Sustainability thoughts 125: Why is pareto efficient in traditional markets outside green pareto efficiency in green markets? What is the structure of green pareto optimality? What are the implications of this?

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Abstract: At the heart of perfect market thinking is pareto efficiency thinking, in consumption and in production, where pareto efficiency in production and consumption is found at the market equilibrium point. The 2012 Rio +20 conference shift to green market thinking means that traditional pareto efficiency thinking is left behind as when internalizing environmental costs in the pricing mechanism of the traditional market we shift the production frontier, the social indifference curve, and the market price line of the traditional market towards the green production frontier, the green social indifference curve, and the green market price line of green markets, and therefore, it is a shift towards green pareto optimality, giving birth that way to green pareto efficiency thinking. This is because at the heart of green market thinking is the concept of green pareto efficiency, in green consumption and in green production, where green pareto efficiency in production and consumption is found at the green market equilibrium point. In other words, a shift from traditional perfect market thinking to perfect green market thinking like the one we had in the 2012 Rio +20 Conference means a shift from pareto efficiency and optimality to green pareto efficiency and optimality, yet to my knowledge nothing is written about this. And this raises questions such as why is pareto efficient in traditional markets outside green pareto efficient in green markets? What is the structure of green pareto optimality? What are the implications of this?

Keywords: Pareto efficient, pareto inefficient, pareto improvement, pareto optimal, green pareto efficient, green pareto inefficient, green pareto improvement, green pareto optimal, paradigm shift, traditional market, green market

Introduction

a) The nature of pareto efficiency thinking

The nature of pareto efficiency thinking can be extracted with the use of three components, the production frontier(PF), the social indifference curve(SIC), and the market price line(MPL) in relation to production and consumption bundles of product Q and product R , as indicated in Figure 1 below:

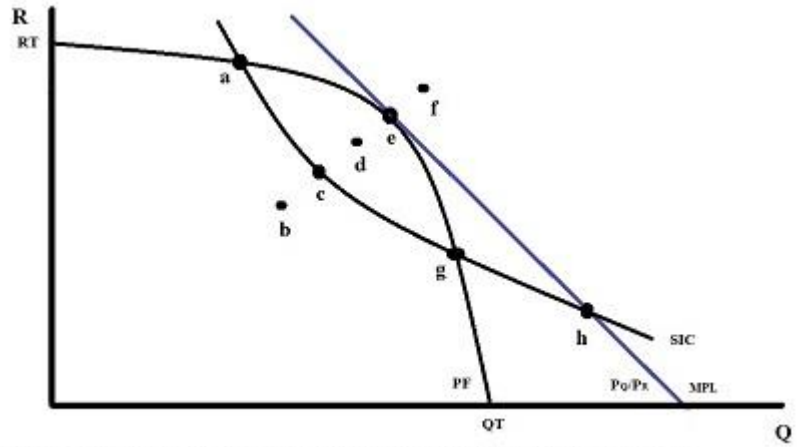

Figure 1 The thinking behind pareto efficient, pareto inefficient, pareto improvement and pareto optimal

Figure 1 above shows a constellations of points that are used below to point out the thinking behind pareto

efficient, pareto inefficient, pareto improvement, and pareto optimal as they relate to the production frontier(PF), the social indifference curve(SIC) and the market price line(MPL), as described in detail below:

1) The thinking behind the production frontier (PF)

We can see in Figure 1 above that there is a production frontier PF, where all production bundles on it like points "a", "e", and "g" are pareto efficient in production because at those points no pareto improvements in production exist. Points "b", "c" and "d" are pareto inefficient in production as pareto improvements in production exist. Points "f" and "h" are production points that falls outside the production frontier so producing at that level is not possible. Producing at point "d' for example is preferred than producing at point "b". Notice that here the idea of more production is better prevails in the analysis.

2) The thinking behind the social indifference curve (SIC)

We can see in Figure 1 in above that there is a social indifference curve SIC, where all consumption bundles on it like points "a", "c", "g" are pareto inefficient in consumption because at those points pareto improvements in consumption exist, and notice that point "h" is a consumption point on the social indifference curve(SIC) that falls outside the production frontier(PF); and therefore, that consumption bundle is not available. Point "b' is the pareto inefficient consumption bundle less preferred and point "f" is the consumption bundle more preferred as it is on a higher indifference curve, but it is not available. Notice that here the idea of more consumption is better prevails in the analysis.

