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Can money be compared to energy? Empirical analysis of making money with the $E = mc^2$ logic

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Abstract

In this study, the $E = mc^2$ principle that energy can be derived from mass and energy as itself was adapted for money. In the study, it was meant to provide a natural dimension to not using money other than the intent of exchange and the necessity of earning money by producing. To this end, the effect of foreign direct investments that are representing production and portfolio investments' effects on economic growth as representing monetary activities. The findings showed that both in the long and short term, there is a positive and significant relationship between FDI and economic growth. No such relationship has been found for portfolio investments. This result coincides with the $E = mc^2$ relationship.

1. Introduction

At the beginning money emerged as a mean of exchange to resolve deficiencies of the barter economy. Although money was preferred only as a mean of exchange at the outset its role has started to change as a tool for savings and speculation in time. Therefore, money has become an important tool for the economy. With this current function money is almost the energy of the economy. In this framework the way money is acquired has utmost importance. In economic life, money is mainly acquired through real or financial sectors. The real sector which is also called as direct investments includes all kinds of production activities and is sensitive to profit rates. As profit rate increases, investments in real sector also increase. The financial sector includes gains due to monetary mobility. In this sector there are many financial instruments such as indirect investments, portfolio investments, and hot money flows. The finance sector is sensitive to interest rates therefore with high interest rates financial instruments increase their attractiveness.

Energy is of great importance for the continuation of vital activities. All living and inanimate beings, especially humans depend on energy for their continuity. For example, without heat and light vital activities could come to almost standstill in the world. As energy can be found readily in nature, it can also be created with mass or from another type of energy. Production of energy from the mass was explained by $E=mc^2$ formula by the famous physicist Albert Einstein. According to this formula mass can be transformed to energy as well as energy can be transformed into mass. Thus, the energy released is very large amounts. Production of energy from other types of energy is also possible and is called transformation of energy. This is indicated by law of conservation of energy. However, the amount of energy after the transformation is one to one at maximum.

Everything that exists in nature is created in a certain balance. The precondition to continue vital activities with harmony is not to lose the existing balance. Many scientific discoveries emerge as a result of observation of natural events. For instance, Isaac Newton discovered the law of gravity through an apple which fell from a tree. Another example is the discovery of the first airplane was inspired by birds. Archimedes saw that some water overflowed

** All responsibility belongs to the researchers. All parties were involved in the research of their own free will.*

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when he entered the bathtub and realized that the overflowing water was equal to the sinking volume of his body and with this observation, he found the force of buoyance. All these inventions can be found in the scientific literature as the way they first appeared, and these original inventions act as resources of inspiration for scientific studies. Based on this idea money is likened to energy that can found in nature and has indispensable importance for humanity. Stable economic growth is one of the main goals that all world economies have in common. In this regard, national economies aim to provide their citizens with a high standard of living and maintain it by raising it even higher (Demir and Bahar, 2021). For the sake of economic stability, the necessity of using money in accordance with its primary purpose is emphasized in this paper.

The research includes introduction, monetary and interest theories, theoretical information on the transformation of energy, literature, empirical analysis, and conclusion parts. In empirical analysis, production related earnings are represented by direct foreign investments whereas financial earnings are represented by portfolio investments and their effect on economic growth are analyzed by the ARDL bounds testing. The research covers the entire world in the period of 1990-2019 through research data taken from the World Bank website. Analyses were concluded using the Eviews-11 program.

2. Money, interest and energy theories

In this section, theories of money, interest as well as theories about energy production will be included. Therefore, this section aims at providing information about theoretical background of mass-production and energy-money similarities.

