Is interest rate still the right tool for stimulating economic growth ? evidence from Japan

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Abstract

A lot of advanced economies have reached a stage of stale economic growth and very low inflation rates or even occasionally deflation. Their policy maker's response was to stimulate the economy through monetary easing in order to make funds available for potential businesses to borrow and grow. Countries such as Japan for example have reduced their interest rates to negative nominal rates in order to try to push the money back into the economy but so far all efforts were futile. This calls for a relook at the real situation and whether interest rates are actually the right tool to stimulate the economy or not. This paper takes a completely different perspective on economic development and attempts to discover the relationship between interest rates and entrepreneurship indicators in Japan with the latter being taken as a proxy for economic development as it is a major driver for economic activity – a proxy that was totally neglected by previous literature. The study performs a time series regression to determine the relationship between interest rates and four drivers of entrepreneurship in order to determine whether interest rates actually stimulate these or not. The study showed that interest rates are rather a driven factor, not a driver when it comes to entrepreneurship and efforts done on interest rates won't have an impact on the real economic entrepreneurship.

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Introduction

Interest rates have been a major tool employed by the government to tweak its monetary policy and control liquidity in the market which in return serves as regulatory valve for inflation and economic development. Central banks often increase interest rates to draw more funds into the country and to mop out excess liquidity in the market to curb inflation and keep it at a manageable rate. Conversely, in stages of stagnation, central banks attempt to reduce interest rates to make it more favourable to invest in the real economy and increase consumption rather than keep the liquidity parked in central bank deposits or commercial bank deposits. This method proved to be very effective for a long period of time across the globe till recently. Advanced economies have reached a form of economic saturation whereby economic growth have slowed down significantly. This cause central banks to attempt at reducing interest rates in hopes of encouraging potential borrowers and consumers to borrow and consume money in order to realise a level of internally driven growth. This behaviour that contravenes conventional belief that interest rates and economic development are inversely related calls for another check for a [hidden link] in between interest rates and economic development that may have caused the interest rates to lose effectiveness on economic development.

The best way to look at this hidden factor is to trace the flow of money from deposits to the economy. In a normal scenario, depositors can be broken down into two main categories with different motivations for depositing money in banks, savers that seek safekeeping and consumption oriented services, and investors that seek investment returns. Of these two categories, changes in the interest rates affect the returns on investment but does not affect the safekeeping purpose of depositors. Hence the flow of liquidity to the real market will only occur from investors that usually seek returns on their investment.

Eventually, for the money flow to make it to the market, it needs potential businesses and entrepreneurs that need that money to finance new economic activities and businesses. The main rationale behind the interest rate and economic development relationship is to make funds cheaper and more available to entrepreneurs to use for their businesses and entrepreneurial activity.

However, the question that comes to mind is, why did this relationship stop working? Why aren't interest rates affecting economic growth anymore?

A common proverb says "you can take the horse to the water, but you can't force it to drink" an analogy that best suits the issue in hand. If the general social mind-set is moving away from entrepreneurship, then making funds more accessible to them is just as lucrative as selling a cooler (at a discount) to the residents of the north pole whereby even if you offer it to them for free, (or even pay them to take it as in the case of negative interest rates) there is no demand for that particular commodity (or money in the case of interest rates).

To investigate the scenario mentioned above the paper discusses the established literature link between entrepreneurship and economic development to validate it as a proxy for economic development, then proceeds to discuss the main drivers of entrepreneurship which can be linked to interest rates in a logical manner and hypothesizes the theoretical relationship between them. It then proceeds to test this relationship statistically to validate or nullify the hypotheses made earlier and determine whether interest rate is really the right tool to stimulate economic growth or not. In not, then what are the policy implications of this research. By doing so, this paper will be the first paper to relate interest rates to entrepreneurship and challenge the direct link previously established between interest rates and economic development and inflation.

This research however is inherently limited by several factors that may have an effect on the accuracy of the results. First of all, the paper is limited by the quality of the input data which have an element of subjectivity in its assessment. For example, in the study of the determinants of entrepreneurship, some qualitative data were translated into quantitative numbers using subjective methodologies by the Global Entrepreneurship Development Institute. Furthermore, this research lacks past literature and guidance on the relationship between interest rates and entrepreneurship thus making a rough attempt to map out this relationship.

Literature Review

A study on the topic of entrepreneurship will face its first obstacle almost instantly at the definition of the concept of entrepreneurship. Entrepreneurship as a phenomenon cuts across many disciplinary boundaries. For that reason, there have been a multitude of definitions of the very concept of entrepreneurship. Early literature has introduced many criteria for the definition of entrepreneurship. For example, (Schumpeter, 1934) made a point that entrepreneurship's definition can be seen as the activity of carrying out new combinations of business while earlier literature by (Knight, 1921) suggests that the definition a certain element of being able to successfully predict the future. Later works by (Leibenstein, 1978) argued that firms do not necessarily operate at their optimum or maximum limits of their production frontiers, hence entrepreneurship is the ability to outsmart or outperform competitors. Another definition by the Entrepreneurship Division's Call for Papers for the 1989 National Academy of Management meeting illustrates the field of entrepreneurship with these words: "the creation and management of new businesses,

small businesses and family businesses, and the characteristics and special problems of entrepreneurs."

