

The crash of the knowledge economy

Ugo Pagano and Maria Alessandra Rossi*

This paper advances the hypothesis that some of the roots of the present crisis are to be found in the present institutions of the knowledge economy. While protectionism is seen as a possible dangerous outcome of the crisis, the extent of protectionism inherent to the strengthening and globalisation of intellectual property rights (IPRs) associated, in particular, with the signing of the Trade-related Aspects of Intellectual Property Rights agreement is not generally perceived as one of its possible causes. Indeed, IPRs have acted as ‘super-tariffs’. They have particularly raised the cost of investments for countries that had neither abundant cheap labour nor high amounts of intellectual property resources. Moreover, IPRs may have later exerted negative effects even on IP-rich firms, as the proliferation of conflicting rights has led firms to increasingly inhibit each other’s investments. The resulting investment strike has manifested itself as a saving glut and has mainly affected the USA in a situation aggravated by inadequate regulations. If intellectual monopolies are one of the causes of the crash, the remedies should not only focus on monetary policy, financial regulations or even on standard Keynesian policies. Aggregate demand stimulus should be coupled with policies that decrease the level of intellectual monopolisation of the economy.

Key words: Intellectual property rights, Economic development, Keynesian multiplier

JEL classifications: O34, O12

1. Introduction

The economy undergoing the present crisis is not only fundamentally different from the economy of the 1930s but also from that of the 1970s and 1980s. While some aspects of the present crisis sound repetitious and familiar, there are some specific mechanisms of

Manuscript received 1 April 2009; final version received 17 May 2009.

Address for correspondence: Ugo Pagano, Department of Economics, University of Siena, Piazza San Francesco, 7, 53100 Siena, Italy; email: pagano@unisi.it

* University of Siena and CEU and University of Siena, respectively. We are very grateful to several blogs where we discussed some of these ideas and, in particular to the goodwinbox at <http://www.econ-pol.unisi.it/blog/>, the PERG blog at <http://pergceu.blogspot.com/> and noiseFromAmerica at <http://www.noisefromamerika.org/>. We are also grateful to the participants to the conference ‘Complexity of financial crisis in a long period perspective: facts, theory and models’. For useful discussion, we wish to thank Simona Benedettini, Michele Boldrin, Lilia Costabile, Yehuda Elkana, Antonio Nicita, Massimo D’Antoni, Marcello De Cecco, Julius Horvath, Fabio Pammolli, Katka Svickova, Alessandro Vercelli, Stefano Zamagni, Giulio Zanella and Gennaro Zezza. The editors and the referees of the *Cambridge Journal of Economics* provided challenging criticism together with invaluable help and encouragement to meet a demanding deadline. In spite of the tight schedule, Sam Bowles was able to read the final manuscript: his place in our non-incriminating thanks is very well deserved. Financial support from the EU VIth FP ‘‘Reflexive Governance for the Public Interest’’ is gratefully acknowledged.

the present knowledge economy that have contributed in novel ways to the crisis and should be considered in terms of their policy opportunities.

The article argues that one specific aspect of the knowledge economy—the extraordinary and well-documented trend towards the over-propertisation of knowledge—may have contributed to the current crisis. This is because the excessive swing of the policy pendulum towards knowledge privatisation and away from ‘open science’ has determined a progressive fall in investment opportunities by raising the cost of investment.

In the past 30 years a number of policy developments has contributed to the strengthening of the intellectual property (IP) system and to its extension to new subject matters and to new geographical locations. In particular, in March 1994, the Agreement on Trade-related Aspects of Intellectual Property Rights (TRIPs agreement), signed as part of the agreement founding the World Trade Organisation (WTO), has determined the harmonisation of the standards of IP protection adopted by WTO member states. Intellectual property rights (IPRs) have thus been ‘globalised’: developed countries’ higher levels of IP protection have been extended to all WTO member states and a more effective enforcement mechanism has been put in place.

Over-propertisation, in turn, has had a two-fold effect. First, it has affected the global division of labour, diminishing the investment opportunities in countries characterised by lower IP intensity and therefore by a higher cost of investment. In other words, increased knowledge privatisation went hand in hand with a global division of labour in which the USA could exploit its technological leadership backed by IP and China specialised in low-cost production, while numerous opportunities for investment were closed to Japan and the former Asian tigers, which had neither America’s monopolistic endowment nor China’s lower costs. Second, at a subsequent stage, due to the negative effects of over-propertisation on the productive utilisation of intellectual resources, there has been a progressive reduction of investment opportunities in the most IP-rich country as well, i.e. the USA.

A curious paradox follows from the argument we propose: it was not the virtues of competition, but rather the advantages conferred by intellectual monopoly that enabled the USA to rapidly catch up with the other Western economies at a time in which it seemed to be lagging behind. Moreover, the very source of the success of the US model of capitalism may ultimately turn out to be the most serious obstacle to its future vitality.

The hypothesis we advance may help explain a number of puzzling empirical facts and suggests that the origins of the current crisis can be found in an ‘investment strike’ rather than in a ‘money glut’ or in a ‘saving glut’. In particular: (i) the downward trend in investment observed since the mid-1990s in Japan, the Euro area and, to an even greater extent, in East Asia excluding China; (ii) the lack of dynamism of US corporate investment, in spite of secularly low borrowing costs and high opportunity costs of saving; and (iii) the interest shown by US businesses in foreign direct investment (International Monetary Fund, 2005).

The interpretation we propose implies that policies aimed at overcoming the drawbacks of excessive knowledge privatisation may play an important role in stimulating the economy. First, efforts should be directed at preserving and increasing the role of open science. The institutions of open science allowed the blossoming of industrial development since its very beginning and should have a far more important role in the architecture of a future post-crisis global economy. This might be achieved—we suggest—through the institution of a World Research Organisation (WRO) that could internalise some of the benefits of open science, overcoming the well-known free-rider problem associated with contributions to the latter.

Second, in the short run we suggest the adoption of a policy enhancing the availability of intellectual assets in the public domain through publicly-funded patent buyouts, along

with monetary policies, policies aimed at redressing the failures of financial markets through more adequate regulations and standard Keynesian measures. By moving knowledge from the private sphere of intellectual monopoly to the public domain it is possible to stimulate aggregate demand to a greater extent than through the standard Keynesian multipliers. Keynesian policies can become much more effective if they exploit the capacity of knowledge to be used an infinite number of times. In this way they can generate effects that can be defined as an investment ‘super-multiplier’, which may contribute to a successful exit from the present crisis.

The paper is structured as follows. In Section 2 we set out the argument that the current crisis finds its origin in an ‘investment strike’ rather than in a ‘money glut’ or in a ‘saving glut’, drawing on International Monetary Fund (IMF) data. In Section 3 we explore the mechanics of the progressive slump in investment opportunities due to the excessive strengthening of the IP system. Section 4 argues that the present institutions of the global economy tend to restrict the role of open science. Section 5 focuses on short-run policy suggestions and Section 6 concludes.

