Sustainability thought 160: System stability issues under the sustainability eye: Stating the market structure-population dynamics-system stability framework and its systematic implications.

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Abstract: It can be said that system stability issues like those associated with climate change are usually looked at through partial frameworks as relevant components or links are assumed to have a neutral role or are assumed not to exist in the analysis. For example, frameworks that link market structure and system stability are thought as delinked from population dynamics. On the other hand, frameworks that linked population dynamics and system stability are taken as being delinked from market structure dynamics. And therefore, the nature of the root cause; and the nature of the consequences affecting the system stability issue will depend on the specific framework being used so each partial framework has a different root cause. It can be said that system stability issues like climate change can also be looked at systematically by linking partial frameworks to generate a full general framework. For example, combining the market structure and system stability framework with the population dynamics and system stability framework we can put together a general market structure-population dynamics-system stability framework to trace root cause and consequences affecting system stability, where market structure drives the population dynamics that affect system stability, positively or negatively. In this framework, there is only one root cause and the others factors are consequences affecting system stability. To my knowledge, no much is written about system stability issues from the sustainability point of view, where all components are linked, and the nature of the first component starts the chain of events that affect system stability. And this raises the question: How can the general market structure-population dynamics-system stability framework be stated? What are the main systematic implications of this? Among the goals of this paper is to provide answers to those questions.

Keywords: Market structure, market price, production, consumption, population dynamics, overshoot, no overshoot, overpopulation, environmental problems, system stability, climate change, responsible behavior, irresponsible behavior.

Introduction

a) Partial system stability frameworks

It can be said that system stability issues like those associated with climate change are usually looked at through partial frameworks as relevant components or links are assumed to have a neutral role or are assumed not to exist in the analysis. For example, frameworks that link market structure and system stability are thought as delinked from population dynamics. On the other hand, frameworks that linked population dynamics and system stability are taken as being delinked from market structure dynamics. And therefore, the nature of the root cause; and the nature of the consequences affecting the system stability issue will depend on the specific framework being used so each partial framework has a different root cause. These frameworks are look in detail below.

i) The market structure-system stability framework(M-R)

Market structure dynamics(M) can have either a positive impact(+) on system stability(R) or a negative one(-), a situation that can be seen easily in Figure 1 below.

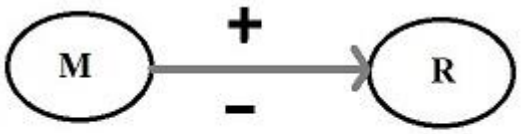

Figure 1 The market structure and system stability framework(M-R framework)

Figure 1 above summarizes the thought that the market structure(M) depending on its nature can have either a positive(+) or a negative(-) impact of system stability(R). A negative impact(-) means that market structure dynamics go beyond the carrying capacity of the system R; and a positive impact(+) means that market structure dynamics operate within or below the carrying capacity of the system R. For example, if the nature of the market structure is optimal or responsible or sustainable, then it will have a positive impact(+) on system stability as it will be within the carrying capacity of the system R, but if the nature of the market is distorted or irresponsible it will have a negative impact(-) on system stability R as it will operate over the carrying capacity of the system R. It is believed that we need to move towards a world of responsible system stability through sustainable production and sustainable consumption as indicated in Goal 12 of the 17 sustainable development goals(UN 2015), a responsible production and responsible consumption goal(UN 2020).

Notice that for presentation purposes, Figure 1 above shows only the root cause link as indicated by the direction of the black arrow to the right, it does not show the fact that the nature of system stability R can affect positively(+) or negatively(-) the nature of the market structure M if closing the loop.

Implication 1: The root cause of system R stability or instability in the M-R framework is the nature of the market structure M.

ii) The population dynamics-system stability framework(T-R)

Population dynamics(T) can have either a positive impact(+) on system stability(R) or a negative one(-) too, a situation that can be appreciated in Figure 2 below.

