

Trends in Financial Innovation and their Welfare Impact: an Overview

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Abstract

There is evidence that financial innovations are sometimes undertaken to create complexity and exploit the purchaser. Thus financial innovation does have a dark side. As far as the financial crisis is concerned, securitisation and subprime mortgages may have exacerbated the problem. However, financial crises have occurred in a very wide range of circumstances, where these and other innovations were not important. There is evidence that financial liberalisation has been more of a problem. There are many financial innovations that have had a significant positive effect including venture capital and leveraged buyouts and innovations to fund environmental and health improvements.

Keywords: *dark side, financial crises, private equity*

JEL Classification: *G18, G20, G24*

1. Introduction

Financial innovation has come under great criticism since the start of the financial crisis in the summer of 2007. The fact that problems in subprime securitisations played a significant role initially raised suspicion among many that this innovation was at fault. Subsequent problems with other securitisations and credit default swaps contributed to this view. Paul Volcker put it succinctly at a conference in the UK in December 2009:

As bankers demanded that new regulation should not stifle innovation, a clearly irritated Mr Volcker said that the biggest innovation in the industry over the past 20 years had been the cash machine. He went on to attack the rise of complex products such as credit default swaps (CDS). ‘I wish someone would give me one shred of

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neutral evidence that financial innovation has led to economic growth — one shred of evidence’, said Mr Volcker.¹

Many others made a similar point. For example, Krugman (2007) argues

(T)he innovations of recent years—the alphabet soup of C.D.O.’s and S.I.V.’s, R.M.B.S. and A.B.C.P.—were sold on false pretenses. They were promoted as ways to spread risk, making investment safer. What they did instead—aside from making their creators a lot of money, which they didn’t have to repay when it all went bust—was to spread confusion, luring investors into taking on more risk than they realised.

This paper assesses the evidence for negative and positive contributions for financial innovation to economic welfare. We start in Section 2 with the evidence for the dark side of financial innovation. Henderson and Pearson (2011) provide evidence on a particular type of structured equity product known as Stock Participation Accreting Redemption Quarterly Pay Securities (SPARQS). They show that these were overpriced and did not provide any redeeming service to investors. Bergstresser (2008) provides further evidence for a large number of securities of the detrimental effect of this type of financial innovation. These kinds of complex products seem designed to fool investors and are not beneficial in any way.

What about the evidence concerning the crisis? One of the features of the current debate on financial innovation is that it focuses very heavily on the US experience in recent years. Section 3 takes a broader look at financial crises associated with real estate booms and busts and assesses the importance of financial innovation as a cause. It is argued that financial crises have occurred with and without financial innovation and that while it may have contributed in some cases as a cause, it is difficult to make the case it did more than exacerbate the situation.

Section 4 considers the evidence for the beneficial effects for two important types of financial innovation, venture capital and private equity. Many of the major corporations in the USA, such as Apple, Cisco Systems, Genentech, Google, Microsoft, and Sun Microsystems used venture capital early on in their development. No other economy has quite the range and depth of high technology companies as the USA and its unique venture capital industry seems to be an important contributing factor. Similarly, the private equity industry has contributed to the restructuring of many parts of US industry during the 1980s and 1990s. There is evidence that private equity controlled firms are better run and more efficient than publicly listed firms.

Another area where financial innovation has contributed significantly is the non-profit sphere. Section 5 focuses on the environment and the development of drugs for curing diseases that primarily occur in developing countries. In the environmental area, financial innovation has allowed many conservation projects to be funded that would not otherwise have been financed. Pollution markets have helped improve the efficiency of environmental regulation. In the drug sphere, governments and donors would traditionally simply give grants to help develop cures. Financial innovation has allowed them to leverage their contributions with private money. Although novel cures

¹ ‘Wake up, gentlemen’, world’s top bankers warned by former Fed chairman Volcker. Patrick Hosking and Suzy Jagger, *The Times*, 9 December 2009, http://business.timesonline.co.uk/tol/business/industry_sectors/banking_and_finance/article6949387.ece.

for developing country diseases may not be commercially viable, they do have the potential to generate significant revenues. Financial innovation allows these revenues to be captured.

Finally, Section 6 concludes.

2. The Dark Side of Financial Innovation

Tufano (2003) provides an excellent survey of the literature on financial innovation. The standard explanation for financial innovation is that it helps correct some kind of market inefficiency or imperfection. For example, if markets are incomplete then financial innovation can improve opportunities for risk sharing. If there are agency conflicts, then new types of security can improve the alignment of interests. Other important motivations for financial innovation are to lower taxes or to avoid the effects of regulations. Since both issuers and buyers must benefit from an innovation for it to be successfully introduced, the traditional view of financial innovation has been that it is desirable.

In an important paper, Henderson and Pearson (2011) provide striking evidence that financial innovation can introduce complexity to exploit uninformed investors. They document 64 issues of SPARQS by Morgan Stanley from June 2001 to the end of 2005 and show that the return on these risky securities was less than the risk free rate. They are able to show that these securities have no advantageous hedging properties, liquidity features or tax advantages that can explain this low return.

During the three and a half years they study, Morgan Stanley issued about \$2.2 billion of these securities. Their payoffs were tied to the stock price of major listed companies. They are typically callable after six months and have a maximum maturity of slightly over a year. Henderson and Pearson demonstrate that they have a price premium when they are issued of 8% compared to an equivalent dynamic trading strategy with exactly the same payoffs. Given the short maturity and interest rates at the time this means their payoff was less than the risk free rate. Since they are positively correlated with major stock indices they do not have any advantageous hedging properties. They are taxed as prepaid terminable forward contracts. If anything this gives them a tax disadvantage rather than advantage. Moreover, they are not particularly liquid. Henderson and Pearson argue investors would have been better off investing in banks' certificates of deposit.

Structured equity products became very popular not only in the USA but also in Asia and Europe. Bergstresser (2008) documents that at the peak structured products reached a total outstanding of €4.4 trillion. He considers a much larger sample than Henderson and Pearson consisting of 314,000 individual notes including issues in Asia and Europe as well as the USA. His results are similar. Prior to 2005, these products were overpriced similarly to those considered by Henderson and Pearson, particularly those issued by Goldman Sachs and Unicredit. However, subsequently this overpricing was considerably reduced.

The literature thus suggests that while financial innovation is often beneficial, this is by no means always the case. There seem to be many occasions where structured equity products were significantly overpriced in order to extract money from investors who did not fully understand the alternatives to what they were buying.

An interesting current example of complex financial innovation is the proposed leveraging of the European Financial Stability Facility. Although the full details have not

Table 1
Contract for Netherlands sovereign debt.

This table shows the contract for Netherlands sovereign debt.

NL0009600593



State of the Netherlands

1% bond 2011 due 15 January 2014 re-opening

Issued under the authorization to contract bonds borne by the State of the Netherlands, given by the Comptabiliteitswet 2001 (Government Accounts Act 2001)

Issuance	commencing 27 September 2011, until further notice
Payment	on 30 September 2011

Interest	1% per annum, the interest is paid on 15 January 2012 and annually thereafter on 15 January
Initial maturity	3 years and 1 day commencing 14 January 2011
Remaining maturity	2 years and 107 days commencing 30 September 2011
Redemption	on 15 January 2014 the principal of the bond will be made redeemable at par; early redemption either in whole or in part is not permitted
Issue price	the initial issue price will be announced via MTS Netherlands by 10.00 a.m. on 27 September 2011 and may be revised at any time
Announcement	the total accepted amount will be announced after the close of the tap issue

Model BBS-12168

been revealed yet, it seems that this will be quite complex. In contrast AAA government debt contracts are typically very simple. Table 1 shows a recent example from the Netherlands. It is written on two sides of a single piece of paper. It will be interesting to see how many pages the new EFSF contracts run to. While the complexity of the instruments will presumably not fool professional investors, they may fool retail investors. They may also fool voters.

Table 1
Continued.