2. The origin of the crisis: ‘money glut’, ‘saving glut’ or ‘investment strike’?

Two competing theories put forward to explain some puzzling aspects of global finance and the financial crisis have attracted considerable attention. The first—particularly popular—might be called the ‘money glut’ theory. It identifies the origin of the crisis in lax monetary policies adopted by the US Federal Reserve and in the ineffective regulatory policies of the US variety of capitalism and traces a link between such policies, the excess liquidity that has flooded the US markets, and the subprime crisis. According to this theory, American central bankers kept the interest rates artificially low and provoked an excessive increase in credit coupled with increased risk-taking. As amply explained by the well-known models of adverse selection, these conditions gave rise to a growing pool of toxic debt, with the consequences now evident worldwide. For most proponents of this view, the main solution to the crisis thus resides in a combination of more stringent monetary policy and more stringent financial regulation.

The second—more articulated and somewhat less straightforward—theory emphasises the role played by ‘global imbalances’ in originating the crisis, namely the fact that the current account surpluses of emerging markets necessarily correspond to a current account deficit in the USA, given that the other industrialised countries do not display either particularly significant surpluses nor particularly significant deficits in the aggregate. In terms of policy implications, the interpretation of the crisis based on the existence of ‘global imbalances’ offers relatively limited guidance in so far as it points to the need for a structural change in the savings/investment patterns of emerging economies that would be the natural consequence of these countries’ progress towards greater financial liberalisation and integration in the global economy.¹

On the source of the ‘global imbalances’ there is, however, scarce agreement. As the very definition of current account as the difference between investment (I) and savings (S) readily suggests, ‘global imbalances’ might be rationalised by reference to US savings, emerging markets savings, US investments and emerging markets investments

¹ The choice between the two theories amounts, to some extent, to a choice of attribution of responsibility for the crisis. Indeed, for the ‘money glut’ theory the origin of the crisis resides in US policy choices, while for the ‘global imbalances’ approaches, the origin of the crisis is to be found mainly outside of the USA.

(Eichengreen, 2007). Indeed, economists have advanced interpretations based on each of these factors.

Economists attributing a primary role to the decline in US savings highlight: (i) a substantial reduction of private savings that might be attributed to declining interest rates, leading to an increase in asset valuations and, in turn, to a reduced incentive to save; and (ii) a reduction in public savings mainly due to tax policy.

The 'saving glut' version of the 'global imbalances' interpretation of the crisis focuses, by contrast, on the existence of an excess of savings originating in emerging economies. It points to the increased lending capacity of countries outside of the USA, generated by the policies aimed at creating and preserving current account surpluses adopted by developing and emerging economies as a precautionary response to the financial crises of the 1980s and the 1990s in Asian and Latin American countries. Among these policies, the purposeful accumulation of US currency reserves is highlighted and seen as being motivated by the aim of keeping emerging economies' currencies undervalued and providing a safety net in case of financial shocks. The beneficial flow of funds from emerging economies—the argument goes—has at first found its way to the US corporate sector, determining positive wealth effects for the households holding US equities and has later translated into a flood when, combined with a rising federal budget deficit, it has determined a decrease in interest rates and an increase in prices in the housing market.

Theories focused on the investment side of the current account definition point either to sharp increases in US investment or to decreases in foreign investment. According to the first view, current imbalances might be attributed to the attractiveness of the US market to foreign capital, determined by the implications of the 'new economy': productivity growth and greater profitability of investment, especially in IT-intensive sectors.

According to the second view, the existence of global imbalances is to be attributed to a decline of investment in countries outside of the USA, especially pronounced in the Euro zone and in East Asia. It is normally pointed out that East Asian countries never fully recovered from the 1997–98 crisis and that mature economies such as those of most of the Euro area are suffering from a lack of dynamism. The causes of the decline in investment are generally not explored in great detail: the East Asian 'investment strike' appears, to some extent, to be a puzzle (IMF, 2005, p. 107).

While elements of the four different versions of the 'global imbalances' hypothesis might play a role in explaining the crisis (US savings, emerging markets savings, US investments and emerging markets investments), the available data tend to support the 'global investment strike' interpretation by suggesting that the 'global saving glut' is only the reverse side of the coin of a slump in investment opportunities.

The data on global saving patterns provided by the 2005 IMF World Economic Outlook might, at first glance, be taken to support the 'global saving glut' hypothesis. Indeed, saving in emerging economies and oil producing countries has been characterised by an upward trend since the 1970s. This trend has offset the downward trend in saving experienced by industrialised countries over the same period, leading to an increase in the net lending capacity of countries outside the USA.

On closer inspection, it appears that the mentioned data are not sufficient to the task. To make sense of the 'global imbalances' that have certainly played a role in originating the crisis, it is necessary to consider also the decomposition of saving across emerging economies and the global trends in investment. By jointly considering global saving and investment trends, it is possible to shed more light on the true determinants of the 'saving glut'. In particular, it appears that instead of, or perhaps to some extent besides, intentional

policies aimed at preserving current account surpluses adopted by emerging countries, it is a remarkable decrease in investment in countries outside of the USA that explains the ‘saving glut’.

This conclusion is supported by at least two observations. First, the saving rate in emerging Asia excluding China remained surprisingly stable over the last two decades and has actually experienced a downward trend over the 1990s and only a slight rebound after the year 2000. The upward trend in saving in emerging countries is therefore mostly explained by the sharp increase in saving experienced by China and the oil producing countries. Second, investment rates have been significantly decreasing both in industrial countries, and particularly in Japan and in the Euro area, and in emerging economies since the Asian financial crisis of 1997–98, with the exception of China and a few other countries. In particular, in East Asia investment rates have experienced a drop of more than 10 percentage points of GDP since the mid-1990s and have only modestly recovered since, mainly on the basis of a sharp increase in public investment. The investment to capital ratio in the East Asian corporate sector has fallen by one half between 1993–96 and 1997–2003 (IMF, 2005). The increase in lending capacity of this region should thus be attributed to an ‘investment strike’ rather than to an increase in the saving rate, as the ‘saving glut’ hypothesis would have it (Moëc and Frey, 2006; also see Figure 1).

An analysis of the US domestic investment patterns is also insightful. Aggregate US investment rose during the period 1991–2004 at only an extremely moderate pace (1% of GDP). What is more striking, investment by US corporations sharply decreased over the same period, in spite of the exceptionally low borrowing costs and of the high opportunity costs of saving.¹ In other words, the US non-financial corporate sector has become a net

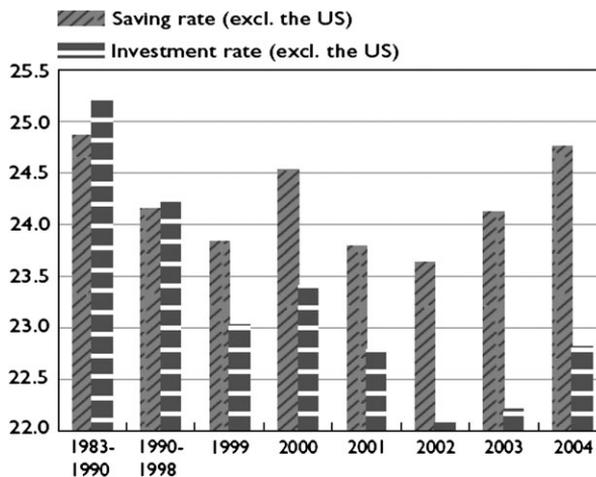


Fig. 1. World savings and investment rates as a percentage of world gross domestic product (GDP). Source: Moëc and Frey, 2006, (p. 3).