2.1. Theories of demand for money

2.1.1. Classical economic thought and money demand

In the classical approach, Irving Fisher's "Quantity Theory of Money" and "Cambridge Quantity Theory of Money" developed by A. Marshall and A. C. Pigou stand out. Fisher demonstrated the relationship between the amount of money and the general level of prices with the Fisher Equation.

$$MV = PY \tag{1}$$

According to this approach V and Y are constant in the short term; in this context, when the quantity of money (M) changes, the general level of prices (P) on the right side of the equation will change in the same direction and at the same rate (Fisher, 1911). I Cambridge approach Quantity Theory is as follows.

$$M_s = MD = k.PY \tag{2}$$

Given that Y and k are fixed in the short term, the change in the amount of money (M) will change the general level of prices (p) in the same direction and at the same rate (Aktan, 2010). In both approaches, production (Y) is constant. In other words, the production has been neglected. Accordingly, it is stated that in the event of an increase in money independent of production, the general level of prices will increase. If we evaluate the event from a different angle, it is possible to see the similar outcome. In Fisher's equation, the velocity (V) of money and the volume of production (Y) are considered constant. In the same sense, if the velocity of money (V) and the general level of prices (P) are considered constant in the short run, it is obvious that the increase in the quantity of money (M) should be indexed to production (Y). The similar property applies within the Cambridge approach. If "k" and "P" are considered constant in the equation, money (MD) increase based on production (Y) is projected. With this move, it is possible to see the relationship between money and production more clearly.

2.1.2. Keynesian theory of demand for money

Keynes (1936) in his work General Theory suggested that the demand for money could be for speculation purposes besides savings purposes. According to Keynes (1973), the most important reason for the traditional theory's inadequacy is its lack of a monetary theory of production. To understand and define real economies there is a need for a monetary (production) economics theory. According to Keynes, in monetary economics entrepreneurs and firms are not interested in production but only in the amount of money that will fall for their share. Firms and entrepreneurs have no purpose except to earn more money in their activities. According to Keynes, while there is production for consumption in a non-monetary economy, in monetary economy the goal is not consumption but to earn more money with money (Sardoni, 1991).

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2.1.3. Modern theory of demand for money

Friedman (1959) according to the new theory of demand for money, which he developed and called Modern Quantity of Money Theory, money is an active value. Accordingly, Friedman's money demand function is as follows:

$$M_d = f[(is.ib\left(\frac{pxdp}{dz}\right)Wh](PY) \quad (3)$$

In modern quantity theory of money, changes in the quantity of money have a great effect on economic activities and general level of prices (Friedman, 1956). According to Friedman in current circumstances the best solution for an economy is to have authorities increasing the monetary base growth rate (Friedman, 1980). In his theory, Friedman advocates production-based money growth in terms of economic stability.

2.2. Interest theories

2.2.1. Classical theory of interest

According to classical economists, interest is a mean of directing the individual's saving behavior (Haron and Ahmad, 2000). Classical theory of interest theory was developed under the leadership of Adam Smith. According to him, when the individual does not use his or her savings but rather lets others use them, the extra income generated in return is defined as interest. This means that an individual with a certain capital can either purchase goods for production purposes or lend it to generate interest income. A. Smith differentiates second option from the first as he calls it earning money from money (Smith, 1909).

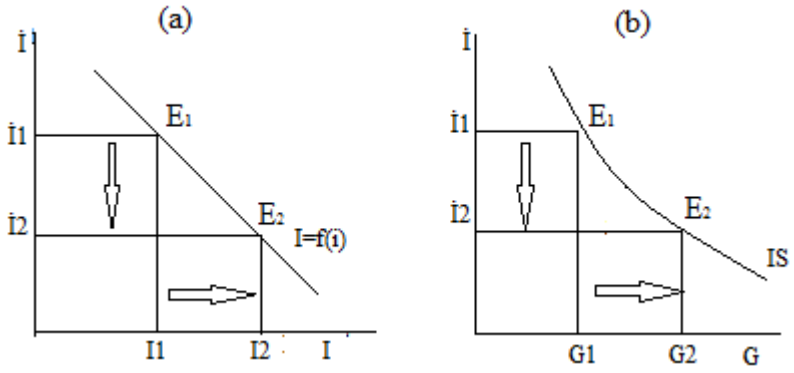
2.2.2. Wicksell's loanable funds theory

An advocate of neoclassical economics Wicksell evaluated interest as monetary interest and natural interest. Monetary interest rates are determined by the banks. Natural interest rates are determined based on investment and savings decisions of economic units. According to Wicksell, fluctuations in the general level of prices can occur due to the interaction between the market interest rate and the natural interest rate. In this context, if natural interest rates are lower than market interest rates, investments will decrease (Wicksell, 1962).