With such variation in the definition, we refer to the Global Entrepreneurship and Development Institute's ("GEDI") index for the constituents and drivers of Entrepreneurship for the purpose of our research. GEDI's methodology was endorsed by the European Union as being a sufficient proxy or measure for the drivers of entrepreneurship in a specific country.

Sub-indexes	Pillars	Variables (ind./inst.)
ATTITUDES SUB-INDEX	OPPORTUNITY PERCEPTION	OPPORTUNITY RECOGNITION
		FREEDOM (ECONOMIC FREEDOM *PROPERTY RIGHTS)
	STARTUP SKILLS	SKILL PERCEPTION
		EDUCATION [TERTIARY EDUCATION*QUALITY OF EDUCATION)
	RISK ACCEPTANCE	RISK PERCEPTION
		COUNTRY RISK
	NETWORKING	KNOW ENTREPRENEURS
		AGGLOMERATION (URBANIZATION*INFRASTUCTURE)
	CULTURAL SUPPORT	CAREER STATUS
		CORRUPTION
ABILITIES SUB-INDEX	OPPORTUNITY STARTUP	OPPORTUNITY MOTIVATION
		GOVERNANCE (TAXATION*GOOD GOVERNANCE)
	TECHNOLOGY ABSORPTION	TECHNOLOGY LEVEL
		TECHNOLOGY ABSORPTION
	HUMAN CAPITAL	EDUCATIONAL LEVEL
		LABOR MARKET (STAFF TRAINING*LABOUR FREEDOM)
	COMPETITION	COMPETITORS
		COMPETETIVNESS (MARKET DOMINANCE*REGULATION)
ASPIRATION SUB-INDEX	PRODUCT INNOVATION	NEW PRODUCT
		TECH TRANSFER
	PROCESS INNOVATION	NEW TECHLOLOGY
		SCIENCE [GERD*(AVERAGEQUALITY OF SCIENTIFICAL INSTITUTIONS +AVAILABILITY OF SCIENTISTS AND ENGENEERS))
	HIGH GROWTH	GAZELLE
		FINANCE AND STRATEGY (VENTURE CAPITAL*BUSINESS SOPHISTICATION)
	INTERNATIONALIZATION	EXPORT
		ECONOMIC COMPLEXITY
	RISK CAPITAL	INFORMAL INVESTMENT
		DEPTH OF CAPITAL MARKET

(The entire table is labelled on the left as GLOBAL ENTREPRENEURSHIP INDEX)

Table 1: Global Entrepreneurship Index constituents (GEDI, 2017)

Although the drivers were clearly stated for the purpose of the institute's data collection, GEDI failed to provide a specific definition for what they consider as entrepreneurship and rather focused their literature on its drivers rather than what it really is. Entrepreneurship also extends beyond individual entrepreneurship according to (Teng,

2007) whereby corporate entrepreneurship requires firms to be bold, proactive and aggressive. The concept of Corporate Entrepreneurship can be defined as the process of continuous renewal in the business (Sathe, 1989) by innovation, strategic renewal, and venturing (Ginsberg & Guth, 1990).

On the other side of our study we need to define the concept of Economic Development as the benchmark for the relationship. (Robert E. Lucas, 1988) sees economic development as the observed accounting pattern across time in the levels and rates of growth of the per capita income in an economy. This is to truly reflect the actual development inflicted on the individuals in a society rather than the whole growth in an economy which will suffer from bias as a result of the population growth. As narrow as this definition may seem, it intrinsically goes well beyond just income in the development. As individuals' income increases in a country, it consequently improves living conditions, health conditions, and above all further human development opportunities that improve the economy's performance in many ways both on a qualitative and quantitative manner.

Entrepreneurship and economic development

The idea of entrepreneurship and its economic impact had witnessed a lot of interest in the past 20 to 30 years. This eventually generated a lot of literature in terms of the determinants of entrepreneurship on a theoretical and empirical levels such as in the works of (Evans & Leighton, 1989) and (Holmes & Schmitz Jr., 1990) respectively. Furthermore, there is no lack of research in terms of linking the effect of entrepreneurship to a firm's performance, or even a regional performance as well as the existence of an academic literature void in the link between entrepreneurship and the country's economy at that specific level. This void was progressively filled by the works of (Carree & Thurik, 2003) which attempted to

link entrepreneurship to economic growth. Works have then started flowing with many researchers such as (Baumol & Strom, 2007) which concluded that "Entrepreneurs who focus on innovation in their products, their production techniques, and their markets play a key role in economic growth". (Audretsch, Keilbach, & Lehmann, 2006) further shed the light on the key role entrepreneurship plays in economic development and argued that the boost in entrepreneurship was the main salvage point for Europe following the 1990s period which was its worst economic period since the second world war.