DEFINITIONS	
The terms used in the conditions have the meanings stated below:	
Bond:	1% bond 2011 due 15 January 2014 issued by the State of the Netherlands;
DSTA:	Dutch State Treasury Agency, part of the Ministry of Finance;
MTS:	MTS Netherlands;
Necige I:	Nederlands Centraal Instituut voor Graaf Effectenverkeer B.V. (Dutch Central Securities Giro Institute);
Euroclear:	Euroclear Bank N.V.;
Clearstream:	Clearstream Banking;
Target:	Trans-European Automated Real-time Gross settlement Express Transfer;
Equans:	Equans N.V. (Intertapay Netherlands);
Admitted party:	Primary Dealer;
Primary Dealer:	Institution appointed as such by agreement with the State of the Netherlands;
Affiliated institution:	Institution affiliated to Necige I;
Proposal:	The offer to buy or sell a traded security via the MTS system with specification of the quantity and the price quoted;
Application:	Participation in a proposal;
Tick:	1 tick represents 0,01% of the par value of the traded security;
Strip:	(Separate Trading of Registered Interest and Principal Securities) a registered claim against the State of the Netherlands pertaining only to a nominal amount which shall be paid at a certain time;
Time:	Time is Central European Time

GENERAL CONDITIONS	ISSUE CONDITIONS										
<p>1. Registered rights The debt issued is embodied in the form of a registered right in the name of the affiliated institutions of Necige I. All or part of the debt issued can be made available for delivery in the form of acquisition of a registered right in a nominal amount of whole euros.</p> <p>2. Interest The interest rate is 1% per annum and will accrue as from 14 January 2011. The interest is paid on 15 January 2012 and annually thereafter on 15 January. The interest is paid on the due date to Necige I in favour of the affiliated institutions and their accountholders. Other rightful claimants are paid directly by DSTA. The interest will cease to accrue on the due date for redemption.</p> <p>3. Redemption On 15 January 2014, the principal of the bond will be redeemable at par. Repayment of the principal is made to Necige I in favour of the affiliated institutions and their accountholders. Other rightful claimants are paid directly by the DSTA. Early redemption either in whole or in part is not permitted.</p> <p>4. Due dates for interest payment and redemption If the Target and Equans systems are not in operation on a due date for payment of interest or principal of the bond as referred to in articles 2 and 3, the interest or the principal will become payable on the next day on which the Target and Equans systems are in operation.</p> <p>5. Limitation The right to payment of interest or the principal of the bond will lapse five years after the beginning of the day following the date on which these amounts first become payable.</p> <p>6. Issue and purchase of strips Upon request of a Primary Dealer DSTA issues strips, simultaneously purchasing part of the bond. Strips thus issued can upon request of a Primary Dealer be repaid by means of DSTA purchasing strips, simultaneously issuing part of the bond. In respect of the volume and due date of the instalments of interest and principal strips are identical to part of the bond. The State of the Netherlands has appointed an institution to administrate rights and obligations pertaining to strips. The issue and purchase, as well as the settlement of strips may be subject to further provisions.</p> <p>7. Applicable law and jurisdiction The bond is subject to Netherlands law. Disputes may be brought exclusively before the competent court in the Netherlands.</p> <p>8. Costs Where these conditions do not expressly state that they will be borne by the State of the Netherlands, costs may not be charged to the State of the Netherlands.</p> <p>9. Listing Listing of this bond on the Official Market of Euronext Amsterdam N.V. will be pursued.</p> <p>10. Conditions In case of dispute as to the interpretation of these conditions, the Dutch text will be binding. Copies of these conditions are available free of charge from admitted parties.</p>	<p>1. Issue price The initial issue price will be announced at 10.00 a.m. on 27 September 2011. The issue price may be revised at any time. The State of the Netherlands reserves the right to cancel the issue at any time up to 10.00 a.m. on 27 September 2011.</p> <p>2. Tap issue The bond will be sold exclusively through admitted parties. Commencing 27 September 2011 between 10.00 a.m. and 5.00 p.m. until further notice, on Target business days, admitted parties may submit their applications in MTS. Acceptance will be in nominal amounts and at the prevailing issue price. The minimum amount accepted per trade is euro 25 million with increments of euro 5 million. Trades less than euro 25 million nominal will be cancelled. Trades more than euro 25 million which are not multiples of euro 5 million will be rounded downwards to the nearest multiple of euro 5 million.</p> <p>3. Accrued interest Interest will be calculated in accordance with section 250 of the ISMA Statutes, by laws, rules and recommendations on an actual actual basis. Any change in the way interest is calculated will become effective no sooner than on the next due date.</p> <p>4. Reservation The right is reserved, without giving reasons, to cancel proposals in whole or in part and to suspend or terminate the tap issue at any time. In addition the right is reserved to unilaterally cancel applications that are not in line with these issue conditions or inconsistent with the market level at the time of execution. To be inconsistent with the market level, the application price must have differed by a minimum number of ticks from the last application executed on MTS within the previous 5 minutes, depending on the maturity of the security, as set out in the table below.</p> <table border="1"> <thead> <tr> <th>Maturity</th> <th>Number of ticks</th> </tr> </thead> <tbody> <tr> <td>0 to 3,5 years</td> <td>20</td> </tr> <tr> <td>3,5 to 6,5 years</td> <td>30</td> </tr> <tr> <td>6,5 to 13,5 years</td> <td>40</td> </tr> <tr> <td>13,5 years and more</td> <td>60</td> </tr> </tbody> </table> <p>To identify the market level in the absence of applications executed within the previous 5 minutes, the second-best proposal present at the time of execution will be considered, taking account of the appropriate side of the market. In case of a unilateral cancellation the DSTA shall notify the counterpart and MTS, via telephone, e-mail or fax without delay, and in any event not later than 15 minutes before the end of opening hours of MTS.</p> <p>5. Settlement Settlement takes place internal in Euroclear on issue account 25003 or in Clearstream through the electronic bridge.</p> <p>6. Payment The amount payable will be equal to the product of the issue price and the awarded nominal amount plus accrued interest. This amount which shall be paid on 30 September 2011 (or in case of after tap placement the day of settlement) on a "trade for trade" basis must be credited to the DSTA's issue account number 25003 with Euroclear.</p> <p>In the event of late payment of the amount due, interest will be charged at a rate of 1% per annum. The right is also reserved to recover any loss suffered by the State of the Netherlands from the admitted party concerned.</p> <p>7. After tap placement The right is reserved to place additional debt after the tap issue has been closed. Mutatis mutandis these conditions will apply to the after tap placement with the exception of articles 1, 2 and 4 of the issue conditions.</p> <p>Den Haag, 21 September 2011</p> <p>The Minister of Finance, On his behalf, The Agent of the Ministry of Finance, Erik Wilders</p>	Maturity	Number of ticks	0 to 3,5 years	20	3,5 to 6,5 years	30	6,5 to 13,5 years	40	13,5 years and more	60
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Source: http://www.dsta.nl/english/News/Borrowing_conditions/Dutch_State_Loans_DSLs

Table 2
Real housing price cycles and banking crises.

This table shows the fall in housing prices associated with a number of severe banking crises. The first column shows the country, the second is the year the banking crisis occurred, the third is the peak of housing prices, the fourth is the trough, the fifth is amount of time the fall in prices lasted and the final column is the real fall in prices.

Country	Crisis date	Peak	Trough	Duration of downturn	Magnitude of decline (in percent)
Advanced economies: The Big 5					
Finland	1991	1989:Q2	1995:Q4	6 years	-50.4
Japan	1992	1991:Q1	Ongoing	Ongoing	-40.2
Norway	1987	1987:Q2	1993:Q1	5 years	-41.5
Spain	1977	1978	1982	4 years	-33.3
Sweden	1991	1990:Q2	1994:Q4	4 years	-31.7
Asian Crisis: The Big 6					
Hong Kong	1997	1997:Q2	2003:Q2	6 years	-58.9
Indonesia	1997	1994:Q1	1999:Q1	5 years	-49.9
Malaysia	1997	1996	1999	3 years	-19.0
Philippines	1997	1997:Q1	2004:Q3	7 years	-53.0
South Korea	1997		2001:Q2	4 years	-20.4
Thailand	1997	1995:Q3	1999:Q4	4 years	-19.9
Other emerging					
Argentina	2001	1999	2003	4 years	-25.5
Colombia	1998	1997:Q1	2003:Q2	6 years	-51.2
Historical episodes					
Norway	1898	1899	1905	6 years	-25.5
US	1929	1925	1932	7 years	-12.6

Source: From Reinhart and Rogoff (2009), Chapter 13. Data from Bank of International Settlements and the individual country sources described in the Data Appendix in Reinhart and Rogoff (2009).