¹ Already in July 2005 an article in *the Economist* talked of a ‘corporate saving glut’, and its subtitle noted that the great corporations, more than the emerging economies, had become the world leaders of the global switch to thrift.

lender over the mentioned period. At the same time, while reluctant to invest at home, US corporations have sharply increased their willingness to invest abroad. Foreign direct investment has increased from 1.0% of GDP at the end of 2002 to 2.0% of GDP in 2004, namely twice the long-term average (Moëc and Frey, 2006).

Moreover, the nature and direction of foreign investment in the USA has changed considerably since the mid-1990s. While in the second half of the 1990s foreign investment in the USA was mainly composed of private investment, in the present decade it is investment by central banks that has the lion's share of it. Over the same period, foreign investment has been redirected away from the corporate sector and towards fixed-income markets, particularly US government securities.

These data are difficult to reconcile with the 'rising investment in the USA' interpretation of global imbalances and with the conventional implications drawn from placing emphasis on the 'new economy'. If the new economy has brought about significant increases in productivity and therefore in profitability, it is difficult to explain why US corporations direct their investments abroad and do not attract significant foreign investment.

While the above data establish the existence of a global investment strike and highlight the relative stagnation of investment in the USA, they point to the need for an explanation of why this is so. Why did emerging countries (as mentioned, excluding China) experience such sharp decline in investment? Why does investment in the USA show signs of a progressive slow down, contrary to what the implications of the 'new economy' thesis would plausibly suggest? A convincing explanation is still lacking. While traditional econometric models have been able to explain the evolution of investment patterns on the basis of economic fundamentals, they have not satisfactorily explained investment behaviour on the basis of such fundamentals (IMF, 2005).

3. Intellectual monopolies and investment blockage

A contribution to the answer to the questions at the end of the previous paragraph may be found in a feature of present-day economies that is not generally taken into account in conventional analyses, namely the extraordinary increase in the extent of knowledge privatisation that has characterised the past two decades. This has generated a progressive slump in investment opportunities first in countries outside of the most intellectual property-rich country of the world—the USA—and later on, to a more limited extent, in the USA as well.

Knowledge privatisation is the result of two sorts of complementary policy developments that have gone hand in hand. On one side, the global intellectual property regime has been strengthened and extended. On the other side, research and innovation policies have more or less intentionally decreased the role played by open science in modern economies. We leave the discussion of the latter set of policy developments to the next section and begin by highlighting the role of IP policies.

Modern economies are conventionally described as 'knowledge economies'. Although a precise definition of the expression is difficult to find, aspects that are often emphasised are that knowledge economies are characterised by a greater reliance on intellectual capabilities than on physical inputs or natural resources, that they are characterised by an acceleration of knowledge production or by a growing importance of science and technology-related activities (see, for instance, David and Foray, 2001).

A number of indicators of knowledge-intensiveness have been proposed to support the view that modern economies are increasingly knowledge-based. One such indicator might be given by the ratio between tangible and intangible assets in the composition of Standard & Poor's 500 firms market value. The estimation of this indicator made by Ocean Tomo, a leading trader of IPR, supports the claim that 'within the last quarter century, intellectual capital has emerged as the leading asset class' (Figure 2).¹

This indicator is admittedly rough. Indeed, accountants have not come to an agreement about the precise measurement of intellectual capital and of other forms of intangibles, so that the value of intangibles is often determined by subtraction from the market value of the firm of the market value of its physical assets. However, there is no doubt that in the evaluation of most firms, including those in former mature sectors like the automobile industry, intellectual capital has an increasingly important weight.

Another commonly used indicator is given by patenting activity. The upward trend in both patent applications and patents granted over the period 1950–2007 in the USA, illustrated in Figure 3, confirms the increased relevance of intellectual assets in the US economy.

What it is important to note is that both of the mentioned indicators should not only be considered as indicators of the extent to which current economies can be characterised as knowledge economies, but also of the extent of the knowledge privatisation that has taken place over the past two decades. The reasons for the increased knowledge privatisation are manifold. A number of policy developments in the intellectual property realm has played, of course, a major role.

First, since the 1980s in the USA and slightly later in other developed countries, most notably European countries and Japan, patentability has been extended to encompass previously excluded technological domains, such as software, business methods and

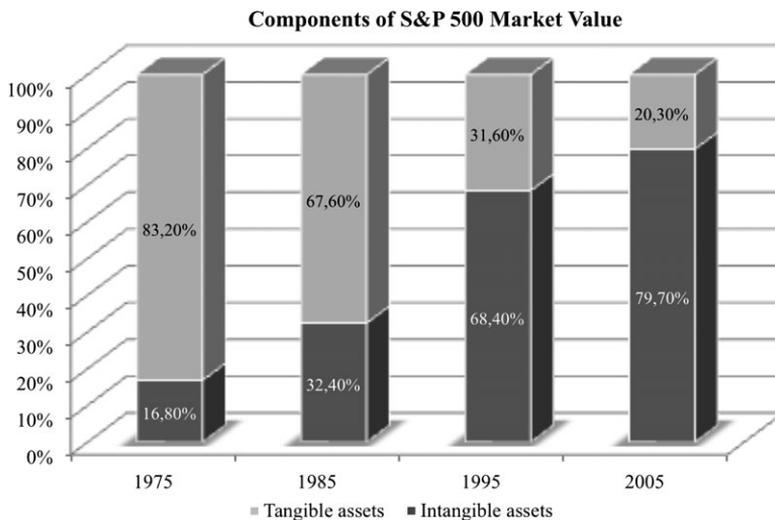


Fig. 2. Changes in the ratio of tangible to intangible assets in the composition of S&P 500 firms market value.

Source: Author's elaborations on data provided by Ocean Tomo (<http://www.oceantomo.com/ice.html>)

¹ See Ocean Tomo at <http://www.oceantomo.com/ice.html>.

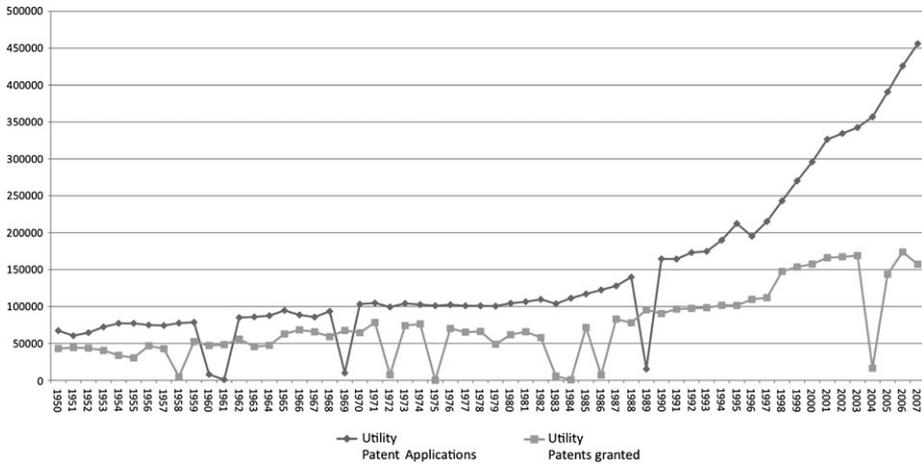


Fig. 3. Patenting activity in the USA over the period 1950–2007.

