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The double bubble at the turn of the century: technological roots and structural implications

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This paper argues that the two boom and bust episodes of the turn of the century—the internet mania and crash of the 1990s and the easy liquidity boom and bust of the 2000s—are two distinct components of a single structural phenomenon. They are essentially the equivalent of 1929 developed in two stages, one centred on technological innovation, the other on financial innovation. Hence, the frequent references to that crash, to the 1930s and to Bretton Woods, are not simple journalistic metaphors for interpreting the 'credit crunch' and its solution, but rather the intuitive recognition of a fundamental similarity between those events and the current ones. The paper holds that such major boom and bust episodes are endogenous to the way in which the market economy evolves and assimilates successive technological revolutions. It will discuss why it occurred in two bubbles on this occasion; it examines the differences and continuities between the two episodes and presents an interpretation of their nature and consequences.

Key words: Technological revolutions, Major technology bubbles, Financial crises, Financial innovation, Financial regulation
JEL classifications: G01, O33, N20

1. Introduction

The economic literature seems to pay less attention to financial bubbles than would be warranted by their profound effect on economic growth both during the boom and after the bust. There tends to be an implicit agreement that they are a derailment of the market mechanism due to external causes. In fact, the Austrian and Chicago schools, but also most neoclassical economists, tend to lay the blame on government, be it monetary policy or distorting regulation (Hayek, 1933 [1939]; von Mises, 1949 [1998]). The rational expectations school is more inclined to see such events as the intelligent work of the invisible hand, as seen in the literature on *rational bubbles* (Blanchard and Watson, 1982; Diba and Grossman, 1988). By contrast, J. K. Galbraith saw them as a recurring loop of

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delusion built-up by the market mechanism, but as fundamentally *irrational* and due to mass euphoria, herd behaviour and greed (Galbraith 1990 [1994]). It was Minsky—following Keynes, and in turn followed by Kindleberger—who saw financial crises as a natural consequence of the way debt markets work and advanced the financial instability hypothesis (Keynes, 1936; Kindleberger, 1978 [1996]; Minsky, 1982).

This paper proposes to distinguish *major technology bubbles* (MTBs) as a special class of bubbles that constitute a recurring endogenous phenomenon, caused by the way the market economy absorbs successive technological revolutions.[1] They are different both in nature and consequence from the bubbles induced by excess liquidity from whatever source and from the Ponzi finance moments identified by Minsky. They are the result of *opportunity pull* rather than of *easy credit push*. But they are indeed bubbles. They are moments of Galbraithian irrationality, but, at least in terms of prefiguring the future value of some of the stocks involved, they also contain an element of rationality (see Pastor and Veronesi, 2004 [2006], 2005).

History has given us the ideal laboratory: an MTB—the 1997–2000 internet mania—followed by the *easy liquidity bubble* (ELB) of 2004–07. The fact that they took place in rapid succession provides us with clearly comparable and compatible data. Yet it also suggests that they are strongly connected and interrelated.

This paper will argue that the two bubbles of the turn of the century are two stages of the same phenomenon. Section 2 discusses the endogenous nature and consequences of MTBs. Section 3 analyses the reasons for the ELB to have followed in the wake of the NASDAQ collapse. In Sections 4 and 5 the two bubbles will be contrasted and compared, distinguishing their differences and similarities. Finally, there is a brief summary of the argument and its implications in terms of policy challenges.

2. Major technology bubbles as endogenous phenomena

An MTB is not an accidental event. It regularly occurs midway along the process of assimilation of each technological revolution. It is the paroxystic culmination of 20 or 30 years of market experimentation, centred on new breakthrough technologies and spurred by the extraordinary profits produced by them.

The main objects of speculation are the companies engaged in those technologies. But, as in any other bubble, asset inflation takes off when the actors in the financial markets clearly switch from seeking dividends to pursuing capital gains, which results in the paper economy decoupling from the real one.

The ensuing collapse not only results in the return to more sensible real values and a reconnection with the real economy; it also signals the end of a period when financial capital is in control of investment to a period in which control passes over to production capital.

These long-term pendular swings are as much in the nature of the market economy as the fact that economic growth, as Schumpeter held, is driven by technical change. Each technological revolution drives a *Great Surge of Development*,[2] which takes more than half

[1] For a complete development of this interpretation see Perez (2002 [2003]). A condensed version is in Perez (2007).

[2] The author introduced this term (Perez, 2002 [2003], pp. 20–1 and ch. 6) to make a clear break with the notion of Kondratiev 'long waves', which expects long-term upswings and downswings in economic growth. A great surge of development, by contrast, represents the process of propagation of a technological revolution across the economy and society. The regularities observed in these surges cannot be reduced to behaviours of aggregate economic variables.

a century to yield its full potential in terms of growth, productivity increases, product range, geographic spread and social benefits. The process follows a basic stable sequence: irruption of the revolution, two or three decades of a turbulent *installation period* ending in a major bubble collapse, then a recomposition of the socio-institutional framework that regulates finance and sets the conditions for the final *deployment period*, a time of more organic growth that lasts until maturity and exhaustion are reached, setting the stage for the irruption of the next technological revolution (Perez, 2002 [2003], 2007).

Table 1 lists the five surges and the corresponding manias. The first column indicates the year of the big bang innovation that embodies the transformation to come (Intel's microprocessor, Ford's model-T, Carnegie's Bessemer steel mill, etc.), and the core country where (and from where) the technological revolution spreads with the greatest intensity. The second column lists the successive 'Ages' identified by the technologies that shape them. Columns 3 and 4 list the manias or bubbles that culminate the installation period and the year and country where the collapse takes place. Finally, column 5 lists the successive 'golden ages' of deployment that have characterised the second half of each surge.

This form of progress by successive surges and by technological revolutions rather than as continuous punctuated change has much more to do with the complexities of the social and economic assimilation of change than with the nature of technology itself (Freeman and Louçã, 2001; Freeman and Perez, 1988). It is because of human resistance to change and organisational inertia in existing institutions that the introduction and diffusion of the new technologies and their best practices has to be forced by ferocious competition and by the high profit pressures imposed by the stock market.

The technologies of each revolution take 50–60 years fully to deploy (and exhaust) their innovation and market potential. By the end, the behavioural patterns of both producers and consumers are adapted to that revolution and its best practice paradigm—one could even say 'over-adapted'—and resistance to change is very high. It is the high mobility of finance that will then enable the reallocation of available funds from the established and mature technologies and industries to the emerging ones. What ensues are two or three turbulent decades involving the dismantling of all obstacles posed by the—now inadequate—institutional framework, while fierce competition tests products and companies in the market with many failures along the way (Dosi and Lovallo, 1997). From the confrontation between them will emerge the novel leaders and the industries that will serve as engines of growth of the economy. At the same time, the experience in using the new technologies, especially the new infrastructures, will result in a different set of best practice principles for efficiency—a new *techno-economic paradigm*—applicable to all other industries and serving to overcome maturity and increase productivity across the whole economy through more efficient equipment, better organisational models and much wider market reach.

Throughout this early process of Schumpeterian creative destruction (Schumpeter 1911 [1962]), of fierce battles of the new against the old, there are enough huge successes to induce an atmosphere of excitement in the financial world. Technological innovation is swiftly followed by financial innovation. The world of finance itself is among the pioneers in adopting the new paradigm, especially in organisation, equipment, transport and communications. It rapidly invents, learns and diffuses new ways of providing venture capital, of attracting new investors and new capital to the market and of leveraging, handling, hedging and spreading risk.

Soon there is more capital wanting a piece of the action than projects looking for funds. Although further financial innovation widens the opportunities by creating new spaces and

Table 1. *Five great surges of growth and five major technology bubbles*

1. Big bang: year and core country	2. Great surge	3. Major technology bubbles(s) in installation	4. Collapse year and country	5. Deployment
1771 England	The 'Industrial Revolution' (mechanisation and water transport)	Canal mania	1793 England	Great British leap
1829 UK	The age of steam and iron railways	Railway mania	1847 Great Britain	Victorian boom
1875 UK, USA and Germany	The age of steel and heavy engineering (civil, chemical, electrical and naval). First globalisation	Multiple bubbles from build-up of world infrastructure for global trade in commodities (steel railways, steamships, ports, telegraph, etc.) financed mainly from the City of London	1890–93 Argentina (Baring crisis), Australia, etc.	Belle Époque (Europe) Progressive Era (USA)
1908 USA	The age of the automobile, oil and petrochemicals	Roaring twenties	1929 USA	Post World War II boom
1971 USA	The age of information and digital communications. Second Globalisation	Double bubble: internet mania followed by financial boom of the 2000s	2000 and 2007–08 USA	A sustainable global knowledge society boom?

instruments of speculation, the heart of the process is the confidence in the new technologies and their profit making potential. Their high visibility in general and that of the resounding successes and the resulting millionaires becomes a magnet to attract investment from all quarters. The illusion is that there are high profits to be had with very low risk. This misperception has an objective fact at the root: after years of experimentation technological uncertainty has been reduced to a minimum. The engineers and entrepreneurs that are bringing out the new products know well what is feasible and almost surely achieve what they propose. The canal makers could confidently project the connection between any two rivers, even crossing over one if necessary, just as today's software developers know the universe of services they can design and provide. Such technological certainty is not necessarily matched by market success. Competition intensifies as diffusion advances and objective market uncertainty is likely to increase, but the faith in the miracle of technology—strengthened by the growing capital gains in the stock market—creates an atmosphere of 'irrational exuberance'. Those are the conditions that lead to the MTB, often preceded by several less intense boom and bust episodes.

