Economic System Rationality Entropy setting for Kenya by Fiscal Policy, Job Re-assignment and Job Creation: Human Capital-based Resilience Indexing against China

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Preprint v1

Aug 8, 2023

https://doi.org/10.32388/PTNTXE

Economic System Rationality Entropy setting for Kenya by Fiscal Policy, Job Re-assignment and Job Creation: Human Capital-based Resilience Indexing against China

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Abstract

A human capital driven economy is less vulnerable to catastrophic effects than a natural resource driven economy. In the face of black swan events like the COVID-19 pandemic, it is important for economies to re-examine their economic anchor to inform their recovery rate. This paper uses economic system rationality entropy to measure resilience by examining 13 country habitats for more than half – 4.063 billion of the world's population. To this end, after working out the economic system entropies using the income consumption rationality function in Nats, the influence of the existing economic driver on the economic system entropy is established. Kirika's rationality matrix is then proposed; leading to the Entropy-Gamma Rationality law. The results show that economic system entropy is not influenced by the economic driver; and that according to the Pareto principle, about 21% of any population is rational in income generation. Surprisingly, a whopping 68% - 74% are irrational income generators but rational consumers, while 5% - 11% of any population is irrational regarding both income generation and consumption – a fundamental policy guide from quantitative behavioural economics. A fiscal policy action recommendation in the short run that indexes Kenya's cogni-economic pressure against China's to reduce both the overall cogni-economic pressure and the economic system entropy through job creation and job re-assignment concludes.

Keywords: *Economic system rationality entropy, Kirika's rationality matrix, Entropy -gamma rationality law*

Introduction

Entropy is a measure of the disorder or randomness of a system (Atkins, Paula & Keeler, 2018).

The concept was introduced by the German physicist Rudolf Clausius in 1850. This initial version

specifically relates to thermal processes in statistical physics or physical chemistry as espoused in the second law of thermodynamics, regarding statistics of the molecular motions of a system. Several interpretations of entropy have since emerged, the most important for purposes of this article deriving from information theory as isolated by Claude Shannon in 1949. That entropy is the inefficiency of a system in transmitting a signal or the loss of information in a transmitted signal. This means that entropy is undesirable – zero entropy is the ideal. Due to the modern portfolio theory employing too few assets and using the mean-variance principle in its return-risk analysis, entropy has been favourably used (Zhou, Cai & Tong, 2013). The asset with the highest entropy is the riskiest and should be dropped; so that an investor would select the assets possessing the lowest entropy.

In the same vein, rational decision-making in human economic agents involves a lot of cognitive energy to make it consistent, since the disorder is more natural than order (Pryde-Eubanks, 2008). For purposes of survival, humans will employ all cognitive, affective and psychomotor faculties to ensure sight of the following day. However, when more resources are available to them progressively, they drop their guard to gravitate towards impulsive buying while paying less attention to income generation to prop it. According to the theory of entropy; "every system in the universe will naturally be found either in the state of maximum disorder, or moving towards it" (Singh, 2013). An economy's decision-making processes entail aggregation of income and expenditure decisions by human economic agents individually or collectively in the form of committees, boards of management, task forces etc. The sum of the inefficiency of all these decisions hereinafter referred to as economic system rationality entropy, either leads to gross domestic product growth or decline by the year's end. How the quality of such decisions can be contrived to arrive at a preset measure of entropy in Kenya is the subject matter of this paper.

Fiscal policy involves government expenditure, taxation and government borrowing (Cole, 2020). When income tax is raised, disposable income reduces, forcing the population to exercise greater economic rationality in their income and consumption decisions. Depending on whether the economy is resource-based or human capital-based, the government, in the case of a resource-based economy may reduce savings in the face of adversity or use existing reserves. But for a human resource-based economy, oftentimes there are no reserves to cushion the population against imminent tax increases.

It is apparent that resource-based economies have a higher probability of aiding human economic agents enjoying less cogni-economic pressure in the face of adversity compared to their human capital-based counterparts facing equivalent adversity in another economy. Banking on natural resources for development has been cited as a "resource curse" (Arhend, 2006), since the population does not get proactive in improving the level of economic rationality they exercise in their income-consumption decision-making processes (Kapkanshchikov, 2021). From the above argument, this paper restricts itself to resilience that derives from human capital upping its economic rationality in the face of adversity rather than depending on government subsidies obtained from reserves born of exports from natural resources. This setting addresses natural catastrophic disruptions like COVID-19 visitation better than a resource-based economic setting.

Being the second largest economy in the world, the choice of China as a benchmark is informed by the fact that China has moved from below position 25 to the second biggest economy within the last half a century (World Bank data, 2021). Moreover, China is a human capital-based economy just like Kenya; where generally, a resource-based economy is defined as one where natural resources comprise more than 10% of the GDP and more than 40% of exports (Arhend, 2006). COVID-19 first struck China and as of 2021 October, China has recovered from the effects of the pandemic. This kind of resilience is what developing countries including Kenya, need. Of necessity and for purposes of generalizability, income consumption rationality functions (Kirika, 2020) of 13 countries home to about 4 billion people are derived using the annual maximum disposable income (Salaryexplorer, 2019). The foregoing arguments are anchored on the entropy rationality framework (Kirika, 2017), whose digression follows.