3) The thinking behind the market price line (MPL)

We can see in Figure 1 above that there is a market price line(MPL), with points like point "e" and "h", where at point "e" there is pareto efficient production and pricing that is optimal as the market line is tangent to the pareto efficient point "e"; and at point "h" there is pricing of a consumption bundle on the indifference curve that falls outside the production frontier, and therefore, it is not available. Notice that here the idea that the market price line when tangent determines optimal production and consumption levels prevail in the analysis.

b) The transition towards pareto optimality

As long as there are pareto improvement moves in consumption such as the ones indicated in Figure 1 above we should expect the social indifferent curve(SIC) to move up towards no pareto improvements in consumption since more consumption is better until it reaches its optimal consumption point at point "e" as indicated in Figure 2 below:

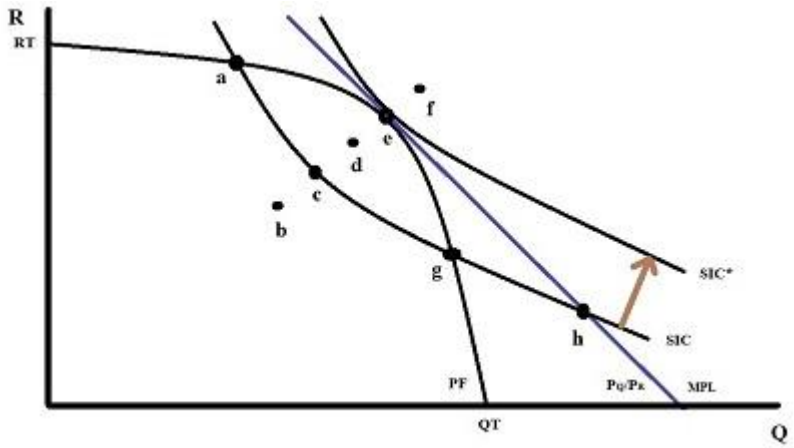

Figure 2 The move from non-optimal social indifference curves(SIC) to the optimal social indifference curve(SIC*)

We can see in Figure 2 above that since consuming more is better the social indifference curve(SIC) will shift up from point "c" all the way to point "e" as there we have the optimal level of consumption and the maximum that can be consumed; and therefore, at that point "e" the social indifference curve(SIC) takes the form of an optimal

social indifference curve(SIC*), where optimal pareto efficiency in consumption exists. In other words, pareto improvements in consumption can be made from point "c" and up, and these possible pareto improvements will stop when the social indifference curve(SIC) reaches point "e", the optimal point in production and consumption and pareto efficient. Notice that consumption at point "f" is preferred to point "e", but it is not available, so the best and optimal consumption point is point "e". Therefore, at point "e" we have optimal production, optimal consumption and optimal pricing, and therefore, point "e" is both pareto efficient and pareto optimal.

c) The structure of pareto optimality

Consistent with the above discussion, at the heart of perfect market thinking is pareto efficiency thinking, in consumption and in production, where pareto efficiency in production and consumption is found at the market equilibrium point, a situation pointed out in Figure 3 below:

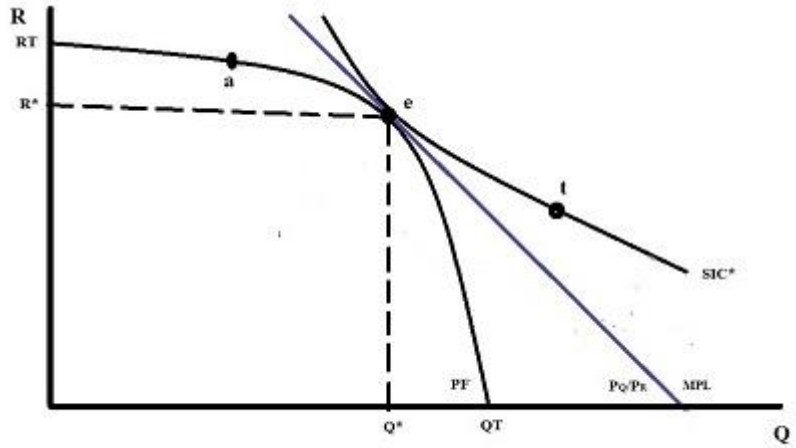

Figure 3 The structure of traditional pareto optimality

We can see in Figure 3 above that point "e" is the optimal point, 1) the point where we have optimal pareto efficiency in production and optimal pareto efficiency in consumption at the same time; and 2) the point where the traditional market price line determines the optimal quantities to be produced and consumed so it is a point of optimal pricing. We can see also in Figure 3 above also the following 1) that any point on the production frontier(PF) that is not "e" such as point "a" is pareto efficient in production, but it is not optimal; 2) that any point of the social indifference curve(SIC*) that is not "e" such as point "t" is pareto efficient in consumption, but it is not optimal; and therefore, 3) only point "e" is pareto efficient and optimal at the same time, in production and in consumption and in pricing.

Notice that since at point "e" the slopes of the production frontier(PF), of the social indifference curve(SIC) and of the traditional market price line(TML) are the same, then the following is true:

1) $|\text{Slope of PF}| = |\text{Slop of SIC}| = |\text{Slop of TML}|$
2) $MCQ/MCR = MU_Q/MUR = PQ/PR$
3) $MC_Q = MU_Q = P_Q$
4) $MC_R = MU_R = P_R$

And therefore, point "e' meets all the pareto optimality conditions in production, in consumption and in pricing at the same time, which is the reason why it summarizes the structure of pareto optimality. Notice that pareto optimality is possible only because of the externality neutrality assumption, which allow for the externalization of costs associated with production like social costs and environmental costs.

d) The nature of green pareto efficiency thinking

The 2012 Rio +20 conference shift to green market thinking(UNCSD 2012a: UNCSD 2012b) in accordance with the Brundtland Commission(WCED 1987) called to put an end to business as usual means that traditional pareto efficiency thinking is left behind as when markets shift the knowledge base of the previous paradigm is left

behind(Muñoz 2020) since when internalizing environmental costs in the pricing mechanism of the traditional market we shift the production frontier, the social indifference curve, and the market price line of the traditional market shown in Figure 3 above towards the green production frontier, the green social indifference curve, and the green market price line of green markets, and therefore, it is a shift towards green pareto optimality, giving birth that way to green pareto efficiency thinking. This 2012 move to be environmentally friendly had strong support from all sorts of institutions (WB 2012; UNDESA 2012; IISD and IIED 2014; OECD 2015a; OECD 2015b; OECD 2015c; UNIDO 2015; UNECA 2016). Notice that green pareto optimality is possible only because in green markets environmental externalities are relevant and internalized in the green pricing mechanism, there is no environmental externality neutrality assumption here(Muñoz 2016a; Muñoz 2019) . When markets shifts from perfect market to perfect market such as the shift from the traditional market to green markets the model structure, the choice s structure, and the price structure all shifts at the same time as when there is a shift the previous knowledge no longer works(Muñoz 2016b). This is because at the heart of green market thinking is the concept of green pareto efficiency, in green consumption and in green production, where green pareto efficiency in production and consumption is found at the green market equilibrium point. In other words, a shift from traditional perfect market thinking to perfect green market thinking like the one we had in the 2012 Rio +20 Conference means a shift from pareto efficiency and optimality to green pareto efficiency and optimality, yet to my knowledge nothing is written about this. And this raises questions such as why is pareto efficient in traditional markets outside green pareto efficient in green markets? What is the structure of green pareto optimality? What are the implications of this?

Goals of this paper

a) To point out that internalizing environmental costs in the traditional market shifts the pareto optimal point to the green pareto optimal point; b) To stress that in the new market even the pareto efficient point is not desirable to green stakeholders as all production and consumption points of the traditional market fall outside the green pareto production and green consumption functions so they are not available in green markets; and c) To state the structure of green pareto optimality both analytically and graphically.