The graphs depicted in Figure 1 illustrate three of the bursts of frenzy centred on the core technologies and infrastructures that characterise the major technology booms. The graphs do not represent the violent increase in stock market prices typical of such bubbles, but rather the number of ventures measured in terms of companies or miles approved or in launches in the stock market. After the fact it seems astonishing that people could believe that such extreme acceleration in the number of companies entering the race, counting on equally exaggerated growth in market value could be anything but a process of overinvestment and a bubble destined to collapse. Yet every time the notion of a 'new economy' seems to take hold, to spread and be held by serious people.[1] This is, in a sense, understandable because technological revolutions do revive the economy across the board (after years of stagnation) and give a sense of new power for modernising production and life as well as for fantastic profit making. In addition, they all seem to experience significant mini-booms, which are alarming at the time. However, since the recovery after these sorts

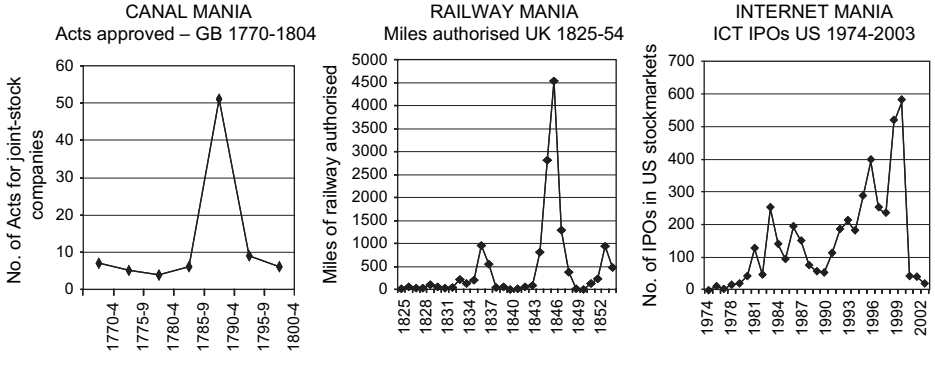


Fig. 1. *Three MTBs as paroxystic culmination of a long process of experimentation with new technologies and infrastructures.*
Source: *Canals from Ward (1974, p. 164), railways from Pollins (1971, pp. 28, 40) and Internet from Thomson One Banker*

[1] See the Report chaired by President Hoover (1929) for the 1920s, Alan Greenspan (cited by Cassidy, 2002, pp. 202–3) and others for the 1990s. Galbraith (1990 [1994]) sees this as characteristic of all bubbles.

of 'precursor bubbles' is relatively swift, the experience actually serves to strengthen confidence for when the real bubble builds up.[1]

The two defining characteristics of these MTBs are: (i) their concentration on the new technologies—especially the new infrastructural networks—and (ii) their decoupling from the real economy. The latter is typical of all bubbles; the former—in terms of a strong bias in investment—is what distinguishes an MTB from an ordinary excess liquidity one.

2.1 The concentration on the new technologies[2]

In 1847, at the peak of the major bubble of the second surge, it is estimated that UK investment in railways reached 7% of national income and nearly 55% of gross national fixed capital formation (Deane, 1968; Mitchell, 1964). In the installation years of the third surge, from the 1870s to the 1890s, between 30% and 50% of all British investment went overseas, in particular to Argentina, Australia, Canada and the USA. The proportion that went to transport and utilities in each of the main recipient countries was about 45% on average but in some cases surpassed 90% (Davis and Gallman, 2001).

In the current surge, venture capital alone (which is the modern institutionalised equivalent of 'friends and family' in earlier surges) amassed funds that grew to as much as 1% of US gross domestic product (GDP) at the peak of the boom. Of these, between 85% and 90% went to projects in information and telecommunications technologies (ICT) (Gompers and Lerner, 2004). Meanwhile, in the stock market the concentration on ICT was also clear. At the peak of the boom the technology stocks represented as much as 35% of total market capitalisation, and internet alone almost 10% (more than a quarter of all technology). It was a process of differential asset inflation.

The MTB of the late 1990s was, in fact, an over-valuation of new technology stocks above and beyond that of other stocks. Figure 2 shows the Dow Jones Technology index together with that of the Dow Jones Total US index (what used to be the Wilshire 5000, covering all stocks listed in the main US markets: NYSE, AMEX and NASDAQ). In the three years that led to the peak of the boom the rise of more than 60% of the whole stock market was indeed impressive. Yet, as shown in the graph, this is largely explained by the intense rise of the technology stocks (300% from 1997 to 2000). At the peak of the bubble, total market capitalisation approached US$15 trillion, while the technology stocks soared above US$5 trillion, or 35% of the total, up from 12% in 1997.

A similar relationship is found regarding market capitalisation in the 1920s bubble. In Figure 3, using 1920 as the base year, one can see that the total market in the New York Stock Exchange rose 75% including the high tech stocks, which were calculated by Eichengreen and Mitchener (2004) to have risen more than 200% until the crash of 1929.

Indeed, the confidence and concentration in the technology stocks during the boom is also shown in the volume of trading. Figure 4 indicates the difference in behaviour between the highly specialised NASDAQ, where the amounts traded quadrupled from 1998 to

[1] The early boom episodes in the installation of ICT peaked and collapsed in 1983 and 1987. There was also the Asian crisis of 1997 that, although it was of a different nature, also provided reassurance when overcome.

[2] The historical examples given will be those of the core country of each surge (see column 1 in Table 1). It is there that the MTB develops and where the collapse has the clearest effects. Thus, British data will be used for the first two surges and US data for the last two. The case of the third is more complex because the crises in London were about collapses of their investments in faraway markets. Yet this focus, while recognising these countries as pioneers in the technological revolutions discussed, does not deny that different experiences in other countries have stimulated technological advance, diffusion and catching-up.

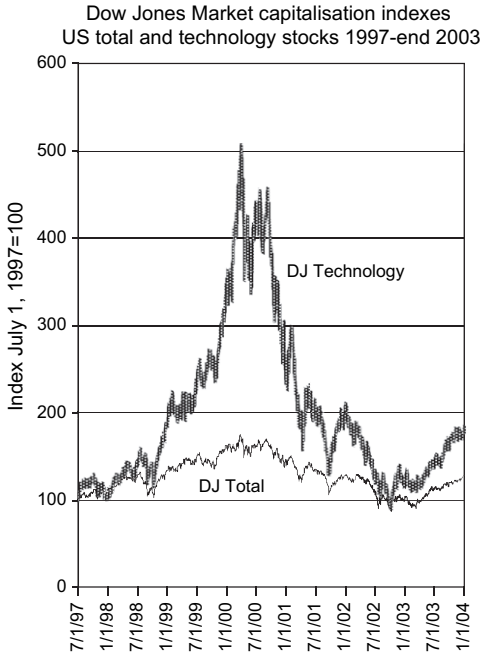


Fig. 2. *Major technology bubbles involve differential asset inflation biased to the 'high tech' stocks—the information technology bubble in the 1990s.*
Source: *Dow Jones.*

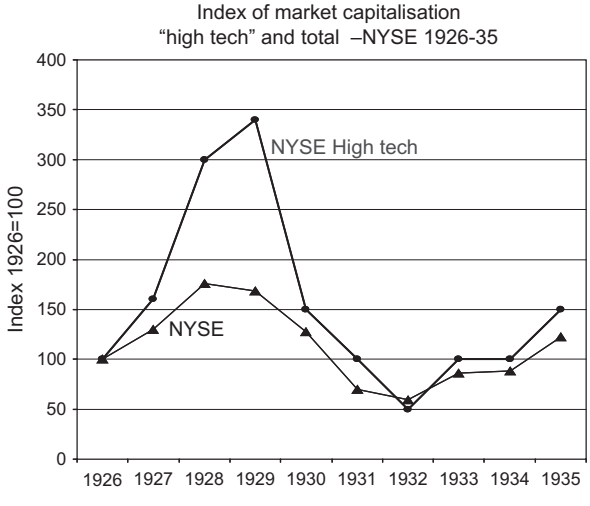


Fig. 3. *The mass production bubble in the 1920s was also concentrated on the high tech stocks.*
Source: *For "high tech", data extracted from Eichengreen and Mitchener (2004, fig 12, p. 217) and NYSE for the total.*

2000, and the more economy wide New York Stock Exchange (NYSE), where trading at the peak, though still with very significant growth, was only half as much.

