank enforces a variety of risk checks to safeguard trading, including:

- Single order notional value checks
- Daily aggregate value risk checks
- Price away checks
- Duplicate order checks
- Order type restrictions.

If a risk check is triggered, Scotiabank may either reject or execute it on a delayed basis after further review. Where a Scotiabank trader reviews an order, they may contact the client to request more information about the transaction to verify that the transaction was not erroneous.

Clients with questions regarding their own risk limits should reach out to the relevant coverage person within Scotiabank's Global FX desk for further information.

Please refer to the following page for a full listing of FX Algos offered by Scotiabank.

## Addendum: FX Algorithm Strategies Offered by Scotiabank

Strategy	Algo Objective	Key Setting	What Does it Do?	When Could I Use It	Algorithm Tactics	User Consideration	Key Parameters
<b>POV</b>	Works the order in line with estimated market volume according to the urgency parameter. However, it looks for short term market movements, becoming more urgent if the market moves on side and backs off as the market moves away.	Urgency	<ul style="list-style-type: none"> <li>- Tap looks to attract passive fills while participating with volume.</li> <li>- It accesses liquidity pools to trade within a range of participation rates according to a specified 'urgency'. Tap has the ability to moderate its level of urgency in response to short-term market moves and becoming more urgent when the market is moving in the client's favour.</li> </ul>	<ul style="list-style-type: none"> <li>- To participate with volume but be more intelligent about short term price movements.</li> </ul>	<ul style="list-style-type: none"> <li>- Trades within a participation band for each urgency and by default utilizes mean reversion logic (i.e., trades more as the price becomes more favourable)</li> </ul>	<ul style="list-style-type: none"> <li>- May not complete the order if it does not find enough liquidity</li> </ul>	<ul style="list-style-type: none"> <li>- Urgency</li> <li>- Trigger Price</li> <li>- Momentum</li> <li>- Spread</li> </ul>
<b>STRIKE</b>	Looks to fill orders urgently using All available liquidity	Limit price	<ul style="list-style-type: none"> <li>- STRIKE looks to fill urgently using all available liquidity</li> </ul>	<ul style="list-style-type: none"> <li>- When wanting to be fill orders urgently, using a wide range of liquidity sources</li> </ul>	<ul style="list-style-type: none"> <li>- Checks visible liquidity and calculates the price that could be achieved</li> <li>- Checks the CME futures market to see if further liquidity/better</li> </ul>	<ul style="list-style-type: none"> <li>- Use Hidden and Iceberg order types to control visibility of the order to the market.</li> <li>- A limit price must always be added</li> </ul>	<ul style="list-style-type: none"> <li>- Immediate Or Cancel (IOC) – Sweep then cancel balance.</li> <li>- Iceberg – Posts passively at your price</li> <li>- Hidden – Stays invisible, hitting price</li> </ul>

Strategy	Algo Objective	Key Setting	What Does it Do?	When Could I Use It	Algorithm Tactics	User Consideration	Key Parameters
					price can be achieved there - All orders are placed simultaneously via timed release from co-located servers. - Any currency futures fills are placed onto a risk book and the Cash equivalent sent back to client.		when available - Different order types give you control of visibility.
<b>TWAP</b>	TWAP is benchmarked to a linear execution profile over a user-defined time period.	End time	- Seeks to trade in a linear way between the specified start and end times	- When seeking to trade at an even pace over the specified time. - Suited for currency pairs when unusual trading activity may impact	- Discretion <sup>1</sup> – use to control how closely to follow the TWAP schedule.	- Discretion <sup>1</sup> gives the parameter permission to deviate further from the benchmark in order to pick up passive fills. A low discretion ties the	- Start/End Price - Time Trigger - Discretion1 - Max Spread

Strategy	Algo Objective	Key Setting	What Does it Do?	When Could I Use It	Algorithm Tactics	User Consideration	Key Parameters
				normal VWAP curves.		algorithm tighter to the TWAP curve - TWAPs work well over periods longer than 5 minutes.	
<b>VWAP</b>	Targets liquidity using a currency pair's expected volume pattern during a user's specified time period.	End time	- Seeks to achieve the market VWAP between the specified start and end times.	<ul style="list-style-type: none"> <li>- When seeking to track a pair's volume profile.</li> <li>- When looking to achieve the average price over the period.</li> <li>- When there is no intra-day directional view and/or the goal is to minimize impact.</li> <li>- When trading over longer</li> </ul>	<ul style="list-style-type: none"> <li>- Discretion<sup>1</sup> gives the parameter permission to deviate further from the benchmark in order to pick up passive fills. A low discretion ties the algorithm tighter to the VWAP curve.</li> <li>- Seeks to execute passively through the algorithm's programmed logic.</li> </ul>	<ul style="list-style-type: none"> <li>- VWAPs normally work best over longer periods where changes in volume are normally expected and will be seen in historic data.</li> </ul>	<ul style="list-style-type: none"> <li>- Start/End Time</li> <li>- Trigger Price</li> <li>- Discretion<sup>1</sup></li> <li>- Max Spread</li> </ul>

Strategy	Algo Objective	Key Setting	What Does it Do?	When Could I Use It	Algorithm Tactics	User Consideration	Key Parameters
				periods and when there is good volume in the market.			
<b>FLOAT</b>	Places orders on the bid, mid-point or offer and floats with price movements.  Anti-gaming functionality looks not to flag the movement.	Peg side	- Floats your order on markets at the bid, offer or mid based on your specified offset and your selected Trading Style (passive, mid, aggressive)	- When wishing to work an order passively in the market	- Posts passively. - Protects orders by using contract level parameters to set a period of time before reacting to spread changes.	- User can choose where the algorithm sits in the spread by selecting a Peg Side of Passive, Mid or Aggressive. - Offset posts a specified number of pips above or below the peg choice - Regardless of setting, the algorithm will not cross the spread Offset	- Peg side - Offset - Trigger price - Max Spread

Parameter	Definition
<b>Start Time</b>	When should trading start?
<b>End Time</b>	When does order expire?
<b>Urgency</b>	How quickly do you want to complete?
<b>Trigger Price</b>	Price at which algorithm will commence.
<b>Max Spread</b>	Max Spread, set in pips, instructs the algorithm not to trade if the spread widens beyond this value. It gives protection during unexpected economic events.
<b>Peg Side</b>	Controls whether the float algorithm works relative to the passive or mid.
<b>Offset</b>	The number of pips relative to the Peg Side that the algorithm should post. Negative means more passive. Regardless of setting the algorithm will not post on the far side.
<b>Discretion</b>	Discretion gives the algorithm greater freedom to move away from the benchmark in order to pick up more passive fills.

<sup>1</sup>The term 'discretion' in these materials refers to the programmed judgment of the particular algorithm.

## Smart Order Router

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