With the relationship between entrepreneurship and economic development established by literature, we tried to find literature on the link between interest rates and entrepreneurship, however there seems to be no significant studies that attempt to relate interest rates to economic development creating a literature gap that needs to be filled. With this gap in sight, this paper aims to be one of the first studies to shed the light on this topic and fill the literature gap.

Methodology & Results

Overview
This paper attempts to study the relationship between interest rates and entrepreneurship and tests if these variables are affected by each other in the long-run using time series modelling. If a relationship is established the paper will further attempt to analyse which one of these two factors under review is a driving factor and which is driven.

Data
With regards to the data collected, the paper took japan as a focus country since it is one of the few countries that suffer from deflation and that have reduced their nominal interest rates to sub-zero nominal rates effectively making depositors pay for the funds left at the central bank. The focus period for the study was limited to 16 years of quarterly data (2000-

2016) due to limitations on the availability of entrepreneurship related data. As for the variables in review, the study focuses on 5 variables being:

1. Call Rate for the central bank of Japan as a measure of the interest rate. On the other hand, we have the entrepreneurship related indicators. Denominated by **("IR")**

2. Perceived opportunity, a measure that shows Japan's population's perception for the existence of a business or an entrepreneurial opportunity. Denominated by **("PO")**

3. Fear of Failure: a measure of the percentage of the population that claim that the fear of failure is a major cause of not venturing into entrepreneurial activities in Japan. Denominated by **("FOF")**

4. Entrepreneurial intentions: a score for the amount of people that have intention of venturing into entrepreneurial activities in the upcoming five years in Japan. Denominated by **("EI")**

5. Total Economic Activity: a measure of the entrepreneurial contribution to the economic activity of Japan. Denominated by **("TEA")**.[3]

The data was collected from two main sources; the interest rates information was collected from the central bank of Japan department of statistics which holds all the past information of the central bank. As for the entrepreneurship data, the source was from the Global Entrepreneurship Monitor ("GEM") an organisation the conducts regular surveys and studies across most of the countries in the world in order to measure the level of entrepreneurship in those countries.

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[3] Further prefixes to the variables are ("L") for Log form, and ("DL") for the first difference of the log form.

Theoretically expected results

As Discussed earlier, there are three main hypotheses that can be made about the relationship between Interest rates ("IR") and entrepreneurship ("EN"):

A. No relationship exists between IR and EN: this hypothesis will show that entrepreneurship is indifferent to changes in interest rates and that eventually no changes in entrepreneurship can be realised from changing interest rates.

B. IR and EN are co-integrated and move together in the Long-run, however, IR is a leading variable and EN is a lagging variable. This eventually shows that using IR to drive EN is in fact a valid policy decision to make and reducing interest rates may eventually become fruitful.

C. IR and EN are co-integrated and move together in the Long-run, however, IR is a lagging variable and EN is a leading variable. This eventually shows that using IR to drive EN is not useful but rather changes in EN may drive down the economy eventually causing policy makers to change interest rates hoping for potential stimulation.

Based on the arguments laid out in the introduction, we foresee that the outcome will be either Hypothesis 1 or 3 signifying that interest rates do not have an effect on entrepreneurship in the long run as witnessed by the economic state of affairs japan had been witnessing for the past decade or so. However, if we get hypothesis 2 to be valid, this should imply that interest rates are in fact the right tool however, the stagnation may be caused by other factors that are hindering its effectiveness.

Steps taken

In order to achieve this, we first start by testing stationarity of the variables to determine if they are stationary in their level form (I 0) or in their first differenced form (I 1) this step

enables us to select the proper methodology and to determine whether we can test for long run co-integration or not. It is worth noting that stationary variables in level form do not carry any long term information and thus we may not be able to bring forth meaningful results as such. The paper performed two-unit root tests being Augmented Dicker-Fulley ("ADF") test of stationarity and followed by using Phillip Perron unit root test for verification. Once stationarity was determined at level and log forms the paper proceeded to identify the number of lag orders (VAR) to be used later in the co-integration tests. Once the number of lag orders was determined, co-integration was tested using Engle-Granger **("EG")** co-integration tests followed by Johansen co-integration tests for verification of the results of the EG test. Once a co-integration is established, the paper proceeded to perform Vector Error Correction Model ("VECM") and generalised Variance Decomposition ("VDC") tests to determine the exogenity of the variables in order to decide on which variable is driving others and which variables are driven. To conclude out empirical testing, the paper will proceed to apply Impulse Response Function ("IRF") and Persistence Profile test to illustrate the response of variables due to applying shocks from within the system (applying shock to one of the variables) or due to external shocks to determine the time-frame required for the system to return to equilibrium.

A. Unit Root Tests and Stationarity of the variables:

Performing unit root tests on variables enables us to determine the variables' stationarity in both level and first differenced forms. This is an integral part of the study as the variable need to be non-stationary in the level form to indicate that they contain some sort of long term information or trend factor. These variables further need to be stationary on the first differenced forms to enable us to be able to integrate them using EG and Johansen co-integration methods.

