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*Invest*ment *Price Index*: an early warning tool for bubbles in investment market

Introduction

At the end of 1999, it became clear that new money was often not being used to purchase goods and services, but rather to acquire investment goods—stocks, bonds, real estate, tulip bulbs, or oil—and was also being deposited in savings accounts. "Over the last few months of 1999, the federal government [of the United States – author] provided the monetary system with abundant liquidity in order to prevent any possible consequences associated with the transition of computer systems to the new millennium. This money had to be spent somewhere, and in the end it went to finance speculation on the stock market" [(1)].

The effect of price divergence is exacerbated by bank lending, which is a typical companion to speculative manias. After all, bankers also want their piece of the pie. Especially when interest rates are low. The result of irrational behavior during periods of speculative mania can be bubbles.

Understanding the inflation of prices for investment goods—real estate, stocks, bonds, and others—will help to identify bubbles in a timely manner and, if adequate measures are taken to tighten monetary, fiscal, and investment policies, prevent bubbles from forming. Avoiding hyperinflation in the prices of investment goods is no less important today than combating hyperinflation in consumer goods.

The investment asset price index (investment inflation, IPI) shows changes in the prices of income-generating assets that are the object of household investment. Such changes affect the real investment capacity of investors' incomes and their well-being.

If "one of the main reasons for compiling the CPI [consumer price index – author] is the need to compensate employees for losses caused by inflation by adjusting their wages in proportion to the percentage change in the CPI" [2], then the purpose of calculating the IPI is:

- the timely detection of bubbles in various types of investment assets;
- identifying the target level of return for investors, both short-term and pension funds;
- timely response by monetary policy authorities to deep inflationary processes in the modern economy.

The above objectives are by no means an exhaustive list of possible applications of investment inflation.

Refined methodology for calculating the investment goods price index

To calculate the IPI, the following important elements must be determined:

- a list of asset goods that generate investment income for households;
- the structure of the index;
- data sources.

The bulk of household investment income comes from stocks, bonds, real estate, and bank deposits. Other assets, such as shares and stocks in investment funds, etc., either consist largely of the above-mentioned commodity assets themselves or are too insignificant to be taken into account when calculating the IPI.

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[1] Kindleberger, C., and Aliber, R. Global Financial Crises: Manias, Panics, and Crashes. St. Petersburg: Piter, 2010, p. 182.

[2] A Guide to the Consumer Price Index: Theory and Practice. Washington, International Monetary Fund, 2007, p. 2

The structure of the index should reflect the weights of specified assets in the total assets of households in a given period of time, where the sum of the weights is always equal to one. The structure of the index is unstable, as investors prefer to hold the most profitable and reliable assets that are accessible to them not only geographically and in terms of time, but also financially. The weights are updated monthly as relevant data becomes available. Weights may change due to price changes or other reasons, such as changes in investment preferences. However, investors influence the formation of prices in the investment goods market by responding to price changes by replacing some assets with others. This phenomenon is called *the substitution effect*. Thus, investors substitute assets with those that they believe will be more profitable and less risky for the investment period. Nevertheless, it is necessary to separate the influence of prices on weight changes from the influence of other factors as much as possible.

Data sources should only be official and publicly available.

First, let's define the list of investment assets that will form the basis for calculating *IPI* investment inflation: stocks, real estate, short-term securities (current accounts in reliable banks with the highest credit ratings), and long-term government bonds.

Precious metals, oil, and other commodities cannot currently be classified as investments due to the relatively small market capacity of these assets. However, in the future, perhaps even the near future, commodities and precious metals may be included in the basis for calculating investment inflation. This is being driven in part by the active development of a new type of investment fund: ETFs (*Exchange Traded Funds*).

If we take the world's largest economy, the US, as a basis, consumer inflation (CPI) in the US at the end of 2020 targeted the retail market for goods and services with a volume of only about $6.2 trillion per year.

And as of July 1, 2021, according to the Fed's Z1 balance sheet (*Flow of Funds Accounts of the United States*[3]), the assets of American households and non-profit organizations amounted to $159 trillion, including debts of almost $18 trillion and the following investment assets totaling $142 trillion:

- real estate – $34.9 trillion (average annual transaction volume in the primary and secondary residential real estate markets in the US is $2.5 trillion);
- businesses, stocks, and mutual fund investments – $56.5 trillion (total market capitalization of S&P 500 companies – $36 trillion);
- deposits and debt market instruments, including bonds – $15.3 trillion (as of Q2 2021, the total volume of *T-Bills* in circulation was $4.3 trillion, and *T-Notes was* $12.1 trillion);
- investments in pension funds – $31.0 trillion;
- cash and quasi-cash – $6.4 trillion.

In other words, the capacity of the investment goods market exceeds the capacity of the consumer goods market by an order of magnitude. A 1% change in consumer prices has a much smaller impact on family budgets than the same 1% change in the prices of investment assets, primarily real estate, stocks, and pension savings.

In the future, this difference will certainly only grow, given the deepening penetration of financial services into modern society. The richer a society is, the less people hope for a large number of children who will provide for their elderly parents' retirement. Today, the only chance for a wealthy person to enjoy a comfortable old age is through their own efforts to invest their personal capital wisely.

Second, let us set the proportions of the main investment assets that form the basis of the investment portfolios of the US population: real estate, stocks, interest-bearing assets (bonds, deposits), and cash (money in current accounts and treasury bills). We will calculate the structure of the investment assets of American society based on data from the Federal Reserve's quarterly report, Form Z1, "Flow of Funds Accounts of the United States," specifically data from tables B.100 and B.100.e.

