Managing Cost of Living and Inflation Expectations: A Basket Case or a Case of Baskets

Dr. Aurobindo Ghosh*
Asst Prof of Finance Education
Lee Kong Chian School of Business
SINGAPORE MANAGEMENT UNIVERSITY

* Based on several joint works including Prof Jun Yu, Alex Clark and Sam Hanes from BIT, Khyati Chauhan, IMF-STI

Primer on Inflation Expectations

"…It does not ask, "What will tomorrow look like?" It asks instead, "What do we have to tackle today to make tomorrow?"
Peter Drucker, The Age of Discontinuity: Guidelines to Our Changing Society,1969

- **Inflation expectations form a key influence** that affect the behavior of households, businesses and consequently the decision of the policymakers in designing economic policies to "nudge" behavior of investment and consumption.
- The major hurdle in **controlling inflation is its measurement and expectations**. It is now widely accepted by both academic and practice professionals that survey-based measures play an important role in such policy analysis among others.
- However, the **major shortcomings of survey-based measures are personal perceptions** can get swayed due to different factors.
- We want to identify such factors to evaluate how to better understand **how consumers and businesses make decisions** vis-à-vis their expectations of inflation, to help influence policy.

DBS-SKBI SInDEx: Why do policymakers need a Measure for Inflation Expectations of Consumers?

- **DBS-SKBI Singapore Index of Inflation Expectations (SInDEx)** started in 2011 in collaboration with SMU-SKBI and other private partners, subsequently funded by MOE Tier 1 Grant under Assistant Professor Aurobindo Ghosh at LKCSB, SMU before SKBI and DBS co-funded since 2019
- The **ONLY index of its kind** in Singapore and in its 12th year. SMU research team partnered with researchers in **MAS and Behavioral Insights Team (BIT)** to update the questionnaire to address any improvements that can be made.
- **Effective and well "anchored" monetary policy depends on future expected inflation** based on model and survey-based measures. However, **effective communication** is quite challenging (Bernanke, 2007)

Results from the 48th wave of the DBS-SKBI SInDEx Survey: One-Year-Ahead Expectations

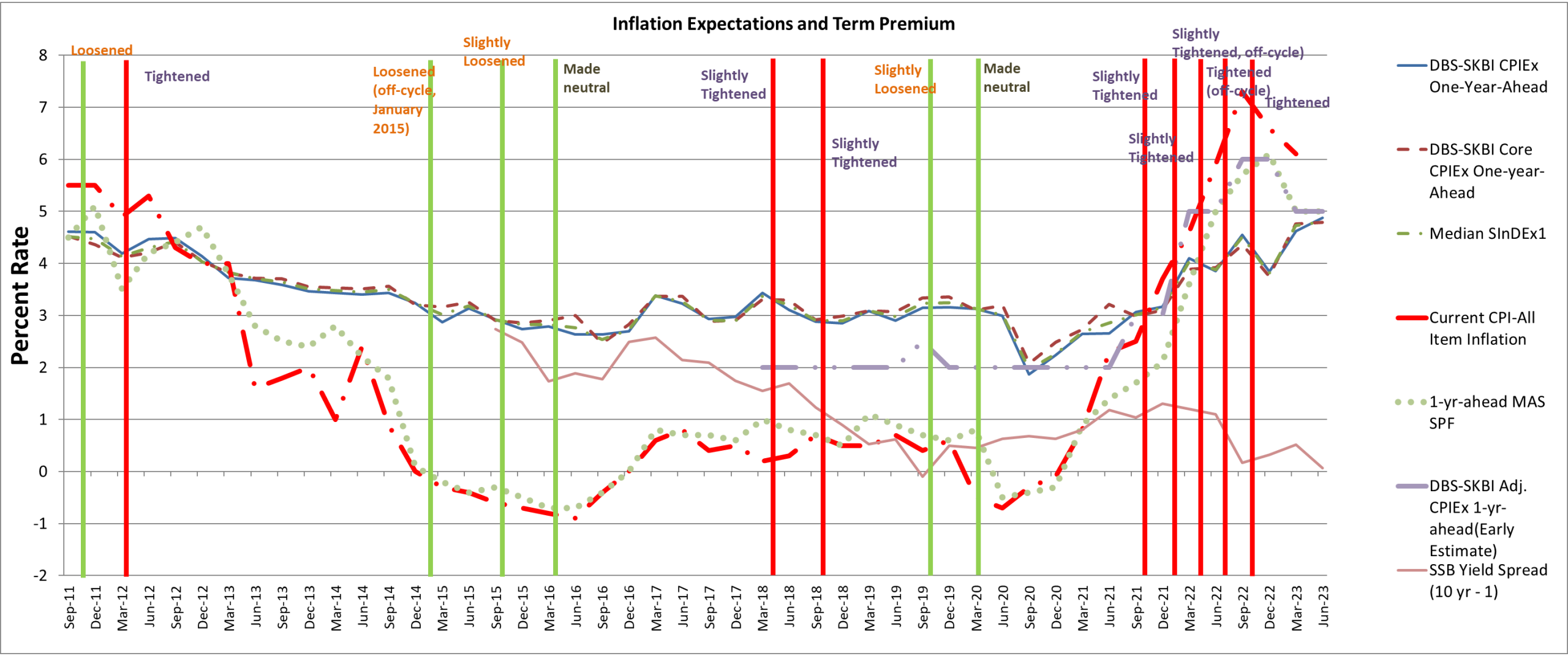
CPIEx	June 2023	March 2023
CPIEx	4.9	4.6
CPIEx Core	4.8	4.8
SInDEx1	4.8	4.7
Subgroup Core	4.9	4.7

- **In Jun 2023, CPIEx Inflation Expectations (Headline) inched up to 4.9%** from 4.6% in Mar 2023
- This is **lower than longer term average of 3.3%** (2012-2012)
- **CPIEx Core Inflation Expectations** (w/o accommodation and private road transport) **was 4.8% in Jun 2023** (flat compared to 4.8% in Mar 2023)
- As a comparison **subgroup who owns accommodation and use public transport**, effectively face core inflation, **polled 4.9 in Jun 2023 (from 4.7 in Mar 2023)**. **SInDEx1**, a composite index, also inched up to **4.8 from 4.6 in Mar 2023**

Results from the 48th wave of the DBS-SKBI SInDEx Survey: Five-Year-Ahead Expectations

CPIEx	Jun 2023	Mar 2023
CPIEx5	5.3	5.2
CPIEx5 Core	5.3	5.1
SInDEx5	5.3	5.2

- In Jun 2023, **Five-year-ahead CPIEx5 Inflation Expectations (Headline) inched up to 5.3%** from 5.2% in Mar 2023
- This is **lower than longer term average of 4.1%** (2012-2022)
- **CPIEx5 Core Inflation Expectations** (w/o accommodation and private road transport) **was 5.3% in Jun 2023** (compared to 5.1% in Mar 2023)
- As a comparison benchmark, a **composite index with lower weights for more volatile components SInDEx5 polled 5.3 in Jun 2023** (from 5.2 in Mar 2023), slowdown in growth



Source: SKBI SInDEx, authors' calculations, Monetary Authority of Singapore, Department of Statistics

DBS-SKBI SInDEx: What are the drivers of bias?*

- Median One-Year-Ahead Inflation Expectations is **higher for individuals who are married, citizens, high real estate expectations, high current inflation, feels higher uncertainty, higher future investment in equity**, while **lower** for those who are **older, unemployed, longer stay, makes decisions, follow media and expect increment**.
- Additionally, the bias measured by difference of median expectation between individuals and experts (SPF) is affected by **age (-), marriage (+), citizen (+), length of stay (-), decision maker (-), expect increment (-), high real estate (+), current inflation (-), uncertainty (+), future investment (+) and unemployment (-).**

