TRACKING GROWTH DURING THE NEW WAVE OF COVID-19 – USING GOOGLE TRENDS

Vo Phuoc Tri

Vietnam – The Netherland Programme

Master of science in applied economics

Dr. Tran Thi Tuan Anh

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PowerPoint Presentation

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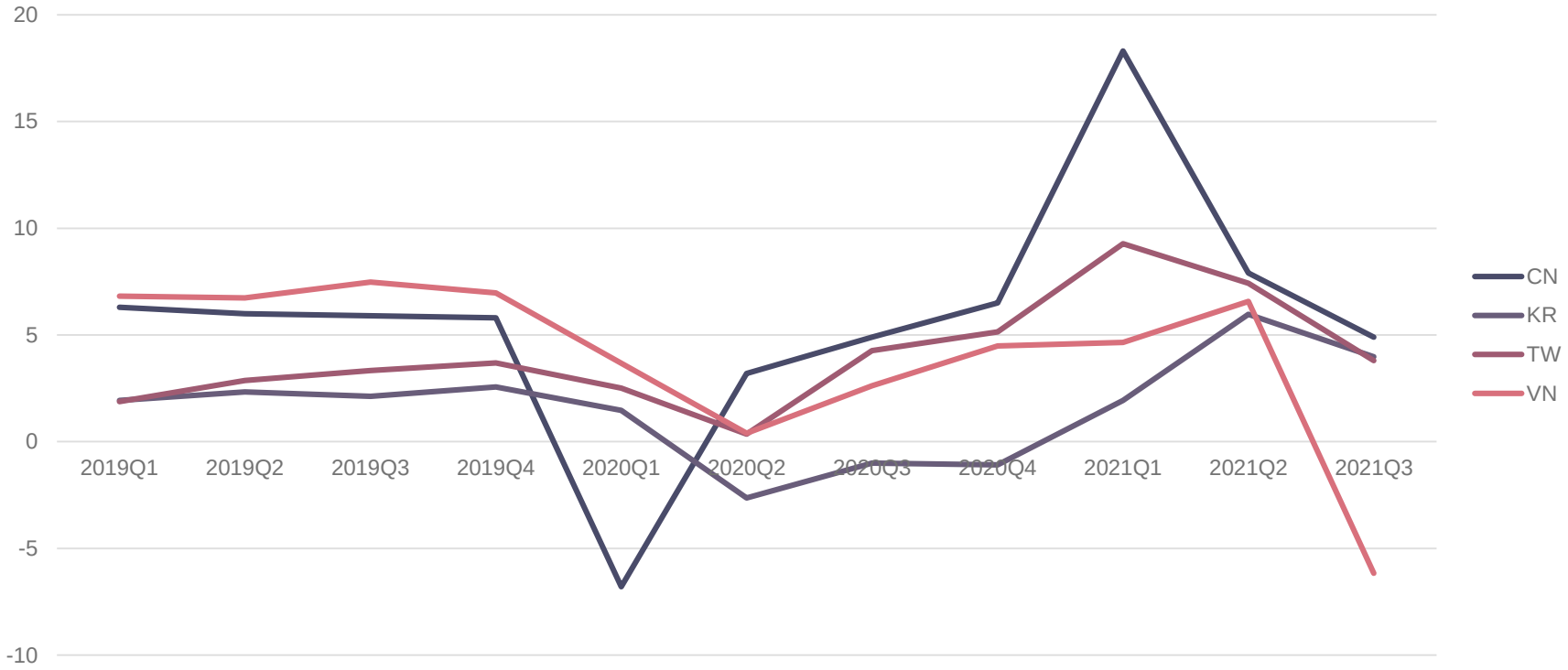
Thesis Presentation Outline

Introduction

GDP growth rate during the Covid-19 pandemic



Introduction

01

Background on Topics

The immediate impact of coronavirus challeges the timely reaction of policy makers.

The dataset from official sources is limitative in the situation of the pandemic.

Google Trends data has advantages to deal with this problem

02

Research questions

1) Does the Tracker built up from Google Trends perform reliably in order to track GDP growth rate of Asia and Pacific economies?

2) How this Tracker fluctuates during the new wave of the Covid-19 pandemic in Asia and Pacific economies?

3) Which factors play key roles for GDP growth rate during the new wave of the Covid-19 pandemic in Asia and Pacific economies?

03

The need for this research

1) Give to policymakers an index reflecting well the fluctuation of economic growth during the pandemic

2) Study the reaction of economic growth during the new wave of the Covid-19 pandemic

3) Policy implications

04

Objectives

1) Construct a reliable Weekly Tracker, by applying Google search data and machine learning, to track the GDP growth rate during the Covid-19 pandemic.

2) How the Weekly Tracker fluctuates during the Covid-19 pandemic new wave in the third quarter and the first haft of the fourth quarter 2021.

3) Investigate which factors play key roles for GDP growth rate during the new wave of Covid-19.

Literature review

Google Trends

- A tool provided by Google.
- Cover a large area of economic fields (Stephens-Davidowitz & Varian, 2014)
- Large panel dataset for research activity (Woloszko, 2020)

The application

- Unemployment (Baker & Fradkin, 2017)
- Private consumption (Vosen & Schmidt, 2011)
- Recession (Chen et al., 2014)
- Consumer confidence (Choi & Varian, 2011)
- Finance (Balakrishnan & Kalpit Dixit, 2013)
- Grain prices (Martinez et al., 2011)

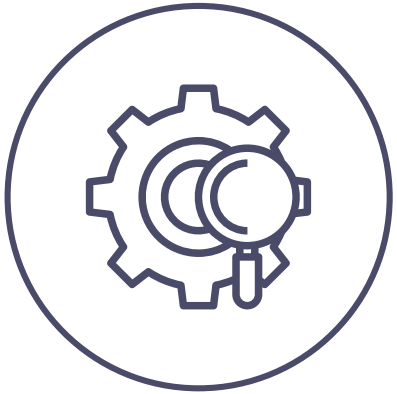
For Covid-19

Eraslan & Gotz (2020), Fetzer et al. (2020), Keane & Neal (2020), Woloszko (2020), Monache et al. (2021)