3. Financial Crises, Real Estate Booms and Busts and Financial Innovation

The charge levelled by Volcker and others is that financial innovation was one of the causes of the crisis. As the previous section has documented, financial innovation certainly appears to have a dark side. But how much did it contribute to the crisis? Much of the recent discussion has focused on the current crisis and in particular what happened in the US. Table 2 is from Reinhart and Rogoff (2009). It illustrates that real estate booms and busts lie at the heart of many financial crises, not just the most recent one. The average fall in housing prices after a financial crisis is very substantial (36%) whereas the duration of the fall (from peak to trough) lasts an average of five years, even excluding Japan.

The table contains only two pre-World War II housing price collapses, as long-dated time series on housing prices are scarce. However, other measures of housing market collapse indicate a similar pattern. Table 3 (taken from Reinhart and Rogoff, chapter 16) illustrates the depth and breadth of the housing price declines that occurred around the Great Depression.

Table 3

Indices of total building activity in selected countries in the Great Depression of the 1930s.

This table provides information concerning the severity of the downturn in housing in various countries in the Great Depression. Direct data is not available so proxies of various kinds are used instead. These are described in the second column. The third column provides the level of the indicator in 1932 relative to the level in 1929, which is normalised at 100. ($1929 = 100$)

Country	Indicator	1932
South Africa	Buildings completed (value)	100
Argentina	Permits (area)	42
Australia	Permits (value)	23
Belgium	Permits (number)	93
Canada	Permits (value)	17
Chile	Permits (area)	56
Colombia	Buildings completed (area)	84
Czechoslovakia	Buildings completed (number)	88
Finland	Buildings completed (cubic space)	38
France	Permits (number)	81
Germany	Buildings completed (rooms)	36
Hungary	Buildings completed (number)	97
Netherlands	Buildings completed (dwellings)	87
New Zealand	Buildings completed (value)	22
Sweden	Buildings completed (rooms)	119
United Kingdom	Permits (value)	91
Unites States	Permits (value)	18
Average		64
<i>Memorandum item:</i>		
United States	Permits (number)	
September 2005 peak = 100	100	25 ¹

Source: From Reinhart and Rogoff, 2009, Chapter 16.

¹Through February 2009.

How much did financial innovation play a role in this wide sample of crises? While it may have contributed in some of them, in many the set of financial products arguably did not change that much during the boom and bust. For example, in the Asian crises financial innovation is not usually discussed as a determinant. A more likely culprit in many of these cases is financial liberalisation. Kaminsky and Reinhart (1996; 1999) study a wide range of crises in 20 countries, including 5 industrial and 15 emerging ones. A common precursor to most of the crises considered was financial liberalisation and significant credit expansion. These were followed by an average rise in the price of stocks of about 40% per year above that occurring in normal times. The prices of real estate and other assets also increased significantly. At some point the bubble bursts and the stock and real estate markets collapse. In many cases banks and other intermediaries were overexposed to the equity and real estate markets and about a year later on average a banking crisis ensues. This is often accompanied by an exchange rate crisis as governments choose between lowering interest rates to ease the banking crisis or raising interest rates to defend the currency. Finally, a significant fall in output occurs and the recession lasts for an average of about a year and a half. In a study of the relationship between financial liberalisation and financial fragility, Demirguc-Kunt

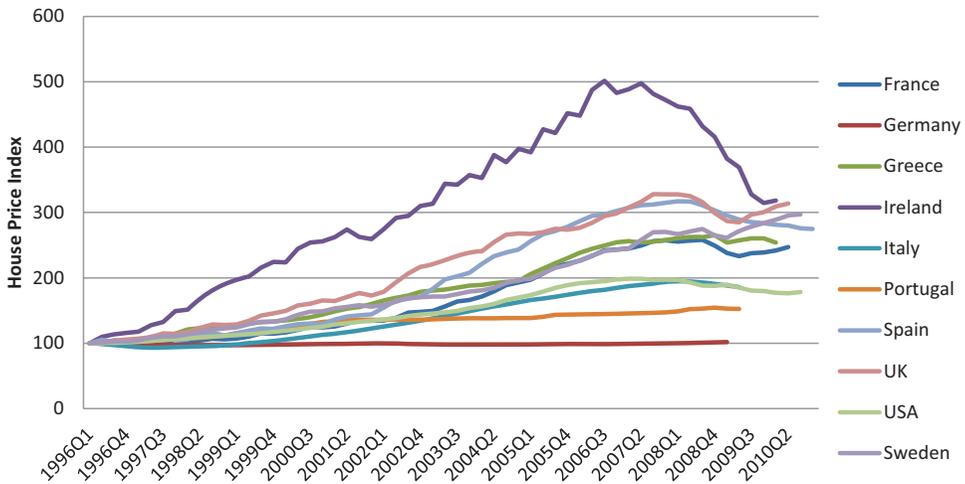


Fig. 1. Nominal housing prices in the USA and various European countries.

The figure shows the variation in nominal housing prices for the USA and various European countries for 1996–2010. The prices are normalised to 100 at the start of 1996. The figure shows the wide range of experiences across countries.

Source: OECD

and Detragiache (1998) study 53 countries during the period 1980–95. They find that financial liberalisation increases the probability of a banking crisis. Drees and Pazarbasoglu (1995) argue that financial liberalisation played an important role in the Nordic crises.

What role did financial innovation play in the current crisis? Figure 1 shows the USA and various European countries. It can be seen that the USA had one of the lowest rises in real estate prices of the countries. However, these are average figures for the country as a whole. Figure 2 shows the regional variations within the USA. It can be seen that there is significant regional variation within the country with the highest cities such as Miami and Los Angeles having price rises comparable to many European countries. One important issue is why there is such large regional variation within the USA and across the countries within the eurozone. For example, despite broadly similar economic conditions, France and Germany have had vastly different experiences with respect to real estate prices. If financial innovation is to blame then this is a financial system wide problem issue rather than a regional one. This is particularly true in the USA where the financial system is broadly similar across all the states. In the eurozone there is in theory a single market for financial services but in practice this is not really the case. National regulation differs considerably and the mortgage products available also differ significantly.

Figure 3, which is from Allen *et al.* (2012),² shows mortgage debt in the USA as a percentage of GDP and the amount of mortgages relative to GDP that were securitised. It can be seen that mortgage debt took a sharp upward turn at the end of the 1990s and went from about 50% in the mid 1990s to around 85% in the mid 2000s. Securitisation started to become significant in the late 1960s. At its peak in the mid 2000s it still

² Figures 4–7 are also from Allen *et al.* (2012).

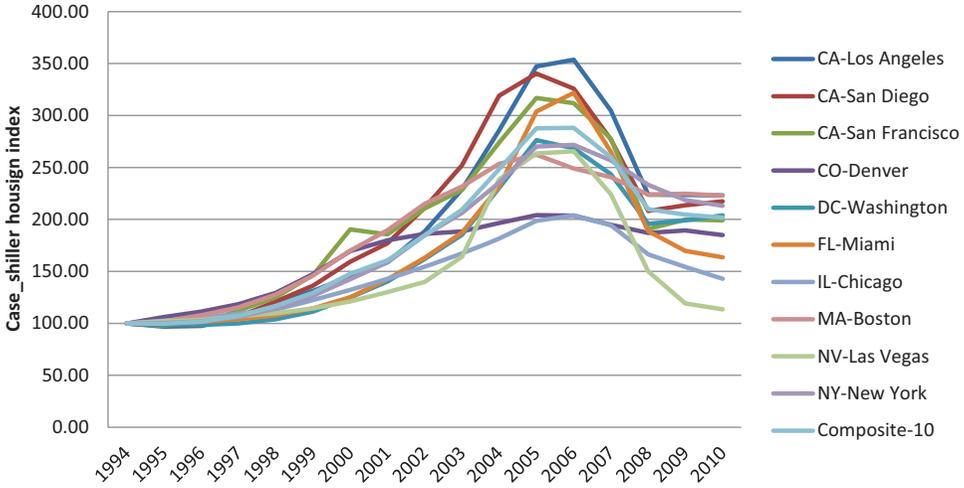


Fig. 2. Variations in house prices for the 10 cities in the Case-Shiller Index.