Source: Author's elaborations on data of the US Patent and Trademark Office (2008).

biological inventions. Second, patenting standards have been considerably relaxed, leading to the shading of the distinction between pure information and practically applicable knowledge.¹ Both of these developments have contributed to the 'upstreaming' of patentability, namely to the tendency of IP rights to protect knowledge ever closer to the realm of abstract ideas. Third, the institution of the Court of Appeals of the Federal Circuit, in the USA, has considerably strengthened the enforcement of IPRs in the USA.

Fourth, and most important, on 15 April 1994 the TRIPs agreement was signed at Marrakech as part of the agreement founding the WTO, thus harmonising (and extending) the extent of IP protection in all WTO member states. Unlike all previous international agreements on IP, the inclusion of the TRIPs agreement in the WTO constitution created an effective mechanism of IPRs enforcement. States could now be disciplined through the institutions of the WTO itself and, in extreme cases, access to international trade by IP 'thieves' could be restricted.

How does this set of IP policy developments relate to the existence of a global investment famine of good productive opportunities? We propose that the mentioned IP policy developments, together with the policy move away from open science (on which more will be said in the next section), has determined a tendency towards over-propertisation of intellectual resources, namely a degree of privatisation that is suboptimal from the social standpoint.² Over-propertisation, in turn, has had a two-fold effect. First, it has affected the global division of labour, diminishing investment opportunities in countries characterised by lower IP intensity. Second, due to the negative effects of over-propertisation on

¹ Requirements analogous to the 'inventive step' requirement of art.56 of the European Patent Convention or the 'non-obviousness' requirement of section 103 U.S.C. 35, but also the standards of utility and novelty embedded in most patent systems, are reportedly applied in a more lenient way than in the past in most developed countries (Barton, 2000).

² This conclusion is backed by the IP literature, which has convincingly made the argument that: (i) the international harmonisation of intellectual property regimes generates a degree of protection excessive from a social standpoint; (ii) the level of public investment in R&D is also suboptimal, when a strong intellectual property regime is available at the international level; and (iii) society as a whole would be better off if increased levels of public spending substituted for excessively strong intellectual property protection (Scotchmer, 2004).

the productive utilisation of intellectual resources, there has been a progressive reduction of investment opportunities in the most IP-rich country, i.e. the USA. Although aware that this interpretation should be subjected to empirical test, in what follows we set out the theoretical argument, leaving the empirical investigation to further work.

Let us consider first the effects of the globalisation and strengthening of IPRs on the global division of labour. The 1994 TRIPs agreement represents a decisive step in the globalisation process: the economy has become global not only because of the diffusion of new technologies or the greater extent of economic integration but also because IPRs, which are intrinsically global rights, have become enforceable across the whole world.

What is important to note is that the extension and strengthening of IPRs at the global level exert a profound impact on the comparative advantage of different countries.¹ In particular, it favours those countries, such as the USA, that have a greater 'initial endowment' of IPRs. Firms in those countries, endowed with globally-protected IPRs, face less obstacles to investment because they can invest in new knowledge knowing that they will bear a lower burden of licensing fees and that there is a reduced risk that their innovative investments will be blocked by costly IP negotiations and refusals to license. Moreover, global IP protection allows firms in IP-intensive countries to decentralise production processes in countries with low labour costs through foreign direct investments with less fear of being imitated. Indeed, there is ample evidence showing that foreign direct investment has been influenced by the strength of IP protection (see, for instance, Oxley, 1999).

As an indirect and very rough indicator of the advantage enjoyed by US firms by virtue of the global enforcement of IP rights, it is instructive to consider the data on the amount of royalty and license fees received by different geo-economic areas over the period 1990–2006, as illustrated in Figure 4.

In addition to the above-mentioned effects, it might also be argued that a stronger global IP system favours those countries that produce more intensively intellectual resources easily amenable to IP protection, such as those generated by science-based sectors. In other words, it favours those countries, and particularly the USA, whose innovation system can be characterised as 'top-down', in that it produces predominantly explicit knowledge that can easily be codified and protected through IPRs, leading to further specialisation in IP-intensive sectors. At the same time, the globalisation of IPRs negatively affects those countries whose innovation systems are 'bottom-up' in the sense that they are relatively more specialised in the production of incremental innovations developed on the basis of firm-specific knowledge and therefore in the production of tacit knowledge that is less easily amenable to IP protection. When IPRs are clearly defined and enforced at the global level, science-based and discontinuous innovations generate higher profits than incremental innovations burdened by costly licenses and by the other costs associated with the use of IP.

The effects of the strengthening of IPRs on the profitability of the American model of capitalism have self-reinforcing properties. The increased profitability of US businesses, fostered by the ability to enforce their own IPRs at home and abroad, attracted foreign savings that, in turn, contributed to consolidate the strength of the model, leading to

¹ This insight extends some intuitions provided by the 'varieties of capitalism' approach (for a collection of relevant articles, see Hall and Soskice, 2001), which stresses that ever more integrated markets tend to favour a process of specialisation according to countries' comparative advantage, where the latter is determined not only by technology and factor endowments, but also by the characteristics of the institutional context. Pagano (2007) considers the limitations set by IPR to the variety of capitalist models. Belloc and Pagano (2009) argue that the multiplicity of models of capitalism is due to the co-evolution paths of the labour and financial market institutions which have occurred in the different countries.

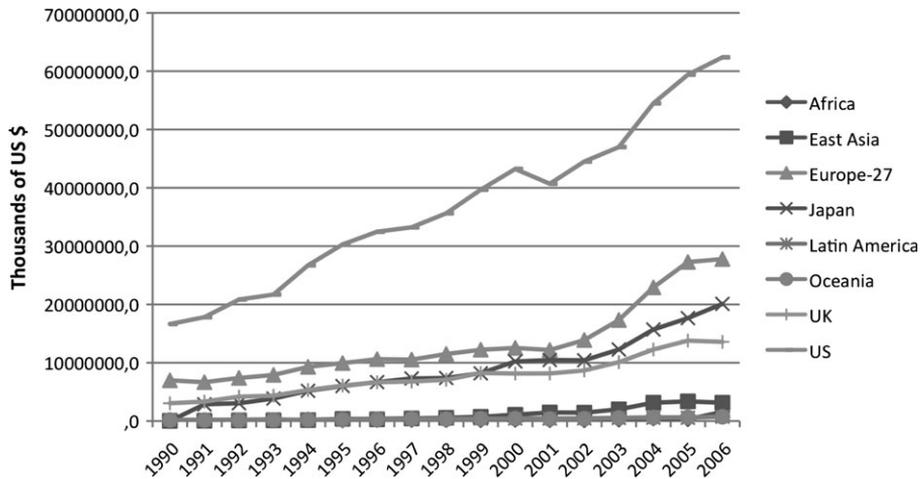


Fig. 4. Receipts of royalty and license fees by geo-economic areas (BoP, current US\$) over the period 1990–2006. Note that the categorisation of countries follows geo-economic criteria. In particular, East Asia comprises the ASEAN countries [Indonesia, Malaysia, the Philippines, Singapore, Thailand, Brunei, Burma (Myanmar), Cambodia, Laos, and Vietnam], India, P.R. China, South Korea, the Republic of China (Taiwan) and Hong Kong. Japan, which is normally included in the group of East Asian Countries is excluded because of its peculiar characteristics in terms of patenting.