Concerns

- Downward trend of several keywords over time (Stephens-Davidowitz & Varian, 2014, Macclum & Bury, 2013; Ficetola, 2013)
- The explanatory of Google search predictors declined rapidly (Woloszko, 2020)
- Does not improve significantly forecasts accuracy (Combes & Bortoli, 2016, Giannone et al., 2018)

Methodology



Follow the two-step model presented by Woloszko (2020)

Apply Artificial Neural Network to train data

Apply SHAP tool to investigate contribution of input features on the prediction

Collect data from22 countries in Asia and Pacific, the period is from the first quarter of 2004 to the second quarter of 2021

Methodology

Step 1

- Apply ANN to train dataset:
- $GDP\ growth\ rate_{iq} = f(d\ svi_{c,q}, cfe_i) + \sigma_i$
- Where $f(d\ svi_{c,q}, cfe_i)$ is a nonlinear function of the year-over-year log-difference of quarterly averages of search volume indices ($d\ svi_{c,q}$) for categories (indexed by c), and country dummies (cfe_i), and σ_i is white noise

Check the accuracy

- Comparing to errors of predicition from Autoregressive model lag 4

Step 2

The function estimated $\hat{f}$ from the quarterly model is used for weekly Google Trends indices to construct Weekly Tracker:

$$WT = \hat{f}\ (d\ svi_{c,w}, cfe_i)$$

WT is the Weekly Tracker, which is interpreted as an estimate of the year-over-year growth rate of "weekly GDP" (same week compared to the past year).

Investigate features contribution

- Apply SHAP Tool

Google Trends data problems

The search volume index is concluded from below formula:

$$SVI_{ct} = \frac{SV_{ct}}{SVT_t} * (max \frac{SV_{ct}}{SVT_t})^{-1}$$

Where SVI_{ct} is the search volume index of query c in time t, SV_{ct} is search volume of query c in time t, and SVT_t is the search volume of total queries in time t

The search volume indices are the percentage ratio and they are affected by time, it is needed for preprocessing data for search series variables before applying to estimate.

Woloszko (2020) suggested that take logarithm-term to reduce the trend effect.

$$svi_{ct} = \log(SVI_{ct})$$

Google Trends topics and categories

- **Based on Woloszko (2020), Choi & Varian (2011), Suhoy (2009), Martinez et al. (2021)**
- **80 topics**
- **100 categories**
- **Monthly frequency for the training step, and then weekly frequency for the prediction step.**

Research Results

Outcome from model and actually quarter GDP growth rate (year-over-year)

Research Results

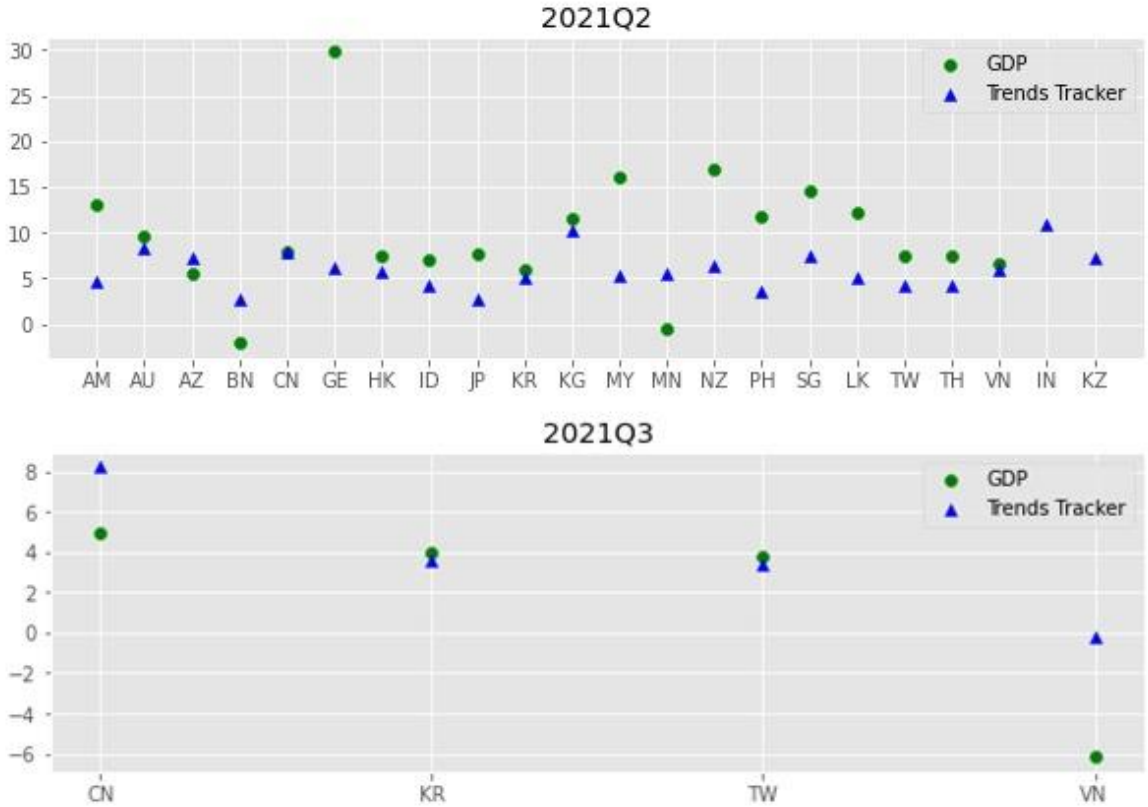
Forecast performance, comparing to AR(4) model.