This figure shows the house price variations from 1994 to 2010 of the 10 cities in the Case-Shiller Index. The prices are normalised to 100 at the start of 1994. It can be seen that the prices diverge dramatically, particularly after 2001.

Source: S&P

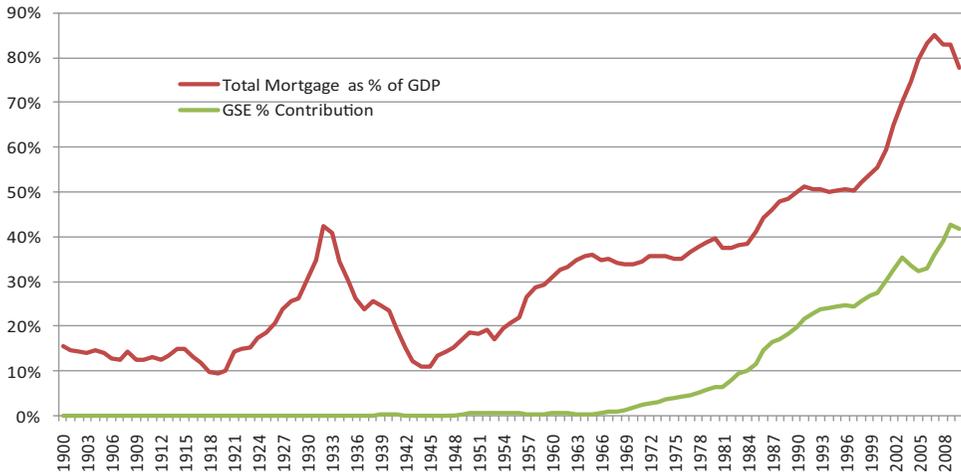


Fig. 3. The role of GSEs in financing homeownership.

The upper graph shows total mortgages as a percentage of GDP while the lower graph shows the mortgages provided by Government Sponsored Enterprises (GSEs). Up until the mid-1960s the GSE contribution was negligible but since then it has grown to about half of the total.

Source: Based on Figure 2.4 in Allen *et al.* (2012).

represented only 40% of GDP or less than half of total mortgages. Figure 4 shows the funding of home mortgages including a range of sources including the different types of securitisation and financial institutions. It can be seen that securitisation essentially took a large part of the share previously met by savings and loans and credit unions. One

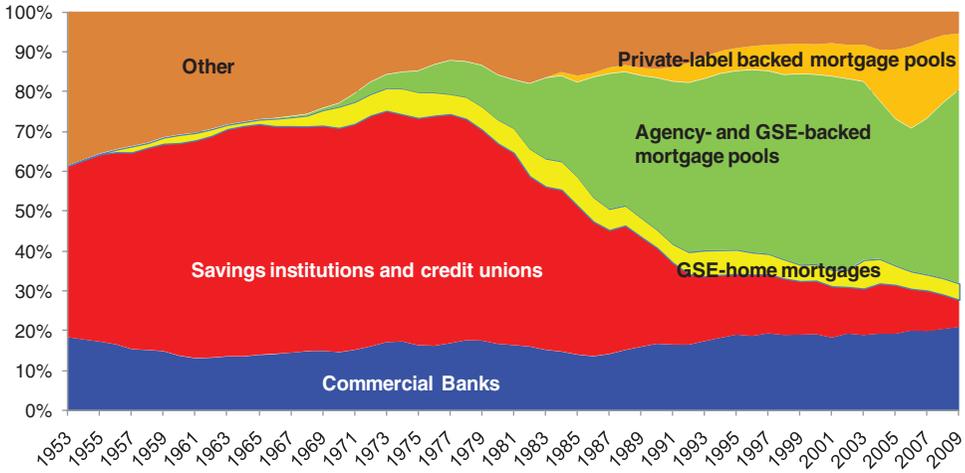


Fig. 4. The funding of home mortgages in the USA from 1952 to 2010.

The figure shows the sources of funds for home mortgages from 1952 to 2010. In the 1950s, the most important source was savings institutions and credit unions. Over the years these have mostly been replaced by agency- and GSE-backed mortgages.

Source: Based on Figure 3.2 in Allen *et al.* (2012)

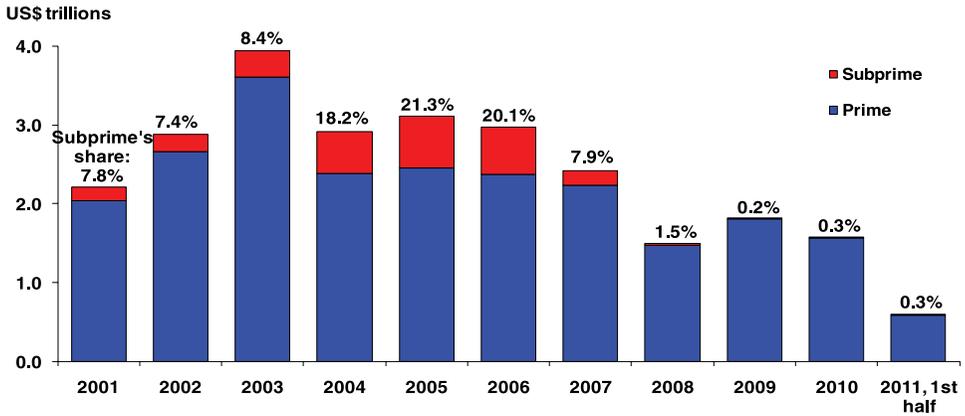


Fig. 5. Subprime share of all home mortgage originations (2001–2011, 1st half).

The figure shows the amount of prime and subprime mortgages from 2001 until the first half of 2011. The figures on the tops of the columns are the percentage that are subprime. The share was below 10% until 2004 when it jumped upwards. It remained around 20% for the next three years before falling below 10% again in 2007 at the start of the crisis. It has been negligible since then.

Source: Based on Figure 3.5 in Allen *et al.* (2012).

striking feature of Figures 3 and 4 is the length of time that securitisation has existed. It has had a significant share for around four decades and until the late 2000s there were no problems in terms of a financial crisis that it could be blamed for. It was the savings and loans sector that suffered the crisis in the 1980s.

Many people have criticised the securitisation of subprime mortgages. Figure 5 shows the proportion of mortgages that were subprime during the 2000s. It can be seen that

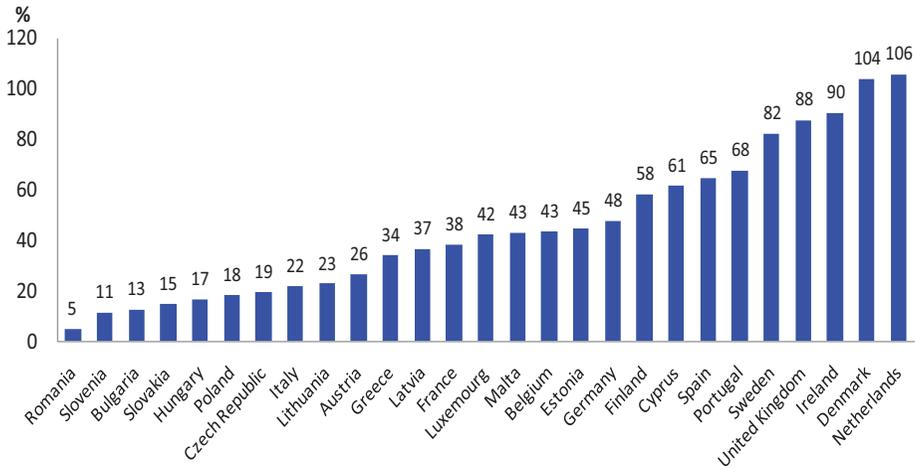


Fig. 6. Home mortgage debt to GDP (%) in European Union countries.

The figure shows the dramatic differences in the ratio of home mortgage debt to GDP across the countries in the European Union. The former communist countries in Eastern and Central Europe tend to have the smallest ratios.