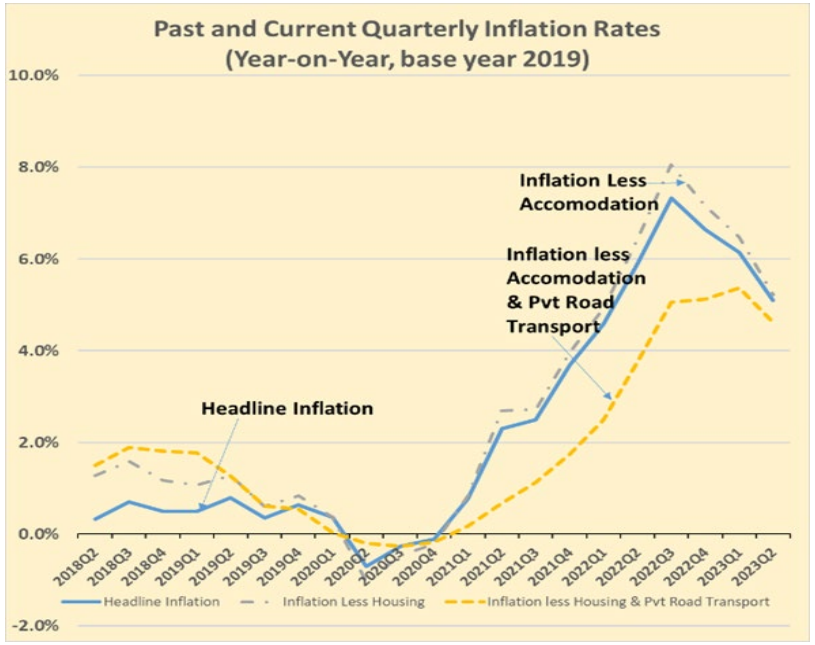
*Ghosh and Yu (2012, 2013)

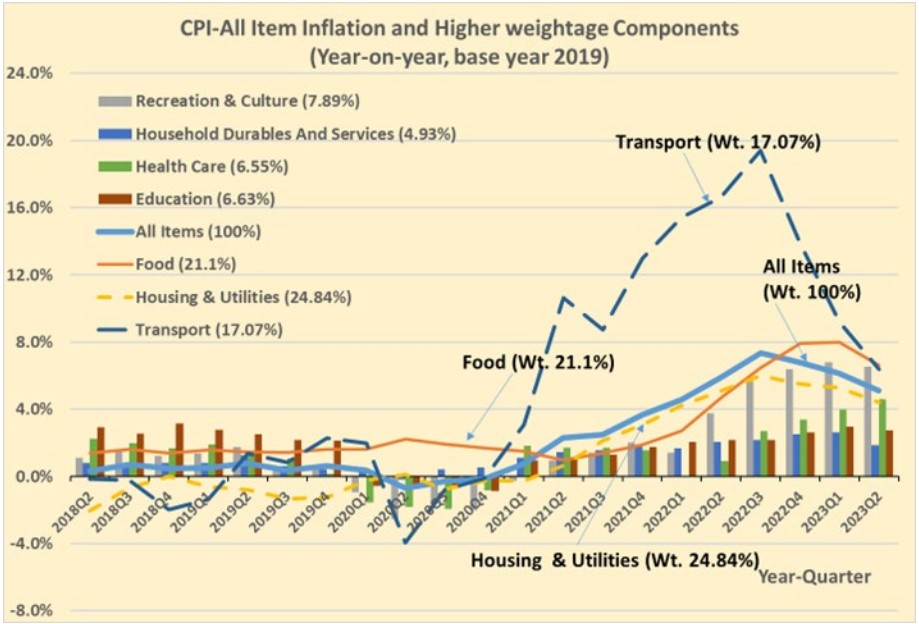
Sample Questions for Reducing Behavioral Bias:*

The charts[CS1] below shows quarterly data on inflation and GDP growth rates of the Singapore economy since 2012[CGS(2)]

Please review the charts in Figures 1-3 and together with any other information that you might know or heard, give us your best guess for the following annualized rates for Quarter 3 2024 (one-year-ahead average Jul-Sep 2024) and for Quarter 3 2028 (five-year-ahead average Jul-Sep 2028) in the space provided, in percentage terms.

a) 1-year-ahead Headline CPI All Item Rate [_____]%
b) 1-year-ahead Inflation less Housing and Pvt Road Transport [_____]%
c) 1-year-ahead ahead Food Inflation [_____]%



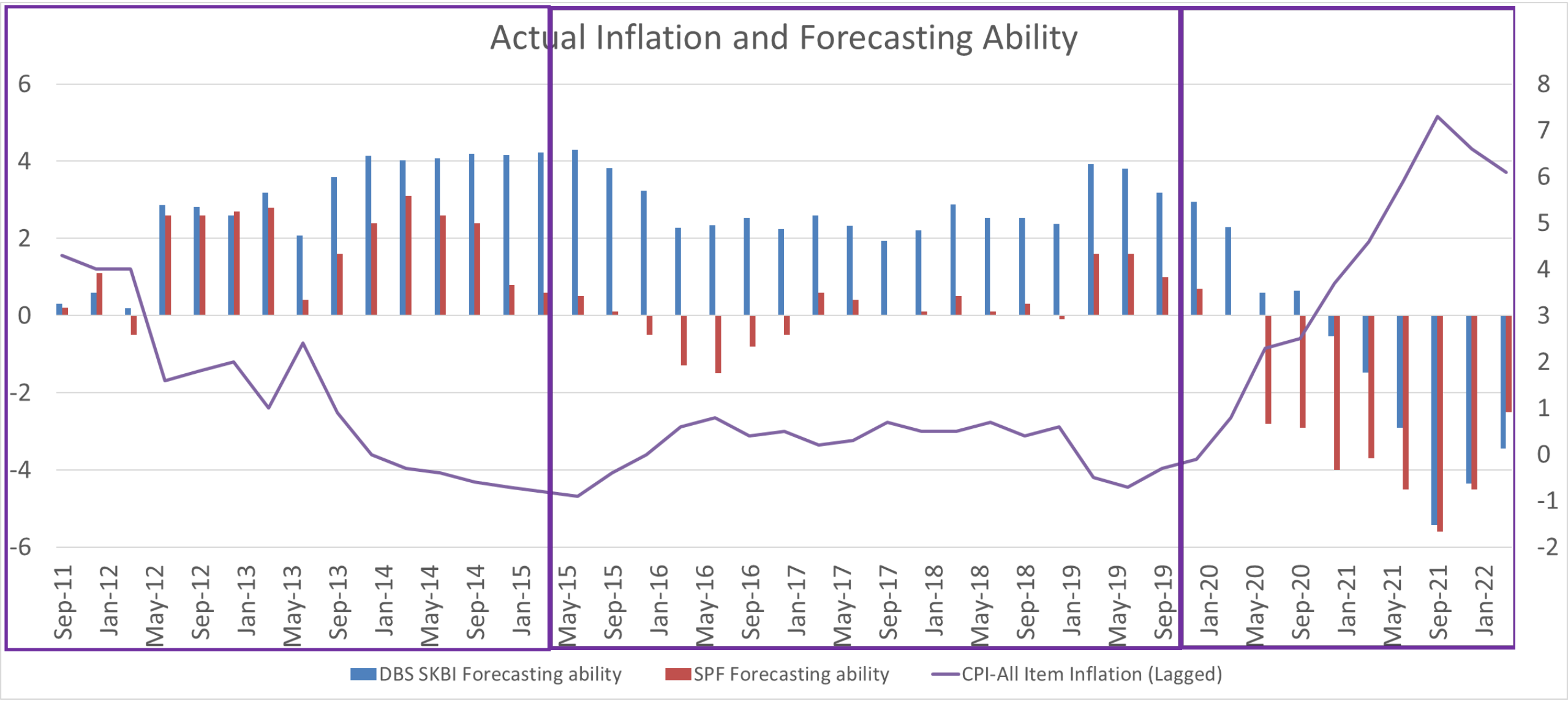


*Clark, Ghosh and Hanes (2018)

Inflation Component	Raw Median	Weights (%)
Food	7.00	21.1
Transport	6.00	17.1
Housing/Utils	6.00	24.8
Healthcare	5.00	6.6
Education	5.00	6.6
Recreation	5.00	7.9
Clothing & footwear	5.00	2.1
Household durables/services	5.00	4.9
Communications	5.00	4.1
Miscellaneous	5.00	4.8
Adj. CPIEx1	5.00	100
Wtd. Adj. CPIEx1	**5.84**	**100**
Adj. Core CPIEx	5.00	100
Wtd. Adj. Core CPIEx	**5.76**	100