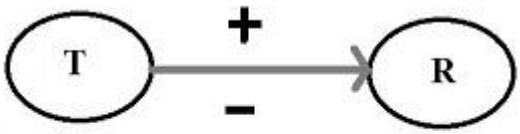

Figure 2 The population dynamics and system stability framework(T-R framework)

Figure 2 above points out the thought that population dynamics(T) depending on its nature can have either a positive(+) or a negative(-) impact of system stability(R). A negative impact(-) means that population dynamics go beyond the carrying capacity of the system R overshooting; and a positive impact(+) means that population dynamics operate within or below the carrying capacity of the system R so they do not overshoot. For example, if the nature of the population is optimal or responsible or sustainable, then it will have a positive impact(+) on system stability as it stays within the carrying capacity of the system R, but if the nature of the population is not optimal or irresponsible or unsustainable it will have a negative impact(-) on system stability as it will operate over the carrying capacity of the system R. The need to move to a world where population dynamics operates within or below the carrying capacity of system stability R and away from ecological overshoot has been stressed recently(Rees 2022).

Notice that for presentation purposes, Figure 2 above highlights only the root cause link as indicated by the direction of the black arrow to the right, it does not show the fact that the nature of system stability R can affect positively(+) or negatively(-) the nature of population dynamics T if closing the loop.

Implication 2: The root cause of system R stability or instability in the T-R framework is the nature of population dynamics T.

b) Full system stability frameworks

It can be said that system stability issues like climate change can also be looked at systematically by linking partial frameworks to generate a full general framework. For example, combining the market structure and system stability framework with the population dynamics and system stability framework we can put together a general market structure-population dynamics-system stability framework to trace root cause and consequences affecting system stability, where market structure drives the population dynamics that affect system stability, positively or negatively. In this framework, there is only one root cause and the others factors are consequences affecting system stability. The thoughts behind this general framework are introduced in detail below, analytically and graphically.

i) The market structure-population-dynamics-system stability framework(M-T-R)

By combining the M-R framework with the T-R framework using qualitative comparative means we can arrive to the general M-T-R framework as shown below:

1) M-T-R = (M-R)(T-R) = M-T-R

Expression 1 above simple says that by merging the two partial frameworks M-R framework and the T-R framework we arrive to the general M-T-R framework.

The M-T-R framework can be expressed graphically as indicated in Figure 3 below:

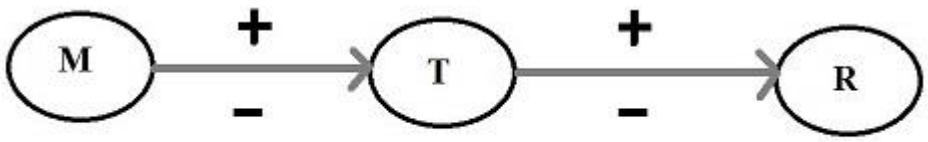

Figure 3 The market structure, population dynamics and system stability framework(M-T-R framework)

Figure 3 above allows us to have a full system view of the system stability issue(R). The following aspects can be stressed based in Figure 3 above: i) the nature of market M determines the type of impact(+/-) on population T; and the nature of population T drives the nature of the population impact(+/-) on system stability R; ii) There are 2 different impact loops through which market structure dynamics operates, a positive loop(+) at the top of M-T-R; and a negative loop(-) below of M-T-R; and iii) A positive market structure M impact on population dynamics T means it leads to good population behavior, keeping population impacts within the carrying capacity of system R; and a negative market structure M impact on population dynamics T means it drives bad population behavior pushing it over the carrying capacity of the system R. For example, the positive loop is associated with responsible market structure behavior such as full or right market pricing while the negative loop is linked to irresponsible market behavior like distorted market pricing.

