A photograph of a two-lane asphalt road with a bright yellow double center line. The road curves slightly to the right and disappears into a distance. To the left, there's a field with sparse vegetation and a few small trees. To the right, a dense forest of tall evergreen trees stands on a slight incline. The sky is filled with heavy, dark, textured clouds, suggesting an overcast day or approaching storm. The overall lighting is somewhat dim, emphasizing the earthy tones of the road and the surrounding environment.

LukkaPrime 1.9

Lukka Prime Price

- Lukka Prime will be the price of the *last transaction* on a *dynamically designated principal exchange*.
- Principal exchange is designated by a publicly known *algorithm* abiding to GAAP and IFRS requirements using publicly available data.
 - Algorithm scores exchanges based on fixed and dynamic factors.
 - Scoring is responsive to information on three separate time scales.

Principal Recipe

Step 1: Assign each exchange for each pair of currencies a ***Base Exchange Score (BES)*** reflecting static exchange characteristics such as oversight, microstructure and technology

Step 2: Adjust the BES based on the relative monthly volume each exchange services. This new score is the ***Volume Adjusted Score (VAS)***

Step 3: Decay the adjusted score based on the time passed since last trade on exchange. Here, we are assessing the level of activity in the market by considering the frequency of trades. The decay factor reflects the time since the last trade on the exchange. This is the final ***Decayed Volume Adjusted Score (DVAS)***

Step 4: Rank the exchanges by the DVAS score and designate the highest-ranking exchange as the ***Principal Market*** for that point in time.

Step 5: Designate the price of the last transaction on the principal market as the Lukka spot price at that point of time.

Step 1: Base Exchange Score (BES)

- 1. Exchange Oversight**
- 2. Microstructure Efficiency of the Exchange**
- 3. Data Transparency**
- 4. Data Integrity**

Exchange Oversight

This score reflects the rules in place to protect and to give access to the investor. The score assigned for exchange oversight will depend on parameters such as jurisdiction, regulation, “Know Your Customer and Anti-Money Laundering Compliance” (KYC/AML), etc.

Level	Jurisdiction	Oversight Score [s^{ov}]
1	US, EU, Japan, Switzerland, Australia, New Zealand, Singapore	100
2	UK, Israel, South Korea, Hong Kong	80
3	Latam, China, India, Russia, Eastern Europe	60
4	South Africa, South East Asia	40
5	Africa, Middle East	20

The hierarchy is based of the S&P Sovereign Foreign-Currency Ratings, S&P Institutional and Economic assessment and whether the local currency is restricted.

