

History, macroeconomics, LENRs, and the price of gold

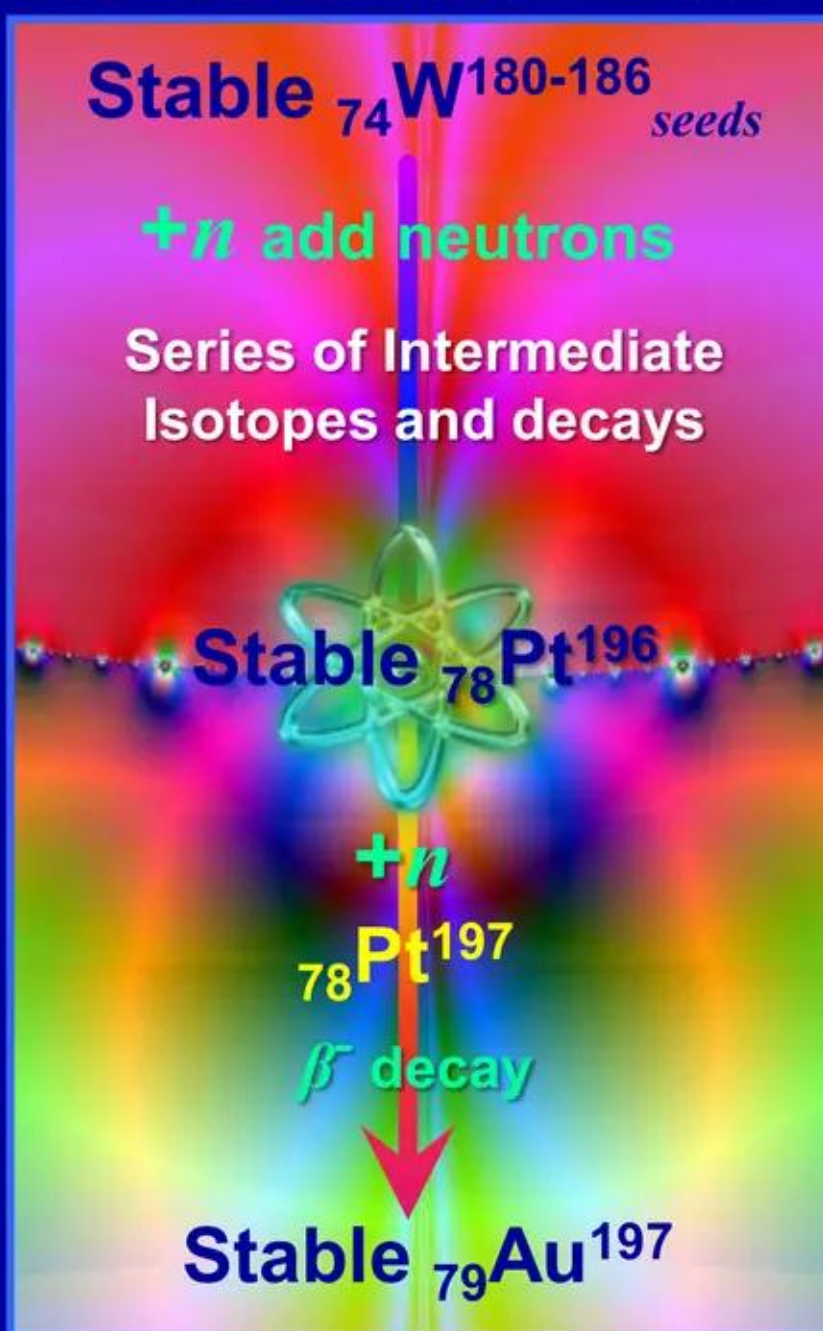
Real gold price vs. prices of other asset classes

Supply, demand, and price: where do we go from here?

LENR transmutation processes could potentially increase supply in future

Future possibilities

Example 1
Making Gold: one possible path



Neutron-catalyzed transmutations

Lewis Larsen

President and CEO

Lattice Energy LLC

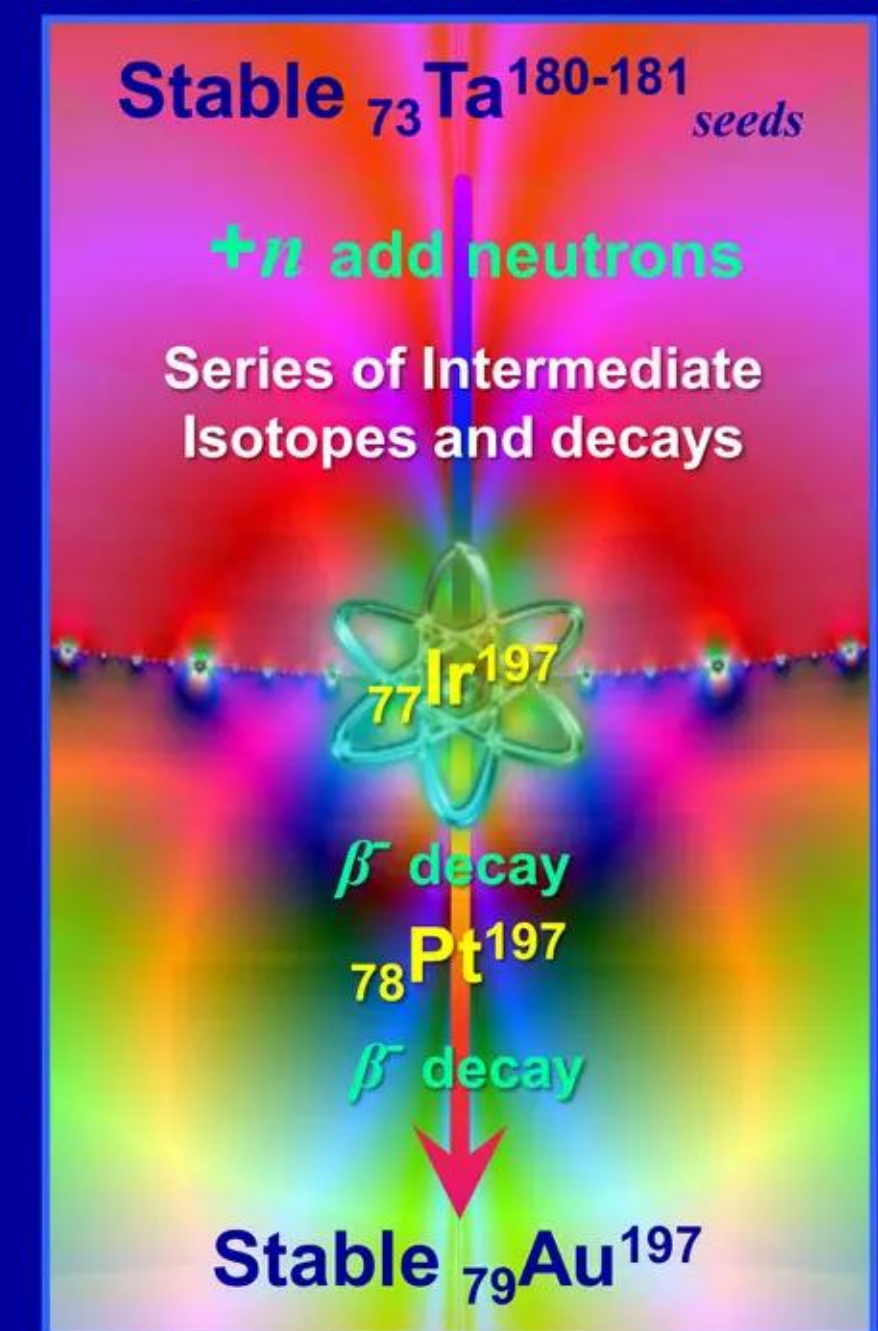
July 4, 2013

“All that is gold does not glitter,
Not all those who wander are lost;
The old that is strong does not wither,
Deep roots are not reached by the frost.

From the ashes a fire shall be woken,
A light from the shadows shall spring;
Renewed shall be blade that was broken,
The crownless again shall be king.”

J.R.R. Tolkien, poem in “The Fellowship of the Ring” (1954)

Example 2
Making Gold: another possible path



Neutron-catalyzed transmutations





History, macroeconomics, LENRs, and the price of gold

Objectives and summary of presentation

Speculative 5 - 15 year scenario for real Gold price vs. other asset classes

- ✓ Will examine recent events and large price movements in world gold market, especially concerning likely nadir in the DJIA/Gold ratio; review long term trends in real DJIA and S&P 500 indices
- ✓ Fischer's multi-decadal "Great Wave" socioeconomic concept will be explained and applied to gold and stock market scenarios; likely to be operating in ~85-year Fischer "period of equilibrium" that began in 1980 and could extend to 2065; low rates of inflation and interest on debt instruments; very high rates of breakthrough technological change and productization
- ✓ If commercialized, LENR transmutation technology could potentially be used to produce gold and platinum from lower-cost metals like tungsten; already achieved in laboratory, but scale-up and production cost parameters still open questions
- ✓ Rates of population growth are dropping all over the world, especially in China and India; this is a negative factor for gold demand; strong damper on any nascent inflationary pressures
- ✓ **Conclusion:** the real price of gold is very likely to substantially underperform the real price appreciation in equities markets during most of the next 5 - 15 years, and perhaps even longer

Clean green radiation-free LENRs

<div style="writing-mode: vertical-rl; transform: rotate(180deg);"> Weak interaction Strong interaction Transmutations: isotope shifts occur; chemical elements disappear/appear </div>	<div style="writing-mode: vertical-rl; transform: rotate(180deg);"> W-L neutron production Neutron capture Decays of unstable, very neutron-rich isotopes: beta and alpha (He-4) decays </div>	LENR Nuclear Realm (MeVs) Occurs within micron-scale patches $\tilde{e}^{-} + p^{+} \rightarrow n_{ulm} + \nu_e$ $\tilde{e}^{-} + d^{+} \rightarrow 2n_{ulm} + \nu_e$ 
		$n_{ulm} + (Z, A) \rightarrow (Z, A+1)$  <p><u>Either a:</u> stable or unstable HEAVIER isotope</p>
		<p>In the case of unstable isotopic products: they subsequently undergo some type of nuclear decay process; e.g., beta, alpha, etc.</p> <p>In the case of a typical beta⁻ decay:</p>  $(Z, A) \rightarrow (Z+1, A) + e^{-} + \bar{\nu}_e$ <p>In the case of a typical alpha decay:</p>  $(Z, A) \rightarrow (Z-2, A-4) + {}^4_2\text{He}$ <p>Note: extremely neutron-rich product isotopes may also deexcite via beta-delayed decays, which can also emit small fluxes of neutrons, protons, deuterons, tritons, etc.</p>

Modern nuclear alchemy

History, macroeconomics, LENRs, and the price of gold

Contents

Speculative 5 - 15 year scenario for real Gold price vs. other asset classes

Supply-demand, macroeconomic factors, price, and investment-related issues are covered in second section; those wishing to avoid technical, science-oriented information can skip forward to Slide #22

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Relevant documents and books



**“Facts do not cease to exist
because they are ignored.”**

Aldous Huxley, “Proper Studies” (1927)

History, macroeconomics, LENRs, and the price of gold

Relevant documents and books

Books:

“The Great Wave - price revolutions and the rhythm of history”

David Hackett Fischer

Oxford University Press 552 pp. (1996)

Fischer’s 47-slide PowerPoint about his book (2008):

<http://csmres.jmu.edu/geollab/fichter/GS102/2008PowerPoints/29-GreatWave-GG102.pdf>

“This time is different - eight centuries of financial folly”

C. Reinhart and K. Rogoff

Princeton University Press 463 pp. (2009)

Reinhart follow-up paper 127 pp. (2010):

http://www.nber.org/papers/w15815.pdf?new_window=1

Documents:

Lattice presentations concerning LENRs and gold:

“LENR transmutation networks can produce Gold”

[66 slides]

L. Larsen, Lattice Energy LLC, May 19, 2012

<http://www.slideshare.net/lewisglarsen/lattice-energy-llc-lenr-transmutation-networks-can-produce-goldmay-19-2012>

“Neutron-catalyzed LENR transmutations produce Gold from Tungsten; Mitsubishi Heavy Industries presents new data at Winter ANS meeting - Comparable results: three sets of different experiments separated by as much as 88 years”

[29 slides]

L. Larsen, Lattice Energy LLC, December 7, 2012

<http://www.slideshare.net/lewisglarsen/lattice-energy-llc-lenr-transmutation-networks-can-produce-golddec-7-2012>

Lattice presentations concerning macroeconomics, Fischer’s Great Wave, and track record:

“Macroeconomics, technology and the long sweep of history” [19 pp. - incl. Larsen 1985 theory paper]

L. Larsen, Lattice Energy LLC, April 14, 2012

<http://www.slideshare.net/lewisglarsen/lattice-energy-llc-macroeconomics-technology-and-long-sweep-of-historyapril-14-2012>

“Lewis Larsen - Forecasting track record re 1980s Barron’s articles by Jon Laing” [26 pp.]

L. Larsen, Lattice Energy LLC, April 15, 2012

<http://www.slideshare.net/lewisglarsen/lewis-larsenforecasting-track-record-re-1980s-barrons-articles-by-jon-laingapril-15-2012>

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Relevant documents and books

Lattice documents concerning unexpectedly rapid slowdown in global population growth rate:

“New data support idea of decelerating population growth”

[14 slides]

L. Larsen, Lattice Energy LLC, April 24, 2012

<http://www.slideshare.net/lewisglarsen/lattice-energy-llcnew-data-support-idea-of-decelerating-population-growthapril-24-2012>

“Latest data suggests global population growth is slowing”

[8 pp.]

L. Larsen, Lattice Energy LLC, August 29, 2011

<http://www.slideshare.net/lewisglarsen/population-growth-decelerating-faster-than-expected-consequences-for-next-50-years-larsenexcerptaug-29-2011>

L. Larsen memo dated August 10, 2011, regarding arbitrage trading of the DJIA/Gold ratio:

URL and password to access this document provided later in this presentation; **download is disabled**

Series of *Barron's* articles by Jon Laing about L. Larsen's work and Lattice White Paper:

“Will Boeing's battery fix fly?”

Jonathan Laing, *Barron's* magazine

April 27, 2013 [12 pp. URL + 3 earlier articles]

<http://www.slideshare.net/lewisglarsen/lewis-larsenbarrons-magazine-articles-by-jon-laingpublished-2013-1999-1988-1986-april-27-2013>

White paper: “Commercializing LENRs: cutting energy's Gordian knot - a Grand Challenge for science and energy” [15 pp.]

L. Larsen, Lattice Energy LLC, April 12, 2010

<http://www.slideshare.net/lewisglarsen/cfakepathlattice-energy-llc-white-paper-excerptapril-12-2010>

Index to large collection of documents:

“Index to key concepts and documents” v. #14

L. Larsen, Lattice Energy LLC, May 28, 2013 [82 slides]

<http://www.slideshare.net/lewisglarsen/lattice-energy-llc-index-to-documents-re-widomlarsen-theory-of-lenrsmay-28-2013>

History, macroeconomics, LENRs, and the price of gold

Historical context of modern alchemy



**“I have learned to use the word ‘impossible’
with the greatest caution.”**

Wernher von Braun

History, macroeconomics, LENRs, and the price of gold

Historical context of modern alchemy

“Delusion of transmutation ...” has persisted though 2,500 years of history

“As we peer down the vista of the past we find the **delusion of transmutation** holding the most prominent place in the minds of thinking men. Frenzied alchemy held the world in its grip for seventeen centuries and more of recorded history. This pseudoscience with its alluring goal and fascinating mysticism dominated the thoughts and actions of thousands. **In the records of intellectual aberrations it holds a unique position. Even Roger Bacon of Oxford, easily the most learned man of his age, the monk who seven hundred years ago foresaw such modern scientific inventions as the steamship and the flying machine, believed in the possibility of solving this all-consuming problem ... Sir Isaac Newton, one of the clearest scientific thinkers of all time, bought and consulted books on alchemy as late as the eighteenth century ...** The power and the influence of many of the alchemists can hardly be exaggerated ... While among the alchemists there were some genuine enthusiasts like Bernard Trevisan, the annals of this queer practice are filled with accounts of charlatans and spurious adepts who, with a deluge of glib words but with only a drop of truth, turned alchemy into one of the greatest popular frauds in history.”

Bernard Jaffe, “Crucibles: the story of chemistry” 4th Revised ed., pp. 7-8 Dover (1976)

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Historical context of modern alchemy

Rutherford and Soddy discovered modern transmutation of elements in 1901

**“For Mike’s sake Soddy, don’t call it transmutation.
They’ll have our heads off as alchemists.”**

Comment made by Ernest Rutherford to Frederic Soddy in 1901; Rutherford received Nobel prize in chemistry in 1908

“In 1901, twenty-four year-old chemist Frederick Soddy and Ernest Rutherford were attempting to identify a mysterious gas that wafted from samples of radioactive thorium oxide. They suspected that this gas - they called it an ‘emanation’ - held a key to the recently discovered phenomenon of radioactivity. Soddy had passed the puzzling gas over a series of powerful chemical reagents, heated white-hot. When no reactions took place, he came to a startling realization. As he told his biographer many years later, ‘I remember quite well standing there transfixed as though stunned by the colossal import of the thing and blurting out-or so it seemed at the time, **‘Rutherford, this is transmutation: the thorium is disintegrating and transmuting itself into argon gas.’** Rutherford’s reply was typically aware of more practical implications.”

J. Magill, “Decay Engine” at www.nucleonica.net

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Historical context of modern alchemy

“God made the neutron” for use in modern transmutation processes

“The neutron plays a pivotal role in manmade transmutations. In the words of Bronowski, ‘At twilight on the sixth day of Creation, so say the Hebrew commentators to the Old Testament, God made for man a number of tools that gave him also the gift of creation. If the commentators were alive today, they would write, **‘God made the neutron.’** Is it far-fetched to consider the neutron to be the Stone of the Philosophers (and atom smashers to be athanors – the furnaces of the Philosophic Egg)? Frankly, yes. **But, in 1941, fast neutrons were used to transmute mercury into a tiny quantity of gold¹.** Was the age old dream realized? Would a modern day version of the Roman Emperor Diocletian have to burn all the notebooks and journal articles and destroy the atom smashers in order to protect the world’s currency? Well, probably not. It is likely that an ounce of such gold would cost more than the net worth of the planet. Also, the gold so obtained is radioactive and lives for only a few days at most. **But, we are not always logical when it comes to gold.** In the words of Black Elk, a holy man of the Oglala Lakota-Sioux on the Pine Ridge Reservation in South Dakota, ‘ ... Our people knew there was yellow metal in little chunks up there, but they did not bother with it, because it was not good for anything’.” ¹[Sherr et al., *The Physical Review* 60 pp. 473 - 479 1941]

Arthur Greenberg, “From Alchemy to Chemistry in Picture and Story” pp. 571 (2007)

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Historical context of modern alchemy

Attitudes about transmutation: “Plus ça change, plus c'est la même chose”

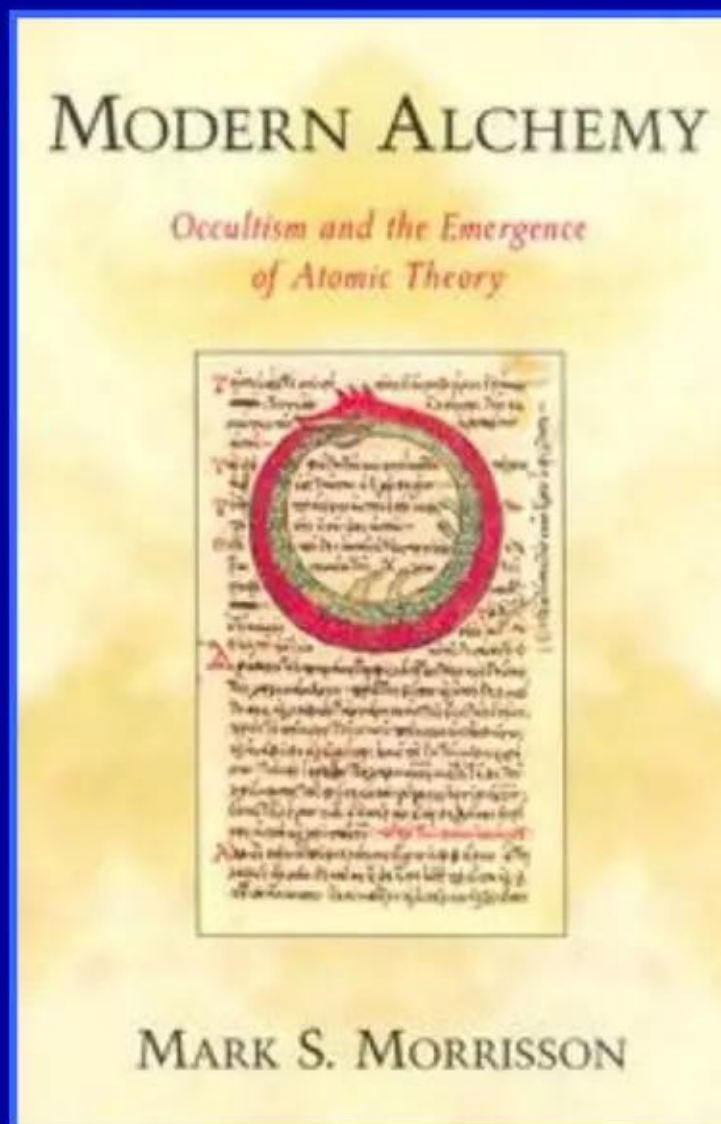
Epigram: Jean-Baptiste Alphonse Karr, in his journal “Les Guêpes” - The Wasps (1849)

1933: “The energy produced by the atom is a very poor kind of thing. Anyone who expects a source of power from the transformation of these atoms is talking moonshine.”