2.2.3. Hicks-Hansen's Neo-Keynesian synthesis (IS-LM analysis)

In 1937 Hicks published the "Mr. Keynes and the Classics" and made a synthesis of the common characteristics of Keynes ' views and the classical view. According to this synthesis, the equilibrium interest rate is determined by both the goods market and the money market (Hicks, 1937). Later this study was advanced by A. Hansen and renamed as "IS-LM analysis". Quantity of investments in an economy depends on the marginal effectiveness of capital (r) and the rate of interest (i). Therefore, investments increase as interest rates fall and investments as well as national income decrease as interest rates rise (Figure 1).

Figure 1. Derivation of the IS curve



The fall in interest rates has boosted investments, Figure 1(a). National income has increased as a result of increased investments, Figure 1(b). The LM curve represents the interest rate-income combinations that make money demand equal to money supply (Keyder, 1993).

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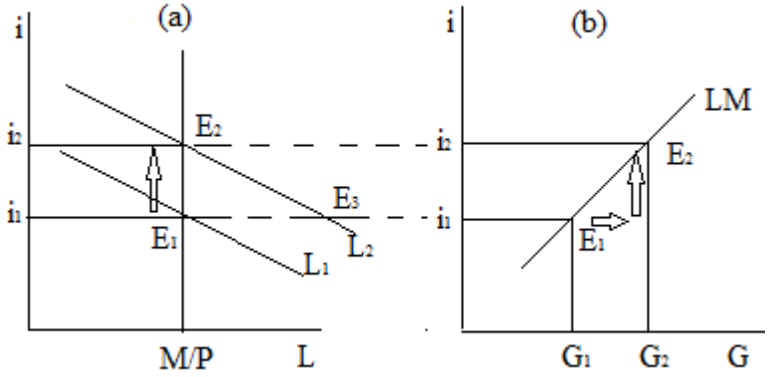
Figure 2. Derivation of the LM curve



In figure 2, The reason that the revenue goes up in G1 to G2 is purely monetary. This increase is not an increase due to production (Ünsal, 2013). The increase in national income (G1→G2) refers to the increase in the income of monetary capital holders.

2.3. Production of energy

In his famous Theory of Relativity, the physics scientist Albert Einstein stated that the energy with a unit value of "erg" is like an extremely low amount of money compared to a mass determined as "gram". According to Einstein, the "exchange rate" between high-value mass and low-value energy coins is expressed only by a very large number. According to this, one gram of mass is equal to 9.10^{20} erg (Infeld, 1950).

2.3.1. How is energy produced from mass?

The most important of Einstein's work, published in the German scientific journal "Annalen der Physic" in 1905, is the basic formula of mass-energy equivalence in physics concerning matter and energy equivalence, defined as the special relativity theory (Einstein, 1916); "$E= mc^2$" When measured by Erg, one gram of mass is the energy equal to the square of speed of the light per second (300,000 km^2). This formula states that the equivalent energy (E) can be calculated as a multiplication of mass (m) by the square of the speed of light ($c = \sim 3 \times 10^8$ m / s) c^2. Similarly, a mass (m) with any energy is obtained by dividing the equivalent energy (E) by the square of the speed of light (c^2). Since the speed of light varies among different units the formula implies that even an object with a small amount of mass has a very large amount of energy from itself. Whether it is a nuclear or chemical reaction during energy transformations energy loses some parts of its luminous or thermal components (David, 2009; Serway and Beichner, 2011). Einstein stated that the theory of relativity belongs to a class of "principal theories". Therefore, he used an analytical method. This means that the elements of this theory are not based on hypothesis but on empirical discovery. Einstein explained his theory by observing natural processes and using mathematical models (Einstein, 1919).

By "$E = mc^2$" formula Albert Einstein overcame the old school of thought until him and has opened a new ground in the world of science. Before that, it was assumed that there was no connection between mass and energy and that they were separate phenomena. Einstein approached the phenomenon of" energy "from a mathematical point of view and concluded that what is called" mass " is actually a special type of energy. The difference is that the mass was much denser, much more concentrated than the other energies. This was evident from the fact that a very small mass can be converted into energy that is incomparable to its volume (Darrigol, 2005; Güran, 2011).