Source: Based on Figure 2.2 in Allen *et al.* (2012).

even at the peak they were only around 20% of mortgages. Prior to 2004 they were less than 10%. However, from Figure 2 much of the appreciation in house prices occurred before then.

What about the role of financial innovation in causing house price increases in other countries? Figure 6 shows home mortgage debt to GDP in European countries. It can be seen there is a wide variation from 106% in the Netherlands to 5% in Romania. A few countries are above the US level of around 80% but most are below. Figure 7 shows how the mortgages were financed in various countries. Securitisation is important in the USA. It is important also in Spain and Ireland. However, comparing with Figure 2 it can be seen that many countries such as France and Sweden that have had a large price rise had almost no securitisation. To blame financial innovation for the real estate booms seems misplaced.

The other issue is that in the crisis investors were unsure where subprime securitisations were held. This led to considerable contagion, as investors were unwilling to commit funds. However, this was not a result of financial innovation. The same is true of holdings of Greek sovereign debt. The same will be true for any undervalued securities.

4. Private Equity: Venture Capital and Leveraged Buyout Funds

Some of the most important financial innovations in terms of business finance in recent decades have involved private equity. Venture capital and Leveraged Buyouts (LBOs), in particular, became important in the 1970s and 1980s and have helped to transform the financial landscape. In an interesting paper, Lerner and Tufano (2010) have considered the impact that these innovations have had.³ Using techniques pioneered by Fogel (1964)

³ This section draws heavily on their paper.

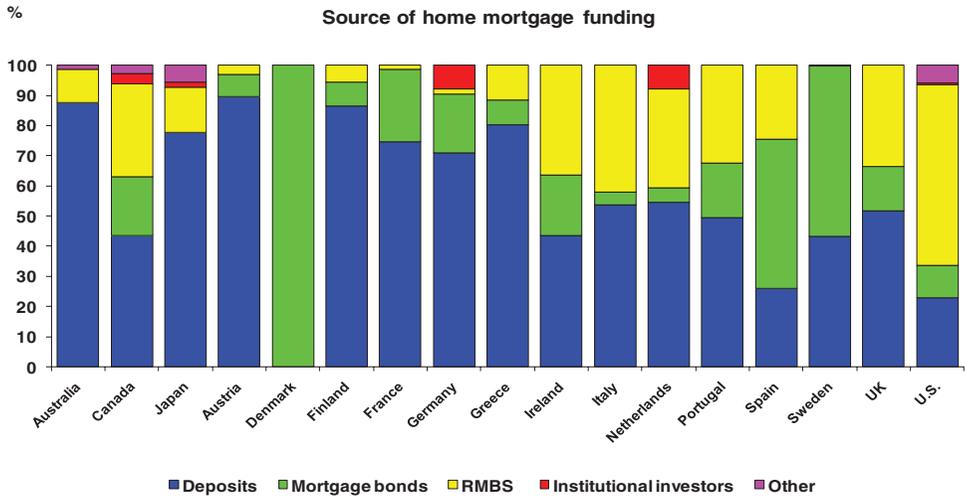


Fig. 7. Sources of funding for home mortgages in selected countries in 2009.

The figure shows the wide variation of the sources of funding for home mortgages in a range of different countries. Deposits are the most important source in most countries. In Denmark mortgage bonds dominate and they are important in a number of other countries such as Spain and Sweden. In the USA, Italy, Ireland and the UK mortgage backed securities play a significant role.

Source: Based on Figure 2.3 in Allen *et al.* (2012).

they compare the current situation with the alternatives that might have been used if these innovations had not been introduced.

4.1 Venture capital

Prior to the Second World War, it seemed that many promising companies went unfunded because wealthy individuals who typically provided funds for small start up firms did not have the time or the expertise to become closely involved. Government innovations introduced by the Roosevelt Administration such as the Reconstruction Finance Corporation were too bureaucratic and rigid to provide an adequate mechanism for funding small start up firms.

Two seminal figures in the development of venture capital were George Doriot, a former general affiliated with Harvard Business School, and MIT President Karl Comptom. They effectively launched the venture capital industry in 1946 with the founding of American Research and Development (ARD), a publicly traded closed-end mutual fund marketed mostly to individuals.

Doriot had an ability to identify the most promising entrepreneurs, and he found two in Kenneth Olsen and Harlan Anderson, who wanted to start a firm to manufacture small computers. They had no money and no credit when they incorporated Digital Equipment. In 1956 Doriot offered to invest \$70,000 in the company in return for a 60 percent stock interest; Olsen and Anderson eagerly accepted. The company and the investment proved to be very successful.

ARD pioneered many of the techniques that subsequently became important in the venture capital industry. They engaged in intensive due diligence of a large number

of small innovative companies that needed funds but provided finance to only a small number that seemed most likely to succeed. After funding they became heavily involved in the governance and management of the firms. This included board seats and informal advice to the managers. Because they were so selective, the fact that they provided finance to a company acted as a form of certification that helped the company subsequently when it started to grow and needed more funds than ARD could provide.

Fenn *et al.* (1997) argue that two things were key in the development of the venture capital industry. The first was the use of a limited partnership organisational form rather than a closed end mutual fund. The problem with the latter was that they were subject to the provisions of the Investment Advisers Act of 1940 that severely limited the way in which the investment managers could be compensated. By using a limited partnership form, much better incentives could be provided to the people selecting the investments. The first venture capital limited partnership was formed in 1958 and the organisational form was developed in the 1960s and 1970s.

The second important development was a September 1978 ruling by the US Department of Labor that was implemented nine months later concerning the Employee Retirement Income Security Act (ERISA). The 'prudent man' provision of ERISA required that pension fund investments be based on the judgement of a 'prudent man'. Prior to the 1978 ruling this had been interpreted as ruling out investments in securities issued by small or new companies and venture capital funds. The ruling clarified that such investments were allowed provided they did not endanger the whole portfolio. This change allowed pension fund investments in venture capital funds directly. It also led to an influx of pension fund money into initial public offering (IPO) markets. This helped venture capital funds exit their investments and encouraged investment in venture capital limited partnerships by others in addition to pension funds. The ruling thus helped the industry grow significantly.

In the 1980s venture capitalists backed many successful companies such as Cisco Systems, Genentech, Microsoft, and Sun Microsystems. However, increased competition as the industry expanded and the entry of inexperienced venture capitalists led to a reduction in returns and a lower volume of funding. The 1990s saw a return of a boom to venture capital as the stock market boomed and the IPO market again took off only to fall back again in the mid to late 2000s.

What impact did the venture capital industry have on the US economy? Lerner and Tufano (2010, p. 19) document that in late 2008 venture-backed firms that had gone public made up over 13% of US public firms in terms of numbers, and 8.4% in terms of value. While among manufacturing and other mature industries, venture-backed firms have modest representation, this is not true in high technology industries. For example, in computer software venture-backed companies represent 75% of total market capitalisation.

Another important issue is the extent to which venture capital impacts the amount of innovation. Investigating this issue is difficult because the direction of causation is difficult to establish. However, some progress has been made. Based on a survey of 170 recently formed venture-backed and non-venture firms in Silicon Valley, Hellman and Puri (2002) find evidence that innovative firms are more likely and quicker to obtain venture capital financing. They are also quicker to take products to markets. Kortum and Lerner (2000) find that on average venture capital financing appears to be three to four times more effective in stimulating patenting than traditional corporate R&D from 1983 to 1992. Thus even though venture capital is only responsible for about 3% of corporate R&D it is perhaps responsible for around 10% of innovations. Mollica

and Zingales (2007) find using regional comparisons that venture capital investments have a positive effect on patents with a one standard deviation increase in venture capital per capita increasing patents 4–15%. Similarly for new business creation, with a 10% increase in volume of venture capital investments increasing new businesses by 2.5%.