The other sector that attracts intense investment during MTBs and that offers equally extraordinary profits and capital gains is the financial sector itself. ICT and finance

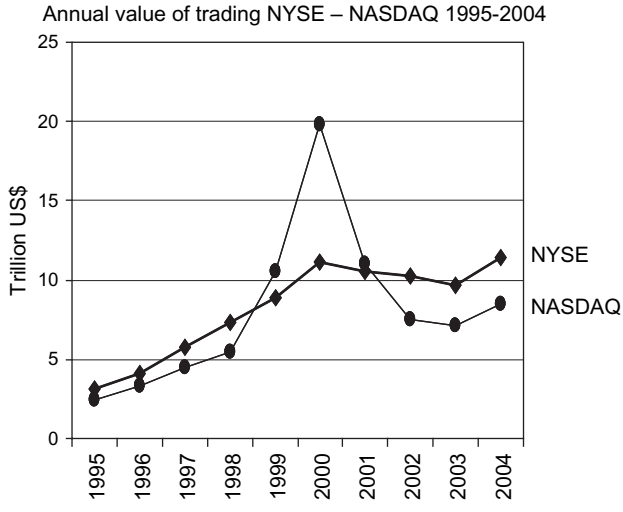


Fig. 4. *At the boom, the NASDAQ overtook the NYSE in volume of trading.* Source: *NYSE.*

together represented more than half the 'initial public offering's (IPOs) for most of the installation period of the current surge.[1]

2.2 Decoupling and switch to quick capital gains

The decoupling of the paper from the real economy during the MTB can be gauged by the price/earnings (P/E) ratios and by the relationship between market capitalisation and turnover.

The bubble takes root in the new technology stocks, but then disregards the "fundamentals" and uses these stocks as mere objects of price-change speculation (as tulips or gold or houses). When the price of the whole stock market surpasses forty times the previous decade's average earnings, as they did in the 1990s bubble (dividends being smaller or even non-existent), it is either an extraordinarily high estimate of future earnings (which could be true for only a few stocks) or the expectation of even higher prices bringing quick capital gains. Both are essential parts of feedback processes that inflate the bubble. Figure 5 shows the Shiller (2000 [2005] updated 2008) P/E ratio in the 1990s and in the 1920s. His measure is of inflation adjusted prices divided by the prior ten-year mean of inflation-adjusted earnings. Although both the peak value of the 44.7 in December 1999 and the low of 15 in 1990, are much higher than the peak of 32.6 in September 1929 and the low of five in the early 1920s, the similarity between the two bubbles is striking.

This excess confidence in the paper economy is much stronger when it involves the new technologies. Those sectors are the most likely contributors to the high ratios indicated in figure 5. For the 1990s bubble one can again have recourse to the difference between the more economy-wide NYSE and the mainly new tech NASDAQ. The increase in the P/E ratio was already significant in the case of the New York Stock Exchange–reaching almost 30 in 1999– but it went to absurd extremes in the case of NASDAQ, where average prices surpassed two hundred times earnings. See Figure 6.

Another way of looking at the decoupling between the stock market and the real economy is to compare the behaviour of profits in the real economy and that of values in the

[1] Thomson One Banker.

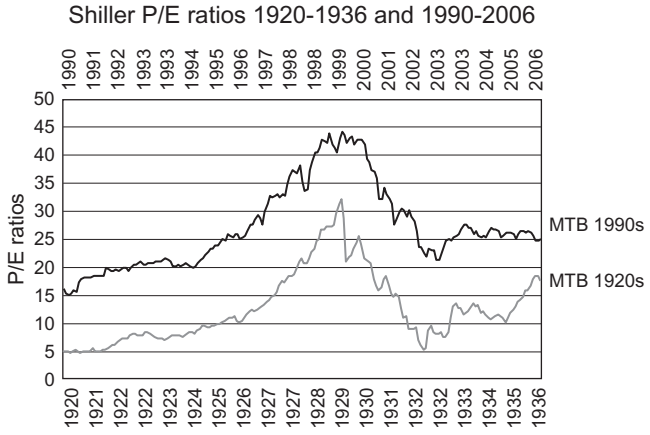


Fig. 5. *The abandonment of fundamentals: not earnings but capital gains.*
Source: *Data extracted from Shiller (2000 [2005]) fig 1.3, p.8) updated in http://www.econ.yale.edu/~shiller/data/ie_data.xls (downloaded August 2008).*

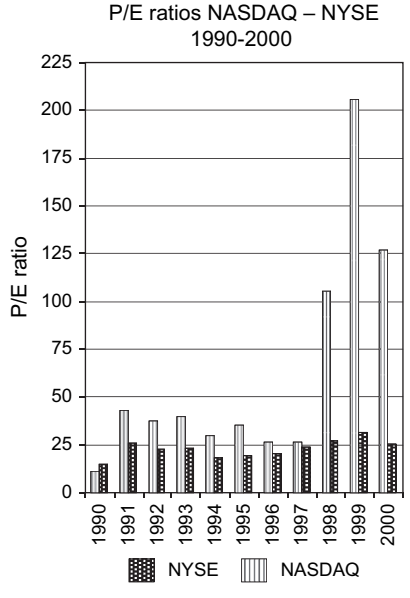


Fig. 6. *The abandonment of fundamentals is even more intense regarding the new technologies.*
Source: *World Federation of Exchanges, available at www.world-exchanges.org [date last accessed 3 March 2008].*

stock market. Between 1996 and 2000, profits in the real economy were basically flat. There is really very little correlation between the rapid increase in total market capitalisation of the US exchanges (DJW5000) and the behaviour of profits of the non-financial sector, as seen in Figure 7.

But neither dividends nor profits determine the flow of investment under MTB conditions. Asset inflation is so intense that, in modern capital markets, it makes sense for capital gains to be realised over and over again (or to use existing stocks as collateral for further leverage). Preference for liquid assets and quick operations accelerates the circulation

of money and increases the volume of trading. The annual turnover figure for the peak of the 1990s bubble was almost twice the value of the whole market (see Figure 8).

The underlying reality supporting such a high turnover figure is also strongly based on the 'general opinion' about the ICT sector. In Figure 9 we can again observe how the intensification of trade during the internet boom was strongly biased towards the shares of the technological revolution, with investors engaging in the purchase and resale of many of the same technology stocks (many of which were giving no dividends and yielding no profit).

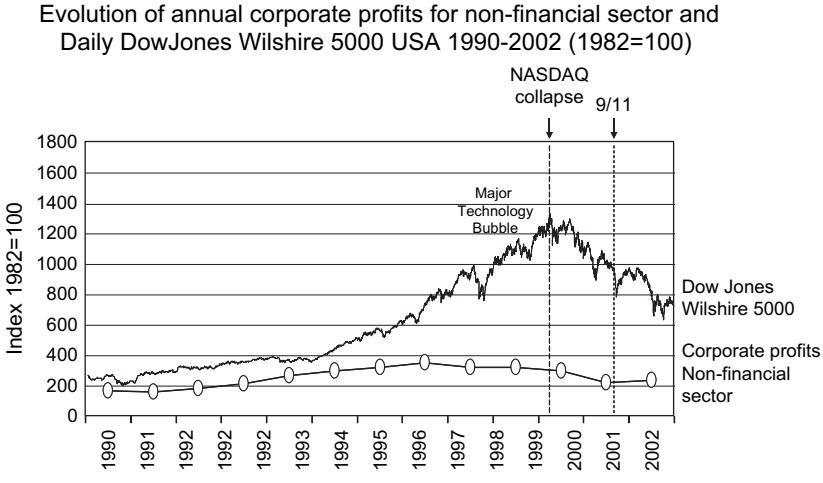


Fig. 7. *The decoupling of the stock market from the real economy:market capitalisation disregards the behaviour of profits.*
Source: *Dow Jones and Bureau of Economic Analysis.*

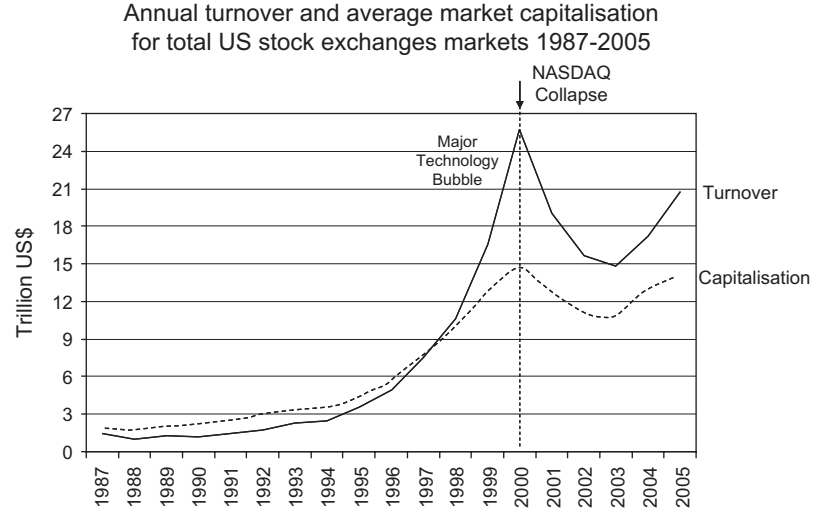


Fig. 8. *The intensification of financial activity overtakes asset inflation during the bubble.*
Source: *Datastream.*

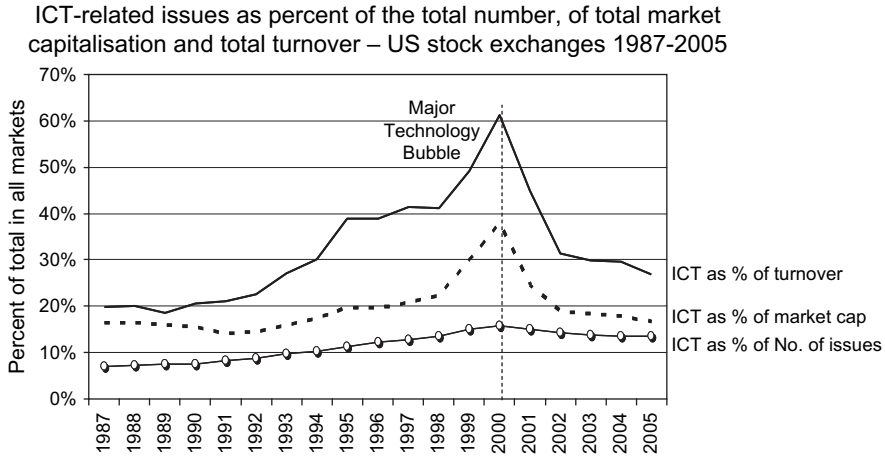


Fig. 9. *Much of the increased bubble activity revolves around the new tech stocks.* Source: *Datastream*.