2.3.2. How is energy produced from other types of energy?

The "law of conservation of energy" was first formally used by William Rankine in 1850 (Rankine,1853). Producing energy from energy is expressed by the law of "Conservation of energy" in Physics. Accordingly, a system that does not receive energy from the outside cannot provide energy more than what it has to its surroundings (Planck, 1927). Since there is friction in the world and friction causes energy loss, energy transformation is never 100% in the globe.

Energy is a magnitude that can be transferred from one object to another. For example, in hydroelectric power plants potential energy of water is converted into electrical energy. In practice, this transformation process cannot

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be one-to-one since there are losses. The reason for these losses is that some of the potential energy of water is converted into heat energy due to the friction of the turbine gears during the conversion of the potential energy of water into electrical energy (Gök, 2013).

Similarly, the heat and light energy emitted by the sun can serve as an example. The sun is a high pressure and temperature star with a diameter of 1.4 million km and 110 times the size of the Earth which is 1.5x1011 m from Earth. The surface temperature, which is about 6,000 °K, is estimated to range from 8x106 °K to 40x106 °K inland. The energy source of the sun, a continuous and natural fusion reactor, is hidden in the transformation of 4 hydrogen atoms into 1 helium atom. 4 hydrogen atoms weigh 4,032 units, although the weight of 1 helium atom is 4,003 units. As a result of this event, Einstein's matter-energy relationship results in 0.029 units of weight energy. Therefore, every unit per second turns into 564 million tons of hydrogen and 560 million tons of helium in the sun, while 4 million tons of mass equivalent to 3,86x1026 J (Energy emerges) is lost (Varınca and Gönüllü, 2006).

3. Literature

3.1. Foreign direct investments (FDI) and economic growth

Wang (2009) studied the heterogeneous effects of FDI inflows at different sector levels on the economic growth of the host country for 12 Asian economies from 1987 to 1997. Accordingly, it was observed that FDI, especially in the manufacturing sector type, had a significant and positive impact on economic growth in the host economies. Ramirez (2010) estimated whether FDI had a positive and meaningful impact on private investment spending during the period 1980-2002, for Latin American countries. The results are that FDI, public investment expenditures and real loans to the private sector have a positive and meaningful impact on private equity formation. Lee and Chang (2009) explored aspects of causality between FDI, financial development, and economic growth for 37 countries the period 1970-2002. As a result of the study, convincing evidence has been obtained that there is a very strong, long-term relationship. Hayat (2019) investigated the impact of direct investments on economic growth and for 104 countries. The results provided evidence that FDI inflows are causing strong economic growth. Mehic et al. (2014), investigated the impact of FDI on economic growth of Southeast Europe's transition countries. The concluded that FDI has a positive and statistically significant impact on economic growth. Dinç and Gökmen (2019), studied the relationship between FDI and economic growth for the Brazilian economy in the period 1970-2017. According to the results, there is a positive and meaningful causality relationship between FDI input and economic growth in the long term. Ming-Ru and Chang (2010) analyzed the relationship between FDI and economic growth of Guangdong Province for the years 1982-2006. In the long term, economic growth and FDI have been positively correlated. Acguah and Ibrahim (2019), examined the relationship between FDI, economic growth and financial sector covering 45 African countries. According to the results, the effect of FDI on economic growth is mostly high. It has also shown that the financial sector has reduced the positive impact of FDI on economic growth. Yazdi et al. (2017), In his study the period 1985-2013 for the Iranian economy, showed that there is a positive relationship between FDI and economic growth in the long and short term. Assefa and Mollick (2017), conducted a study that found that in 15 African countries for the period 1995-2010, FDI had consistently positive effects on economic growth. Vita and Kyaw (2009), found that FDI for the period 1985-2002 had growth-enhancing effects for 126 low, low middle and upper middle-income countries.