4.2 Leveraged buyouts

Fenn *et al.* (1997) point out that before the 1980's funds for non-venture private equity investments came from venture capital funds and informal investor groups. During the 1980s limited partnership funds were created specifically to provide non-venture funds. The largest of these specialised in the leveraged buyouts of large public companies. These funds tended to be much larger in size than venture capital funds. This meant they appealed more to pension funds with large amounts of funds to invest. Many well known companies were purchased during the 1980s including Avis, Beatrice, Dr. Pepper, Gibson Greetings, and RJR-Nabisco. As with venture capital, LBOs went through a boom bust cycle. Early funds made high returns, then others entered and drove down returns. This reduced investment, driving up returns and the cycle repeated in the 1990s and 2000s.

Early studies focused on LBOs in the USA in the 1980s.⁴ They documented that they were successful in terms of returns and improving operating efficiency. The average debt-to-capital ratio was roughly 90%. Managerial equity stakes were typically around 17–20%. Operating income increased by about 40% on average over a period ranging from two to four years after a buyout. These changes in operating performances were due to changes in incentives, monitoring, and governance structure.

Recent research has been more comprehensive. Stromberg (2008) considered 21,397 transactions around the world between 1970 and 2007. He found that exited buyout transactions had an annual rate of bankruptcy or major financial distress of 1.2% per year. This compares favourably with the 1.6% per year default rate on US corporate bond issues. In addition he found that over time the period the funds held the purchased companies had increased.

Using a large sample of private equity owned, privately owned, family and government firms in Asia, Europe and the USA, Bloom *et al.* (2009) compare management practices using surveys. They find that private equity owned firms lead to better management practices than the other types of ownership.

Lerner *et al.* (2008) examine investments in innovation such as long-run R&D expenditures. They find patent levels are largely unchanged before and after buyouts. However, after buyouts patents are more economically important as measured by patent citations. This is a result of the firms improving and focusing their research in their traditional areas of expertise.

4.3 Contribution of venture capital and leveraged buyouts

The evidence presented suggests that venture capital and LBOs do contribute to economic efficiency in a number of ways. Venture capital has helped many prominent firms do well and there is evidence that it increases innovation. Similarly, LBOs seem to also improve

⁴ See Kaplan (1989) and Baker and Wruck (1989) and the references therein.

economic efficiency in a number of dimensions. The question remains, however, whether alternatives available before these innovations would have done equally well.

Lerner and Tufano (2010) argue there would have been three alternative providers of capital. These are individuals, government and banks or other financial institutions. With regard to individuals, Lamoreaux *et al.* (2007) provide some historical evidence that entrepreneurs can access funds through friends and family. On the other hand, Hoberg *et al.* (2009) provide evidence that angel financing of this sort has important limitations. While it is roughly equally effective to venture capital for small transactions, for large ones venture capital performs better in terms of incidence of failure and the probability of an IPO or an acquisition. As far as governments are concerned, Lerner and Tufano cite the example of the €2 billion the European Commission provided to the European Investment Fund for venture capital. The funds were spread across every country and region and in the end this meant the amounts available covered administrative costs but there was very little left over for actual investments in companies. With regard to banks and other similar institutions, Lerner and Tufano argue that the empirical evidence suggests that in practice they are not nearly as effective as venture capital funds.

The conclusion is that venture capital and LBOs have contributed significantly to economic progress. These are therefore important innovations and have allowed higher growth and improved welfare.

5. Financial Innovations to Improve the Environment and Global Health

While many financial innovations have focused on financing businesses there have been financial innovations that have improved the allocation of resources in many other areas. In this section we will focus on the environment and global health. Allen and Yago (2010) consider a range of other applications in addition such as development and housing.⁵

From experience with curtailing acid rain via the sulphur dioxide allowance market to the implementation of the Clean Water Act, market-based solutions have proven consistently more effective in protecting the environment than government regulation alone. Project financing, public/private partnerships, and tradable permits have come to supplement or replace conventional command-and-control regulation and purely tax-based instruments. This approach can minimise the aggregate costs of achieving environmental targets while providing dynamic incentives for the adoption and diffusion of greener technologies.

Market-based financial and public policy instruments emerged in the 1980s and have steadily gained momentum. Tradable permit systems have been deployed to phase down use of leaded gasoline and end the use of ozone-depleting chlorofluorocarbons. In fact, the United Nations Environment Programme has launched a Finance Initiative as a formal mechanism for mobilising the financial sector to take a more active role in protecting the environment.

For many years, the US financed environmental improvements such as sewage treatment plants with substantial one-time grants made by the federal government to localities. But as the demand for funding grew, policymakers and capital market experts began to think creatively about how to leverage finances: to generate, for example, \$2 million of pooled capital from a one-time \$500,000 grant.

⁵ This section draws on Chapters 5 and 7 of Allen and Yago (2010).

5.1 *State revolving funds (SRFs)*

In 1987, the US Congress passed the Federal Clean Water Act and replaced its aging grants program with state revolving funds. Under this model, each state applies for a federal capital grant, which requires a 20% local match; this pool of funding is then supplemented with capital market investment and possibly ‘seed money’ from philanthropies. The states then make low-interest loans to local municipalities and organisations, which repay the loans from project revenue and local taxes. States may provide loans to communities, individuals, nonprofit organisations, and commercial enterprises. Their repayments recapitalise the state fund, creating a sustainable resource for funding.⁶

This model maximises the impact and longevity of government grants. SRFs have successfully ensured a steady flow of capital into water quality and management projects in rural areas, small towns, and major cities. The Environmental Protection Agency (EPA) estimates that they have provided more than \$68.8 billion in cumulative assistance, serving more than 115 million people; the agency also states that between 1987 and 2005, the funds created more than 600,000 construction jobs and 116,000 additional jobs.⁷

There are two basic SRF models. The ‘cash-flow model’ uses the fund’s original equity (the federal and state contributions) to originate direct loans to the communities. Repayments are pledged to bond issuance, with more loan repayments coming in than are actually needed to pay the bond debt. The proceeds from the sale of the bonds go to fund additional loans, creating a collateralised cash flow. The coverage from the direct loans provides added security as well as the subsidy on the loans.

The ‘reserve model’ uses the original equity to create a pool that cushions the fund from any potential defaults. The size of the reserve can vary anywhere from 30 to 70 percent of overall transactions. Bonds are then issued, and the proceeds from these bonds provide loans to local communities for river projects. The interest earned by the reserve subsidises the loans.

5.2 *Debt-for-nature swaps*

At first glance, a country’s external debt and its ability to protect biodiversity might appear to be completely unrelated. But linking these issues creatively through debt-for-nature swaps has made progress possible on both fronts. By relieving the foreign debt burden carried by developing nations, it is possible to secure their commitment to invest in local conservation projects and save imperilled ecosystems.

Debt-for-nature swaps are the brainchild of Thomas Lovejoy of the World Wildlife Fund, who developed the idea in 1984 as a way to deal with the entwined problems of environmental degradation and the crushing sovereign debt burdens shouldered by many developing nations. When the Latin American debt crisis hamstrung the ability of many highly indebted nations across the region to focus on conservation, Lovejoy called for building an explicit link between debt relief and environmental protection.⁸

⁶ See Environmental Protection Agency EPA (2008a).

⁷ See EPA (2008b), p. 2.

⁸ See T. Sancton, B. Hillenbrand and R. Hornik, ‘Hands across the sea’, *Time*, 2 January 1989 (<http://www.time.com/time/magazine/article/0,9171,956635,00.html>).