Figure 1. Dynamics of the gross value of Americans' personal assets, which form the basis for calculating the IPI, in billions of US dollars

[3] http://www.federalreserve.gov/datadownload/Choose.aspx?rel=Z.1

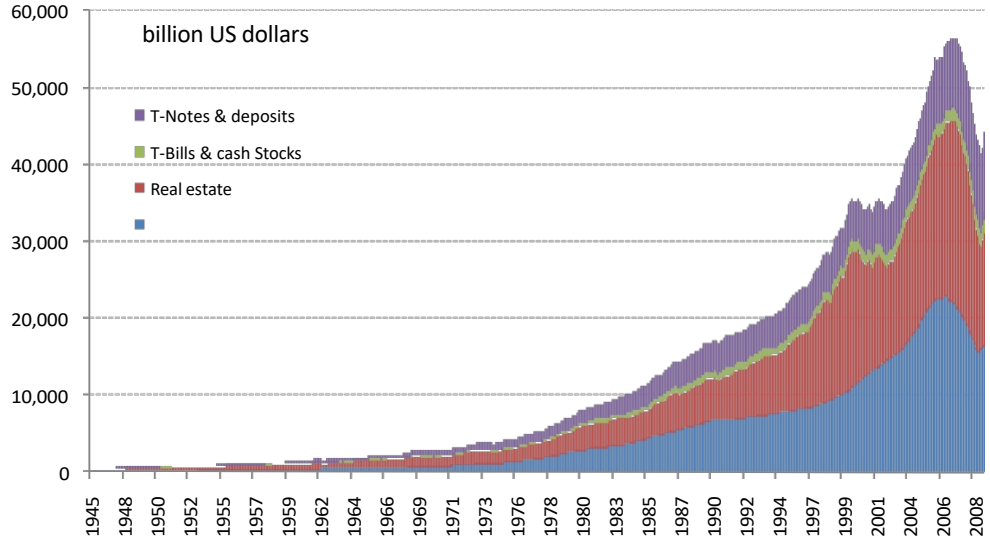

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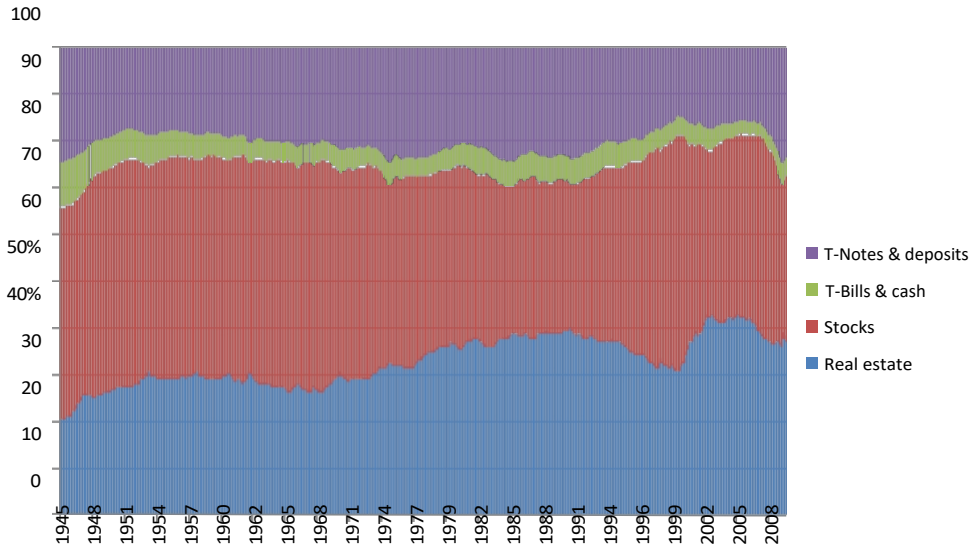
Figure 2. Dynamics of the structure of Americans' personal assets, which form the basis for IPI calculating



Source: http://www.federalreserve.gov/datadownload/Choose.aspx?rel=Z.1

Since the US Federal Reserve only provides statistics on personal assets of the country's population starting from December 1945, for the purposes of calculating the IPI, we will use the structure for the earlier period, from January 1913, at the level recorded in December 1945.

Data sources

To calculate the weight of an individual investment asset, we use data from the quarterly report Form Z1, "Flow of Funds Accounts of the United States," specifically data from tables B.100 and B.100.e.

Real estate price index - U.S. Census Bureau report (http://www.census.gov/const/www/newressalesindex.html). The source of historical estimates is data from Yale University professor Robert Shiller, presented in the book Irrational Exuberance (2000).

Stock price index – based on data on the dynamics of the S&P 500 stock index.

Interest-bearing asset value index – based on secondary market data on the yield of 10-year US Treasury bonds (10Yr US T-Notes).

Cash cost index – based on secondary market data on the yield of 3-month US Treasury bills (3Mo US T-Bills).

IPI calculation formula

According to research by IMF experts (the detailed results of their work are set out in the 700-page publication "A Guide to Consumer Price Indexing: Theory and Practice," published in 2004 and translated into Russian in 2007[4]), the price index formula should belong to the class of *hyperbolic* indices. The Fisher index, which is calculated as the geometric mean of the Laspeyres (P_L) and Paasche (P_P) price indices, is recommended as the most accurate CPI:

$$P_F = \sqrt{P_L \over P_P} = \sqrt{\frac{\sum_{i=1}^{n} p_i^t q_i^0}{\sum_{i=1}^{n} p_i^0 q_i^0} \times \frac{\sum_{i=1}^{n} p_i^t q_i^t}{\sum_{i=1}^{n} p_i^0 q_i^t}}, \text{ where}$$

p_i – price of item *i*;
q_i – quantity of good *i*;
n – total quantity of goods;
^{0} – base period;
^{t} – current time period for which the index is calculated.

