The Positive Effects of GLOBALISATION (I& II)

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Dedicated to my parents.

The Positive effects of Globalisation -I
Jagannadha Pawan.

This model is STATIC one. It models global trade at an instance of TIME. A dynamic model taking into consideration the successive instances of TIME can be developed over this. The dynamic model (Part –II of this article) takes into account the results of the static model and in this sense is a function of the results of the STATIC model that is constructed here.

Aim:

1.To model a global economy that permits optimum utilization of global resources and maximises the profits accruing because of Labour division of greatest level.

2.To mathematically prove that GLOBALIZATION is for the benefit of all nations.

Assumptions:

1.Prices of goods transportation costs and tariffs are the main factors influencing the trade other than security perceptions and “willingness to develop”.

2. We can quantify security perceptions between nations and their inclinations for development [in normalised figures]

IDEAL STATE OF AFFAIRS:

1 **Absence of tariffs** on trading nations.

2.**People are interested in overall welfare of everyone in the world...and the extent they are concerned about others is measurable** [This assumes that such an interest is a function of the present relations of people of the concerned nations]

3.There is more inclination on development of individuals of GLOBE than of citizens of NATIONS. **Security of Nations** is assured.

Axioms:

1.Certain quantities that are ordinal in nature can be expressed cardinally

2.Every measurement can be normalised.

Explanation:
Normalised Measure(i)=Actual Measure(i)/Maximum Value of Measure(i)

Definitions: [Normalized Measures]

1.**T*ijk***: Tariff imposed by Nation (j) on Nation (i) with respect to import of commodity k.

2.**L*ik***: Denotes labour specialization in Nation(i) with respect to commodity/service(k).

3.**P*ik***: Price in Nation(i) of commodity(k).

4.**TC*ijk***: Transportation Costs of Transporting product(k) from Nation(i) to Nation(j).

Here we can improvise the model by viewing the entire world as a collection of regions specialising in particular services or resources.

5.**W*ij***: Willingness of people in Nation (i) to co-operate with people in Nation(j).

6.**WD*i***: Willingness to invest in global development in Nation (i).

7.**S*ij*:** Security Nation (i) perceives with respect to Nation (j).[This is a function of relations that nation(i) has Nation(j).

<u>Theorem</u>: Given IDEALS listed above, a stable, prosperous Global economy results. Alternately,
1.Tijk →0 for all i,j,k
2.Wij → 1 for all i,j
3.WDi →1 for all i
4.Sij → 1 for all i,j
are necessary conditions for obtaining a network of links that optimises the Global trade.

Formal Definitions of the Domains and Ranges of the Functions:

N=Set of Nations engaging in Trade.
C=Set of commodities that are traded.

1. **T*ijk*:NxNxC → [0,1]**

2. **L*ik*:NxC → [0,1]**

3. **P*ik:*NxC → [0,1]**

4. **TC*ijk*:NxNxC → [0,1]**

5. **W*ij*:NxN → [0,1]**

6. **WD*i*:N → [0,1]**

7. **S*ij*:NxN → [0,1]**

We are concerned not only with the price of a commodity in a nation but also its relative value in other nations. Its value in other nations is a function of the tariff the other nation imposes on this commodity originating from the exporting nation, the transportation costs involved in the transaction etc.

PRijk:Relative price in Nation(j) of the Commodity(k) produced by Nation(i) =

{
(Price of commodity k in Nation(i))+
(Cost of Transportation of C(k) from Nation(i) to Nation(j))+
(Tariff that Nation(j) imposes on C(k) being imported from Nation(i)) }/
(Maximum Value that price of C(k) assumes)

Observations(…Dependencies):

1.PRijk:PRijk(depends on…Tijk,Pik,TCijk,...)

2.Tijk:Tijk(depends on…Wij,WDi,Sij)

3.Pik:Pik(depends on….Lik and on 'Ofik'→ Other factors).

4.Wij:Wij(depends on ….WDi,Sij)

5.Sij:Sij(depends on …Relations between the Nations.)

6.TCijk=TCijk(depends on… Dij,ATij))
Where Dij is Distance between Nation(i) and Nation(j).
ATij-Availability of transport between Nation(i) and Nation(j).