Methodology

1) The terminology used to support the ideas in this paper are shared; 2) The process behind the shift from pareto efficiency to green pareto efficiency when environmental costs are internalized is indicated; 3) The nature of green pareto efficiency thinking is pointed out in detail; 4) The pareto efficiency world is compared to the green pareto efficiency world to stress that all consumption points and production points in the traditional market and traditional pareto optimality thinking including the pareto optimal point fall outside the green production frontier; and therefore, they are not possible choices in green markets; 5) The migration of green social indifference curves towards green optimality is described as driven by moves from green pareto inefficient points to a green pareto efficient point; 6) The structure of green pareto optimality is highlighted graphically and analytically; and 7) Some food for thoughts and relevant conclusions are provided.

Terminology

RT = Total production of product R R* = Optimal production and consumption of product R
QT = Total production of product Q R = Product R
Q* = Optimal production and consumption of product Q Q = Product Q
GR = Green product R GRT = Total production of green product R
GQ = Green product Q GQT = Total production of green product Q
MPL = Traditional market price line GMPL = Green market price line
SIC = Social indifference curve GSIC = Green social indifference curve
SIC* = Optimal social indifference curve PF = Production frontier
GSIC* = Optimal green social indifference curve GPF = Green production frontier
e = Pareto optimal point i = Green pareto optimal point
GR* = Optimal green production and green consumption of green product R
GQ* = Optimal green production and green consumption of green product Q

Operational concepts

1) Traditional market, *the economy only market*
2) Green market, *the environmentally friendly market*
3) Traditional market price, the *general market economic only price or the price that covers the cost of production at profit(TMP = ECM + i = P) or zero profit(TMP = ECM = P).*
4) Green market price, *the price that reflects both the economic and the environmental cost of production or the price that covers the cost of environmentally friendly production.*

5) Cost externalization, *the leaving out of the pricing mechanism of the market relevant costs associated with production.*

6) Social cost externalization, *the leaving out of the pricing mechanism of the market the social costs associated with production.*

7) Environmental cost externalization, *the leaving out of the pricing mechanism of the market the environmental costs associated with production.*

8) Cost externalization assumption neutrality, *the assumption that production has minimal or no cost impact on external factors to a market model.*

9) Full costing, *the reflecting in the pricing mechanism of the market all cost associated with production; there are no market distortions.*

10) Partial costing, *not reflecting in the pricing mechanism of the market all cost associated with production; there are partial market distortions.*

11) No costing, *not reflecting in the pricing mechanism of the market any costs associated with production; there is full market distortion.*

12) Fully independent development choices, *when we have individual development choices unrelated to each other or pure choices such as society only(A), economy only(B), and environment only(C). In this world only fully independent development choices exist so the set = {A, B, C}. This is the world of the Arrow Impossibility theory and theorem.*
13) Partially codependent development choices, *when we have mixed/paired development choices such as socio-economy(AB), socio-environment(AC), and eco-economy(BC). In this universe only codependent development choices exist so the set = {AB, AC, BC}. This is outside the normal world of the Arrow Impossibility theory and theorem.*

14) Full cost externalization, *all costs associated with production are not reflected in the pricing mechanism of the market.*
15) Partial cost externalization, *some costs associated with production are not reflected in the pricing mechanism of the market.*
16) No cost externalization, *all costs associated with production are reflected in the pricing mechanism of the market.*
17) Full cost internalization, *all costs associated with production are reflected in the pricing mechanism of the market.*
18) Partial cost internalization, *some costs associated with production are reflected in the pricing mechanism of the market.*
19) No cost internalization, *all costs associated with production are not reflected in the pricing mechanism of the market.*
20) Externalities, *factors assumed exogenous to a model*

21) Full externality assumption, *only one component is the endogenous factor in the model; the others are exogenous factors.*

22) Partial externality assumption, *not all factors are endogenous factors at the same time in the model.*
23) No externality assumption, *all factors are endogenous factors at the same time in the model.*

24) Economic externality, *the economic costs associated with production not reflected in the pricing mechanism of the market.*
25) Social externality, *the social cost associated with production not reflected in the pricing mechanism of the market.*
26) Environmental externality, *the environmental cost associated with production not reflected in the pricing mechanism of the*

market.