The entropy rationality model and the income consumption rationality function

George Homans (1990) expounded the rational choice theory he developed in 1961 – a behaviouralist decision theory that explains how humans make economic decisions. Sociologists and political scientists build theories around the idea that all action is fundamentally "rational" in character (Scott, 2000), also a basic assumption in neo-classical economics. This paper prefers the wording "… fundamentally rational in character…", to mean an unmeasured generality. The entropy rationality model developed a measure of economic rationality driven by the argument that the wealth creation process requires rational economic decision-making. To this end, the following model was developed (Kirika, 2017), from the Bayesian multi-period probability model.

$$\Gamma = \frac{crp^{i}(1-p)^{d}}{rp^{i}(1-p)^{d} + (1-r)\mathrm{q}^{i}(1-q)^{d}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where: Γ = Gamma Rationality Measure

c = Updating Consistency Level (parameter)

r = Prior rationality level (parameter)

p = Probability of wealth increase after making a rational decision (variable)

q = Probability of wealth increase after making an irrational decision (variable)

i = Number of wealth increases in a given time interval (parameter)

d = Number of wealth decreases in a given time interval (parameter)

Closely following, was the income consumption rationality function (Kirika, 2020), which defines the economic rationality exercised by economic agents at every income level generated and at every consumption level from the income generated depending on the economy in question. This is a single parameter equation – the curvature, which is a proxy measure for income inequality and/or governance quality for the economy.

$$\Gamma = \left(\frac{a}{y_d + a} \right)^{20} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where: Γ = Gamma Rationality Measure

a = Curvature

y_d = Annual disposable income (after-tax income)

A lower consumption level than the income generated results in savings. It is these accumulated savings that get invested for economic growth. Higher consumption level than the income generated leads to dependency hence contraction of the economy. The basic Income Consumption Rationality Function (ICRF) is driven by the survival motivation of economic agents while all higher ICRFs are driven by ambition motivation. Moreover, as an economy improves, the operational ICRF shifts to the right to reflect the new survival function, effectively reducing inequality represented by a higher curvature value. For ICRF-Survival, a = 18,081,793.5; for ICRF-Ambition 1, a = 20,081,793.5 and for ICRF-Ambition 2, a = 22,081,793.5. Given that point, B represents an income level of KES 1,500,000 p.a. and A represents a consumption level of KES 800,000 p.a., at economic rationality levels of 20% and 40% respectively, KES 700,000 is saved for investment. If alternatively, the consumption level is KES 1,600,000, the individual will

perpetually be in debt of KES 100,000, becoming a dependent. That is, if he rationalizes his consumption at lower than 20%. It is clear that higher income levels involve the employment of lower cognitive energy (economic rationality) to generate, which affords the individual greater savings power.

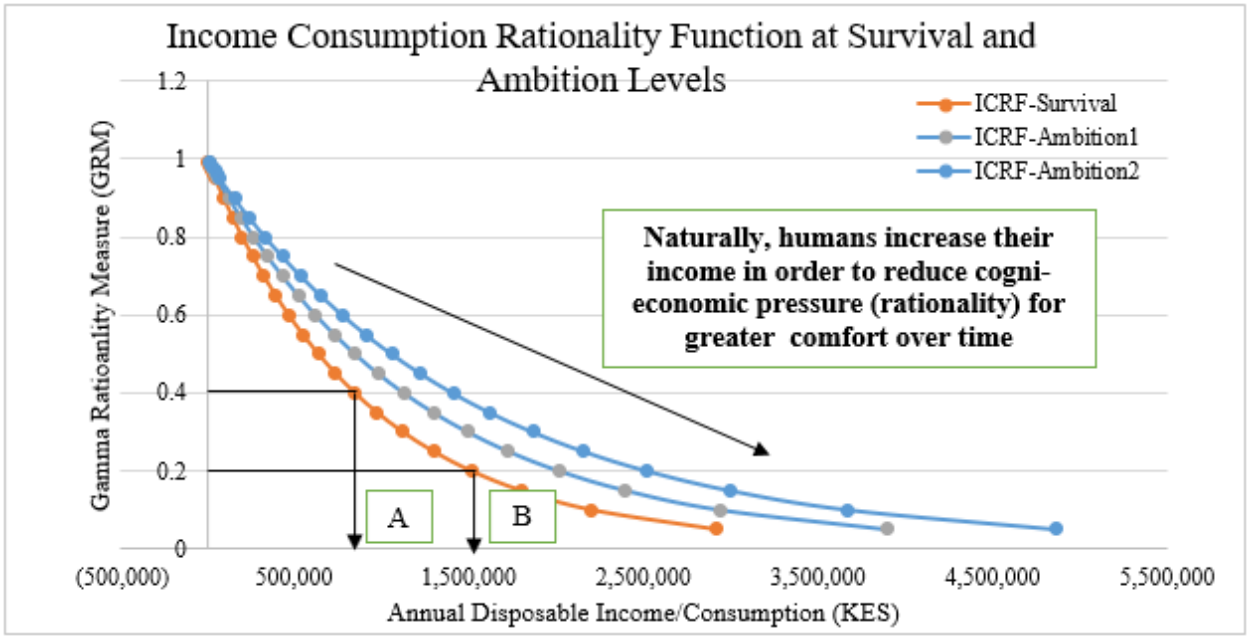

Figure 1: Income consumption rationality functions driven by survival and ambition

