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The Analogy of Economics Principles and Physics Theory

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Abstract
Physics and Economics were developed by using the scientific method approach. Economics, focus in discussing the use of limited resources by people efficiently and effectively. Physics focus in discussing the result of natural phenomena because of the interaction between energy and matter. This paper will be analyzed whether the principles in the economy has analogies with the theories and the laws in physics. In general there are tenth economics principles namely: *the first principle* "People face tradeoffs", *the second principle* "The cost of something is what you give up to get it", *the third principle* "Rational people think at the margin", *the fourth principle* "People respond to incentives", *the fifth principle* "Trade can the make everyone better off ", *the sixth principle "Market are usually a good way to organize economics activity*", *the seventh principle "*Governments can sometimes improve market outcomes", *the eight principle* "Country's standard of living depends on its ability to produce goods and services", *the ninth principle "* Prices rise when the government prints too much money", *the tenth principle* "Society faces a short-run trade-off between inflation and unemployment". Ten principles of economics turned out to have an analogy with the theory and the laws of physics, namely: the law of conservation of energy, the laws and theory of thermodynamics, opportunity theory, the theory of statistical physics, Newton's law, Ohm's law, equilibrium theory, the theory of atomic bonding, composite bonding theory and law of Stefan Boltzmann and Wien.
Keywords: Econophysics, Economics principles, physics theory

1. Introduction

1.1 Concept of Physics and Economics

Physics phenomena occurs because of the interaction between matter and energy in space and a specific time interval. Interaction between energy and matter causes wave phenomenon, temperature, heat, motion, light, electric / magnetic field and others. The main object of physics is the study of energy, matter, space and time. Interaction between mechanical energy and matter cause the motion phenomenon in mechanics, interaction between heat energy and matter cause the temperature and heat phenomena, interaction between electrical energy and matter cause electrical phenomenon. Physics phenomena occurring naturally follow the laws of nature that cannot be controlled by humans (Halliday, et. al., 2001). Through the description above, it can be concluded that physics is the study of the causality relation among Physics quantities on a Physics phenomenon that occurs as a result of the interaction between energy and matter.

The term 'economy' comes from the Greek origin of the word *'oikosnamos'* or *'oikonomia'* which means 'management of household affairs', especially the provision and administration of income. According to Albert L. Meyers economics is the science which discuss about the needs and the satisfaction of human needs. Things that cause problems in the economy is, due to the scarcity gap between human needs for goods and services infinite, while on the other side the good and services as a means of satisfying the needs of its scarce or limited. This things cause human in fulfill their needs are always dealing with disappointment or uncertainty (Frank, 2003). Other economists argued that economics is the science of human effort towards prosperity. That opinion was very realistic, because in terms of economics aspects in which human beings as economics beings (*Homo Economicus*) essentially leads to the attainment of prosperity. Prosperity becomes a central goal in human life economically, according to Adam Smith who wrote the book *"An Inquiry into the Nature and Cause of the Wealth of Nations"* in 1976. Others experts argued, economics is the study of the behavior of people and communities in choosing how use of scarce resources and have few alternative uses, in order to produce various commodities, to then distribute for now and in the future to various individuals and groups within a society (Branson, 2000). Economics is the science about choose that is studying how people choose the use of resources are scarce or limited production to produce various commodities and distribute it to the various members of the public for immediate consumption (Samuelson and William, 2001). Through the above description can be concluded economics is the science that studies the behaviour of individuals or the community in determining the rational choice of the scarce resources to fulfill the needs and efforts to improve prosperity.

Economics focus on the phenomenon of people behavior in the use of limited resources efficiently and effectively, while physics focusing on the physics phenomenon in the material due to changes in the value or form of energy. The use of resources in the economy analogous to the change in value or form of energy.

1.2 The development of Physics and Economics

Physics and Economics is the science that developed with the scientific method, so the truth of both science are not absolute but is tentative, theory and laws that explains the physics phenomenon and economy continue to experience growth. In Physics known classical physics with main character is Isaac Newton (1642-1727) and the era of Modern Physics with famous characters: Albert Einstein (1879-1955), Erwin Schrodinger (1887-1961), Werner Heisenberg (1901-1976), Louis Victor de Broglie (1892-1987), Max Planck (1858-1947) and others. Assumptions used in classical physics are: large-sized material (on top of the micro-order) and material speed far below the speed of light. In classical physics, Newton's laws can explain the phenomenon of equilibrium and motion of matter well (Giancolli, 2000). In the assessment of the material motion at speeds approaching speed of light turns the classical theory and Newton's laws cannot be used to explain this phenomenon well. Einstein's theory of relativity to explain the phenomenon of motion of matter which approach the speed of light (Hewitt, 1998). The interesting thing is formulation of the theory of relativity will be a classic again when substituted with values of speed under the speed of light. For the motion phenomenon of matter that has a micro size, turns the classical theory and the theory of relativity can't be explained the phenomenon that occurs. On the phenomenon of micro particles, energy has discrete characteristic corresponding to Planck theory, the position of a particle cannot be determined exactly according to Heisenberg's theory and particle has characteristic as matter and wave accordance with the theory of de Broglie. The phenomenon of micro-particles can be explained using quantum theory. Formulation of quantum theory will be the classical theory again when classical assumptions can be met (Giancolli, 2000).