Source: Authors' elaborations on World Bank Development Indicators (World Bank, 2008).

further accumulation of intellectual monopolies. As new spaces opened up for the American companies super-endowed with IP 'resources', numerous opportunities for investment were closed to Japan and the former Asian tigers, which had neither America's monopolistic endowment nor China's lower costs.

To sum up, the first part of the argument that we are proposing implies that the globalisation of IPRs might have played a much greater role than it is currently believed in reducing investment opportunities outside of the most IP-rich country—the USA—and therefore in contributing to the significant decrease in investment experienced in Japan, the Euro area and East Asia (excluding China) after the mid-1990s. The same phenomenon might also be considered a factor in explaining the propensity of US businesses to invest outside of the USA and therefore the significant increase in foreign direct investment witnessed in the same period.

Although it does not prove the point we are making, it is at least suggestive that in the first half of the 1990s the 'American model' of capitalism was perceived as falling behind the alternative German and Japanese models, whereas by the end of the 1990s, after the signing of the TRIPs agreement in 1994, the situation had completely reversed. The USA (and the UK) had become the model to imitate, and yesterday's heroes (not only Germany and Japan but, after the 1997 crisis, also all the Asian tigers) strove to restructure their economies mimicking the so-called Anglo-American model.

The interpretation we advance thus highlights a curious paradox: it was not the virtues of competition, but rather the advantages of intellectual monopoly, which enabled the USA to catch up with the other Western economies so quickly. More than that: notwithstanding the seductive rhetoric extolling free trade and private property, the Marrakech agreement introduced super-tariffs such that the most extreme form of protectionism pales into

insignificance. Through such tariffs, developed countries are kicking away the ladder from developing countries (Chang, 2002).

Let us now turn to the second part of our argument: that the excessive degree of privatisation of intellectual resources has led, through time, to a progressive fall in investment opportunities in the USA as well. This, in turn, explains the limited dynamism of US corporate investment.

The preamble to TRIPs states as self-evidently obvious that 'intellectual property rights are private rights' like all other private property rights. This, of course, implies that they are as crucial to investment incentives as the protection of tangible property. Yet this obviousness would have been unknown to an innovation economist of Schumpeter's calibre, and it has been widely disputed.

Indeed, the conventional wisdom has it that private property rights over intellectual resources are an essential precondition for protecting innovators' incentives to invest and for enabling the commercialisation of intellectual resources whose exchange would otherwise be hampered by the well-known 'Arrow's paradox'. The ability to exchange intellectual resources, in turn, has a positive effect on investment incentives. While the essence of the argument is clearly correct, the IP literature has highlighted that more IPRs is not always better. A consensus has emerged on the fact that the strengthening and extension of IPRs can have negative effects on the incentives to invest and on the existence of a need for reform of the patent system (see, for instance, Bessen and Meurer, 2008; Boldrin and Levine, 2008; Jaffe and Lerner, 2006; National Research Council, 2004).

The IP literature has, in particular, highlighted the problems that IPRs might generate in the commercialisation of knowledge. The range of transactional problems that may determine the under-utilisation of intellectual resources has been synthesised in the famous metaphor of the 'tragedy of the anticommons', which refers to the possibility that the excessive fragmentation of IPRs, especially on upstream research inputs, might reduce investment in the productive exploitation of intellectual resources because of the transaction costs involved in the need to assemble a great number of IPRs (Heller and Eisenberg, 1998).

More generally, the IP system may not ensure an adequate division of profits among successive innovators (Green and Scotchmer, 1995), which translates into inefficient incentives to invest either for the 'pioneer' or for the subsequent innovator in technologies characterised by knowledge cumulateness. Given that the most dynamic sectors of the economy are characterised by a high degree of knowledge cumulateness, the risk of a negative effect of patents on investment becomes particularly salient.

Excessive strengthening of IPRs might also decrease investment incentives because IP-holders tend to increasingly use IP strategically (Rivette and Kline, 2000). In particular, owners of IPRs increasingly tend to adopt restrictive contractual practices in the management of their intellectual resources (refusals to license, exclusive licensing, clauses extending control of the IP holder to future developments of the technology such as 'reach-through claims' and grant-back clauses; Organisation for Economic Cooperation and Development, 2005); to raise barriers to entry through the building of 'patent fences' (Cohen *et al.*, 2000); to adopt 'patent flooding' strategies, namely strategies aimed at obtaining patents on a trivial variant of an initial innovation so as to 'surround' the rival's innovation and force a cross-licensing agreement (Sankaran, 2000); to threaten litigation with the only aim of extracting royalties through so-called 'patent trolls'.

The increased strategic use of patents might contribute to explain why firms, and especially US firms, spend resources in acquiring IPRs although they consider them only

a secondary means for the protection of investment in the majority of sectors, with the exception of the chemical, the pharmaceutical and the medical devices sectors (see, e.g., Cohen *et al.*, 2000). Firms find themselves in a 'prisoner's dilemma' situation in which acquiring IPRs is the dominant strategy. The accumulation of patents (often of uncertain validity), in turn, exacerbates the negative effects on incentives to invest and on the profitability of investment highlighted above.

To sum up, it may well be the case that IPRs are determining a progressive fall of investment opportunities in the country that has accumulated the highest number of IPRs overall, by raising the costs and the risks of investment. The point is difficult to prove empirically, if anything because it requires abstract comparisons of the present scenario with an IP-free counterfactual, but the mentioned concerns should not be considered only theoretical speculations. Indeed, businesses do report increasing difficulties in dealing with the drawbacks of the IP system (U.S. Federal Trade Commission, 2003). Moreover, empirical research has shown that, in the USA, the strengthening of IP legislation has determined an increase in the number of patents granted but not an increase in R&D spending (Jaffe, 2000).

4. The closure of open markets and of open science

As is well-known, knowledge production involves a typical free riding problem, which cannot be solved by the incentives provided by standard competitive markets, due to the combination of non-excludability and the existence of fixed production costs. The IP solution to this problem involves a trade-off between incentives to invent and efficient static access to intellectual assets, because of the characteristic of non-rivalry of knowledge that implies that the marginal cost of access to new knowledge does not increase with the number of users of such knowledge, so that efficiency would require access to be granted *ex post* to all potential users at zero cost (Arrow, 1962).

Awareness of this trade-off has always suggested the need to find a delicate balance between the granting of intellectual monopolies, even for a limited period of time, and the creation or preservation of the institutions of 'open science', namely institutions whose main purpose is the creation and diffusion of publicly available knowledge. Of course, public production or public sponsorship of the production of knowledge has never been considered as the single most appropriate solution to the problem. Indeed, no State or other central planner can *ex-ante* obtain sufficient information to estimate the value that new knowledge will have for all potential users. Each of the possible incentive mechanisms—IP, prizes, public procurement, direct public production of knowledge—has problems of its own (Gallini and Scotchmer, 2002; Wright, 1983). A complex mix of real life imperfect institutions has therefore always characterised the production of knowledge.

The non-rival or, better, the augmenting nature of knowledge, has been a key-factor in human development since the dawn of our species (Battistini and Pagano, 2008) and could be increasingly relevant in modern knowledge economies (Bowles, 2006). The paradox of the knowledge economy, however, appears to be that the mix of institutions for knowledge production is progressively shifting in the direction of knowledge privatisation and away from the institutions of open science, which undermines the possibility of exploiting the benefits of non-rivalness at a time when knowledge is becoming increasingly relevant to economic activity.