<u>THE OPTIMA RULE:</u>

Nation (j) imports commodity (k) from the Nation that satisfies the following equality:

Select Nation(r) for which PRrjk= min {PRijk for all i} for all k,

<u>Constraints and their Satisfaction:</u>

1. In the event of Nation(r) being unable to attend to the needs of the Nations that have it as the source of their imports based on the above rule then the next favoured Nation is obtained using the above rule on {N}-Nation(r), after the supply that Nation(r) can afford is entirely exhausted.

2. If more than one nation has a Nation(i) as the most favourable nation then Nation(i) will first satisfy the demand of that nation that has least relative pricing.

Explanation: If Nation(i) is the most favourable nation for trade(with respect to commodity k) for nations n1,n2 that is, if
RPi1k>RPi2k.Then Nation(i) will first meet to the demands of Nation(2).

3. **If Nation(j) does not have any other nation with which it can transact for commodity k other than Nation(i)** which can result if the difference of relative prices for import of commodity k(here after referred to as C(k)) from Nation(i) and relative pricing with respect to any other Nation is greater than a certain thresh hold value..ie..(|RPijk-RPink|>T) then Nation(i)'s first priority will be Nation(j) for export of C(k). Nation(i) will try to give its affordable export of C(k) in a particular ratio that ensures that all such nations get a weighted share of its exportable quantity of C(k).

<u>Claim:</u> The above-defined rule will give us optimal global trade ("constrained local optima") for any given situation.
Moreover, if the IDEALS are also satisfied then optimal global trade resulting is a constrained global optima.(Best of constrained local optima)

<u>Observations:</u>

1.Every nation will engage in trade with that nation that for which the function PRijk is minimised. Since continuity of the function PRijk is not guaranteed, the formulation of minimisation problem using Calculus is not being used.

Still an assumption of continuity on PRijk would lead to the finding of the most appropriate nation for imports using the following equations.

Let y=PRijk
1. $\partial y/ \partial i=0$
Alternately,
$\boldsymbol{\partial y/\partial i< \eta}$ is a point in the neighbourhood of 0.(This is the case when the ideal nation does not have the capacity to satisfy all the demands its being requested)
2. $\partial y^2/ \partial i^2>0$;

We find that domains of each of the above functions can be viewed as subspaces of different abstract spaces given by the cross product of the space of nations (N) and the space of commodities(C).

<u>Sub Claims:</u>

1.N is a compact space.

2.C is a space synonymous to the space of Natural numbers.(In case we consider the set C of all traded commodities as equal to all the commodities in the world).

Proof: Sub Claim 1:

The set of all nations is finite and hence is closed bounded discrete set in the Universe. Hence, by definition it is a compact space.

Proof: Sub Claim 2:

We consider a mapping v: Naturals → C defined by

v(i)=Commodity(i).
The proof that ‘v’ is a bijection is trivial. C is thus synonymous or equivalent to the set of Naturals.
By definition for every C(i) in C there exists a ‘i’ in N such that v(i)=C(i).
This implies ‘v’ is an ‘onto’ function.
If v(i)=v(j) then we have Commodity(i)=Commodity(j) which is a contradiction.(Since all commodities are unique).This implies that v is an into function also. **Therefore ‘v’ is a bijection.**

Let **S**={Tijk, TCijk, L*ik*, P*ik* ,W*ij*, WD*i,* S*ij}*

The elements of **S** need not be continuous higher dimensional functions .**We can bring in their continuity by mapping the domain into a pseudo domain and then viewing each of the above function as a function defined on that pseudo domain.**
Let ‘g’ denote a function from the above set of functions.
Then g is of one of these forms:
1.g:NxNxC → [0,1].
2.g:NxC → [0,1]
3.g:NxN → [0,1]

To prove: 'g' is continuous on a pseudo domain constructed as an image of the actual domain.