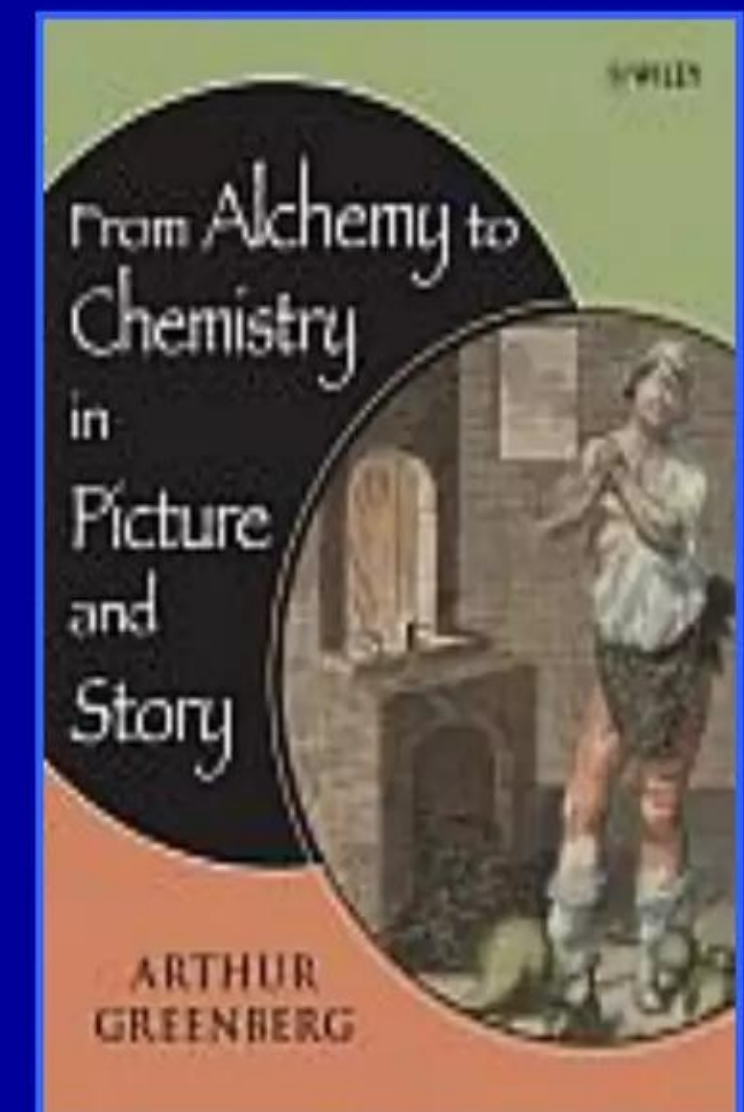
Prof. Ernest Rutherford (1933); fission discovered by Hahn and Strassmann - 1938; Fermi's first reactor went critical - 1942; use of nuclear weapons - 1945; first commercial fission reactor - 1957

1993: “The idea of producing useful energy from room temperature nuclear reactions is an aberration.”

Prof. John Huizenga, a well-respected chemist and physicist, was here referring to “cold fusion” in his very critical book, “Cold fusion - The scientific fiasco of the century” (1993)



Oxford University Press (2007)



Wiley – Interscience (2007)

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Historical context of modern alchemy

US Atomic Energy Commission produced manmade Gold again in 1948

“Alchemy, derived from the Arabic word ‘al-kimia’ is both a philosophy and an ancient practice focused on the attempt to change base metals into gold, investigating the preparation of the ‘elixir of longevity’, and achieving ultimate wisdom, involving the improvement of the alchemist as well as the making of several substances described as possessing unusual properties. The practical aspect of alchemy generated the basics of modern inorganic chemistry, namely concerning procedures, equipment and the identification and use of many current substances. **Alchemy has been practiced in ancient Egypt, Mesopotamia (modern Iraq), India (modern Indian subcontinent), Persia (modern Iran), China, Japan, Korea, the classical Greco-Roman world, the medieval Islamic world, and then medieval Europe up to the 20th century, in a complex network of schools and philosophical systems spanning at least 2,500 years.**”

Source: Wikipedia article (as of July 7, 2010)

Comment: according to the Widom-Larsen theory, nuclear and chemical processes can interconnect on nm - μ length-scales in condensed matter systems under very ‘mild’ conditions compared to interiors of stars, nuclear weapons, and operating fission reactors. Modern production of Gold from ‘base’ elements is simply not the result of some age-old mystical alchemical “delusion.” *Au contraire*, it is now a very understandable result of neutron-captures and subsequent beta decays, which are now well-accepted in nuclear science



Dreams of the ancient alchemists come true in the chain-reacting pile at Oak Ridge, Tenn.

U. S. Alchemists Make Gold

Applying atomic magic to aid medicine and research, radiochemists duplicate nature's elements and create new ones.

By Alden P. Armagnac
Drawings by Ray Ploch

AT Oak Ridge, Tenn., the United States Atomic Energy Commission has gone into the business of manufacturing synthetic gold. The atomic pile is the Philosopher's Stone, long sought by the ancient alchemists, which has the 24-carat touch.

Most curious part of the new enterprise is the odd behavior of the man-made gold. Though locked in the strongest vault, most of it would disappear within a week's time.

Strange to say, this extraordinary way of acting actually enhances the gold's value. What makes it so desirable is the fact that it is radioactive. Hence the ray-emitting "radio-gold" offers medical men a priceless tool for treating such maladies as leukemia, lymphoma and Hodgkin's disease. At one institution alone, Vanderbilt University Medical School in Nashville, Tenn., it has benefited 61 patients in the first year of use.

For therapy and for "tagging" chemicals used in research, Oak Ridge's alchemists—or "radiochemists," as they call themselves—produce scores of artificially radioactive elements like radiogold. But they are by no means limited to "freak" products that have no counterpart in nature.

MARCH 1948 159

Popular Science magazine article, March 1948

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**Gold has been created in various
terrestrial experiments**



**“For the truth of the conclusions
of physical science, observation
is the supreme Court of Appeal.”**

Sir Arthur Eddington
“The Philosophy of Physical Science” pp. 9 (1939)

History, macroeconomics, LENRs, and the price of gold

Gold has been created in various terrestrial experiments

Astrophysicists believe gold produced naturally in supernova explosions

- ✓ Producing gold from base metals was a key goal of many alchemists for more than 1,000 years
- ✓ First good modern experiments reporting production of gold and platinum from a base metal (mercury - Hg) were conducted by Hantaro Nagaoka *et al.* in Japan and published in *Nature* in 1924; results not understood or widely believed at that time because they involved high-current electric arcs in transformer oil laced with Hg; ~similar German results were widely discredited
- ✓ Experiments reporting production of radioactive gold from a base metal (Hg) were conducted and published in 1940s in connection with US nuclear weapons programs; involved neutron-catalyzed transmutation of target elements that were exposed to high neutron fluxes produced in operating fission reactors – results were believed because government scientists did the work
- ✓ Different method for producing gold and platinum from a base metal (tungsten - W) was reported by Cirillo & Iorio (Italy) in 2004; results not understood or widely believed at that time because they involved high-current glow-discharge cathodes in aqueous electrolytic cells – nucleosynthesis is not supposed to ever occur in prosaic chemical cells at ~macroscopic STP
- ✓ At 2012 Winter meeting of American Nuclear Society Yasuhiro Iwamura *et al.* (Mitsubishi Heavy Industries, Japan) reported production of stable osmium and platinum from forced diffusion of deuterium gas through tungsten targets implanted in palladium; results were startling to many
- ✓ **Widom-Larsen theory both predicts and explains all of these disparate experimental results**

Supernova remnant: Helix Nebula (NGC 7293) --- Images: Spitzer Space Telescope combined with Galaxy Evolution Explorer (GALEX). Credit: NASA / JPL-Caltech

History, macroeconomics, LENRs, and the price of gold

Nucleosynthetic pathways for gold with LENR technology



**Advance of a new scientific paradigm involves,
“... handling the same bundle of data as before, but
placing them in a new system of relations with one
another by giving them a different framework.”**

Herbert Butterfield, “The Origins of Modern Science,” London (1949)

History, macroeconomics, LENRs, and the price of gold

Nucleosynthetic pathways for Gold with LENR technology

Predicted by Widom-Larsen theory and realized in different experiments

Legend:

Neutron capture and nuclear decay processes:

ULM neutron captures proceed from left to right  except for upper-left corner; Q-value of capture reaction (MeV) in green either above or below horizontal arrow.

Beta⁻ (β^-) decays proceed from top to bottom; denoted with bright blue vertical arrow  pointing down with Q-value (MeV) in blue either to left or right; beta⁺ (β^+) decays are denoted with yellow arrow  pointing upward to row above

Alpha decays, indicated with orange arrows, proceed mostly from right to left at an angle with Q-value (MeV) shown in orange located on either side of the process arrow. 

Electron captures (e.c.) indicated by purple vertical arrow ; Q-value (MeV) to left or right.

Note: to reduce visual clutter in the network diagram, gamma emissions (converted to infrared photons by heavy e^- electrons) are not shown; similarly, except where specifically listed because a given branch cross-section is significant, beta-delayed decays also generally not shown; BR means “branching ratio” if >1 decay alternative

Color coded half-lives:

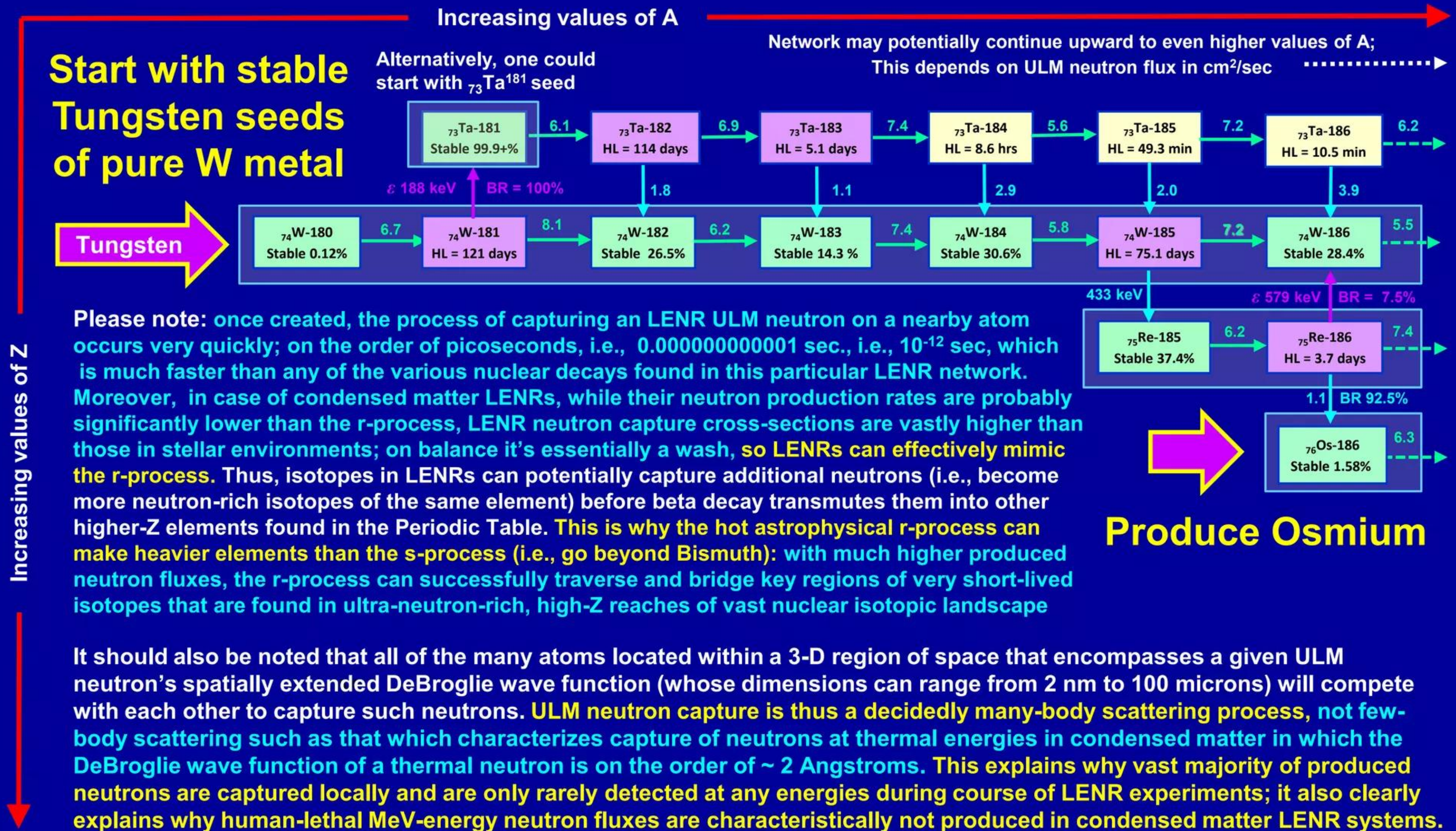
When known, half-lives shown as “HL = xx”. Stable and quasi-stable isotopes (i.e., those with half-lives > or equal to 10^7 years) indicated by green boxes; isotopes with half-lives < 10^7 but > than or equal to 10^3 years indicated by light blue; those with half-lives < than 10^3 years but > or equal to 1 day are denoted by purplish boxes; half-lives of < 1 day in yellow; with regard to half-life, notation “? nm” means isotope has been verified by HL has not been measured

Measured natural terrestrial abundances for stable isotopes:

Indicated with % symbol; note that $_{83}\text{Bi}^{209}$ = 100% (essentially ~stable with half-life = 1.9×10^{19} yrs); $_{82}\text{Pb-205}$ ~stable with HL= 1.5×10^7 yrs;

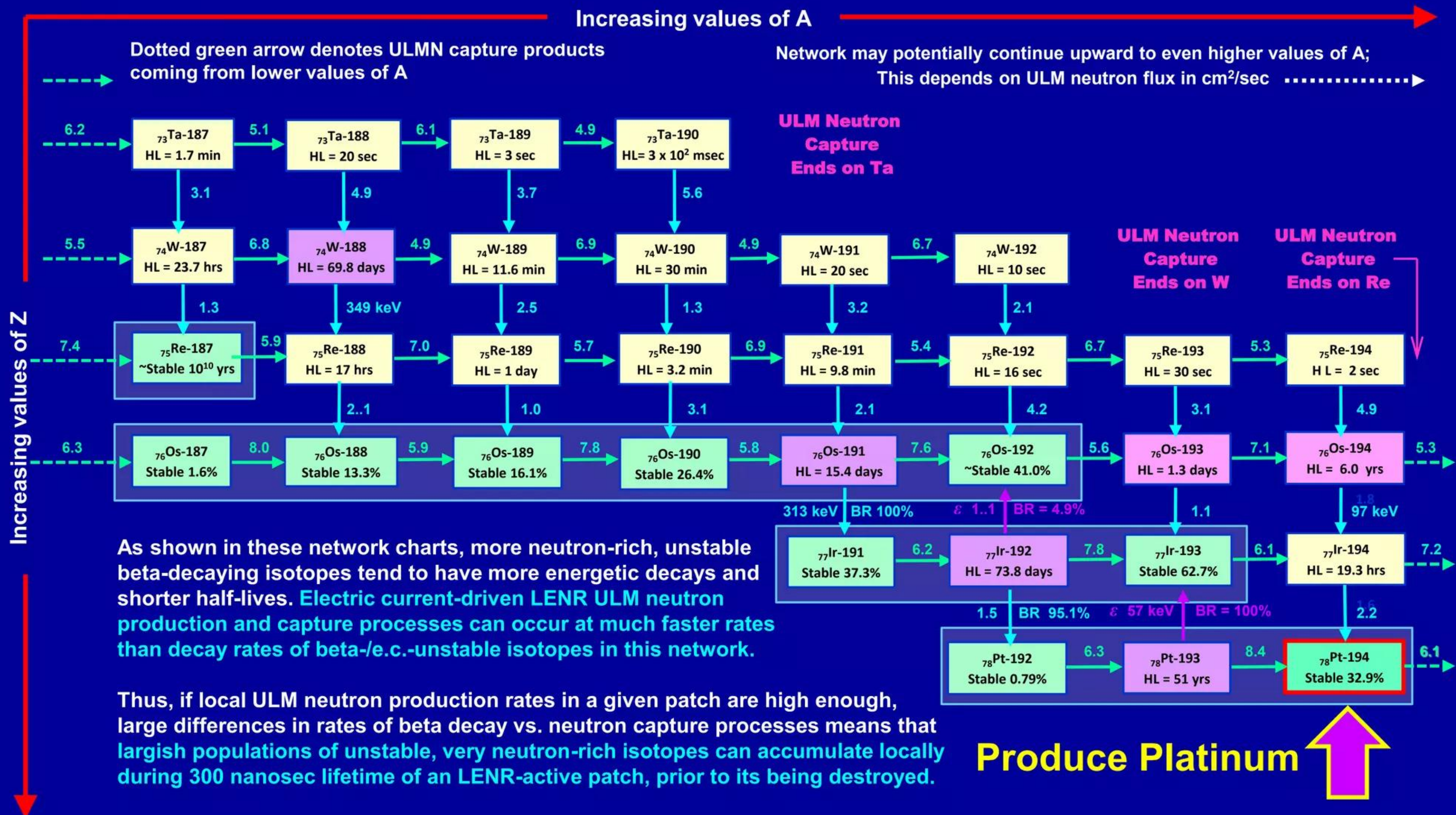
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Nucleosynthetic pathways for Gold with LENR technology



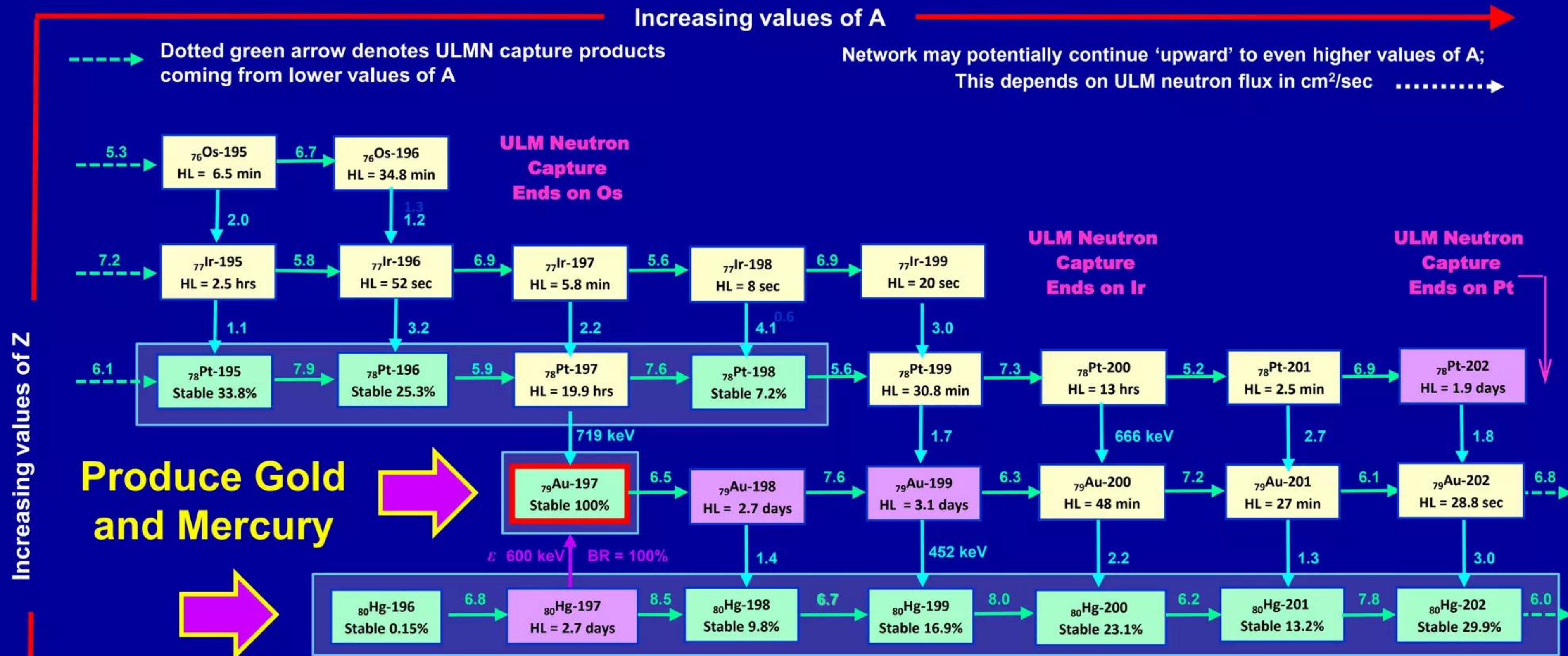
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Nucleosynthetic pathways for Gold with LENR technology