In the previous section we have considered the effects of the strengthening of the IP system and of its extension to all WTO member states. In this section we describe the

origin and the importance of the institutions of open science and the progressive reduction of their role in the knowledge economy.

What is particularly unfortunate about the dawn of the institutions of open science is that the growth of a common pool of publicly available basic knowledge—‘why’ knowledge, in Mokyr’s (2002) terminology—is a necessary condition for the continuous growth of technical knowledge (‘how’ knowledge). A delicate balance between the global common basic knowledge and the proprietary technical knowledge must exist: the up-streaming of the proprietary arrangements to basic knowledge may imply the self-destruction of the conditions of its growth.

According to Mokyr (2002), the industrial revolution was made possible by a long period of industrial enlightenment. Before British early industrialisation, much ‘why’ knowledge had been accumulated and made easily accessible. A large pool of ‘why’ knowledge made possible the development of ‘how’ knowledge in a form such that it was possible to move easily from one technology to another or from one ‘how’ question to another. In situations where the epistemic basis of technology was underdeveloped, technological innovations were isolated answers to particular ‘how’ questions and it was not possible to generate a continuous process of technological innovation. By contrast, once a rich basis of ‘why’ knowledge was made available, it was possible to start a self-feeding interaction between why-knowledge and how-knowledge. It was the institutions of open science that ensured the availability of ‘why’ knowledge.

But how could open science develop before the industrial revolution? We have no ambition to give an answer to this complicated question. However, it is a fact that some important global institutions of open science came into being well before the English industrial revolution and even before the revolution of productive methods that took place during the Italian Renaissance. Indeed, it might be argued that they emerged as the unintended result of the problems and the conflicts of the late Middle Ages. In the words of Paul David (2004):

Rather than emerging and surviving as robust epiphenomena of a new organum of intellectual inquiry, the institutions of Open Science are independent, and in some measure fortuitous, social and political constructs. They are in reality intricate cultural legacies of a long past epoch of European history, which through them continues to profoundly influence the systemic efficacy of the modern scientific research process.

In this respect, the foundations of universities marked an important change in the production of knowledge. As Berman (1985, pp. 159–60) has pointed out:

What has been especially characteristic of Western Science, including legal science, since the twelfth century is its close historical connection with the institution of university; science was born in university and the university bestowed upon it its precarious heritage of freedom of teaching and research [. . .]. It takes more than the progressive translation of the works of Aristotle to explain why in the year 1150, possibly ten thousands students from all over Europe could be found in the town of Bologna in northern Italy studying legal science. They were there because society made it possible—indeed—made it urgent that they were there [. . .].

Interestingly enough, universities did not only emerge well before the advent of capitalism but also well before the emergence of nation-states. They came about at a time when knowledge was conceived as a global common good to be used in the government of the global institutions that characterised the Western Europe Middle Ages. These global institutions had fierce contrasts but they recognised that each one of them had a proper sphere of influence. Good rules were needed to specify the appropriate domain of their power.

The Middle Ages were characterised by legal pluralism, that is a common legal order containing diverse legal systems (church versus crown, crown versus town, town versus lord, lord versus merchant). Legal pluralism was a source of freedom and of legal sophistication and was a decisive factor in the foundation of universities and the origin of Western science. The typical questions, which emerged in this framework of overlapping legal systems were: which court has jurisdiction? which law is applicable? how are different legal differences going to be reconciled? The independence of scholars became a precious asset in solving these disputes.

Universities emerged as the locus where both independence and fair adjudication of scholarly disputes could emerge. In this respect, they were profoundly different from the classical academies dominated by a single school of thought. Universities were based on the idea that there was some way to adjudicate truth that would emerge through proper debates and reference to the appropriate texts. For this reason, in the Western legal tradition, law was conceived to be a coherent whole within which all the disputes among the various authorities could be solved. In the formative era of the Western legal tradition, natural-law theory predominated. It was generally believed that human law derived ultimately from, and was ultimately to be tested by, reason and conscience.¹ It was the twelfth-century scholastic technique of reconciling contradictions and deriving general concepts from rules and cases that first made it possible to coordinate and integrate the Roman Law of Justinian. The same methodology was then applied to other disciplines and paved the way for the emergence of Western science.

In some respects, the institutions under which Western science emerged are polar opposites of those of the contemporary economy. They came about in an era dominated by global political powers such as the Church and the Empire, which were supposed to represent the global interests of humankind and accepted only limits due to their specific function. Local powers were weak, markets were not integrated, private property had still to see the emergence of the enclosure. The why-questions dominated the interests of people and offered a fertile ground to the growth of universities and, in general, to the emerging institutions of open science.

The present world is characterised by an absence of global political powers and by integrated markets, including markets for knowledge. In this world, which open science has so dramatically helped to create, the institutions that make knowledge a global common are increasingly weaker than those that make it a private good. For a long time our world has been a World of Nations, interested in science and culture for the power that they conferred to their States.

The development of markets has certainly favoured the diffusion of knowledge beyond national boundaries. However, this has made open science relatively less appealing in comparison to closed science. While global institutions (WTO and the related TRIPs agreement) have made private IP more profitable, no institution has similarly increased the convenience of public intellectual property. The present (and, even more so, the missing) institutions of the global economy have made it convenient to over-privatise knowledge and over-monopolise the economy by means of a tight web of IPRs.

¹ This theory had a basis in Christian theology as well as Aristotelian philosophy. But it also had a basis in the history of the struggle between ecclesiastical and secular authorities and the politics of pluralism. From this point of view the legal doctrines developed in the first European Universities were much more than a simple rediscovery of Roman Law. Roman Law did not have the same aim or the same need to constitute a coherent whole within which the conflicts among authorities could be solved. Indeed, the phrase '*corpus juris Romani*' was not used by the Romans but by the twelfth and thirteenth century European canonists.

These broad tendencies have been realised through a number of concrete developments. Starting from the 1980s, policies have been enacted in the USA and later in the rest of the world that have strongly encouraged the patenting of publicly funded research results by universities, small firms and public research organisations in general.¹ Since then, most universities, both in the USA and in other developed countries, have entered into the IP management business, to an extent that has led US courts to state that they do not deserve anymore a 'research exemption' from patent infringement because they pursue a private interest as any other research-oriented business.² More generally, it appears that the culture of open science distinctive of public research and Mertonian science (Merton, 1973) has been jeopardised by the new IP rules, with obvious consequences for the free dissemination of research results.³ Finally, a shift seems to have occurred in the research agendas of most public institutions away from basic research and towards applied, and more directly rewarding, research endeavours.

While its present institutions are likely to contribute to a prolonged stagnation, the knowledge-intensive economy offers great opportunities for more effective Keynesian policies. Instead of being used inefficiently to nationalise the assets of firms producing private goods, public funds could be used to decrease the monopolisation of knowledge and to efficiently transfer knowledge from the private to the public sphere. The institution of a strong World Research Organization (WRO) should balance the WTO, which has increased the relative convenience of intellectual private property to such a great extent. A WRO should create the conditions whereby public acquisition of IP is feasible whenever it is able to foster development. All governments should acknowledge that knowledge is a non-rival (or even an anti-rival) good that should be treated as the most precious and specific global common of humankind.