3.2. Portfolio investments (PI) and economic growth

Syed et al. (2015), examined the determinants of increased PI in Pakistan. According to the findings portfolio mobility in Pakistan is more based on speculative motives. In his study Noemi (2014), observed that after the impact of financialization in emerging economies where capital markets were weak, the structure of the productive sector has changed. Edem and Samuel (2016), examined the different effects of capital flows on economic growth in Ghana. The findings show that both short-and long-term financial capital flows have negative effects on economic growth. Malik and Iftikar (2019), examined the dynamic short-and long-term relationship between FPI and Pakistani stock prices. According to the results, the increase in FPI is relatively due to the growth of the stock markets in these countries, the liberalization of their economies, and the high return on investment. Malgarzot et al. (2018), investigated the relationship between finance and growth in 14 countries from Central, Eastern, and southeastern Europe for the period 1995-2015. Accordingly, the negative impact of bank credit on economic growth and results in cyclical fluctuations in bank credit have been found. Samuel and Edem (2018), examined the different effects of capital flows on economic growth in Sub-Saharan Africa countries during the period 1970-2014. Accordingly, while FDI has a significant positive impact in Burkina Faso, it has a negative effect in Gabon

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and Niger, the impact of PI is negative in all countries. Sawyer (2016) explored the relationship between financialization and economic performance. Sawyers showed that as financialization increases in an economy economic performance is negatively affected. Barradas (2020), analyzed the relationship between financial mobility and economic growth in Portugal from 1977 to 2016. The findings suggest a negative relationship between financial mobility and economic growth. Ezzeddine and Hamami (2019), examined the impact of international financial integration in Tunisia on economic growth for 1970-2012. In this study it was found that Tunisia's policy of integration into the global financial market has not been beneficial for growth in the short term or in the long term. Aizenman et al. (2013), examined the relationship between economic growth and PI for 100 countries for the 1990-2010 period. According to the results, the relationship between growth and short-term debt is zero before the crisis and negative during the crisis. Sin-Yu and Iyke (2020), Conducted a study on the determinants of economic growth in Ghana from 1975 to 2014. Found that long-term financial development and debt service had a negative impact on output.

4. Empirical analysis

4.1. Model and data set

This research has been done for the whole world at a global level. In the study the relationship between "Foreign Direct Investments", "Portfolio Investments" and "Economic Growth" variables are discussed. The period range was set as 1990-2019. Data from was compiled from the World Bank web page. The "ARDL bound test" model was used for analysis. For this, the Eviews-11 program was utilized.

ARDL consists of two stages in the bound test approach. First, the cointegration relationship between the error correction model (ECM) and the variable in the model is investigated. If there is a cointegration relationship between the variables, then the second stage starts. At this point the short and long period coefficients of the model are estimated (Akalin et al., 2018). In the ARDL approximation, the variables must be maximum First-Order stationary.

First of all, a logarithm of household expenditure data was taken. Unit root testing was performed for the logarithmic series. Also, a number of specification tests were done. The cointegration relationship between variables is formulated as follows.

$$\text{Cointegration Relation} = Log(GDP) - [0.0999xLog(FDI) + 0ç0348xLog(IFI) \quad (4)$$

4.2. Unit root tests

One of the most preferred methods for stationarity tests is the Augmented Dickey Fuller (ADF) test. However, Perron (1989) showed that the ADF test fails in cases of structural break in the data set. The study referred to the ADF test as well as the Philip-Perron (PP) test (Akel and Ghazal, 2014). For stationarity testing augmented trendless model analysis was performed.

$$\Delta y_t = \mu + \delta y_{t-1} = \sum j = 1p\delta i\Delta y_{t-j} + \varepsilon_t \quad (5)$$

When the lagged value of the dependent variable is not included in PP models, the equation becomes as follows:

$$\Delta y_t = \emptyset y_{t-1} + \varepsilon_t \quad (6)$$

The series has been stabilized by applying both ADF and PP unit source testing (Table1).

Table 1. Unit root test results

Variables	ADF Test First Difference	PP Test First Difference
GDP	-6.054385 (0.000)	-12.47734 (0.000)
FDI	-5.734385 (0.000)	-14.99964 (0.000)
PI	-4.658624 (0.001)	-26.80670 (0.000)

As shown in Table 1, the first difference in the GDP, FDI and PI series I (1) was stationary.