Behaviorally Adjusted CPIEx and Components

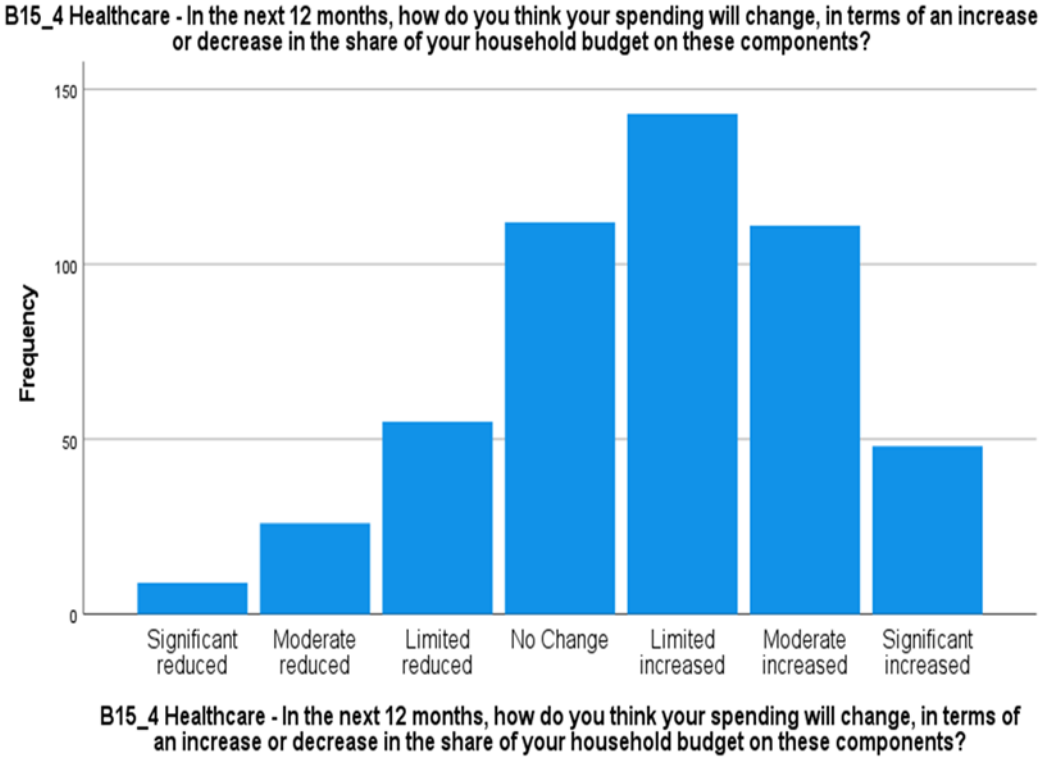
- When we **adjust for behavioural biases**, we see **an uptick in inflation expectations** (using the 5th decile to represent median).
- Overall, **June 2023 estimates** gives **Adj. CPIEx at 5.0**, **unchanged Mar 2023**. Adj. CPIEx Core at 5.0, also unchanged from Mar 2023. It seems **policy action has impacted inflation expectations** when measured in aggregate using behavioral methods.
- When aggregated for components, **Wtd. Adj. CPIEx elevates to 5.8% which is slightly higher than 5.2% in Mar 2023**, whereas the **Wtd. Adj. Core to 5.8% slightly higher** from **5.3%** in Mar 2023.
- This **divergence potentially signals how respondents might not be thinking rationally** when asked about components expectations.



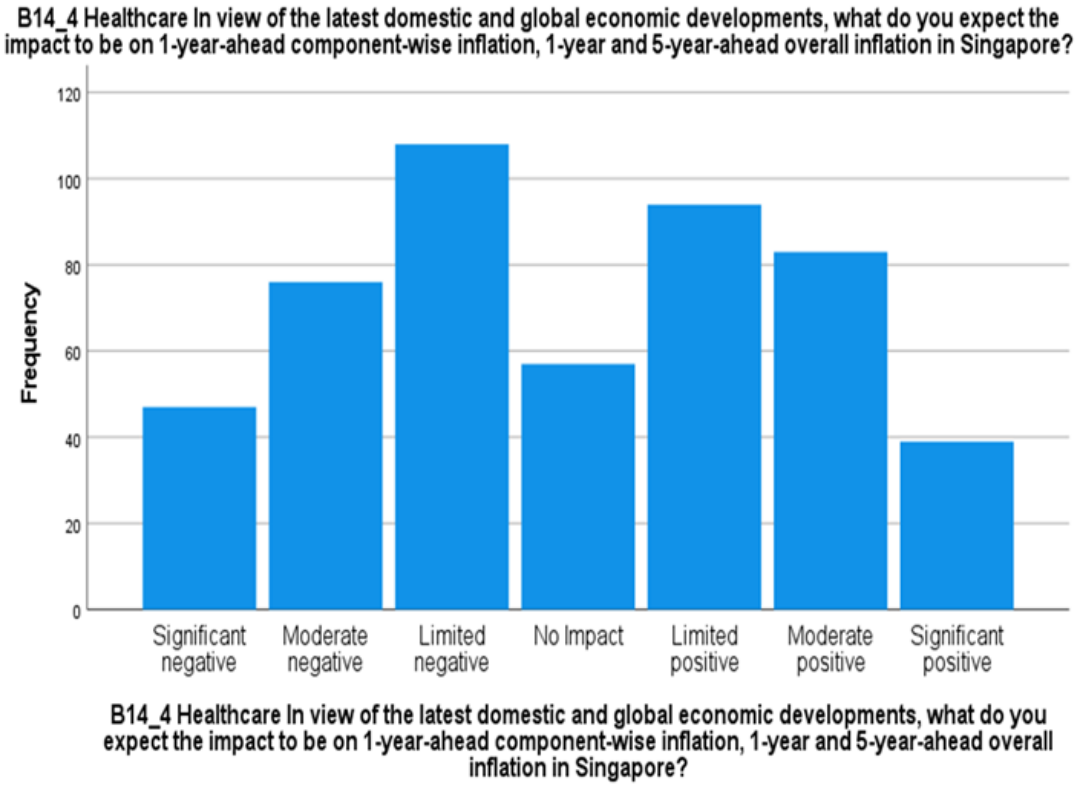
Source: SKBI, Department of Statistics

Perceived impact of Covid19 on Healthcare Inflation

We find that there has been some downward impact on healthcare inflation, on the right panel though there is some divergence. We also **find some increase in healthcare in consumption basket** which could an impact of multiple factors including service inflation (Cavallo, 2020).



