

# “Theoretical aspects of investment demand for gold”

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## Theoretical aspects of investment demand for gold

### Abstract

The main objective of this article is construction of a theoretical model of investment in gold. Our model is based on two main variables: the investors' reaction to price changes and their price expectations formed on the basis of price performance.

One of the main features of our analysis is that we try to show the process of forming price expectations and dealing correspondingly with formed expectations on the demand curve. So, one of the main results of our investigation is a creation of different schematic investment demand for gold curves. These curves characterize investor's behavior at different price periods which are divided into three categories: price periods where gold is underestimated, overestimated and correctly estimated. It is necessary to underline that investor's performance is analyzed in terms of the current price and the expected price ratio.

Our article is intended to emphasize that the laws that usually prevail on the goods market lose their influence on the precious metals investment market. However, expectations of individuals play a key role and prevail. In our opinion it is important to put expectations as a key variable which mainly determines decision-making process of economic individuals, especially investors. Corresponding with this, we offer a new view of the investment demand for gold function where not only the current, but also the expected price of gold acts as a variable.

It is important to emphasize the practical value of our investigation. This model of investment demand for gold can be a useful base for analyzing investor's behavior on the gold market.

**Keywords:** investment demand for gold function, price expectations, expected price, investment in gold, precious metals investment market, information revealed through prices.

**JEL Classification:** D84, G11, G17.

### Introduction

The appearance of gold-backed ETFs (Exchange Traded Funds) has made gold investment much more accessible to a wider audience. Economic growth in China, India and many other emerging economies of South East Asia has been particularly relevant to the gold investment increase. As GDP and incomes in these countries raised so did investment demand for gold. Thus, the investment demand for gold became more relevant in the sense of influencing gold's price, especially in a short run. This relevance can be exhaustively illustrated on the basis of many examples. The last clear example of defining the price of gold by the investment demand is the dramatic pullbacks in the gold price in the first half of 2013 which were totally prompted by the decrease in ETFs' gold holdings.

One of the antirecessionary measures of Cyprus' government in April 2013 was a selling of its gold holdings. This decision prompted the process of the radical changing and revision of expectations of investors and all gold market participants. The latest gold market events have caused many questions among economists. And one of these questions was whether this asset would continue to play the role of the perfect diversifier of an investor portfolio.

But the most important issue is about the principles of investors' economic behavior on the gold market.

We suppose that the best way of investigation and predicting of investor's performance is the analyzing of expectations forming process.

Prices are the basic market signals that include all the information that is available in a particular moment. In many cases price can be the main source of information for economic individual and thus the background of forming expectations. In this reason, it is important to explore the essence of forming expectations of investor on the basis of price performance.

In this article, we try to show the process of forming investors' price expectations on the basis of information revealed through prices and dealing correspondingly with formed expectations on the demand curve.

In our analysis, we use the expected price as a key variable which mostly determines the way of investors' behavior. The expected price in our analysis is an endogenous variable if it is formed on the basis of information revealed through prices. Otherwise, if there are any other factors which influence the process of forming the expected price of investors (information which isn't revealed through prices) then it is an exogenous variable.

One of the main results of our investigation is construction of different schematic investment demand for gold curves. These curves characterize investor's behavior at different price periods which are divided into three categories: price periods

where gold is underestimated, overestimated and correctly estimated. It is necessary to underline that investor's performance is analyzed in terms of the current and the expected price ratio.

In this article we intend to show that the laws that usually prevail on the goods market lose their influence on the precious metals investment market. However, expectations of individuals play a key role and prevail. Corresponding with this, we offer a new view of the investment demand for gold function where not only the current, but also the expected price of gold acts as a variable.

We hope that this model of investment demand for gold will be helpful for analyzing investor's behavior on the gold market.

### 1. Literature review

An individuals' behavior is based on expectations of what future is going to bring. Expectations are the integral part of economic relations. Otherwise, the absence of expectations of economic individuals, as a rational incentive of their behavior, would lead to impossibility of forming economic relations.

Adam Smith, the founder of classical economics, was one of the first economists who mentioned expectations for explanation of features of people behavior (Smith, 1759).

John Maynard Keynes said that expectations are the element of mechanism which prompts entrepreneurs to work (Keynes, 1936).

