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The Role of Insurance in Ensuring Financial Market Liquidity

by Philippe Trainar*

In the last 20 years, economists and financial analysts have reacted to Keynesian and post-Keynesian analyses by turning away from macro-economics or by focusing more narrowly on inflation and structural factors, rather than on liquidity. At the same time, they have not really called into question the basic assumptions of the Keynesian paradigm, according to which the central bank controls economic liquidity by controlling money supply.

Recent financial crises have quite understandably shaken their convictions. First of all, the crisis that rocked the economies of South-East Asia underscored the importance of liquidity in driving market efficiency, and the pivotal role that financial institutions could play quite independently of the central banks. Secondly, the Japanese crisis has called attention to the special role played by the insurance industry in ensuring economic liquidity, a role that is often insufficiently understood. Of particular significance is the fact that, although the insurance industry cannot play a counter-cyclical role with respect to global demand, it can nonetheless play just this role with respect to financing the economy.

This article explores and develops the role of insurance in supplying liquidity. After defining a few useful terms, we will turn to the role played by insurance in supplying macro-economic liquidity. We will then attempt to gain a better understanding of how insurance contributes to micro-economic liquidity, a subject of analysis that we believe is both fruitful and largely underexploited.

1. Review of preliminary definitions

Our aim in offering a set of preliminary definitions is not to repeat a few banalities of economic and financial analysis, but rather to remove all possible ambiguity concerning the concepts that underpin our discussion. This brief detour is all the more important considering that, in ordinary language usage, these concepts can mean different things to different people.

First definition: what exactly is insurance (and reinsurance)? It is above all a promise to compensate or indemnify the consequences of a loss-producing event or, more generally, a risk whose contours have been delineated in advance. The risk factor must be present in all

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types of insurance coverage – property, casualty, and life. It is the presence of the risk factor that differentiates a savings product from a life insurance product, and banking from insurance. This promise is extended over a defined period, which may be short (motor insurance, for example) or long (casualty or liability insurance, for example), and which is usually limited to a defined geographic scope. Of equal importance is the notion that this promise is made in return for the prior payment of a premium, calculated using actuarial methods. For this reason, the type of risk pooling practiced by insurance differs fundamentally from the "solidarity" or mutual support that characterizes pay-as-you-go social security systems. The premium paid by the holder of an insurance contract is calculated to cover the likelihood *ex ante* of the occurrence of an insured risk, while the contribution paid into the social security system is calculated to cover current expenditures.

Second definition: what is financial liquidity? In the *Treatise on Money*, John Maynard Keynes offers a concise and comprehensive definition of asset liquidity: "one asset is more liquid than another if it is more certainly realisable at short notice without loss." More generally, financial market liquidity refers to the ability of economic agents to find counterparties willing to finance their profitable ventures under reasonable terms while at the same time finding buyers willing to purchase their assets for a reasonable price. Thus, it encompasses a dual dimension: micro-economic, if we focus on the liquidity of individual economic agents, and macro-economic, if we focus on the liquidity of a group of economic agents or an entire economy.

We will examine the links between insurance and financial market liquidity from this dual perspective, keeping in mind that the distinction between the two approaches is more a matter of perspective than a substantive issue, and that economic and financial analysis has tended to focus on the former and to neglect the latter since the decline of Keynesian analysis. Nonetheless, the macro-economic approach remains predominant in the study of monetary policy.

2. Insurance and macro-economic liquidity

The relationship between insurance and macro-economic liquidity is threefold: first, insurance contributes to ensuring liquidity by pooling the risks it covers; second, it enhances liquidity by reducing the cost of financial intermediation; and third, insurance can be the source of a liquidity crisis and systemic risk, a premise worth exploring. These three contributions to macro-economic liquidity will be examined in detail below.

2.1. Money creation and risk pooling

A look at the differences between banking and insurance puts the role of insurance in the economy into particularly sharp focus. Despite their numerous similarities as financial institutions, banks and insurers contribute to economic liquidity in strikingly different ways. There are two fundamental differences worth noting.