In the Economics is also known as Classical Economics. Famous figures in classical economics is Adam Smith (1723-1790) who published his book which entitled *An inquiry into the Nature and Causes of the Wealth of Nations,* which known as *Wealth of Nations* (1776). Adam Smith determine that like nature run completely regulate, economics system is also will able to recover itself (*Self adjustment*), because there strength regulator which called as the invisible hands. In simple words, that magic hand mentioned is market mechanism that is resource allocation economics mechanism based on the interaction of the demand forces and supply. Adam Smith believed that market mechanisme will become resource allocation instruments efficiently, if goverment do not participate in economics. Confidence against to marker mechanism reinforcing when a French economist, Jean Baptiste Say (1767-1832), make Smith's mind mature by let fly opinion which now known as Say's law, **"... supply creates it's own demand ...** " in his book *: A Treatise on Political Economy* (1803). Intent of that statement is that goods and service produced definitely absorbed by request until reached equilibrium of market. The assumptions that used by classical economics theory follows, *first:* market structure is perfect competition; perfect information and symmetrical; *input* and *output*are homogeneous; the performer economics is rational and aim to maximum uses or benefits; *second* Money neutrality which has consequence price is flexible or can be changed instantly *(price flexibility).* During its development of classical economics theory cannot explain the phenomenon when lethargy occur in world economics year 1929-1933 which known as *Great Depression,* the expert believe market mechanism, but Depression *Great Depression* interrupted confidence to the hypothesis of Classical economic, because Depression Large occur in long period time (1929-1933) and bulk big problems. In State America between a periods Depression Large level of unemployment reach more than 25% of the labor force, economoic *output* is reduced to 50%, while level of investment sink sharply. At that time was born theory proposed by John Maynard Keynes (1883-1946), through his book *"The General Theory of Employment, Interest and Money",* which rise in 1936 more known as *The General Theory,* according to Keynes, weakness of classical theory is weak of assumption about market that considered too idealism *(utopian)* and too emphasis economics problem on offer side. Related with that criticism, Keynes convey second principal mind on form of recover proposal by enter the **role government** in economics to stimulate the offer side.

On Classical Economics, economics market equilibrium based individual equilibrium (consumen and produsen). In **Keynesian theory,** in the truth market is not like classical community imagine, where market structure tend to monopolistic, inform ation not complete and asymmetrys. While *Input* and *output* exchanged is heterogeneous. This Condition cause price tend to rigid, in meaning is difficult turns spontaneously. On Classical Economics role of money not more than transaction instrument (medium of exchange). Because of it was not influence on real variables (Output and work opportunity). This view is represented by latest flow Classical as flow real economics cycle *(*Real Business Cycle*).* Another views is a view which still able to accept the role of government. For example flow of Monetary *(monetarism)* still able to accept the role of goverment, during just through monetarism policy. On Keynesian Economics Theory, According to him money not only just transaction instrument (medium of exchange), but also as store of value. This store of value function that make money possible use to get benefit through spertaculation action, besides for transaction and just in case, therefore money is not neutral, in meaning money able to influence real variables (*output* and work opportunity). The emergence of Keynesian theory, instead of Classical Economics Theory wrong, but Keynes Macroeconomics theory has perfected the classic theory. Macro Economics Theory Keynes will return to the Classical Theory, if the classical assumptions can be fulfill.

Physics Science and Economics is the science which is developed by using the scientific method. Scientific method is a method that truth must be proved rationally and empirically. Truth in Physics and Economics are tentative, not absolute truth. If an empirical theory cannot explain the new phenomenon that happens, then the old theory must be developed in order to explain new phenomena.

1.3 Physics quantities and Variables In Economics

Physics quantities is a concept that can be measured and in general using the ratio scale. Some common Physics quantities that we use in everyday life can be state as follows:

Mechanics subject. Mechanics is a Physics phenomenon associated with the motion of the object and the result of the balance of mechanical energy acting on the body. Some of the major scale and commonly used are: speed (v), the force (F) and work (W) and the other (Tipler, 1991).