The Unit Root tests performed with ADF and PP tests whereby Akaike Information Criteria (AIC) and Schwarz Bayesian Criterion (SBC) assisted in the prediction of the best order of lags. AIC tends to choose higher order of lags as it is less concerned on over-parameter, while on the other hand, SBC mostly chooses lower order of lags. On the other hand, PP Tests show a test statistic that is to be compared to its critical value to determine stationarity.

Level form:

ADF Test Results:

LPO	Statistic	CV	LL	AIC	SBC	HQC
DF	-1.1919	-3.1366	74.7007	71.7007	68.51	70.448
ADF(1)	-2.4729	-3.1421	92.9428	88.9428	84.6886	87.2725
ADF(2)	-2.794	-3.1816	94.0859	89.0859	83.768	86.9979
ADF(3)	-3.0641	-3.1088	94.9305	88.9305	82.5491	86.425
ADF(4)	-2.3867	-3.0905	95.7988	88.7988	81.3538	85.8757
ADF(5)	-2.9095	-3.1493	97.8282	89.8282	81.3197	86.4876

Conclusion: Variable non-stationary ; T-stat < C.V. @ ADF (1) –SBC , AIC

LFOF	Statistic	CV	LL	AIC	SBC	HQC
DF	-2.7445	-3.4467	81.3965	78.3965	75.2058	77.1438
ADF(1)	-2.5523	-3.437	92.3515	88.3515	84.0973	86.6812
ADF(2)	-2.5318	-3.4451	92.8762	87.8762	82.5583	85.7883
ADF(3)	-2.66	-3.3689	93.9198	87.9198	81.5384	85.4143
ADF(4)	-3.1436	-3.3588	96.6443	89.6443	82.1993	86.7212
ADF(5)	-2.8123	-3.4088	96.8815	88.8815	80.3729	85.5408

Conclusion: Variable non-stationary; T-stat < C.V. @ ADF (4) –AIC & ADF (1)-SBC

LEI	Statistic	CV	LL	AIC	SBC	HQC
DF	-1.4378	-3.1366	38.9195	35.9195	32.7288	34.6667
ADF(1)	-2.3634	-3.1421	45.2037	41.2037	36.9494	39.5333
ADF(2)	-2.7066	-3.1816	46.2372	41.2372	35.9193	39.1492
ADF(3)	-2.1783	-3.1088	46.7934	40.7934	34.412	38.2879
ADF(4)	-1.6152	-3.0905	47.6579	40.6579	33.2129	37.7348
ADF(5)	-1.6355	-3.1493	47.7256	39.7256	31.2171	36.3849

Conclusion: Variable non-stationary; T-stat < C.V. @ ADF (2) –AIC & ADF (1)-SBC

LTEA	Statistic	CV	LL	AIC	SBC	HQC
DF	-1.6087	-3.1366	58.1667	55.1667	51.976	53.914
ADF(1)	-2.7912	-3.1421	68.9745	64.9745	60.7202	63.3041
ADF(2)	-3.0025	-3.1816	69.6272	64.6272	59.3093	62.5392
ADF(3)	-2.4954	-3.1088	70.0137	64.0137	57.6323	61.5082
ADF(4)	-1.9014	-3.0905	72.4649	65.4649	58.0199	62.5418
ADF(5)	-2.3029	-3.1493	74.6362	66.6362	58.1276	63.2955

Conclusion: Variable non-stationary; T-stat < C.V. @ ADF (5) –AIC & ADF (1)-SBC

LIR	Statistic	CV	LL	AIC	SBC	HQC
DF	-1.0339	-2.5774	-52.8645	-54.8645	-56.942	-55.6754
ADF(1)	-1.7813	-2.5894	-43.7752	-46.7752	-49.8915	-47.9917
ADF(2)	-1.838	-2.5191	-43.6393	-47.6393	-51.7944	-49.2613
ADF(3)	-1.8143	-2.502	-43.6198	-48.6198	-53.8137	-50.6473
ADF(4)	-1.8997	-2.5183	-43.395	-49.395	-55.6276	-51.8279
ADF(5)	-1.5541	-2.5941	-42.5915	-49.5915	-56.8629	-52.4299

Conclusion: Variable non-stationary; T-stat < C.V. @ ADF (5) –AIC & SBC[4]

PP Test Results:

	Statistic	CV	Conclusion	Rationale
LPO	-1.6107	-3.0957	non-stationary	T-stat < C.V.
LFOF	-2.4866	-3.0957	non-stationary	T-stat < C.V.
LEI	-1.8701	-3.0957	non-stationary	T-stat < C.V.
LTEA	-1.9562	-3.0957	non-stationary	T-stat < C.V.
LIR	-1.7997	-3.2457	non-stationary	T-stat < C.V.

