

**THE 'PHYSICS' OF MARKET FORCES WITH REFERENCE TO INFORMATION**

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**Abstract**

*Information is an indispensable element in the composition of market dynamics and changes as created by forces. Information is seen here as a force, viewed through the lens of science and analysed through the theory of it. The dynamics of today's market behaviour is one that has grown in complexities and as result requires a more critical and study way to look at it, know it and adjust it. Thus, as a force is an influence capable of producing a change in an object's motion or state of rest so is an information capable of the doing the same in the electromagnetic-like field of the market. The knowledge of the ways, modes, rates, speed, weight at which or by which information moves (velocity, and mass) is of critical essence. This paper explains the impact or resultant effect of the speed and mass of information in the market. It also goes deeper analysing and explaining the characteristic motion of information as an object using the scientific collision theory. In summary, this paper attempts to understand and interpret various market behaviours, reaction and dynamics and mechanisms as it affects the effective and efficient dissemination of information or optimum reaction as it is being explained here.*

*Keywords: Market, Information, Dynamics, Buyer & Seller.*

**INTRODUCTION**

Statistic is often seen or known as the research discipline quite related with the interpretation of the market, economy and population but here is a further insight as to the analysis or x-raying of what goes on in the realness of the market realm with the physics microscope. We are individual human beings before a population. While statistics is focusing on the analysis of population through samples, physic is focused on the origin, humans, where the samples being used by the statisticians are gotten from.

The likes of Sir Isaac Newton, Albert Einstein, Max Planck and a host of other physics have brought the world to this level of jet of age by the magnificent discoveries they were able to explain and deliver in their time as it is being passed on till this day.

Physics (from Ancient Greek: physis "nature") is a part of natural philosophy and a natural science that involves the study of matter and its motion through space and time, along with related concepts such as energy and force. More broadly, it is the general analysis of nature aim at understanding the behaviour of the universe.

The best way to engineer, programme or make-adjustable a thing is first by understanding its nature which it operates or manifests by default i.e. natural characteristics. The essence of this is the pivot of physics studies in general. Physics is one of the oldest academic disciplines, perhaps the oldest through its inclusion of astronomy. Thus physics is veteran at understanding and explaining anything which has got a nature whether living or non living things, natural or artificial. Physics is a branch of fundamental science, not practical science.

The physics scientific method employs *a priori* reasoning as well as *a posteriori* reasoning. That is the study of a before and after behaviour of reaction that takes. By this physics is capable of quite accurately predicting the outcome a thing just like statistics but here eliminating likelihood of probabilities whatsoever. Physics theories lie in explicit domains of applicability. Physics is used heavily in engineering. With the standard consensus that the laws of physics are universal and do not change with time, physics is laudable by most scientists and in the real world as it can be used to study things that would ordinarily be mired in uncertainty.

The difference between mathematics, a father to statistics, and physics is quite distinct, but not always obvious, especially in mathematical physics. Ontology is a prerequisite for physics, but not for mathematics. Ontology means physics is ultimately concerned with descriptions of the real world- the natural characteristics of a thing- while mathematics is concerned with abstract patterns, even beyond the real world. Thus physics statements are synthetic, while math statements are analytic. Mathematics contains hypotheses, while physics contains theories. Mathematics statements have to be only logically true, while predictions of physics statements must match observed and experimental data. Thus physics is a senior over statistics in the real world (Wikipedia 2013).

As said earlier physics is the study of matter and its motion through space and time, along with related concepts such as energy and force. It is of essence to throw a little more light on these variables; time, motion, energy, force etc.

Motion is same as moment however could take different forms. Any object in motion implies that it possesses either speed or velocity. That is the combination of an object's speed and direction of motion unlike speed, velocity always implies a direction. Time on the other hand means period as it relates to speed or velocity.

On a further note, Momentum can be defined as "mass in motion. The amount of momentum that an object has is dependent upon two variables: how much stuff is moving and how fast the stuff is moving. Momentum depends upon the variables mass and velocity. Momentum = mass x velocity (The Physics Classroom 2013).