History, macroeconomics, LENRs, and the price of gold

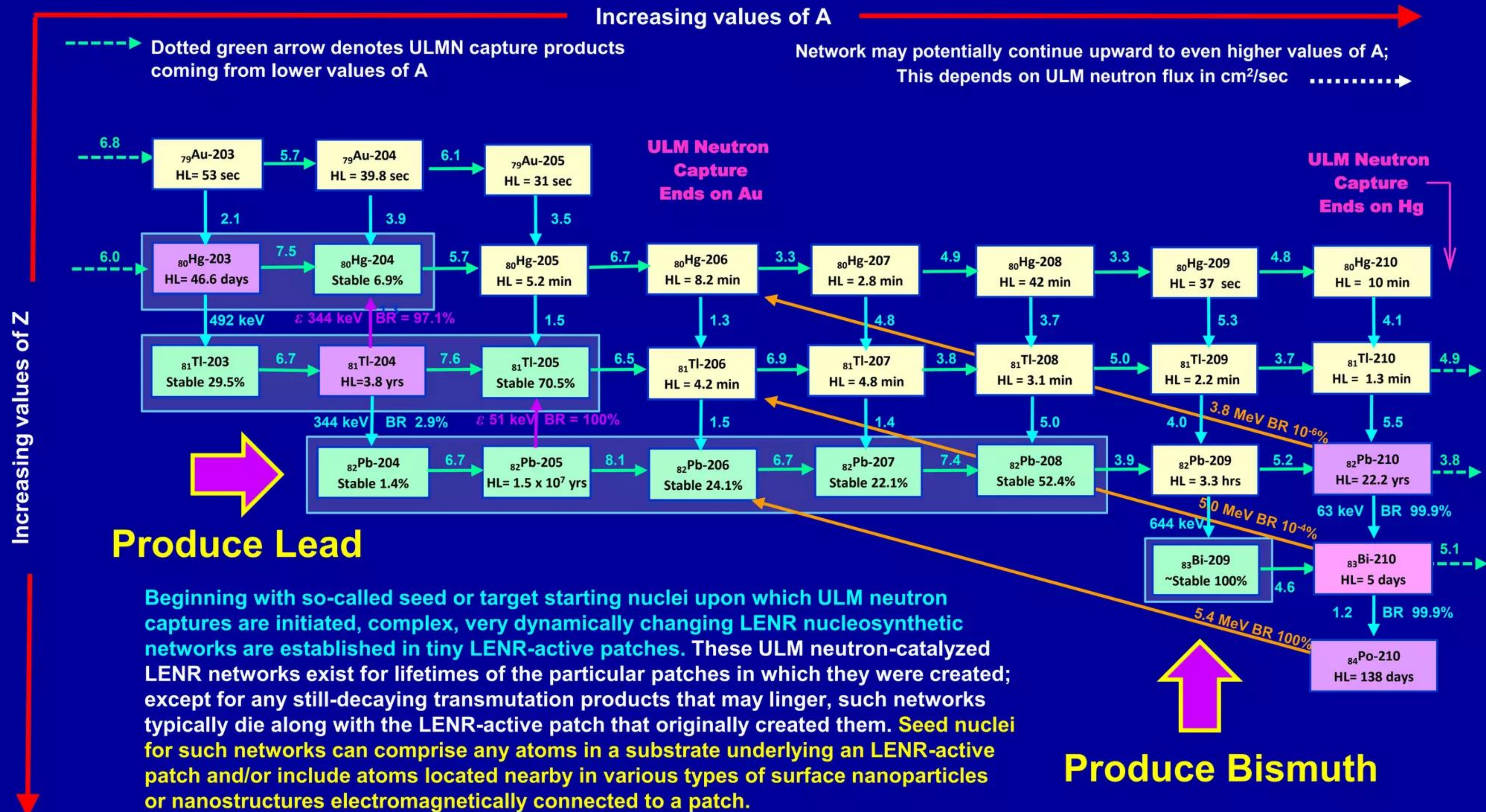
Nucleosynthetic pathways for Gold with LENR technology



Please note that: Q-value for neutron capture on a given beta-unstable isotope is often larger than the Q-value for the alternative β -decay pathway, so in addition to being a faster process than beta decay it can also be energetically more favorable. This can also contribute to creating fleeting yet substantial local populations of short-lived, neutron-rich isotopes. There is indirect experimental evidence that such neutron-rich isotopes can be produced in complex ULM neutron-catalyzed LENR nucleosynthetic (transmutation) networks that set-up and operate during brief lifetime of an LENR-active patch; see **Carbon-seed network on Slides # 11 - 12 and esp. on Slide #55 in <http://www.slideshare.net/lewisglarsen/lattice-energy-llctechnical-overviewcarbon-seed-lenr-networkssept-3-2009>**

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Nucleosynthetic pathways for Gold with LENR technology

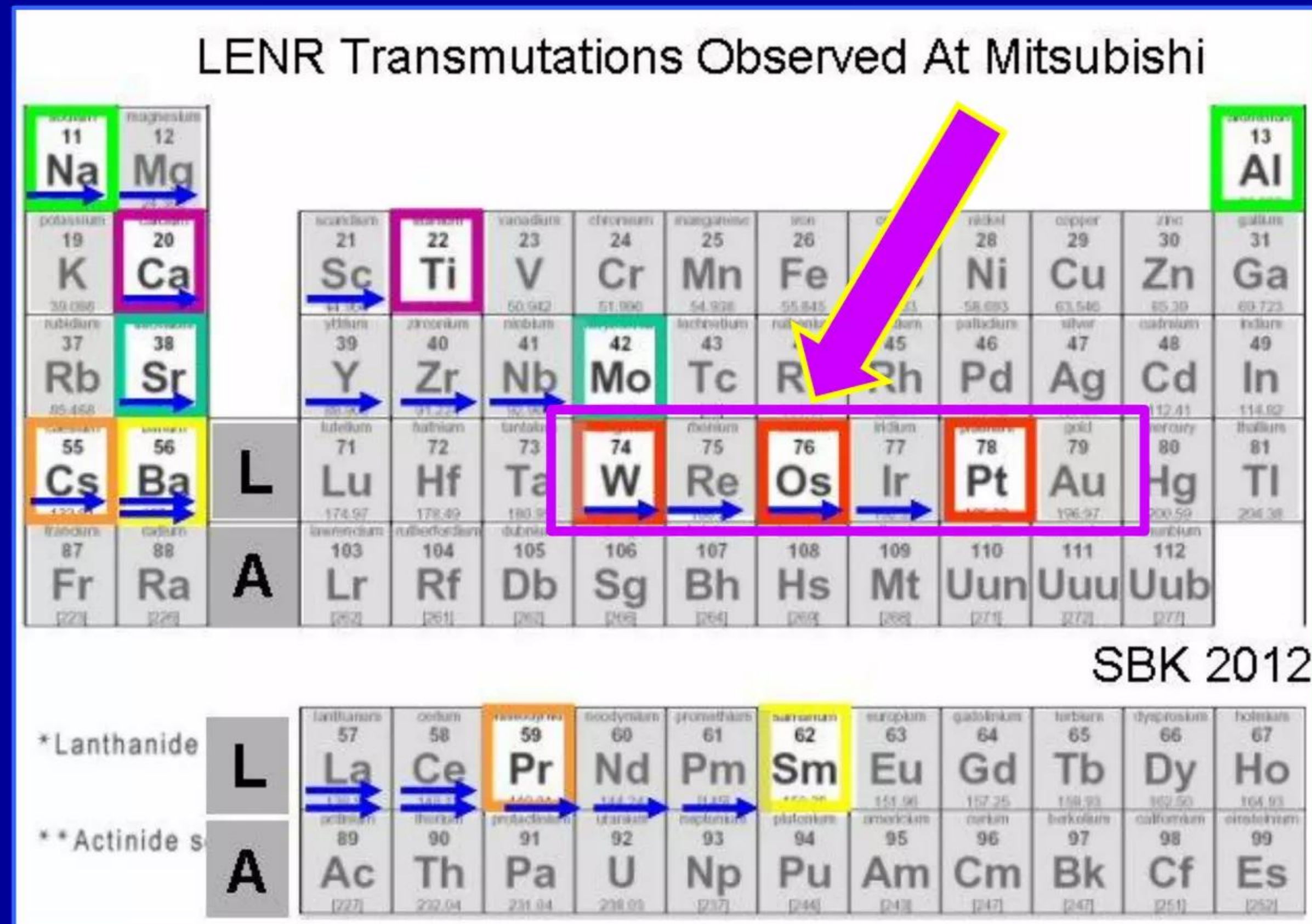


History, macroeconomics, LENRs, and the price of gold

Nucleosynthetic pathways for Gold with LENR technology

Mitsubishi reported new experimental results at Winter 2012 ANS meeting

Confirm vector of LENR gold transmutation pathway predicted by Widom-Larsen theory



Source of adapted graphic is *New Energy Times*:

<http://news.newenergytimes.net/2012/12/06/mitsubishi-reports-toyota-replication/>

History, macroeconomics, LENRs, and the price of gold

Multi-decadal socioeconomic/technological forces shape today's markets

**“History doesn't repeat itself,
but it does rhyme.”**

Attributed to Mark Twain



“WIPO sets record for international patent filings in 2011; LDCs not a factor”

“The World Intellectual Property Organization today announced that it set a new record for international filings of patents in 2011, in what the UN agency attributed to a focus on innovation. Patents filed under the WIPO-managed Patent Cooperation Treaty shot up more than 10 per cent last year in the fastest growth since 2005”

<http://www.ip-watch.org/2012/03/05/wipo-sets-record-for-international-patent-filings-in-2011-ldcs-not-a-factor/>

History, macroeconomics, LENRs, and the price of gold

Multi-decadal socioeconomic/technological forces shape today's markets

Fischer's Great Wave period of equilibrium driven by rapid technological innovation

Note: on Slide #5 herein please see two Lattice documents dated April 14 and 15, 2012; also see reference to David Hackett Fischer's seminal 1996 book *The Great Wave* on same slide; URLs to documents containing copies of 1986, 1988, and 1999 *Barron's* articles and Lattice White paper dated April 12, 2010, can be found on Slide #6

- ✓ In his book, Fischer meticulously characterizes and describes the details of what he calls four global "Great Waves" that have occurred during the past ~1,000 years from the High Middle Ages up until today. In Fischer's two-stage conceptual model of a "Great Wave," the first stage is a relatively noninflationary, so-called "period of equilibrium" which typically lasts for 60 to 100 years (typical avg. duration is ~85 years); associated with substantial increases in real wages, improvement in standards of living, and an explosion in new technologies and products
- ✓ A Great Wave's second, longer stage is called a "price revolution" whose total duration is much more variable than the first stage. In sharp contrast to periods of equilibrium, price revolutions are characterized by progressively higher rates of inflation and interest on debt obligations. They typically reach their final climax in an inflationary economic cataclysm that is subsequently followed by a massive deflationary financial system and price crash which sets the stage for the beginning of the world's next period of equilibrium (which also happens to mark the starting point and beginning seed for next multi-decadal global Great Wave)

History, macroeconomics, LENRs, and the price of gold

Multi-decadal socioeconomic/technological forces shape today's markets

Fischer Great Wave's period of equilibrium driven by rapid technological innovation

- ✓ Over the past ~1,000 years, periods of equilibrium have occurred at one point during four well-known historical epochs commonly known as the High Middle Ages (ca. 1000 - 1200), Renaissance (ca. 1400 - 1600), Enlightenment (ca. 1700 - 1800), and finally the Victorian Era (ca. 1830 - 1900); i.e., at certain times during the eleventh, fifteenth, eighteenth, and nineteenth centuries
- ✓ In 1997, Larsen fully completed Fischer's conceptual model by postulating that periods of equilibrium are mainly triggered and maintained by bursts of innovation and deployment of newly commercialized technologies, broadly writ (as Larsen stated in 1999 *Barron's* article)
- ✓ Thus David Hackett Fischer's historical research intersects Larsen's earlier macroeconomic work in that major bursts of technological innovation (we are in one right now; it began just after W.W. II) that have been identified with historical patent issuance data are responsible for triggering and driving what Fischer refers to in his book as global "periods of equilibrium"
- ✓ Both David and I presently believe that a new such period of price equilibrium may have begun in approximately 1979 -1980. **If our speculative conjecture ultimately proves to be correct, its ramifications could have important strategic implications for science and technology, macroeconomics, business, and geopolitics over the next three to five decades**

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Multi-decadal socioeconomic/technological forces shape today's markets

Fischer Great Wave's period of equilibrium driven by rapid technological innovation

- ✓ There is another subtle yet very important socioeconomic factor that one should be aware of: recent data on total world population growth strongly indicates that it is finally slowing down and perhaps even flattening-out. If such apparent trends in recent world population data prove to be correct, **the current era would be the very first period of equilibrium in over 800 years during which the world population growth rate was actually *decelerating*, instead of rapidly accelerating**
- ✓ **The following point is crucial:** over the past 1,000 years, as soon as advances in technology improved living conditions, ordinary people started feeling more optimistic about the future and started having more children which in turn caused the population growth rate to accelerate. Eventually, the population was growing much faster than improvements in technology could lower the cost of goods and services and so the price inflation rate accelerated in parallel with increases in population. Since price inflation engenders positive feedback in terms of human economic behavior, a non-linear ratcheting effect starts to drive prices which creates Fischer's pernicious "price revolution" and ensuing crash when economic and financial system feedback loops spin completely out-of-control; economists blithely call this a "hard landing"
- ✓ **Alluding to Reinhart & Rogoff's book title, this time it may well be different: if the nonlinear positive feedback linkage between improved socioeconomic (living) conditions and acceleration of population growth has finally been decisively broken, it means that the current period of equilibrium (presuming that we are in one right now) could potentially extend well beyond 2065**

History, macroeconomics, LENRs, and the price of gold

Very long time-series macroeconomic data

“Above all, our emphasis is on looking at long spans of history to catch sight of ‘rare’ events that are all too often forgotten, although they turn out to be far more common and similar than people seem to think. Indeed, analysts, policymakers, and even academic economists have an unfortunate tendency to view recent experience through the narrow window opened by standard data sets, typically based on a narrow range of experience in terms of countries and time periods.”



“A large fraction of the academic and policy literature on debt and default draws conclusions based on data collected since 1980, in no small part because such data are the most readily accessible. This approach would be fine except for the fact that financial crises have much longer cycles, and a data set that covers twenty-five years simply cannot give one an adequate perspective ... To even begin to think about such events, one needs to compile data for several centuries.”

C. Reinhart and K. Rogoff

“This time is different - eight centuries of financial folly”
Princeton University Press pp. xxvii - xxviii (2009)

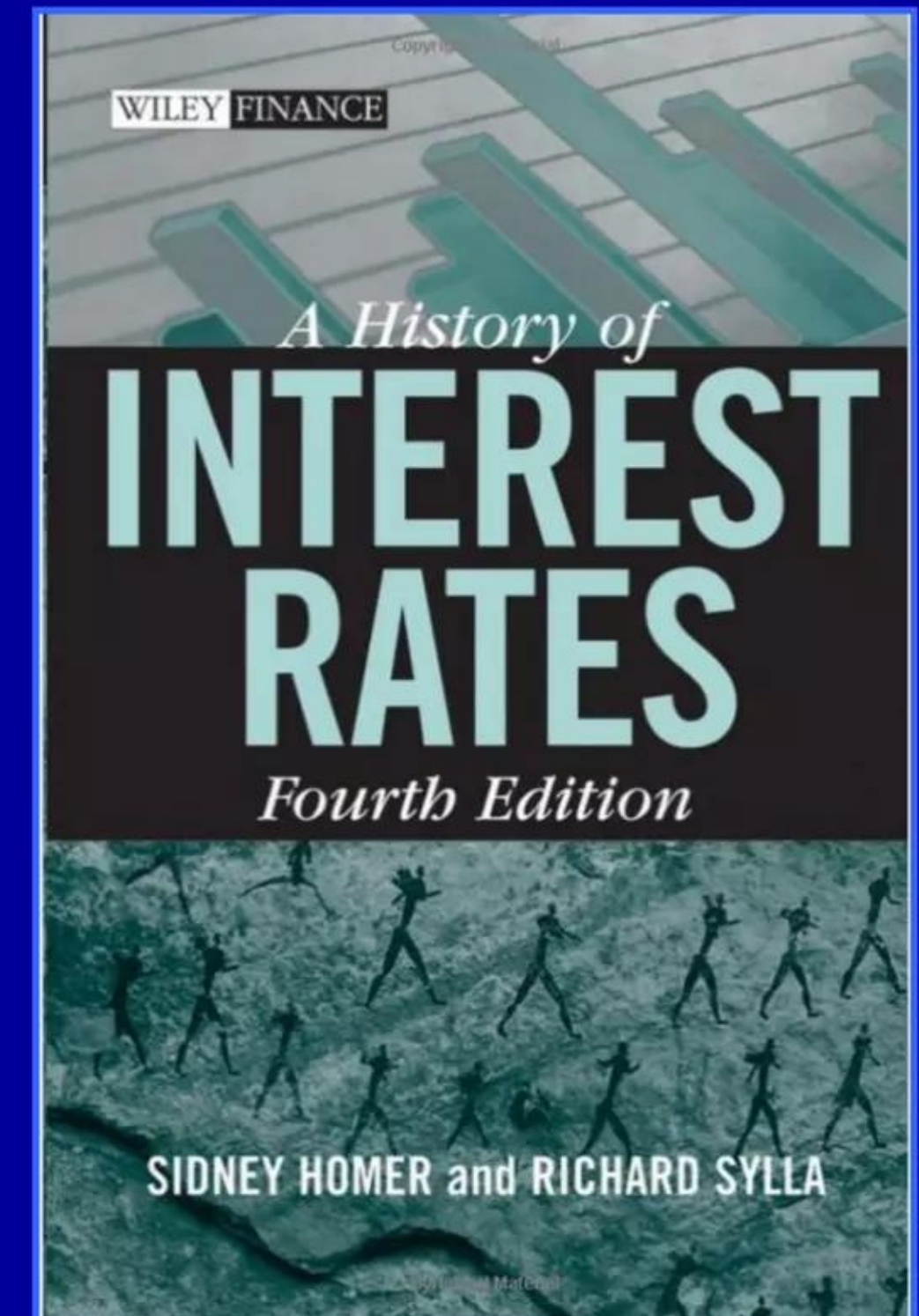
History, macroeconomics, LENRs, and the price of gold

Very long time-series macroeconomic data

Totally agree with Reinhart & Rogoff that long time-periods must be studied

Note: on Slide #5 herein please see two Lattice documents dated April 14 and 15, 2012; also see reference to Reinhart & Rogoff's 2009 book and Reinhart's follow-up paper on same slide

- ✓ To truly understand ultra-long-term macroeconomic phenomena that subtly shape many aspects of today's markets for stocks, bonds, and physical commodities, it is essential for researchers to study time-series data that go back just as far as possible into the deep historic past
- ✓ Fischer explored ~1,000 years when researching *The Great Wave*, Reinhart & Rogoff went back 800 years; Homer & Sylla compiled 4,000 years of interest rate data
- ✓ 1985 Larsen theory paper reflects this philosophy about time-series data; enables one to make sense of secular trends in long-term interest rates that extend for decades
- ✓ When one analyses Fischer's data, it appears that typical average duration for a period of equilibrium is ~85 years; if a new one started in ~1980, that brings us out to 2065