4.3. Structural break testing

CUSUM (cumulative sum) and CUSUMSQ (cumulative sum of squares) tests were performed to determine whether there is structural break of the variables in ARDL model. The results are shown in the chart. If CUSUM and CUSUMSQ remain within critical limits (between two lines) at the level of 5% significance, then the H0

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hypothesis, which states that the coefficients in the ARDL model are stable, will be accepted (Bahmani and Raymond, 2002).

Figure 3-4. CUSUM and CUSUMSQ

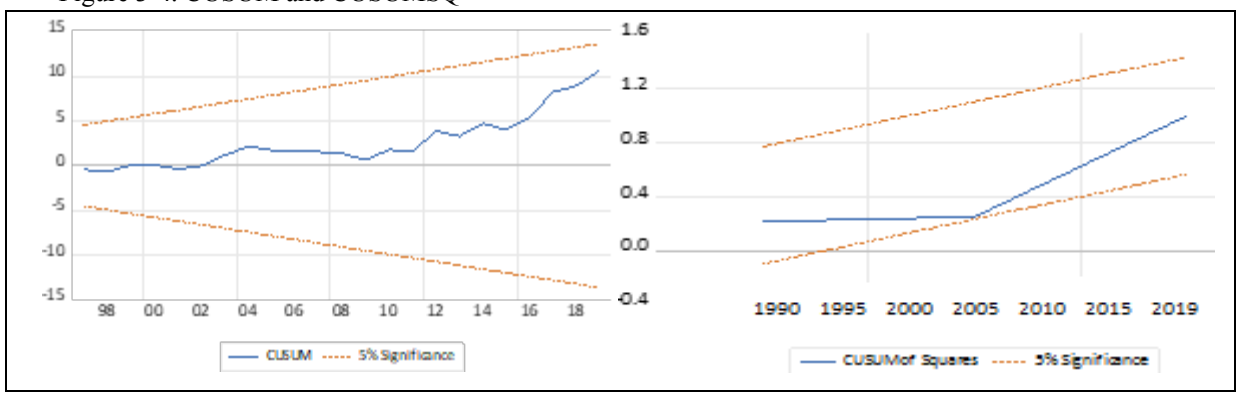


Table 2. Breusch-Godfrey serial correlation LM test

Null hypothesis: No serial correlation at up to 2 lags			
F-statistic	0.044003	Prob. F (2,16)	0.9571
Obs*R-squared	0.131287	Prob. Chi-Square (2)	0.9365

The probability value of the F statistic has been calculated as 0.9571 and this value is greater than the table value of 0.005. This shows that there is no problem of autocorrelation in our model.

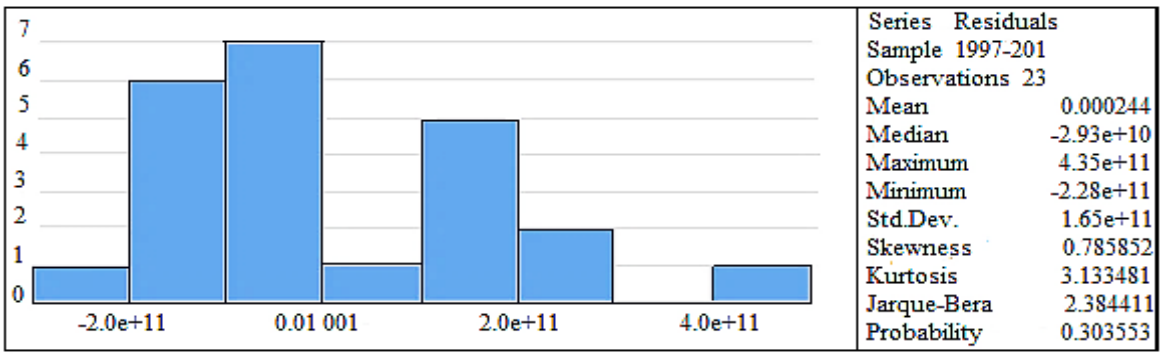
Table 3. Heteroskedasticity test: Breusch-Pagan-Godfrey

F-statistic	0.094091	Prob. F (19,3)	0.9997
Obs*R-squared	8.588134	Prob. Chi-Square (19)	0.9797
Scaled explained SS	0.155863	Prob. Chi-Square (19)	1.0000

The probability value of the F statistic has been calculated as 0.997 and this value is greater than the table value of 0.005 Accordingly, it is understood that there is no changing variance problem in our model.