In terms of numbers, the ICT-related securities go from 8% of the total in 1987 to 16% in 2000. With that proportion of companies, ICT reached 35% of total market capitalisation and absorbed over 60% of the turnover. That was around US$14 trillion at the peak—more than 1.4 times that year's GDP.

This intense activity in the stock market is multiplied several times by that of the various components of the banking system, which can mount multiple lending and investment instruments as well as complex operations around the core bubble, thus compounding the effects.

2.3 The unwitting role of the MTB

So that is how the market system revitalises the economy every half century or so. When a set of new technologies reaches exhaustion of products, productivity increase and markets (as mass production did in the late 1960s and early 1970s), financial capital abandons its old clients and joins the new entrepreneurs, giving strong support to technologies that had been in gestation for years but limited by the prevailing paradigm (Perez, 2002 [2003], pp. 27–32). The financial success of this process leads to the MTB, which not only intensifies the full experimentation with the new technologies and the modernisation of most industries, but also fosters over-investment in the new infrastructures. These usually need to reach full coverage to be effective and thus require high up-front investment and take time to become profitable. It is the switch to short-term gains during the bubble that attracts the necessary capital to be poured into the infrastructural networks of each revolution.

When the boom and bust of the MTB mark the end of this *installation period*, most of the economy has been modernised, ample coverage of the new infrastructure is in place and new corporate giants are ready to lead the expansion by taking full advantage of the new potential. But by this time, the financial world will have acquired the habit of being in control of investment and of getting constant high returns. Quarterly profits will have become the main measure and production companies will find themselves forced to avoid long term projects and to constantly deliver short term gains. For this reason, the golden

age of more harmonious growth—or *deployment period*—that follows in the last two or three decades of each *surge of development* will depend on the capacity of the State to restrain the financial casino that typifies the bubble and to hand over power to production capital, allowing its longer term horizons to guide investment once more. This has usually involved changes in the financial architecture and in the incentive structure of investment.

On this occasion, such regulatory and institutional changes have had to wait until the collapse of a second, much greater and more global boom and bust.

3. Why the double bubble? The technological and historical factors

The recurring sequence discussed above is not to be interpreted mechanically. Each surge is shaped by endogenous and exogenous forces. The endogenous forces, i.e. those that belong to the causal chain that explains the sequence, are shaped by the specificity of the technological revolution and are always subjected to multiple exogenous factors. The actual historical sequences present breaks and overlaps and a great diversity of manifestations. The variety applies also to the form taken by the bubble that marks the switch from installation to deployment. In the third surge there were multiple bubbles in faraway countries, most of them funded from the London stock exchange, which led the process of globalisation based on the rapid steamships, the transcontinental railways and the transoceanic telegraph lines. The fourth surge saw the replacement of the UK by the USA as core country of what became the age of the automobile and mass production as well as the shift of the most dynamic stock exchange from London to New York; the depression that followed was the longest and deepest to date. The current fifth surge saw several collapses in different parts of the global economy and the boom at the end of installation in two major episodes. Thus, each MTB is unique both because of the characteristics of the new technologies it carries and because of the historical conditions that provide the context.

The main historical factor explaining the rapid revival of the financial casino was the lack of the regulation that could have been expected after the collapse of the internet mania, to restrain excess risk and to favour investing in the real economy. In the usual sequence of events, the burst of the MTB, the recession, the major losses and the revelations of fraud and general misbehaviour in the financial world generate enough popular indignation and put sufficient pressure on politicians to establish strict controls. After 2000, however, the pressure was not there. The losses were encapsulated in the NASDAQ, which was a stock exchange specialising precisely in the new technologies; the recession was not long or deep enough and was cut short by the drastic reduction in interest rates and the increase in liquidity that followed the 9/11 attack in 2001. In addition, the scandalous revelations were mainly related to the real economy rather than to finance. Enron, WorldCom, Tyco, etc. led to Sarbanes-Oxley, which was meant to control the management of corporations rather than to supervise the financial sector itself.

Another element of the sequence that was absent after 2000 was the constriction of demand. Historically, the recession that follows the bust hurts both consumers and producers. The production capacity that is built up during the boom finds a violent contraction in incomes, which reduces sales and forces personnel reduction with the ensuing vicious spiral. At the same time, finance (if it was left with funds to lend) finds no willing and worthy creditors. On this occasion, the incorporation of the so-called 'second world' to the market economy had opened from the early 1990s a fresh and gigantic set of opportunities for investment, sales and loans. The countries of the ex-Soviet system and

especially China were ready to become a 'miracle cure'. The intensification of globalisation that followed the NASDAQ collapse not only expanded markets in the emerging countries, but also, due to astonishingly low wages, increased the real value of salaries in the developed world, thus amplifying demand.

The export surplus generated in the emerging economies also contributed to overcoming the demand restriction. By investing much of that surplus in the advanced economies, especially in the USA, the Asian economies fed their own export markets. The significant amount of liquidity that became available for easing credit lent more fuel to the housing bubbles that had already begun to inflate during the internet mania. This further increased consumption capacity on the back of the growing value of household assets. Hence, the global imbalances that rightly can be blamed as the main causes of the bust were also an essential part of the feedback loop that generated the boom.

But by the time lending to 'sub-prime' households was expanded to 'ninja' extremes, the excess liquidity looking for profit opportunities had already found equally risky but immediately profitable outlets. Futures, commodities, private capital buyouts, hedge funds, derivatives and any amount of synthetic instruments from securitised mortgages (collateralised debt obligations) to mutual hedging, credit default swaps, etc. flooded the markets and turned the financial world into a veritable casino.

All this took place in a context of inadequate regulation and no transparency but especially in a financial sector that had already accumulated many years of experience in computerised operations and instantaneous global trading. This is one of the factors feeding the bubble that stemmed from the nature of the specific technologies of the surge. The ease with which financial 'innovations' could be designed, introduced and traded across frontiers accelerated the rate at which the whole financial world became opaque and impossible to supervise (even by the heads of the banks, let alone the government agencies) and that the new instruments seemed trustworthy, although no one could rate them accurately. What is more, although systemic risk was increasing, as revealed after the bust, it was generally agreed that those new instruments were actually spreading and reducing risks and that the unfettered free market was delivering unprecedented prosperity. No one wanted to hear the lone warnings, even if from knowledgeable sources. Among successful financiers, Stephen Roach, as Chief Economist of Morgan Stanley, repeatedly called attention to the dangers of global imbalances (Roach, 2006), George Soros warned of a global collapse (Soros, 1998) and Warren Buffet called derivatives 'weapons of mass destruction' (Buffet, 2002). Prestigious voices from academia also sounded alarm bells: Robert Shiller (2005) predicted the collapse of the housing bubbles; Nouriel Roubini (see interview by Robledo, 2006) foretold the catastrophic consequences of the growth of systemic risk. But the optimistic excitement was equally shared by the financial 'geniuses' and by the governments that were basking in the glow of the boom. This had been typical of all MTBs, from canal mania to the roaring twenties (Galbraith, 1990 [1994]).

Thus, the aftermath of the NASDAQ bust was not a reckoning and recomposition of the game board but a revival of the casino with even greater confidence, but this time without the experimental role. The stock market was indeed no longer centred on the new technologies. Figure 10 shows how the technology stocks remained basically flat after the collapse, while it was other components that lifted the stock market during the 2000s. As usual after a bubble, it is those objects of speculation that had been at the centre of the boom that are the hardest hit and are avoided in the aftermath.