The institutions of open science that preceded the advent of Nation States and of the Industrial Revolution should play a more important role in the modern economy and, in some cases, should be funded at the global level. By taking this route, the private industry can find itself again in harmony with the institutions of open science and contain the erosion of the institutions that created some of the initial conditions necessary for industrial development. Within a new architecture of the global economy, free markets and open science must regain a great deal of the ground that they have lost to monopolised markets and closed science.

5. In the short-run, beyond credit regulations: the knowledge-economy super-multiplier

A project that increases the space for free markets and open science may sound a good opportunity to recall the Keynesian scepticism for an uninteresting long run (where we are all eventually dead, especially if a crisis requires immediate and effective policies). However, the long-run vision of the future of the global economy also suggests great opportunities for short-run Keynesian policies.

¹ The landmark event in this respect can be considered the issuance in the USA in the 1980s of the Bayh-Dole Act, concerning the patentability of federally-funded research results.

² The reference case in this regard is the famous US case *Madey vs Duke University*. The court held that Duke University was in the business of doing research and denied the existence of a research exemption.

³ A modification of the scientific culture has taken place especially in the life sciences, where research materials are withheld from public access more frequently than in the past and contractual agreements between university and industry often impose publication delays and/or the deletion of some information from publishable papers (Thursby and Thursby, 2002).

We submit that in the current crisis public funds should not only finance new public research projects but should also be used to acquire immediately well-established IPRs from private firms. This policy can have immediate effects and go well beyond those entailed by many currently proposed anti-crisis measures.¹

First of all, this form of public funding does not involve the nationalisation of firms or the use of taxpayers' money without any returns. By contrast, the IPR is paid at a price corresponding to its private value but it is transferred into the public domain where it has a much greater value and could potentially reduce the costs of production of many producers. Only a monopolist capable of perfect price discrimination (which is, of course, only a useful theoretical abstraction) can obtain from her IP a social benefit equal to the benefit that would be obtained by making it available to all her competitors. Moreover, IPRs are currently undervalued (together with the stock values of the firms that hold them) so that they could be acquired at a price that might be advantageous both for the monopolist seller and for the community that acquires them.

Second, this system may guarantee a financial inflow to those firms that have demonstrated to be most innovative. A strong stimulus to new investments may come in this way from two sides. On one hand, these firms will obtain new funds; on the other hand, by selling their IP, they will face stronger competition. As a consequence, they will have both the financial means and the incentive, due to competitive pressure, to invest in innovation stimulating aggregate demand. The whole chain of innovative process would therefore be accelerated, with positive consequences for the growth of the economy and the efficiency of firms.

Third, it should be noted that through this mechanism a monopoly price would be substituted by a lower competitive price. This aspect has a positive effect on aggregate demand, not inferior to the one that would be obtained through other policies aimed at lowering production costs such as, for instance, tax breaks.

Finally, the 'anti-commons' problem, i.e. the problems in the commercialisation of knowledge arising from the transaction costs associated with the excessive fragmentation of IPRs is eased; everyone can now invest in new knowledge being aware that complementary pre-existing knowledge is less likely to be owned by other firms and involve costly future negotiations, which may fail (Pagano and Rossi, 2004). Indeed, moving IPRs into the public domain clearly reduces the extent of property rights fragmentation, lowering the costs, the risks and more generally the obstacles associated with access to pre-existing knowledge. While the immediate benefits of new funding go to incumbent innovative firms, which may often belong to the richer countries, new knowledge becomes freely available to everyone and yields widespread beneficial effects, thereby contributing to the overall development of the world economy.

There are, of course, many aspects of the working of a patent buy-out system of the sort we propose that should be further analysed in order to ensure its successful concrete implementation. First of all, a solution should be found to the inevitable free-riding problem arising at the international level. In this respect, some form of international coordination might be needed, such as, for instance, the creation of a new supra-national institution (such as the WRO mentioned in the previous section). Second, it is necessary to identify a mechanism of definition of the buying price of IPRs and to define priorities for

¹ Kremer (1998) is one of the few authors to consider the possibility of a patent buy-out. However, although he explores the properties of a mechanism of patent buy-out from a theoretical perspective, he does not consider the wider economic implications of such a policy in a situation of crisis such as the one we presently face.

intervention or, in other words, to select the IPRs that should be acquired by the public institution, on the basis of a quantification of the positive effects expected from the release of the underlying knowledge in the public domain. Finally, ways should be found to avoid phenomena of adverse selection in the acquisition of IPRs from the public sponsor and to make the mechanisms of price definition and selection of IPRs immune to collusive behaviours and to the influence of lobbies that could distort the choices of the public institutions acquiring them.

The existence of these (minor, we think) unresolved issues should not obscure the fact that the multiplicative effects just outlined are highly likely to be stronger than those traditionally associated with standard Keynesian policies: they are more powerful both on aggregate demand and on the level of efficiency of the economy. An investment ‘super-multiplier’ can be made to work in knowledge-intensive economies.

6. Conclusion

Owing to the long-standing academic dominance of neo-liberal ideology, in the present crisis state intervention is seen as a necessary short-run evil, which will necessarily produce serious long-run problems. The kind of policy measures we propose, however, aimed at redressing the balance between public and private knowledge, would not only have strong short-run super-multiplicative effects but would have long-run benefits as well. What makes this policy difficult to implement is that it requires international cooperation and appropriate anti-lobby measures. Different countries should share the funding of the global commons of basic knowledge. Lobbies may exploit the fact that, while a ‘fair price’ can be obtained for most IPRs, there is no well-defined market price for them. However, the current crisis may create the conditions that enable free-riding to be overcome, and lobbying activities to be restricted.

The present economic crisis looks increasingly similar to the situation of the 1930s. Evidence is accumulating that we are in a liquidity trap where monetary policies have a limited effect, and that massive public investments are going to be necessary to re-launch the economy. In a situation in which most economists have been blinded by an ideological commitment to ‘market fundamentalism’ (Soros, 2008), it is not surprising that the policies and the theories of the 1930s are among the few reliable references to deal with the crisis. However, one should not underplay the extent to which the economy has changed since the Great Depression. In the 1930s, in order to stimulate aggregate demand, the focus was placed on building physical infrastructure. In a modern knowledge-intensive economy (Hodgson, 1999), these policies should be integrated by policies exploiting the new opportunities for Keynesian-type measures offered by the institutions of contemporary economies.

The measures considered in this article should, certainly, be part of a package comprising other, more traditional policies. The multiplicative effects of traditional public works are likely to be transmitted to less knowledge-intensive countries in terms of increased immigration, and their public nature (in terms of non-rivalry and widespread availability) is limited in comparison to knowledge goods. In the current situation, however, some increase of traditional public investments is certainly useful (to alleviate, for instance, the dramatic crisis of the building industry).

Monetary policy should continue to make borrowing as cheap as possible, but a liquidity trap seems close at hand. Financial regulations are going to be very useful in the long run to limit the damage caused by the next bubble, but the dramatic shrinking of employment in

the financial sector is going to be irreversible for some time. Indeed, one of the worst effects of ‘market fundamentalism’ has been that some of the best minds of a generation have been misallocated to ‘bubble production’ and their jobs have suddenly ‘burst’. The potential investment super-multiplier existing in the knowledge economy can also ease unemployment in the financial engineering sector by increasing demand for more beneficial engineering skills.