Momentum is also a vector quantity. That is quantities that are fully described by both a magnitude and a direction unlike scalar quantity that are fully described by a magnitude (or numerical value) alone.

Force is an influence that produces a change in an object's motion or state of rest. A force has a specific direction and magnitude. Forces only exist as a result of an interaction. Forces could be direct like implied force or from a distance like gravitational forces. Force also begets motion albeit could take different forms. Motion in turn could be seen in the light of speed or velocity as explained prior. Momentum is a function of the mass of the object set in motion.

Information can be likened to objects which can be set in motion (same direction or opposite) in view of a head-on collision which could result in elastic or inelastic collision, however perfect- perfectly elastic or perfectly inelastic collision. Thus information can be seen like a ball-like object.

The business dictionary describes market as an actual or nominal place where forces of demand and supply operate, and where buyers and sellers interact (directly or through intermediaries) to trade goods, services, or contracts or instruments, for money or barter. Markets include mechanisms or means for determining price of the traded item, communicating the price information, facilitating deals and transactions, and effecting distribution. The market for a particular item is made up of existing and potential customers who need it and have the ability and willingness to pay for it.

Thus one can vividly see here that forces exist in market from the two sides, buyers and sellers. It could as well be directly (as relatable to contact force) or through intermediaries (relatable to force from a distance). There must as well be an interaction of the forces and market as well operates on a number of mechanisms which is why the physics of it is quite important.

From an eagle's eye view, *Market can be seen as two-mouth open ended tube capable of allowing information or market forces to flow through both. However, both ends can be adjust, known or unknown, intentional or unintentional, to the operators of the market not forgetting that buyers and sellers and the main actors of the market.* Thus, information should flow from both ends, buyer and the seller side, and should collide with each other at in a way capable of allowing them to stuck and move together after colliding.

*Information at a sky scraper view can be seen as an object or matter although intangible. That is, it is also inherent of mass and space and much more, it is capable of being sent into motion.* Information is set in motion in diverse ways. One main essence of communication, transportation and the technological experienced timely in this light is due to drive for dissemination information as quick as possible.

However in an attempt to take a deep into the world of physics as it relates to information dissemination, it is quite necessary to yet again familiarise ourselves, for those who have forgotten or to acquaint for those who don't know, with some background which shall later culminate to main essence of the write up.

Taking a look back into the Newton's first law of motion which states that the velocity of an object is constant if the net force acting on it is zero. Thus, only external forces- forces exerted by agents external to the system- will change the motion or course of the system.

Likewise according to the conservation of momentum principles, the total momentum of a system is constant if the net external force acting on it is zero.

$$L_i = \sum (MU) = M_1u_1 = m_2u_2 = m_3u_3 \dots = m_1v_1 = m_2v_2 = m_3v_3 \dots$$

The formula above is simply interpreting that the velocity of an object and its mass when static (zero momentum) shall equate to the velocity (counting momentum) of an external force (moving object) that collides with it. This scenario implies that either the static body is capable of absorbing the momentum of the moving object on collision or the moving body is capable of transferring its momentum to the static body. In summary, there is a transfer of momentum from the moving body of mass, velocity and direction to the other with same or unequal variable of mass, velocity and direction.

Taking a step deeper, for a system made up of a number of objects, the sum of momenta of all the objects at some initial time is equal to the sum of the momenta of all the objects at some later, or final, time if no external forces act on the system. If the system is made up of only one object, this is too simple- velocity and mass are unchanged. On the other hand, if the system is made up of two or more system might not remain unchanged. In the case of multi-object system, if one object's velocity increases, another object's velocity decreases to keep the total momentum of the system balanced.

## LOOK OUT POINTS AND HINTS

Unweaving the elements that makes the market momentum, particularly information which is the essence of this write up, it is necessary to mention the various in light of the physics of it.