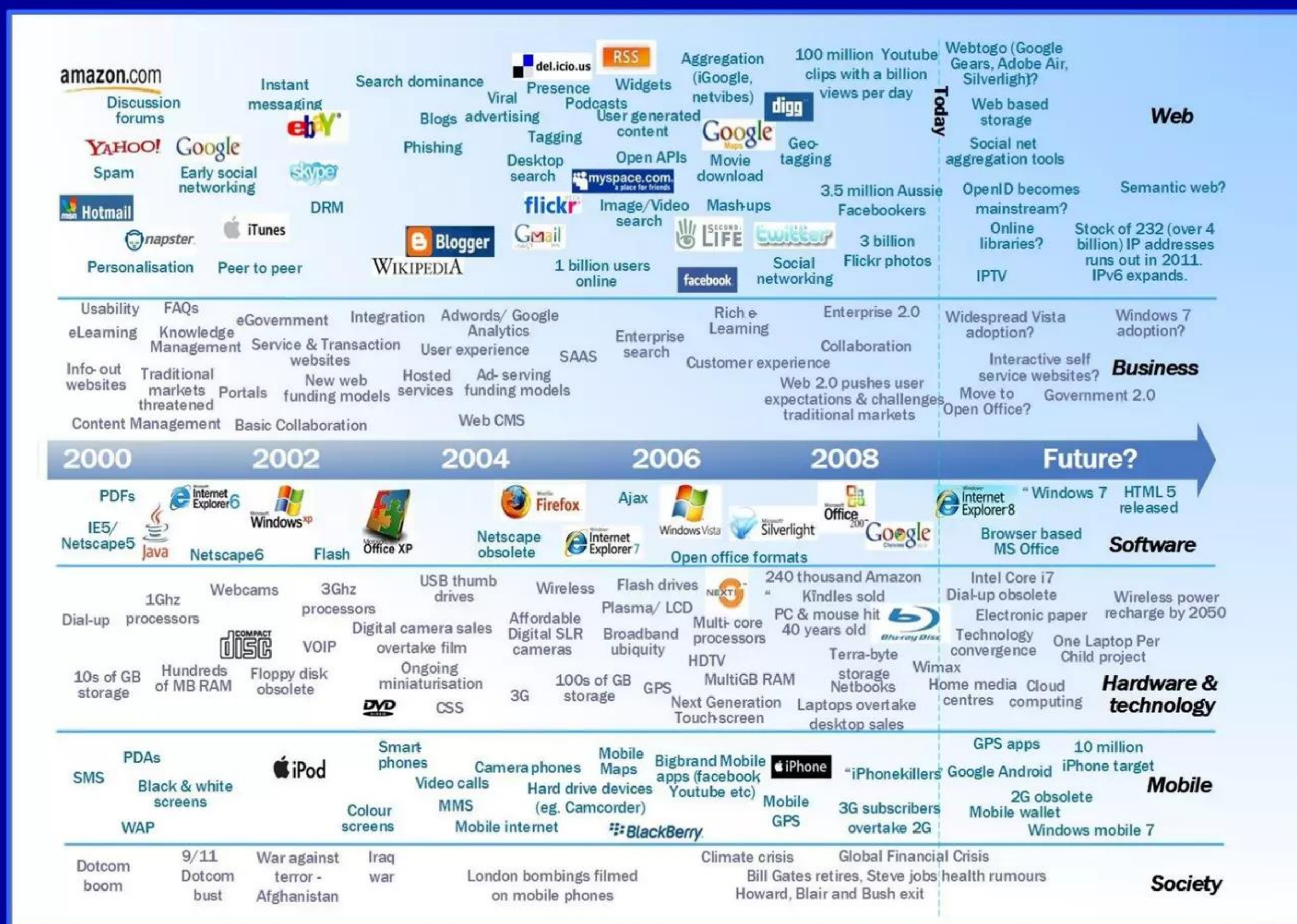
John Wiley & Sons, Inc. 4th ed. (2005)

History, macroeconomics, LENRs, and the price of gold

Very long time-series macroeconomic data

Technological innovation is accelerating in present period of equilibrium

Internet innovation timeline below is but one example; nanotechnology is also booming

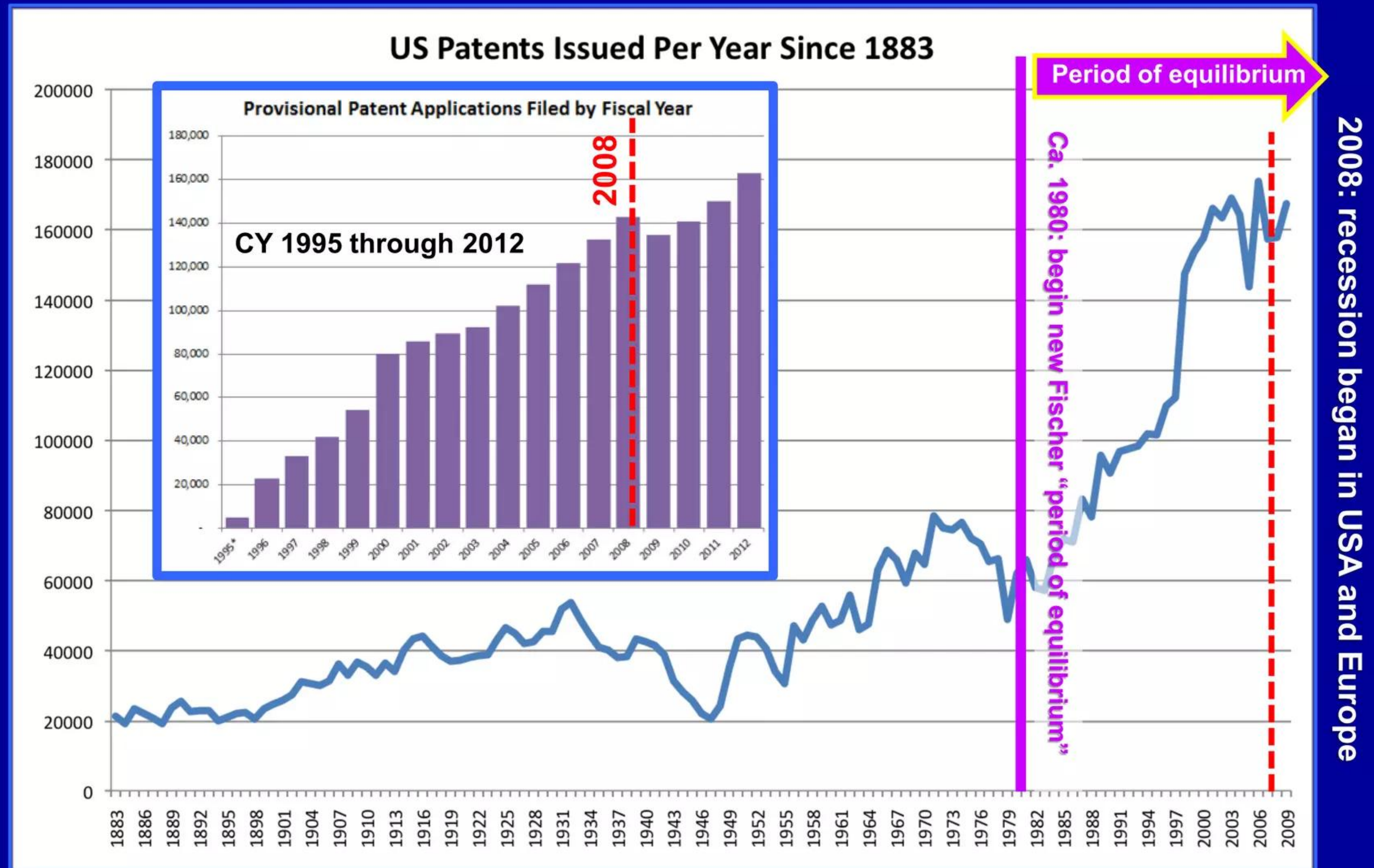


Source: Mark Thompson: <http://www.stayonsearch.com/what-will-the-internet-be-like-in-2025>

History, macroeconomics, LENRs, and the price of gold

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Issued patents explode ca. 1980: onset of new Fischer period of equilibrium

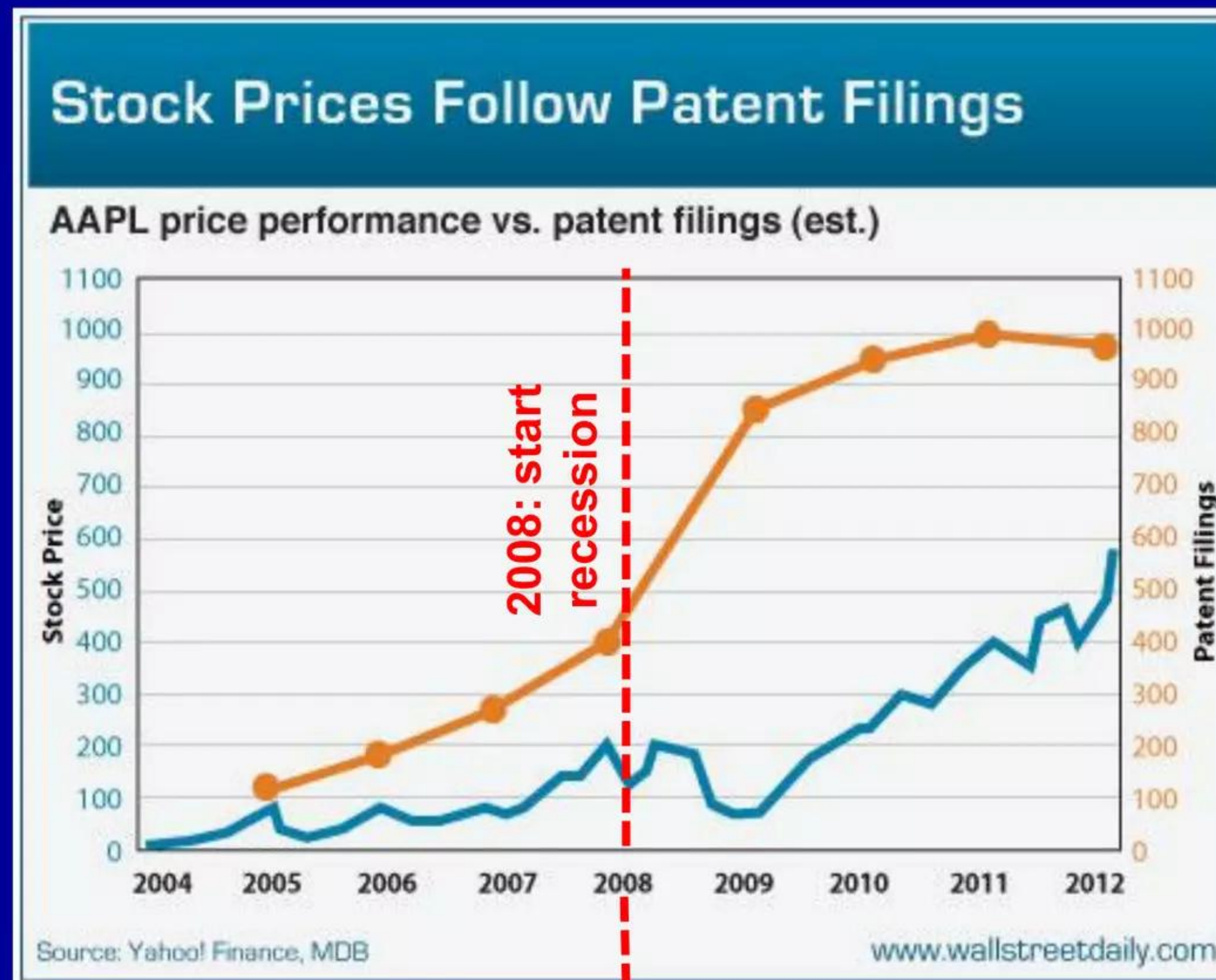


History, macroeconomics, LENRs, and the price of gold

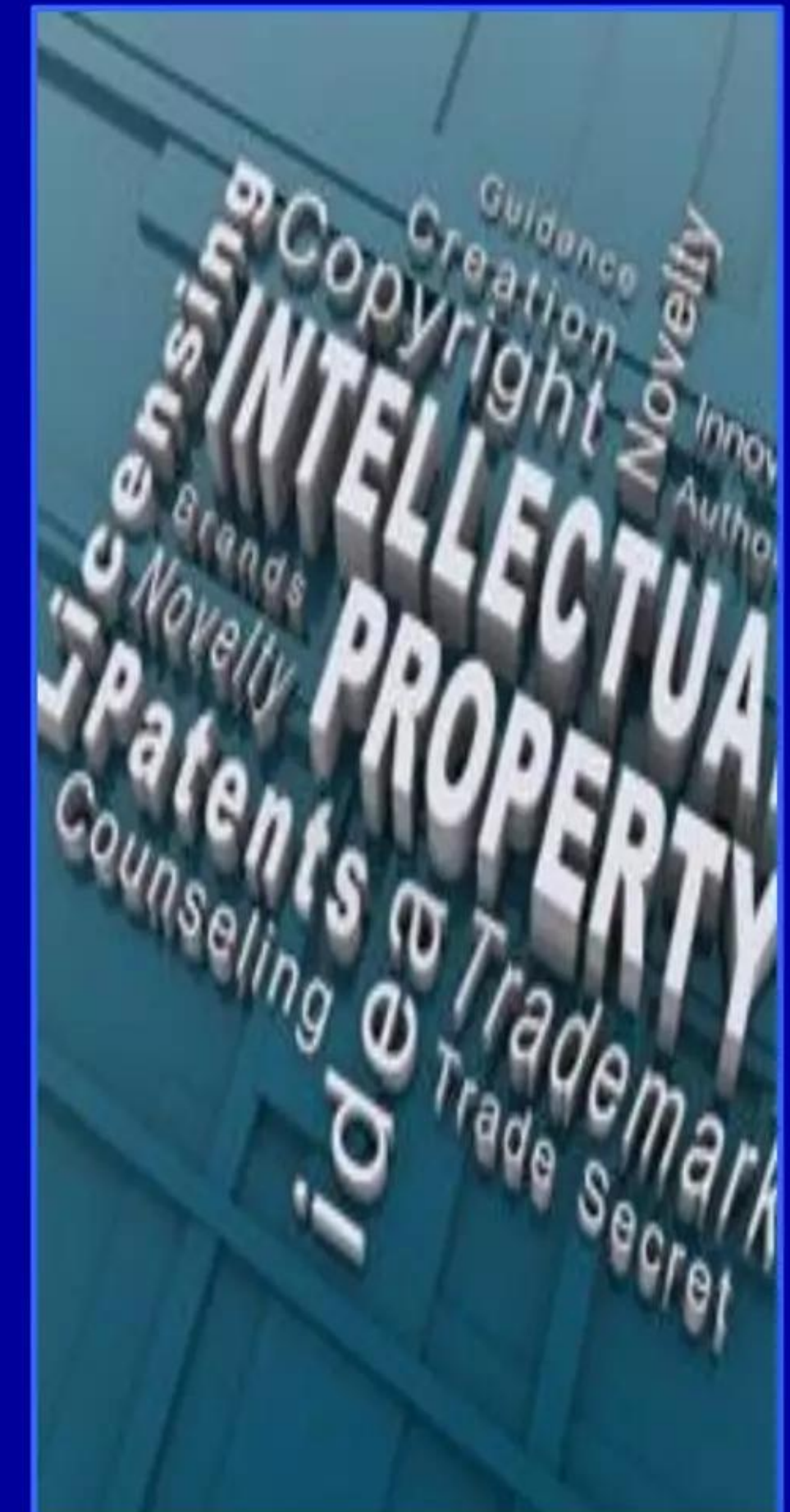
Very long time-series macroeconomic data

Loose but nonetheless real relationship between patent filings and stock price

This example shows recent data for Apple Computer



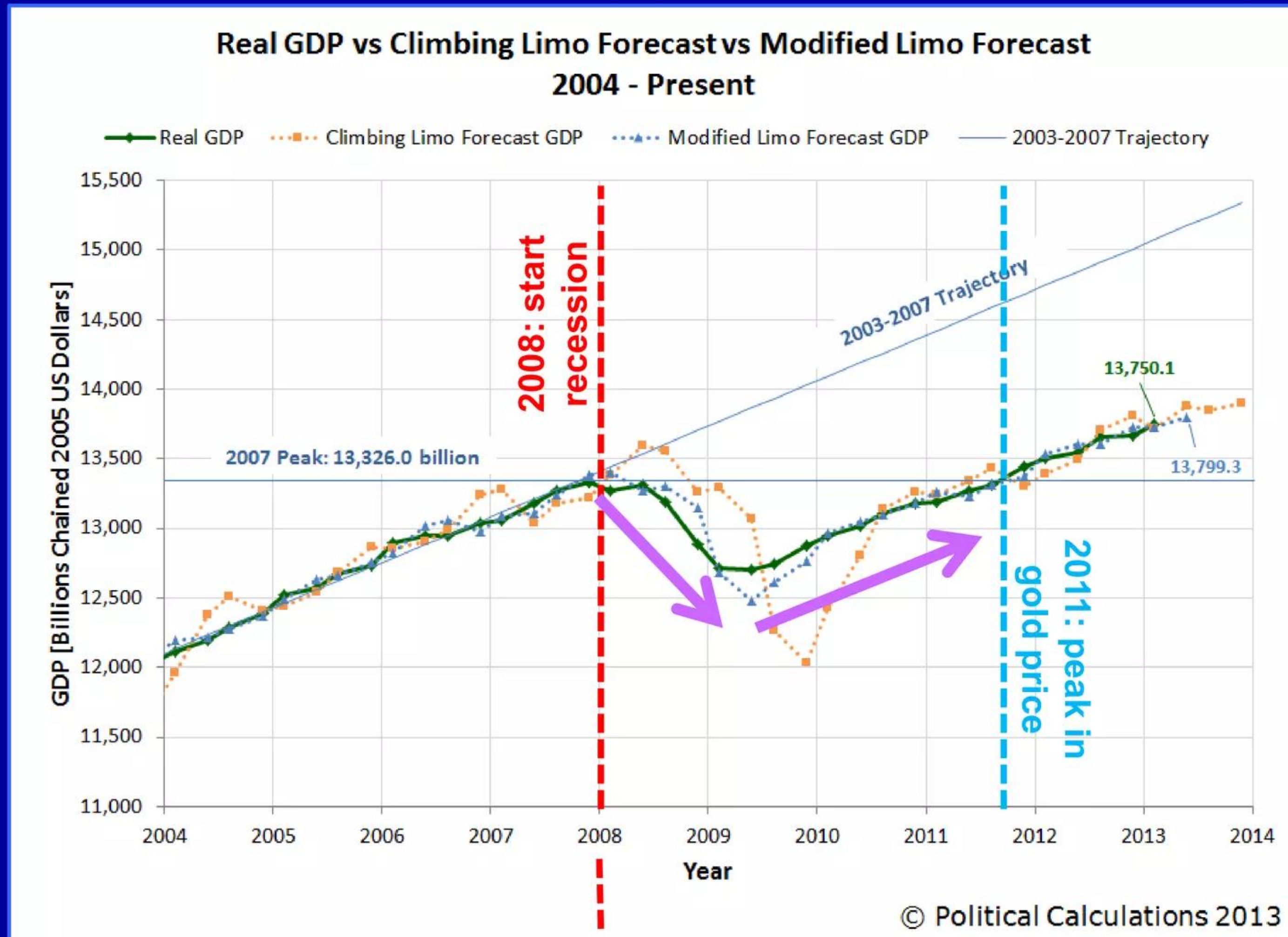
Source: Louis Basenese, Investment U Research, "Patent Filings: The Next Great Leading Indicator," March 20, 2012
<http://www.investmentu.com/2012/March/patent-filings-leading-indicator.html>



History, macroeconomics, LENRs, and the price of gold

Very long time-series macroeconomic data

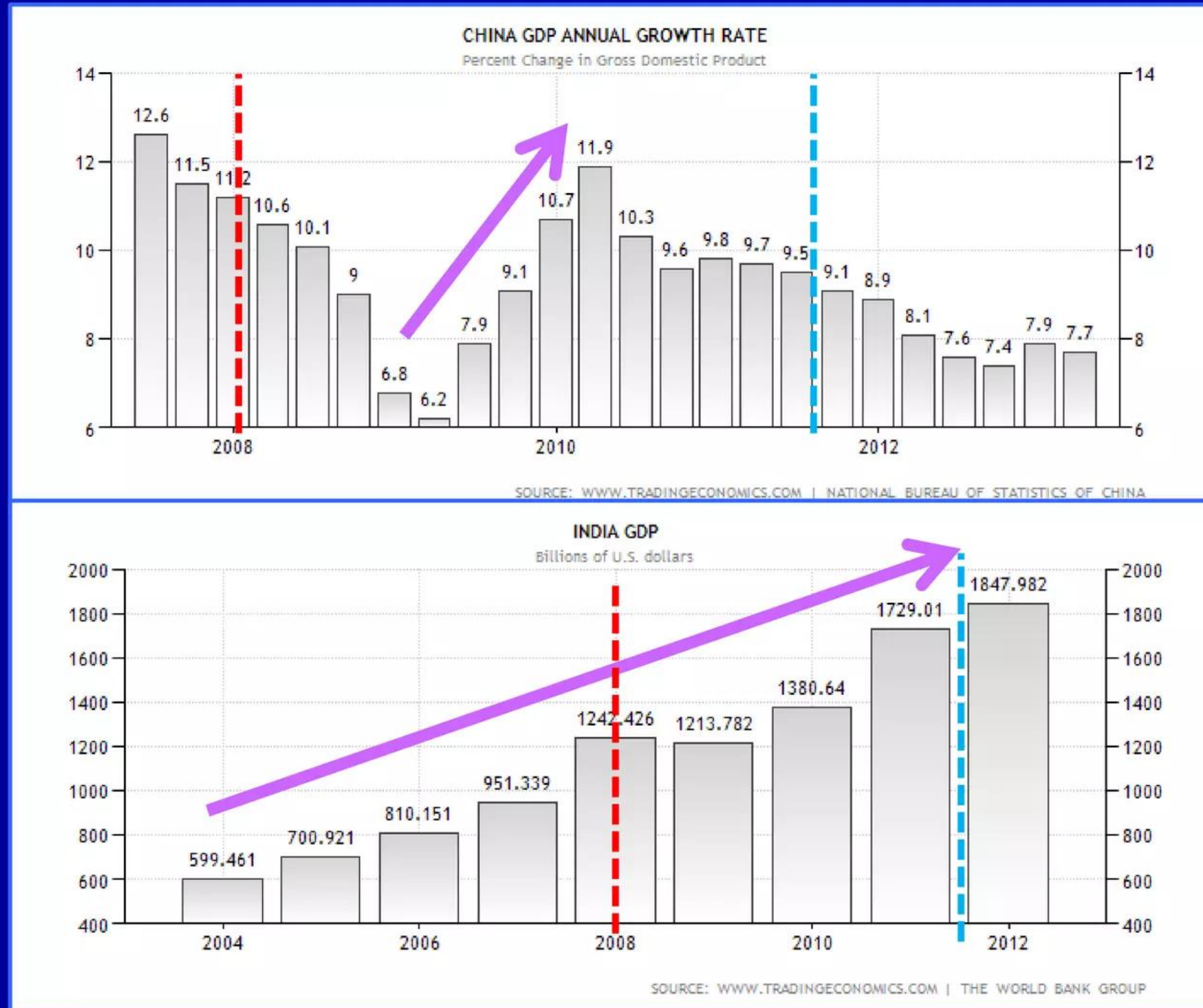
US banking crisis triggered a recession *cum* depression that began in 2008