Thermodynamics subject. Thermodynamics are Physics phenomena associated with the temperature and heat, due to the interaction between heat energy to a substance or object. Some of the common scale are: temperature (T), heat energy (Q), entropy (S) and the other (Tipler, 1991).

Electric and magnetic subject. Magnetic Electricity is a Physics phenomenon associated with the motion of electrons in the material. Electron transfer can lead to the phenomenon of electricity and magnetism. Some of the common scale is: electrical voltages (V), power (P), a strong electric current (i) and the other (Tipler, 1991).

Physics statistics subject. Physics statistic is physics that examines the behavior of micro-particles that build systems using physics theory and statistics. Physics statistic quantities that are widely used: temperature, entropy, work, total energy, classical opportunities distrubution, Bose Einstein distribution opportunities and opportunities of Fermi Dirac distribution. Physics statistic is a theory of physics which are widely applied in the analysis of economics phenomenon in the finance capital markets. The complexity of the particle system analogous to the complexity of the fluctuation of the stock in the stock market.

Variables in economics analogous to Physics quantities. Variables in Economics Sciences is a concept that can be measured and use a ratio scale (Dombusch, et. al., 2008). Some Economics variable commonly used are: taxes, interest rates, price, income, consumption, savings, costs of production, the amount of production, inflation, unemployment, the number of requests, and a number of other offers. Through a number of research results in economics variables have an analogy with some Physics quantities such as: entropy analogous to the production function, the temperature is analogous to the level of income, effort or work is analogous to the use of labor and other (Juergen Mimkes, 2006). The existence of an analogy with the Physics quantities in economics variables, are theoretical and apply the basic laws of physics in explaining economics phenomena.

1.4 Scientific Methods in Economics and Physics

The scientific method is a method of inquiry that are rational, empirical and systematic. Rational gives the sense that the truth can be supported and accepted theory is logically the deduction method. Empirical gives the sense that the real truth can be proven in accordance with field data using the method of introduction. Systematically gives the sense that the stages in the scientific method is regular and repeatable.

In general, the scientific method has the following stages:

1. **Formulation of the problem.** Formulation of the problem may be a comparison of two or more variables, a causal relationship variables and interrelationships variables.
2. **Formulate a hypothesis.** Answer to the problem posed on the terms of theory and previous research. Hypothesis formulation prepared using the method of deductive thinking.
3. **Hypothesis Testing.** Testing hypotheses using empirical data or measured field data of the study sample. Hypothesis testing using the method of inductive thinking.
4. **Discussion.** Comparing and critiquing empirical paper examines the theory and previous research.
5. **Conclusion.**

Research results obtained by the scientific method is universal. Truth gained the scientific method is not absolute, but is probability and tentative. A theory is accepted as true within a certain period, can be rejected or need to be refined in another period, if the theory cannot explain the phenomenon.

Physics and Economics, in terms of research methods both use the scientific method, but have some similarities and differences. Some of the similarities and differences of Physics Science and Economics when viewed from several aspects can be presented as follows:

Table 1. Differences and similarities Physics and Economics

No.	Aspect	Physics	Economy
1	The research methodology	The scientific method	The scientific method
2	Object of research	Phenomena arising from changes in the value of the material or form of energy	Rational human behavior in decision-making in using limited resources efficiently and effectively.
3	Variable measurement scale or magnitude	Ratio	Ratio
4	The results of the study	Universal	Universal
5	Truth	Not absolute, and the probability Tentative	Not absolute, and the probability Tentative
6	Relationship model variables	Have a regular pattern that can be arranged in the form of mathematical models	Have a regular pattern that can be arranged in the form of mathematical models
7	Instrument	Using a measuring instrument with standards	Observation sheet for recording economics variables
8	Data retrieval	Observation	Observation or secondary data

Through **Table 1**, it can be seen that there are many similarities between the science of Physics and Economics. This difference is the object of research. Objects physics research is the interaction between matter and energy, while the economics examines human behavior in a rational decision to use resources more efficiently and effectively. Rational behavior is behavior that uses the logic that has a value of true or false and have a quantitative measure. Humans have the capability of logic, ethics and aesthetics. The size is right and wrong logic, the size is good and bad ethics, aesthetics while having a wonderful size and worst In human decision making is always influenced by rational and emotional factors, if the emotional dimension of human beings can be controlled by the ratio of the otherwise rational human decisions if an emotional dimension dominates the human decision is emotional. Economics is a science that is built with a rational approach, then the economy can only explain the phenomenon of human behavior in making decisions rationally. The laws of physics are the laws of nature, especially the truth is rational and cannot be controlled by humans. This leads to making decisions in a rational man must conform with the laws of nature. In the practical application of economics in society cannot always be applied scientifically, because human behavior influenced by emotional factors, social factors and political factors of the country.