Many debt-for-nature swaps begin with a non-governmental organisation (NGO) or a 'conservation investor' undertaking the purchase of a developing country's hard-currency debt titles. A commercial bank might even be willing to sell to the NGOs at a discount, since the ability of the debtor nation to repay is already considered shaky. The NGO then forgives the debt in exchange for the debtor country's commitment to fund a conservation project or set aside a crucial parcel of land. The debtor government might also be asked to use this newly freed-up financial stream to issue bonds, appointing local environmental groups to make grants from the proceeds. Conservation International conducted its first debt swap transaction in 1987, when it purchased a portion of Bolivia's foreign debt from a commercial creditor, then cancelled that debt so the Bolivian government would set aside 3.7 million acres in and around the Beni Biosphere Reserve.⁹

The US Tropical Forest Conservation Act (TFCA) was enacted in 1998 to further institutionalise the idea of debt-for-nature swaps. Under this program, developing countries can reduce high levels of debt owed to the US government, generating funds in local currency for programs that will protect local rain forests. Hundreds of millions of dollars that once went to debt payments has now been redirected to conservation activities in more than a dozen countries, from Botswana and Bangladesh to Paraguay and the Philippines.¹⁰

NGOs often help broker TFCA agreements and contribute additional funding. The Nature Conservancy and Conservation International each contributed \$1.26 million to facilitate a 2007 debt-for-nature swap under the TFCA, in which the USA forgave \$26 million of Costa Rica's debt.¹¹ The debt relief will finance forest conservation in Costa Rica over the next sixteen years, helping rural and indigenous communities pursue sustainable livelihoods while protecting one of the world's great natural treasures for future generations. A portion of this funding will go to protect La Amistad region, a tract of virgin rain forest that shelters some 90 percent of Costa Rica's known plant species, more than 350 species of birds, and a host of exotic animals including giant anteaters and ocelots.¹²

5.3 Pollution markets

The most practical solution for building a greener economy is to correct faulty pricing by making consumers and firms pay for the environmental damage they cause. Once these negative externalities are internalised, they will be incorporated in the prices of goods and services, creating real incentives for the creation and adoption of clean technologies. One of the most compelling examples of using these principles to fix broken markets is that of cap-and-trade pollution markets. In such markets, the *cap* (or maximum amount of total pollution allowed) is usually set by government. Businesses, factory plants, and other entities are given or sold permits to emit some portion of the region's total amount. If an organisation emits less than its allotment, it can sell or *trade* its unused permits to

⁹ Conservation International, http://www.conservation.org/sites/gcf/Documents/GCF_debtfor_nature_overview.pdf.

¹⁰ See USAID, http://transition.usaid.gov/our_work/environment/forestry/tfca.html.

¹¹ See M. Lacey, 'Costa Rica: US swaps debt for forest aid', *New York Times*, 17 October 2007.

¹² See The Nature Conservancy, <http://www.nature.org/wherewework/centralamerica/costarica/misc/art22576.html>.

other businesses that have exceeded their limits. Entities can trade permits directly with each other, through brokers, or in organised markets. This approach leaves individual companies free to choose if and how they will reduce their emissions and by how much. Firms will choose the most affordable way to comply with the pollution cap.

In 1990 the USA passed new amendments to the Clean Air Act. With these changes, the EPA placed a national cap on emissions of sulphur and nitrogen oxides and set up a system for polluters to trade permits among themselves. Title IV of the 1990 Clean Air Act established the allowance market system known today as the Acid Rain Program, which eventually became the prototype for emissions trading in all other major pollutants. The ultimate goal was to reduce annual SO₂ emissions to about half of their 1980 levels. The cap was gradually lowered, with implementation coming in two stages of tightening operating restrictions on power plants.¹³ The market for emissions allowances simply would not function and create accurate pricing without an effective regulatory cap on the total number of allowances available.

5.4 Individual transferable fishing quotas

For millennia, fisheries have been considered a common property resource. Most people believed that the ocean's supply of fish was limitless. But population growth and the industrialisation of fishing have depleted that stock of capital at an alarming rate. Surrounded by the sea and its seemingly infinite abundance, New Zealanders never thought of fish as a limited resource before the 1970s. But things began to change by the early 1980s. More and more boats were plying the waters, but hauling in meagre catches.

Regulations and fishing bans were tried, to no avail. When nothing seemed to work, the fishing industry and the government turned their thinking upside down: Instead of dictating fishing methods and restricting the number of boats going out, they would limit *how many* fish could be caught and put their faith in the marketplace to achieve the rest.

In 1986, the government introduced the Quota Management System, with the fishing industry firmly on board. Each year scientists determine a maximum sustainable yield for each species and region. Based on their findings, the government sets a total allowable catch for each fishery, and individual fishing operations are given quotas for a portion of that total (usually based on their average historical catch). Individual quotas can be leased, bought, sold, or transferred (though they cannot be traded across regions or species, or banked for the future). This provision tends to make permits migrate to the most efficient vessels.

The quota system has been tweaked since its introduction, but the basic concept is still at work today. Evidence indicates that fish populations are showing clear signs of recovery. Having forged a new way of thinking about fisheries, New Zealand is now regarded as a world leader in resource management and these techniques have been adopted elsewhere.¹⁴

¹³ See EPA, Overview: The Clean Air Act Amendments of 1990, Title IV: Acid Deposition Control, http://www.epa.gov/air/caa/caaa_overview.html#titleIV.

¹⁴ See J. Sanchirico and R. Newell, 'Catching market efficiencies: quota-based fisheries management', *Resources* (Resources for the Future, Spring 2003); B. Worm *et al.*, 'Rebuilding global fisheries', *Science*, Vol. 325, 2009, pp. 578–85; and R. Newell, J. Sanchirico and S.

5.5 Financial innovations to improve global health

One of the most glaring imbalances in the allocation of health-care investment worldwide is that less than 10 percent of global investment in pharmaceutical R&D targets diseases such as malaria, AIDS, and tuberculosis that cause great suffering in developing nations and may affect up to 90% of the world's population (see Lichtenberg (2003)).

Gallup and Sachs (2001) argue that the elimination of widespread ailments such as malaria would have a significant impact on economic growth in emerging nations, reducing inequality around the globe. But profit pressures lead pharmaceutical companies to focus on 'lifestyle' drugs and treatments for 'Western' diseases that are concentrated in more affluent nations, leaving other drug development issues unaddressed. In the current financial environment, good ideas with the potential to cure diseases of poverty are nearly impossible to fulfil. Creative strategies are needed to channel capital to where it is most urgently needed.

The fight against tuberculosis is a case in point. The World Health Organisation (WHO) estimates that a third of the world's population is vulnerable to TB, which claims 1.7 million lives each year.¹⁵ The nonprofit Global Alliance for TB Drug Development (the TB Alliance) formed a public-private partnership between Bayer Healthcare AG to jumpstart the fight against this deadly disease. It has been estimated that the global market for a tuberculosis drug market is \$261–\$418 million (see Schwalbe *et al.* (2008)). The relatively small profit potential in this market (especially when weighed against drug development costs), plus the fact that TB disproportionately affects emerging nations, has made this effort unattractive for any single drug company. As a consequence, doctors treating TB patients are forced to rely on drugs that were developed decades ago; these outdated therapies must be taken for six months at a time.¹⁶

The Alliance has taken steps to catalyse medical solutions and save lives. It pursues intellectual property rights in the area of TB research, as well as coordinating drug trials and research efforts. It is funded through country donations (primarily from Europe and the USA), as well as the Bill & Melinda Gates Foundation and the Rockefeller Foundation.¹⁷

The Bayer/TB Alliance partnership was announced in 2005. Its goal is to coordinate global clinical trials to study the potential of an existing antibiotic, moxifloxacin, in the treatment of TB. In an animal study, moxifloxacin shortened the standard six-month clinical treatment of TB by two months.

The TB Alliance has been coordinating and helping to cover the cost of the trials, leveraging substantial support from several US and European government agencies. The partnership's goal is to make an anti-TB drug available at a not-for-profit price. With its costs covered, Bayer could sustain the supply. Furthermore, if the drug development process is successful, Bayer will receive approval from the FDA for an additional

Kerr, 'Fishing quota markets', Resources for the Future, Discussion Paper 02–20, August 2002.

¹⁵ See World Health Organization, Initiative for Vaccine Research, Selection of Diseases in IVR Portfolio, http://www.who.int/vaccine_research/diseases/ari/en/index4.html.

¹⁶ See TB Alliance, Mission & History, <http://www.tballiance.org/about/mission.php>.

¹⁷ See TB Alliance, Donors, <http://www.tballiance.org/about/donors.php>.

prescriptive use for moxifloxacin (under the brand name Avelox).¹⁸ After decades with no progress being made on this deadly affliction, this innovative partnership model has revived the drug pipeline for TB.

Another interesting public-private partnership was forged between GlaxoSmithKline Biologicals (GSK) and the International Aids Vaccine Initiative (IAVI). Similar to the TB partnership discussed above, GSK and IAVI are collaborating to stop the spread of HIV/AIDS. Their goal is to make a sustained supply of an AIDS vaccine available at a not-for-profit price by GSK.¹⁹ In the first years of the alliance, new neutralising antibodies have been discovered that give promise for further drug development for a vaccine drug target.