In 1987 the Brundtland Commission(WCED 1987) concluded that social and environmental unsustainability were the result of a traditional business model not working properly and in need of correction; and in 2012 the United Nations Commission on Sustainable Development(UNCSD 2012a; UNCSD 2012b) decided to implement an environmental correction through green markets, green growth and green economies to at least deal with the environmental unsustainability in traditional markets. Those social and environmental sustainability problems highlighted by the Brundtland Commission then have been accumulating since 1776(Smith 1776) when Adam Smith gave us the theory of the perfect traditional market as economic expansion in a more at the lowest cost possible is better paradigm led through time to over production and over consumption and over population and overshoot. That means that Adam Smith's market prices have been distorted from the beginning(Muñoz 2010) forcing us now to go backwards in terms of economic thinking(Muñoz 2012) to address the fact that the assumptions of social and of environmental externality neutrality in this model were actually wrong, and perhaps

this view prevented him then from stating instead the theory of the perfect sustainability market(Muñoz 2015) as had the pricing of the traditional market been truly optimal from the beginning they would have reflected all the cost associated with production, and that would have led to optimal production, optimal consumption, optimal populations and no overshoot.

Notice that for presentation purposes, Figure 3 above shows only the root cause link as indicated by the direction of the black arrow to the right, it does not show the fact that the nature of system stability R can affect positively(+) or negatively(-) the nature of the market structure M if closing the loop.

Implication 3: The root cause of system R stability or instability in the M-T-R framework is the nature of the market structure M.

c) The need to look at system stability issues from the sustainability angle

To my knowledge, no much is written about system stability issues from the sustainability point of view, where all components are linked, and the nature of the first component starts the chain of events that affect system stability. And this raises the question: How can the general market structure-population dynamics-system stability framework be stated? What are the main systematic implications of this? Among the goals of this paper is to provide answers to those questions.

Goals of this paper

a) To extend the market structure and system stability framework(M-R framework) to highlight price, production and consumption links to system stability; b) The extend the population dynamics and system stability framework(T-R framework) to point out possible positive and negative impacts on system stability; c) To extend the general M-T-R framework to stress its systematic structure linking root causes to consequences to system stability; d) To point out that the linking of the M-R framework and the T-R framework leads to the M-T-R framework; and f) To highlight the nature of the general M-T-R framework and the systematic implications to current development dynamics in terms of policy action.

Methodology

First, the terminology, some operational concepts and merging rules are shared. Second, the market structure and system stability framework is expanding by using the market structure components, market price, consumption and production. Third, the population dynamics and system stability framework is expanded by using the two different overshooting behavior displayed by populations. Fourth, the market structure, population dynamics and system stability framework is expanded by adding market structure components and population impacts. Fifth, the market structure, population and system stability framework is extracted by internalizing the population dynamics and system stability framework into the market structure and system stability framework. Sixth, the general market structure, population dynamics and system stability framework is highlighted and its systematic implications stressed. And finally, some food for thoughts and relevant conclusions are provided.

Terminology

M = Market structure dynamics	T = Population dynamics
R = System stability	MP = Market price
C = Consumption	P = Production
OVS = Overshoot	NOVS = No overshoot
A = Dominant / active component	a = Dominated / passive component
M-R framework	T-R framework
M-T-R framework	TM = Traditional market price

Operational concepts and merging rules

i) Operational concepts

1) Responsible market price, a *price that reflects all the cost of production*
2) Irresponsible market price, *a price that does not reflect all the cost of production*
3) Responsible population behavior, *one that lives under the carrying capacity of the system so it does not overshoot*
4) Irresponsible population behavior, *one that goes over the carrying capacity of the system so it overshoots.*
5) Responsible production, *the one driven by a responsible market price*
6) Irresponsible production, *the one led by an irresponsible market price*
7) Responsible consumption, *the one driven by a responsible market price*
8) Irresponsible consumption, *the one led by an irresponsible market price*
9) Right market price, *a responsible market price*
10) Distorted market price, *an irresponsible market price*