The first difference lies in the fact that, unlike insurers, banks can create money from their assets. In banking, it can be said that "money to lend comes primarily from deposits". In other words, the funds deposited by economic agents are the requisite counterpart to the credit that is extended to these same agents or their debtors. Bank money is primarily created out of the confidence that bankers have in the creditworthiness and liquidity of their clients. The lender's trust in its client is greater than the depositor's trust in the bank. In banking, the creation of social wealth is thus *ex post facto* to monetary creation; indeed, the latter makes

the former possible. In insurance, the monetary production cycle is the reverse: deposits condition lending. In other words, the insurers' debits – premiums paid by policyholders for coverage in the event of a loss – form the substance of its financial investments. The insurer does not create money; it merely transfers money that already exists and that has been provided by policyholders who have placed their trust in the insurer. In insurance, the creation of social wealth precedes the transfer of funds, because the premiums paid in by policyholders can only be derived from income they have earned and hence from work already accomplished. At the same time, the creation of social wealth is also *ex post facto,* to the extent that the investments made by insurers in equities, fixed maturities and real-estate assets help finance the economy, in the same way that bank lending does. And like bankers, insurers also anticipate the future creation of wealth.

The second fundamental difference between banking and insurance is that the insurer, unlike the banker, can leverage liabilities to improve economic liquidity. What differentiates the insurance contract from other types of contracts is that it pools the risks it covers. Insofar as these risks are independent of the will and behaviour of "insureds" (hence free of moral hazard), and spread among insureds (hence free of adverse selection), the insurer can offer this protection for a sum that is considerably lower than that which the insured would be required to set aside if he decided to insure himself. But even assuming that this were not the case, insurance at the very least protects the insured against the financial constraint that results from the occurrence of a loss, and from the danger of not having the required financial resources to offset or mitigate its impact. This point is a crucial one with respect to our subject: in the eyes of the insured, the insurer plays the role of reducing the financial constraint of insured risks.[1] This in turn makes it possible for the insured to reduce the amount of savings he must set aside to deal with contingencies of this type, consequently improving the level of liquidity in the economy and facilitating the Keynesian equalization of the savings and investment rate at a high level of activity. This is not the case in banking, where the level of deposits has no particular influence on the general level of liquidity in the economy.

These differences between banking and insurance can be illustrated by the simple IS–LM model (Figure 1).[2] This model describes economic equilibrium as a function of the level of domestic income and the level of interest rates. This equilibrium should enable the product market and the monetary market to balance out. The IS curve describes all points of equilibrium in the product market. The slope is negative because an increase in the interest rate adversely affects investment due to the decrease in the marginal efficiency of capital, which must lead to a decrease in income to bring savings down to the level of investment. The LM curve describes all points of equilibrium in the money market. The slope is positive because, for a given money supply and money velocity, an increase in product demand leads to a parallel increase in money demand, which can only be reabsorbed by an increase in the interest rate. In a universe devoid of insurance and banking, the economy's point of equilibrium would be reached at the intersection (A) of the IS and LM curves. The introduction of insurance reduces precautionary savings and therefore increases both demand and income (interest rates being equal), which corresponds to a shift to the right in the IS curve (toward IS′). With the introduction of banking (and hence lending), the real money supply increases for a given interest rate, which corresponds to a shift to the right in the LM curve (toward LM′).

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[1] This aspect is explored in F. Ewald and C. Gollier's forthcoming work *Le Risque* (Risk) Paris, Gallimard. See, in particular, chapter 6.

[2] See J. R. Hicks (1937), "Mr Keynes and the Classics", *Econometrica,* Vol. 2.