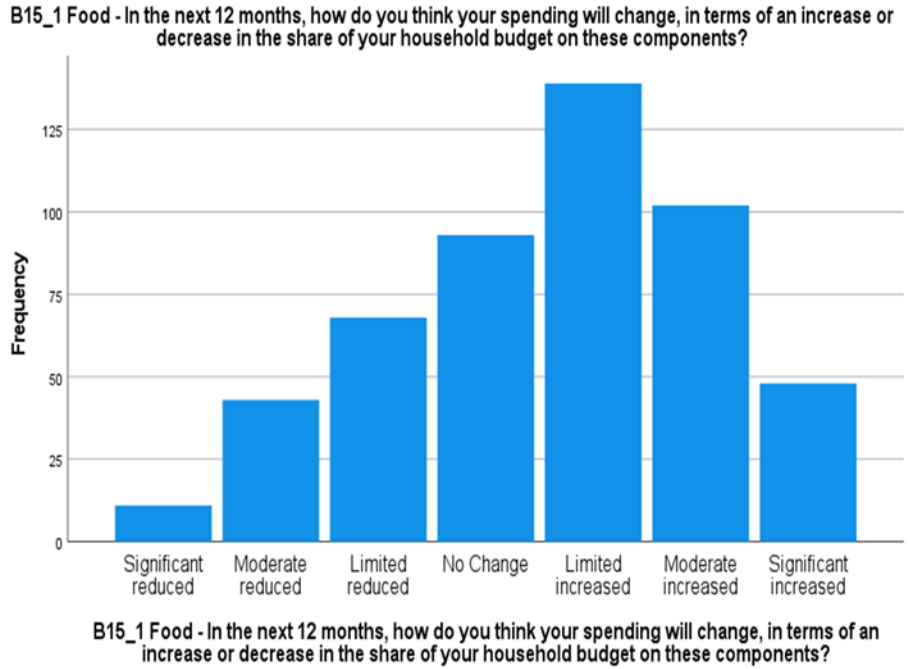
Source: SInDEx, SKBI



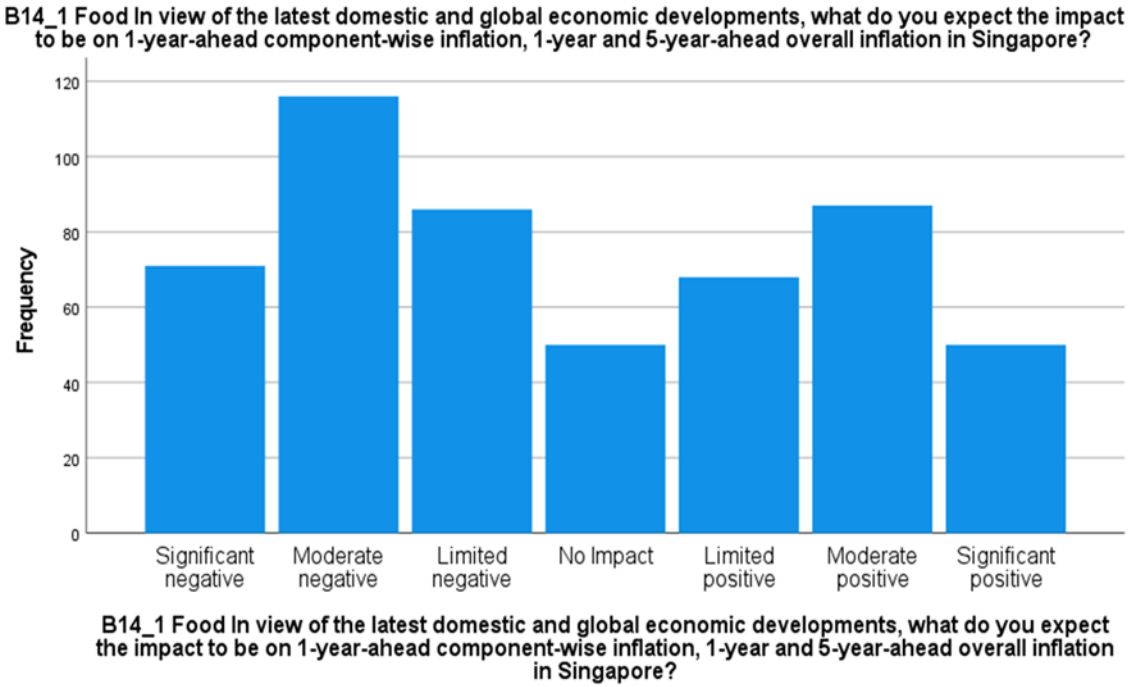
Source: SInDEx, SKBI

Impact on Food inflation and consumption basket

We find that there has been a divergent impact on food prices, even though **average seem to have limited negative impact (right)**. We also **find limited increase in food in consumption basket** possibly due to Covid19 or conflict supply dislocations, as well as **transport, housing & utilities, while others like recreation and culture, footwear and clothing baskets etc. have no impact** (Cavallo, 2020).



Source: SInDEx, SKBI



Source: SInDEx, SKBI

CONSUMER PRICE INDEX (CPI):*

The Laspeyre's index (Laspeyre, 1871) is given by

$$CPI_L = \frac{\sum_{i=1}^{n} p_{1i} q_{0i}}{\sum_{j=1}^{n} p_{0j} q_{0j}} = \sum_{i=1}^{n} \frac{p_{1i}}{p_{0i}} \left[\frac{p_{0i} q_{0i}}{\sum_{j=1}^{n} p_{0j} q_{0j}} \right] = \sum_{i=1}^{n} \frac{p_{1i}}{p_{0i}} s_{0i},$$

where for the i^{th} commodity or service the prices $p_{ki,}$ and the quantities q_{ki} are for the current (period k=1) and base periods (k=0).

$s_{0i} = p_{0i} q_{0i} / \sum_{j=1}^{n} p_{0j} q_{0j}$ is the expenditure weight of the i^{th} item in price and quantity at period 0, the reference period.

Diewert (1987, p. 6231) also claims that both the Laspeyre's and the Paasche indices (Paasche, 1874) can "…approximate the *superlative* indexes to the first order at an equal price and quantity point…"

- Laspeyre's index over estimates the true CPI
- Paasche's index under estimates the true CPI
- Fisher's "ideal index" (geometric mean of Laspeyre's and Paasche's index) was proposed and was proved to be a superlative and exact index (Diewart, 1976, 1987)

Assumptions as a Cost of Living index:

- **Quantities remained unchanged** even when the prices change
- This **violated the law of demand** (*ceteris paribus*) ***unless* the demand was goods is inelastic** (which is true for some components overall but not all)
- In the context of CPI constructed in Singapore (DOS, 2019), **this assumption of inelastic demand is not sustainable** for over 600 items, 6800 brands of items or for 140 items in Economic Intelligence Unit (EIU WCOL)

*based on ongoing work with Khyati Chauhan

True Index of Cost-of-Living

- **True index of cost of living** can be obtained by **dividing the cost of living at one period by the cost of living in the other period, provided the standard of living** (or the general status of want-satisfaction or utility) remains the same for the family (Konus, 1939)

- This index shows the **relative change occurring in the monetary cost of those consumers' goods** which are necessary for the maintenance of a **certain standard of living** (Konus, 1939)

- A simplifying assumption: The cost-of-living index is **more of an *economic* interpretation rather than a statistical one**
- Main assumption is that the **consumption of goods and services reacts continuously due to changes in prices and the pattern of change in quantity consumed is stable** (ergodic) and changing geometrically over time between two surveys of household expenditures
- Under the simplifying assumption, **relative cost of living is the ratio if the expenditures** on two baskets that give **similar levels of satisfaction**
- Hence, we propose **a more encompassing and dynamic measure of inflation as a cost of living** where we address the **changing consumption patterns over time in response to changes in price** (Aoki and Kitahara 2010 and Sutoris, 2020)

Framing Cost of Living as a weighted index:

$$CLI_L = \frac{\sum_{i=1}^{n} p_{1i}q_{1i}}{\sum_{j=1}^{n} p_{0j}q_{0j}} = \sum_{i=1}^{n} \frac{p_{1i}}{p_{0i}} \left[\frac{p_{0i}q_{0i}\, q_{1i}/q_{0i}}{\sum_{j=1}^{n} p_{0j}q_{0j}} \right] = \sum_{i=1}^{n} \frac{p_{1i}}{p_{0i}} \left[\frac{p_{0i}q_{0i}k_{01i}}{\sum_{j=1}^{n} p_{0j}q_{0j}} \right],$$

where k_{01i} is the ratio of the quantity consumed in the current period and the base period.

- As attractive as it may seem to look at the formula, it is **nearly impossible to calculate *unless* we have the exact composition of the basket *every year,*** in particular the quantities of goods and services consumed

However, to make it operational, **we will replace the k_{01i} with an approximation with the assumption that quantities of good consumed changes geometrically** over the duration between two periods of the household economic survey in 2014 and 2019 (HES 2017/2018)

$$CLI_L = \frac{\sum_{i=1}^{n} p_{1i}q_{1i}}{\sum_{j=1}^{n} p_{0j}q_{0j}} = \sum_{i=1}^{n} \frac{p_{1i}}{p_{0i}} \left[\frac{p_{0i}q_{0i}\, q_{1i}/q_{0i}}{\sum_{j=1}^{n} p_{0j}q_{0j}} \right] = \sum_{i=1}^{n} \frac{p_{1i}}{p_{0i}} \left[\frac{p_{0i}q_{0i}\hat{k}_{01i}^{m}}{\sum_{j=1}^{n} p_{0j}q_{0j}} \right],$$

where $\hat{k}_{01i} = \left(q_{1i}/q_{0i} \right)^{0.2}$ and $m = 1,2,3,4,5$ is the number of years after the base year.

How does the CLI_L relate to the CPI_L?