ii) Merging rules

a) The case of frameworks

Let's assume we have a stability system with 4 components A, B. C and D and 4 different frameworks: F1 = A-D, F2 = B-D, F3 = C-D, and F4 = A-B-D, where D is the stability issue and the other components are the root causes and/or consequences, then the following merging rules hold:
1) F1-F2 = (A-D)(B-D) = A-B-D as DD = D
2) F1-F3 = (A-D)(C-D) = A-C-D as DD = D
3) F2-F3 = (B-D)(C-D) = B-C-D as DD = D
4) F1.F4 = (A-D)(A-B-D) = A-B-D as AA = A and DD = D
5) F2-F4 = (B-D)(A-B-D) = A-B-D as BB = B and DD = D
6) F3.F4 = (C-D)(A-B-D) = A-B-C-D since DD = D

b) The case of dominant component based systems

Let's assume we have a development model with 3 components A, B. and C; and we have 4 possible dominant component based models: M1 = A, M2 = B, M3 = C, and M4 = BC, then the following merging rules hold:
1) M1.M2 = (A)(B) = AB
2) M1.M3 = (A)(C) = AC
3) M1.M4 = (A)(BC) = ABC
4) M2.M3 = (B)(C) = BC
5) M2.M4 = (B)(BC) = BC

c) The case of dominant and dominated component based systems

Let's assume we have a development model with 3 components A, B. and C; and we have 4 possible dominant and dominated components based models: M1 = Abc, M2 = aBc, M3 = abC, and M4 = aBC, then the following merging rules hold:

1) M1.M2 = (Abc)(aBc) = ABc
2) M1.M3 = (Abc)(abC) = AbC
3) M1.M4 = (Abc)(aBC) = ABC
4) M2.M3 = (aBc)(abC) = aBC
5) M2.M4 = (aBb)(aBC) = aBC

Extending the market structure and system stability framework(M-R framework)

We can extend the M-R framework in Figure 1 of the introduction by using the components of the market structure(M), which are market price(MP), consumption(C), and production(P), as indicated in Figure 4 below:

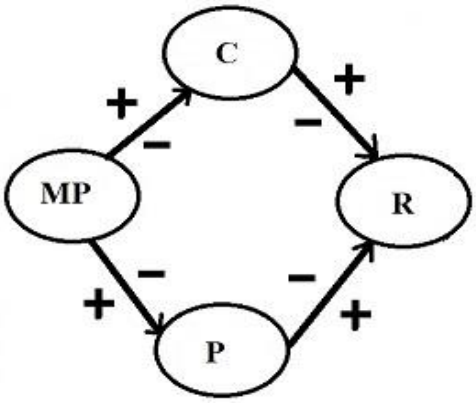

Figure 4 Extending the market structure and system stability framework(M-R framework)

We can appreciate based on Figure 4 above that the nature of the market price(MP) determines the nature of consumption(C) and production(P), which in turn determines the nature of their impact on system stability R. For example, responsible market pricing(MP) has a positive stability impact on consumption(C) and production(P) as it leads to responsible production and consumption behavior and this has a positive impact on system stability(R). On the other hand, irresponsible market pricing(MP) has a negative stability impact on consumption(C) and production(P) as it leads to irresponsible production and consumption behavior, and this has a negative impact on system stability(R).

Notice that for presentation purposes, Figure 4 above shows only the root cause link as indicated by the direction of the black arrows going to the right, it does not show the fact that the nature of system stability R can affect positively(+) or negatively(-) the nature of the market price MP if closing the loop.

Implication 4: The root cause of system R stability or instability in the extended M-R framework is the nature of the market price and the nature of production and consumption behavior is consistent with the nature of the market price MP.