Effectively, the mean rationality exercised by the individual is determined by:

Mean rationality = Income rationality x Proportion of savings + Consumption rationality x proportion of consumption

$$\Gamma_M = (1-S)\Gamma_C + S\Gamma_Y \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

These principles apply throughout the discussion. The layout of this paper proceeds as follows: the annual median disposable income is used to work out the average economic rationality exercised in each of the thirteen economies. The median is preferable to the mean since it is not severely affected by the skewness of the data. Gross domestic savings (World Bank Data, 2019) are then used to derive the probability of rational expenditure after rational income earnings. Finally, the minimum annual disposable earnings are used to derive the probability of rational consumption. These three pieces of information are sufficient to extract all other relevant probabilities using Bayes theorem, for purposes of determining joint entropy in an economic system. Kirika's rationality matrix is then derived after conducting a normality test on each of the four emerging combinations of economic players as one of three interpretations. A discussion

finally ensues on how Kenya can attain the entropy of China using fiscal policy, job creation and job re-assignment.

Statement of the problem and objectives

While Kenya has been generally a mixed economy since independence (1963), China only changed to a mixed economy in 1979 from a communist state. It has since steadily risen to occupy the second position globally in economic size. Several questions beg; first, given that 10% of the world's population owns 88% of the world's wealth, (Davies, Lluberas & Shorrocks, 2017) is it random? If not, what behavioural attributes does the 10% possess and possibly, where does it live? What in specific terms is the difference between the Kenyan economy as compared to the Chinese economy in terms of population behavioural attributes?

Kenya was only able to save 4.45% of its gross domestic product (GDP) while China saved 43.98% of its GDP in 2019 (World Bank data, 2020); yet, China is a human capital-based economy just like Kenya, pointing to a difference in economic behavioural attributes of the inhabitants of the two countries. To establish the existing behavioural differences, the following objectives were pursued. First, to determine the Economic System Rationality Entropy (ESRE) of thirteen selected countries home to 4.064 billion people, from their income consumption rationality functions for job creation and fiscal policy recommendations by indexing economic decision-making practices to China's; second, to formulate Kirika's rationality matrix by establishing behavioural traits distribution of economic agents in the selected economies for job re-assignment policy recommendation. Finally, the paper envisages to derive and propose the Entropy-Gamma rationality law.

Literature review

George Homans' rational choice theory (1961), has been described as a simplistic representation of the real-world decision-making process regarding consumption decisions (Jacoby, 2000). This paves the way for more realistic theories that capture the economic decision-making processes of humans better. Bounded rationality theory (Simon, 1997) parades a better way of explaining the exercise of economic rationality (Wheeler, 2018). That human rationality is constrained by two factors: the amount of information available and the cognitive ability to process that information. Cumulative prospect theory (1992), a modified version of prospect theory (1979) by Kahneman and Tversky posits that economic agents tend to underweigh higher probability prospects and

overweigh lower probability prospects whether in income or expenditure decisions. Proponents of these two theories are Nobel Economic Science laureates in 1978 and 1992, Herbert Simon and Kahneman & Tversky respectively.

The oversight in the two theories under consideration in this article is that the execution of economic decisions by economic agents happens within a certain socio-economic environment, considered a universal set. Considering the two constraints cited by Herbert Simon, if economic agent A perceives that their survival is more threatened than the much economic agent B feels their survival threatened, A is likely to deploy all the mental faculty ability to process available information to both A and B more than B would. In the same light, if a worker migrates from a less competitive economy to a more competitive one, the decision weights function of the individual will have to be adjusted to reflect the new prevailing circumstances.

The notion of survival as a fundamental motivation for rational decision-making is well-captured by the Emotional Theory of Rationality (Garces & Finkel, 2019). "According to this theory, the emotional system is responsible for assessing and qualifying all the stimuli simultaneously attempting to access cognitive resources, modulating attention systems to prioritize and resolve conflicts, thereby assigning available resources to different stimuli according to their criticality". In short, in both bounded rationality and prospect theories, context has been ignored. This provides the motivation for advancing the Economic System Rationality Entropy (ESRP), which introduces the context variable at a macro level. Notably, context would affect the parameters in each theory or model, not necessarily the applicability of the theory.

Method and discussions

To establish the income consumption rationality function of the selected countries, the single parameter (curvature) is determined by substituting the maximum annual after-tax (disposable) income in that economy in Equation 2. The median income generation rationality P(YR=1) is obtained by substituting the annual median after-tax income in the income consumption rationality function. Consumption rationality after income rationality P(CR=1|YR=1) in the economy is obtained by deducting the GDP savings (World Bank Data, 2019) given as a percentage of income, from the annual net median income. This figure is then substituted into the income consumption rationality function. Finally, to find the probability of rational expenditure P(CR=1), (without the ability to save), the annual minimum after-tax salary is substituted into the income consumption rationality function. P(CR=1) refers to the amount of money an individual would earn and consume

for survival only i.e., without any remainder for saving. It may be recognized that earnings below this amount would render the individual a dependent. All income and consumption are measured in Kenya Shillings (KES); so, a column for the average exchange rate for 2019 is given.