We define function h:D → PD(**pseudo domain)**
h(y)= ŷ
where ŷ belongs to PD such that
For every ε>0 there exists a δ>0 such that whenever |g(y)-g(w)|< ε
we have | ŷ- ŵ|< δ. where ŵ=h(w) for y ∈D
ie |h(y)-h(w)|< δ

Let ĝ = goh(inv).
The function ĝ :PD ⟶ [0,1] is a continuous function from PD to [0,1] by virtue of its construction.
This result assumes importance because the points that are clustered near particular value in the range side are images of points are images of points that are clustered near some other point in the pseudo domain PD. This pseudo domain is synonymous to the actual domain in the sense that an isomorphism can be constructed between them.

Continuity of ĝ implies that we are able to work on the best alternatives available for trading in case the OPTIMA Rule is not satisfied.

An assumption that the function ĝ is analytic at all points in the domain would enable us to obtain higher order derivatives of the functions and perform other mathematical calculations.

The 4-dimensional space consisting of the following coordinate axes is of particular interest to achieve the goals of this paper.

1.Nations (A Compact Discrete Finite set in which nations are ranked by the strength of their economies).

Explanation:
i>j ⇒ strength of Nation(i)'s economy is greater than strength of Nation(j)'s economy. Comparative strengths are determined taking into consideration various factors that indicate the social and economic development of nations.

2.Nations (Same as above)
3.**Commodities** (A set which can be of the following categories):

a. Finite discrete set in case we are considering only a finite number of commodities as being traded.
b. Infinite discrete set in case we are considering all distinct commodities of uniform quality in the world as being traded.
c. Infinite continuous set in case we consider the quality variations in each commodity also.

4.**TRADE** (Real numbers)
TRADE= ƒ (Nation,Nation,Commodity)
Where ƒ: NxNxC → R and is defined based on certain observations on the behaviour of the elements of S.

<u>Equivalent Statement of the THEOREM</u>

An ideal index of TRADE should give a constrained global optimum value of TRADE under IDEALS.
Some plausible definitions of **TRADE**

Trade(i,j)=
1.(Sij*Sji*WDi*WDj*Wij*Wji)/ E(Tijk)*E(Tjik)*E(TC ijk)*E(Pik)*E(Pjk)

2.[Sij*WDi*Wij/E(Tijk)*E(PR ijk)*E(TC ijk)]+
[Sji*WDj*Wji/E(Tjik)*E(PR jik)*E(Tcjik)]

3.**ωij*[**Sij,WDi,Wij,E(Tijk),E(PRijk),E(TCijk)]+
ωji*[Sji,WDj,Wji,E(Tjik),E(PRjik),E(TCjik)]

4. **ωij*[**Sij,WDi,Wij,E(Pik),E(PR ijk)]+ **ωji***[Sji,WDj,Wji,E(Pjk),E(PRjik)]

where E(*) in the above definitions is the expectation of the quantity in the brackets and ω ij and ω* are weights that are computed based on the ranking of the strengths of the economies.

Formula(4) above can be used in case PRijk explicitly uses E(Tijk) and E(TCijk) in its computation. Here Tijk and TCijk exert hidden influence on

the Index since an increase in the value of Tijk or Tcijk increases the value of PRijk.
Assuming that Tcijk is an non-influence-able measure, our attention turns to Tijk which can be influenced.

1.TRADE=E(Trade(i,j))
2.TRADE=ω*(Trade(i,j)).

The above measures are indicative of the possible measures that we can define using the defined functions**. An exploration into the behaviour of the above indices or some more of them would lead us to an IDEAL measure of trade.**

<u>Equivalent Statement of Theorem:</u>

If the global trade activity can be quantified by an ideal index TRADE, the necessary conditions to have TRADE maximized, are

1.Tijk →0 for all i,j,k
2.Wij → 1 for all i,j
3.WDi →1 for all i
4.Sij → 1 for all i,j

Proof :(Based on inherent proportionalities is constructed since **function *f* need not be continuous.)**

Proportionalities inherent in elements of S:

1.PRijk:PRijk 'α' Tijk, Pik, Tcijk('α' → is directly proportional to)

2.Tijk:Tijk 'α' 1/Wij ,1/Wdi, 1/Sij ('1/α' inversely proportional to)

3.Pik:Pik 'α' Lik, Ofik

4.Wij:Wij 'α' WDi , Sij

5.Sij:Sij 'α' Tjik for all k.