In late 2004, Britain announced major support to shore up the fight against HIV/AIDS. A key element of the British proposal was a major advance purchase agreement (also known as an advance market agreement)—in other words, a pledge to purchase millions doses of an AIDS vaccine, if and when it is developed.²⁰ Under advance market commitments, donors commit money to vaccine makers, guaranteeing the price of vaccines once they have been developed; this gives vaccine makers the incentive to invest the sums required to conduct research, pay staff, and utilise or build manufacturing facilities. Participating companies make binding commitments to supply the vaccines at lower, sustainable prices after donor funds are used up.

Advance purchase agreements change the economics of the public-private partnership by creating a stable market that will pay fair-market price for the therapy. They create a privatisation effect, eliminating the need for complex coordination between multiple government agencies, foundations, and the nonprofit catalyst. Where drug makers were once reluctant to enter markets for treating diseases of poverty, this innovation reduces their uncertainty about future returns. By creating a stable market, governments and NGOs can redirect the industry's research capacity to where it is most desperately needed.

6. Concluding Remarks

Financial innovation does have a dark side; it can have detrimental effects. There is evidence that financial innovations are sometimes undertaken to create complexity and exploit the purchaser. As far as the financial crisis that started in 2007 is concerned, securitisation and subprime mortgages may have exacerbated the problem. However, financial crises have occurred in a very wide range of circumstances, where these and other innovations were not important. There is evidence that in the long run financial liberalisation has been more of a problem than financial innovation.

There are also many financial innovations that have had a significant positive effect. These include venture capital and leveraged buyout funds to finance businesses. In

¹⁸ See J. Lauerman, 'Bayer drug may cut tuberculosis cure time by months', Bloomberg, 17 September 2007.

¹⁹ See 'GSK Biologicals and IAVI Partner to Develop AIDS Vaccine', IAVI press release, June 21, 2005 (available at <http://www.iavi.org/Information-Center/Press-Releases/Pages/GSK-Biologicals-and-IAVI-Partner-to-Develop-AIDS-Vaccine.aspx>).

²⁰ See B. Russell, 'Brown to earmark £200 M a year to fund AIDS vaccine', *The Independent*, 1 December 2004.

addition, financial innovation has allowed many improvements in the environment and in global health. On balance it seems likely its effects have been positive rather than negative.

References

- Allen, F. and Yago, G., *Financing the Future: Market-Based Innovations for Growth* (Wharton School Publishing-Milken Institute Series on Financial Innovations, Pearson Education: Upper Saddle River, NJ, 2010).
- Allen, F., Barth, J. and Yago, G., *Fixing the Housing Market: Financial Innovations for the Future* (Wharton School Publishing-Milken Institute Series on Financial Innovations, Pearson Education: Upper Saddle River, NJ, 2012).
- Baker, G. and Wruck, K., 'Organizational changes and value in leveraged buyouts: the case of the O.M. Scott Company', *Journal of Financial Economics*, Vol. 25, 1989, pp. 163–90.
- Bergstresser, D., 'The retail market for structured notes: issuance patterns and performance, 1995–2008', *Working Paper* (Harvard Business School, 2008).
- Bloom, N., Sadun, R. and Van Reenen, J., 'Do private equity-owned firms have better management practices?', in Gurung, A. and Lerner, J., eds, *Globalization of Alternative Investments?* Working Papers Volume 2: Global Economic Impact of Private Equity 2009, (World Economic Forum USA, New York, 2009), pp 1–23.
- Demirguc-Kunt, A. and Detragiache, E., 'Financial liberalization and financial fragility', *Working Paper* 98/83 (International Monetary Fund, Washington, DC, 1998).
- Drees, B. and Pazarbasioglu, C., 'The Nordic banking crises: pitfalls in financial liberalization?', *Working Paper* 95/61 (International Monetary Fund, Washington, DC, 1995).
- EPA, 'Guidebook of financial tools: paying for sustainable environmental systems', 2008a, available online at www.epa.gov/efinpage.
- EPA, 'Clean water state revolving fund programs, 2008 Annual Report: Cleaning Our Waters, Renewing Our Communities, Creating Jobs,' 2008b, available online at <http://www.epa.gov/OWM/cwfinance/cwsrf/>.
- Fenn, G., Liang, N. and Prowse, S., 'The private equity market: an overview', *Financial Markets, Institutions & Instruments*, Vol. 6(4), 1997.
- Fogel, R., *Railroads and American Economic Growth: Essays in Econometric History* (Johns Hopkins Press, Baltimore, 1964).
- Gallup, J. and Sachs, J., *Cause, Consequence and Correlation: Assessing the Relationship between Malaria and Poverty* (Commission on Macroeconomics and Health, World Health Organization, 2001).
- Hellmann, T. and Puri, M., 'Venture capital and the professionalization of start-up firms: empirical evidence', *Journal of Finance*, Vol. 57, 2002, pp. 169–97.
- Henderson, B., and Pearson, N., 'The dark side of financial innovation: a case study of the pricing of a retail financial product' *Journal of Financial Economics*, Vol. 100, 2011, pp. 227–47.
- Hoberg, G., Goldfarb, B., Kirsch, D. and Triantis, A., 'Does angel participation matter? An analysis of early venture financing', Robert H. Smith School Research Paper No. RHS 06–072 (University of Maryland, 2009), available online at <http://ssrn.com/abstract=1024186>.
- Kaminsky, G. and Reinhart, C., 'Banking and balance-of-payments crises: models and evidence', *Working Paper* (Board of Governors of the Federal Reserve, Washington, DC, 1996).
- Kaminsky, G. and Reinhart, C., 'The twin crises: the causes of banking and balance-of-payments problems', *American Economic Review*, Vol. 89, 1999, pp. 473–500.
- Kaplan, S., 'The effects of management buyouts on operations and value', *Journal of Financial Economics*, Vol. 24, 1989, pp. 217–54.
- Kortum, S. and Lerner, J., 'Assessing the contribution of venture capital to innovation', *Rand Journal of Economics*, Vol. 31, 2000, pp. 674–92.
- Krugman, P., 'Innovating our way to financial crisis', *New York Times*, 3 December 2007.

- Lamoreaux, N., Levenstein, M. and Sokoloff, K., 'Financing invention during the second industrial revolution: Cleveland, Ohio, 1870–1920', in Lamoreaux, N., and Sokoloff, L., eds, *Financing Innovation in the United States, 1870 to the Present* (MIT Press, Cambridge, 2007).
- Lerner, J. and Tufano, P., 'The consequences of financial innovation: a counterfactual research agenda', *Working Paper* (Harvard Business School, 2010).
- Lerner, J., Sorensen, M. and Stromberg, P., 'Private equity and long-run investment: the case of innovation', *Working Paper* 14623 (NBER, 2008).
- Lichtenberg, F., 'Pharmaceutical innovation, mortality reduction, and economic growth', in Murphy, K. and Topel, R., eds, *Measuring the Gains from Medical Research: An Economic Approach* (University of Chicago Press, Chicago, 2003) pp. 74–109.
- Mollica, M. and Zingales, L., 'The impact of venture capital on innovation and the creation of new business', *Working Paper* (University of Chicago, 2007).
- Reinhart, C. and Rogoff, K., *This Time is Different: Eight Centuries of Financial Folly* (Princeton University Press, Oxford and Princeton, 2009).
- Schwalbe, N. *et al.*, 'Estimating the market for tuberculosis drugs in industrialised and developing nations', *International Journal of Tuberculosis and Lung Disease*, Vol 12(10), 2008, pp. 1173–81.
- Strömberg, P., 'The new demography of private equity', in Gurung, A. and Lerner, J., eds, *Globalization of Alternative Investments Working Papers Volume 1: Global Economic Impact of Private Equity 2008*, (World Economic Forum USA, New York, 2008), pp. 3–26.
- Tufano, P., 'Financial innovation', in Constantinides, G., Harris, M. and Stulz, R., eds, *Handbook of the Economics of Finance*, Volume 1a Corporate Finance (Elsevier, 2003), pp. 307–336.