Nevertheless, globalisation itself was made possible by the internet. Through it—together with computers and software—instantaneous transactions became possible

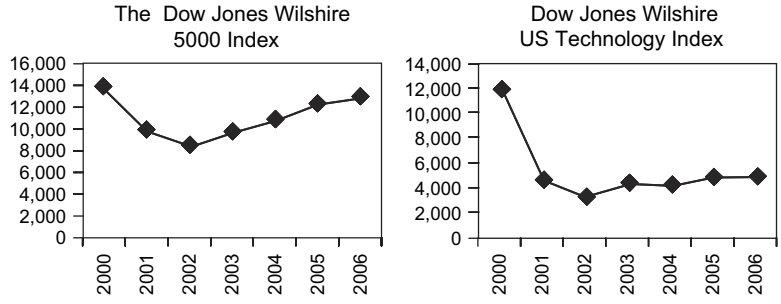


Fig. 10. *The more enduring impact of the bubble collapse on the new technology sectors than on the rest.* Source: *Dow Jones*.

around the clock and globally traded financial instruments flooded the market in the following years. A similar leap in financial transaction power occurred in the previous globalisation, in the installation of the third surge towards the end of the nineteenth century, when transcontinental telegraph and the ticker tape vastly increased and accelerated both local and worldwide transactions.

4. Two different bubbles: from technological to financial innovation

The two main differences between an MTB and an ELB are the forces that drive them and the chosen objects of speculation. MTBs are driven by the existence in the real economy of a clearly visible technological opportunity space promising to yield extraordinary profits and thus attracting investment money from wherever it can be found. By contrast, ELBs are driven by the availability of abundant cheap credit searching for whatever object of speculation is on hand or can be created by financial innovation.

All manias—whether MTBs or ELBs—are fertile ground for financial innovation. Financiers are equally creative when confronted with either 'idle money' or technological opportunities, but the results of their successful talents can be quite different for the economy. Every set of new technologies has requirements that can strongly diverge from those of the previous one and only if finance accommodates can the new ventures comfortably proliferate. In the third surge, Germany gained an advantage over Britain by developing medium sized credits to finance the export of electric motors. This was an innovation that supplied credit greater than that for trade in consumer products yet smaller than that necessary for the usual capital goods. Equally, the booming of venture capital (preceded by the so-called 'angels') gave Silicon Valley a huge advantage in the current surge. In fact, new business models and new types of instruments have given birth to a proliferation of novel financial companies in all installation periods. So it was during the internet bubble.

Figure 11 indicates how, from the 1970s, the number of IPOs in ICT and finance grew apace throughout the installation period. It was in the years of the MTB that ICT stocks grew phenomenally in numbers. This time it was due to the dotcom craze, but the take-off had been equally astonishing in canals and railways as was seen in Figure 1.

The interesting pattern in this case is that, after 2000, the IPOs in ICT were reduced to a number inferior to that in the 1980s, while the IPOs in finance were equivalent to those in the 1990s boom. And this does not include the countless private equity firms and hedge funds that proliferated outside the stock market in those excess liquidity years.

This is very different from what happened in the 1920s. Then, the MTB encompassed financial innovation and finance-centred speculation together with the technology boom. The introduction of consumer credit and the proliferation of investment trusts facilitated both the demand for the new technology products and the 'retail' participation in the stock market and was an important contributor to the boom. In fact, from 1927 to 1929 the growth in the value of new issues in financial companies outstripped by far the rhythm in the rest. Figure 12, estimated from Schumpeter's data (1939, p. 878), shows the explosion in new financial stocks that took place in the most intense years of the frenzy of the time. The crash wiped out interest and trust in the stock market both for financial and non-financial companies. The ensuing paralysis was generalised, except in the utilities (the

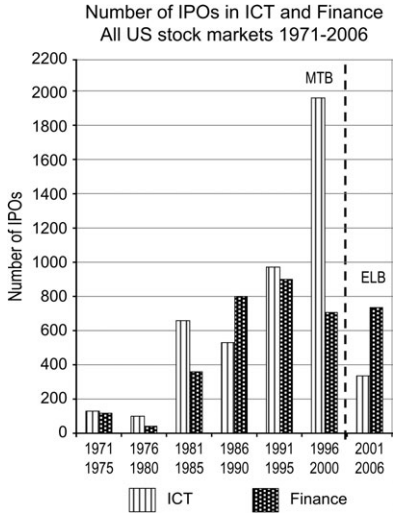


Fig. 11. *The major technology bubble also fosters the flourishing of new companies and types of funds in the financial sector.*
Source: *Thomson One Banker.*

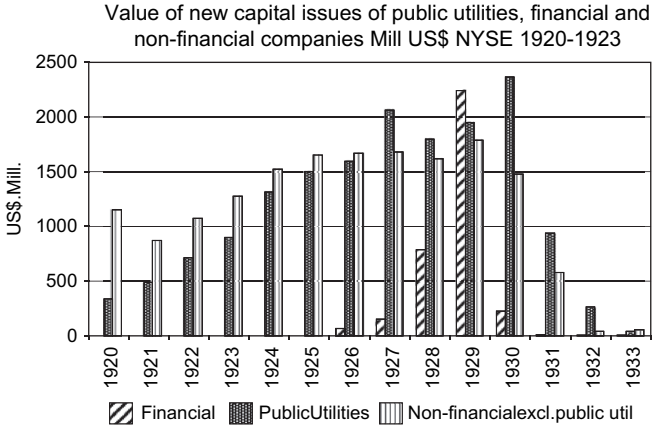


Fig. 12. *The late 1920s as a single major technology bubble.*
Source: *Schumpeter (1939, p. 878)*.

infrastructure of that surge, together with the road system) where investment kept up for a couple of years, until the trough in 1933.

Another indicator of the difference between the two bubbles is the percentage of all IPOs represented by the new technology and financial sectors. In the MTB, ICT represents between 40% and 60% of IPOs and is reduced to 20% during the ELB. The figures are almost exactly reversed for the shares of the financial IPOs in the two booms (see Figure 13). Yet, it is worth noting that the two sectors together continue to represent 40–60% of new launches in the market.

In terms of market capitalisation there is also a clear bias towards technology stocks in the MTB shifting towards financial stocks in the ELB, as shown in Figure 14.

The difference is also visible in the distribution of the trading volume between the NASDAQ and the NYSE in the two bubbles. Figure 15 is an update of Figure 4, including the second boom. Although the NYSE also trades in a certain number of technology stocks, it concentrates most of the financial companies and a much wider range of other sectors in which, as in commodities or real estate, there was strong bubble-type inflation in the 2000s.

4.1 From opportunity pull to easy credit push

The switch in objects of speculation reveals a fundamental difference between the drivers of the two bubbles. The technology bubble proper was driven by what one could call 'opportunity pull', whereas the second set of bubbles was driven by 'easy credit push'. In the first case it was the excitement about new technology that attracted the money into the casino, almost regardless of cost; in the second it was the excitement about abundant easy money that pushed investors to get credit and to seek new objects of speculation. As indicated before, that can in fact be taken as the basic distinction between MTBs and ordinary bubbles.

Figure 16 shows that the real interest rates for the whole duration of the MTB were the second highest in the three decades of the installation period, hovering between 6% and 7%. The only time when they had been higher (though by not much more than 1.5 percentage points) was during the time when Paul Volker, as Chairman of the US Federal

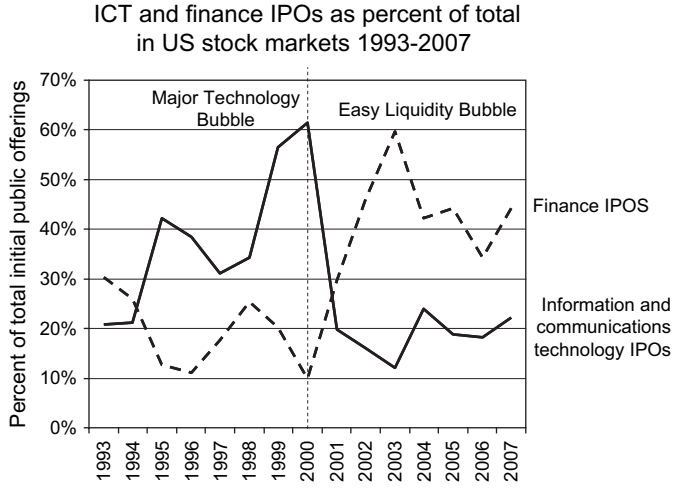


Fig. 13. *The 1990s and the 2000s: different focus on technology or financial shares.*
Source: *Thomson One Banker.*

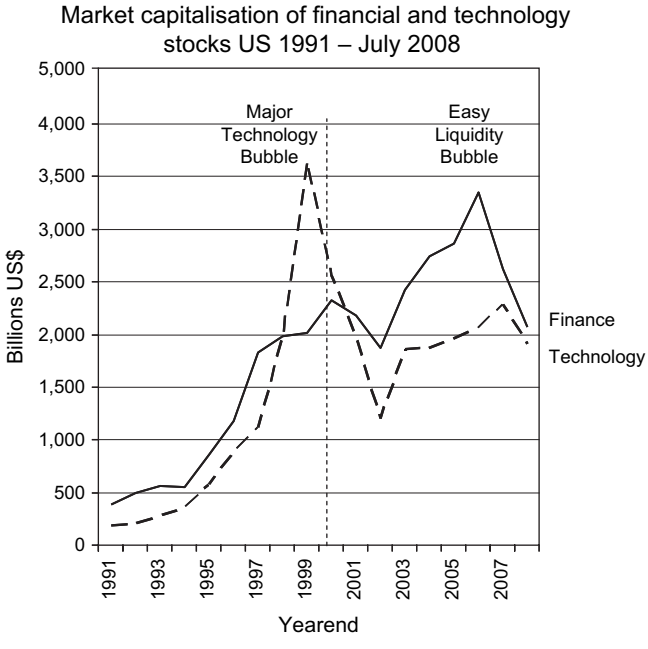


Fig. 14. *The 1990s and the 2000s: Differential asset inflation.*
Source: *Thomson Datastream*.