	2005-2021 (Full sample)			2008-2011 (Crisis period)			2020-2021 (Covid-19 pandemic period)		
	Unadjusted	Standardised	Relative to AR(4)	Unadjusted	Standardised	Relative to AR(4)	Unadjusted	Standardised	Relative to AR(4)
China	1.04	0.31	0.41	0.8	0.42	0.47	2.28	0.33	0.33
Japan	0.64	0.22	0.33	0.99	0.2	0.36	0.81	0.15	0.19
Kyrgyz Republic	2.9	0.29	0.39	5.4	0.36	0.41	3.82	0.49	0.38
Korea	0.56	0.27	0.45	0.53	0.14	0.28	0.5	0.18	0.21
Singapore	2.89	0.56	0.95	6.22	0.72	1.61	2.4	0.28	0.34
Taiwan	2.44	0.65	1.33	4.92	0.61	2.16	2.18	0.79	0.91
Thailand	1.26	0.31	0.45	0.78	0.15	0.26	1.18	0.2	0.22
Viet Nam	0.77	0.34	0.39	1.03	0.35	4.3	1.19	0.3	0.26
Median	1.16	0.3	0.43	0.98	0.31	0.36	1.92	0.31	0.33

The first column (Unadjusted) signifies Root Mean Squared Error (RMSE) in forecast simulations. RMSEs are standardised by the GDP growth rate standard deviation in the second column (Standardised), and divided by the RMSE of an AR(4) model in the third one [Relative to AR(4)]

Research Results

Tracker's prediction for 2021 Q2 and Q3.



Circles are official report GDP growth rate, and triangles represent for tracker index.

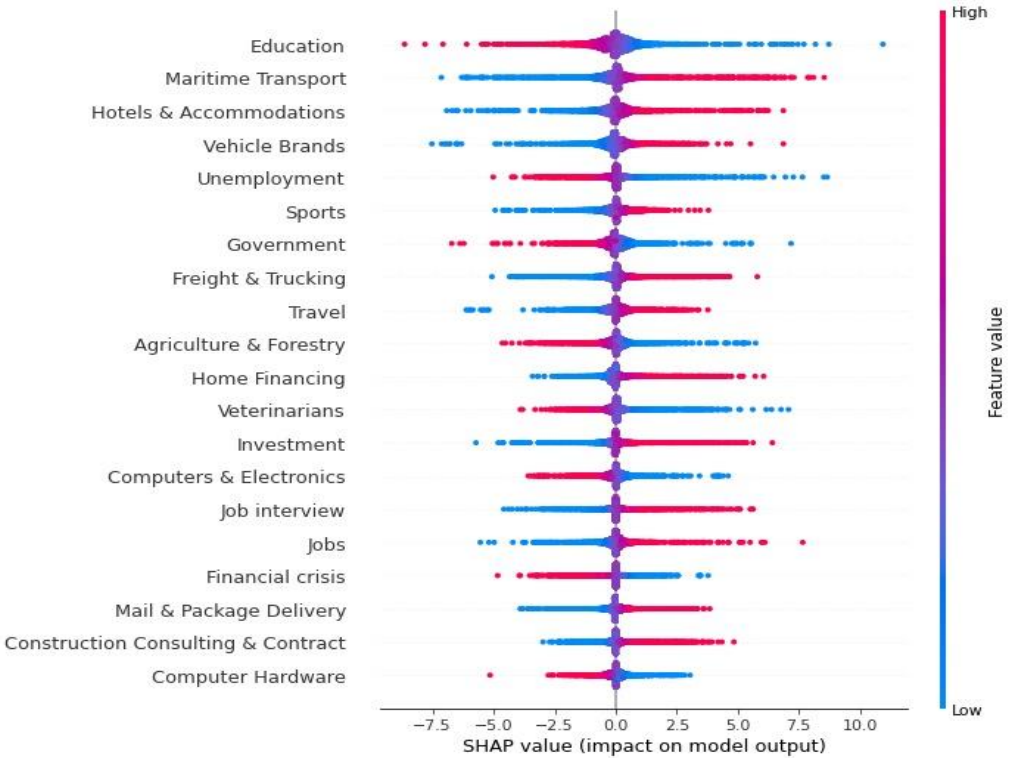
With the 2021 Q2, figure show all countries in sample except India and Kazakhstan.

While 2021 Q3, only focus on four countries that reported GDP growth rate of the third quarter.

(GDP data from ADB)