The combination of Mass and velocity are major variables capable of birthing the vector quantity, momentum. Momentum here is in view of information. Thus information has mass and is being set in motion through diverse ways and mechanisms

Thus for the purpose of this, we shall be equating mass as 1 unit and velocity as another unit. Under any scenario when one variable is greater than the other, we shall be assuming that it is 2 times greater than it.

For direction, in the cases where we have opposite directions of a straight line head on collision, we shall be assuming a negative resultant reaction (-) and the converse for the same direction. That is a positive reaction (+) if the objects are moving in the same direction.

Every negative reaction implies that seller is the one at loss, not monetary, but he succumbed to the weight of the seller being exerted on him

The variables which are at par, by implication, cancels out each other making the value of what is left to explain the post collision effect. That is they have equal level of disagreement as far as that variable is concerned.

For opposite directions, inelastic collision has coefficient of -1 one thereby annulling the negative reaction and making it positive

The sellers shall be designated as object A and the buyers as object B.

In the situations where we have the sellers resultant momentum- relative mass and velocity- outweighing that of the buyer in an opposite direction collision often gives birth to an overall negative reaction interpreting as the buyers losing and the seller gaining. That is, the buyer gave in to the force from the seller side either due to ignorance or lack or choice among others.

### **Illustration**

If the force from seller side is supplying of cars and the information is being carried is pregnant with this while the forces from the buyers side is demanding of fuel efficient cars, the buyers will have to buy the cars, however fuel efficient or not. That is, ultimately, the seller gains and the buyer losses.

### **Or**

If the forces (information) from the buyers side is demanding of low call rates the force from the buyers side is radiating that of high cost rate, the buyers eventually end of buying the seller goods, thus making the buyer lost and the seller to gain. The reverse could be but rarely the case.

In a scenario when we have two parties, sellers and buyers, getting stuck to each other and moving at the same velocity implies that we have neither a positive or negative reaction but Zero. That is neutral and balanced reaction or optimum reaction

The different scenarios capable of springing forth on event of objects colliding can be explained into two forms, elastic and inelastic. However, different sub-scenarios can be brought from the each of the forms.

### **ELASTIC COLLISION**

Knowing that two static objects cannot collide, there must be at least a movement from an object in relation to the other. For the purpose of this article, the market forces variable

(information) shall be split into 2; mass, velocity. Direction shall be relating to the coefficient of the reaction.

Where mass = to 1 unit of force and velocity = 1 unit. Thus, variables of the actors' side, buyers and sellers can outweigh each other. For example, where the seller has greater mass and same velocity with that of a buyer, we have a 3:2 ration scenario. That is, seller has 1 unit of mass and 1 unit of velocity while the buyer has 1 unit of mass and 1 unit of velocity but since seller has a greater mass (assumed to the 2 times that of the buyer) we have a 1 +1 unit of mass=2 unit of mass plus 1 unit of velocity equating of a total number of 3 units from the seller and seller having 1 unit of mass plus one unit of 1 unit of velocity equating to total of 2. Thus we have 3: 2 scenario.

We also have a total reaction negativity of 1 i.e. that is -1. That is, 2 units of the buyer is subtracted from the 3 units from the seller = 1 (negative reaction) = -1

### Scenario 1: same mass and one object in motion

By illustration, if an object (A) is set into motion, head on against another static object (B) and object A collides with object B at the centre of it, the resultant is that Object B now moves at the same velocity as object A was before the collision. That is object A has 1 unit of mass and 1 unit of velocity while object B has only 1 unit of mass.

We have 2:1 ratio and a -1 reaction.

### Relating

If the information from the seller (inherent of mass, velocity and direction like object A) collides with a static object like (zero momentum in object B), the buyer, the result is that B known or unknown, intention or unintentional, succumbs to seller. Thus, he moves in the direction of the seller without the seller having to move anymore(that is make anymore effort) and deals get done.

### Scenario 2: Unequal mass and one object in motion

That is, like in scenario 1 above but in the case we have unequal mass of the object as object A outweighs object B.

1 unit of mass x 2 = 2 unit of mass plus 1 unit of velocity = a total of 3 unit from the seller while the buyer has 1 unit of mass without no velocity.