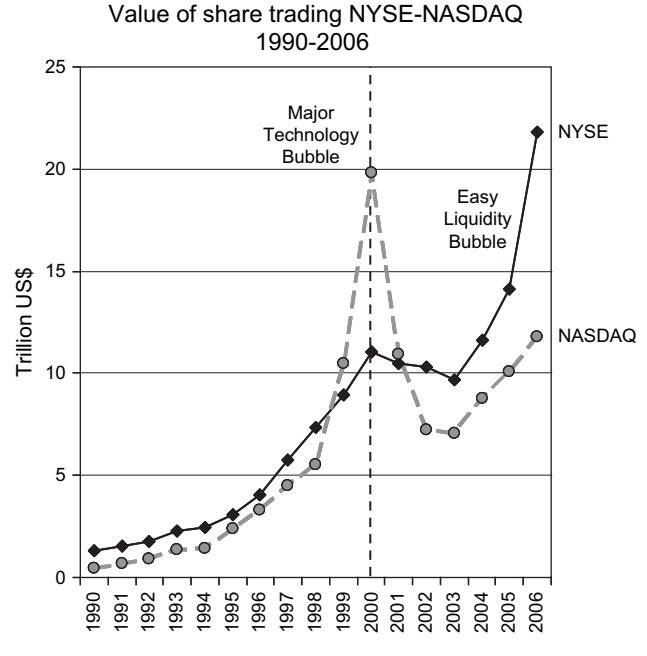


Fig. 15. *The 1990s and the 2000s: change in the weight of new technology shares.*
Source: *World Federation of Exchanges*.

Reserve, was fighting stagflation in the early 1980s. By contrast, during the ELB of the 2000s the real interest rate was the lowest since the 1970s. High real interest rates were also the case in the late 1920s when brokers' loans charged very high premia. The fact that investors were willing to borrow at such high costs is seen by Rappoport and White (1993) as evidence of extraordinarily high return expectations.

As to the monetary expansion, Milton Friedman himself provided us with the series that he considered relevant to represent the rhythm of monetary expansion or contraction during and after three bubbles: the 1920s and 1990s in the USA and the 1980s in Japan (see Figure 17). In our interpretation, the first two are MTBs and the third is one of those mixed bubbles that seem to occur in fast-catching-up and forging ahead situations (as in Germany and the USA in the early 1870s). Friedman's purpose was to show the success of the only post-bubble expansionary policy of the three cases. It is ironic that this success only led to another bubble of perhaps greater negative consequences on growth, which he did not live to see.

According to Friedman's calculations, money stock at the time of the NASDAQ collapse was merely 12% more than the average between 1994 and 2000; whereas in 2004 it was 50% more than the average.

It is clear that a boom needs to count on enough liquidity to be able to develop. The argument being put forth here is that, in the case of MTBs, *opportunity pull* plays a greater role than low interest rates or monetary expansion. Easy credit, rather than being the initial push factor unleashing the technology bubble, would act as a reinforcing response to the explosion of opportunities, leading to a positive feedback loop. In the case of most other bubbles, easy credit tends to be the initial unleashing mechanism. Thus, the asset inflation of the NASDAQ bubble was driven by the attraction of ICT, whereas that of the 2004–07 boom was driven by both low interest rates and abundant liquidity.

4.2 The structural transformation in the economy

The emphasis given here to the decoupling from the real economy that occurs during bubble frenzies should not deter us from understanding the whole installation period as a time of profound structural transformation. The new technologies grow from small beginnings to a set of new interrelated industries with giant new companies at the helm; some old industries wane or disappear, some are replaced but the great majority are rejuvenated with the new paradigm; some geographical regions emerge as dynamic growth poles while others diminish in importance and the same happens to the ranking of countries. All this is facilitated by an emboldened financial sector and it intensifies during the MTB precisely because of differential asset inflation in favour of the new technologies. After the collapse the transformation continues but with a change of gear. The new giants that survive the bust engage in an intense process of restructuring. Mergers and acquisitions, which had usually begun during the bubble, mop up the weaker companies that either went bankrupt or are struggling to keep afloat. Whatever valuable assets they may have in terms of access to markets or supplies, specific technological advantages or—as in the case of railways and canals—connections that can enhance the coverage and continuity of a major network, becomes the reason for the new giants to incorporate them in one way or another. In general, the aftermath of the MTBs is a time of industrial restructuring, usually leading to oligopolies, in every sector of the economy. It is the resulting new fabric of the economy, with its emerging leaders, that will carry the deployment period after recovery from the recession.

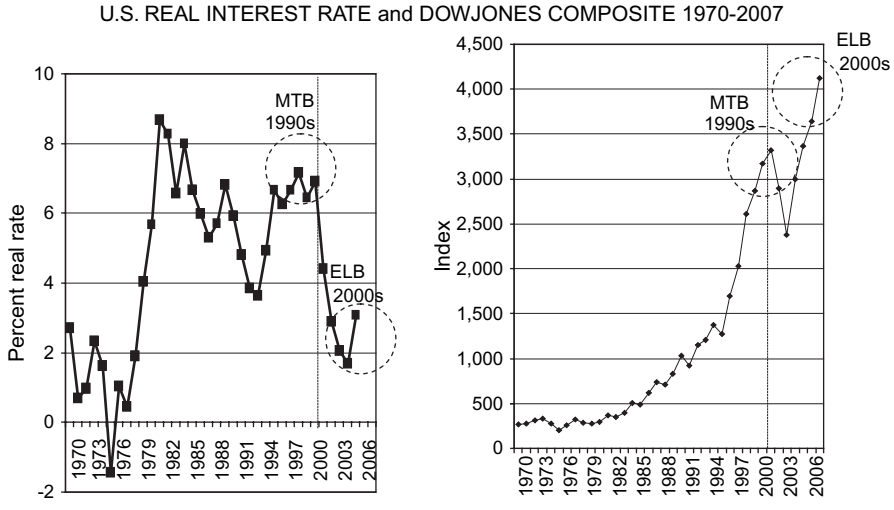
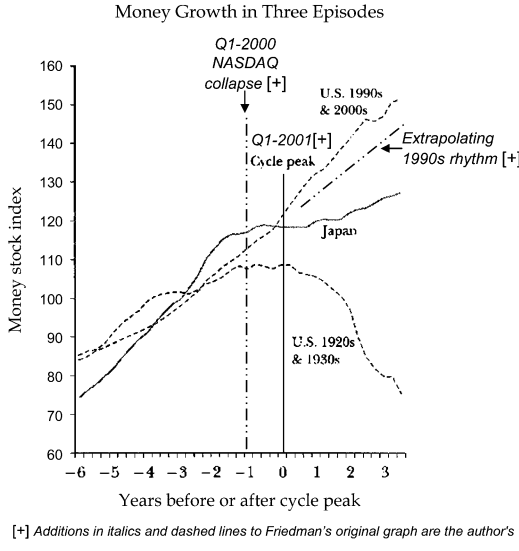


Fig. 16. *The 1990s and the 2000s: very different real interest rates.*
Source: *World Development Indicators for interest rates and Dow Jones for index.*

'*Notes:* Data are money stock as percentage of average for six years prior to peak. Dates are chosen to align cycle peaks. The initial dates in the figure are 1923:3 for the U.S. 1920s, 1986:1 for Japan 1980s and 1995:1 for U.S. 1990s. The peak occurs at 1929:3 for the U.S. 1920s, at 1992:1 for Japan 1980s and at 2001:1 for U.S. 1990s. The terminal dates in the figure are 1933:1 for the U.S. 1920s, 1995:3 for Japan 1980s and 2004:3 for U.S. 1990s.' *(Our emphases).*



[+] *Additions in italics and dashed lines to Friedman's original graph are the author's*

Fig. 17. *Two rhythms of monetary expansion according to Milton Friedman*
Source: *Friedman (2005, p. 147, Fig. 1).*
Note: The author thanks the American Economic Association for permission to reproduce this figure.

And that is indeed what happened after the NASDAQ collapse, even as the new financial bubble was beginning to inflate. Indeed, some of the most important activities that finance continued to engage in, as regards the real economy, were precisely mergers and acquisitions, private equity buyouts and restructuring, off-shoring as a form of global repositioning of the new giants and other such activities—very different from supporting the new entrepreneurs in the hope of a multi-million dollar IPO. In fact, this role is being

increasingly played by the new giants themselves, which are now full of cash. Hence, the aspiration of small new companies has been to be taken over by Google or Microsoft or Cisco at prices that have at times resembled those of the late 1990s IPOs.