$\hat{k}_{01i}$ is fixed for all commodities or services, then the average value $\hat{k}_{01i}$, say $\hat{k}_{01}$, or more precisely

$\hat{k}^m_{01i}$, m=1,2,3,4,5 depending on number of years

after the base year can be used as a rate multiplier of the CPI to get the CLI, this would be the average ratio of the quantity indices for period 0 and 1. In that case, we have the following relationship

$$CLI_L = \frac{\sum_{i=1}^{n} p_{1i}q_{1i}}{\sum_{j=1}^{n} p_{0j}q_{0j}} = \sum_{i=1}^{n} \frac{p_{1i}}{p_{0i}} \left[\frac{p_{0i}q_{0i}\hat{k}^m_{01i}}{\sum_{j=1}^{n} p_{0j}q_{0j}} \right]$$

$$= \sum_{i=1}^{n} \frac{p_{1i}}{p_{0i}} \left[\frac{p_{0i}q_{0i}\hat{k}^m_{01}}{\sum_{j=1}^{n} p_{0j}q_{0j}} \right] = \hat{k}^m_{01} \sum_{i=1}^{n} \frac{p_{1i}}{p_{0i}} \left[\frac{p_{0i}q_{0i}}{\sum_{j=1}^{n} p_{0j}q_{0j}} \right]$$

$$= \hat{k}^m_{01} CPI_L,$$

where $\hat{k}^m_{01i} = \left(q_{1i} / q_{0i} \right)^{0.2m} = \hat{k}^m_{01}$

and $m = 1, 2, 3, 4, 5$ is the number of years after the base year.

How to accommodate changing overall Cost of Living Index (COLI) and changing baskets?

$$1+I_{CLI_t}=\frac{CLI_t}{CLI_b}=\left(\frac{CLI_t}{CPI_t}\right)\left(\frac{CPI_t}{CPI_b}\right)\left(\frac{CPI_b}{CLI_b}\right)$$

$$=\frac{\left(\frac{CLI_t}{CPI_t}\right)\left(\frac{CPI_t}{CPI_b}\right)}{\left(\frac{CPI_b}{CLI_b}\right)}$$

$$=\frac{\left(1+I_{Aspirational_t}\right)\left(1+I_{\mathrm{CPI}_t}\right)}{\left(1+I_{Aspirational_b}\right)}, \text{ where}$$

$$I_{CLI_t}=\frac{CLI_t-CLI_b}{CLI_b},$$

$$I_{Aspirational_t}=\frac{CLI_t-CPI_b}{CPI_b}$$

$$\text{and } I_{\mathrm{CPI_t}}=\frac{CPI_t-CPI_b}{CPI_b}$$

$$1+I_{CLI_t}=\frac{\left(1+I_{Aspirational_t}\right)\left(1+I_{\mathrm{CPI}_t}\right)}{\left(1+I_{Aspirational_b}\right)}$$

$$\Rightarrow \ln(1+I_{CLI_t})=\ln\left(1+I_{Aspirational_t}\right)$$

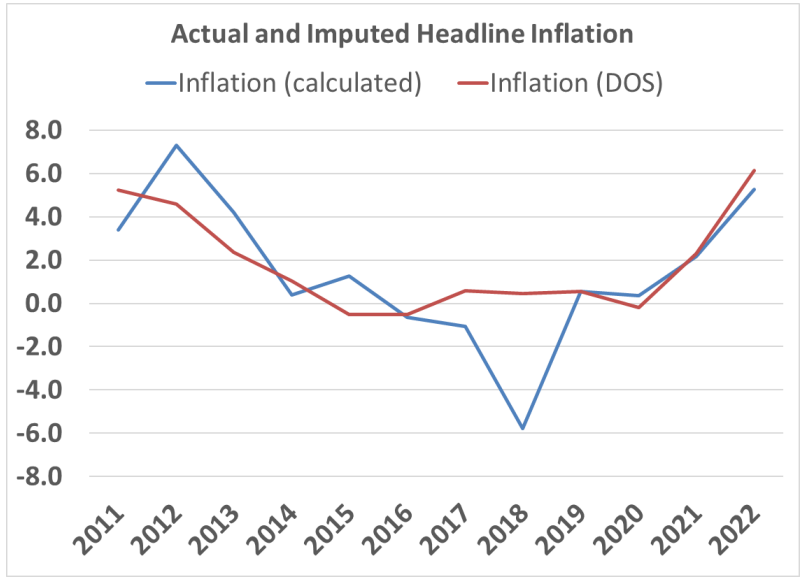
$$+\ln\left(1+I_{\mathrm{CPI}_t}\right)-\ln\left(1+I_{Aspirational_b}\right)$$

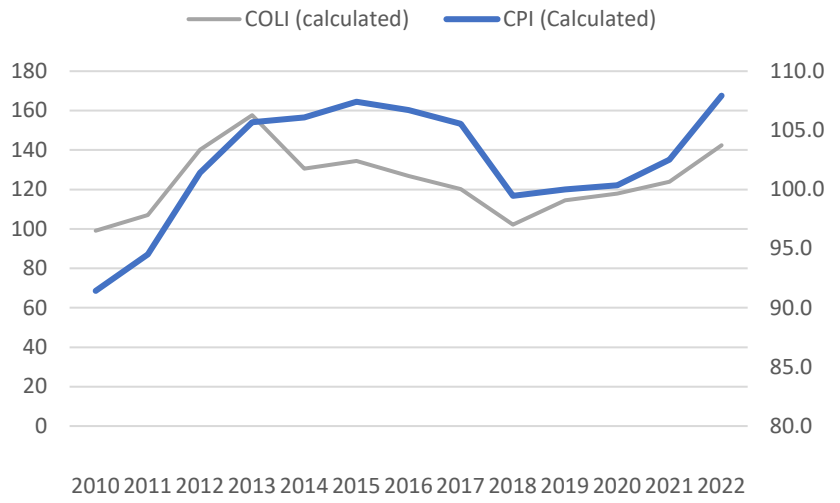
$$\Rightarrow I_{CLI_t}=I_{Aspirational_t}+I_{\mathrm{CPI}_t}$$

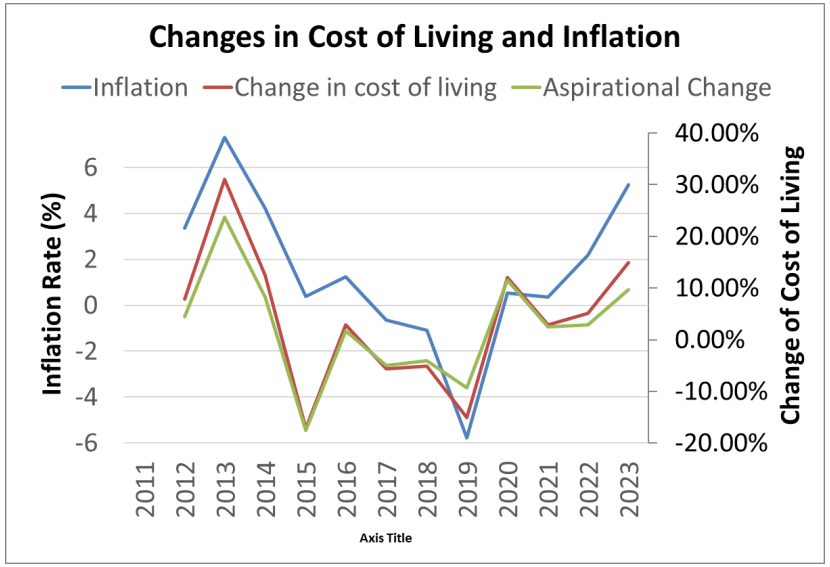
We have thus shown how Cost of Living Inflation (CLI_L) or what we measure can be decomposed into an Inflation related to aspirational expenses and one related to CPI or inflation with a fixed basket of goods and services or fixed standard of living compared to base period b=2019.