Given the three probabilities worked out above, P(CR=0|YR=1) is obtained by deducting P(CR=1|YR=1) from unity. Similarly, P(YR=0) and P(CR=0) are respectively obtained by subtracting P(YR=1) and P(CR=1) from unity. Using the six probabilities so availed, Bayes theorem is then invoked to derive all the other probabilities. Economic System Rationality Entropy is obtained using the joint probabilities P(CR=1&YR=1), P(CR=0&YR=1), P(CR=1&YR=0) and P(CR=0&YR=0) according to equation 3. Dropping the "R" notation from each probability to secure a single-line formula fit, the equation is represented thus;

$$H = -\left\{P(C=1\&Y=1)\ln P(C=1\&Y=1) + P(C=0\&Y=1)\ln P(C=0\&Y=1) + P(C=1\&Y=0)\ln P(C=1\&Y=0) + P(C=0\&Y=0)\ln P(C=0\&Y=0)\right\}$$

…….. (4)

After summarizing the four joint probabilities in a table for the 13 countries, the Shapiro-Wilk normality test is done for each of the joint probabilities to arrive at the generalization of Kirika's Rationality Matrix. Using equation 3, total rationality in each economy is worked out. The relationship between entropy and total rationality, entropy and income rationality and, entropy and consumption rationality are finally explored using regression analysis to bring forth the Entropy-Gamma Rationality Law.

Table 1: Annual disposable income**, c**urvature and savings as a proportion of GDP

Annual Disposable Income, Curvature and GDP Savings

Country	FX/KES2019	Maxsalnet	Medsalnet	Minsalnet	Curvature	Sav%	Pop. (Million)
Japan	1.07	24,788,989.60	7,650,763.43	1,111,752	80,283,983.20	0.24558	126.26
China	0.0677	14,363,699.47	4,261,373.71	1,203,989.39	46,519,645.44	0.43981	1,398.00
Uganda	35.93	3,698,675.00	945,703.23	120,004.50	11,978,881.42	0.19677	44.26
Kenya	1.00	5,577,823.20	1,246,124.40	229,192.80	18,119,590.57	0.04451	52.57
UK	0.0076784	20,217,892.54	5,880,370.72	978,325.32	65,479,162.06	0.29263	66.84
USA	0.009805	25,843,909.04	6,682,207.34	986,588.23	83,700,545.80	0.18166	328.33
Russia	0.6451613	6,668,090.07	1,584,211.46	196,287.66	21,595,911.73	0.31321	144.41
Indonesia	136.30	3,307,495.75	778,368.30	205,227.96	10,711,970.82	0.31012	270.63
South Africa	0.141557	8,129,038.36	2,121,442.49	360,194.52	26,327,478.03	0.18467	58.56
Nigeria	3.506	5,962,453.52	1,460,126.42	679,132.80	19,310,569.97	0.23235	200.96
India	0.690179	1,156,939.70	279,162.46	39,363.72	3,746,975.13	0.27686	1,366.00
Singapore	0.013334	27,004,974.17	7,069,843.49	1,817,703.51	87,460,881.93	0.40052	5.70
Luxembourg	0.0087559	21,715,783.69	6,083,521.70	1,055,288.39	70,330,125.65	0.53416	0.62

Source: Researcher workings from Salary Explorer (2019) and World Bank Data (2019)
Disposable salary values have been worked out using income tax rates applicable in 2019

Though the curvature in Table 1 represents income inequality, it should be noted that within an income consumption rationality function, the minimum salary and median salary may vary, to exhibit different actual income inequalities. This means that curvature just indicates the maximum income inequality that can feature in that economy. This also means that two economies with the same curvature values may manifest different inequality values primarily depending on the minimum and medium salaries. For instance, Indonesia and Uganda have almost the same curvature value, with Uganda at a higher level. Yet, Uganda has a lower minimum salary at KES 120,004.5 p.a. while Indonesia affords KES 205,227.96 p.a., almost twice. This scenario depicts an overlap in the income inequality measure. India is the most unequal society as reflected by both earnings and curvature. With almost the same population as that of China, India may be required to borrow a leaf from China on how to revitalize its economy. But with all the misfortunes of India, it has been able to save 27.69% of its GDP earnings, unlike Kenya which saved a paltry 4.5% in 2019.