Research Results

Most important variables and their contributions to predictions

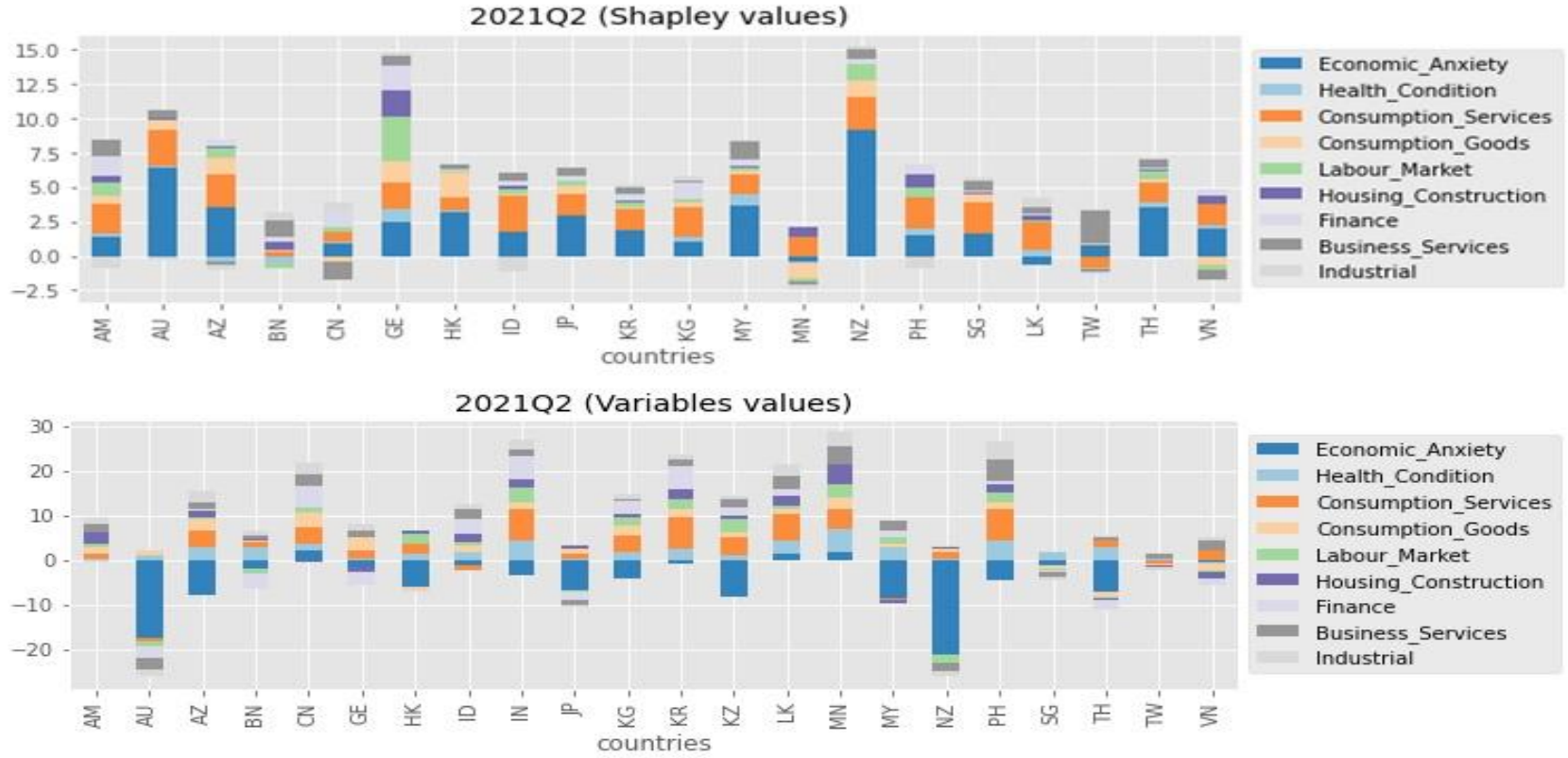


Shapley values are the contributions of variables to the GDP growth rate estimated by the model. Ranking variables bases on importance, and for each variable.

Each point indicates to an observation (that is a given month * a given country) and its color depends on the value of the variable.