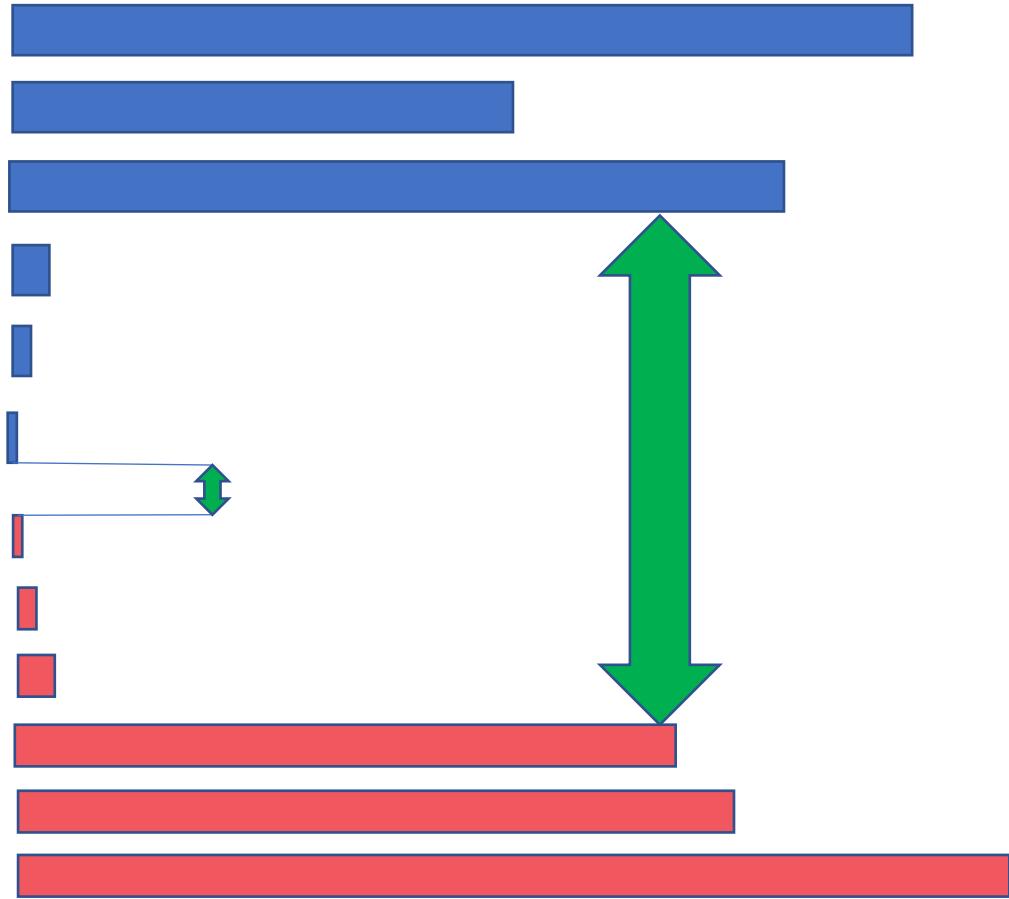
Microstructure Efficiency

The second exchange characteristic is microstructure efficiency. Based on prior research, (Roll, 1984), we take the effective bid ask spread as a proxy for efficiency. For each exchange and currency pair we take an estimate of the “**effective spread**” relative to the price in “pips”. The score for exchange $i = 0, \dots, n$ is computed as:

$$s_i^{eff} = 100 * \frac{sp_i - \min_j(sp_j)}{\max_j(sp_j) - \min_j(sp_j)}$$

Where sp_0, sp_1, \dots, sp_n are the spreads of the relevant exchanges measured as pips (1/10,000) of the asset price.

Effective Spread



- Ideally would be estimated using TaQ data for reconstructing the order book
- Could be estimated using model (Roll)
 - Might have implication on the accounting standing as far as level of data applies
 - Would likely require some state based volatility model

Data Transparency

Transparency is the term used for a quality score that is determined by the level of detail of the data offered by an exchange and is based on the hierarchy provided in following table

Level	Data Detail	Score [s^{tran}]
1	Orders	100
2	Order Book / TAQ	80
3	Trades	60
4	Candles	40
5	None	20

Data Integrity

Integrity is evaluated on three-time scales, on tick level, short term (minutes) and daily, with the following scores

s_{ord} - order reconstruction

s_{minute} - minute volume matching

s_{day} - daily volume matching

A weighted average of these scores will give the data integrity score. The weights are based on the relative importance of each factor at a point in time as assessed by the entity.

$$S^{int} = \omega_{ord} \cdot s_{ord} + \omega_{minute} \cdot s_{minute} + \omega_{day} \cdot s_{day}$$

Order Reconstruction

Exchanges with Level 1 transparency will provide for each transaction a corresponding “Order ID” with size information on the order. An order for which we can identify all transactions that were completed as part of the order (including cancellation) is considered a “reconstructed order”. Let the volume weighted fraction of reconstructed orders be $p_{ord} > 0$ then the corresponding score is:

$$s_{ord} = 100 * (1 - e^{-\nu \cdot p_{ord}}) \text{ for } \nu > 0.$$

Minute/Daily Order Matching

Level 3 transparency will provide tick by tick data for trades, level 4 transparency will provide candle data.

Let $p_{min} > 0$ be the fraction of the volume on the time bar accounted by individual trades, then the corresponding score is

$$s_{minute} = 100 * (1 - e^{-\nu \cdot p_{min}}) \text{ for } \nu > 0$$

Let $p_{day} > 0$ be the fraction of the daily volume accounted by individual trades, then the corresponding score is

$$s_{day} = 100 * (1 - e^{-\nu \cdot p_{min}}) \text{ for } \nu > 0$$

Adding it all up - Base Exchange Score (BES)

The base exchange scores (BES) for exchange ex_1, \dots, ex_n is computed as follows:

$$S_{ex_i}^{BES} = \omega_{ov} \cdot S_{ex_i}^{ov} + \omega_{eff} \cdot S_{ex_i}^{eff} + \omega_{tran} \cdot S_{ex_i}^{tran} + \omega_{int} \cdot S_{ex_i}^{int}$$

The weights are based on the relative importance of each factor and their direct impact on the overall quality of the exchange based on managements' assessment.

For example, it is likely that oversight and efficiency would typically have more weight than transparency and data integrity

Step 2: Volume Adjusted Score (VAS)

For computing the volume adjusted scores (VAS) let vol_0, \dots, vol_n be the monthly volumes of these exchanges, the volume adjusted score is then:

$$s_{ex_i}^{VAS} = \frac{vol_{ex_i}}{\sum_j vol_{ex_j}} \cdot s_{ex_i}^{BES}$$

Data Sources

1. Oversight:

- Exchange webpages
- Direct engagement
- Public Data (credit ranking etc.)

2. Efficiency

- TaQ data book positions
- Model based estimation using DevEx trade data

3. Transparency

- Exchange API or support material

4. Integrity

- Upgraded DevEx data (collecting additional fields for same trade data)
- Directly collecting data from exchanges

5. Volume Adjustment

- DevEx data

Next Research Steps

1. Benchmark

- Fix / VWAP for book closing

2. Mark to Model:

- Illiquid assets

3. Exchange Analysis

- Bogus volume reporting
- Data quality

4. Futures and Derivatives