27) Green or environmental margin, *to cover the extra cost of making the business environmentally friendly.*

28) Social margin, *to cover the extra cost of making the business socially friendly.*

29) Economic margin, *to cover only the economic cost of production*

30) Profit, *the incentive to encourage economic activity*
31) Full cost price, *a price that reflects all costs associated with production.*
32) Some cost price, *a price that reflects only some costs associated with production.*
33) No cost price, *a price that does not reflect any cost associated with production.*
34) Circular market illusion, *the idea that production activity can take place without producing relevant externalities.*
35) Circular traditional economy illusion, *the idea that production activity can take place without producing relevant social and/or environmental externalities.*
36) Circular dwarf green economy, *the idea that market prices can be manipulated externally to generate revenue to cover the cost of dealing with the externality they create to close the non-free market cycle production-consumption-environmental externality.*
37) Circular green economy, *the idea that market prices reflect the cost of making business environmentally friendly in order to cover the cost of dealing with the environmental externalities they create to close the free market cycle production-consumption-environmental externality.*
38) Circular environmental externality management based market illusion, *the idea that you can solve an environmental externality problem by dealing with the consequences of that problem, not the cause.*
39) Circular green economy illusion, *the idea that green production and green consumption can take place without having social impacts(E(A) = 0).*
40) Pareto optimal, *the levels of production and consumption determined by the traditional market price.*
41) Green pareto optimal, *the levels of green production and green consumption determined by the green market price.*

The shift from pareto efficiency to green pareto efficiency

When the environmental cost of doing business is internalized in the pricing mechanism of the traditional market the whole pareto optimal structure in Figure 3 above shifts towards the green pareto optimal structure as indicated in Figure 4 below:

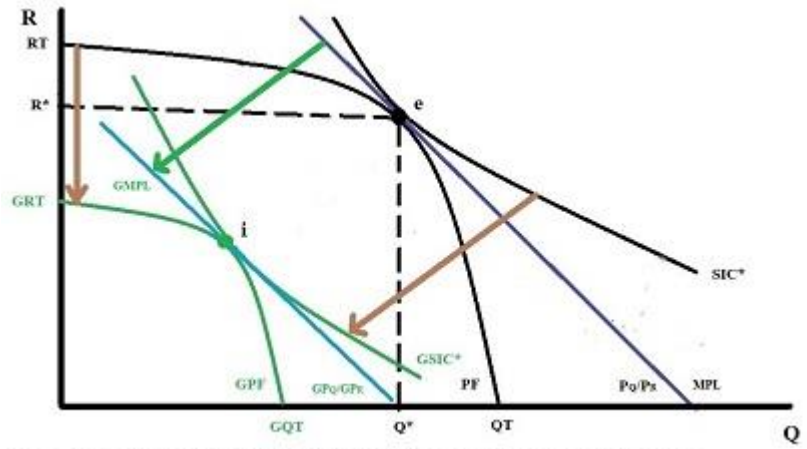

Figure 4 The shift from traditional pareto optimality at point "e" to green pareto optimality at point "i"

Figure 4 helps see the following consequences of environmental cost internalization in the traditional market producing commodities Q and R: 1) The traditional production frontiers(PF) shifts and takes the form of the green production frontier(GPF) as indicated by arrow going from RT to GRT; 2) the traditional optimal social indifference curve(SIC*) shifts and takes the form of the green optimal social indifference curve(GSIC*) as indicated by the arrow going from SIC* to GSIC*; and 3) The traditional market price line(MPL) shifts and takes the form of the green market price line(GMPL) as shown by arrow going from MPL to GMPL. Hence, Figure 4 above helps us appreciate that the internalization of environmental costs shifts the traditional pareto optimal point at point "e' to the green pareto optimal point at point "i".

The nature of green pareto efficiency thinking

The nature of green pareto efficiency thinking then can be extracted with the use of three components, the green production frontier(GPF), the green social indifference curve(GSIC), and the green market price line(GMPL) in relation to green production and green consumption bundles of product Q and product R , as indicated in Figure 5 below:

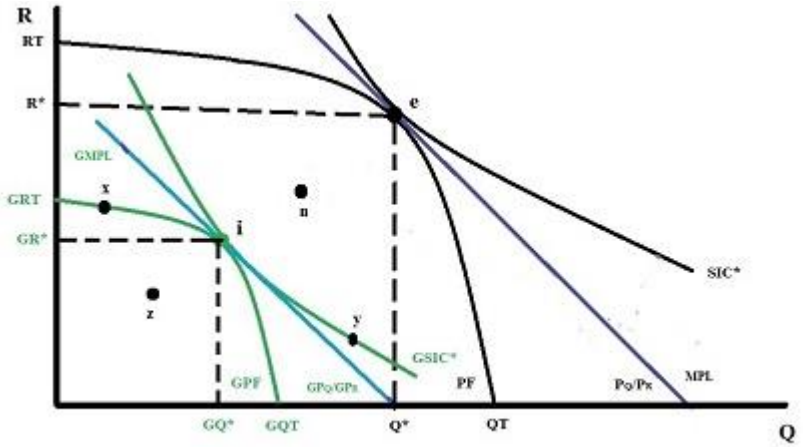

Figure 5 Contrasting the green pareto optimality at poing "i" with traditional pareto optimality at point "e"

Figure 5 above shows a constellations of points that are used below to highlight the thinking behind green pareto efficient, green pareto inefficient, green pareto improvement, and green pareto optimal as they relate to the green production frontier(GPF), the green social indifference curve(GSIC) and the green market price line(GMPL), as described in detail below:

1) The thinking behind the green production frontier(GPF)

We can see in Figure 5 above that there is a green production frontier GPF, where all production bundles on it like points "x" and "i" are green pareto efficient in production because at those points no green pareto improvements in green production exist. Points "z" is green pareto inefficient in production as green pareto improvements in green production exist. Point "n" is a production point that is preferred to "z" but falls outside the green production frontier so producing at that level is not possible. Notice that here the idea of more green production is better prevails in the analysis.

2) The thinking behind the green social indifference curve(GSIC)

We can see in Figure 5 in above that there is a social indifference curve GSIC, where all consumption bundles on it like points "y" and "i" are green pareto efficient in consumption because at those points green pareto improvements in consumption do not exist, but notice that since point "y" falls outside the green production frontier(GPF) that green consumption bundle is not available. Point "z' is the green pareto inefficient consumption bundle less preferred and point "n" is the green consumption bundle more preferred, but it is not available. Notice that here the idea of more green consumption is better prevails in the analysis.

3) The thinking behind the green market price line(GMPL)

We can see in Figure 5 above that there is a green market price line(GMPL) going through point "i" tangent to the green production frontier(GPF) and to the green social indifference curve(GSIC*) at the same time ; and this means that at point "i" there is green pareto efficiency in production, green pareto efficiency in consumption and pricing that is optimal. See that point "x" is green pareto efficient in production, but it is not optimal and point "i" is green pareto efficient in production and it is optimal. Point "y" on the other hand, if it existed, it would be green pareto efficient in green consumption, but it is not optimal while point "i" is green pareto efficient in consumption and it is optimal. Notice that here the idea that the green market price line(GMPL) when tangent determines optimal green production and green consumption levels prevail in the analysis.

Comparing the world of pareto efficiency with that of green pareto efficiency

When comparing the structure of pareto optimality at point "e" with green pareto optimality at point "i" in Figure 5 above we can see the following: 1) Traditional optimal pareto production and consumption is higher than optimal green pareto production and consumption(Q* > GQ*; R* > GR*); 2) if we were living in a green market based world and we suddenly externalize all environmental costs, then green markets would become traditional markets operating at point "e"; and 3) if we are living in a world of perfect traditional markets and we suddenly internalize all environmental costs, then traditional markets would become green markets operating at point "i". By comparing point "e" and point "i" in Figure 5 above we can state that 1) pareto optimality is not green pareto optimality; and therefore, 2) even pareto efficient and optimal points like point "e" would not be available under green markets as they fall outside the green market production frontier. In other words, we can see clearly in Figure 5 above that pareto efficient in traditional markets falls outside green pareto efficiency in green markets as even the pareto optimal point falls outside the green production frontier(GPF) so traditional market choices would not be available in green markets.

The migration of green social indifference curves towards green optimality

As long as there are green pareto improvement moves in green consumption possible such as point "z" in Figure 5 above we should expect the green social indifferent curve(GSIC) to move up towards no green pareto improvements in green consumption since more green consumption is better until it reaches its optimal green consumption point at point "i". In other words, we can see in Figure 5 above that since consuming more is better the green social indifference curve(GSIC) will shift up from point "z" all the way to point "i" as there we have the optimal level of green consumption and the maximum that can be consumed; and therefore, at that point "i" the green social indifference curve(GSIC) takes the form of an optimal green social indifference curve(GSIC*), where optimal green pareto efficiency in green consumption exists. Notice that green consumption at point "n" is preferred to point "i", but it is not available, so the best and optimal green consumption point is point "i". And this means that at point "i" we have optimal green production, optimal green consumption and optimal green pricing at the same time, and therefore, point "i" is both green pareto efficient and green pareto optimal.