Thus, we have a resultant ratio of 3:1 and a -2 negative reaction.

That is, the post collision scenario is that object B which was previously static (no momentum) now moves in the same direction and pace as object A before the collision but object A keep moving in the same direction but at a much slower pace. If the momentum is transferred completely to object B, A wouldn't move at all and we have a *perfect elastic* collision type.

$$V1=2m2u2+ (m1-m2) u1/m1+m2 \quad \text{and} \quad V2=2m1u1+ (m2-m1) m2/m1+m2$$

**Relating:** If the information or force (counting momentum) from the sellers is having a higher mass greater than the zero-momentum buyers, the buyers will go at the same pace and direction of the seller. That is, momentum has been passed on to the buyer but seller may have to press a little more. If in the case of the perfectly elastic collision where there is a completely transfer of momentum, then the seller may need not press further.

### **Scenario 3: opposite direction, same velocity and mass**

The resultant effect of this is that the two objects will move in opposite direction with their pre-collision velocity.

1 unit of velocity + 1 unit of mass = 2 unit of momentum from the seller

1 unit of velocity + 1 unit of mass = 2 unit of momentum from the buyer

We have 2: 2 rations and 0 negative reactions. This may be called 0 negative because there may either be a shared gain or transaction, reaction or satisfaction or a share loss of same.

**Relating:** if the information from the seller side is moving against that of an on-coming information from the buyer side, at the same velocity and mass, the mass sellers and buyers will move in opposite direction at the same velocity as before the collision. That is the information from the sellers will be rightly cross-checked by the sellers. Thus agreement may be quite difficult as most sellers try to profit of with the ignorance and lack of alternatives of the buyers. That is both sellers and buyers can match up and counter each other and buyer will look for a number of alternatives that they can because of the wealth of knowledge they have in this light. This full power of negotiation is exerted and they could be deal or not deal with each other not running at loss or gain of each other. This scenario is that in a perfectly elastic demand and supply scenario.

### **Scenario 4: opposite direction, same mass, different velocity**

By illustration, if object A is moving head-on in a straight line to a right direction at greater speed against a left-moving object B. on collision, object A will move in an opposite direction at a slower speed while object B will be the same direction at same speed. If the collision is perfectly elastic, momentum will be completely transferred to the other. Thus pre-collision momentum of object A equals to post collision momentum of object B and vice versa.

Buyers side = 1 unit of mass + 1 unit of velocity(x2) = 3 units

Seller side = 1 unit of mass + 1 unit of velocity = 2 units

**We have ratio of 3:2 and -1 reaction.**

**Relating:** if information or force coming from the seller's side is of same magnitude but at a higher velocity against that from the buyer means that the momentum information from the buyers side will crossed out, to the extent which it can, with that coming a higher velocity from

the seller. The sellers will have to go an opposite direction but at a slower speed while the buyers goes in the same direction at a higher speed. Thus, there is for a short time, a period of reconsideration or reconciliation . That is the buyer is till unsatisfied at way his need is met because he now possess higher taste or means due to the high information which he has got. However, in a condition where we have a complete transfer of moment, like under a very effective and efficient system, the sellers may not move at all.

### **Scenario 5: opposite direction, different mass and velocity**

In this case, there occurs a bounce off of each other and they move in opposite direction at their pre-collision velocity.

Seller side = 1 unit of mass (x2) + 1 unit of velocity(x2) = 4 units

Buyers side= 1 unit of mass = 1 unit of velocity =2 unit

We have a total of 4: 2 and -2 negative reaction

**Relating:** That is, where the sellers' information or forces outweighs the buyer in a ratio manner like we have here, the buyers and sellers go at opposite direction.

### **Scenario 6: opposite direction, different mass, same velocity**

Under this, the post collision of the lighter object B (Buyer) will be faster than its pre-collision velocity while the post collision of the heavier object A (seller) will be slower than its pre – collision.