The existence of some similarity economics with physics, namely the similarity method is the scientific method (rational and empirical), the complexity of Physics phenomena involving many particles and economics phenomenon that involves a lot of individuals who interact in decision-making, a factor which is used by the experts in applying physics in explaining economics. Some experts have done some research on the theory and application of the laws of physics in explaining the phenomena occurring in the science of Economics. Through the result showed that a number of theories and proven laws of physics can be used to explain the economics behavior of individuals or communities. Study of the application of physics in economics termed econophysics which is a blend of physics as the *"king of natural science"* and the economy as the *"queen of the social sciences"*.

Research by Juergen Mimkes (2006) with the title "*A Themodynamic Formulation of Economics"* obtained that revenue and economics growth phenomenon can be explained by using the amount of entropy, heat and temperature in thermodynamics.

Research by Stanley, et. al., (1999), with the title "*Econophysics: Can physicists contribute to the science of economics?*" obtained that the value of shares in the capital market can be explained by using the probability distribution of particles in the Physics Statistics.

Research by Palerou, et. al., (2000) with the titled was Econophysics: financial time series from a statistical physics point of view. This research may explain how the phenomenon of the financial economy as a function of time in the stock market by using the concept of Statistical Physics. Research by Cizeau, et. al., (1997) with the titled Volatility distribution in the S&P500 stock index. This research may explain the fluctuations in the average index of stocks in the stock market with the concept dsitibusi chances in statistical physics.

1.5 The application of the theory and the laws of physics in explaining the principles of the science and economics.

In the following description will be analysed tenth principles of economics propounded by N. Gregory Mankiw (2007) by using the analogy theory and the laws of physics. The economics principle is a basic truth that became law theory and economics thought.

Principle I: People face tradeoffs.

This principle explains that in every economics decision making, we are faced with a choice, a choice which option expense of another. As an example. When we choose something, then something else would be sacrificed. This can be a sacrifice of time, money, concentration, or other. Writing a blog makes me lose time to relax. Continuing to college will sacrifice the opportunity to work with a decent salary. The larger outlay state/government to build defenses (guns), the less resources left to produce consumer goods (butter) to improve people's living standards and vice versa.

In physics this economics principle can be described by using the law of conservation of energy. Energy is fixed. Energy cannot be created and destroyed, and energy can be transformed from one form to another but the amount of energy remains (Hewitt, 1998). The task of human as a rational being is how to change energy from one form to another, more valuable or useful. Mechanical energy can be converted into electrical energy, electrical energy can be converted into heat energy.

Here is an example of the application of theoretical physics to explain the first principle in Economics Sciences.

If E1 + E2 = constant, then when we will raise the energy E1 then we have to sacrifice or reduce energy E2, otherwise if we are going to raise E2 then we have to sacrifice or reduce the value of E1. To get a new form of energy, it is necessary to sacrifice other energy to be converted into a new form of energy.

In free fall motion Ep + Ek = constant. When the kinetic energy increases, there is a big sacrifice or reduction in potential energy and vice versa.

In one day and one night on earth, we got the next 24 hours. Supposed that time is used 8 hours rest, 8 hours of work and 6 hours and 2 hours worship. If we are going to raise as much as 10 hours of work time, then we have to sacrifice or reduce the amount of time in the other for 2 hours.

Principle II. The cost of something is what you give up to get it

Someone will choose product A as compared to choose product B, if you choose a product likely to be more profitable than choosing B. The cost of this product is also called the opportunity cost. The opportunity cost, the cost of lost opportunity in order to run an option. Example: A famous football players decided to sacrifice not go on to college and choosing football as a professional athlete, because it considers the 'opportunity cost' career as a professional athlete is more advantageous than the opportunity cost of college tuition.

This economics principle can be described by using probability theory. Naturally change a system move towards greatest probability or opportunity (Amit and Verbin, 1999).

$$P(E) = \frac{n}{N}$$

$P(E) =$ probability of events E occurs

n = the amount of events E arise

N = the amount of mutually exclusive experiment

At the coin toss freely, then the probability of the emergence of a picture or figure most of each half (½). If the tosses as much as 100 times the probability that an image or figure of about 50 times to get the greatest opportunities ½. In throwing dice freely, then the greatest opportunity emergence numbers 1, 2, 3, 4, 5 or 6 of each is 1/6. If the tosses as much as 600 times the probability that a figure of about 100 times to get the greatest opportunity 1/6.