The structure of green pareto optimality

At the heart of perfect green market thinking as pointed out above is green pareto efficiency thinking, in green consumption and in green production, where green pareto efficiency in green production and green consumption is found at the green market equilibrium point, a situation indicated in Figure 6 below:

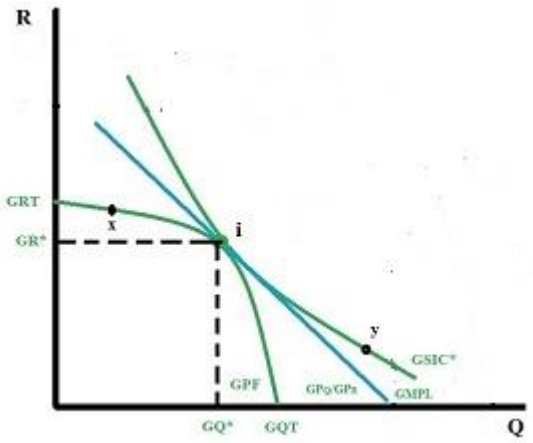

Figure 6 The structure of the green pareto optimality

We can see in Figure 6 above that point "i" is the optimal green point, 1) where we have optimal green pareto efficiency in production and optimal green pareto efficiency in consumption at the same time; and 2) the point where the green traditional market price line(GMPL) determines the optimal green quantities to be produced and consumed so it is a point of optimal green pricing. We can see also in Figure 6 above also the following 1) that any point on the green production frontier(GPF) that is not "i" such as point "x" is green pareto efficient in

production, but it is not optimal; 2) that any point on the green social indifference curve(GSIC*) that is not "i" such as point "y" is green pareto efficient in consumption, but it is not optimal and it is not available; and therefore, 3) only point "i" is green pareto efficient and optimal at the same time, in green production and in green consumption and in green pricing.

Notice that since at point "i" the slopes of the green production frontier(GPF), of the green social indifference curve(GSIC) and of the green market price line(GMPL) are the same, then the following is true:

1) $\left|\text{Slope of GPF}\right| = \left|\text{Slop of GSIC}\right| = \left|\text{Slop of GTML}\right|$
2) $GMCQ/GMCR = GMU_Q/GMUR = GPQ/GPR$
3) $GMC_Q = GMU_Q = GP_Q$
4) $GMC_R = GMU_R = GP_R$

And therefore, point "i' meets all the green pareto optimality conditions in green production, in green consumption and in green pricing at the same time, which is the reason why it summarizes the structure of green pareto optimality. Notice that green pareto optimality is possible only because there is no environmental externality neutrality assumption here in green markets as both the economic and environmental costs of production are reflected in the green market price.

Food for thoughts

1) Do paradigm shift means that the knowledge base of the old paradigm does not work in the new paradigm? I think yes, what do you think?; 2) Can green pareto optimality be seen as a fix of traditional pareto optimality to make it environmentally friendly? I think yes, what do you think?; 3) Can we think of the gap between green pareto optimality and traditional pareto optimality as an environmental externality management market zone? I think yes, what do you think?.

Conclusions

1) The internalization of environmental costs in the pricing mechanism of the traditional market shifts the pareto optimal structure to the green pareto optimal structure; 2) The nature of green pareto efficiency thinking can be taken as a correction of pareto optimality thinking to make it environmentally friendly; 3) Once in green markets, traditional pareto efficiency thinking does not work as now all traditional pareto efficiency choices, included the optimal choice falls outside the green production frontier and so they are not available in green markets; 4) Green social indifference curves migrate just like traditional social indifference curves, but now the driver is the presence of green pareto improvements; and 5) The structure of green pareto optimality shows that if environmental concerns are fully internalized, then we leave the world of traditional pareto optimality behind as now we are in the world of green markets.

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