It is notable that expectations play a key role in management since individuals are motivated if they believe that their efforts will be fruitful to reach goals (Vroom, 1964).

One of the first models of extrapolative expectations was made by economist Metzler (1941). The key point of his model is that expectation of future sales may depend not only upon the past level of sales, but also upon the direction of change of such sales.

In our days the most popular theories are the theory of adaptive expectations and the theory of rational expectations. The adaptive expectations theory supposes that expectations of individuals are formed on the basis of past and current available information. Nerlove (1958) offered one of the first models of adaptive expectations. Adaptive expectations are represented as an exponentially weighted sum of past prices. If it turns out that expectations do not coincide with the actual state of variables, then an intelligent decision-maker would refrain from using the method by which expectation were formed (Mills, 1961). It is important to say that an expectational error is a very important constituent of adaptive expectations (Cagan, 1956).

There are many other different models of adaptive expectations that take into consideration different factors. Kenneth J. Arrow and Leonid Hurwicz (1962) while analyzing the relations between current and expected prices and demand alleged that current prices are changed by current excess demand for commodities, and that the excess demand depends on both current prices and expected future prices, the latter being formed adaptively to the past history of prices.

Expectations can be used to investigate many economic phenomena. In macroeconomics expectations are usually used in investigation of monetary policies (Feige, 1967, Lucas and Rapping, 1969). The store of goods can also be the factor of expectations (Negishi, 1964).

Rational expectations theory is a hypothesis in economics which states that agents' expectations of future variables are not systematically wrong and all errors are random. Moreover it is supposed that individuals effectively use all available information.

Rational expectations theory uses price expectation as one of the most important variables. When investigating the effects of inventory speculation, Muth (1961) assumes that an individual acts according to the expectation of gain. In this sense, it means that the individual expects a higher price in the future period of time. Moreover, predictions of future events are formed on the basis of the relevant economic theory and all available information.

Oliver J. Blanchard (1979) says in his paper "Backward and Forward Solutions for Economies with Rational Expectations" that there is always one more price (expected price), in spite of the market one, to clear up. In his opinion, indeterminacy is a general feature of models in which current prices depend on expected future prices or the expected rate of change in prices.

In the model of land speculation studied in Futia's paper (1981) there is a speculative demand equation which includes the speculator's forecasted future price in spite of the current price. In his model Futia defines the expected price as a random variable which is a linear function of the speculator's information. And the information is the one that is available to the speculator at the moment of making a decision. It includes both the information exogenous to the market as well as the information endogenously generated by the market process, e.g. past prices. Moreover, it is alleged that the information is exogenous in the sense that it is unaffected by the market process and the market activities.

"The key point which Hicks emphasized is that the expectations held by firms about future endogenous

variables (such as tomorrow's price of corn) actually help determine the true value of the future endogenous variables" (Grossman, 1981).

When analyzing the process of forming the farmer's expected price which is offered by Muth, Grossman emphasizes that if the farmer knows the stochastic structure generating prices then the price he expects or anticipates for the next period of time is a conditional expectation of this price given all past realizations of the stochastic process. In other words, individuals with rational expectations form anticipation of the future expected price by using the knowledge of process generating prices while individuals with adaptive expectations use only information about the past price performance or look at past prices. When describing the Muth's perfect foresight model of a stochastic economy, Grossman presents the expected price as a function of two other random variables: a random variable summarizing the stochastic factors affecting demand in the next period of time and a variable indicating the random shocks affecting supply in the next period of time. However in Section 3 of his paper Grossman, considering equilibrium under asymmetric information, confirms that the expected price (or the market-clearing price) depends on all individual's information at the time of making decisions and the two aforesaid variables. Grossman says that traders have different price expectations and this creates an incentive for opening of a futures market where they can bet against each other. In other words different expectations of future prices are the main reasons of existence of speculative markets. Moreover Grossman discusses the informativeness of prices and therefore shows the role of prices as a mean of information exchange between traders in a stochastic economy where traders don't know all the information (Grossman, 1981).

In turn Radner (1979), in the article "Rational Expectations Equilibrium: Generic Existence and the Information", says that when traders come to a market with different information about the items to be traded, the resulting market prices may reveal to some traders the information originally available only to the others. Furthermore, the main assumption of Radner's theory is that equilibrium prices in his model reveal to all market agents all the information initially available to all the agents.