5. The underlying continuity: the exacerbation of the casino from one boom to the next

Up to now, the discussion has concentrated on showing the differences between the two bubbles of the turn of the century. Yet, as suggested at the beginning, these two processes share fundamental causes and have basic similarities stemming from the ICT base that facilitated the behaviour and the specific types of financial instruments and modes of operation. In that sense, one could say that the ELB was basically the amplification of some of the features of the MTB that allowed finance to decouple from the real economy. The whole of the second boom was carried on the back of stretching to the limit the financial innovations that had already been introduced during installation and in the internet boom itself. From the Brady Bonds that securitised the third world debt to face the threat of defaults in the 1980s to the collateralised debt obligations that securitised the sub-prime mortgages, there is a continuous thread. As there is also continuity between the trust placed in the profit making capacity of technology (increasingly based on unrealistic capital gains) and the trust that was gradually transferred to the innovations of the financial world.

In fact, the switch to housing and commodities speculation or to the equivalent of casino gambling was not simple and direct as it was in the past, but rather strengthened by sophisticated synthetic instruments and supported by ever more refined software programmes. This is what helped create an illusion almost as powerful as the technological certainty of the internet boom. The term 'masters of the universe', often quoted to refer to the financial geniuses that were supposed to have engineered the unending prosperity of the mid-2000s, expresses the way in which they were seen as powerful innovators, spreading risk and somehow magically evaporating it in the vast complexity of the financial galaxy.

Enormous amounts of innovative financial instruments of the derivative and synthetic sort were mobilised during the two bubbles, thanks to information technology and global communications for seamless transfers and operations. It all began to accelerate during the MTB and then continued at a frantic pace during the ELB boom.

An example of this is the growth of derivatives. Figure 18 shows the notional amounts outstanding in interest rate and currency derivatives (which represent the great majority of these instruments) as estimated by the International Swaps and Derivatives Association (ISDA). To try to understand the size of the staggering figure of US$382 trillion being covered in 2007, one can say that it is the equivalent of seven times the world GDP of $54 trillion in that year. And it should be noted that the figure does not include credit default swaps or equity swaps, which together reached another US$72 trillion according to the same source.

Thus, what was already an impressive amount in the late 1990s was completely dwarfed by the astonishing quantities involved in 2007. Yet, the continuity in growth rhythm was equally remarkable. Between 1994 and 2000 the notional amounts grew 457%, which is equivalent to the 452% growth from 2001 to 2007. Similarly, in the last three years of each period total growth was 117% and 108%, respectively.

The globalisation of financial flows is another trend that was magnified as was the possibility, by various means, of generating growing profits while leaving behind investment in the real economy.

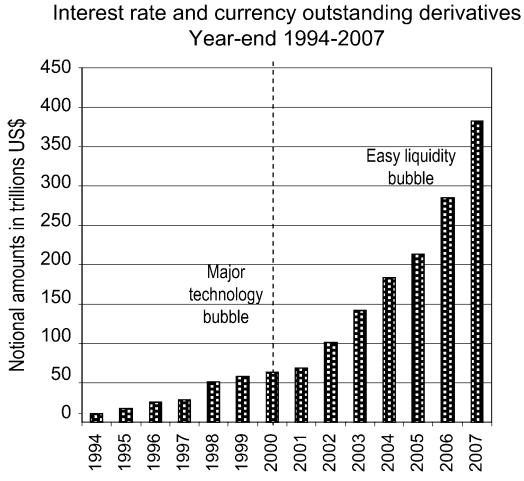


Fig. 18. *The 1990s and the 2000s: Continuity and acceleration in the instruments of casino-type speculation.*
Source: *International Swaps and Derivatives Association, Inc.*

Figure 19 shows how the growth of world stock exchanges followed those of the core country during the MTB but then took off at a much greater pace during the ELB. Between 2002 and 2007, the market value of stocks in the US exchanges grew 100%, while that of those in Europe and Asia Pacific almost doubled that rate. Indeed, much of that growth in capitalisation accompanied the off-shore movement of global corporations in the 1990s and its intensification in the wake of the NASDAQ collapse.

5.1 The bias towards finance

Another trend in the first bubble that became amplified in the second was the bias towards financial profits. Figure 20 shows how the greater growth of profits in financial corporations that was already notable in the 1990s, is even stronger in the 2000s. This slant is further reinforced by the fact that many non-financial corporations bought into the financial frenzy and increased their purely financial investments, to an extent that an increasing portion of their profits came from capital gains or dividends (Krippner, 2005).

Throughout the installation period, the intense activity of the financial world is likely to outpace investment in the real economy. This is especially so in the bubble episodes due to the decoupling phenomenon already discussed. Figure 21(A) shows how in the early bubbles of the 1980s and then again in the 1990s there are noticeable bursts of activity when compared with real investment. Yet the violent increase that took place in the 2000s strongly suggests that the link between paper and real investment in the economy had been broken.

This is all the more striking when compared with the post-war period, which was the deployment of the mass production surge. In those years, private fixed investment involved significantly greater amounts than those in financial flows (much of it probably financed out of profits rather than recurring to loans or the stock market). As can be seen in Figure 21(B), investment was 80% greater in 1947 and still about 40% more than financial flows in 1969, just before the context changed completely with the irruption of the information revolution, the energy crisis and stagflation.

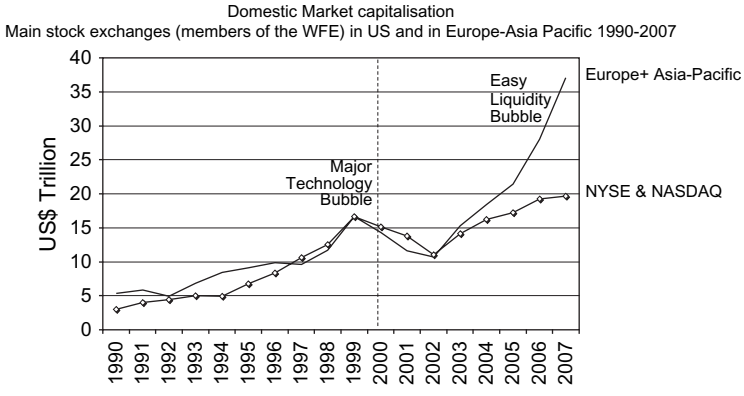


Fig. 19. *The intensification of globalisation after the major technology bubble collapse and into the easy liquidity bubble.*
Source: *World Federation of Exchanges (note: data includes only member exchanges of the WFE).*

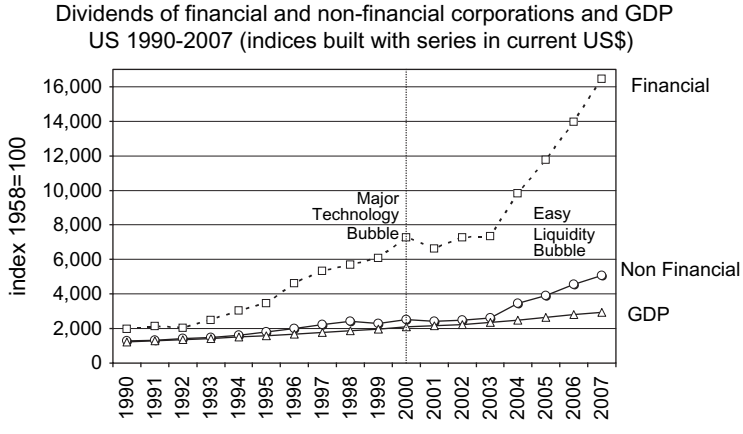


Fig. 20. *The intensification of the major technology bubble bias towards financial profits during the easy liquidity bubble.*
Source: *Bureau of Economic Analysis.*

5.2 The double bubble and the full consequences

What came after the internet bubble collapse was not the restructuring of the real economy that tends to occur in the aftermath but a casino revival that only fulfilled part of that task. There can be, however, little doubt that this second major bust and its consequences are likely to follow the script and facilitate the necessary institutional recomposition to unleash the deployment period of the current surge. The massive revelations of irresponsibility, incompetence, outright fraud and illegitimate enrichment of many of the actors involved make a sufficient indictment of unregulated finance and the unfettered free markets under which they operated to create an atmosphere of widespread indignation that puts pressure on politicians to act.