However, this formula gives inaccurate results when the base date of calculation changes, i.e., the condition of reversibility in time is not met. Therefore, we modify the Laspeyres ($P^t{}_L$) and Paasche ($P^t{}_P$) price index formulas by replacing the calculation of returns by simple division with logarithms. As a result, in order to calculate investment inflation, we obtain the following investment goods price index $_{PIPI}$:

$$P^t{}_{IPI} = \sqrt{P_L^t P_P} = \sqrt{\left(e^{\sum_{i=1}^{n} \ln\left(\frac{p_i^t}{p_i^{t-1}}\right) \times q_i^{t-1}} \times P_L^{t-1} \right) \times \left(e^{\sum_{i=1}^{n} \ln\left(\frac{p_i^t}{p_i^{t-1}}\right) \times q_i^t} \times P_P^{t-1} \right)}, \text{ where}$$

p_1 is the price index for 3-month Treasury bills (T-Bills); p_2 is the price index for 10-year Treasury notes (T-Notes); p_3 is the index value of the S&P 500 stock index;
p_4 is the price index for residential real estate in the primary and secondary markets in the United States;
q_1 is the weight of the 3-month Treasury Bill (T-Bill) price index;
q_2 is the weight of the 10-year Treasury Note (T-Note) price index;
q_3 is the weight of the S&P 500 stock index;
q_4 – weight of the residential real estate price index in the primary and secondary markets in the United States.

US primary and secondary residential real estate price index:

$$p_4^t = \frac{P^t_{House}}{P^0_{House}} \times 100, \text{ where}$$

$P^t{}_{House}$ – current average prices for residential houses on the primary market (*Median Sales Prices of New Homes Sold*);
$P^0{}_{House}$ – base average prices for residential homes on the primary market (*Median Sales Prices of New Homes Sold*).

S&P 500 stock index values:

$$p_3 = \frac{P^t_{S\&P500}}{P^0_{\text{S\&P500}}} \times 100, \text{ where}$$

$P^t{}_{S\&P500}$ – current value of the S&P 500 stock index;
$P^0{}_{S\&P500}$ – base value of the S&P 500 stock index.

10-year Treasury Bond Price Index T-Notes:

[4] http://www.imf.org/external/pubs/ft/cpi/manual/2004/rus/cpi_ru.pdf

$$p_2^t = \frac{\left[P^t_{T-Notes} + P^{t-1}_{T-Notes} \times \frac{YTM^{t-1}_{T-Notes}}{12} \right]}{P^{t-1}_{T-Notes} \times \left(0.01631 \times \left[YTM^{t-1}_{T-Notes} \right]^2 + 1 \right)} \times p^{t-1}_2, \text{ where}$$

$$P^t_{T-Notes} = \frac{1000}{\left(1 + \frac{YTM^t_{T-Notes}}{2}\right)^{20}}, \text{ where}$$

$YTM^t_{T\text{-}Notes}$ – yield on 10-year US Treasury bonds.

Treasury 3-month bill price index:

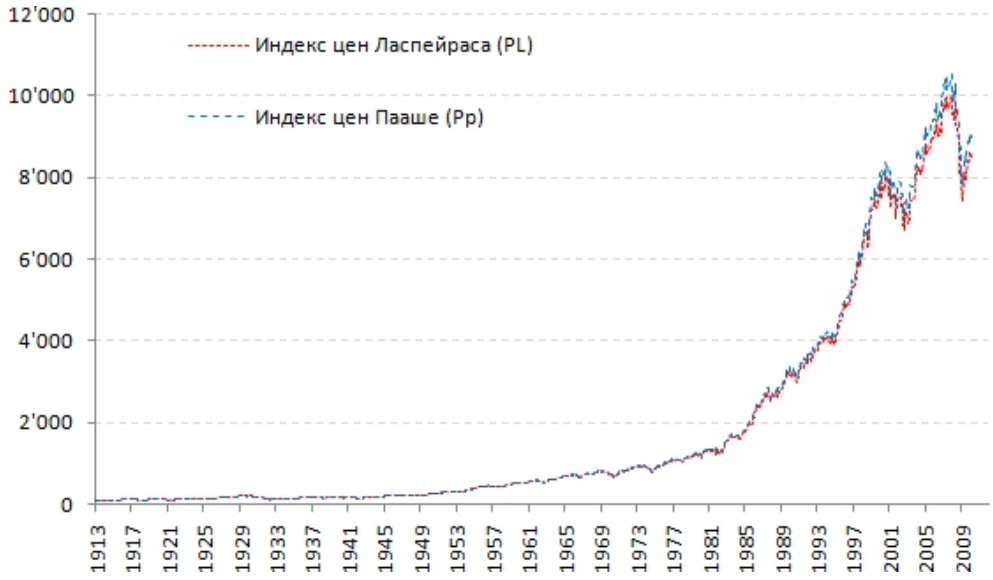
$$p_1^t = \frac{\left[P^t_{T-Bills} + P^{t-1}_{T-Bills} \times \frac{YTM^{t-1}_{T-Bills}}{12} \right]}{P^{t-1}_{T-Bills}} \times p_1^{t-1}, \text{ where}$$

$$P^t_{T-Bills} = \frac{1000}{1 + \frac{YTM^t_{T-Bills}}{365} \times 91}, \text{ where}$$

$YTM^t_{T\text{-}Bills}$ – yield on 3-month US Treasury bills;

Looking ahead, I would like to note that the modified Laspeyres and Paasche price indices give very similar results, which you can barely see in Figure 3 below.

Figure 3. Dynamics of the modified Laspeyres and Paasche indices



Source: own calculations

Over a period of 109 years (from 1913 to 2021 inclusive), the modified Laspeyres index was 5.63% lower than the modified Paasche index. As is known from index theory, "if there is a *positive* [italics in the original] correlation between weighted changes in prices and quantities, the Paasche index exceeds the Laspeyres index" [5] , which is observed in our case of calculating investment inflation. As we know, a positive correlation means that price increases are accompanied by an increase in the weight of a given commodity in the index. This confirms the well-known investment rule "Trend is your friend" — **the existence of trendiness in the behavior of investors in the investment commodity markets**.