History, macroeconomics, LENRs, and the price of gold

Very long time-series macroeconomic data

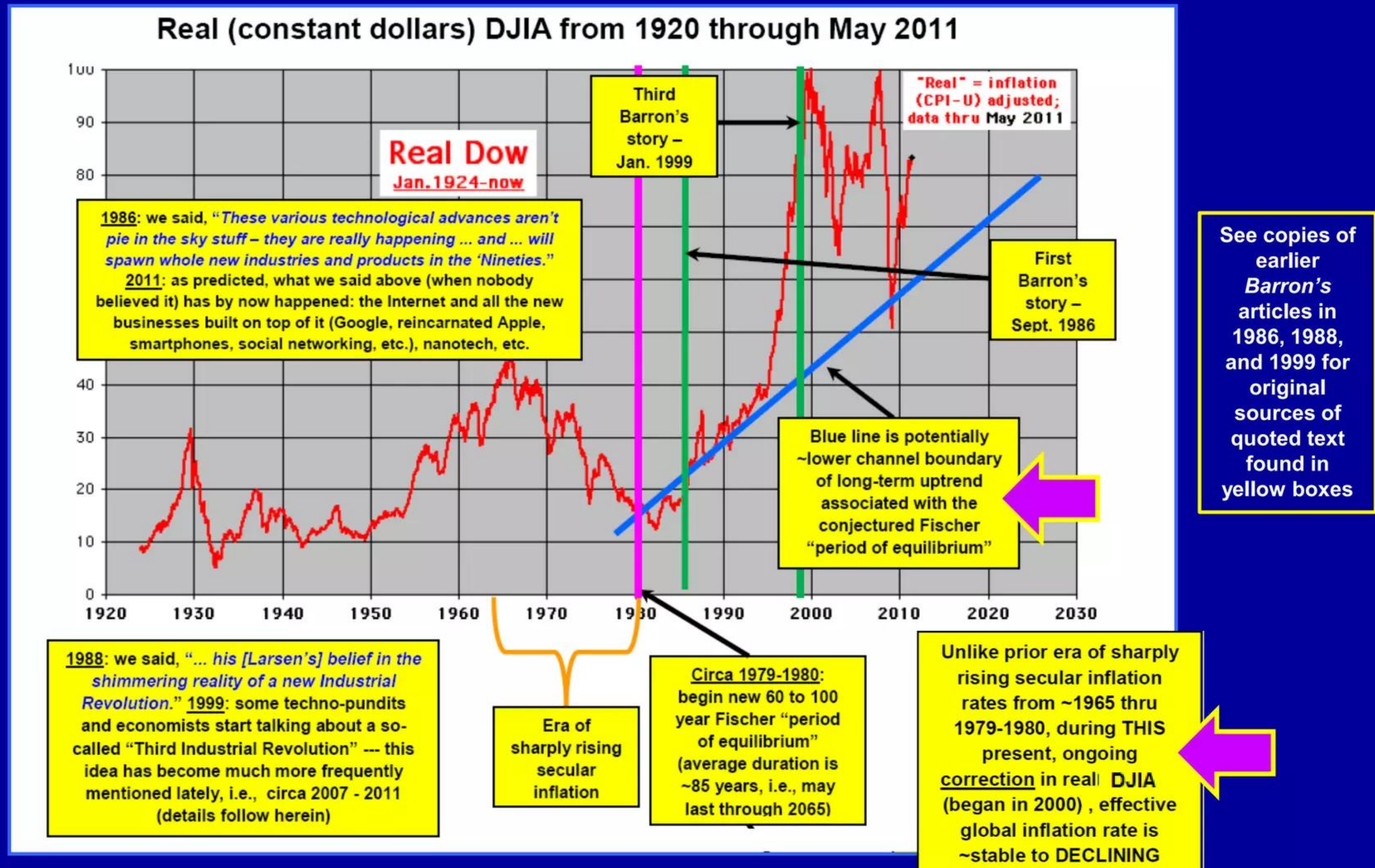
While US/Western Europe GDPs were contracting, China and India still grew



History, macroeconomics, LENRs, and the price of gold

Very long time-series macroeconomic data

Multi-decadal secular uptrend in real DJIA that began ca. 1980 still continues



History, macroeconomics, LENRs, and the price of gold

Very long time-series macroeconomic data

Recent data suggests that multi-decadal uptrend in real Dow still continues



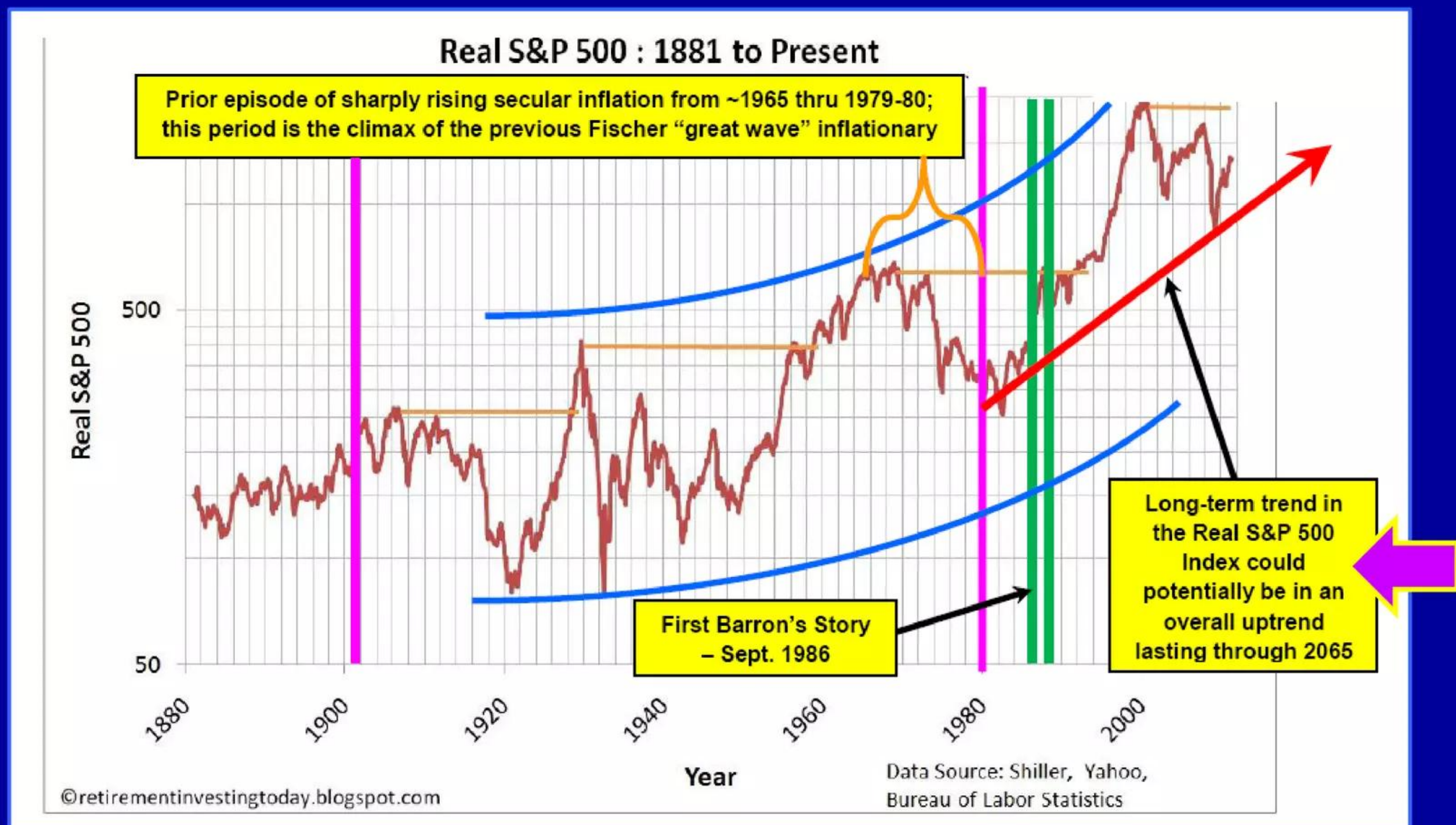
Source: <http://www.showrealhist.com/>

History, macroeconomics, LENRs, and the price of gold

Very long time-series macroeconomic data

If period of equilibrium hypothesis is right, uptrend in real S&P could go to 2065

Major upside potential in S&P 500 if present macroeconomic and technology trends persist

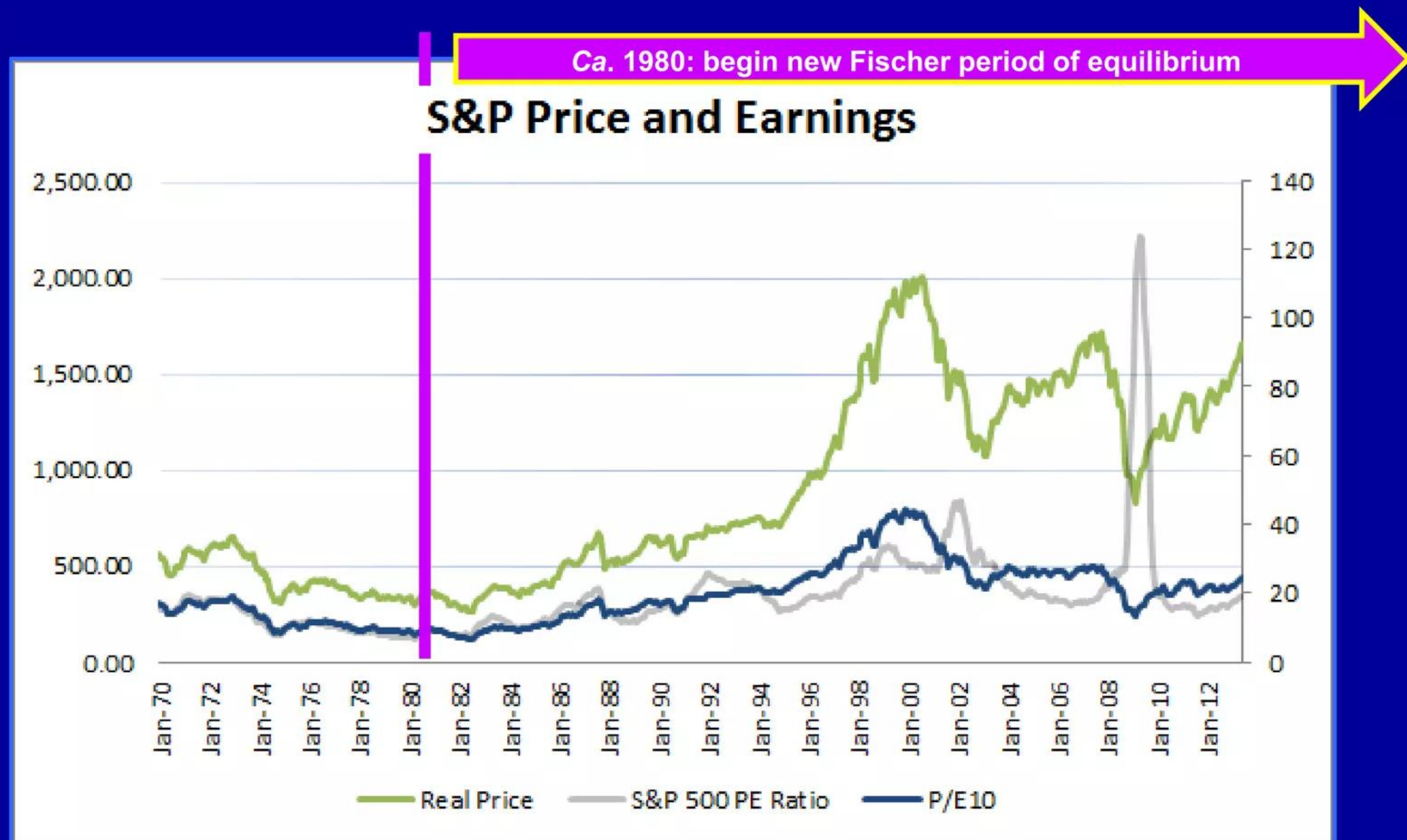


History, macroeconomics, LENRs, and the price of gold

Very long time-series macroeconomic data

If uptrend in S&P continues, upside potential in equities could be substantial

Real price S&P 500 data (green line) shown below starts in 1970 and ends in May 2013



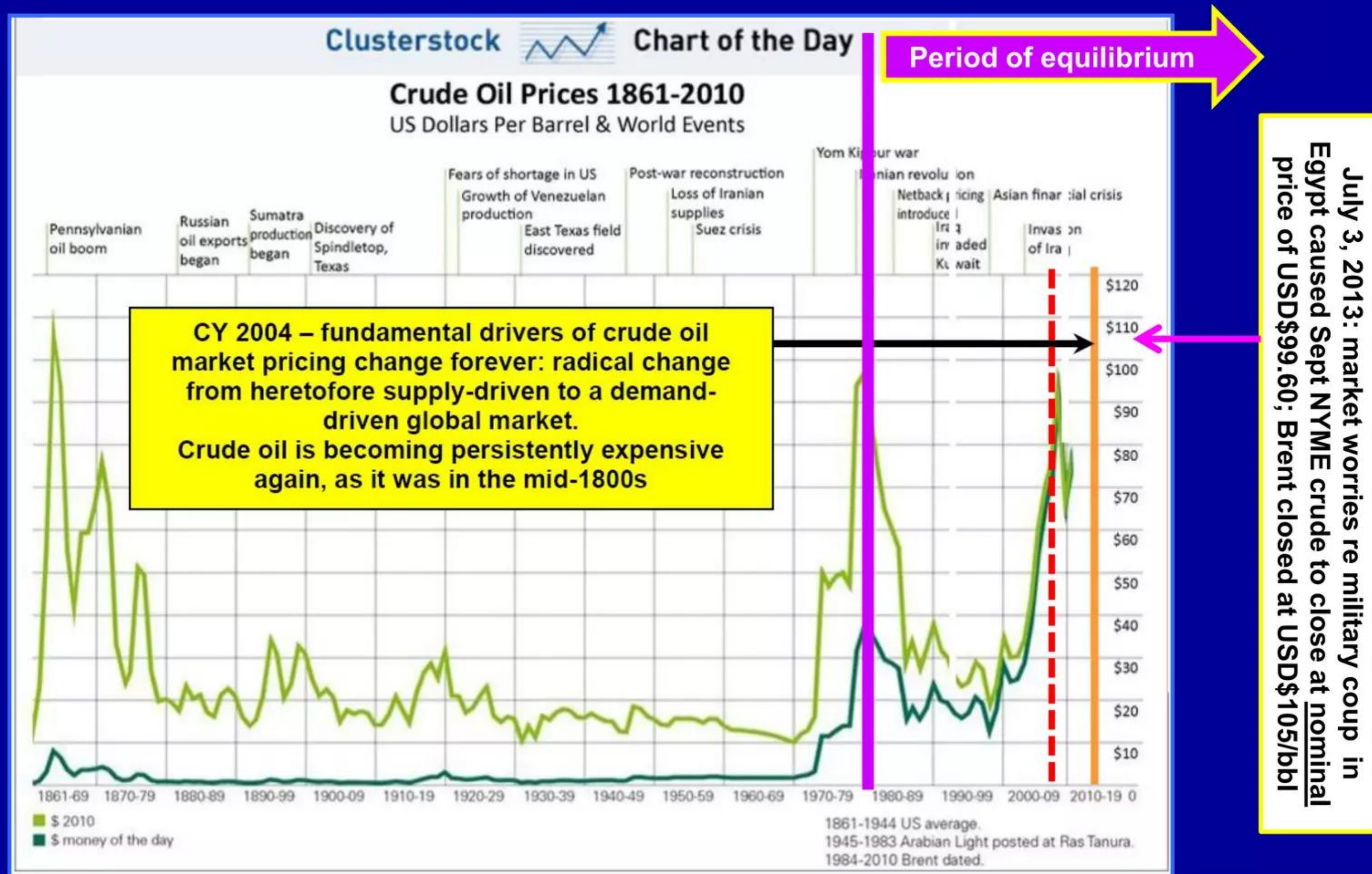
Source: "Wall Street Cheat Sheet", Dan Ritter, May 26, 2013 at <http://wallstcheatsheet.com/stocks/is-the-fed-feeding-mr-markets-addiction.html/?a=viewall>

History, macroeconomics, LENRs, and the price of gold

Very long time-series macroeconomic data

Oil price remains high despite oil & gas fracking production boom in USA

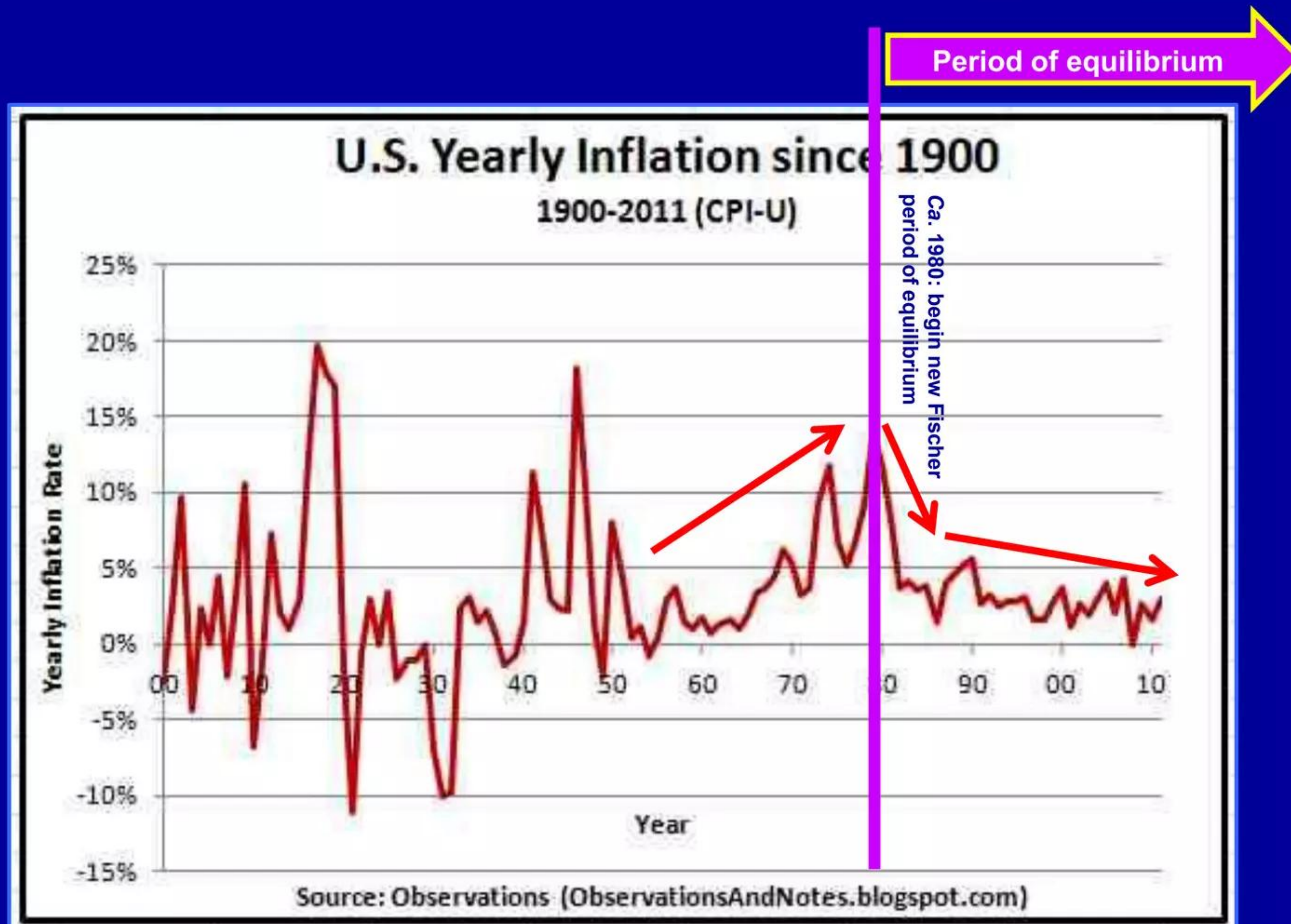
Real price of oil high in historical terms because global supply/demand balance very tight