Table 2: Income, consumption, average rationalities, joint probabilities and entropy

Country	**IncRat**	**ConRat**	**AvgRat**	**Joint Probabilities**				**Economic System Entropy**
	P(Y=1)	**P(C=1)**	**P(R=1)**	**P(C=1&Y=1)**	**P(C=0&Y=1)**	**P(C=0&Y=0)**	**P(C=1&Y=0)**	
Japan	0.1619	0.7700	0.6207	0.0404	0.1215	0.1085	0.7296	0.8567
China	**0.1519**	**0.8288**	**0.5311**	**0.0517**	**0.1002**	**0.071**	**0.7771**	**0.7674**
Uganda	0.2188	0.7777	0.6677	0.0640	0.1548	0.0675	0.7137	0.8874
Kenya	**0.2637**	**0.7774**	**0.7545**	**0.0737**	**0.19**	**0.0326**	**0.7037**	**0.8666**
UK	0.1791	0.7433	0.5782	0.0523	0.1268	0.1299	0.6910	0.9367
USA	0.2152	0.7704	0.6695	0.0607	0.1545	0.0751	0.7097	0.8964
Russia	0.2427	0.8345	0.6491	0.0908	0.1519	0.0136	0.7437	0.7828
Indonesia	0.2459	0.6842	0.5483	0.0925	0.1534	0.1624	0.5917	1.1135
South Africa	0.2123	0.7620	0.6605	0.0595	0.1528	0.0852	0.7025	0.9128
Nigeria	0.2327	0.8132	0.6783	0.0753	0.1574	0.0294	0.7379	0.8137
India	0.2376	0.8114	0.6525	0.0832	0.1544	0.0342	0.7282	0.8417
Luxembourg	0.1903	0.7424	0.4475	0.0864	0.1039	0.1537	0.6560	1.0112
Singapore	0.2113	0.6627	0.4819	0.0820	0.1293	0.2080	0.5807	1.1118
Kenya Indexed	0.1519	0.8288	**0.6034**	0.0424	0.1095	0.0617	0.7864	**0.7370**
Mean	0.2126	0.7675	0.6108	**0.0702**	**0.1424**	**0.0901**	**0.6973**	**0.9076**
Std Dev	0.03364	0.05135	0.0877	**0.0166**	**0.0248**	**0.0593**	**0.0571**	**0.1114**

The column labelled P(Y=1), refers to the average proportion of income generation decisions that are rationalized in the economy. For Japan, 16.19% of such decisions must be rationalized. Alternatively, it means that income generation decisions are rationalized 16.19% of the time, while consumption P(C=1) decisions are rationalized 77% of the time. Were consumption decisions to be rationalized at the same 16.19%, no savings would be obtained for Japan for later investments. The average economic rationality is the weighted value of income and consumption where the weights are the proportion of savings for income rationality and consumption for consumption rationality, obtained using equation 3 to derive the column labelled P(R=1).

From this column, Kenya has the highest cogni-economic pressure (Kirika, 2020) explained by a very low savings rate. Note also that Kenya has the highest income rationality at 26.37%. This means that it requires a lot of effort to keep a job in Kenya, or even to secure one or sustain a business. Business sustenance means retention of a continuous flow of sales. This is closely followed by Indonesia at 24.59%. The country with the highest consumption rationality is Russia at 83.45%. This means that for every 100 consumption decisions an individual makes in Russia, 84 of them have to be rational. This is the highest cogni-economic consumption pressure on the list. China follows closely at 82.88% approximately 83 decisions in every 100. Incidentally, China has the lowest income rationality, meaning that jobs are plenty for 56% working population compared to 38% working population of Kenya (World Bank Data, 2019). Evidently, it is better to work in the UK than in the USA for a Kenyan. The income and consumption pressure in the UK is 17.91% and 74.33% respectively; compared to the USA with income and consumption pressures of 21.52% and 77.04% respectively.

From Bayes theorem, all joint probabilities are obtained e.g.

$$
\begin{aligned}
&P(C=1\&Y=1) = P(C=1|Y=1)xP(Y=1)\\
&P(C=0\&Y=1) = P(C=0|Y=1)xP(Y=1)\\
&P(C=1\&Y=0) = P(C=1|Y=0)xP(Y=0) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (5)\\
&P(C=0\&Y=0) = P(C=0|Y=1)xP(Y=0)\\
&P(C=0\&Y=1) = 1 - P(C=1\&Y=1)
\end{aligned}
$$

Finally, using equation 4, Economic System Rationality Entropies (ESRE) for all the countries are worked out. The country with the greatest consistency in economic decision-making (least

entropy) is China at 0.7674 Nats; for this reason, this article's intention is to benchmark Kenya against China. Surprisingly, the UK and USA have a higher economic decision-making disorder (entropy) at 0.9367 Nats and 0.8964 Nats respectively, compared to Kenya's 0.8666 Nats – the reason why Kenya's economy was described as "extraordinarily resilient" by the Central Bank Governor (Miriri, 2017) after a political showdown. Kenyans do carry great economic pressure and still survive.

Indexing Kenya's income rationality against China's by job creation

The estimation of working populations for both Kenya and China in 2019 is derived from World Bank Data (2019). The working population of Kenya was 18.1 million out of a total population of 52.57 million (34.43%) and 811 million out of a total population of 1398 (58.01%) million for China. A greater working proportion of the population in China is responsible for lower-income cogni-economic pressure (0.1519) compared to Kenya (0.2637). It can be established that this is almost purely the reason by computing 0.5801*0.1519/0.3443 = 0.2559 which compares favourably with 0.2637; excess pressure which may be attributed to other inefficiencies like underdeveloped infrastructure in Kenya. This means that by increasing Kenya's working population to 58% from 34.43% in 2019, income generation pressure can be reduced to 0.1519.