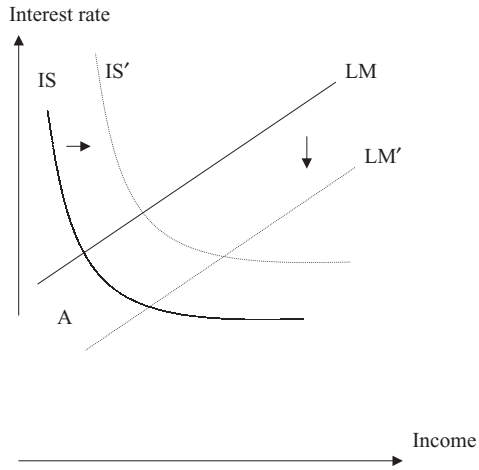

Figure 1

2.2. *Intermediation and the liquidity of financial markets*

In spite of these fundamental differences, banking and insurance also make similar contributions to the level of liquidity in their shared capacity as financial intermediary. Both make a significant contribution to adjusting supply and demand in the capital markets, despite the fact that the trend toward disintermediation has limited this contribution to some extent. In order to adjust supply and demand, banks and insurers have developed the activity of transformation, transforming the structure of maturities (by extending asset durations compared to liabilities), the structure of risks (by converting material risks into financial risks, or financial risks into credit risks) and the structure of negotiability (by using insurance contracts or deposits that are not readily negotiable in and of themselves to finance equity and fixed maturity securities, which are). This transformational role is essential given that indivisibilities exist, transaction technologies are not convex, and the insurance product market is characterized by asymmetric information (which leads to the risk of adverse selection or moral hazard and the cost of *ex post* verification),[3] factors that tend to increase transaction costs and reduce liquidity. In playing this transformational role, banks and insurers offer their clients diversification and a risk spread that is closer to the optimal structure they could obtain if markets were complete and functioned perfectly.[4] In other words, as a financial intermediary, the role of the insurer, like that of the banker, is threefold.

The insurer as liquidity pool. This involves insurance liabilities. The occurrence of a loss imposes adjustment costs on the agents affected, which can be thought of as idiosyncratic liquidity shocks that may affect agent patterns of consumption and investment. To the extent that these shocks are not perfectly correlated within the system, the cash outlay required to

[3] See J. Gurley and E. Shaw (1960), "Money in a Theory of Finance", Brookings Institution, and E. Fama (1980), "Banking in the Theory of Finance", *Journal of Monetary Economics,* 6(1).

[4] See Hellwig (1991), "Banking, Financial Intermediation and Corporate Finance", in A. Giovannini and C. Mayer (eds), *European Financial Integration*, Cambridge University Press.

repair the damage resulting from the loss increases less than proportionately to the number of insureds covered. By pooling individual risks, the insurer is able to reduce the volume of liquidity that the economy must maintain to absorb these losses. Hence, the insurer serves as a liquidity pool that saves liquidity, thereby making it available for other activities. In playing this role, the insurer contributes to efficient capital allocation within the economy, thereby enhancing the overall efficiency of the financial markets.

The insurer as coalition for sharing information for the benefit of businesses seeking to raise capital. This involves insurance assets, as seen from the perspective of the businesses they finance. Businesses that raise public equity capital are generally better informed of their quality as an investment than individual retail investors are. Consequently, the retail investor who wants to build savings by investing in these companies as a way of securing protection against the occurrence of certain types of risks faces the problem of adverse selection. In order to signal their quality to individual investors, these businesses can invest a significant portion of their equity capital in their own projects, which they in fact do, but to a limited degree given their aversion to risk and the unreasonably high cost that this strategy implies for "good" businesses. Insurance provides the latter with a mechanism for presenting themselves to policyholders as a homogenous coalition of uniform quality, selected by insurance companies, and this in turn allows businesses to procure better financing terms than they could if they appealed to each of these investors individually. This coalition is all the more effective given that the individual returns of coalition members, which are imperfectly correlated among themselves, can be pooled.

The insurer as mandated manager on behalf of policyholders. Once again, this involves insurance assets, but this time from the perspective of the policyholder. Returning to the notion of asymmetric information mentioned above, it is clear that investors must thoroughly research businesses that raise equity in the capital markets and monitor them over time to avoid falling prey to opportunists, and even to punish such behaviour when it does occur. By delegating the management of their precautionary savings to insurers, policyholders benefit from the fact that the cost of gathering information on businesses and monitoring them grows less rapidly than the number of policyholders and the volume of funds available for investment. This mechanism is beneficial to policyholders to the extent that the returns resulting from this delegation are higher than the cost of monitoring insurers, either directly, by policyholders themselves, or indirectly, via public services officially charged with this watchdog function in each country. Viewed from this perspective, insurance offers a comparative advantage over banking due to its expertise in the area of risk.