6.Tcijk: 'α' Dij , 1/ATij

We prove the statement using an alternate heuristic method.
Observation: There are certain characteristics of an ideal TRADE index that indicate the conditions for its plausible optima.

A.Observations on proportionality(above)indicate that TRADE is directly proportional to the
1.Percerption of Security between nations.
2.Willingness of nations to develop.
3.Willingness of nations to cooperate.

B. And is inversely proportional to the following
1.Tariff on goods
2.Transportation Costs
3.Relative prices of the goods, which in turn are directly proportional to Tariffs and Transportation charges.

B2 is cannot be influenced. This implies that B1 is the most important factor in measuring TRADE since B3 also is dependent on B1 and B2.
This leads us to the following conclusions:

1.TRADE is maximized when A1~A3 are maximized.
2.TRADE is maximized when B1~B3 are minimized.

1 and 2 are necessary conditions for maximising any ideal index of trade.

As Sij →1,WDi →1,Wij →1 and Tijk →0 we have TRADE maximized.

An Algorithm to stimulate TRADE

Step0:Input Values of Trade tariffs on different commodities by different nations, transportation costs ,prices of commodities in all nations.

Step1:ComputeNormalisedValues(Tijk,Tjik,Tcijk,Tcjik,Sij,Sji,WDi,WDj,Wij, Wji,……) where,
Normailsed Value= Actual Value/Maximum value the Variable assumes.

Step2:Compute PRijk := {(Price of commodity k in Nation(i))+(Cost of Transportation of C(k) from Nation(i) to Nation(j))+(Tariff that Nation(j) imposes on C(k) being imported from Nation(i)}/Maximum Value that price of C(k) assumes.

Step3: **For every j and for every k select that Nation(i) that minimises PRijk for import of C(k) by Nation(j).**

If Nation(i) cannot satisfy the entire need of Nation(j) of C(k) then the next most favourable importing nation is chosen for the import of k by Nation(j) by using the above rule on the set {{N}-Nation(i)}.

If Nation(j) does not have any other Nation with which it can transact for C(k)} other than Nation(i)(which can result if the difference of relative prices for import of commodity k from Nation(i) and relative pricing with respect to any other nation is greater than a certain thresh hold value..ie..|RPijk-RPink|>T.)

Then

Nation (i)'s first priority will be Nation (j) for export of C(k) and Nation(i) will try to give its affordable export of C(k) in a particular ratio that ensures that all such nations get a weighted share of its exportable quantity of C(k).

Step4: Proceed until all the links are established and a complete model is constructed.

<u>Improvements on the Model:</u>

1.Restructuring this static model into a dynamic model. This will enable study of the after effects of implementation of this model.

2.Reducing the computational complexity involved.

3.Viewing all nations as a space and regions with specialisations as subspaces with certain attributes, we can model much more efficiently, economic trade between these regions. Here our theory wills into cognisance the regional specialization in production of goods and not national specialisations as such. Hence, we obtain pockets in the GLOBAL space that are responsible for production of certain goods extensively bringing into picture highest possible division of labour.

A model that incorporates some improvements suggested above is discussed in Part II of the article.

The Positive effects of Globalisation-II
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Variables influencing trade:

1.Regional specialisations. (There can be multiple regions specialising in an activity).

2.**Willingness to cooperate** between regions (maximum between friends and minimum between foes).

3.**Security perceptions**.(mostly insecure by the nation nearest to it….and is also dependent on the economic development of the other nation. More developed other nation means an increased threat in case the other nation is a foe and decreased threat in case the other nation is a friend).

In this paper, variables corresponding to clauses 2 and 3 above are assumed to be at the most favourable level. There is absolute willingness to co-operate and Security is at its best.

S=Set of all Regions in the world.