Estimates of the CPI-All Item and the Cost-of-Living Index

- Price data available through the Economic Intelligence Unit (EIU) City database that includes the prices from 2010 onwards
- Two sets of price data are available: supermarket and mid-priced store: we conclude from the results that the mid-priced store prices reflect market more accurately
- Weights are calculated using 2017/18 HES for CPI and CLI calculation
- As we do not have the most current value of k_{01i} we will be using the proxy which is the ratio of the commodities between subsequent Household Economic Surveys (HES, 2017/18 and 2012/13)



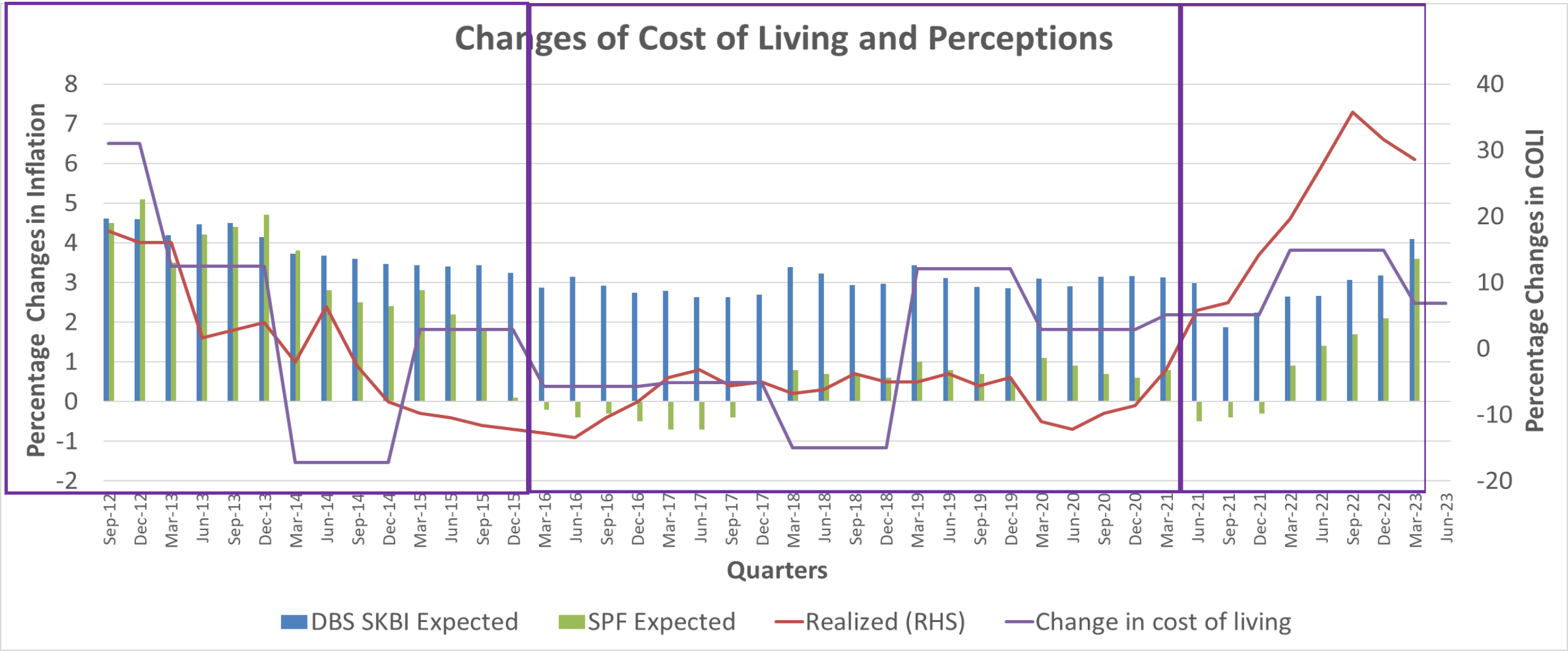




Source: Department of Statistics, SInDex, SKBI, authors' calculations

Cost of Living and Inflation

- While Inflation measures like the consumer price index were constructed as measures of cost of living, it has diverged mainly because the former is calculated based on a fixed basket while cost of living is calculated often on a changing basket due to endogenous choices (IMF, 2020)
- We evaluate how overall cost of living can be decomposed into the aspirational cost of increased standard of living and one with a fixed basket or standard of living
- This together with a continuous change of basket helps us evaluate even when inflation is low, an increased aspiration can cause overall cost of living to go up.



Source: MAS Survey of Professional Forecasters, SKBI, authors' calculations

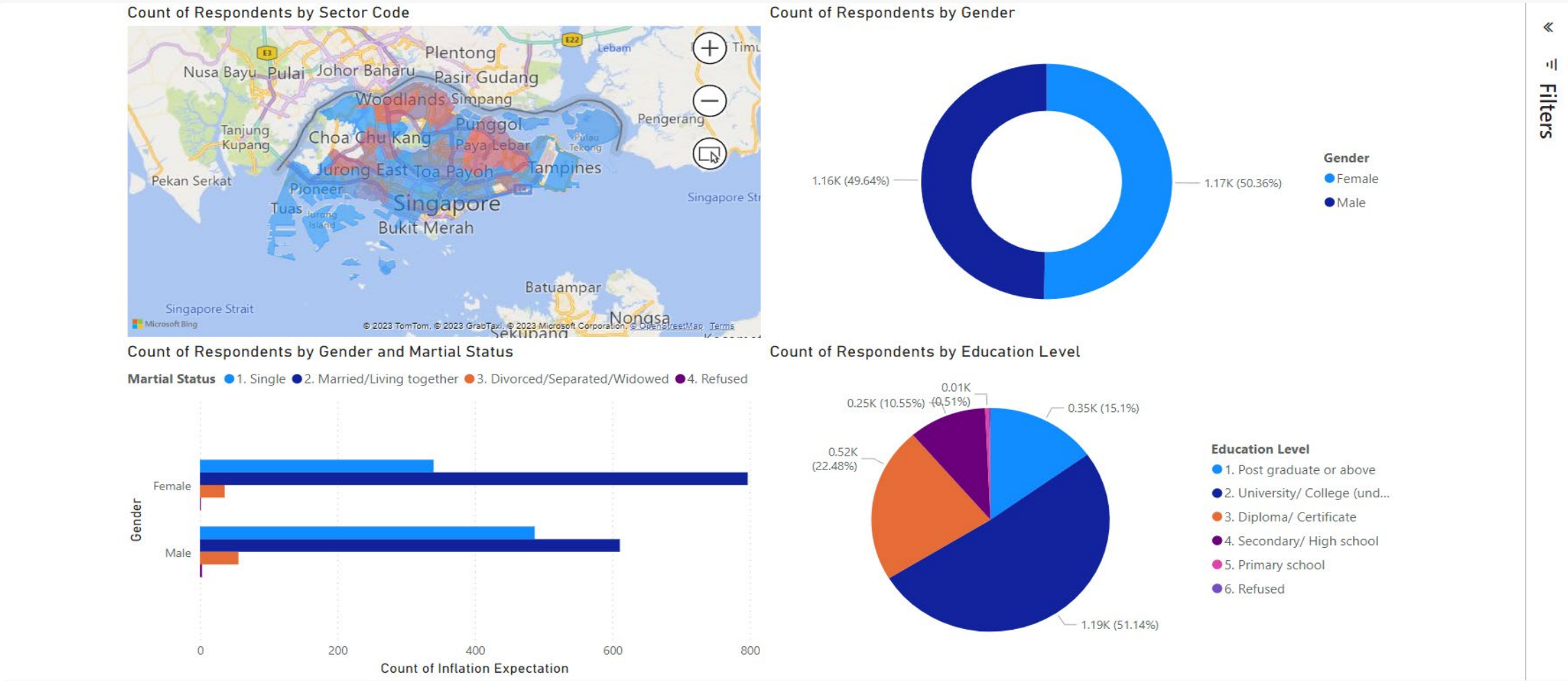
Inflation Expectations and Stationarity

- We find that **MAS Survey of Professional Forecasters Granger Causes SInDEx one-year-ahead inflation expectations**, but **not the other way around** although marginally
- However, the **results probably are misleading** as **both DBS-SKBI CPIEx and MAS SPF seems to be unit root processes**.
- We find that **Inflation Expectations are quite persistent**. In fact, it is an I(1) process as the difference series seem to be stationary using an Augmented Dickey Fuller Test i.e., **changes of inflation expectations seem to be a stationary process**.
- With 48 quarterly data points we can identify that the **MAS SPF and DBS-SKBI SInDEx One-Year-Ahead Inflation Expectations are cointegrated signaling long term anchoring of inflation expectations**