Through the above description is obtained that naturally will choose or change the system towards the greatest opportunities. This result is analogous with the second principle economics. Human decision-making choose something that gives greater profit opportunities from a number of options available.

Principle III: Rational people think at the margin.

If a person consumes something then someone will calculate additional benefits or value derived by

each increase of one unit of goods consumed. When someone needed clothes then an additional unit of clothing will increase or additional benefit margins, at some point no longer raise additional clothing benefits but it can decrease due to the additional benefits of the garment units. When a person is thirsty, drink a glass first and second will increase the benefits, but to drink three glasses and so will reduce benefits. In this economics phenomenon is referred to as the law of diminishing gain benefits or the law of diminishing marginal utility (LDMU). This law can explain why diamonds are more expensive than water. In additional benefits provided water to more quickly achieve the maximum benefits provided additional than diamond.

In physics this economics principle can be described by using Ohm's law and the theory of heat transfer. In Ohm's law the magnitude of the current strength is inversely proportional to the large barrier and directly proportional to the large electrical potential difference. In a conductor of heat transfer in the amount of heat transfer is directly proportional to the temperature difference and inversely proportional to the length of conductors (Halliday, et. al., 2001).

Ohm's Law:

$$i = \frac{V}{R}$$

Where as: i = the amount of current, V= potential difference, R=the amount of resistance.

Heat transfer:

$$H = k\frac{\Delta T}{L}$$

$$H = speed\ of\ heat\ transfer$$

$$k = conductivity\ coefficient$$

$$\Delta T = temperature\ different$$

$$L = length\ of\ conductor$$

Here is an example of the application of theoretical physics to explain the second principle in Economics Sciences.

If the electrical resistance R1> R2> R3, arranged in parallel and a potential difference V the most powerful currents occur at the smallest obstacle is R3. The results suggest that most of the electrons likely to choose the path with the smallest barriers, barriers of options available. If the conductor of length L1 barriers >L2> L3 each given temperature difference ΔT, the heat transfer occurred at the smallest length barrier. These results also explain that the heat will choose the path with the smallest bottleneck.

Through the above description it can be concluded that the magnitude of a strong electric current or energy transfer in naturally larger conductor through a small obstacle compared major obstacle. This result is analogous to the third principle of economics that the retrieval of human decision to choose something that provides greater benefits or barriers are smaller than a number of options available.

Principle IV: People respond to incentives.

Incentives are something (as is likely to reward or punishment) that can induce a person to act. Someone will usually be "active" while someone is an additional benefit of what he was doing. Someone will work according to the current standard fixed incomes, but when there is an incentive then he will work extra than before. In economics, the incentive is very crucial. Knowledge about incentives and what the reaction to such incentives is very important to know the work and the movement of the market, as well as for policy makers.

In physics this economics principle can be explained using third Newton's law. If object A exerts a force acts on the object B then object B will provide reaction force as great as do A. $F_{action} = - F_{reaction}$; F = force magnitude; negative sign indicates the opposite direction (Giancolli, 2000).

Here is an example of the application of physics theory to explain the fourth principles of Economics Sciences.

If object a giving force of 100 newton acts on object B, then object B will also react to exert a force of 100 newton in the opposite direction. When object A to raise an additional force of 1 newton acts then object B will react by raising additional reaction force of 1 newton. This phenomenon is analogous to the fourth principle in economics.

Through the above description, the magnitude of action force analog with incentives, while reaction force analogous to that given the public response to incentives.

Principle V: Trade can make everyone better off.

Trade will make people better. If there is no trade, then the person must produce all its needs, this situation is clearly not possible. A State will produce a good or service in accordance with the most optimal capability is low production costs, high production capability, and good quality of products sold to the results of another country which is not the optimal production of these goods. Production of goods that cannot be produced optimally then the State will buy from other countries whose production is more optimal. Indonesian state need wheat flour, but the Indonesian state is not able to produce optimally, then the country must import it from other countries. And vice versa Indonesia could produce crute palm oil (CPO) and its derivatives optimally, the Indonesian state export it to other countries that are not optimal in producing palm oil and its derivatives. Mutual cooperation meets the shortfall between what the individual or the state or the country will make the community better.

In physics this economics principle can be explained using the bonding phenomenon and the substance or mixture of substances composite phenomenon. In solids we know the type of ionic bonding, covalent, metallic and molecular bonding. Of the four types of bonds is then covalent bond is a type of the strongest (Giancolli, 2000). Other Physics phenomena that can explain this economics principle is cooperation or a mixture of high elastic objects with less force with lower elastic substance but better hardness. Cooperation between the two types of substances will result in a stronger mixture of substances.