Extending the population dynamics and system stability framework(T-R framework)

We can extend the T-R framework in Figure 2 of the introduction by using the two possible overshooting behaviors that a population(T) can display, which are no overshooting behavior(NOVS) and overshooting behavior(OVS) as displayed in Figure 5 below:

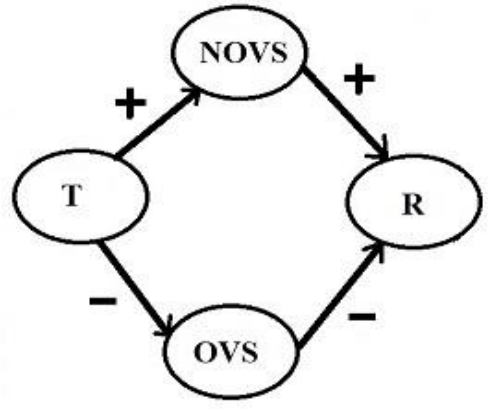

Figure 5 Extending the population dynamics and system stability framework(T-R framework)

We can see based on Figure 5 above that the nature of the population(T) determines the whether they overshoot(OVS) or not(NOVS), which in turn determines the nature of its impact on system stability R. For example, responsible populations(T) have a positive stability impact on No overshoot(NOVS) as they encourage no overshoot; and no overshooting has a positive impact on system stability(R). On the other hand, irresponsible populations(T) have a negative stability impact on overshooting(OVS) encouraging even a more extreme overshooting behavior, and this has a negative impact on system stability(R).

Notice that for presentation purposes, Figure 5 above has only the root cause link as indicated by the direction of the black arrows going to the right, it does not show the fact that the nature of system stability R can affect positively(+) or negatively(-) the nature of population dynamics T if closing the loop.

Implication 5: The root cause of system R stability or instability in the extended T-R framework is the nature of population dynamics; and the nature of the overshooting behavior is consistent with the nature of population dynamics T.

Extending the market structure, population dynamics, and system stability framework(M-T-R framework)

We can extend the M-T-R framework in Figure 3 of the introduction by using the market structure components(MP, C, P) as the market structure M; and using the two possible overshooting impacts(NOVS, OVS) that populations T have as shown in Figure 6 below:

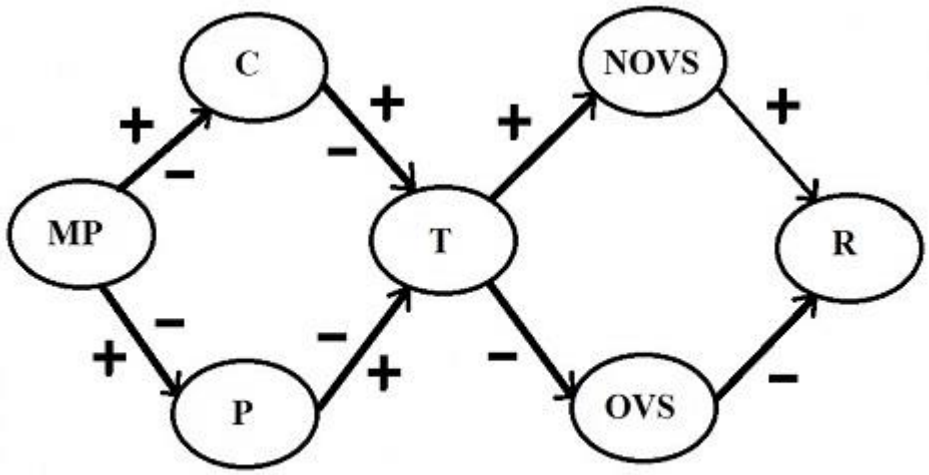

Figure 6 Extending the general market structure, population dynamics and system stability framework (M-T-R framework)

We can highlight the following aspects based on Figure 6 above: i) The nature of the market price(MP) determines the nature of consumption(C) and production(P); ii) the nature of consumption(C) and production(P) shape the nature of populations(T); iii) the nature of populations(T) leads to whether they overshoot(OVS) or not(NOVS); and iv) The nature of the overshooting behavior determines whether the impact is positive or negative on system stability.