History, macroeconomics, LENRs, and the price of gold

Very long time-series macroeconomic data

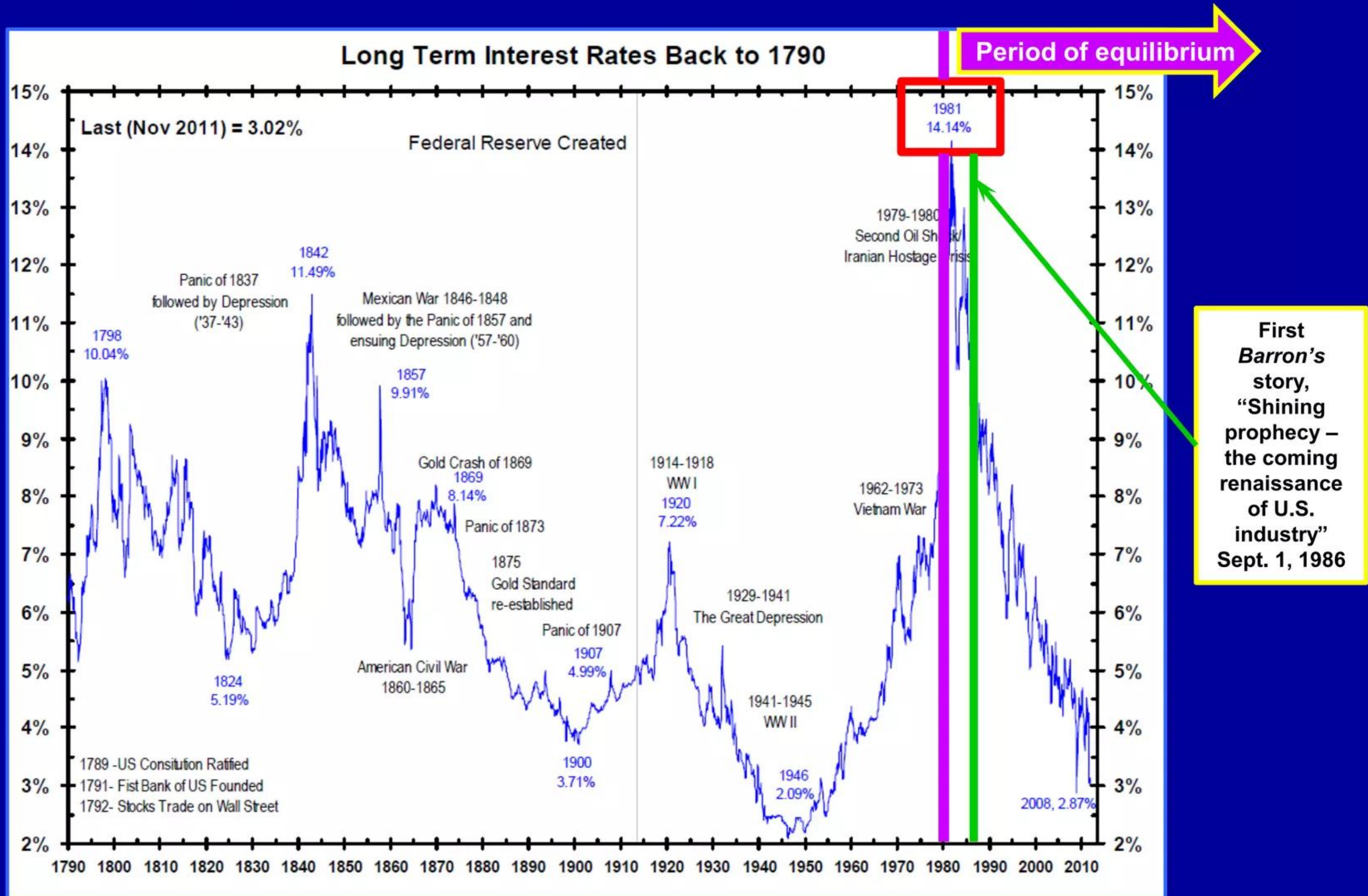
Per Fischer, global inflation rates tend to be lower during periods of equilibrium



History, macroeconomics, LENRs, and the price of gold

Very long time-series macroeconomic data

Behavior of long term rates is consistent with Larsen theory paper (1985)



History, macroeconomics, LENRs, and the price of gold

**Gold's recent price decline vs. equities
was expected**



**“An era can be said to end
when its basic illusions are exhausted.”**

**Arthur Miller, American playwright and essayist
“When it came apart,” New York Magazine
Dec. 30, 1974 - Jan. 6, 1975**

History, macroeconomics, LENRs, and the price of gold

Gold's recent price decline vs. equities was expected

In August 2011 it was very apparent that DJIA/Gold ratio was likely at a nadir

Note: copy of 13-page Larsen DJIA/Gold memo dated April 10, 2011 is 'hidden' on Lattice's SlideShare website; to access it, go to URL <https://www.slideshare.net/secret/1ZKlb7TOg6XkXH> and use the password (all lower-case) **paradigmshift1** to open the document in a browser window. **This unusual step was taken because we wanted to insure that readers had at least some conceptual preparation before trying to read it; in some ways its use of charts is terse.**

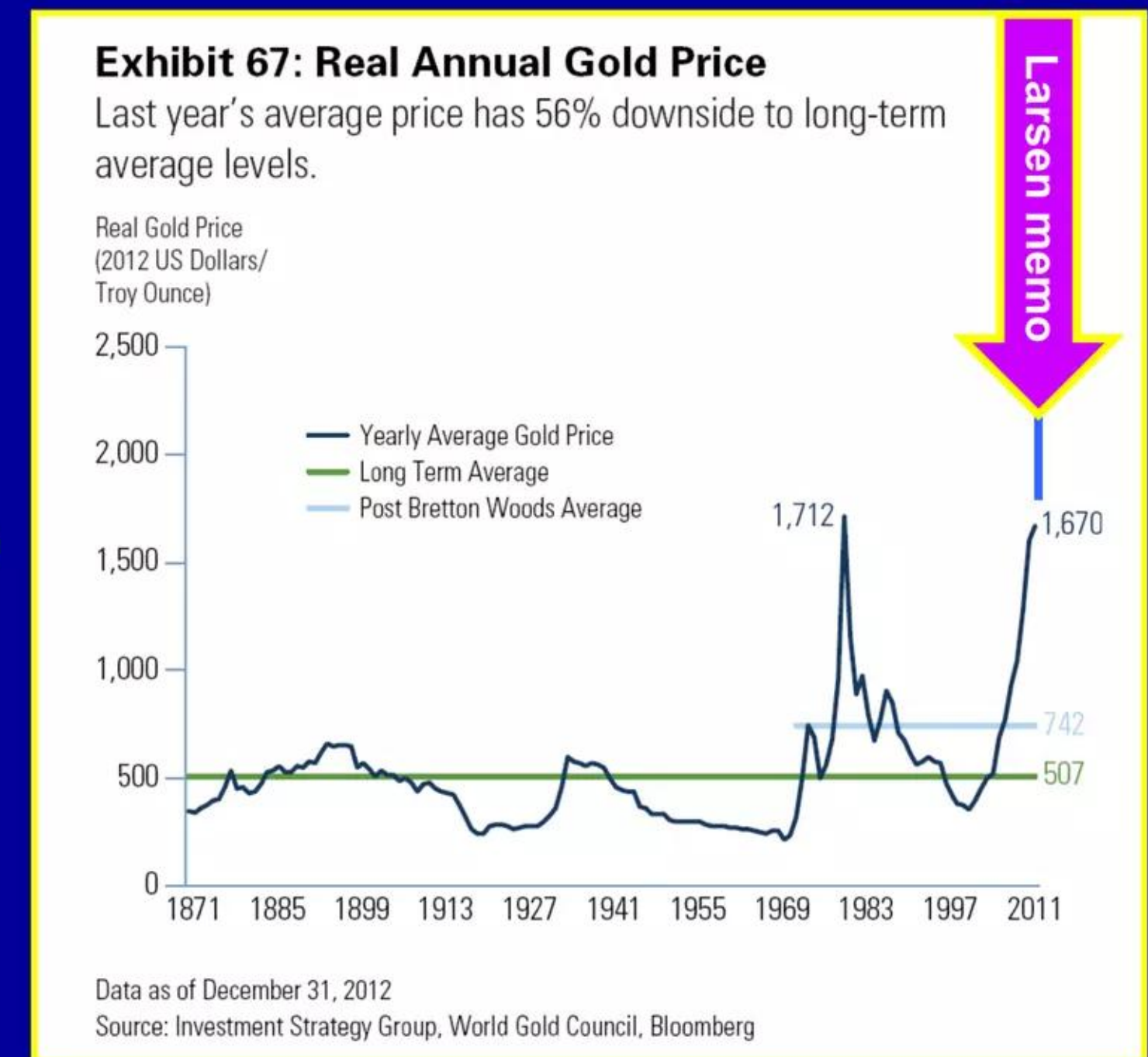
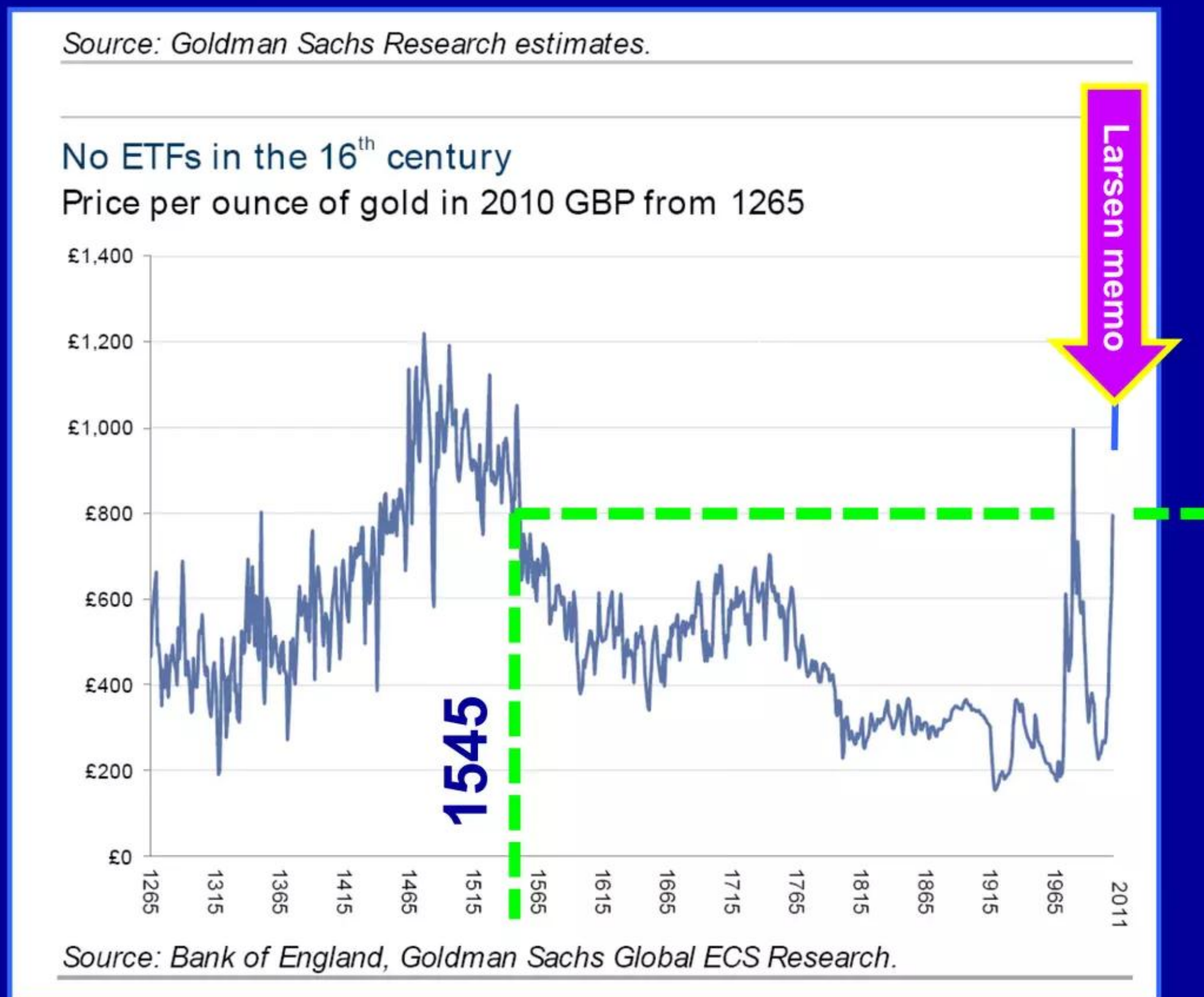
- ✓ Extreme random market volatility at that time indicated that market participants were very unsure of direction of stock and gold prices; extremely worried about US and Euro economies at that time; **then, Chinese and Indian economies were still growing strongly and essentially booming compared to struggling GDPs in US and Europe**
- ✓ Barring a global depression as a result of catastrophic monetary policy/stimulus errors by the US and EU gov't officials, and **given that the previous multi-decadal uptrend in stock indices was still technically intact (and assuming that we are in fact living in a Fischer period of equilibrium), it was therefore highly likely that stock prices would increase further as the global economic mess slowly sorted itself out over the next 1 - 2 years going forward**
- ✓ **On the gold side in August 2011, the macroeconomic situation was very different: long- and short-term interest rates were at historically low levels and inflation rates in the US and Europe were also very low. In terms of market psychology, the wild card catastrophic risk scenario was widely perceived to be a global depression with massive unemployment, not a run away hyperinflation in physical commodity prices. This situation was diametrically opposite to the macroeconomic matrix that drove the gold price to record highs in 1979 - 80. This all suggested that the run-up in gold from 2008 - 2011 was most likely caused by transient factors on the demand side, namely purchases of physical gold by prosperous Chinese and Indians (presently ~61% of total demand) who had funds to invest but were terrified of a global collapse in stock (equity) prices; gold was thus likely to be near a price peak**
- ✓ **Given all of the above, it was therefore probable that the DJIA/Gold ratio had reached a nadir in August 2011**

History, macroeconomics, LENRs, and the price of gold

Gold's recent price decline vs. equities was expected

Gold real price peak in Aug 2011 not high as 1979-80; but ~same price as in 1545

Peaks in 1979-80 coincided with zenith of Great Wave of inflation; this was not true in 2011



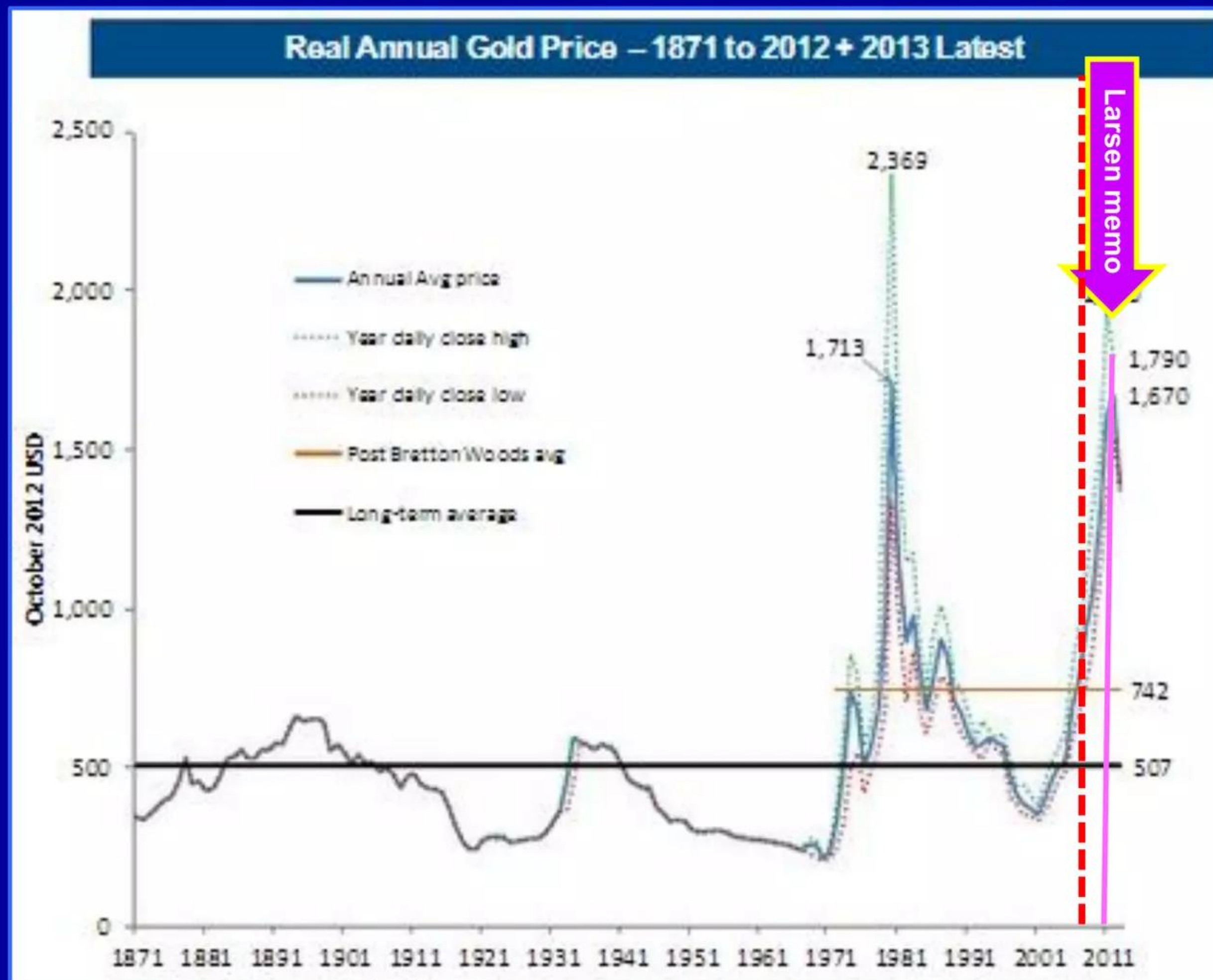
Source: Goldman Sachs: "Outlook – Over the Horizon"
(January 2013)

Source: Goldman Sachs Equity Research: "The best of fortnightly thoughts
– 100 charts that matter the most" (December 15, 2011)

History, macroeconomics, LENRs, and the price of gold

Gold's recent price decline vs. equities was expected

Real annual gold price peak in 2011 nearly equaled the peak hit back in 1979-80



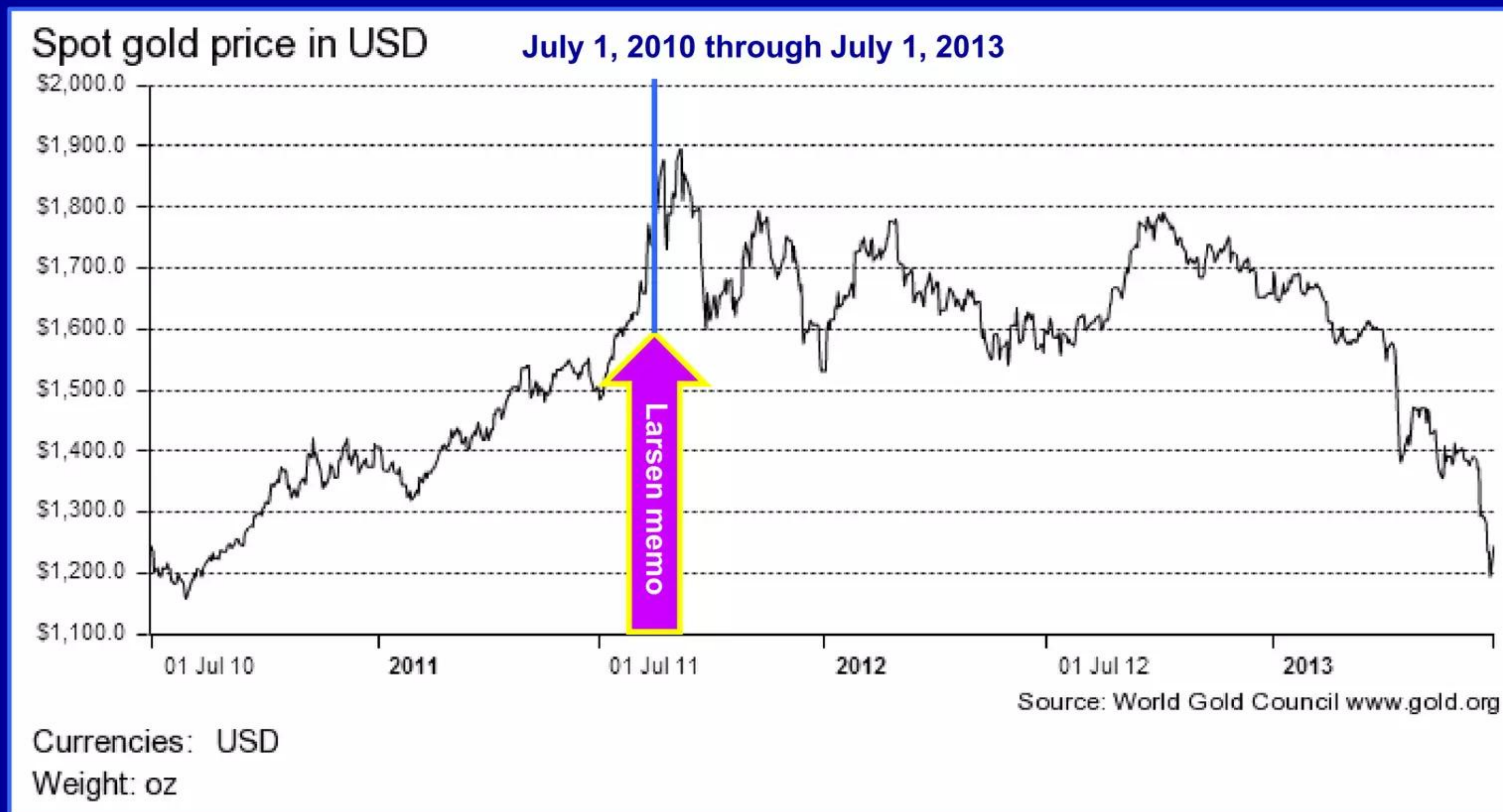
History, macroeconomics, LENRs, and the price of gold

Gold's recent price decline vs. equities was expected

Spot gold nominal price finally peaked at nearly USD\$ 1,900/oz. shortly thereafter

Spot gold nominal price on August 10, 2011 date of memo was USD\$ 1,760/oz.