SCk=Partition consisting of Regions of the world, created on the basis of specialization in production of a certain good Ck}

SCk={R1,R2,…..Rn}
Such that U R*i*=S and R*i*^R*j*= Ø;

A family of functions {g*i*} is constructed which represents the map of the relative prices of the good Ck on different regions in *SCk.*
g*i*:S/Ri→[0,1] {S/R***i***→ Space S restricted to Region R*i* . R*i* is an element of *SCk.*}

The minimum of the function indicates the particular point in the region R*i* that has greatest advantage in the production of Ck. An assumption that there is a symmetric increase in the value of the function in the neighbourhood of this point on its either side induces an inference that this function could be of parabolic nature.
A function G that consists of all such functions is defined as follows:

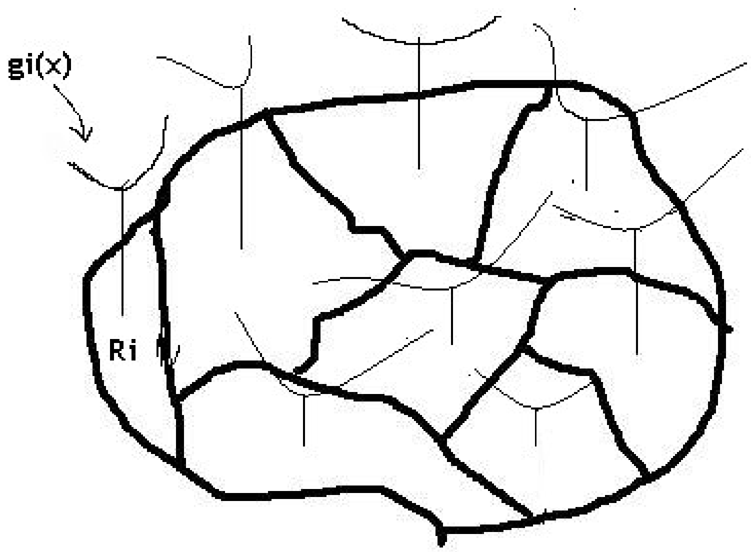
$\boldsymbol{G}$:S $\rightarrow$[0,1],defined as,
$\boldsymbol{G}(x)= \sum R_i\chi(x)g_i(x)$

Where $R\chi(x)$ is the characteristic function defined as follows:
$R\chi(x) =1$ if $x \in R$
=0 otherwise.

If $\mathbf{G}(x)$ emerges as a union of parabolas given by

$$G(x) = \sum_{i=1}^{n} R_i\chi(x)\, A_i(x-a_i)^2.$$

A_i and a_i are constants for i=1to n.



Then the minimum of G(x) is the point which has maximum relative advantage in the production of Ck.

$G'(x)= 2\sum R_i\chi(x)A_i(x-a_i).=0$ at the optimal value (The minimum relative price).

$G''(x)>0$

Observation: G'(x) may be zero at more than one point indicating that there can be many regions that can specialise in C*k*. Let 'x*' be one such point.

The solution of the above equation corresponds to that point in the Globe that has greatest advantage in the production of good C*k*.

There exists a region Rζ in S (Rζ ∈ SCk) to which 'x*' belongs and in this region G(x) takes on a global minima.

If $\int_{R\zeta}$ **G(**x) dx= $\int_{S} R\zeta\chi(x)*G(x)\,dx = \int_{R\zeta} g_i(x)dx$ is the minimum of $\{\int G(x)\,dx\}_{R_i:R_i \in SC_k}$

then this region is the region with greatest advantage in the production of C*k*.

Otherwise, the region corresponding to min $\{\int G(x)\,dx\}_{R_i:R_i \in \{SC_k\}}$ is the region with greatest advantage in the production of C*k*.

Let R*k* be such a region.

Since production of C*k* (specialised by R*k*) is not absolute, the capacity of production of C*k* by the entire set of regions is also considered to determine the next viable regions for specialization of C*k*.

Let P(x) be the function giving normal relative production of C*k*. Let P*max*(x) be the function giving the maximum possible production when the regions specialize in the production of C*k*.

Observations:

1.Production of all regions together is 1 that is,
$\int_{S} P(x)=1$;

2.CR*i*: Capacity of region R*i*(under normal conditions) R*i*= $\int_{R_i} P(x)dx$

3.CRS*i*:Capacity of region R*i*(under specializtion)= $\int_{R_i} P_{max}(x)dx$.

Since for a particular good C_k ,R_k has been obtained as an ideal region that should specialise in its production, the production of C_k in R_k is increased to realise its maximum capacity.