4.4. Normality (Jarque-Bera) test

Figure 5. Normality test



The Jarque-Bera test concluded that the residues were normally dispersed because the probability value was 0.30553> 0.05.

Table 4. Specification test

	Value	df	Probability
t-statistic	0.926405	2	0.4520
F-statistic	0.858226	(1, 2)	0.4520
Likelihood ratio	8.212245	1	0.0042

Since the statistical value of f is 0.4520 > 0.05, there is no specification error in our model.

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4.5. Finding the length of the delay

Table 5. VAR lag order selection criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
6	-1859.884	7.785828	4.02e+69*	166.6855*	169.4996*	167.3933*

* Indicates lag order selected by the criterion

The number of delays is set to 6 (Table5). After the delay number is determined, the relation between series and the bound test approach is investigated.

4.6. ARDL long term results

The Wald test is used to test the existence of a long-term relationship between variables. The hypotheses of this test are as follows:

$$H_0 : \delta_1 = \delta_2 = 0 \quad (7)$$

$$H_1 : \delta_1 = \delta_2 \neq 0 \quad (8)$$

ADF probability value = 0.005 <0.05 means H_0 to be rejected and H_1 to be accepted. PP probability value = 0.0000 <0.05 means H_0 to be rejected and H_1 to be accepted. The calculated F statistic is compared with asymptotically derived levels of significance in the work of Pesaran Shin and Smith (2001). In this study, lower and upper values are given according to the variables I (0) and I (1). If the statistical value of F is greater than the upper limit of critical values then the zero hypothesis, which implies that there is no long-term relationship between variables, will be rejected (Akel and Gazel, 2014). For this purpose, the ARDL model, which first examines the long-term relationship, is as follows (Esen et al. 2012):

$$Y_t = \alpha_0 + \sum_{i=1}^{m} \alpha_{1i}\ \Delta Y_{t-i} + \sum_{i=0}^{n} \alpha_{2i}\ \Delta X_{1t-i} + \ldots + \sum_{i=0}^{r} \alpha_{ki}\ \Delta X_{kt-i} + u_t \quad (9)$$

Table 6. ARDL long run form and bounds test

Dependent Variable: D(LOGGDP)				
Selected Model: ARDL (3, 0, 0)				
Variable	Coefficient	Std.Error	t-Statistic	Prob.
LOGFDI	0.099948	0.043792	2.282350	0.0348
LOGPI	0.034786	0.038165	0.911478	0.3741
EC = LOGGDP - (0.0999*LOGFDI + 0.0348*LOGPI)				
F-statistic	16.19366	10%	3.17	4.14

According to Table 6, The F-statistical value "16.19366" went above the upper critical values of 4.14; 4.85; 5.52 and 6.36. Accordingly, it is understood that there is a long-term cointegration relationship between the variables. When we look at long-term coefficients, GDP increases by 0.099% when direct investments increase by 1% in the long-term. This result is statistically significant (0.0348<0.05). However, there was no significant relationship between portfolio investments and economic growth (0.3741>0.05).

4.7. ARDL short-term results (Error correction model)

An error correction model, based on ARDL may be used to determine short-term relationships between variables, such as the following.

$$Y_t = \alpha_0 + \sum_{i=1}^{m} \alpha_{1i}\ \Delta Y_{t-i} + \sum_{i=0}^{n} \alpha_{2i}\ \Delta X_{1t-i} + \ldots + \sum_{i=0}^{r} \alpha_{ki}\ \Delta X_{kt-i} + \mu ecm_{t-1} + u_t \quad (10)$$

Unlike the long-term equation, the term error correction has been added to the model. The expectation is that the sign of this coefficient is negative and meaningful (Esen et al. 2012).

Table 7. Results of the error correction model (Short-term relationship)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.092963	0.163636	-0.568111	0.5770
D (LOGGDP (-1))	1.548507	0.381411	4.059945	0.0007
D (LOGGDP (-2))	0.780575	0.233532	3.342478	0.0036
CointEq (-1) *	-3.292741	0.448173	-7.347031	0.0000

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The error correction coefficient has increased to a negative value of -3.292741. This is also statistically significant (prob. =0,000). However, it is clear that that the calculated value does not conform to the standard t distribution. So, the calculated probability value is not reliable. Because of this the limit test of the t statistic was performed.