Here is an example of the application of l physics theory to explain the fifth principles of Economics Sciences. In covalent bonding of carbon atoms in the diamond one is working with four other carbon atoms by using the four outer electrons together to form a strong bond. The concept of complementary cooperation proved a powerful crystal form. In reinforced concrete structures, cooperation between the elastic rod iron with cement and sand are less elastic to form a powerful new blend.

Through the above description is obtained that meets the mutual cooperation becomes what element or material shortage will make the material stronger. This phenomenon is analogous to the fifth principle in economics that trade cooperation mutually fulfilling what the shortcomings of two or more groups of people will make communities stronger.

Principle VI: Market are usually a good way to organize economics activity.

The market in general is a place and a good way to organize economics activities. In economics a market mechanism is a suitable method for efficiently regulating economics activity. The market is a meeting place between producers and consumers. The market mechanism based on collective decisions of households and firms in the allocation of resources. The market is able to collect and domestic companies to provide offers and raises the demand for goods and services. The market has formed a natural balance when the number of products offered equal in number to supply the required product is equal to the fever. Through the mechanism of a perfectly competitive market occurs, so that the quality and prices of similar goods is the same. In this mechanism is referred to as the economics invisible hand (the invisible hand). Centralized economics weakness is market-oriented or not, is not enough incentive to go forward and do more. All is set by the government. The other drawback is that the government does not have the ability to allocate resources appropriately.

In physics this economics principle can be described by using the laws of thermodynamics and Newton's laws in achieving equilibrium phenomena. In thermodynamics, heat will move from high temperature to low temperature until a temperature equilibrium temperature of both objects is the same. In a balanced system mechanics, if the net force acting on the system is zero. Stationary objects and objects moving with constant velocity is in mechanical equilibrium objects. In the two systems are in balance, then the amount of energy in the system is fixed, so it does not need additional energy. Natural phenomena naturally move towards the equilibrium state (Amit and Verbin, 1999). The phenomenon of landslides, floods, earthquakes are events seeking a new balance due to the loss of equilibrium on the old system. A balanced system is an efficient system.

Here is an example of the application of theoretical physics to explain the fifth principles of Economics Sciences.

Heat energy will naturally move from high temperature to low temperature and naturally will reach equilibrium if the temperature of the two objects together. This process occurs naturally balance. High temperature difference between the two systems is analogous to the amount of supply or demand. If the temperature is higher than consumer manufacturers, mean offers greater than demand, and vice versa. If the same temperature then analogous to the large demand with supply have equal or balanced. The phenomenon of movement of motor car. Motor car speed can be increased if the thrust of motor car is greater than the friction force and the velocity will be constant or may not be increased, when the motor car have thrust equal to the friction force. In accordance with Newton's law, if the amount of force zero then the object will be stationary or moving at a constant speed. This situation is called a state of balance forces.

Through the above description, provide information that the process of natural balance in physics analogous to the process of economics balance in which the balance between supply and demand due to the

invisible hand.

Principle VII: Governments can sometimes improve market outcomes.

The government should regulate the market in the event of market failure, the presence of externalities, or the presence of economics actors that dominate the market (having market power). The goal is for efficiency and equity. In sixth principle that the market mechanism can allocate resources effectively and efficiently. The question is, why should the government? One is to make sure the market mechanism works well through law enforcement and provision of infrastructure. The market mechanism is not useful if the theft is rampant, the trade agreement is not met and the poor transport links (and there is not enough incentive for the market to provide transport paths)? The government's role is not only to stop as facilitator but here the government can do two things: increase the efficiency and fairness. Intervention against the market mechanism is needed, if the balance of the market according to classical economics theory difficult to achieve. Causes of market inefficiencies include externalities, i.e. the effect of an action against the general public. Externalities (negative) is the most common pollutants. There is another factor of market power, in which a single power (or a few people) has a tremendous influence on the market. It could also be called a monopoly. Government has a role to prevent the onset of these factors can lead to the failure of the market mechanism work. Then talk about fairness, the market mechanism can only regulate the allocation of resources based on the ability to produce something where people are willing to pay for it. The invisible hand does not guarantee that every person can have a job, be able to eat enough or could be treated if sick. The government was responsible for justice for all people, with a mechanism of taxes, subsidies and wellness programs or cheap groceries.

Another example is if a lot of companies that go bankrupt and market failure, the government can step in and save the company from bankruptcy, and maintain production capabilities and minimize unemployment by offering to buy out or takeover of a company by the government.