[5] http://www.imf.org/external/pubs/ft/cpi/manual/2004/rus/cpi_ru.pdf, p. 5

If the correlation were negative and the Laspeyres index exceeded the Paasche index, price increases would be accompanied by sales of goods that had risen in price and their replacement with cheaper goods. This substitution process is commonly observed in markets for consumer goods that are interchangeable: "Since consumers are usually not involved in setting market prices, they tend to respond to price changes by substituting *relatively* [here and below italics in the original] cheaper goods and services *for relatively* more expensive ones. This phenomenon, known as *the substitution effect*, is mentioned in many sections of this Guide, as well as in a number of other publications on indices. Substitution usually creates a negative correlation between price and quantity relationships, with the Laspeyres index being greater than the Paasche index, and the difference between them tends to increase over time" [(6)]. For example, rising beef prices increase demand for other types of meat (pork, lamb, chicken) and reduce the share of beef in people's diets. In our case, the positive correlation indicates that investors are not inclined to sell goods that have risen in price and replace them with cheaper ones. However, this fact does not yet indicate a tendency for investors to increase their purchases of appreciating assets, thereby further increasing the share of appreciating investment assets in their portfolios. Identifying the reasons for the increase in the share of rising goods in the index structure, which leads to a positive correlation between prices and weights — namely, price increases, new purchases, or both — requires additional calculations.

This behavior by investors, which is reflected in the positive correlation between prices and the weight of a commodity in the index, contributes to the periodic emergence of bubbles in financial markets. This is a phenomenon that you will not see in the consumer goods market. In such markets, it is more likely to see periodic shortages. In other words, a price bubble is the result of excess demand, while the rise in prices of scarce goods is a consequence of insufficient supply.

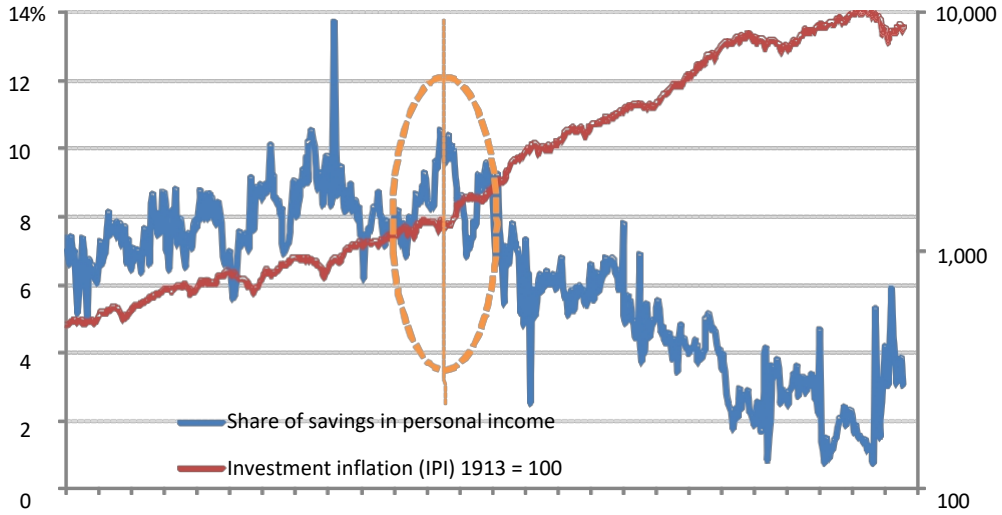
"Investors who transferred their capital to the United States bought dollar-denominated securities, which pushed up the prices of these securities. Americans who sold their shares to foreigners then had to decide what to do with the proceeds from the sale. As a result, most of the money was spent on buying other securities from other Americans, as well as on buying American goods [and not only American goods, but primarily imported goods – author], since savings goals had already been achieved. The slowdown in savings growth and the increase in the US trade deficit were inevitable consequences of the inflow of foreign capital into the US.

According to available data, Americans spent 95 to 97% of the proceeds from the sale of their securities to foreign buyers on the purchase of other American securities, and only 3-5% of the income was used to purchase goods. But no matter how insignificant the share of funds directed to consumption may seem, the rate of savings growth gradually declined [7].

Figure 4. Dynamics of investment inflation in the US against the backdrop of Americans' propensity to save (ratio of new savings to personal income)

[6] http://www.imf.org/external/pubs/ft/cpi/manual/2004/rus/cpi_ru.pdf, p. 5

[7] Kindleberger, C., Alier, R. "World Financial Crises: Manias, Panics, and Crashes." – St. Petersburg: Piter, 2010, p. 283



Source: own calculations

The surge in Americans' propensity to save in 2008-09 occurred against a backdrop *of* investment *deflation*, which once again confirms the link between the IPI and the propensity to save.

Alan Greenspan, former chairman of the US Federal Reserve, explained the high propensity to save among citizens of developing countries by the underdeveloped social security system and the lack of consumerism: "The level of savings among the population in such countries [developing countries - author] has always been much higher than in industrialized countries. To a certain extent, this is explained by the weakness of social protection systems and, as a result, the desire of citizens to save as much as possible for a rainy day. There are other reasons as well. For example, people are less inclined to spend due to the lack of a developed consumer culture" (8).

And since developing countries accumulated large amounts of cash, this "forced" the Fed to increase the money supply and lower interest rates. At the same time, this did not cause consumer price inflation to soar, at least in developed countries.

Investment inflation has a strong impact on the real economy. For example, the surge in investment asset prices and the corresponding growth in the IPI give investors "paper" unrealized profits. And although investors (and developers, in the case of the real estate market, for example) do not yet have these profits, many of them are already starting to spend them.

Alan Greenspan writes in his memoirs: "The decline in real long-term interest rates observed over the past twenty years is associated with an increase in the price/earnings ratio [P/E - author] for stocks, real estate, and indeed any income-producing assets ... Prices for stocks and bonds, residential and commercial real estate, art, and many other assets have risen sharply. In many developed countries, homeowners have been able to use the increased value of their homes to finance purchases that they would otherwise have been unable to afford. The growing purchasing power of the population, especially in the United States, has covered a significant portion of exports from rapidly enriching developing countries" (9).