Kenya's population in 2019 by census was 47.6 million. 58% of this gives 27.6 million. But a birth rate of 28.298 per 1000 people and a mortality rate of 5.393 per 1000 people prevails in Kenya; with a net birth rate of 22.905 per 1000 people per year. Holding this net birth rate constant, in ten years the population would be 47.6*1.022905^10 = 57.0544 million by the year 2029. Working out 58% of 57.0544 obtains 33.1 million working population. The current working population after a loss of 700,000 jobs to COVID-19 is 17.4 million; meaning that 33.1 million – 17.4 million gives a jobs deficit of 15.7 million jobs. Ignoring the multiplier effect, by creating 15.7/10 = 1.57 million jobs a year, it is possible to attain China's behavioural attributes of income generation.

Indexing Kenya's consumption rationality against China's by fiscal policy

Consumers in Kenya exercise less economic rationality (0.7774) than China (0.8288). To increase consumption cogni-economic pressure, taxation of goods needs to be increased; to impact an overall effect of (0.8288-0.7774)/0.8288 = 0.0514, approximately 5%. However, this cannot be implemented before jobs have been created, for it would increase the overall cogni-economic pressure in the economy to unbearable levels. Having indexed both income and consumption

rationalities, it is possible to achieve China's savings level of 43.98% of GDP. However, this can only be achieved by the end of ten years of indexing implementation. The Kenya-indexed computed values at the bottom of Table 2 have been worked out using a savings level of 33% of GDP applied to Kenya's income consumption rationality function. Effectively, this indexing results in an overall economic rationality of 0.6034 (60.34%), and an entropy of 0.7370 lower than the current China's entropy of 0.7674. This means that with sufficient jobs, Kenya's population has what it takes to become a first-world country within 10 years.

Kirika's Rationality Matrix

A close look at the values of the four joint probabilities reveals that the values are within a given range for each of the joint probabilities. Since only 13 countries were examined, we cannot assume normality by invoking the central limit theorem. It is a requirement to establish the normality of each group of joint probabilities. Both Kolmogorov-Smirnov and Shapiro-Wilk tests were employed. Of course, the Shapiro-Wilk test is preferred for not suffering from oversensitivity. However, though only one of the groups was found to significantly vary with the normal distribution using the Kolmogorov-Smirnov test, by increasing the test to cover 13 items (to include Singapore), there was evidence that even Kolmogorov-Smirnov test would eventually indicate the normality of the probabilities. The results are shown in Table 3.

Table 3: Tests of Normality for 12 Countries

	Kolmogorov-Smirnov[a]			Sha piro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
PC1Y1	.128	12	.200*	.951	12	.650
PC0Y1	.296	12	.005	.878	12	.082
PC0Y0	.157	12	.200*	.934	12	.426
PC1Y0	.211	12	.145	.902	12	.166

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Table 4: Tests of Normality for 13 Countries

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
PC1Y1	.146	13	.200*	.948	13	.569
PC0Y1	.265	13	.013	.902	13	.141
PC0Y0	.148	13	.200*	.941	13	.465
PC1Y0	.228	13	.063	.879	13	.069

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

From the above revelation, the normal distribution is assumed and, invoking the t-test, an interval estimate of the joint probabilities can be estimated from the mean and standard deviations worked out in Table 2 (in bold). At a 5% significance level, the t critical value for 13 -1 = 12 degrees of freedom is 2.179; so that: Population mean = Sample mean $\pm$ 2.179xStd Dev/13^0.5. This produces the following interval estimates.

Table 5: Population joint probability intervals at a 5% level of significance

	Joint Probability			
	P(C=1&Y=1)	P(C=0&Y=1)	P(C=1&Y=0)	P(C=0&Y=0)
Normal distribution interval at 5% SL	6.02% - 8.02%	12.74% - 15.73%	66.28% - 73.18%	5.43% - 12.59%

Interpretation

From Table 5, three interpretations regarding economic agents' decision-making dispositions may be deduced. First, in terms of rational and irrational decisions made per unit time. Second, in terms of the proportion of time, economic agents remain rational in any given interval of time and third, in terms of personality trait dispositions to be rational or irrational income generation and rational or irrational consumption decisions. While the first two can only apply to pure probabilities for income or consumption, a critical submission here is that joint probabilities can only apply to personality trait dispositions. Surprisingly, these probabilities fall within certain ranges; the distribution is not haphazard! It is argued in this article that any population of economic agents can be divided into four mutually exclusive groups.

The first group comprises rational income generation decision-makers as well as rational consumers. This is undoubtedly the most valuable group. This group is able to accumulate wealth progressively since they consistently create savings arising from rational consumption after making very rational income generation decisions. This group solely comprises visionary/builder or lifestyle entrepreneurs (Salmony & Kanbach, 2021). The government, on identification of these people, should ensure to support them for this 7% of the population forms part of the 10% of all start-ups that survive in the long run. Survival and opportunistic entrepreneurs finally fall by the wayside when they secure a job or have gathered enough money for other ventures.

The second group of about 14% of the population is composed of people who know how to look for money (income generators) but do not know how to spend it. These should ideally be paired with rational consumers for progress (savings for investments) to be made. Such people are superb marketers and salespersons. Such people should work under the direction of a group of one person for optimal results. The third group comprising about 70% are persons who are very good spenders and rational consumers but do not know how to generate income. These basically man the cost centres of an organization.