Sellers side: 1 unit of mass (x2) + 1 unit velocity = 3

Buyers side: 1 unit of mass+1 unit of velocity =2

We have 3:2 and -1 negativity

**Relation:** This situation is quite similar to Scenario 4 above, what the behaviour or reaction of the buyer may be based on various other criteria he considers important to him or her.

### **Scenario 7: Same direction and mass, different velocity**

A same direction scenarios means that we have a positive reaction. Thus, the momentum of the faster one is completely transferred to a slower moving object and equal. Immediately after the collision, the previously faster moving object decreases its speed to the previous moving slow object and vice versa.

Sellers side: 1 unit of velocity + 1 unit of mass(x2) =3

Buyers side: 1 unit of velocity +1 unit of mass=2

We have 3: 2 and a +1 scenario because of the same direction

**Relation:** if the information momentum from the seller side is greater that of the buyer in the same direction at the point of collision, it mean that the consumer is okay with the result of collision albeit there is room for improvement for better reaction, transaction or satisfaction

**Scenario 8: Same direction and velocity, different mass**

Here, the velocity of the greater mass is transferred to the lesser one and the momentum of the lesser mass is switched over to that of the greater mass.

Sellers side=1 unit of velocity plus 1 unit of mass(x2) =3

Buyers side+ 1 unit of velocity plus one unit of mass= 2

We have a 3: 2 and a +1 reaction like scenario like we have in scenario 7 above.

**Relation:**

Same goes as in scenario 7

**INELASTIC COLLISION**

Inelastic collision is that type of collision that gives birth to the two objects getting stuck together and moving together after colliding at the same velocity

$V_1=v_2=v...$  final velocity

$M_1u_1+m_2u_2= (m_1+m_2) v$

For opposite directions, inelastic collision has coefficient of -1 thereby annulling the negative reaction and making it positive.

**Relation**

The interpretation of this is that both the force (information) from the buyer and seller side meet at a point and it a way that allows for them to move together at the same velocity.

That is, the resultant answer is 0 positive reactions as the cases may be. Meaning that there is balance of forces equating to zero and there is an actual transaction, satisfaction or positive reaction as both parties' gains unlike the Scenario 3 above where both parties can either walk or deal with each other with an equally shared sum of gain or loss. The scenario here is only positive i.e. we only have the possibility of an equally shared gain. This is optimum reaction.

In Summary, where we have a negative reaction, however large or small, implies that the buyers incurs of form of loss, known or unknown, intension or unintentional, because he has got no choice than to succumb to the momentum of the seller and follows his will and market. More so where we have a positive reaction implies that the buyer is quite gainfully but can be gain more depending on his respective scenario and where we have a zero negative reaction implies that we can either have an equal share of gain or loss in terms of reaction or decision, satisfaction and transaction and zero positive implies can we have can only have a share gain of the same. That is optimum reaction is only feasible at this scenario.

## COEFFICIENT OF RESTITUTION

This is more of an overwhelming light of physics of in this direction. Coefficient of restitution is the absolute value of the ratio of the velocity of separation to the velocity of approach. The velocity of separation is the difference between the velocities of the two colliding object just after collision. It describes how fast they are moving away from each other. The velocity of approach is the difference between the velocities of the two colliding objects just before the collision. It describes how fast they are moving towards each other.

The coefficient of restitution has no units. For perfectly elastic collision, the coefficient of restitution is 1.0, its maximum value. For perfectly inelastic, the coefficient of restitution is zero, its minimum value. The coefficient restitution is affected by the nature of both objects in the collision.

Thus inferring from the above, the coefficient of restitution for a perfectly inelastic collision is zero just like we have in the inelastic collision above. Physics and the collision principles are almost applicable to almost all facets which operate in some form of mechanism or the other.

## SUMMARY

In summary, looking and analysing the role of information as a force in the market using the scientific torch and eye is one that can afford academics and professionals a deeper insight in the explanation of market dynamics and mechanisms and give them an edge in adjusting and gaining the control of market. It also affords us a leap of not easily taken by surprise of market turns and winds.

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