According to the Greenspan-Kennedy report for the period from 1998 to 2005, Americans quadrupled their use of cash (from $347 billion to $1,428 billion [10]) received in various forms from the increase in housing values, which in turn was the result of a bubble in the real estate market.

As a result, "paper" profits create demand for real goods and services, including investment assets themselves. But the production of goods and services usually lags behind rapidly growing demand, which creates a price imbalance. So the surge in investment

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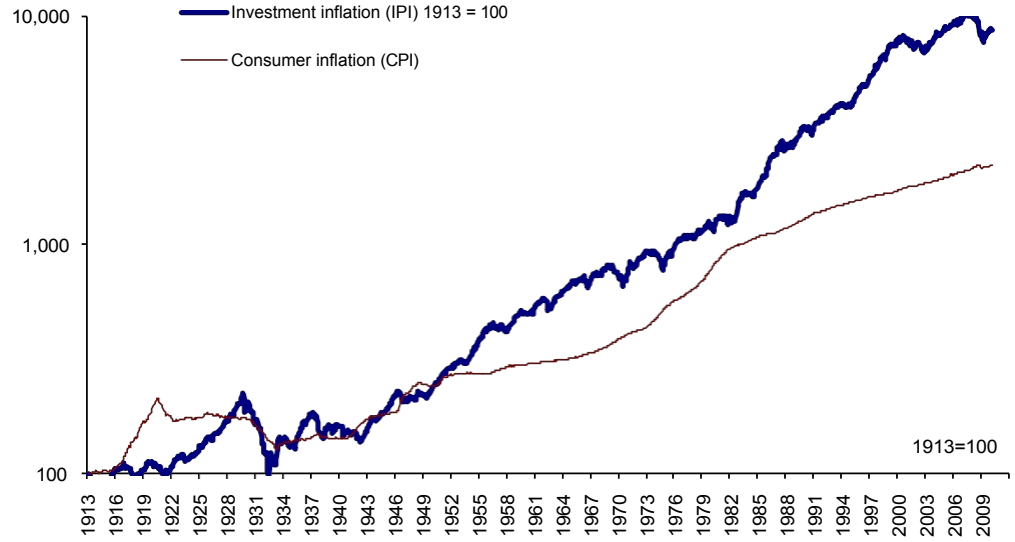
[8] Alan Greenspan. "The Age of Turbulence: Challenges and Prospects for the Global Financial System" - Moscow: Alpina Business Books, 2008, p. 22

[9] Alan Greenspan. "The Age of Turbulence: Problems and Prospects of the Global Financial System" - Moscow: Alpina Business Books, 2008, pp. 23-24

[10] http://www.federalreserve.gov/pubs/feds/2007/200720/200720pap.pdf, pp. 16-17

Inflation almost always creates the conditions for an increase in ordinary inflation, as well as for the self-acceleration of this same investment inflation – a stock market boom.

Figure 5. Investment Price Index (IPI) against the backdrop of consumer inflation in the US, logarithmic scale



Source: own calculations

Events in the recent past, as well as during the Great Depression, unfolded according to a similar scenario. The latest IPI boom began in the 1980s, coinciding with a sharp increase in US public debt and trade deficit, i.e., the investment inflation of the latter period was a consequence of the growth in credit activity and monetization of the US economy.

Investment deflation has an even greater impact on the real economy. A striking example of this was the events of 1929-33 in the US and Western Europe, as well as 2008-09 almost everywhere in the world.

Incidentally, Figure 5 above clearly shows the bubbles that periodically arise in the markets for various investment goods. For example, the latest bubble, which I expect to threaten another crash, appeared in the US long-term government securities market. Investors, fearing for their money, fled from stocks and real estate to this instrument, which is considered the most reliable and guarantees the safety of money. However, this widespread flight of capital into defensive assets has overheated the US government bond market. And as soon as inflation expectations and subsequent interest rate hikes begin to rise, the fall in bond prices will bury a lot of capital. The jump in the long-term government bond index also points to an upcoming increase in government bond yields and the cost of servicing the US national debt, which will increase the burden on government spending.

What do poor and uneducated people fear? Consumer inflation and the devaluation of their money. In general, consumers benefit from lower prices. When a country is experiencing a period of rapid inflation, newspapers and television screens are often filled with recommendations to spend your money before it loses all its value. For this reason, many non-professional investors buy real estate, stocks, gold, and other investment assets, transferring their consumption behavior stereotypes to investments. Probably 90% of the population does this. In this regard, the behavior of wealthy but uneducated Ukrainians during the devaluation of the hryvnia in the fall of 2008 was very interesting. The devaluation of the dollar stimulated a surge in purchases of new cars, from cheap brands to luxury Maseratis, Porsches, etc. People mistakenly confused an investment commodity with a consumer car. As a result, after just a couple of weeks, these same Ukrainians rushed back to the car dealerships asking to take the cars back. Naturally, such an "investment" resulted in significant losses—at least 10-15% or the freezing of cash assets. This behavior on the part of wealthy people is quite understandable—no one explained to them the difference between consumer and investment inflation.

This policy led to the severe economic crisis of 2007-09. During this period (until March 2009, when stock prices hit rock bottom), American retirees lost up to half of their savings invested in the stock market. And about a quarter of all people who bought homes on credit in 2006-08 found themselves owing more on their loans than the value of their purchases by 2009.