August 10, 2011: Larsen memo suggested that DJIA/Gold ratio had likely bottomed-out

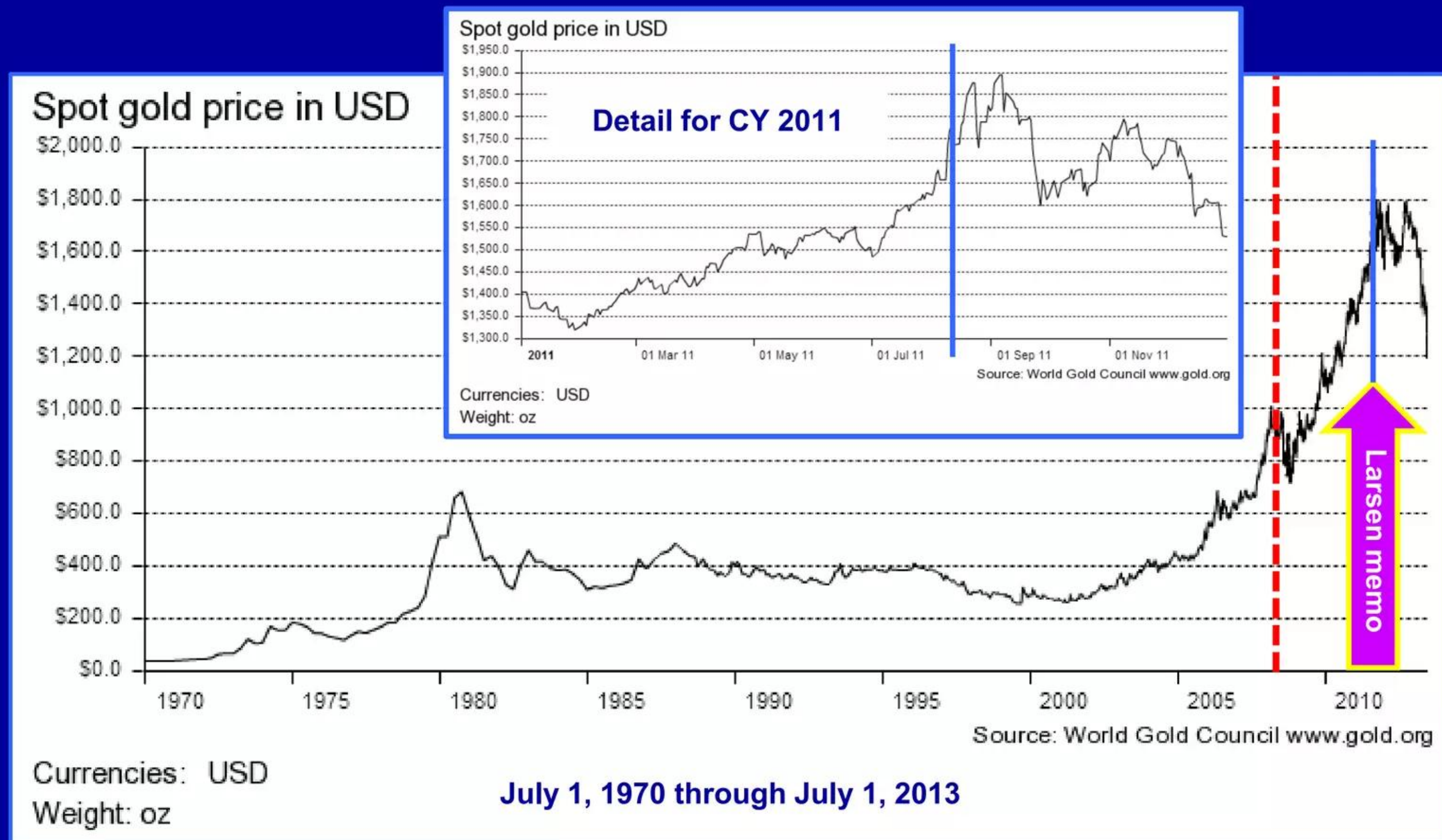


History, macroeconomics, LENRs, and the price of gold

Gold's recent price decline vs. equities was expected

August 10, 2011: Larsen memo just prior to recent peaks in nominal gold price

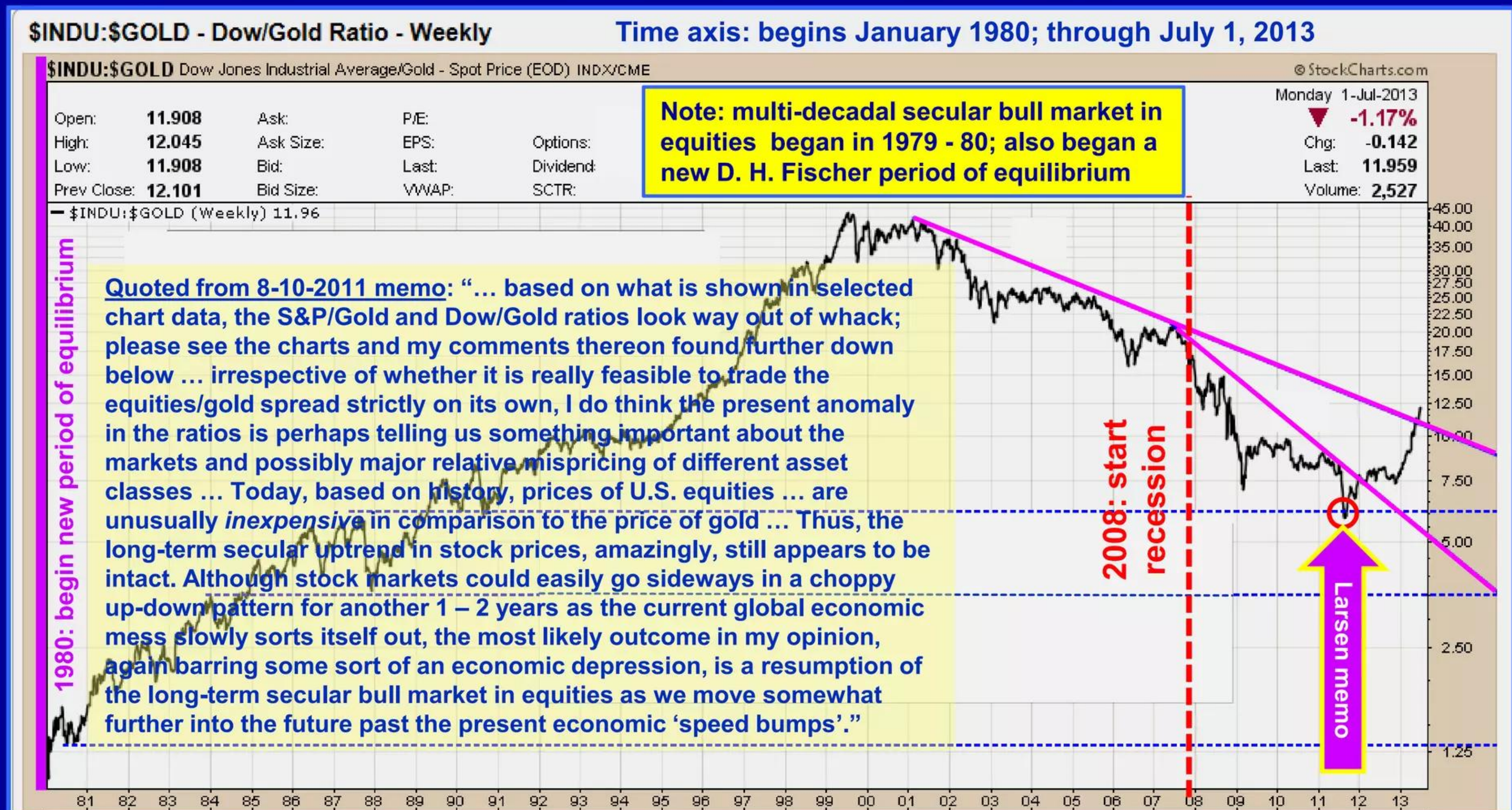
Spot gold's nominal price on August 10, 2011 date of the memo was USD\$ 1,760/oz.



History, macroeconomics, LENRs, and the price of gold

Gold's recent price decline vs. equities was expected

Intermediate nadir in DJIA/Gold ratio occurred back in August 2011



Source: stockcharts.com

History, macroeconomics, LENRs, and the price of gold

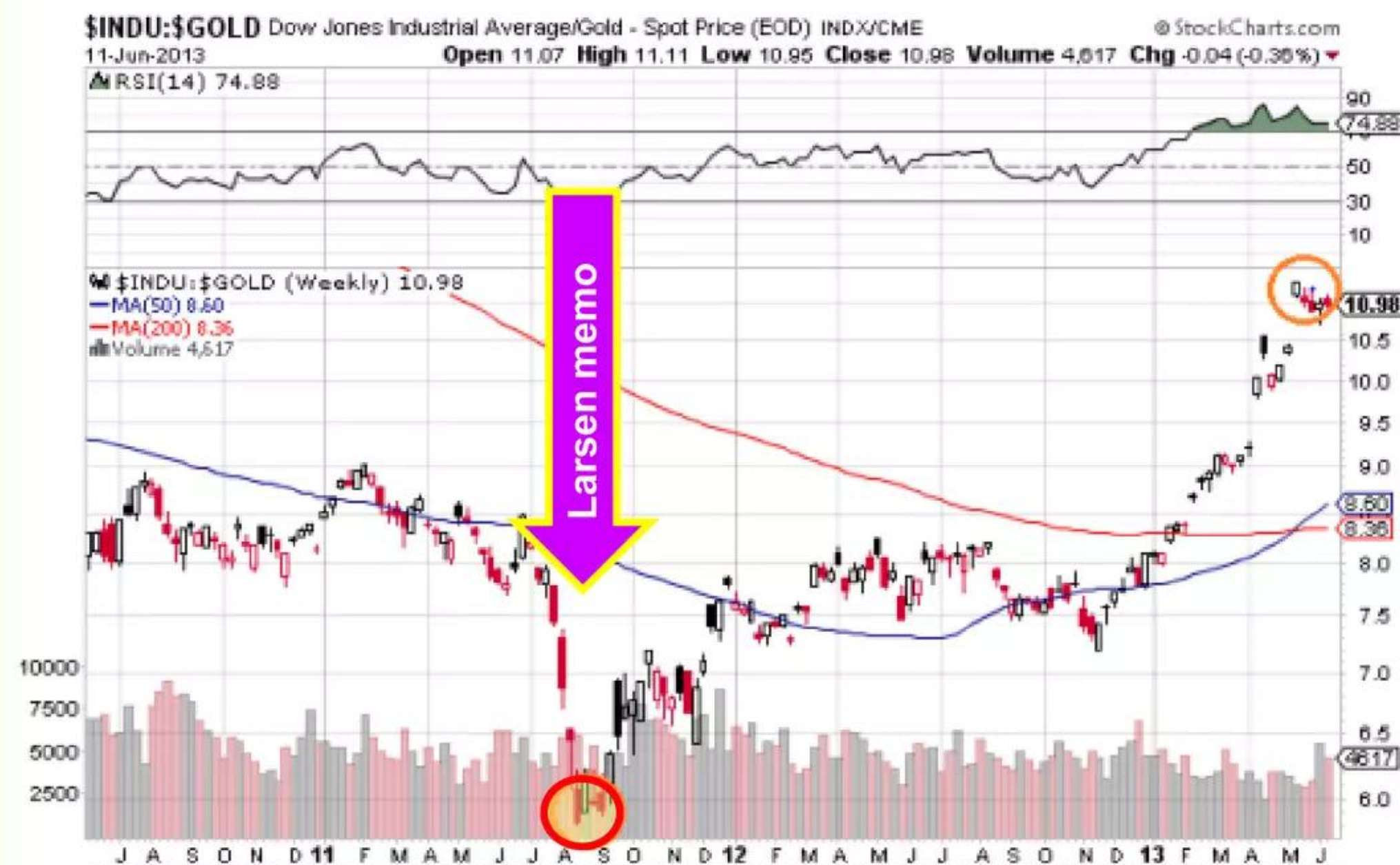
Gold's recent price decline vs. equities was expected

Intermediate nadir in DJIA/Gold ratio occurred back in August 2011

Finer details of recent action shown here - source: John Hampson's SOLARCYCLES

Dow-Gold Ratio Time axis: begins June 2010; through June 11, 2013

The opposing trends in the Dow and gold over the last 2 years have doubled the Dow-gold ratio from its 2011 low to around 11 today:



Source: <http://solarcycles.net/2013/06/12/dow-gold-ratio/>

History, macroeconomics, LENRs, and the price of gold

Slowdown in population growth rates and gold demand

“The world’s seemingly relentless march toward overpopulation achieved a notable milestone in 2012: Somewhere on the planet, according to U.S. Census Bureau estimates, the 7 billionth living person came into existence ... A somewhat more arcane milestone, meanwhile, generated no media coverage at all ... the rate of global population growth has slowed. And it’s expected to keep slowing.”



“Indeed, according to experts’ best estimates, the total population of Earth will stop growing within the lifespan of people alive today ... The way things are going, Western Europe as a whole will most likely shrink from 460 million to just 350 million by the end of the century. That’s not so bad compared with Russia and China, each of whose populations could fall by half ... According to a 2008 IIASA report, if the world stabilizes at a total fertility rate of 1.5 --- where Europe is today --- then by 2200 the global population will fall to half of what it is today. By 2300, it’ll barely scratch 1 billion.”

Jeff Wise “About that overpopulation problem” Slate, January 9, 2013

http://www.slate.com/articles/technology/future_tense/2013/01/world_population_may_actually_start_declining_not_exploding.single.html

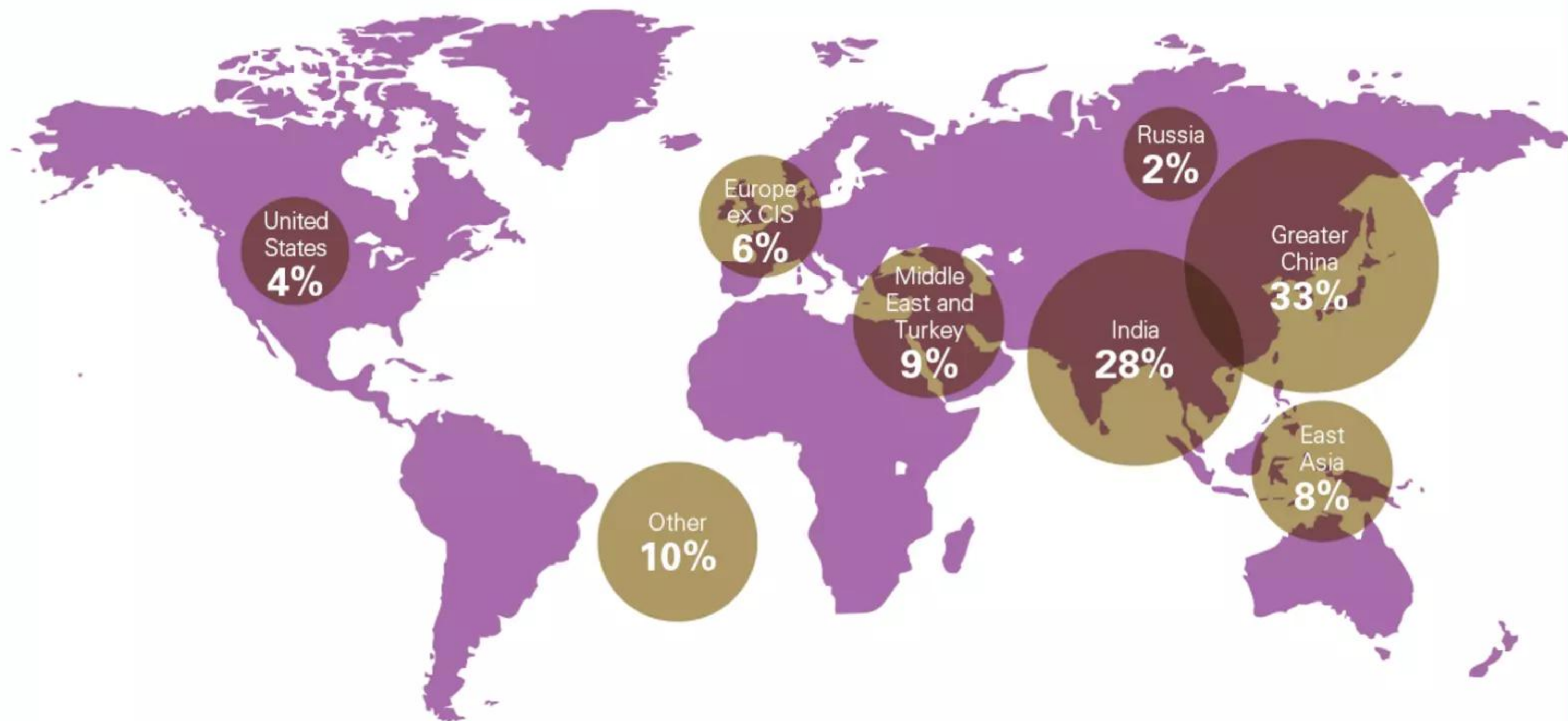
History, macroeconomics, LENRs, and the price of gold

Slowdown in population growth rates and gold demand

China and India presently comprise ~39% of the global human population

Q1 in 2013: China and India together accounted for 61% of world physical gold demand

Chart 2: Percentage share of total physical demand by region in Q1'13



Note: Middle East and Turkey comprises; Saudi Arabia, Egypt, UAE, Other Gulf and Turkey. East Asia comprises; Indonesia, South Korea, Thailand and Vietnam.