In Section 4 of his article "On the possibility of speculation under rational expectations" Tirole (1982) assumes that in the market with homogeneous information traders base their behavior on the comparison between the current price and the probability distribution of the next period price.

Verrecchia (1982) confirms that the information revealed by price depends upon what information each trader acquires, and the information each trader acquires depends upon what he can learn costlessly through price. One of the main important features of his paper is that in equilibrium traders' conjectures about how much information is revealed through prices are fulfilled by their own acquisition activities. Moreover he says, "The level of informativeness of prices generally increases with decreases in the level of noise, the cost of acquiring information, and the risk aversion of traders taken as a group." The most important advantage of the Verrecchia's model is that it shows that the prices play the role of an aggregator, and not merely a transmitter, of information.

Thus there are many different theories and opinions about the nature of expectations, its role in forming economic behavior and about the ways they are formed. But all these theories underline that expectations are very important for analyzing a decision-making process of economic individuals.

## 2. Investment demand for gold function

Investment demand for gold has major variety of typical features. Flexible reaction to price signals and high significance of price expectations in sense of forming investors' behavior have more importance on the gold market than on the stock market. That is because the level of yields on the market of gold investment is completely defined by the price performance of concerned asset.

The expected revenue of the concerned asset directly depends on its expected price at the end of a period:

$$R^e = \frac{P^e}{P} - 1, \quad (1)$$

where  $R^e$  is the expected revenue for a period of holding,  $P^e$  is the expected price of an asset at the end of a period and  $P$  is the current price of an asset (Sharpe, 1995).

As we can conclude from the formula above, change of the expected price straightly impacts investors' behavior. But there is a reasonable question: does the change of the expected price of gold impact investors' demand or quantity demanded? The answer depends on the nature of forming investors' price expectations, on the factors that influenced this process: endogenous or exogenous relatively to the model. If the expected price is formed on the basis of endogenous variables it leads to quantity demanded changes. And if the expected price is formed on the basis of exogenous variables it leads to changes in demand. In our model price signals are endogenous variables.

Analyzing of price performance over some period of time on the market is one of the main ways of forming price expectations of investors. This analysis can be divided into two parts: historical prices analysis and present prices analysis. In other words, past and present price changes are the main variables forming expected price. Corresponding with this, expected price can be presented as a simple function:

$$P^e = f(\Delta P^{t-1}; \Delta P^t), \tag{2}$$

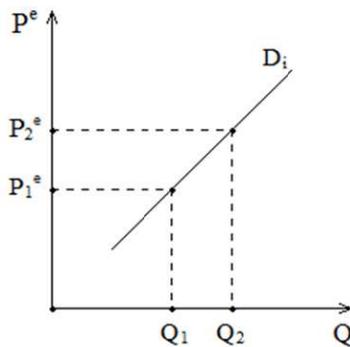
where  $\Delta P^{t-1}$  is the price change in the past period of time ( $t-1$ ),  $\Delta P^t$  is the price change in the current period of time  $t$ .

Thus, change in the expected price, formed in aforesaid way, leads to change in quantity demanded by investors, other things being constant:

$$Q_{d_i} = f(P^e), \quad P^e = f(\Delta P^{t-1}; \Delta P^t), \tag{3}$$

where  $Q_{d_i}$  is the quantity of gold demanded by investors.

This functional relationship between the expected price and the quantity of gold demanded by investors is schematically shown as a curve in Figure 1.



**Fig. 1. The relationship between expected price of gold and quantity demanded by investors**

If the expected price of gold  $P_1^e$  at which the quantity demanded by investors is  $Q_1$  increases to  $P_2^e$  then the quantity demanded increases to  $Q_2$ . The higher the expected price, the higher the quantity of gold is demanded by investors. The lower the expected price of gold, the lower the quantity demanded. Other things are constant.