Research Results

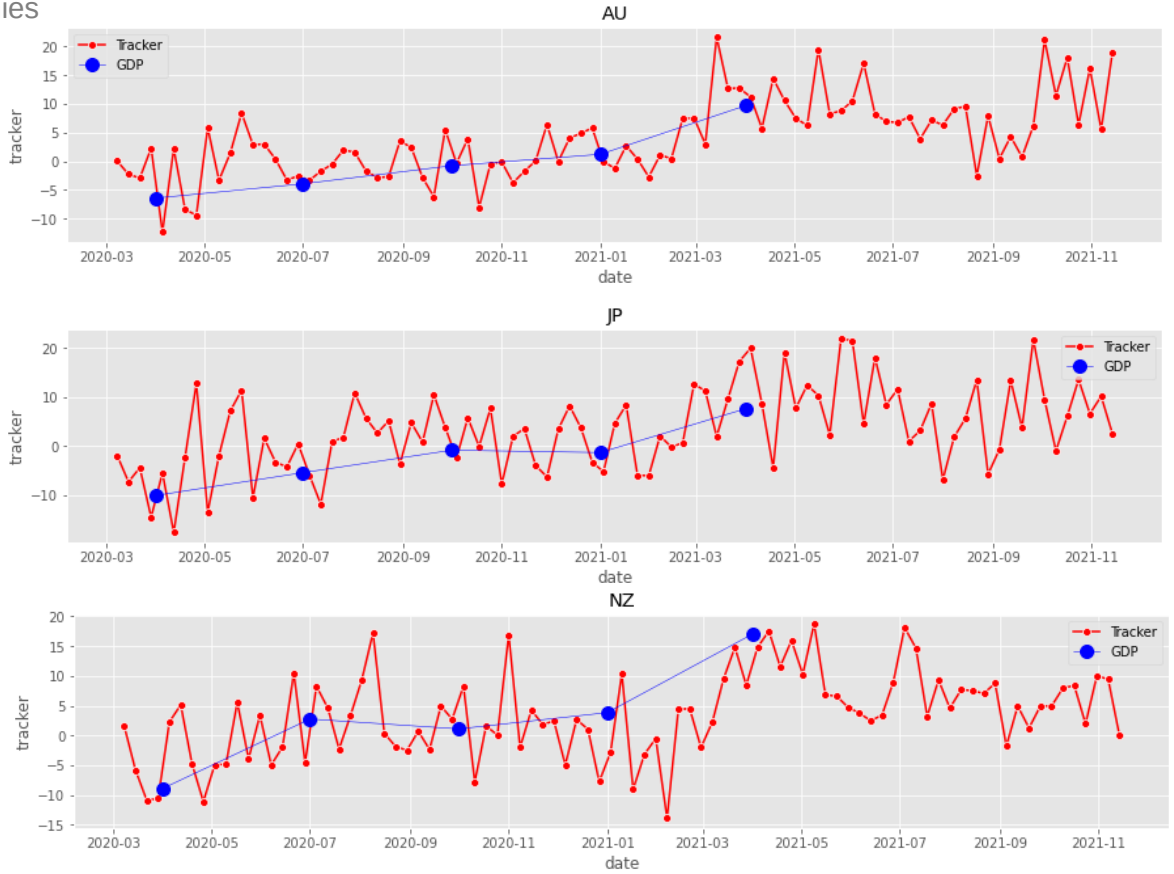
A focus on 2021 Q2



Research Results

Weekly Tracker: High-income economies

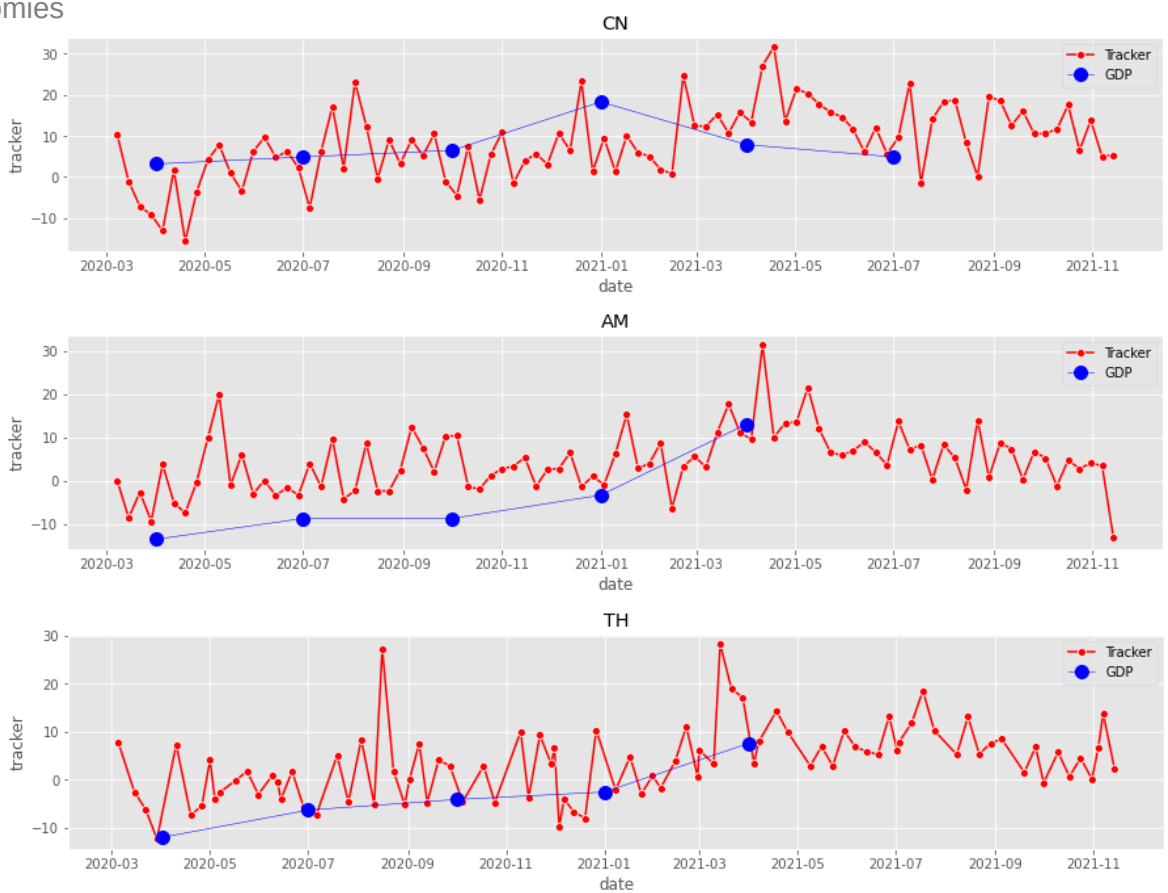
Weekly Tracker points out the concern about the significant negative impact of the new wave of Covid-19. This shock reduces the weekly GDP growth rate estimate close to 0% and even negative at some points



Research Results

Weekly Tracker: Upper-middle income economies

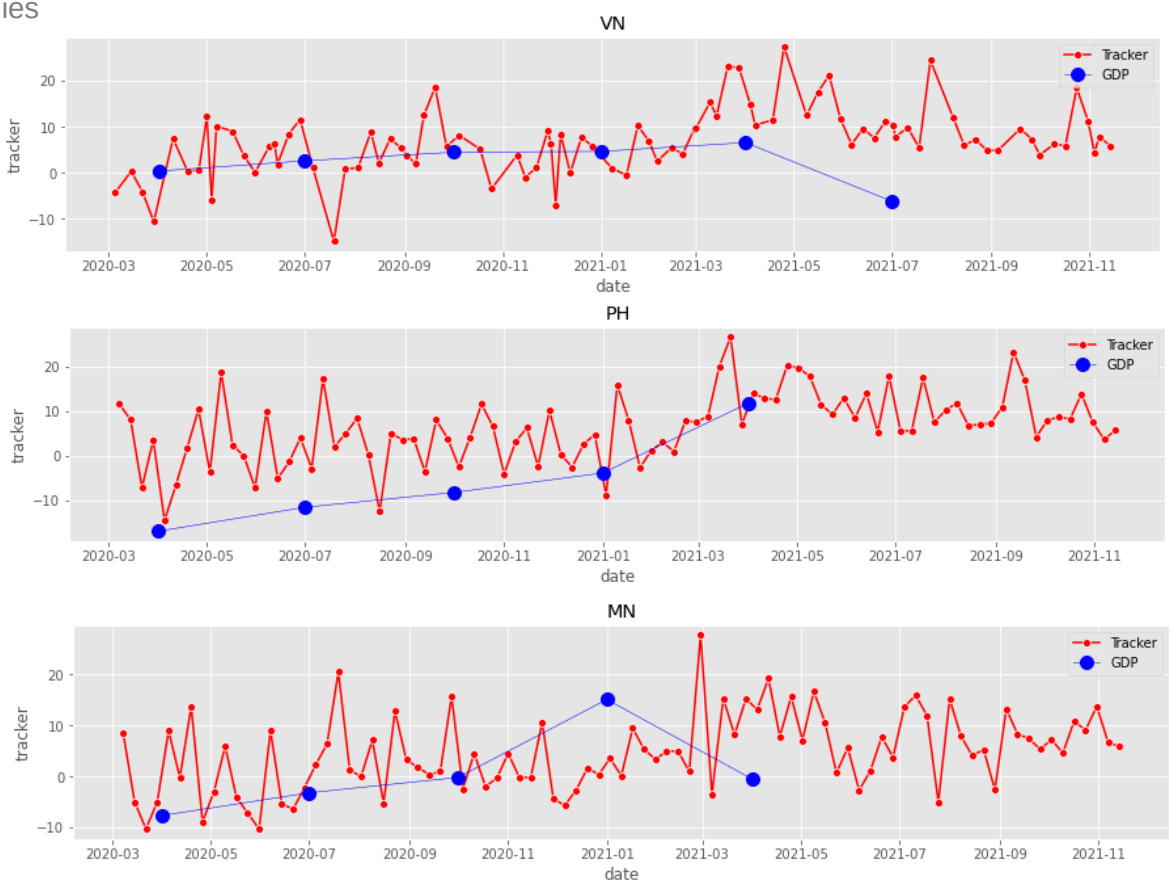
A steep down trend of Weekly Tracker has been immediately recorded since June