First- Difference Form:

ADF Test Results:

DLPO	Statistic	CV	LL	AIC	SBC	HQC
DF	-3.7359	-3.1824	88.2941	85.2941	82.1278	84.0532
ADF(1)	-2.9518	-3.18	88.843	84.843	80.6212	83.1884
ADF(2)	-2.8283	-3.2031	88.8853	83.8853	78.6081	81.8171
ADF(3)	-3.4703	-3.1096	91.4038	85.4038	79.0712	82.922
ADF(4)	-2.7883	-3.1118	91.8981	84.8981	77.5101	82.0027
ADF(5)	-2.9921	-3.1531	92.5615	84.5615	76.118	81.2524

Conclusion: Variable stationary; T-stat >C.V. @ ADF (3) AIC

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[4] Although Interest rates are typically stationary in level form. In the case of japan, the rate had been constantly declining showing sort of a trend behavior causing it to be recognized as non stationary.

DLFOF	Statistic	CV	LL	AIC	SBC	HQC
DF	-4.5909	-3.1824	83.2894	80.2894	77.1231	79.0485
ADF(1)	-3.9704	-3.18	83.2939	79.2939	75.0722	77.6394
ADF(2)	-4.6087	-3.2031	85.6555	80.6555	75.3783	78.5873
ADF(3)	-5.3231	-3.1096	88.5778	82.5778	76.2451	80.0959
ADF(4)	-3.9313	-3.1118	89.0003	82.0003	74.6122	79.1048
ADF(5)	-3.2571	-3.1531	89.3264	81.3264	72.8829	78.0173

Conclusion: Variable stationary; T-stat >C.V. @ ADF (3) AIC & ADF (3)-SBC

DLEI	Statistic	CV	LL	AIC	SBC	HQC
DF	-5.2448	-3.1824	41.2167	38.2167	35.0504	36.9758
ADF(1)	-4.066	-3.18	41.3399	37.3399	33.1182	35.6854
ADF(2)	-4.5931	-3.2031	43.3325	38.3325	33.0553	36.2643
ADF(3)	-4.9496	-3.1096	44.9826	38.9826	32.6499	36.5007
ADF(4)	-4.1179	-3.1118	44.9871	37.9871	30.599	35.0917
ADF(5)	-3.0157	-3.1531	45.8193	37.8193	29.3758	34.5102

Conclusion: Variable stationary; T-stat >C.V. @ ADF (3) AIC & ADF (1)-SBC

DLTEA	Statistic	CV	LL	AIC	SBC	HQC
DF	-4.5097	-3.1824	63.6139	60.6139	57.4476	59.373
ADF(1)	-3.8055	-3.18	63.6181	59.6181	55.3963	57.9635
ADF(2)	-4.2391	-3.2031	65.2137	60.2137	54.9365	58.1455
ADF(3)	-5.2431	-3.1096	69.0991	63.0991	56.7665	60.6173
ADF(4)	-3.4653	-3.1118	70.4644	63.4644	56.0763	60.5689
ADF(5)	-2.8733	-3.1531	70.6556	62.6556	54.2122	59.3466

Conclusion: Variable stationary; T-stat >C.V. @ ADF (4) AIC & ADF (3)-SBC

DLIR	Statistic	CV	LL	AIC	SBC	HQC
DF	-4.5451	-3.1878	-44.9286	-47.9286	-51.0193	-49.1325
ADF(1)	-4.0504	-3.192	-44.924	-48.924	-53.0449	-50.5292
ADF(2)	-3.7026	-3.1645	-44.895	-49.895	-55.0461	-51.9014
ADF(3)	-3.2085	-3.1595	-44.8775	-50.8775	-57.0588	-53.2853
ADF(4)	-3.6125	-3.231	-43.5054	-50.5054	-57.717	-53.3145
ADF(5)	-2.3464	-3.29	-40.847	-48.847	-57.0888	-52.0573

Conclusion: Variable non-stationary; T-stat < C.V. @ ADF (3) –AIC & SBC

	Statistic	CV	Conclusion	Rationale
DLPO	-3.9981	-3.1662	stationary	T-stat > C.V.
DLFOF	-4.0525	-3.1662	stationary	T-stat > C.V.
DLEI	-6.0436	-3.1662	stationary	T-stat > C.V.
DDLTEA	-4.3397	-3.1662	stationary	T-stat > C.V.
DLIR	-4.4946	-3.1559	stationary	T-stat > C.V.

The unit root tests showed that all variables are non-stationary at level form and stationary at the first differenced form (I 1) therefore, we are able to proceed with co-integration tests.

B. Optimum Lag order:

Unrestricted VAR post estimation was used to determine the optimum lag; the results were as follows:

	Order	P-Value
AIC	4	0.00
SBC	1	0.00

We decided to take the lower order VAR due to the limited sample size as higher lag order may produce more difficulties in further tests.