Consequently,

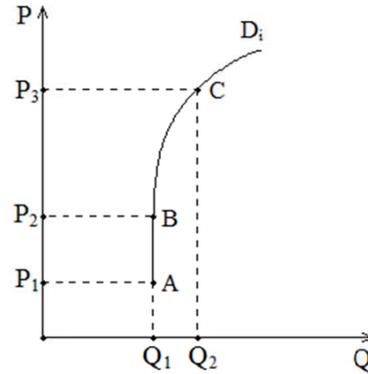
$$\frac{\Delta D_i}{\Delta P^e} > 0, \tag{4}$$

where  $\Delta D_i$  is a change in the quantity of gold demanded by investors,  $\Delta P^e$  is a change in the expected price of gold.

Therefore, the investment demand for gold function can be presented in this simple way:

$$Q_{d_i} = f(P; P^e(\Delta P^{t-1}; \Delta P^t)). \tag{5}$$

There are two main endogenous variables in this function: the current and the expected prices of gold. So, the investment demand for gold curve is schematically presented in Figure 2.



**Fig. 2. Investment demand for gold curve**

This curve is conditionally divided into two segments: AB and BC. Investor's expectations of tendency (direction) of price changes of gold are formed on the segment AB. As we can see from Figure 2 this segment is perfectly inelastic. So there are no changes in the quantity demanded by an investor in response to price changes when he is forming expectations about price of gold tendency. At this segment the investor analyzes information revealed through prices on the gold market to construct his forecast about direction of price changes.

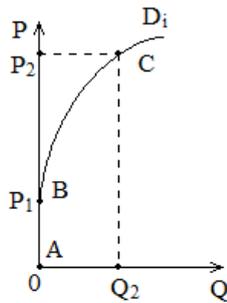
Let's assume that the price increases from  $P_1$  to  $P_2$ . It is supposed that this price increase leads to forming positive expectations of price tendency on the gold market. In other words investor expects further increase in price of gold.

Corresponding with this and taking into account the price increase from  $P_2$  to  $P_3$ , investor increases the quantity demanded from  $Q_1$  to  $Q_2$  at BC segment. In doing this, investor expects further increase in price. As we can conclude from this situation, the expected price is formed by the investor on both AB and BC segments of the curve. In this sense segment AB can be characterized as the investor's analysis of price performance in the past period of time and BC can be characterized as analysis of price performance in the moment of making a decision. It means that the expected price is formed on the basis of past and current information revealed through prices of gold. As we said before, the investor increases amount of gold purchased since he expects that price will rise. And for him the expected price is bigger than the current one.

It was assumed that the investor formed his expectations about the direction of price changes on the AB segment correctly. He expected increase in

price level and his expectations were correct. Our assumption in this model is that information revealed through prices is adequate and authentic.

In the previous situation it was supposed that the quantity of gold demanded by an investor in the period of forming expectations about the direction of price changes was  $Q_1$ . However, it can be the case in which the initial quantity of gold demanded by investor is equal to zero. This situation is presented in Figure 3.



**Fig. 3. Investment demand for gold curve with initial zero quantity of gold demanded by investor**

So, for AB segments of concerned curves this simple equation is appropriate:

$$\frac{\Delta D_i}{\Delta P} = 0, \tag{6}$$

where  $\Delta D_i$  is a change in the quantity of gold demanded by investor,  $\Delta P$  is a change in the current price of gold.

In turn positive sloping BC segments are characterized by this simple inequation:

$$\frac{\Delta D_i}{\Delta P} > 0. \tag{7}$$

For the whole concerned curves this simple inequation is implemented:

$$\frac{\Delta D_i}{\Delta P} \geq 0. \tag{8}$$

As we said before, investor's expectations of tendency (direction) of price changes of gold are formed on the segment AB where an investor observes the gold market and doesn't undertake any actions in response to price changes. But how long does this process last? How much time does an investor use to form his expectations of tendency of price changes? The answers to these questions depend on individual features of a particular investor, risk aversion, rationality, etc.

It is important to underline that the current and the expected price ratio has a very significant meaning in analyzing speculators' actions. If the expected price of gold is higher than the current one, it will be an incentive for speculators to buy gold. Therefore,

an essential condition for increasing the quantity of gold demanded by investors is as follows:

$$\frac{P^e}{P} > 1. \tag{9}$$

Otherwise, the essential condition for decreasing of the quantity of gold demanded by investors is as follows:

$$\frac{P^e}{P} < 1. \tag{10}$$

In the period of forming of expectations of price changes direction the expected price is equal to the current one.