Inflation Expectations and COVID-19*

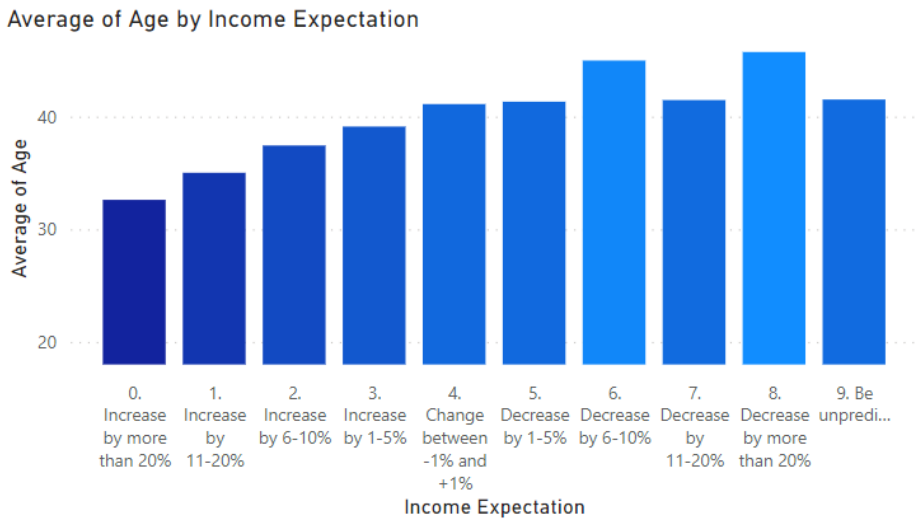
*based on work by IITKGP MBA students for the I2XL Challenge