Research Results

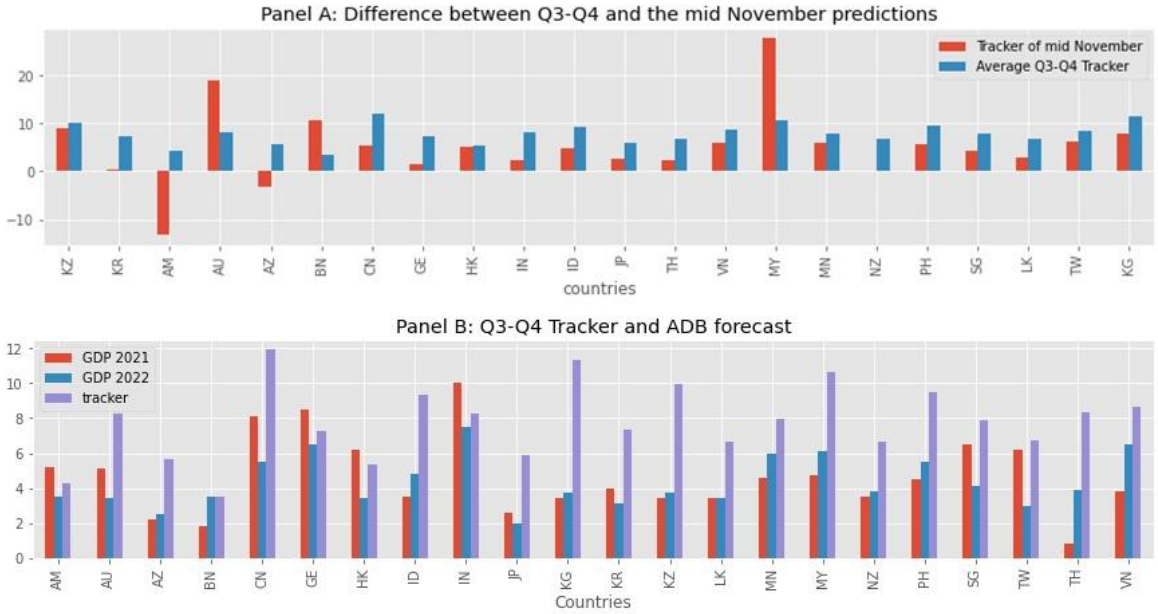
Weekly Tracker: Lower-middle income economies

Compare to advanced countries and upper-middle-income countries, the Weekly Tracker of lower-middle-income economies appears more stable during 2021 Q3 and Q4



Research Results

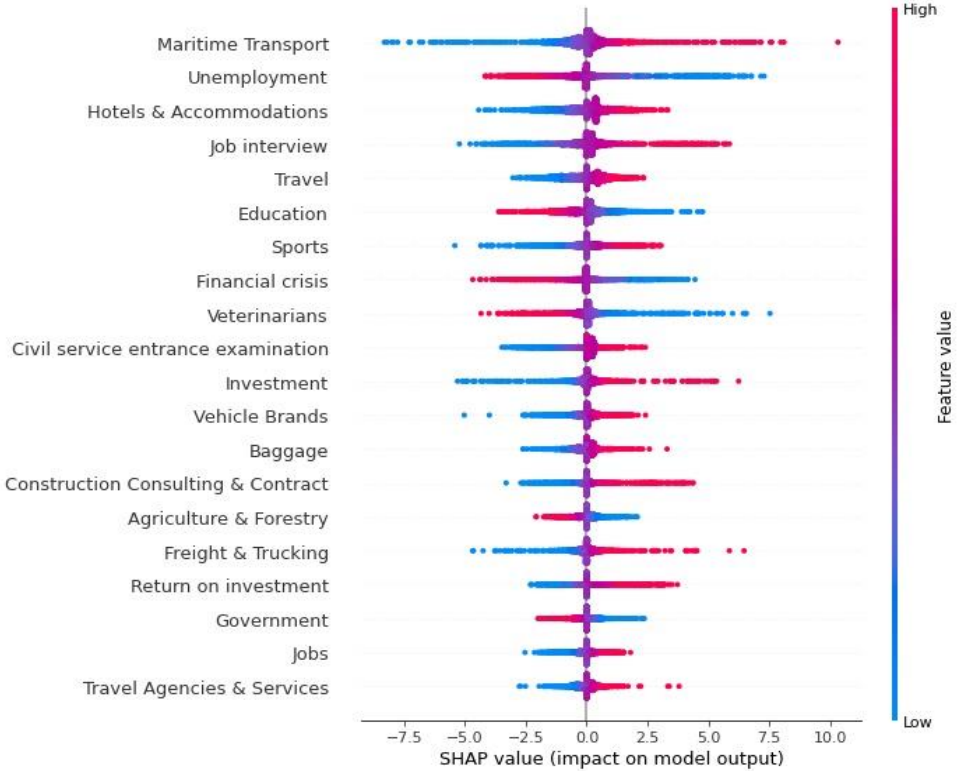
Most recent predictions of the Weekly Tracker



"Q3-Q4 Tracker" of both panels is the average value of the Weekly Trackers during Q3 and the first haft Q4 of 2021. In panel B, the GDP growth rate of 2021 and 2022 is the forecast of ADB.

Research Results

Contribution of variables to predictions during the Covid-19 pandemic



Google searches related to "Maritime Transport" have the largest contribution to the GDP growth rate estimates.

Topics and categories related to Consumption (for examples: "Hotels & Accomodations", "Travel", "Sports", "Freight & Trucking", "Travel Agencies & Services", "Vehicle Brands", "Baggage"), Labor Market ("Job interview", "Jobs", "Civil service entrance examination"), Finance ("Investment", "Return of investment") and Housing Construction ("Construction Consulting & Contract) also contribute positively to the Weekly Tracker.