In physics this economics principle can be explained using the second law of thermodynamics is a phenomenon in order to achieve efficiency. According to the laws of thermodynamics most efficient engine is Carnot engine (Amit and Verbin, 1999). The efficiency of the combustion engine shows a large percentage of heat energy that can be used or converted into mechanical energy (work).

$$\eta = \frac{W}{Q} \times 100\%$$

$$\eta = \left(1 - \frac{T_1}{T_2}\right) \times 100\%$$

$\eta = \text{efficiency}$

$\mathrm{W} = \text{work}$

$\mathrm{Q} = \text{calor energy}$

$\mathrm{T}_1 = \text{low reservoar temperature}$

$\mathrm{T}_2 = \text{high reservoar temperature}$

Empirically efficiency of 100% cannot be achieved, because in order to achieve 100% efficiency of the low reservoir temperature should be 0 K. Temperature 0 K is empirically not been achieved. Empirically government's role in controlling the market in order to occur efficiency of 100% may not be achievable. This is consistent with what is often the case in the market that the occurrence of unfair competition, and other inflation is a phenomenon that cannot be eliminated in full.

Here is an example of the application of physics theory to explain the fifth principles of Economics Sciences.

To obtain motor fuel-efficient engines, the technology must be developed that can alter the results of combustion heat energy as possible into work or mechanical energy. To obtain efficient lighting, the technology must be developed that can transform electrical energy into energy maximum illumination.

Through the above description, it can be concluded that the phenomenon of the role of government in regulating markets to enable the efficient market dynamics analogous to the role of technologies in engineering to apply a natural process that is efficient.

Principle VIII: Country's standard of living depends on its ability to produce goods and services.

The standard of living of a country depends on the country's productivity in producing goods and services. This principle can be seen from the fact that shows the differences in living standards between

countries is quite striking that exist in the world. The World Bank divides the income level of a country into Low Income (LIC) for under $ 785, Lower Middle Income (LMC) for $ 766 - $ 3035, Upper Middle Income (UMC) for $ 3036 - $ 9385, and High Income for over $ 9,386. Indonesia itself is located at the level of the LMC. Income levels also lead to differences in standards of living: the ownership of electronic goods, access to education and health services, availability of nutrients, to the level of life expectancy (life expectancy). Productivity is the factor that determines the level of a country's standard of living. Productivity is the amount of goods and services that can be produced per hour of work. The more productive people of a country, the greater their ability to enjoy a better standard of living. To increase the productivity of a country, need a good education, adequate facilities, appropriate policy and technology support qualified (Mankiw, 2007).

In physics theory the eigth principle of economics can explain by using the Stefan Boltzmann and Wien law namly phenomenon of black body radiation. Any object will emit energy that proportional to the fourth power of the temperature of the object. In accordance Wien law the wavelength of the maximum radiation energy black body to the smaller for greater temperature (Halliday, Resnick, and Walker, 2001).

Formulation of the Stefan Boltzmann Law

The rate of thermal radiation energy proportional to the area of an object and fourth power of the absolute temperature.

$$P = e.\sigma.A.T^4$$

Description:
P = power (watts)
e = emissivity / emission coefficient ($0 \leq e \leq 1$)
σ = Constant Stefan - Boltzmann ($W/m^2.K^4$)
T = absolute temperature of the object
A = area (m^2)

Radiation energy will be zero if the temperature of objects zero kelvin. Energy emitted by objects coming from outside the energy received by the object. Object will absorb heat from another object its temperature is larger and will transmit back to the other objects that temperatures are lower. Energy received from outside the object will be stored as energy in the system. Matter radiation process is the input and output of energy. Characteristics of energy absorbed and emitted objects is determined by the magnitude of the temperature.

Here is an example of the application of physics theory to explain the eight principles in Economics Sciences. In economics, production is the process of transforming resource inputs into valuable outputs. Incident radiation is analogous to the production process, because there is energy input and output. Analog input energy to raw materials. Radiation or energy output of the analog object with products produced objects. Characteristics of the input energy is different to output energy. The process of changing one form of energy into another form of energy analogous to the production process. Naturally the material in nature do carry out the production process. The energy emitted is proportional to the fourth power of the temperature. The greater the temperature, the greater the energy emitted. The greater the energy emitted by the larger analog products. Temperature is analogous to the level of income of employees. The level of production is proportional to the level of income of employees. The more productive the more prosperous groups of individuals, because of the greater level of income.

Through the above description, it can be concluded that the matter in nature are productive its able to absorb energy from the high temperature and radiate energy in the another form to another matter which lower temperature.

Principle IX: Prices rise when the government prints too much money.