Greenspan writes: "It should be remembered that the market value of income securities is determined by their expected future income multiplied by a discount rate, the value of which varies depending on euphoria, panic, or rational forecasts. It is these sentiments that determine the value of stocks and other income-producing assets. It is these sentiments that determine the wealth of society. Large factories, office buildings, and even residential buildings are worth exactly what market participants estimate their prospects for use to be" [(11)]. However, the former chairman of the US Federal Reserve forgot to mention that monetary policy of the financial authorities is at the root of expected returns. If there are no inflation expectations and monetary policy is ultra-loose, a sharp decline in discount rates and an overvaluation of investment assets are inevitable. In addition, we cannot ignore the irrationality of investor behavior, which Alan Greenspan liked to repeat many times. It is quite possible that this *irrationality* is reflected in the positive correlation between the modified Laspeyres and Paasche indices in our calculation of the IPI investment goods price index. But should we expect investors to behave *rationally*, as consumers do in the market for ordinary goods (and even that is a stretch, given the omnipotence of modern marketing, which has a truly limitless influence on people's behavior and consumer preferences today)? Would you want to sell an investment asset that is constantly rising in price simply because it has risen in price?

The rationality of consumer and investor behavior is similar when choosing interchangeable alternatives. For example, if the price of beef has jumped, we can replace it with another type of meat. Similarly, a surge in the price of one bank's shares will certainly make us pay attention to the shares of its competitor.

However, if all types of meat become more expensive, consumers may prefer other food groups, even returning to cheaper bread, potatoes, and noodles.

However, if there is a surge in prices for all types of shares, i.e., a typical stock market boom, history shows that investors are unlikely to stop buying shares and switch to bonds, for example, for this reason alone. On the contrary, a sharp or steady rise in stock prices will attract new investors to this type of investment asset, drawn by high returns.

A comparative analysis and identification of multiple differences in consumer behavior in the market for ordinary consumer goods and services and investor behavior in the market for investment goods could go on for a very long time. But that is not the subject of our study at this time.

Here are just a few of the most typical examples of how expectations influence the dynamics of individual investment goods, regardless of their current prices:

a) expected corporate profits increase – stocks rise;

b) inflation expectations (acceleration of consumer inflation) increase – long-term bond prices fall and their yields rise;

c) fears and expectations of a global collapse increase – yields on short-term government securities fall.

Can such an impact of expectations be called irrational? Perhaps only sometimes. At the same time, the impact of such expectations on price dynamics has much more in common with consumer behavior during periods of panic caused by shortages.

The leading factor influencing investment inflation is the dynamics of the monetary base adjusted for excess bank reserves.

It is logical to assume that monetary aggregates influence the dynamics of investment inflation. The more dollars there are in circulation, the higher the prices of investment assets usually rise.

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[11]Alan Greenspan. The Age of Turbulence: The World Financial System in Transition. Moscow: Alpina Business Books, 2008, p. 460.

Monetary causes of accelerated investment inflation, often accompanied by speculative bubbles, were also characteristic of earlier times: "In 1720, the price
bubbles of the South Sea and Mississippi companies were interrelated and financed by monetary expansion in two countries at once, which allowed speculative excitement to be inflated to critical levels" [12].

When state control over the expansion of the monetary base is weak or non-existent, speculators will always find a way to issue surrogate money, which gives rise to speculative bubbles. This was the case during the tulip mania and again at the beginning of the third millennium, when swaps and other derivatives were added to the dollar, and securitization made it possible to convert future cash flows into today's securities. The rapid development of bank lending in the seventeenth and eighteenth centuries led to the introduction of special restrictions on the size of loans issued in relation to the size of a bank's equity capital, as well as the introduction of various reserve requirements. But as soon as new restrictions appear and the demand for money remains high, banks and entrepreneurs find ways to circumvent them.

In 1763, the increase in credit in Holland was financed by creating a pyramid of "friendly" promissory notes that merchants wrote to each other. The excitement surrounding canal construction that erupted in Great Britain in 1793 was fueled by easily accessible loans that numerous newly established banks in the country issued to entrepreneurs involved in the "canal business."

During periods of economic crisis, the money supply, including surrogate money, shrinks to a level as close as possible to the original monetary base.

The better the economy feels, the greater the demand is met by ubiquitous financiers through lending and the issuance of various instruments.

The IPI investment inflation index shows the closest correlation with the dynamics of the monetary base (Monetary Base) minus excess bank reserves (Reserves of depository institutions, Excess): forty-one years, from 1980 to August 2021 inclusive, the correlation coefficient was in a very narrow range of 0.93-0.99.

The monetary base must be adjusted for excess bank reserves in order to compare it with IPI dynamics due to the extraordinary actions taken by the US authorities in 2007-09 to overcome the deepest financial and economic crisis since the Great Depression by pumping liquidity and doubling the monetary base.

Investment inflation also has a strong correlation with other monetary indicators and inflation indicators, but it is less stable and close.

Figure 6. Dynamics of IPI correlation coefficients with a number of indicators: CPI, PPI, money supply M1, M2, bank lending volumes, and adjusted monetary base (Monetary Base – Excess Reserves), USA, 1959-2021