Topics and categories related to Economic Anxiety ("Unemployment", "Financial crisis", "Government") harm the predictions

Research Results

Drivers of the growth rate during the Covid-19 new wave

Contributions of variables to outcome are represented by Shapley Value.

The search value index is indicated by the difference of svi year-over-year.

Variable contributions and year-over-year differences svi are aggregated into economically relevant subgroups reflecting key economic sectors, after taking the sum of all countries in the sample.

Discussion

Discussion 1

The Weekly Tracker suggests the upward trend of GDP growth rate at the beginning of 2021 has been cut off since the new wave of the Covid-19.

Discussion 2

The positive point is the impact of the Covid-19 during 2021 Q3 and Q4 seemly does not make a downward movement for the economic growth rate, as Weekly Tracker points out

Discussion Tip #3

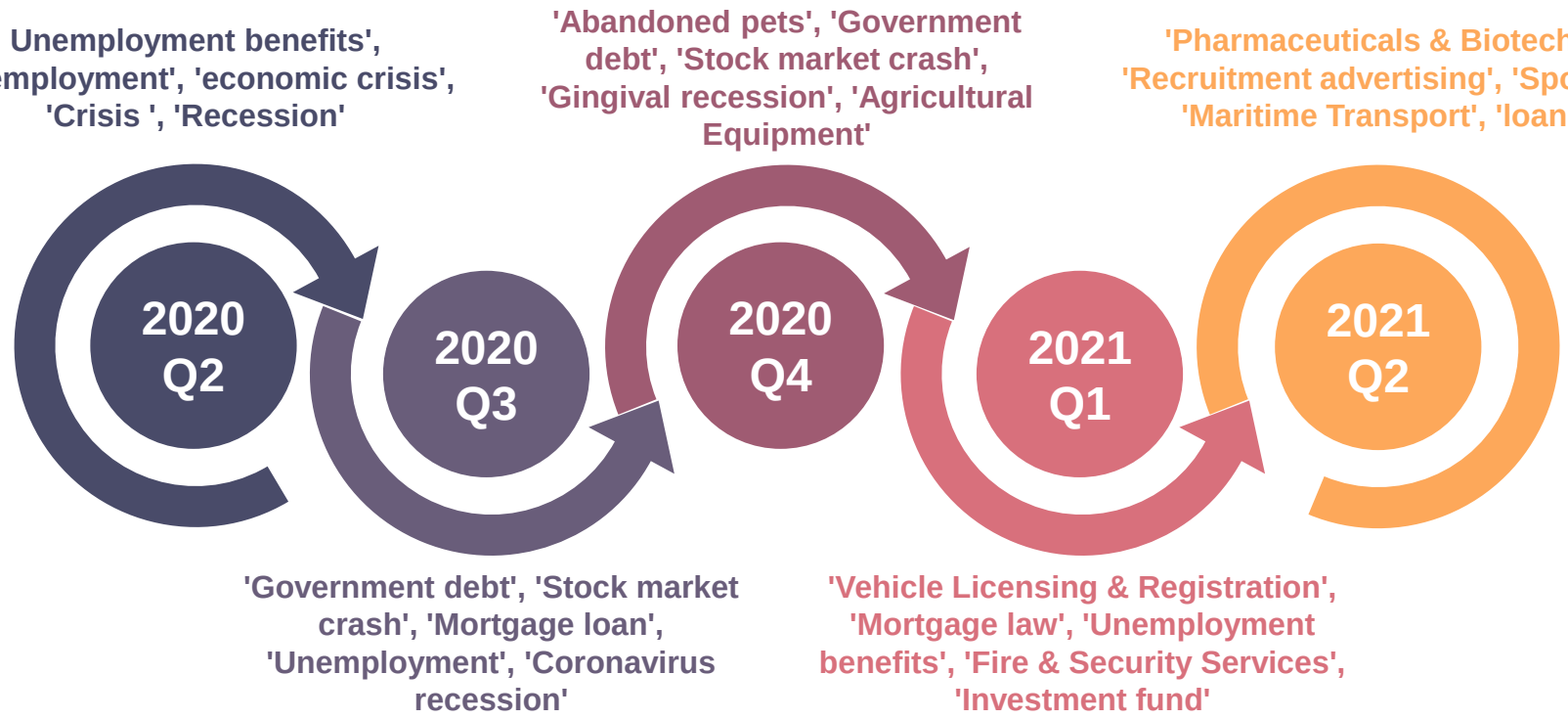
The pandemic needs to be kept in control for guaranteeing that economies not to be hurt because of the impact of the fear, the reduction of consumption, and the risk closing trade

Discussion Tip #4

The topics and categories related to trade and consumption can be considered the motivation for keeping the Weekly Tracker still be positive during the new wave of the Covid-19.