Amazingly, in any organization, cost centres are usually more than profit centers. Cost centres include all production departments human resource departments etc. Properly trained persons in this group do serve to control the costs of the entire organization. Lastly, the fourth group comprises 9% of people who are irrational spenders who even do not know how to generate income. These are usually dependents in society. They exert a great deal of pressure upon their managers seeking to manage them. They generally do not improve their economic status for the same reason. They are a necessary liability to the society. Survival entrepreneurs are made up of 70% of the group plus 9% of the group; only the 70% group are rational spenders but irrational income generators. This analysis is summarized by a proposed rationality matrix named Kirika's Rationality Matrix in Table 6.

Table 6: Kirika's Rationality Matrix

	Rational Earners	**Irrational Earners**	**Total**
Rational Consumers	7%	70%	77%
Irrational Consumers	14%	9%	23%
Total	21%	79%	100%

Table 7: Tests of normality for rational income generators

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
PY1	.177	13	.200*	.956	13	.699

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

When confidence boundaries were worked out for rational income generators at a 95% confidence level, the mean proportion of rational income generators was found to be 21.26% ranging from

19.23% to 22.19% of any random population. This means the distribution of rational income generators follows the **Vilfredo Pareto Principle**. That is, about 20% of the population feeds the entire population (both themselves and the remaining 80%). Since this proportion is a sum of two joint probabilities {P(C=1|Y=1) and P(C=0|Y=1)}, exhibition of normality of the sum of the two means normality of the individual distributions.

Job re-assignment using Kirika's rationality matrix

Conventional progression towards employment is to acquire an education, and then training as necessary. Oftentimes, employees do not get job placements according to their education and/or training. When it comes to delivery on the job, employers find certain employees fit more in different jobs from the ones they have qualified in, with the employee's consent. It may be more profitable to obtain a classification of personal traits using this matrix to arrive at the right quadrant each employee belongs as a primary consideration followed by educational or professional qualifications. Post-COVID-19 pandemic, a vital submission is that if this consideration is made, greater resilience is more likely to be harnessed than just following educational or professional qualifications.

Entropy-Gamma rationality law

An examination of the relationship between entropy and income rationality, entropy and consumption rationality, and entropy and overall rationality including combinations of each was done. Tables 8 to 15 show the results. Apparently, income rationality has no relationship with entropy on its own, evidenced by a significance value of 0.726. The reason for plotting rationality on the x-axis is that the exercise of high rationality results in orderly decision-making hence a lower entropy. The direction of causality is therefore from rationality to entropy.

Table 8: Regression of Entropy on PY1 Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	.832	.213		3.897	.002
	PY1	.357	.993	.108	.360	.726

a. Dependent Variable: entropy

But consumption rationality has such a profound effect on entropy, significant at less than 1% and an R square of 0.942 as shown in Table 9. It's worth noting, though, that the combined effect yields an adjusted R square of 0.98, which is the highest.

Table 9: Regression of Entropy on PC1 Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	2.528	.116		21.805	.000
	PC1	-2.111	.151	-.973	-14.004	.000

a. Dependent Variable: entropy

Average rationality has a significant effect on entropy but only at a significance level of less than 5% and not less than 1% as shown in Table 10. Like consumption rationality (PC1), average rationality has a negative effect on entropy. The reason for this is that the greatest component in average rationality is consumption rationality in all the data save for Luxembourg which has a savings rate of 53.42% of GDP.

Table 10: Regression of Entropy on average rationality Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	1.356	.193		7.034	.000
	rat	-.734	.313	-.578	-2.347	.039

a. Dependent Variable: entropy

The combined effect of income and consumption rationality on entropy in Table 11 is such that income rationality has no effect just as it was as singly. However, the level of insignificance has declined from 0.726 to 0.243. This means that the presence of the consumption rationality variable aids its significance level.

Table 11: Regression of Entropy on PY1 and PC1 Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	2.465	.124		19.890	.000
	PY1	.279	.225	.084	1.242	.243
	PC1	-2.106	.147	-.971	-14.310	.000

a. Dependent Variable: entropy

Again, the combination of average rationality with income rationality has a significant effect on entropy surprisingly. But income rationality alone has no effect on its own. While its effect is only significant below 5% and not below 1% (0.043 in Table 12), it already qualifies as an important variable. The tragedy is that in Table 13, the same income rationality turns insignificant when combined with average rationality, and with a huge margin.

Table 12: Regression of Entropy on PY1 and average rationality Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	1.187	.179		6.647	.000
	rat	-1.110	.311	-.874	-3.574	.005
	PY1	1.874	.810	.566	2.313	.043

a. Dependent Variable: entropy

Finally, a combination of all three kinds of rationalities results in a perfectly significant effect all of which are below a 1% level of significance. In this case, just like before, the constant in the model is consistently significant. This may be interpreted to mean that according to the maximum rationality principle, substituting all rationality types with zero yields a maximum disorder measure of 2.335 Nats. Excepting any of the three would result in omitted variable bias as indicated by the consistent increase of adjusted R square. Since average rationality combines income and consumption rationalities with savings % of GDP, it means that savings are an important variable in the model.