Table 1 below provides an idea of the relative weight of insurance in financing the

Table 1

Percentage of stocks and bonds held by insurers	**France**	**U.S.**	
		excluding pension funds	**including pension funds**
Stocks	4.5%	6.0%	16.0%
Bonds	35.5%	14.5%	20.0%

Source: Comptes de patrimoine, Banque de France; Flow of funds accounts, Board of Governors of the Federal Reserve Bank for 1999.

economy via the markets. In France, the insurance industry plays a much greater role in the bond market than it does in the equity market compared with the role of insurance in the United States, where the difference between the two is minimal. This difference is attributable to the fact that, in France, a substantial portion of equities are held by their historical owners and by foreigners, and also to the importance of pension funds in the United States (which becomes clear when the figures are adjusted for pension funds, see below). However, current efforts to modernize French capitalism, combined with the need to deal with the ageing of the population and its impact on retirement funding, should enable insurers to play a greater role in supplying liquidity to the French economy, particularly in the form of equity investments.

2.3. Insurance, systemic risk and liquidity crisis

It is important to consider the extent to which insurance can both supply liquidity to the economy and, like banks, also be a source of systemic risk and the originator of a liquidity crisis. Bank-driven panics were a recurrent phenomenon up to and through the crash of 1929. More recent crises, in Japan and in Eastern and South-East Asia, have shown that the phenomenon has not entirely disappeared. Indeed, it has been a major preoccupation of international financial institutions in recent years (e.g. the IMF and Joint Forum). Within the banking system, the systemic risk begins with a local incident, involving a particular banking institution, which then spills over into the entire financial sector, regardless of the solvency of the individual institutions affected, leading to a collapse in the system of payments and, consequently, to a general economic crisis. The shock wave is propagated via inter-bank and corporate lending activities, without which banks and businesses could not continue to operate. This type of risk should not be confused with a general shock that impacts all banks at the same time (for example, an interest rate shock, an inflationary shock or a stock market shock). The contagion in question here has causes that are primarily psychological: in a universe where information is imperfect, agents will tend to interpret the failure of the first bank as a threat to all other banks, and will feel justified in adopting an attitude of mistrust with respect to banks in general. This type of contagion is typical of an economy with multiple points of equilibrium. It is an essentially self-fulfilling prophecy whose impact is impossible to predict.[5] While the initial incident can be likened to a solvency crisis, the spilling over of the crisis through contagion bears the hallmarks of a liquidity crisis: economic agents have quite simply lost faith in the system.

There are at least four good reasons for thinking that the economy is less exposed to a systemic risk originating in the insurance sector than it is to one from the banking sector.

- The liquidity that banks pump into the economy in the form of credit is not contingent on some prior creation of wealth; it is the anticipation of the creation of wealth. Conversely, as we saw earlier on, the liquidity that insurance injects into the economic system, while it also anticipates some future creation of wealth, is only a transfer of liquidities resulting from the prior creation of wealth on the part of policyholders. Consequently, the failure of a bank has a potential impact on a large number of individuals, not just on its own clients, and this lends itself to panic, while the insolvency of an insurer impacts a group of clearly identified policyholders and beneficiaries, which helps contain any tendency to lose faith.

[5] In the words of W. Bagehot (1873), "Every banker knows that if he has to prove that he is worthy of credit, however good may be his argument, in fact his credit has gone."

- The short-term liquidity of bank deposits is vitally important, since such funds are used by their depositors to cover daily cash needs. Conversely, only a portion of the claim policyholders have on insurers corresponds to a possible short-term liquidity need – that needed to cover a loss occurrence over the short term. This situation only serves to aggravate the risk of a panic movement in the banking sector compared with the insurance sector.
- Depositors can withdraw all their money from their bank at any time and immediately, without paying any financial or tax penalty. Policy surrender is necessarily more gradual, since it is less easy and costlier for the policyholder, due to the nature of insurance contracts that have to remove risks of free riding and moral hazard. In life insurance, for example, early withdrawals are slowed down: first, by contractually binding penalties due to the insurer (which in France can run as high as 5 per cent); second, by the loss of entitlement to the favourable tax treatment generally granted (in France, a withdrawal within eight years results in the taxation of revenues at the marginal income tax rate, but only at 7.5 per cent thereafter); and third, by the delay usually allowed for repayment of the cash value of the policy (in France, insurers have two months to give back the money). Consequently, a sudden massive flight of depositors is a possibility, whereas any flight on the part of policyholders from their insurer is necessarily more gradual.
- Finally, the tissue of financial relationships that insurance enterprises have with other financial institutions is not particularly entangled, with the exception of reinsurance relationships and equity investments. Banks, on the other hand, are part of a dense and interlocking network of inter-bank loans and credit arrangements.