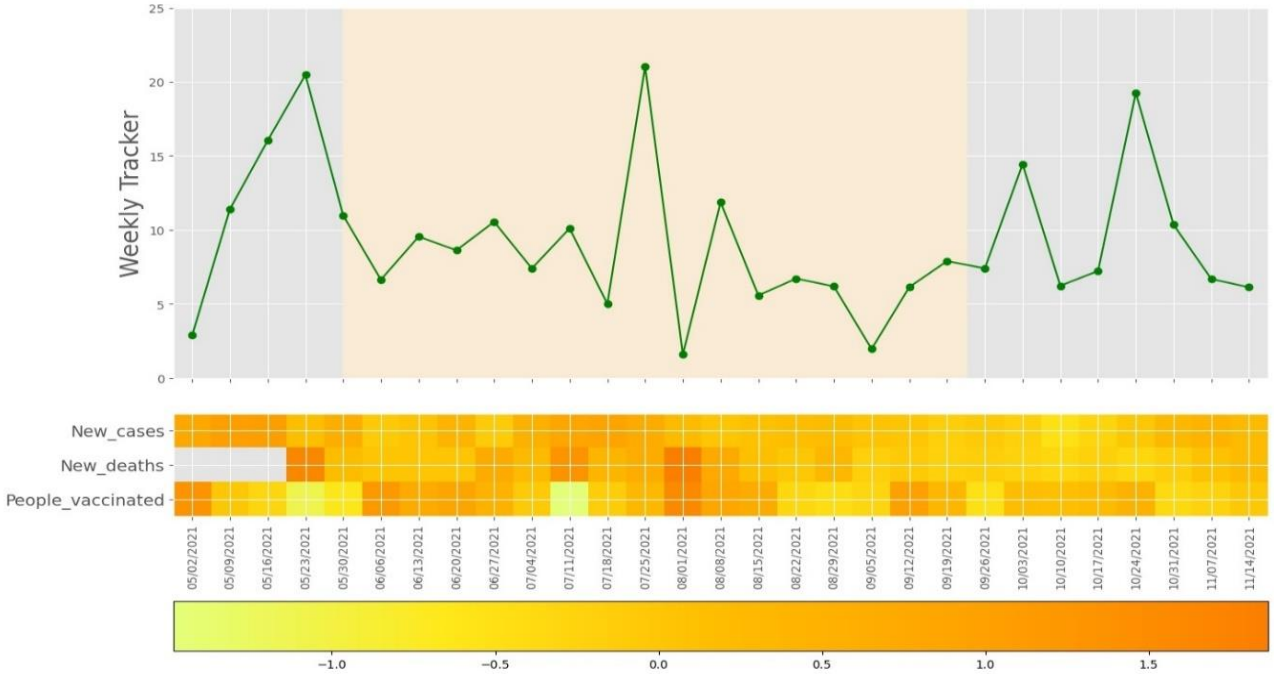
Discussion

Top categories and topics **svis** since the coronavirus spread out



Research Results

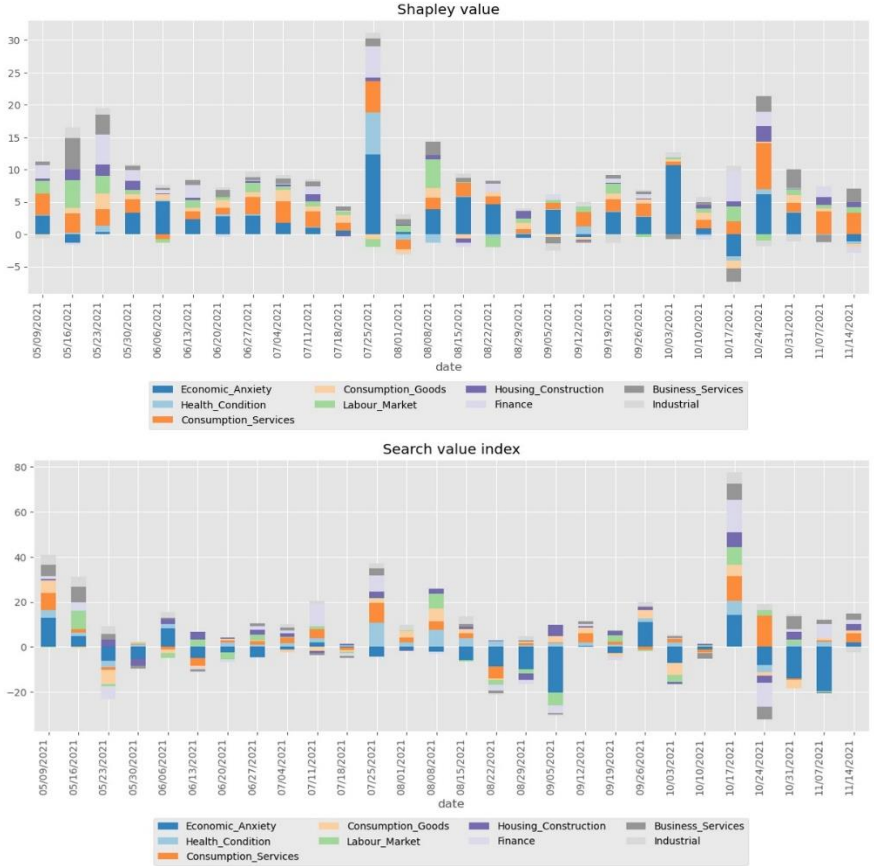
The Weekly Tracker of Vietnam during the new wave of Covid-19



This Figure shows the percentage change for the previous week of new cases and new deaths caused by the pandemic and the number of people vaccinated (data from WHO). The orange side in the Weekly Tracker graph covers months that Ho Chi Minh City applied to lock down protocol, from July to September 2021.

Research Results

Drivers of the growth rate during the Covid-19 new wave in Vietnam



Contributions of variables to outcome is represented by Shapley Value. Search value index is indicated by the difference of svi year-over-year. Variable contributions and year-over-year differences svi are aggregated into economically relevant subgroups reflecting key economic sectors, after taking sum of all countries in sample.

Conclusions / Findings

- Weekly Tracker is valuable for tracking GDP growth rate during the Covid-19 pandemic.
- The recovery of 22 economies in the sample has been constrained during the new wave of Covid-19.
- Consumption topics and categories, especially trade and services, are the variables that have a key role in the recovery
- The topics and categories related to Economic Anxiety were popular and lead the negative impact.

Policy implications

#1

Consumption is the sector that contributes largely to the economic recovery. Internet is the most important infrastructure that government has to focus on in the pandemic time.

#2

Labor market and trading for the recovery after the depression because of the Covid-19 pandemic. Policies makers need to be careful when applying the travel limitation protocol during the pandemic

#3

The fear of people during the pandemic has an extreme impact on the growth rate. Comforting residents is an activity that government should consider and improve their knowledge about the pandemic is also important

Limitations of Your Study

Further research

1

Include official weekly data to study the impact of different sectors (such as financial variables, commodity prices, or electricity consumption)

2

Compare the reaction of official indicators and Google search to the fluctuation of the economy during the Covid-19 pandemic.

QUESTIONS

THANK YOU !