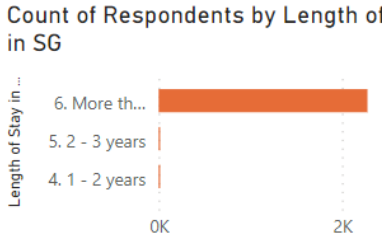
Microsoft Power BI

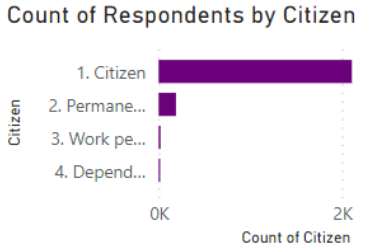


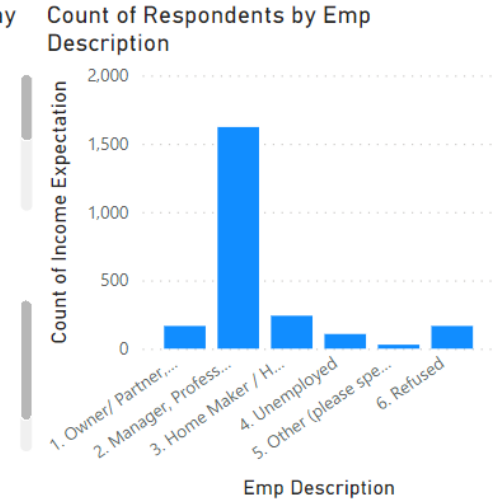
Source: Authors' calculations

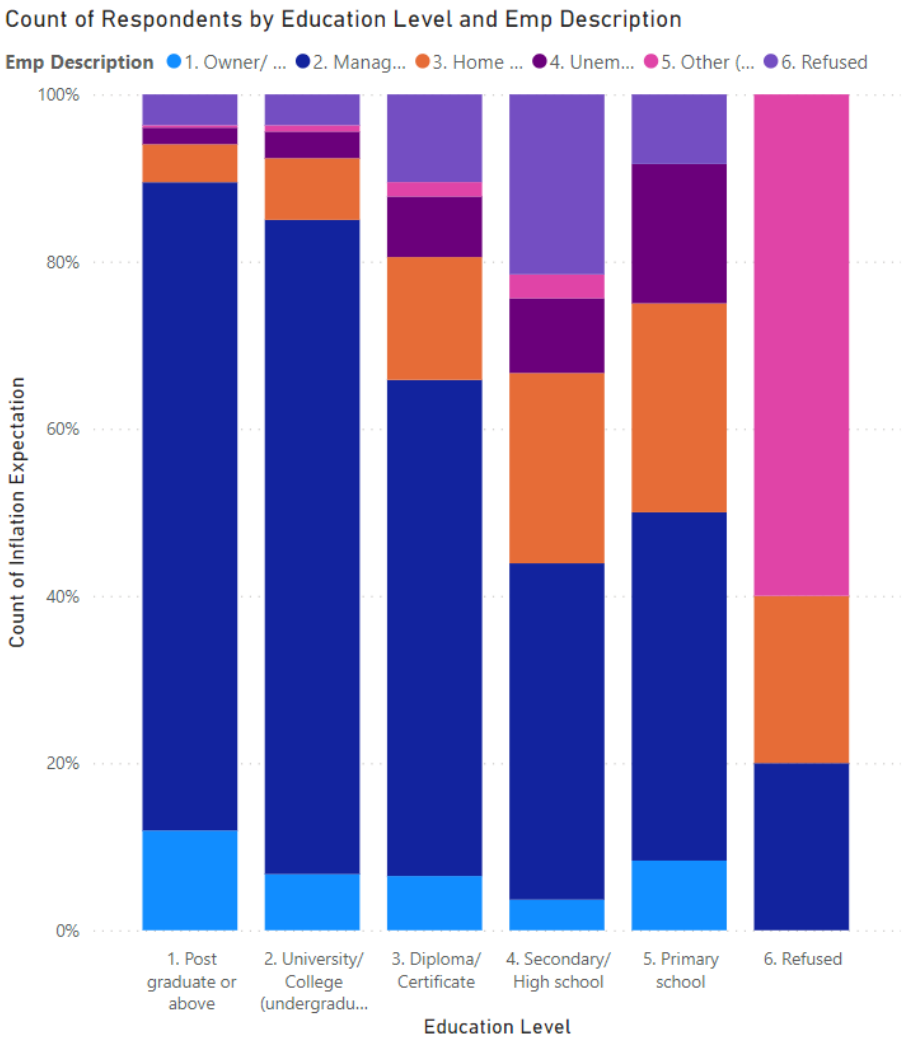
Microsoft Power BI











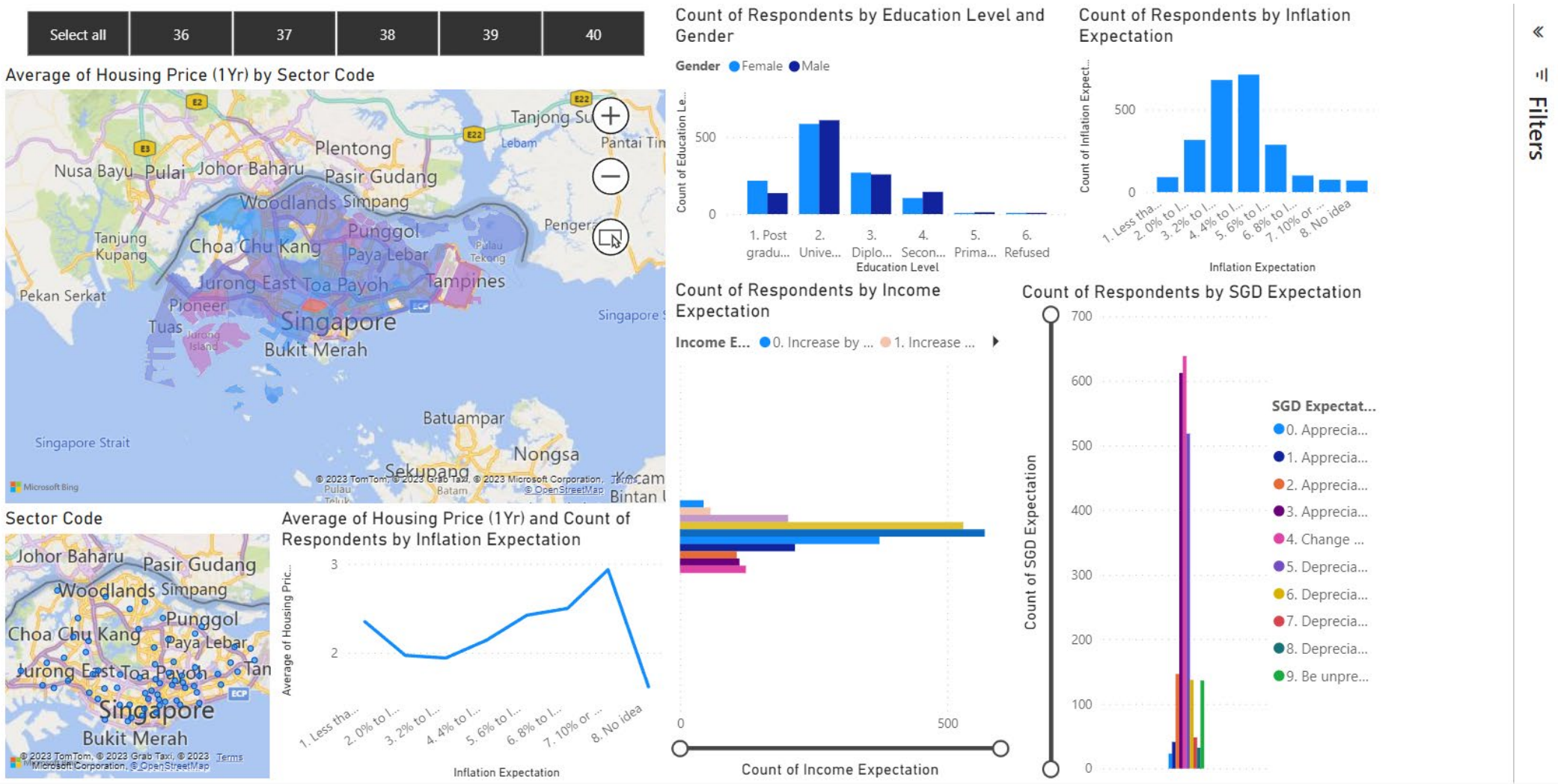
Filters

SMU DBS Dashboard_I2XL Team 3, Data

Data updated on 4/5/23, 10:36 am

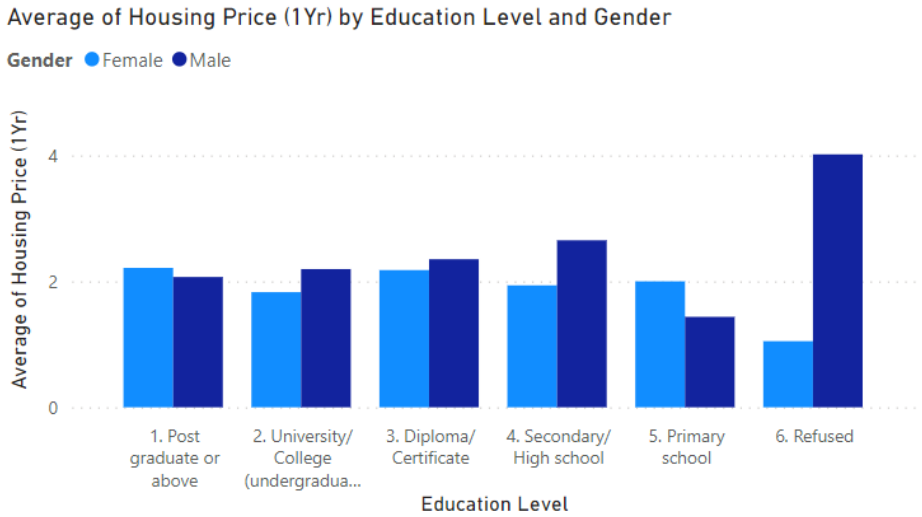
Source: Authors' calculations

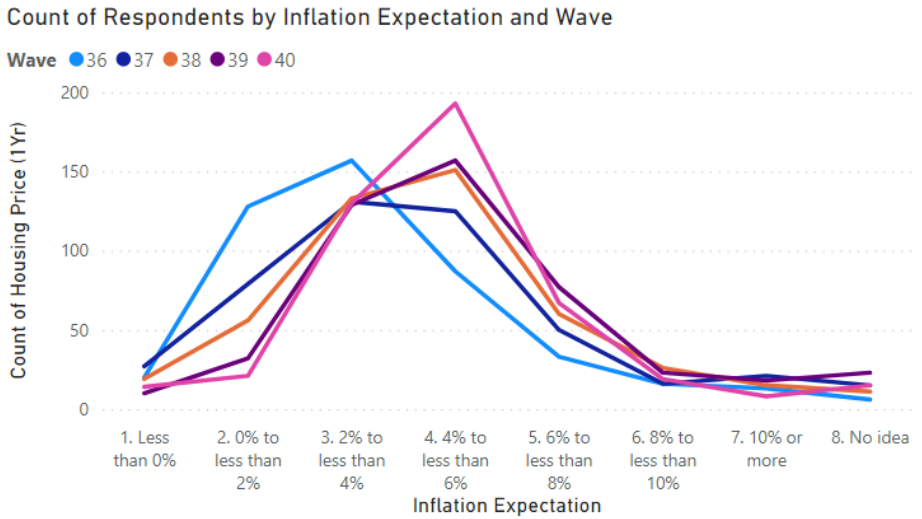
Microsoft Power BI

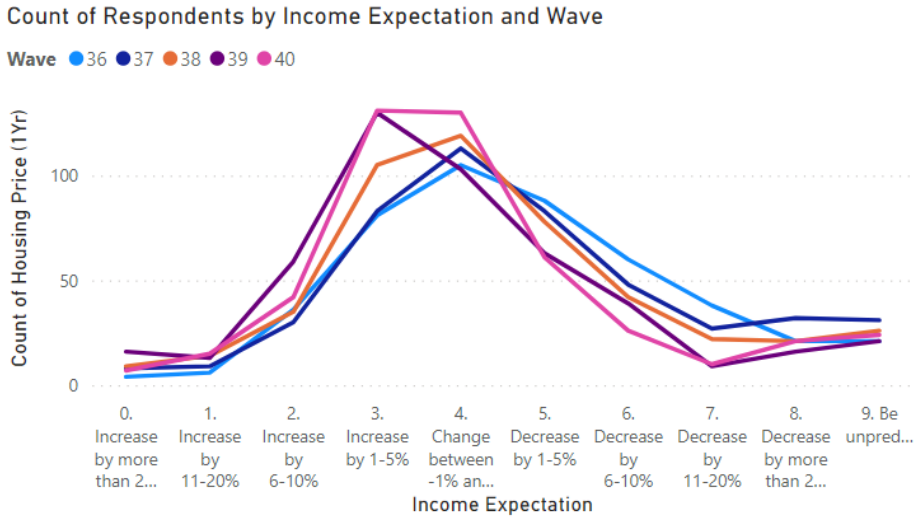


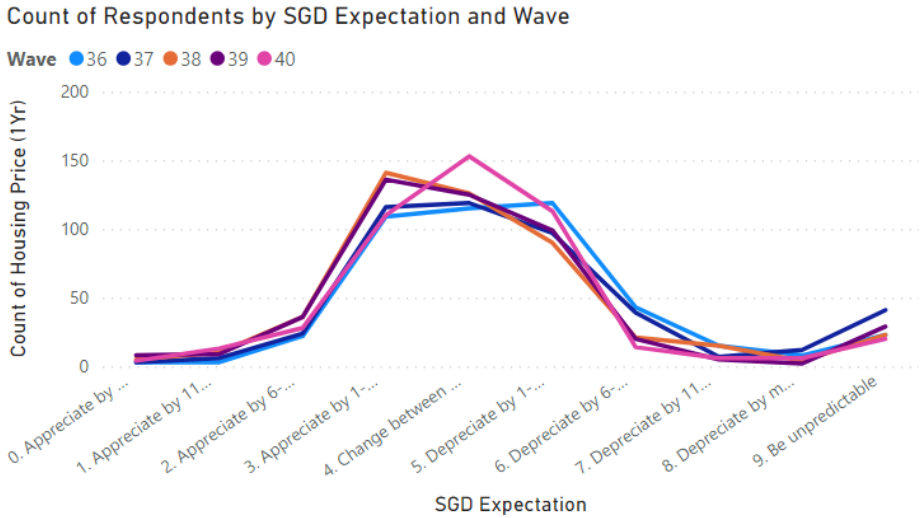
Source: Authors' calculations

Microsoft Power BI









Filters

SMU DBS Dashboard_I2XL Team 3, Housing Price Count

Data updated on 4/5/23, 10:36 am

Source: Authors' calculations

Conclusions and Way Forward

- We find that **inflation and cost of living are related concepts**, however, they differ in their measurements
- We have found **cost of living can be decomposed into CPI inflation** (with a fixed basket or fixed standard of living) **and Aspirational inflation** (with changing standard of living). We find **changing expected basket** composition.
- We find **Inflation Expectations seem to be persistent or nonstationary process**, and **MAS Survey of Professional Forecasters seem to be co-integrated with DBS-SKBI One-year-ahead CPIEx** signaling **long-term anchoring of One-Year-Ahead inflation expectations**
- We find a **regional distribution of inflation expectations of house price and headline inflation expectations is different and changing before and after vaccination for COVID-19** was developed and deployed.