C. Co-Integration tests:

This paper commenced with the performance of Engle Granger co-integration test whereby a model is first estimated then the residuals left from that model are tested for stationarity. Non-stationary in the variance of the residuals indicates that no long term relationship can be found while the existence of stationary residuals indicates that there are co-integrating variables within the model. This was further verified using Johansen Test at both 90% and 95% confidence intervals. The results were as follows:

A. Engle Granger Unit root test of residuals:

Test	Statistic	LL	AIC	SBC	HQC

DF	-3.2264	-65.6116	-66.6116	-67.6588	-67.0212
ADF(1)	-4.7855	-57.5549	-59.5549	-61.6492	-60.3741
ADF(2)	-4.2741	-57.4605	-61.7996	-65.6451	-61.6893
ADF(3)	-3.7341	-57.4564	-61.4564	-67.0354	-63.0948
ADF(4)	-2.8671	-56.7996	-60.4605	-63.602	-63.8476
ADF(5)	-2.0066	-52.5424	-58.5424	-64.775	-60.9753

Residuals stationary, co-integration exists, T-stat > Critical Value (3.50) at 95% confidence interval @ADF (2) and ADF (3) for AIC and SBC respectively.

The result from the above table shows that there is at least 1 co-integration available. However, one of the limitations of EG method is that it can only tell if there is one co-integration and is unable to determine if there is more than 1 co-integration in the model. Hence we proceed to Johansen test that can determine beyond 1 co-integration.

B. *Johansen Co-integration method*

Maximal Eigenvalue

Null	Alternative	Statistic	95% Critical Value	90%Critical Value
r = 0	r = 1	54.1226	37.86	35.04
r<= 1	r = 2	31.0473	31.79	29.13
r<= 2	r = 3	21.194	25.42	23.1
r<= 3	r = 4	6.4862	19.22	17.18
r<= 4	r = 5	4.251	12.39	10.55

Trace

Null	Alternative	Statistic	95% Critical Value	90%Critical Value
r = 0	r>= 1	117.1011	87.17	82.88
r<= 1	r>= 2	62.9785	63	59.16
r<= 2	r>= 3	31.9312	42.34	39.34
r<= 3	r>= 4	10.7372	25.77	23.08
r<= 4	r = 5	4.251	12.39	10.55

According to both Maximal Eigenvalue and Trace tables, we can conclude that we have 1 co-integration at 95% confidence level which is in accordance with the results of the EG method. We further deduce that we can have 2 co-integrations if we relax our confidence interval to 90% percent. However, for the sake of

consistency and accuracy the paper will neglect the results obtained at 90% confidence interval.

Furthermore, we proceeded to test for exact and over specifications using the long run structural model ("LRSM") to check for the significance of the variables and their coefficients. Taking IR as the dependent variable, the results showed that the significant variables were PO and EI while the insignificant variables were FOF and TEA accordingly. Testing the over-specification showed that excluding FOF alone and setting its coefficient as 0 made that over-specification incorrect, while removing TEA or both TEA and FOF showed that the over specification was still correct. This can be deduced by dividing the coefficients by Std errors, whereby results that exceed 2 imply significance and results below 2 are insignificant. The results table is as follows:

Variable	Panel A	Panel B	Panel C	Panel D
	Vector 1	Vector 1	Vector 1	Vector 1
LIR	1	1	1	1
	(*NONE*)	(*NONE*)	(*NONE*)	(*NONE*)
LFOF	1.4668	0	1.7459	0
	-1.0706	(*NONE*)	-1.2319	(*NONE*)
	1.3700729	-	1.417241659	-
LPO	-3.2278	-2.5964	-4.2436	-3.5843
	-1.0181	-0.94874	-1.0619	-0.99123
	3.1704155	2.736682	3.996233167	3.616012
LEI	-3.1739	-2.8363	-5.9066	-5.8449
	-1.4903	-1.5962	-0.65528	-0.69997
	2.1297054	1.776908	9.013856672	8.350215
LTEA	-3.7442	-4.146	0	0
	-1.9409	-2.0962	(*NONE*)	(*NONE*)
	1.9291051	1.977865	-	-
Trend	0.01751	0.040205	0.02638	0.054874
	-0.022859	-0.01701	-0.02574	-0.01784
		1.7688[.184]	3.2447[.072]	5.0970[.078]

Since we have established the existence of a co-integration, it is safe to assume that our first hypothesis (no relationship exists) can be nullified in favour of the second and third hypotheses. The selection of which hypothesis will hold will be performed in the next step.

D. Exogenity and Variance Decomposition Tests:

The order of leading and lagging variables can be determined using VECM and VDC accordingly. In this section, we will use VDC alone as it is more informative in the sense that it can give out relative exogenity and show the order of exogenous strength while VECM can only show absolute exogenity and will only show whether a variable is exogenous or endogenous but won't show the extent of endogenity. The results of VDC were taken at 3 forecasted intervals being 5, 10, and 15 periods accordingly. The results are as follows:

5	LIR	LFOF	LPO	LEI	LTEA		Self-Dependence	Rank
LIR	37%	1%	7%	27%	28%	100%	37%	5
LFOF	2%	93%	3%	0%	2%	100%	93%	1
LPO	2%	1%	81%	11%	4%	100%	81%	2
LEI	31%	3%	11%	47%	9%	100%	47%	4
LTEA	30%	1%	1%	16%	52%	100%	52%	3