Any successful anti-crisis policy must be a complex mix of policies, and it would be very useful to know the correct weight to give to each one of them. Unfortunately, there are no experiences from which we can extract these weights, and there is even less time available for the painstaking accumulation of evidence. In these circumstances, we must accept that the policy mix can only be adjusted by a fallible process of trial and error.

The purpose of this essay has been to argue that some of the causes of the crisis are due to the very institutions of the knowledge economy, which has become a world of closed science and of intellectual global monopolies. However, even if one does not accept this analysis, it would be helpful for the mix that is initially chosen to try to exploit the super-multiplicative features that knowledge has when its use is not restricted in the cage of intellectual monopoly. The main cause for catching a bad flu may be the cold weather but staying closed in a warm house is only one of the remedies.

Bibliography

- Arrow, K. J. 1962. Economic welfare and the allocation of resources for invention, pp. 609–25 in Nelson, R. R. (ed.), *The Rate and Direction of Inventive Activity: Economic and Social Factors*, National Bureau of Economic Research, Conference Series, Princeton, Princeton University Press
- Barton, J. 2000. Reforming the patent system, *Science*, no. 287, 1933–4
- Battistini, A. and Pagano, U. 2008. Primates’ fertilization systems and evolution of the human brain, *Journal of Bioeconomics*, vol. 10, no. 1, 1–21
- Belloc, M. and Pagano, U. 2009. Co-evolution of politics and corporate governance, *International Review of Law and Economics*, vol. 29, 106–114
- Berman, H. J. 1985. *Law and Revolution*, Cambridge, MA, Harvard University Press
- Bessen, J. and Meurer, M. J. 2008. Patent Failure: How Judges, Bureaucrats, and Lawyers Put Innovators at Risk, Princeton, Princeton University Press
- Boldrin, M. and Levine, D. K. 2008. *Against Intellectual Monopoly*, Cambridge, Cambridge University Press
- Bowles, S. 2006. *Microeconomics: Behavior, Institutions, and Evolution*, The Roundtable Series in Behavioral Economics, Princeton, Princeton University Press
- Chang, H. J. 2002. Kicking Away the Ladder. Development Strategy in Historical Perspective, London, Anthem Press
- Cohen, W., Nelson, R. and Walsh, J. 2000. ‘Protecting Their Intellectual Assets: Appropriability Conditions and Why U.S. Manufacturing Firms Patent (or Not)’, NBER Working Paper 7552, available at <http://www.nber.org/papers/w7552> [date last accessed 24 May 2009]
- David, P. and Foray, D. 2001. ‘An Introduction to the Economy of the Knowledge Society’, Working Paper, MERIT, Maastricht
- David, P. 2004. Understanding the emergence of ‘Open Science’ institutions: functionalist economics in historical context, *Industrial and Corporate Change*, vol. 13, no. 4, 571–89
- Eichengreen, B. 2007. The future of global financial markets, in Zedillo, E. (ed.), *The Future of Globalization: Explorations in Light of Recent Turbulence*, London, Routledge
- Gallini, N. and Scotchmer, S. 2002. Intellectual property: when is it the best incentive mechanism? pp. 51–78 in Jaffe, A., Lerner, J., and Stern, S. (eds), *Innovation Policy and the Economy*, Vol. 2, MIT Press [also in Cafaggi, F., Nicita, A. and Pagano, U. (eds) *Legal Orderings and Economic Institutions*, Routledge Studies in Political Economy]

- Green, J. and Scotchmer, S. 1995. On the division of profit in sequential innovation, *RAND Journal of Economics*, vol. 26, 20–3
- Hall, P. A. and Soskice, D. W. (eds), 2001. *Varieties of Capitalism: the Institutional Foundations of Comparative Advantage*, New York, Oxford University Press
- Heller, M. and Eisenberg, R. 1998. Can patents deter innovation: the anticommons in biomedical research, *Science*, vol. 280, 698–701
- Hodgson, G. M. 1999. *Economics and Utopia. Why the Learning Economy is not the End of History?* London, Routledge
- International Monetary Fund (IMF). 2005. *World Economic Outlook: Globalization and External Imbalances*. Washington, DC
- Jaffe, A. B. 2000. The U.S. patent system in transition: policy innovation and the innovation process, *Research Policy*, vol. 29, 531–57
- Jaffe, A. B. and Lerner, J. 2006. *Innovation and Its Discontents: How Our Broken Patent System is Endangering Innovation and Progress, and What to Do About It*, Princeton, Princeton University Press
- Kremer, M. 1998. Patent buy-outs: A mechanism for encouraging innovation, *Quarterly Journal of Economics*, vol. 113, no. 4, 1137–67
- Merton, R. 1973. *The Sociology of Science: Theoretical and Empirical Investigations*, Chicago, University of Chicago Press
- Moëc, G. and Frey, L. 2006. ‘Global Imbalances, Saving Glut and Investment Strike’, Occasional Paper No 1, Banque de France
- Mokyr, J. 2002. *The Gifts of Athena. Historical Origins of the Knowledge Economy*, Princeton and Oxford, Princeton University Press
- National Research Council. 2004. *A Patent System for the 21st Century*, Washington, DC, National Academies Press
- Organisation for Economic Cooperation and Development. 2002. *Genetic Inventions, IPRS and Licensing Practices*, OECD Draft Report, Paris
- Organisation for Economic Cooperation and Development. 2005. *Guidelines for the Licensing of Genetic Inventions*, Paris, OECD
- Oxley, J. E. 1999. Institutional environment and the mechanisms of governance: the impact of intellectual property protection on the structure of inter-firm alliances, *Journal of Economic Behavior & Organization*, vol. 38, 283–309
- Pagano, U. and Rossi, M. A. 2004. Incomplete contracts, intellectual property and institutional complementarities, *European Journal of Law and Economics*, vol. 18, no. 1, 55–76
- Pagano, U. 2007. Cultural Standardization, Institutional Diversity and the Unequal Accumulation of Intellectual Capital, *Cambridge Journal of Economics*, vol. 31, 649–667
- Rivette, K. and Kline, D. 2000. *Rembrandts in the Attic: Unlocking the Hidden Value of Patents*, Cambridge, MA, Harvard Business School Press
- Sankaran, S. K. 2000. Patent flooding in the United States and Japan, *IDEA*, vol. 40, no. 393, 394
- Scotchmer, S. 2004. The political economy of intellectual property treaties, *Journal of Law, Economics and Organizations*, vol. 20, 415–37
- Soros, G. 2008. The crisis & what to do about it, *The New York Review of Books*, vol. 55, no. 19, 4
- Thursby, J. and Thursby, M. 2002. Who is selling the ivory tower? Sources of growth in university licensing, *Management Science*, vol. 48, no. 1, 90–104
- U.S. Federal Trade Commission. 2003. *To Promote Innovation: The Proper Balance of Competition and Patent Law and Policy*, available for viewing at: <http://www.ftc.gov/reports/index.htm>
- US Patent and Trademark Office (USPTO). 2008. *US Patent Statistics Report*
- World Bank. 2008. *World Development Indicators 2008*, Washington, DC, World Bank
- Wright, B. D. 1983. The economics of invention incentives: patents, prizes and research contracts, *American Economic Review*, vol. 73, 691–707