After the meltdown of this second bubble, the actors in the real economy—both producers and consumers—see themselves as the direct victims of the false promises of the

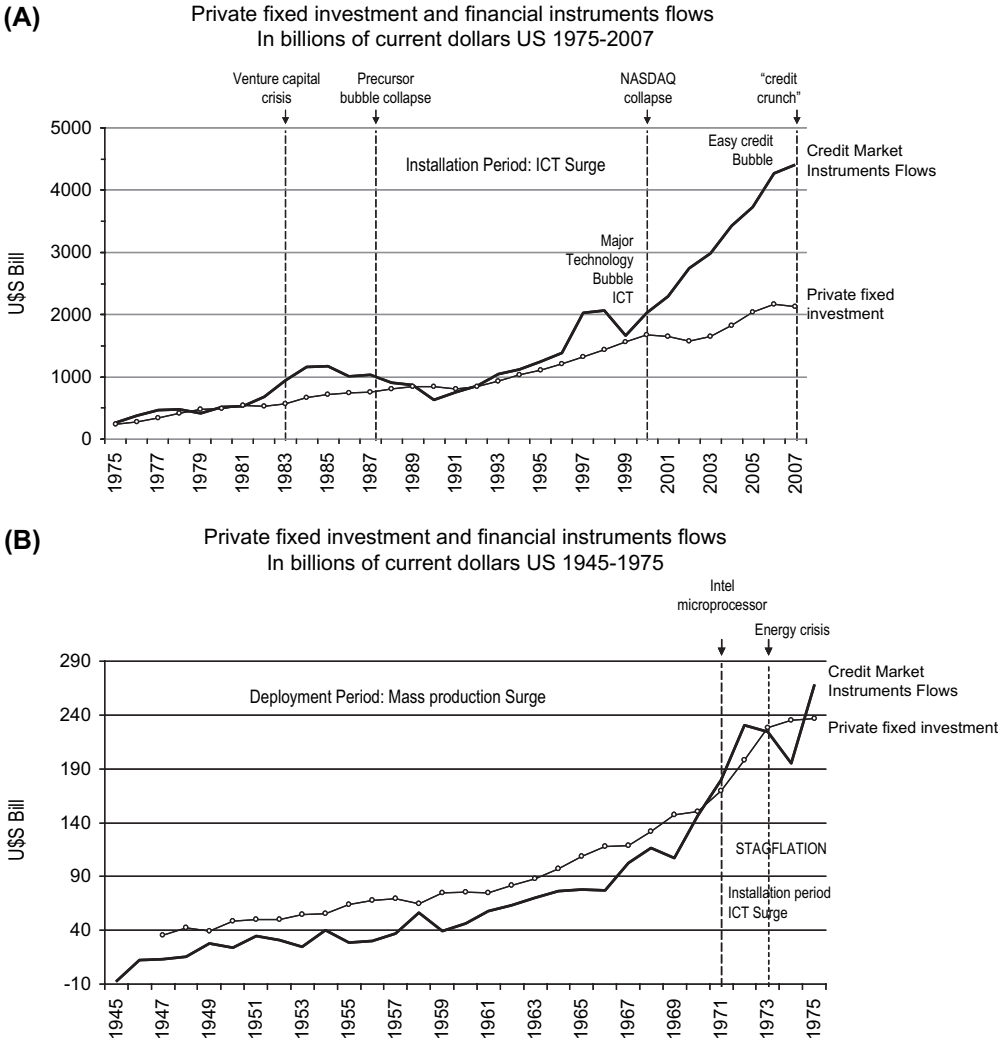


Fig. 21. *(**A**) The decoupling from the real economy intensified from the 1990s to the 2000s. (**B**) The contrast with the deployment period of the previous surge: 1947–1974.*
Source: *US Federal Reserve, Flow of Funds Accounts (with period indications by the author)*.

casino and its disastrous consequences. Finance has done its job and overstayed its welcome at the helm of investment; it is time for production capital to take over and to fully unleash across the world the wealth-creating potential already installed. This will require governments to once again design appropriate policies and provide the general guidelines.

Nevertheless, the conditions are not necessarily all set for this change. Several authors have pointed out that finance has come to dominate the economy to an extent that could be termed 'financialisation' (see Arrighi, 1994; Dore, 2008; Krippner, 2005; van Treeck, 2009) and that this constitutes a fundamental change in the market economy. A similar

process in the third surge at the end of the nineteenth and beginning of the twentieth centuries, led Rudolf Hilferding to hold that the fusion of industrial, mercantile and banking interests had brought a new stage of 'monopolistic finance capitalism' with the State under its control (Hilferding, 1910 [1981]). Yet finance was no longer leading the economy from the 1930s to the 1970s.[1] So history shows that these processes, however intense, are reversible. And yet, this time the resistance can be particularly formidable.

Indeed the overwhelming power acquired by the financial world in the 2000s and its success in managing what appeared to be a never-ending prosperity legitimised its hold on the completely free market and its ideology and also allowed its interests (and its leaders) to deeply influence the political elite in some of the most advanced countries. Although this connection between the financial leaders of the major bubbles and the State has been present in each historical case, it would seem that in the third surge and in the current one the phenomenon has presented more acute characteristics. One factor could be the globalising character of both sets of technologies being installed, which objectively places finance above the control of national governments.

On the other hand, the emerging leaders of the new production capital, the new ICT giants that would serve as engines of growth of the world economy and shape the deployment period, are yet to recognise and wield their power and influence in the course of events, nationally and globally. If in the fourth surge the chief of General Motors could rightly say that what was good for GM was good for the USA and *vice versa*; today the global ICT companies could say that what is good for them is good for the world economy. Yet they do not seem to be questioning the leadership of finance or vying for a place at the top. Whatever their participation, the outcome will be resolved in the political arena.

6. Conclusion: the special nature of MTBs and the policy challenge

This paper has argued that not all bubbles are of the same nature. There is a particular type that is endogenous to the process by which the economy and society assimilate each great surge of technical change. These are the major technology bubbles that tend to occur midway along the diffusion path of each technological revolution. The collapse of such a bubble signals the need to switch from a period of *installation* when the new technologies are tested and investment is led by the short term goals of financial capital to a period of *deployment* when all the conditions are in place to let the longer-term aims of production capital guide investment again. This transition usually needs government action to overcome the recessionary consequences of the major bubble, to enable the shift from an economy focused on paper wealth to one where production, employment and social responsibility tend to occupy centre stage, while a competent and responsible financial sector uses its innovative power to profit from the success of the real economy.

It has further been argued that the MTB of the information and communications revolution took place in two episodes: the internet mania of the late 1990s ending with the NASDAQ collapse in 2000 and the ELB of the mid 2000s ending in the financial crisis of 2007–08. The first was based on technological innovation, the second on financial innovation, facilitated, accelerated and made global by information technology and the internet.

[1] Soros (2008) describes the atmosphere of the financial world in the USA in the late 1960s and early 1970s as unimaginative and uninteresting, 'banks were considered the stodgiest of institutions' (p. 109). Philippon and Reshef (2009) show how relative wages in the financial world fell far from their peak in the late 1920s and rose again throughout the 1980s.

There are many circumstances that explain why the first episode was not big enough in its consequences to require the type of regulation and policies that would restrain financial excesses. There are others that explain the easy liquidity that prevailed in the second episode and the global imbalances that intensified it. But the claim is that although the two bubbles are fundamentally different, there is also between them an essential continuity that leads to expect the typical consequences of MTBs to occur after the collapse of the second one.

It was also suggested here that MTBs are generated by *opportunity pull*, whereas ELBs are the result of *easy credit push*. The first bring money to the market in search of the extraordinary profit opportunities shown by the successes of the new technologies; the others look for objects of speculation with which to make the easy money yield ever better and quicker returns. The occurrence of a sequence of two very different bubbles, which are, nevertheless, continuous in basic aspects, allowed the analysis of the similarities and differences of the two types of bubble with compatible data.

Further research is necessary to fully understand the processes by which MTBs and ELBs are formed in the market system. Among other things, the results would help identify the mechanisms that could avoid the worst excesses and the most painful consequences. But the focus cannot be confined to the economic space. Both technical and institutional change—including innovation in the financial system and in its instruments—would have to be included in the analysis. The institutional response to the current collapse of the financial system and to the ensuing recession should also be an important part of the objects of study.

The fundamental implication of the interpretation presented here is that what we are facing is not just a financial crisis but rather the end of a period and the need for a structural shift in social and economic context to allow for continued growth under this paradigm. Both globalisation and national prosperity will depend upon and be shaped by the long-term solutions implemented to face the challenges posed by the current recession.

The transformation effected by the information and communications revolution during the installation period has already provided the world economy with a gigantic innovation and growth potential to be tapped by all sectors of activity and across the planet. The environmental, energy, materials and geopolitical restrictions are as many challenges to guide technological and organisational innovation contributing to a change in consumption and production patterns. Such changes are particularly amenable to the innovation trajectories facilitated by ICT. The massive and varied investments required will open abundant profit opportunities while bringing employment and increasing incomes to greater and greater portions of the population of all continents.

The legitimacy of capitalism rests upon its capacity to turn individual quest for profit into collective benefits. The pendular swings from installation to deployment, from financial to production control of investment, from a *laissez faire* State to an active one, from income polarisation to more progressive income distribution and from unlimited individualism to emphasis on social responsibility and back might be inevitable in the way a market economy evolves. Perhaps the system can only maintain its stability by emphasising one direction or the other. In which case, continuing with the *laissez faire* model would be as much of an obstacle to growth now as maintaining all the bureaucratic fetters of government would have been in the shift to installation from the 1970s.

The current generation of political and business leaders has to face the task of reconstituting finance and bringing the world out of recession. It is crucial that they widen their lens and include in their focus a much greater and loftier task: bringing about the structural shift within nations and in the world economy. Civil society, through its many

new organisations and communications networks, is likely to have a much greater role to play in the outcome on this occasion. Creating favourable conditions for a sustainable global knowledge society is a task waiting to be realised. When—or if—it is done we should no longer measure growth and prosperity by stock market indices but by real GDP, employment and well-being, and by the rate of global growth and reduction of poverty (and violence) across and within countries.

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