10	LIR	LFOF	LPO	LEI	LTEA		Self-Dependence	Rank
LIR	34%	1%	8%	28%	30%	100%	34%	5
LFOF	3%	93%	3%	1%	1%	100%	93%	1
LPO	1%	1%	77%	15%	6%	100%	77%	2
LEI	29%	2%	13%	43%	12%	100%	43%	4
LTEA	35%	1%	1%	15%	47%	100%	47%	3

15	LIR	LFOF	LPO	LEI	LTEA		Self-Dependence	Rank
LIR	32%	1%	8%	28%	30%	100%	32%	5
LFOF	3%	92%	4%	1%	0%	100%	92%	1
LPO	1%	1%	76%	16%	6%	100%	76%	2
LEI	29%	2%	13%	42%	13%	100%	42%	4
LTEA	36%	1%	2%	16%	46%	100%	46%	3

The results of the Variance DeComposition test showed that Fear of Failure ranked 1st in exogenity and was the most influencing variable followed by Perceived opportunity, economic activity and Entrepreneurial Intent. The results further showed that Interest rates are in fact the most endogenous variable hence implying that it doesn't have a significant impact on the other variables. Which leads us to eliminate our second hypothesis and validate our third hypothesis accordingly.

E. Impulse Response Function and Persistence Profile:

IRF results typically show endogenity and exogenity in a graphical manner and by testing the effect of a shock to a single variable to the other variables. The results typically do not deviate from VDC results. We utilize the Generalised Impulse response function to perform this test as it does not depend on the particular ordering of the variables in the VAR neither does it shut off other variables when shocking the variable in focus as opposed to the Orthoganlised Impulse Response

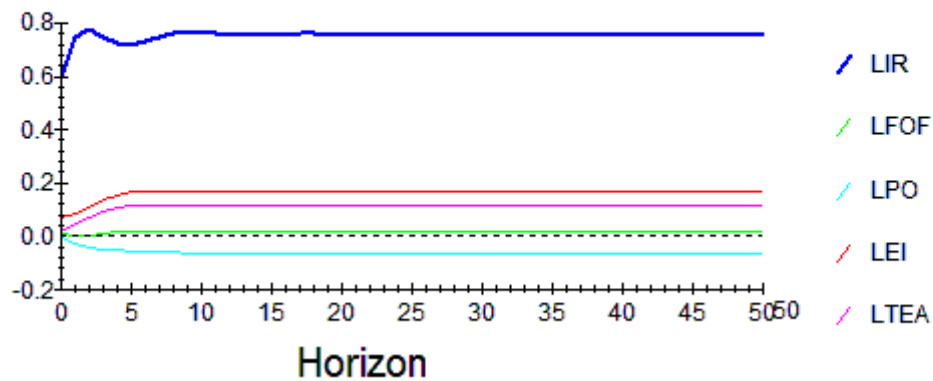Function   The   graphs   obtained   are   as   follows:

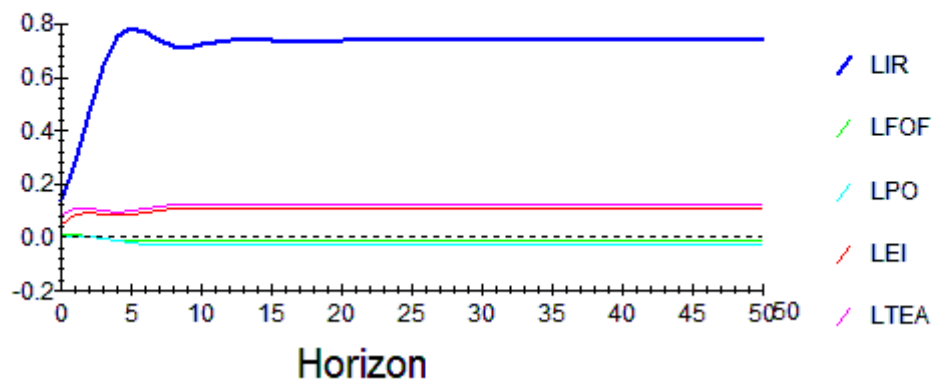## Generalized Impulse Response(s) to one S.E. shock in the equation for LPO
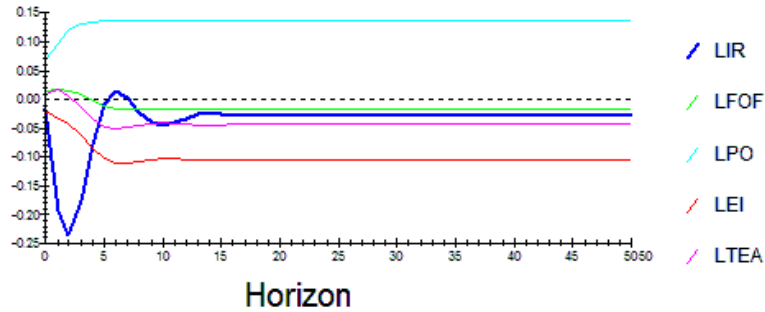
Generalized Impulse Response(s) to one S.E. shock in the equation for LFOF
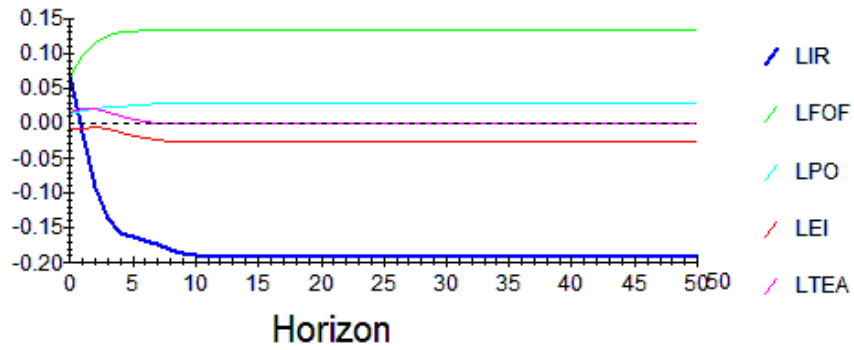
## Generalized Impulse Response(s) to one S.E. shock in the equation for LIR