Table 13: Regression of Entropy on PC1 and average rationality Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	2.519	.114		22.175	.000
	PC1	-2.000	.173	-.922	-11.589	.000
	rat	-.124	.101	-.098	-1.226	.248

a. Dependent Variable: entropy

The overall model here named **Entropy-Gamma Rationality Law** is stated thus;

$$H = 2.335 + 0.748\Gamma_y - 1.801\Gamma_c - 0.335\Gamma_m \quad \ldots\ldots\ldots\ldots\ldots (6)$$

Where, H = Entropy; Γ_y = Income rationality; Γ_c = Consumption rationality; Γ_m = Mean rationality. The law may also be stated as in equation 7, where *S* is savings as a percentage of GDP.

$$H = 2.335 + 0.413\Gamma_y - (2.136 + 0.335S)\Gamma_c \quad \ldots\ldots\ldots\ldots (7)$$

The coefficients are drawn from Table 14. To achieve the lowest entropy, an economy should engage in the lowest income rationality and the highest consumption rationality. On the same breadth, contrivance should be done to maximize the mean rationality; this may only happen, again, if consumption rationality is maximized since it comprises the greatest component of mean rationality.

Table 14: Regression of Entropy on PY1, PC1 and average rationality Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	2.335	.081		28.729	.000
	PY1	.748	.176	.226	4.258	.002
	PC1	-1.801	.115	-.830	-15.686	.000
	rat	-.335	.079	-.264	-4.247	.002

a. Dependent Variable: entropy

A model fit test was done using the mainstream non-parametric test of Wilcoxon and related tests, between the actual entropy and estimated entropy using the model. Of course, a Pearson correlation was possible, but it assumes linearity which may not necessarily be a valid assumption, especially because the expansion of equation 7 exhibits joint variation between savings and consumption rationality. Clearly, all four tests prescribe retention of the null hypothesis with related-samples sign test showing an exact deterministic fit.

Table 15: Hypothesis Test Summary for the model fit

	Null Hypothesis	Test	Sig.	Decision
1	The median of differences between entropy and estentr equals 0.	Related-Samples Sign Test	1.000[a]	Retain the null hypothesis.
2	The median of differences between entropy and estentr equals 0.	Related-Samples Wilcoxon Signed Rank Test	.917	Retain the null hypothesis.
3	The distributions of entropy and estentr are the same.	Related-Samples Friedman's Two-Way Analysis of Variance by Ranks	.782	Retain the null hypothesis.
4	The distributions of entropy and estentr are the same.	Related-Samples Kendall's Coefficient of Concordance	.782	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .050.

a. Exact significance is displayed for this test.

Conclusion and further research

Greatly consoling results that economic decision-making disorder is not a preserve of low-income countries but is rather evenly distributed amongst humanity is moreover encouraging. The main difference between performance in economies in the globe is the way they organize their economic systems. It is elating to find that there is actually greater economic decision-making disorder in the United States of America and the United Kingdom than there is in Kenya. This may explain why when workers migrate from low-income countries to high-income countries they perform exemplarily well; and why all that is required is to organize the low-income economies to perform equivalently with high-income countries. That distribution of disorder in economic decision-making is independent of underlying income inequality in any given economy is rewarding new knowledge. The fact that Kenya rationalizes its income decisions at the highest-pressure level – almost twice the much as China does, with job creation, this pressure can only reduce. The government of Kenya needs to perhaps stop any other business and embark on job creation only; if it can enable the creation of 1.57 million jobs a year for the next ten years, no doubt that Kenya can easily leap to a first-world country in the economic mind of the inhabitants.

The other thrilling finding is that rational income generation and rational consumption abilities are evenly distributed in the world. This means that governance is the main factor that causes wealth disparity in economies. This matrix prompts the development of a tool that can be used to classify economic agents especially for purposes of entrepreneurship start-up funding and revenue and cost centre job placement of employees to maximize productivity. Motivation should be employed after the correct classification of employees. Otherwise, motivation programs may not yield much results. No declared entrepreneur identified to belong to the first quadrant (rational income generator and rational consumer) should go without funding; for it is a sure bet that the business they would engage would survive in the long run. Since these traits are innate, more studies need to be done on the influence of temperament and personality on placement in any one of the four quadrants of Kirika's rationality matrix. This matrix also would help the government in budgeting for the unfortunate in society, besides employee job placement in the civil service. The matrix also goes a long way to underscore the importance of the Pareto principle in this additional field.

The Entropy-Gamma rationality law is a remarkable breakthrough. The law provides a mathematical relationship between economic decision-making in the economy on one hand and economic rationality in its various three forms and national savings on the other. Since the law was so accurately derived, it can be used by economies to set the entropy levels they need to achieve in the structural equation, so that governments can set the parameters they desire to achieve a predetermined level of entropy in the economy using a range of interventions including job creation, and fiscal policy that includes government borrowing and taxation. The equation can also be used to determine the maximum entropy (disorder) by substituting for all rationalities with zero. Ordinarily, from the income consumption rationality function or psycho-socio economic equation, such a substitution would lead to indeterminate form solutions. But this gives a clear maximum of 2.335 Nats. In very specific terms, a high-income rationality serves to increase overall entropy while a high-consumption rationality serves to reduce entropy increasing quality decision-making in the economy for greater order.

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