Inflation (rising prices in general) will happen if the money supply too much. The high rate of circulation of money as a result of higher production of money itself, cause the value of money is becoming increasingly less valuable impact on inflation. So the prices of goods increase because the value of money decreases. This phenomenon can also be explained at the demand and supply aspects. When the money supply rises, the number of demand for goods increases, increased demand causes prices to rise. Ideally, the money supply must be balanced by the number of products.

In physics theory the ninth economics principles can be explained using the second law of thermodynamics namely the concept of entropy. Entropy of a system describes the value of disorderly particles

that build system (Yoshioka, 2007). If the entropy more increasing then particles that build system will more disorderly, and vice versa. The phenomenon of entropy formula (Amit and Verbin, 1999):

$$dS = \frac{\delta Q}{T} = \frac{C.dT}{T}$$

$$S = c\int_{T1}^{T2} \frac{dT}{T} = C \ln \frac{T_2}{T_1}$$

$S = \text{entrophy}$

$\text{Q} = \text{heat}$

$\text{C} = \text{heat capacity}$

$\text{T} = \text{temperature}$

If the temperature rises then the entropy will increase. Entropy more increasing means the system particles more disorderly.

Entropy in physics analogous to the production function. A product consists of a number of the component that assembles products. Suppose a product consists of five components A, B, C, D and E, then the amount of permutations is 5! or 120. As has been the product then the magnitude of the permutation is one. These results illustrate that cause the system to become a regular production or entropy that is getting smaller. The bigger the production of the components forming the system of production will be reduced so that more and more regularly it is analogous to the decrease in entropy. Entropy decreased analog with increased production, and vice versa. Temperature is analogous to the level of income or the amount of money supply. If the temperature rises then the entropy will increase analogous if the money supply to the rise of production will decrease. The decline in production will lead to rising prices or inflation.

Principle X: Society faces a short-run tradeoff between inflation and unemployment.

If inflation rises, unemployment will drop, and vice versa. This can be explained by using the Phillips curve. In the long run inflation is the main effect of the money supply, in the short term a lot of money printing can actually reduce unemployment. This phenomenon can be explained as follows. Increasing the money supply to stimulate purchasing power so that the level of demand increases. The increase in the level of demand is likely to increase the price, but it will also attract entrepreneurs to increase the production of goods and services to meet the demand. For that, we need more workers. In general, employment will increase and unemployment was declining. Thus, the overall scale of the economy, there is also trade off, between inflation and unemployment. Policy makers can take advantage of short-term trade-off is determined the combination of inflation and unemployment are deemed appropriate. How to set up government spending, tax rates and the amount of money printing.

In physics this principle economics can be explained using the second law of thermodynamics to the phenomena of the refrigerator engine.

To be able to move heat from a low temperature (T_1) reservoir Q1 to the high temperature (T2) reservoir Q2 required effort or work W. The greater temperature high reservoir then the greater working for heat transfer. Work on the engine coolant can be formulated as follows (Tipler, 1991):

$$W + Q1 = Q2$$

Q1 = heat transferred from a low temperature reservoir T1.
W = work to move heat.
Q2 = heat at a high temperature reservoir T2.

If the high reservoir temperature rise, it is necessary to work for W greater heat transfer Q from the lower reservoir to a higher reservoir temperature. Here is an example of the application of physics theory to explain the tenth principles of Economics. When the high reservoir temperature rise, then the work or effort to move the heat from the lower reservoir to rise. The increasing high reservoir temperature is analog with the increasing in the money supply. The increasing work (W) means the engine needs to work with a larger capacity. Working capacity of a larger engine is analog with the increasing to labor needs, so as to reduce unemployment.

2. Conclusion

Theory and the laws of physics can be used to explain phenomena in the science of Economic and

economics principles. The first principle of economics, “People face trade-offs” can be explained by using the law of conservation of energy. The second principle of economics "The cost of something is what you give up to get it" can be explained by using the theory of probability. The third principle of economics "Rational people think at the margin" can be explained by using Ohm's law and heat transfer on the conductor. The fourth principle in economics "People respond to incentives" can be explained using Newton's third law. The fifth principle in economics "Trade can the make everyone better off" can be explained by using the theory of atomic bonding and bonding of composite materials. The sixth principle of "Market are usually a good way to organize economics activity" can be explained by using the theory of equilibrium. The seventh principle of economics "Governments can sometimes improve market outcomes" can be explained by the theory of the second law of thermodynamics namely engine efficiency. The eighth principle of economics "Country's standard of living depends on its ability to produce goods and services" can be explained by the concept of Stefan Boltzmann and Wien law. The ninth principle of economics "Prices rise when the government prints too much money" can be explained using the concept of entropy. Tenth principle of economics "Society faces a short-run trade-off between inflation and unemployment" can be explained by seconde law of thermodynamic in refrigerator.

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