Generalized Impulse Response(s) to one S.E. shock in the equation for LTEA

From the graphs above, we note that

As opposed to the individual variable shock approach held by IRF, Persistence Profile typically shocks the whole system of variables from an external source and measures the time required for the system to return to equilibrium. The external shock effectively moves variables in a non-co-integrated manner in the short run. However, the test eventually sees how long would it take for these variables to return to their normal condition of co-integration. The results below show that approximately 7 quarters are required to return the system to equilibrium which is a relatively short time.

Persistence Profile of the effect of a system-wide shock to CV'(s)
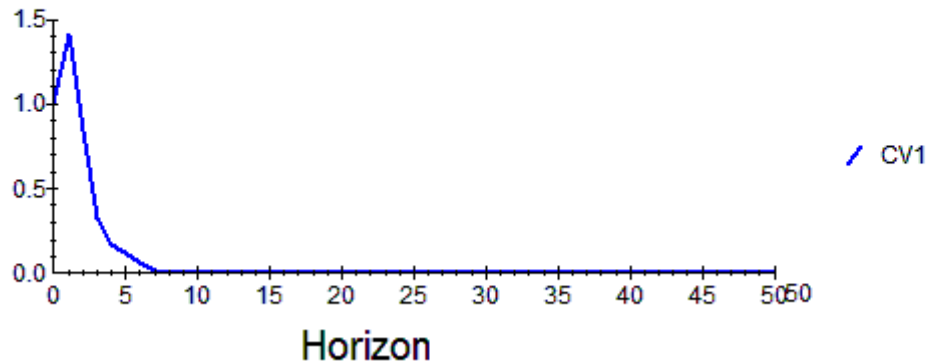
Discussion of Results

From the tests above, we manage to eliminate hypotheses 1 & 2 and validate hypothesis 3 which states that IR and EN are co-integrated and move together in the Long-run, however, IR is a lagging variable and EN is a leading variable. This eventually shows that using IR to drive EN is not useful but rather changes in EN may drive down the economy eventually causing policy makers to change interest rates hoping for potential stimulation.

This is observed through the existence of co-integration proven through Engle Granger test and Johansen Tests of co-integration. Furthermore, Variance Decomposition showed that the 2 main effective constituents of entrepreneurship which are perceived opportunities and fear of failure are the exogenous (driving variables) and that interest rate is actually the most endogenous (driven variable). This further explains why interest rates are not stimulating the economy even in a negative nominal rate. The results further show that the most significant variables are actually fear of failure and perceived opportunity which indicate that the general public usually wont engage in any entrepreneurial activity due to high fear of failure and lack of potential opportunities that justify the risk taken. When

closely examined together with interest rates, we can hypothesise that the general public won't engage in economic entrepreneurial activity due to these two reason and thus consequently won't seek funds in the first place. Making funds cheaper and more available still won't have an effect as nobody wants these funds to begin with.

Conclusion

The results obtained above explained that interest rates are actually a driven variable and that entrepreneurship is in fact the driving factor in the interest rate – entrepreneurship relationship. This result is in line with our theoretical review in the sense that Interest Rates are not the main driver for entrepreneurship and thus cannot stimulate economic activity. Our data showed that entrepreneurship indicators were declining and consequently causing interest rates to decline as the government tries to stimulate the economy one rate cut after another. This leads us to conclude that interest rates are not the right tool to stimulate the economy anymore as it is strongly influenced by entrepreneurship and is has insignificant influence on entrepreneurship in return. That being said, Japanese policy makers should realise that the root of their stagnation problem can't be fixed by interest rate cuts and should rather focus on social and economic field work that stimulates entrepreneurs and the general public by providing them a multitude of potential opportunities and by incorporating programs that eliminate or at least decrease the fear of failure amongst their population as this is the root cause.

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