And the quantity of gold demanded by investors doesn't change:

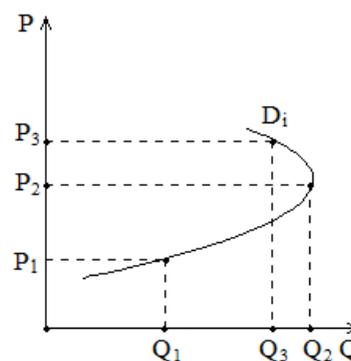
$$\frac{P^e}{P} = 1 \Rightarrow \Delta Q = 0, \tag{11}$$

where  $\Delta Q$  is a change in the quantity of gold demanded by investors.

### 3. Price period where gold is overestimated

Positive reaction of investors to increase in the price of gold can't last indefinitely. When the price of gold exceeds some point, gold becomes an overestimated asset. When aspiring to equilibrium, the market will prevent further increase in the price of gold. It means that when gold becomes overestimated, the quantity of gold demanded by investors decreases in response to increase in price. The investment demand for gold curve will have a negative slope in the case of overestimation of gold. This situation is presented in Figure 4.

As we can see from Figure 4, increase in the price of gold from  $P_1$  to  $P_2$  causes increase in the quantity demanded from  $Q_1$  to  $Q_2$ . But further increase in the price from  $P_2$  to  $P_3$  causes decrease in the quantity demanded from  $Q_2$  to  $Q_3$ . This is because gold is considered to be overestimated when its price is over  $P_2$ . When gold is overestimated, the expected price of this asset is lower than the current one, i.e. investors expect decrease in the price level.



**Fig. 4. Price period where gold becomes overestimated**

#### 4. Price period where gold is underestimated

Negative reaction of investors to decrease in the price of gold has its limit. This limit is defined by the price, below which gold is considered to be underestimated. For example this price can be equal to minimal gold mining costs per ounce.

When the price of gold decreases below this “minimal” price, the investment for gold demand curve becomes negatively sloping. This situation is presented in Figure 5.

As we can see from Figure 5, decrease in the price of gold from  $P_1$  to  $P_2$  causes decrease in the quantity demanded from  $Q_1$  to  $Q_2$ . But further decrease in price from  $P_2$  to  $P_3$  causes increase in quantity demanded from  $Q_2$  to  $Q_3$ . That is because gold is considered to be underestimated when its price is below  $P_2$ . When gold is underestimated, the expected price of this asset is higher than the current one, i.e. investors expect increase in the price level.

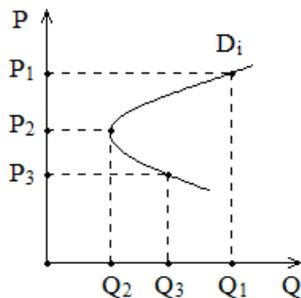


Fig. 5. Price period where gold becomes underestimated

#### 5. Price periods where gold is correctly and incorrectly estimated

There is a price period where gold is correctly estimated and the investment demand for gold curve has a positive slope. This price period is situated between two price periods where gold is overestimated and underestimated and near equilibrium price. It was said that when gold is not correctly estimated (overestimated or underestimated) the investment demand for gold curve is negatively sloping. When this investment asset is considered to be incorrectly estimated, the market seeks to return its cost to borders of normal price range within which an equilibrium price of an asset fluctuates. And the speed of this process is defined by the level of market efficiency. Efficient market hypothesis states that market is efficient concerning any information if it is completely reflected in the asset price and this process lasts for a minimal period of time (Burton, 2003). Aspiration of the market to an equilibrium state according to theorists of classical economics is its integral part (Samuelson, 1947). Thus, according to Adam Smith “the invisible hand” of the market coordinates distribution of market resources at which equilibrium is reached (Smith, 1904).

#### 6. Determinants of investment demand for gold

We have considered the dynamics of endogenous variables which are determinants of the quantity demanded in this model. Thus, changes in these variables lead to moving along the investment demand for gold curve. In this section, we consider the dynamics of exogenous variables which are determinants of demand in this model and changes in these variables lead to shifting of the investment demand for gold curve.

There are many determinants of investment demand for gold. Consequently, we take into consideration factors that are prevailing.

Expectations of prices that are not formed on the basis of information revealed through prices, i.e. expectations formed exogenously, are the important determinants of investment demand for gold.