Source: Thomson Reuters GFMS, World Gold Council

History, macroeconomics, LENRs, and the price of gold

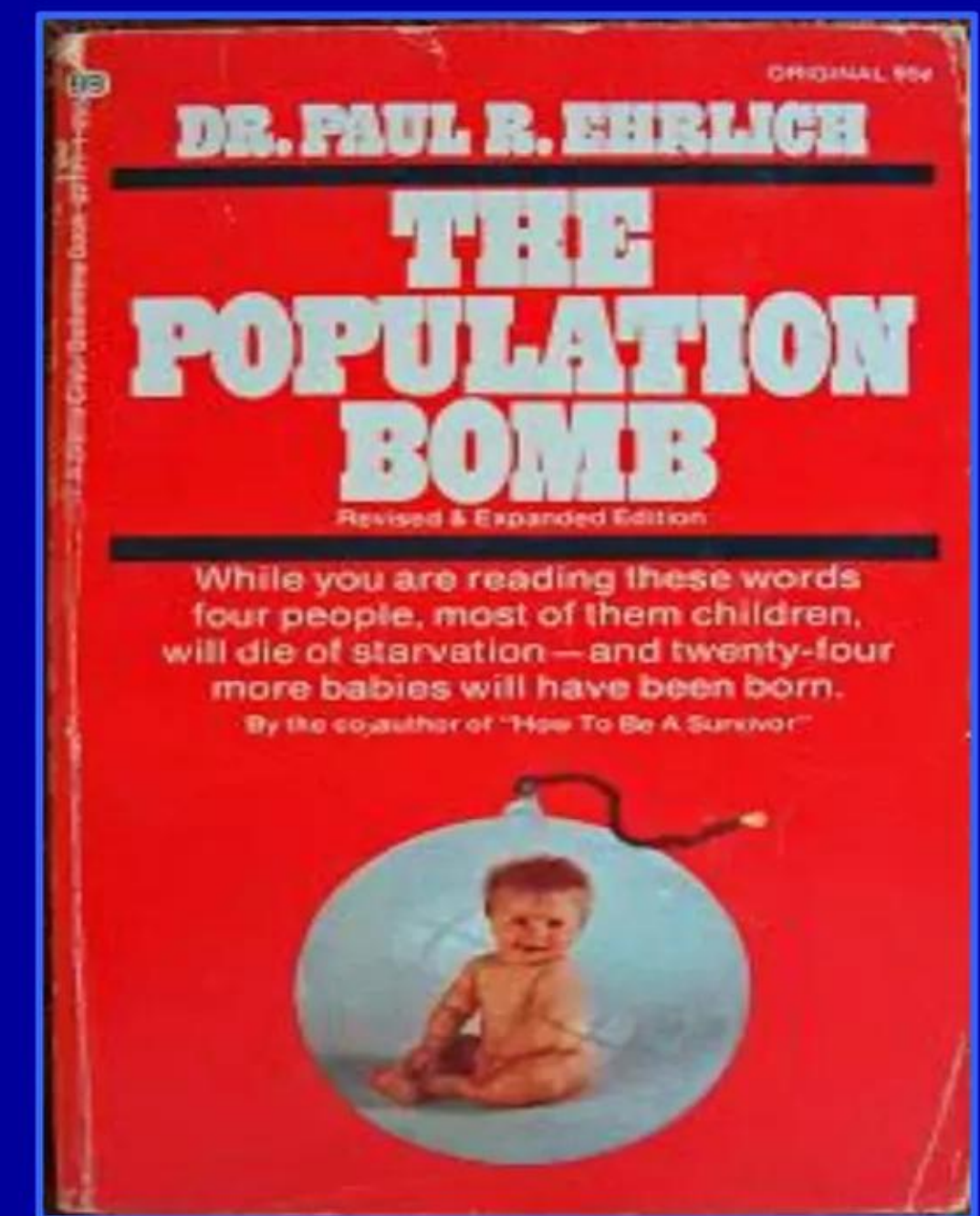
Slowdown in population growth rates and gold demand

Slowing expansion of Chinese and Indian populations is a negative for gold

Note: on Slide #6 herein, for more details please see two Lattice documents concerning rapid deceleration in population growth rates that are dated August 29, 2011, and April 24, 2012

- ✓ According to World Gold Council, as of Q1 2013 greater China and India together account for ~61% of total world physical gold demand; comprise ~39% of world's population
- ✓ As revealed in recently published population statistics, rates of population growth have dramatically slowed in both China and India (and most of the rest of the world, for that matter)
- ✓ Report recently released by OECD, stated that economies in many nations in Africa (which has a total population of 1 billion) are experiencing good rates of real GDP growth for the first time in a half-century; per demographic transition theory, this suggests birth rates will also drop fast in Africa
http://www.oecd-ilibrary.org/development/african-economic-outlook-2013_aeo-2013-en
- ✓ If global equity markets perform well in near-future as world economy finally extricates itself from flirting-with-depression era of 2008 - 2012, and all other things being equal, reduced population growth rates will tend to favor equities vs. gold

Much-feared “population bomb” of 1970s-era activists has fizzled



Paul Erlich, “The population bomb”
Sierra Club/Ballantine Books (1968)

History, macroeconomics, LENRs, and the price of gold

Advances in technology and the future supply of gold



**“Tight-lipped, guided by reasons only,
cautiously let us step into
the era of the unchained fire.”**

Czeslaw Milosz, poem “Child of Europe,” New York (1946)

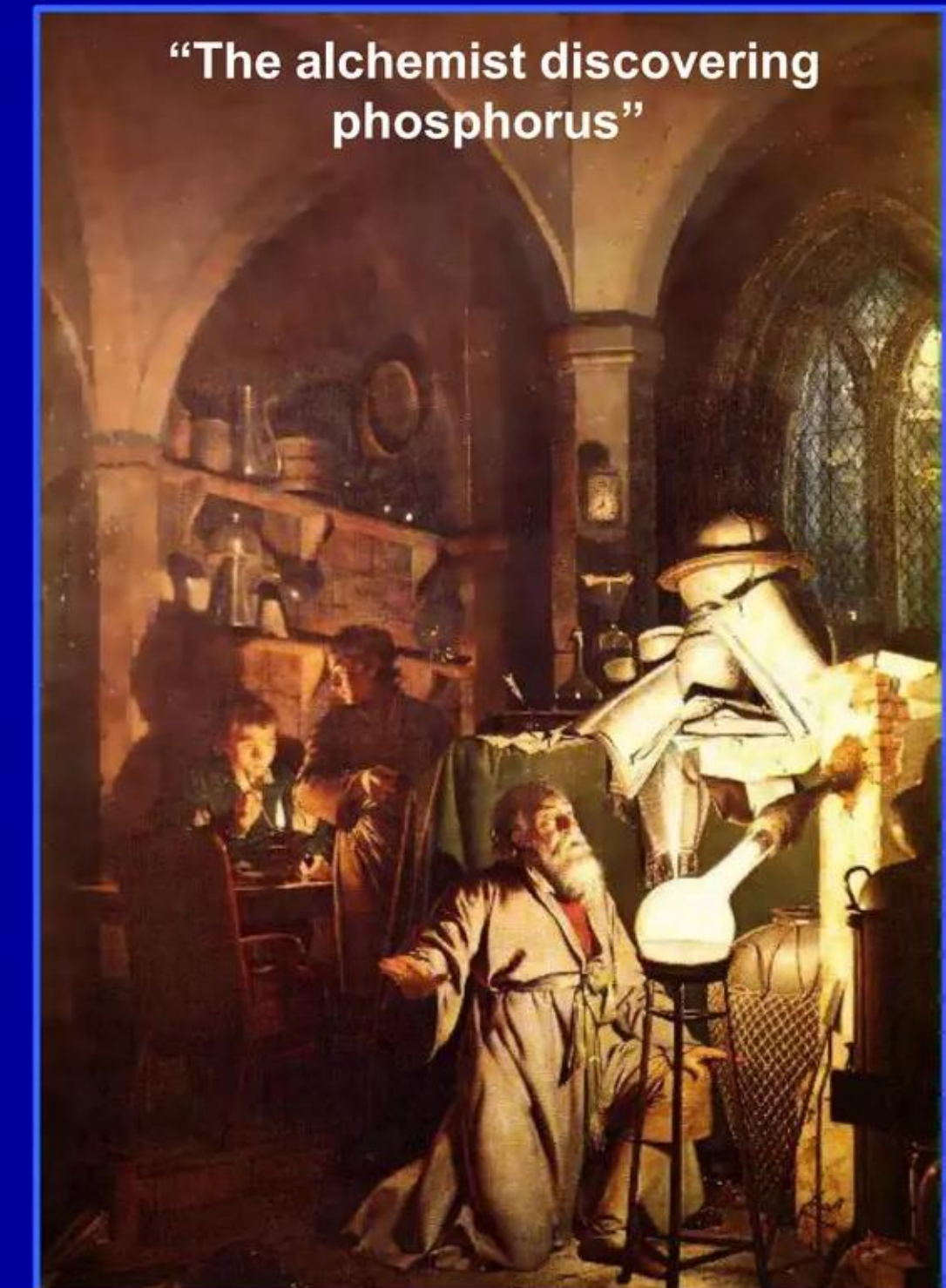
History, macroeconomics, LENRs, and the price of gold

Advances in technology and the future supply of gold

Modern alchemy creates small amounts of gold in laboratory-scale experiments

Note: on Slide #5 herein please see two Lattice documents concerning abiological and biological production of gold with LENRs that are dated May 19, 2012, and December 7, 2012

- ✓ Third-party data has been published which strongly suggests that $W \rightarrow Au$ (LENR transmutation of tungsten into gold) precious metals production by the Widom-Larsen mechanism has been observed in different laboratory experiments that go all the way back to the 1920s (Nagaoka *et al.*, *Nature* 1924)
- ✓ Based on published data, it appears that natural $W \rightarrow Au$ LENR transmutations may occur out in Nature abiotically and perhaps even biologically with certain species of extremophile bacteria
- ✓ Speculative analysis of the potential economics of future $W \rightarrow Au$ transmutation factories for production of precious metals such as Gold and Platinum suggests that, if present relative price relationship of Tungsten vs. Gold and Platinum continued into the future, conversion of Tungsten into precious metals has potential to become a highly profitable business. **If such processes could be scaled-up volume-wise and production costs reduced further by riding the “experience curve,” LENRs might compete with conventional mining within <10 - 15 years**



Artist: Joseph Wright of Derby, England
(1734 - 1797)

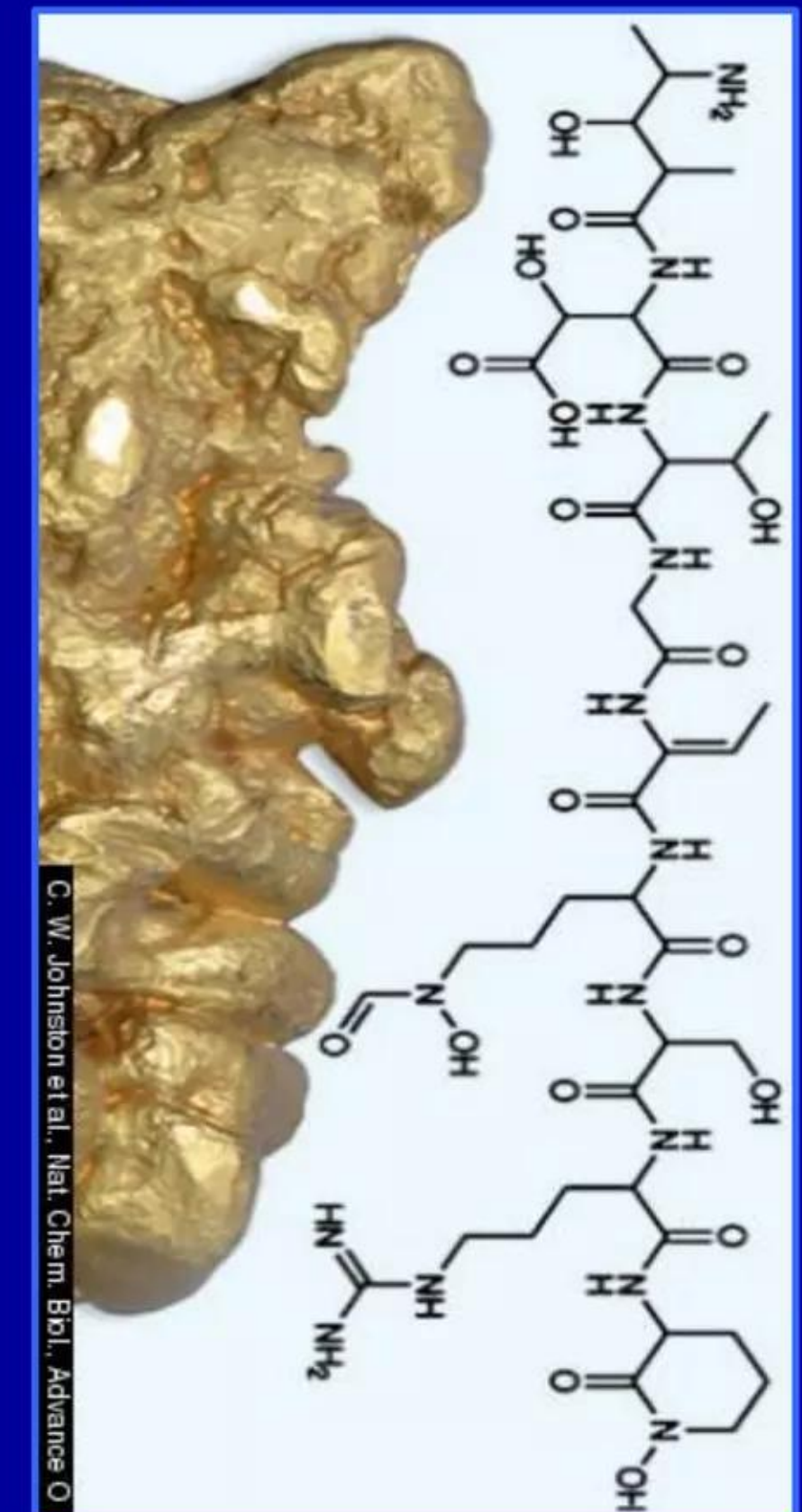
History, macroeconomics, LENRs, and the price of gold

Advances in technology and the future supply of gold

Also possible that certain bacteria can produce gold from tungsten via LENRs

- ✓ **Recap:** Widom-Larsen theory of LENRs predicts that Gold can be created via a nucleosynthetic transmutation process that involves $e + p$ electroweak neutron production followed by captures of ultra low momentum (ULM) neutrons on stable isotopes of **Tungsten (W)**
- ✓ This theoretical prediction has been effectively confirmed in data from at least three sets of published laboratory experiments that differ significantly in experimental techniques but nonetheless involve exactly the same underlying Widom-Larsen nucleosynthetic process and LENR network pathway: **W** → **Re** → **Os** → **Ir** → **Pt** → **Au**
- ✓ These measured data provide effectively comparable experimental confirmations of our theoretical prediction that are separated in time by as much as ~88 years; namely, Nagaoka *et al.* (Japan, 1925); Cirillo *et al.* (Italy, circa 2004), and just recently at the American Nuclear Society 2012 Winter Meeting session on LENRs in San Diego, CA, Yasuhiro Iwamura *et al.* (Mitsubishi Heavy Industries, Japan, 2012) --- **all these experiments are consistent with W-L theory**
- ✓ Quoting directly from *New Energy Times* subscriber-only content concerning 2012 Winter ANS meeting, “A member of the audience asked Iwamura whether other Japanese companies besides Toyota and Mitsubishi are working on LENR. Iwamura said yes but they were not disclosing it.” **These companies are serious LENR players**

Bacteria can precipitate gold nuggets from toxic solutions



C. Johnston *et al.*, “Nature Chemical Biology” 9 pp. 241 - 243 (2013)

History, macroeconomics, LENRs, and the price of gold

Price of gold and precious metals vs. other asset classes over next 5 - 15 years



**“In truth, the gold standard is already a
barbarous relic.”**

**John Maynard Keynes
“Monetary Reform” pp. 172 (1924)**

History, macroeconomics, LENRs, and the price of gold

Price of gold and precious metals vs. other asset classes over next 5 - 15 years

Stock indexes likely to significantly outperform gold during near-future

- ✓ Retrospectively, DJIA/Gold ratio appears to have made an intermediate low back in August 2011; this nadir could end-up being unchallenged for a considerable time period - decades?
- ✓ If our speculative hypothesis that gold's torrid price run-up from 2008 - 2011 involved transient demand factors proves to be correct, and if we are living in a Fischer period of equilibrium, this ratio still has substantial upside potential over the next 5 - 15 years
- ✓ Independent of the gold price, the multi-decadal uptrend in real DJIA and S&P 500 indices appears to be intact; the US economy is finally crawling out of its near-depression and poised for reasonable rates of growth over the next 5+ years. If this scenario is realized, the secular bull market uptrend in stock prices (equities) will return with a vengeance, first in the US with Europe and many other countries' stock markets following thereafter. The last such run went from ~1980 to 2000 (20 years); thus it is possible that the next leg in the uptrend in equities could go from 2013 - 2033, which would still fall well-within the boundaries of the present Fischer period of equilibrium (which could potentially extend out to at least 2065)
- ✓ Ongoing explosion in new technologies and products continues to accelerate, as evidenced by vast volumes of patent filings; e.g., nanotechnology, robotics, amongst a huge multitude
- ✓ In the case of the price of gold, a period of equilibrium is not characterized by high rates of inflation and hyperinflations in fiat currencies of major countries. Furthermore, if LENRs are commercialized in the near-future (which is likely), manmade gold could represent a new source of supply. On the demand side, worldwide deceleration in rates of population growth, especially in China and India, are a negative factor. In such an environment, it's difficult to construct a bullish supply/demand scenario for gold. **Consequently, real price of gold likely to substantially underperform real appreciation in equities during most of next 5 - 15 years**



Natural Gold crystals
Eagle's Nest mine, Placer Co., CA, USA

History, macroeconomics, LENRs, and the price of gold

Working with Lattice



“Energy, broadly defined, has become the most important geostrategic and geoeconomic challenge of our time.”

Thomas Friedman
New York Times, April 28, 2006

History, macroeconomics, LENRs, and the price of gold

Working with Lattice

We are commercializing LENRs; also consult to advance LENR technology

1-312-861-0115 lewisglarsen@gmail.com

- ✓ Lattice welcomes inquiries from large, established organizations that have an interest in seriously discussing the possibility of becoming a strategic capital and/or technology development partner in the near- or long-term time frames
- ✓ To augment working capital and promote further development of LENR technology, Lattice also selectively engages in some fee-based third-party consulting. This work covers various topics in the context of micron-scale, many-body collective quantum effects in condensed matter systems (including photosynthesis), field failures involved in Li-ion battery thermal runaways, nuclear waste remediation, and ultra-high-temperature superconductors, among others. **Additional areas of expertise include long-term strategic implications of LENRs on high cap-ex investments in power generation and petroleum-related assets, as well as long-term price outlooks for precious metals and crude oil.** We consult on any of these subjects as long as it does not involve disclosing proprietary engineering details applicable to Lattice's planned LENR power generation systems. Consulting is subservient to company's main goal: commercializing LENRs for applications in ultra-high energy density portable, mobile, and stationary power generation systems
- ✓ Larsen c.v.: <http://www.slideshare.net/lewisglarsen/lewis-g-larsen-cv-june-2013>



Natural Gold crystals
Eagle's Nest mine, Placer Co., CA, USA

History, macroeconomics, LENRs, and the price of gold

Parting thoughts and images



**“To see the world in a grain of sand,
And heaven in a wild flower;
Hold infinity in the palm of your hand,
And eternity in a hour.”**

William Blake, “Auguries of Innocence” 1789

With thanks to Ernest Sternglass (1997)

"Stairway To Heaven"

Lyrics by Led Zeppelin, released November 8, 1971

"There's a lady who's sure, all that glitters is gold
And she's buying a stairway to heaven.
When she gets there she knows, if the stores are all closed
With a word she can get what she came for.
Ooh, ooh, and she's buying a stairway to heaven.

There's a sign on the wall, but she wants to be sure
'Cause you know sometimes words have two meanings.
In a tree by the brook, there's a songbird who sings,
Sometimes all of our thoughts are misleading.
Ooh, it makes me wonder,
It makes me wonder.

There's a feeling I get when I look to the west,
And my spirit is crying for leaving.
In my thoughts I have seen, rings of smoke through the trees,
And the voices of those who stand looking.
Ooh, it makes me wonder,
Really makes me wonder.

And it's whispered that soon, if we all call the tune
Then the piper will lead us to reason.
And a new day will dawn, for those who stand long
And the forests will echo with laughter.

If there's a bustle in your hedgerow, don't be alarmed now,
It's just a spring clean for the May queen.
Yes, there are two paths you can go by, but in the long run
There's still time to change the road you're on.
And it makes me wonder.

Your head is humming and it won't go, in case you don't know,
The piper's calling you to join him,
Dear lady, can you hear the wind blow, and did you know
Your stairway lies on the whispering wind.

And as we wind on down the road
Our shadows taller than our soul.
There walks a lady we all know
Who shines white light and wants to show
How everything still turns to gold.
And if you listen very hard
The tune will come to you at last.
When all is one and one is all
To be a rock and not to roll.

And she's buying a stairway ... to heaven."

<http://www.youtube.com/watch?v=w9TGj2jrJk8>

History, macroeconomics, LENRs, and the price of gold

**“In a revolution, as in a novel,
the most difficult part to invent
is the end.”**

Alexis de Tocqueville (1840)



Beautiful gold (Au) crystals grown via chemical
transport reaction in chlorine gas; purity >99.99%

Source: Wikipedia