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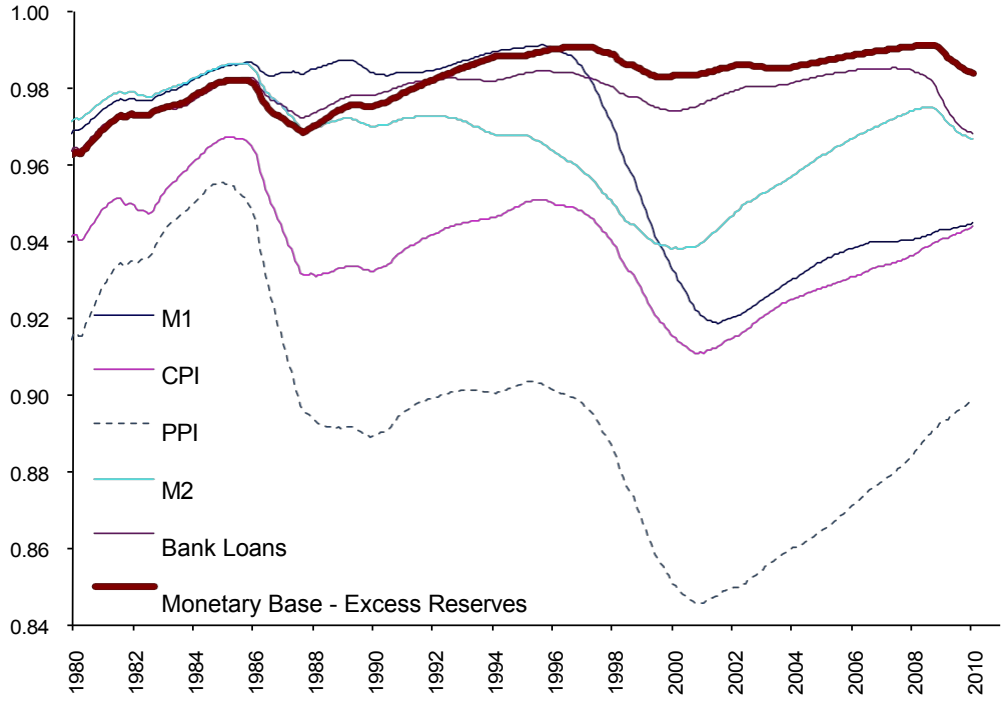
12 Kindleberger, C., Aliber, R. Global Financial Crises: Manias, Panics, and Crashes. St. Petersburg: Piter, 2010, p. 107

13 Kindleberger, Charles, and Robert Aliber. Global Financial Crises: Manias, Panics, and Crashes. St. Petersburg: Piter, 2010, p. 116.

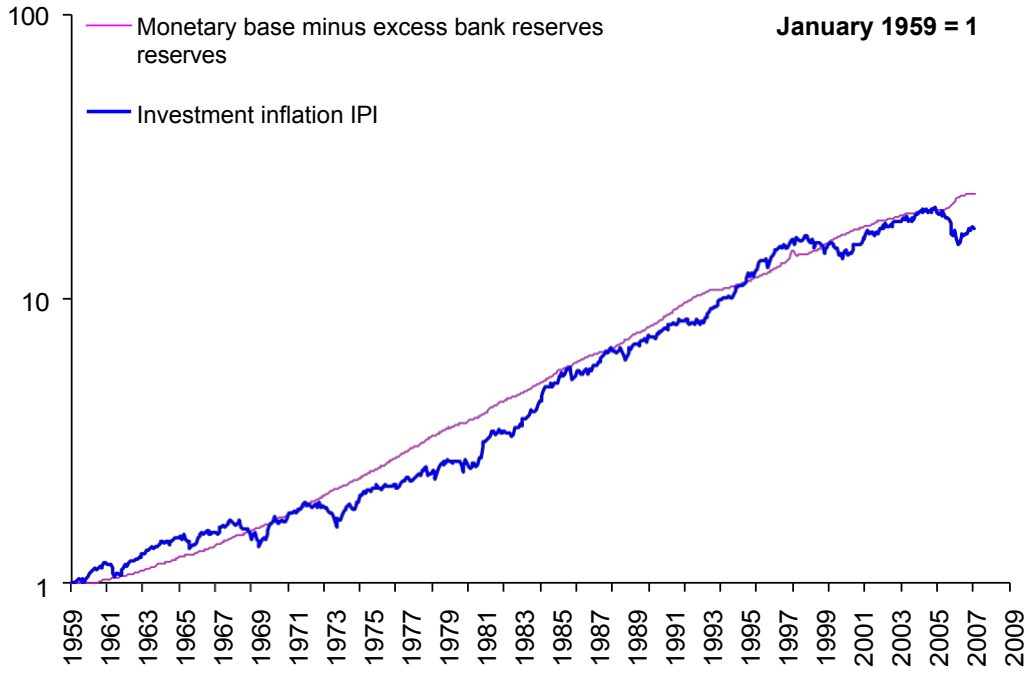


Source: author's calculations

The strongest correlation between the monetary base and investment inflation occurs when the former shifts back several months. In other words, the monetary base is the leading indicator, while the IPI is the lagging indicator. And since we already know the past values of the monetary base, this allows us to make assumptions about the dynamics of investment inflation in the near future.

Incidentally, investment inflation has been growing since 1959 at the same rate as the monetary base adjusted for excess bank reserves.

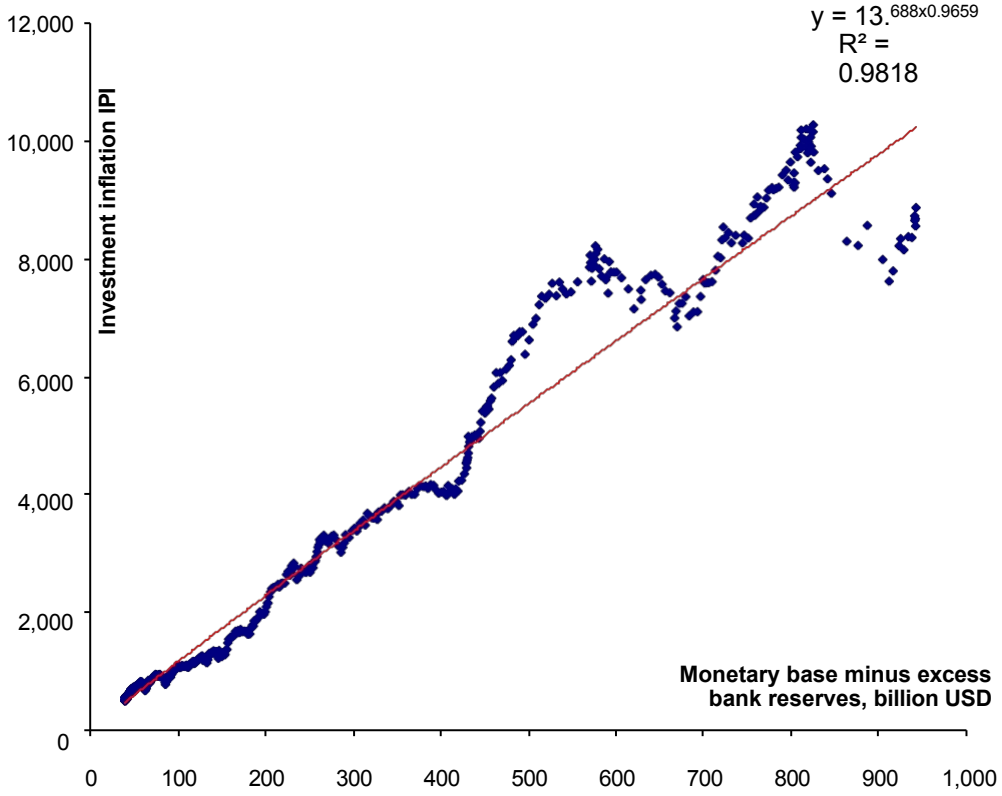
Figure 7. Dynamics of IPI investment inflation and adjusted monetary base in the US (January 1959 = 1)