Notice that for presentation purposes, Figure 6 above shows only the root cause link as indicated by the direction of the black arrow to the right, it does not show the fact that the nature of system stability R can affect positively(+) or negatively(-) the nature of the market price MP if closing the loop.

Implication 6: The root cause of system R stability or instability in the extended M-T-R framework is the nature of the market structure, and the nature of consumption and production, of population dynamics and of overshooting behavior is consistent with the nature of the market price MP.

Linking the M-R framework with the T-R framework

Notice that we can arrive at the M-T-R framework in Figure 6 above by internalizing the T-R framework in the M-R frameworks as indicated in Figure 7 below:

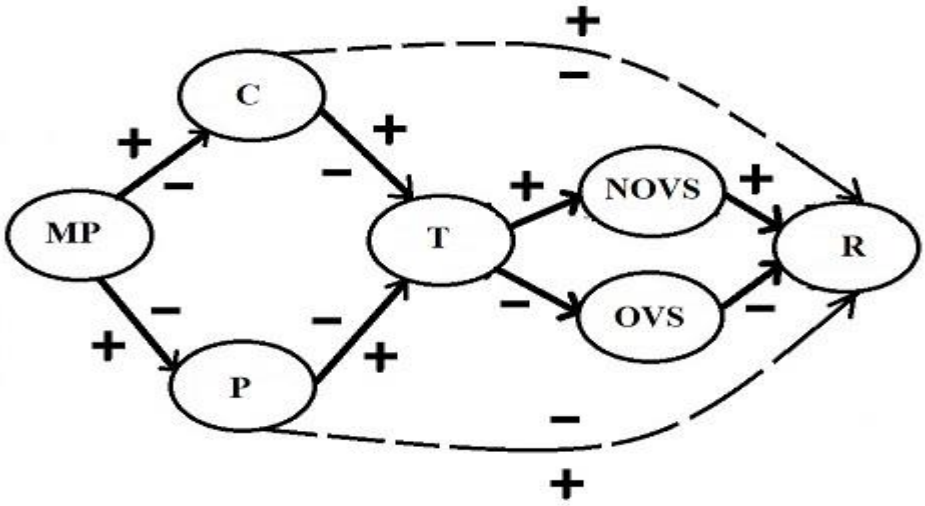

Figure 7 Internalizing the population dynamics and system stability framework(T-R framework) into the market structure and system stability framework(M-R framework)

Figure 7 above tells us that when you internalize population dynamics and system stability framework(T-R framework) into the market structure and system stability framework(M-R framework) then market structure dynamics(M) links to population dynamics(T) as indicated by the continuous arrows from consumption(C) and production(P) to population(T) and by the broken arrows from consumption(C) and from production(P) to system stability R. Hence, the nature of market structure dynamics shapes the nature of population dynamics, responsible to responsible or irresponsible to irresponsible. In other words, the structure in Figure 7 is the same as the structure in Figure 6, the M-T-R framework.

The general M-T-R framework

Hence, the M-T-R framework can be generalized by dividing components into root cause, consequences, and system stability, where the nature of the root cause determines the nature of the consequences, which then determine the nature of the impact on system stability as indicated in Figure 8 below:

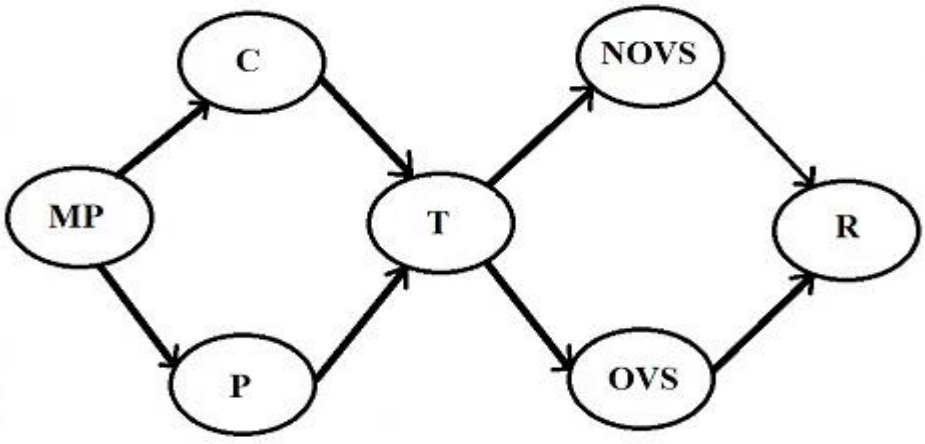

Figure 8 The general market structure, population dynamics, and system stability framework (M-T-R framework)

The following aspects can be highlighted based on Figure 8 above: i) market pricing(MP) is the root cause of impacts on system stability R, be it they positive or negative; ii) The nature of population dynamics(T) is the consequence of the nature of market price dynamics; iii) overshooting behavior(OVS) is associated only with irresponsible population behavior driven by irresponsible market structure dynamics; and iv) No overshooting behavior(NOVS) is linked to responsible population behavior led by responsible market structure dynamics. The structure in Figure 8 above then highlights the systematic nature of system stability issues R such as climate change, requiring a systematic policy response whether it is to promote system stability friendly market and population policies or to discourage system stability unfriendly trends.

Summary

In the expanded market structure and system stability framework(M-R framework), the root cause of system stability dynamics is market price dynamics, responsible pricing leads to system sustainability and irresponsible pricing leads to system unsustainability. In the expanded population dynamics and system sustainability framework(T-R framework), the root cause of system stability dynamics is the nature of the population, responsible populations do not overshoot as they stay within the carrying capacity of the system; and irresponsible populations overshoot as they go over the carrying capacity of the system. In the expanded market structure, population dynamics and system stability framework(M-T-R framework) and general framework, the root cause behind system stability dynamics is market structure dynamics and here population dynamics is a consequence of market structure dynamics as the nature of consumption and production behavior is consistent with the nature of the market pricing.

General implications

The framework in Figure 8 above is consistent with the following two thoughts: a) Optimal market pricing would lead to optimal production and consumption, which shape optimal populations, which do not overshoot as they would live within the carrying capacity of the environment; b) Non-optimal or distorted market pricing would lead to over production and over consumption, which shape overpopulation's led population dynamics that overshoot as they will go over the carrying capacity of the system; and therefore; c) the general M-T-R frameworks can be a useful tool for understanding the link between root causes and consequences affecting system stability in a systematic way both under optimality pricing thinking and non-optimal pricing thinking; and for using this knowledge to develop systematic policies to encourage system stability friendly behavior in markets and populations or to discourage system stability unfriendly behavior in markets and populations or to understand what needs to be done to transition markets and populations from an irresponsible state to a responsible one.

Food for thoughts

a) Can we solve system stability issues by focusing on current system stability issues only? I think No, what do you think?; b) Can we solve system stability issues by focusing only on preventing future system stability issues? I think No, what do you think?; and c) Does the solving a system stability issue requires both preventive action and current action at the same time? I think Yes, what do you think?

Conclusions

First, it was shown by means of the expanded M-R framework that the nature of production and consumption behavior is determined by the nature of the market price. Second, it was stressed by means of the expanded T-R framework that the nature of the overshooting behavior is determined by the nature of the population dynamics. Third, it was highlighted by means of the expanded M-T-R framework that the natures of the production consumption behavior, of the population dynamics behavior, and of the overshooting behavior are all shaped by the nature of the market price. Fourth, it was pointed out that if we internalize the extended T-R framework into the extended M-R framework by linking market structure(M) to population dynamics(T) we generate the structure of the extended M-T-R framework. And fifth, it was indicated that because the general M-T-R framework allows for a systematic look at system stability issues it can be used for putting together a systematic solution to system stability issues by implementing policies that prevent future system stability issues while addressing current ones all at the same time.

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