Changes in investment demand are also driven by changes in financial capability of investors.

The most important determinants of investment demand for gold are fiscal and monetary policies and macroeconomic statistics of the biggest open economies.

Determinants of investment demand for gold also are: rate of inflation in the biggest open economies, rate of increase in the world money supply, exchange rates of reserve currencies, profitability of alternative financial assets, the economic and political situation in the world, interest rates.

#### 7. Price elasticity of investment demand for gold

In this section we consider some of the main factors influencing price elasticity of investment demand for gold.

**7.1. Market strategy of investor and his reaction to market signals.** Every economic individual reacts to market signals, for example prices, differently as well as every investor has his own market strategy. Both these factors define price elasticity of any particular investor.

**7.2. Individual market boundaries.** Price elasticity of investment demand for gold depends on an investor’s vision of market boundaries. In turn, this vision of market boundaries ultimately influences the quantity of substitute assets for an investor. So, the wider the market boundaries for the investor, the bigger amount of substitute assets are for him and thus the higher his price elasticity on the market of gold investment. And the narrower the market boundaries for the investor, the smaller amount of substitute assets are for him and thus the lower his price elasticity.

**7.3. Available time.** The more time is available for analysis and decision-making process of an investor, the higher his price elasticity of demand. And the less time is available for him to analyze market and make a decision, the less his price elasticity of demand.

**7.4. Rate of inflation.** If the rate of inflation increases, price elasticity of an investor decreases. This is because in the period of increasing of rate of inflation there is decrease in demand for substitute assets. But if the rate of inflation decreases, price elasticity of the investor increases.

It was previously said that rate of inflation acts as a determinant of investment demand for gold as well as a determinant of price elasticity of investment demand for gold. On the one hand, rate of inflation influences capital inflow and outflow on the market of gold investment and thus impacts on the investment demand for gold. But on the other hand, rate of inflation also influences demand for substitute assets which in turn determine price elasticity of investment demand for gold. Thus rate of inflation has a complex impact on the investment demand for gold.

## **8. Income and substitution effects on the market of gold investment**

It is known that in economic theory demand curve traditionally has a negative slope. It is caused by the income and substitution effects. However, there are several exclusions: for example demand curves plotted for Veblen's and Giffen's good are positively sloping (Veblen, 1899; Heijman, Mouche, 2012). It means that these two effects do not always prevail. In this sense, it is necessary to analyze the role of these effects on the market of gold investment.

The income effect has a limited impact on the investment demand since the main flow of investment in gold is driven by institutional investors which operate a large amount of financial capital. In the case of individual investors, the income effect prevails but in the case of institutional investors, it does not.

The substitution effect is based on the presence of substitute assets. But gold is traditionally known as a unique financial asset in the sense of preserving

wealth and protection from inflation and economic shocks. Gold is one of the best diversifiers of investment portfolio (World Gold Council, 2013). In this reason, the amount of substitute assets on the market of gold investment is extremely restricted and thus the substitution effect is not often prevailing on this market.

Therefore, the income and substitution effects do not prevail on the market of investment in gold. In turn, the effect of expected income is predominant on this market. And that is the main reason of a positive slope of investment demand for gold curve in a prevalent range of price levels.

## **Conclusions**

Increase in the price of gold especially for a long period of time leads to increase in the quantity demanded for this asset by investors, other things being constant. This is caused by price expectations that are formed on the basis of information revealed through prices. That is the reason of a positive slope of the investment demand for gold curve in a prevalent range of price levels.

However, there are two situations when the investment demand for gold curve has a negative slope, i.e. when gold is overestimated and when it is underestimated.

In our analysis we tried to show that price expectations play a key role on the market of gold investment and directly determine investors' behavior. So laws that usually prevail on the goods market lose their predominance on the gold investment market.

It is known that gold is considered to be an asset which price reflects the world economic situation. The price of gold reflects not only supply and demand dynamics but also the state of the world economy. Moreover, "...gold should be seen as a barometer of global inflation, one that responds to inflationary pressures in developed markets as well as in emerging markets" (World Gold Council, 2013). Corresponding with this, the price of gold has a very high informative value and can serve as a basis of forming expectations of economic individuals, especially investors.

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