Source: own calculations

This correlation with the shift can be explained by the simple fact that the monetary base is the basis for the multiplier of credit and investment activity. Each dollar of increase in the monetary base, with a capital adequacy ratio of 10% and a bank reserve requirement ratio of 10%, results in a $9 increase in the net assets of commercial banks (1*(100%-10%)/10%)[14]. And the more loans are issued, the higher the prices of investment assets rise. But there is, of course, a time lag between the growth of the monetary base, the issuance of loans, and the subsequent rise in prices.

Figure 8. Correlation between investment inflation and the monetary base (actual values)



Source: own calculations

Based on data on the actual correlation between the monetary base and investment inflation from 1959 to 2021, we can forecast investment inflation using the following formula:

$$IPI_t = 17.6 \times MB_{t-5}^{1.2161}$$, where

IPI_t – investment inflation in the month of calculation t; MB_{t-6} – monetary base six months ago.

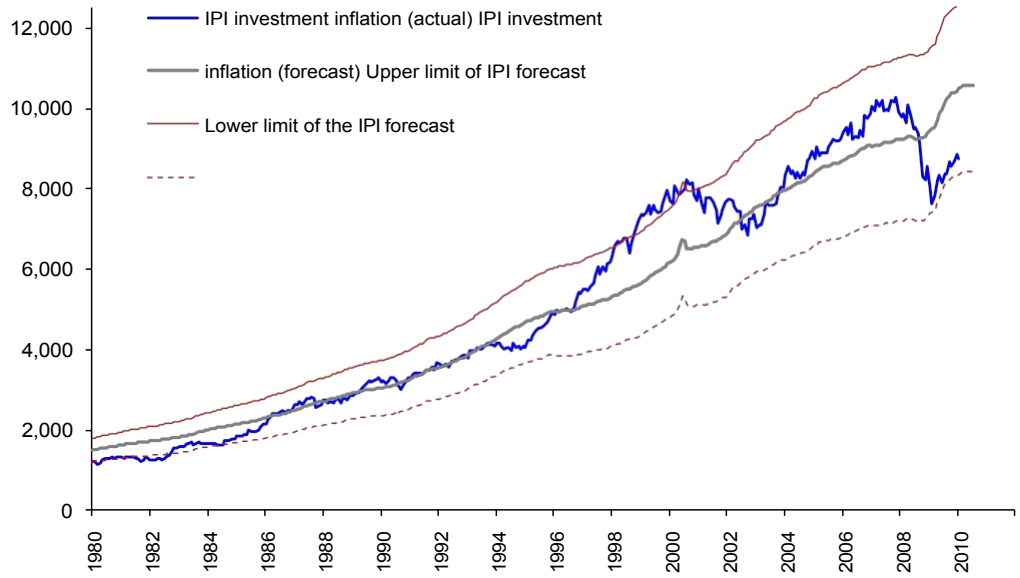
The correlation between the future values of investment inflation calculated using this formula based on data on the adjusted monetary base five months ago and its actual values for the period 1959-2021 is 0.9889.

In addition to the forecast itself, it is possible to calculate the confidence interval of the forecast based on the standard deviation (calculated as one standard deviation over the last 20 years).

As can be seen from the figure below, actual investment inflation (IPI) remained within one standard deviation of the forecast value of investment inflation calculated on the basis of monetary base data from five months ago for most of the time (84%).

[14] http://www.rayservers.com/images/ModernMoneyMechanics.pdf

Figure 9. Dynamics of actual and forecast values of investment inflation IPI, as well as forecast confidence intervals (one standard deviation)



Source: own calculations

The actual IPI values exceeded the forecast limit during the stock market boom in the US in 1998-2000. The lower limit was breached in 1980-82 against the backdrop of weak financial markets during the period of stagflation in the US.

The events of 2007-09 and the aggressive growth of the monetary base in the US to combat the severe financial and economic crisis led to a corresponding surge in investment inflation, confirming the correlation between these macroeconomic indicators that we had already identified earlier.

Thus, the source of investment inflation is the growth of the monetary base, which is reflected in the IPI on average after five months.

Conclusions

Successful and timely identification of price bubbles in investment goods markets can enable financial and economic authorities to adjust their policies to prevent the recurrence of crises such as the Great Depression in the US and the recent global economic crisis.

Calculations of the Laspeyres and Paasche indices revealed a positive correlation between weighted price changes and quantities. This means that the growth in investment asset prices is accompanied by an increase in the weight of the commodity in the index. Thus, investor behavior is directly opposite to consumer behavior in consumer goods and services markets. A positive correlation means that investors do not reduce their purchases of assets that have risen in price. This fact is the cause of bubbles. In this regard, central authorities should respond differently to sharp price changes—accelerating inflation or deflation of investment asset prices—than they do to changes in consumer inflation.

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