In other words
$CR_k \rightarrow CRS_k$.
Therefore dynamically the region between the curves P(x) and $P_{max}(x)$ tends to zero over the region R_k with P(x) approaching $P_{max}(x)$ with change in time.

$$\left| \int_{R_k} P_{max}(x)dx - \int_{R_k} P(x)dx \right| \rightarrow 0$$ under specialization.

Aggregate demand D for the good is determined at the price of the most favourable nation's price of export.

Though R_k is the region with greatest advantage in the production C_k it need not necessarily be the most favourable region for import of C_k for all the nations in the Globe. This can be explained by fact that a region located far away from this region will certainly experience high transportation costs for importing C_k from region R_k. This indicates that a particular region can have a region other than R_k as the most favourable nation for importing C_k.

Assumptions:
1.At any time there is one region that is most favourable to all regions for import of Ck(there is only one current global minima of G(x) over the region that is under consideration),though there may be other regions that also specialize in production of Ck.

2.The entire increase in the quantity obtained because of specialization is available for export.

Region R_k is most favourable for import of Ck for all other regions.

The extent R_k can export C_k, is a fraction of its capacity expressed as,

$$\mu * \int_{R_k} P_{max}(x)dx$$

The remaining demand for C_k given by,

$$D - \mu * \int_{R_k} P_{max}(x)dx$$

is met by the region(R_i) that has greatest advantage in the production of C_k, where $R_i \in \{ SC_k - R_k \}$.

This process is recursively adhered to till the entire demand for C_k is met. The assumption is that the demand for C_k produced in R_k is not influencing the price of C_k originating in R_k and that price of Ck in R_k is determined solely by its internal factors.

Moreover, the moment R_k's share of exports is exported the next best-chosen region having a higher price faces lesser demand. This induces into the picture a convergence of Remaining Demand to zero.

This implies, $| D - \mu * \int_{R_k} P_{max}(x)dx | \rightarrow 0$ as regions with higher relative prices of C_k start becoming most favoured regions from where C_k can be imported.

Labour specialization implies that this region(here R_k) also reaps the benefits of labour specialization of other commodities by other regions.

Let $\delta(PC_k)R_i$ represent the change in the production of C_k owing to specialisation in region R_i.

$\sum_{i=1}^{n} \delta(PC_k)R_i$ represents the increased output from all the regions that are specialising in production of C_k.

The sacrifice that a particular region(R_k) makes in order to specialize in the production of C_k is given by,

$$\{\delta(PC_j)R_k : j \neq k, \}$$

Total sacrifice that all such regions specialising in the production of Ck, is equal to

$$\left\{ \sum_{i=1}^{n} \delta(PC_j)R_i : R_i \text{ specialize in production of } C_k : j \neq k \right\} \text{ for } j \in \{J\}.$$

Where any commodity can be written as $C\alpha$ for $\alpha \in \{J\}$.

For an equilibrium to occur it has to be ensured that this loss of the nations specialising in C*k* is compensated by the regions that specialize in the production of other commodities$\{ C_j : j \neq k\}$.

{Loss of regions in producing other commodities specialising in C*k*} ≤
{Gain of regions that specialize in the producing the other commodities but don't specialize in the production of C*k*}

$$\left\{ \sum_{i=1}^{n} \delta(PC_j)R_i : R_i \text{ specialize in production of Ck } \right\}$$

$$\leq \left\{ \sum_{i=1}^{n} \delta(PC_j)R_i : R_i \text{ doesnot specialize in production of Ck } \right\}$$

The inequality should hold for every $j \neq k$.

This ensures that the entire loss accruing because of specialization of a particular commodity by the nations is compensated by the nations specializing in the production of other commodities.

The ideal condition for trade is given by the above inequality. The maximization of the difference between the left hand side and the right hand side of the above inequality gives the maximum possible utilisation of resources and maximum production accruing as a result of division of labour.

This paper stands concluded with a thought. The assumption of absolute security and high willingness to develop amongst regions and people enables trade to take place with a fair sense of competition. Without this assumption, the paper would have been forced to concentrate on these attributes. This would have deviated us from understanding the obvious benefits of Globalisation.