Table 8. Error correction model T statistics references

Test Statistic	Value	Signif.	I (0)	I (1)
t-statistic	-7.347031	10%	-2.57	-3.21
		5%	-2.86	-3.53
		2.5%	-3.13	-3.8
		1%	-3.43	-4.1

The result of the t statistic was negative as a result of the critical values. When we take the absolute value of these values, the calculated t statistical value is greater than the upper critical value. Accordingly, it means that our error correction model is functioning. Therefore, it has been concluded that there is a cointegration relationship between the series in the short period. Accordingly, a short-term deviation (1/-3.292741) comes to equilibrium in the long-term after approximately 0.30 quarters.

5. Conclusion and discussion

In the study, the fact that energy can be derived from mass is adapted for money. Here, an analysis was made comparing energy, money, mass, and production. This analogy is made in terms of obtaining both energy and money and the benefits they provide. This study is a mere validation of A. Einstein's discovery that that more energy will emerge if energy is obtained from mass with the $E=mc^2$ formula for money in economics.

For this purpose, the impact of FDI and PI on economic growth was analyzed by establishing the ARDL model. The findings suggest that there is a positive and meaningful relationship between FDI and economic growth both in the long term and in the short term. There was no significant relationship between portfolio investments and economic growth in the long and short term. This result coincides with the $E=mc^2$ relation.

It is possible to see the validity of our results in the quantity theories of Fisher and Cambridge School. In both of these approaches production (Y) is constant. In other words, the production has been ignored in these approaches. This means that in the event of an increase in money independent of production, the general level of prices will increase. If we evaluate this from a different angle, it is possible to see the similar outcome. In Fisher's equation, the velocity of money (V) and the volume of production (Y) are considered constant. In the same sense, if the velocity of money (V) and the general level of prices (P) are considered constant, it is obvious that the increase in the amount of money (M) should be indexed to production (Y). The similar property applies to the Cambridge approach. If "k" and "P" are considered constant in the equation, then an increase in Money (MD) based on production (Y) is projected. With this move, it is possible to see the relationship between money and production more clearly.

Energy is all around us, and the universe is made up of energy. All the activities that exist in nature are carried out through energy. So, energy is the indispensable building block of natural life. Problems that may arise in energy will negatively affect all life. For example, the increase or decrease of heat or luminous energy from the sun will upset the entire natural balance. Similarly, money is also the basic tool of the economy. All economic activities take place thanks to money.

Humans will gain maximum benefit only if they use whatever they have designed and found ready in nature to suit their purpose. Everything used outside of its purpose has caused problems that cannot be compensated over time or require high costs. In other words, the fact that money mediates different purposes is the subject of speculative activities. As the human population increased, the need for more production arose. Combined with the phenomenon of excess production and excessive profits, entrepreneurial income increased extraordinarily, and money became abundant. Money, which initially served only to meet needs, began to be used for speculative purposes with its abundance. Instead of investing in the real sector, economic units tend to generate income easily. In this context, money income is directed towards financial investments in order to generate more interest income. With the use of money as a speculative tool, economies have become more fragile and sudden economic crises have become common.

The gains made after monetary activities are more individualistic and just as easy. The benefit is mainly limited to the owner of the capital. Here, the relationship between buyer and seller is one to one. It's like getting energy

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from energy. Making money based on production can involve some effort and risk. But the marginal benefit it provides is much greater. Both the owner of capital and other economic units benefits from this. It is like the mass-energy equivalence $E=mc^2$, which suggests that more energy can be obtained from mass.

In this context, if money is used for the purpose of exchange in accordance with its original purpose of existence, it will be subject only to production-oriented activities, in particular injustice in income distribution, unemployment, inflation, etc. negativity will disappear.

Author contribution statements

Authors contributed equally to the design and implementation of the research, to the analysis of the results and to the writing of the manuscript.

Disclosure statement

No potential conflict of interest was reported by the authors.

Ethics committee approval

All responsibility belongs to the researchers. All parties were involved in the research of their own free will.

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