For this reason, the insurance industry is primarily perceived as a risk absorber. Not a single bankruptcy on the part of an insurer or reinsurer has triggered a macro-economic crisis. During the real-estate crisis of the late 1980s and early 1990s, insurers did not rush to divest themselves of their real-estate assets like the banks did. Moreover, it took a full ten years for the Japanese crisis to bring some of Japan's major insurers to their knees. Its banking sector, meanwhile, is mired in a deep crisis that has weighed heavy on the domestic economy for many years now, despite major attempts to shore it up through monetary policy and public funding. In the absence of detailed data from companies, we can nonetheless test the impact of the contagion phenomenon in the banking sector compared with the insurance sector by studying the statistical relationships between the stock price quotations of publicly listed companies in these sectors, synthetic indices of these sectors, and the global market index. Appendix 1 presents the data we used for this purpose and the modelling that was done. As Table 2 below illustrates, these data support the thesis that banks are far more exposed to the contagion phenomenon than insurance companies:

- The percentage of historical stock price volatility for each company taken individually that is attributable to shocks triggered by other companies in the same economic sector is 1.5 times higher in the banking industry than in the insurance industry;
- The percentage of the historical volatility of the CAC 40 that is attributable to shocks triggered by insurance is negligible compared with that which is attributable to banking;
- Finally, the percentage of historical volatility in banking and insurance stock price indices that is attributable to insurance is negligible compared with that which is attributable to banking.

The data in the last column can be alternatively represented as in Figure 2, which shows the respective 120-month impact on the average stock price of all companies of a one-off

Table 2

	Breakdown in historical variances in stock market prices		
Percentage attributable to shocks triggered by:	***Insurance enterprises***	***Banking enterprises***	***All corporations (CAC 40 or SBF 250)***
Enterprises concerned	26%	17%	–
Insurance industry	19%	–	11%
Banking industry	–	32%	25%
Economy as a whole (CAC 40 or SBF 250)	55%	51%	64%

Source: Datastream and author's calculations.

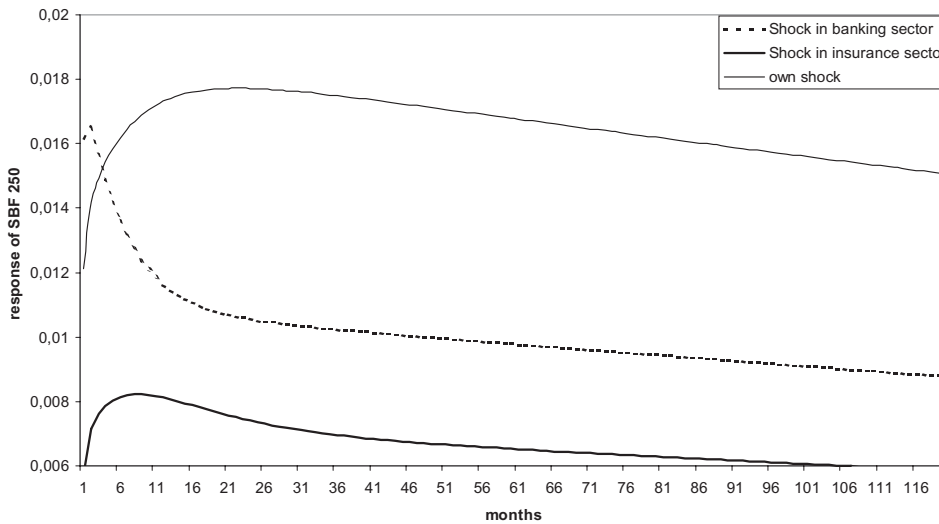

Figure 2: Response of SBF 250 to their own, insurance and banking shocks

shock triggered by the insurance industry, the banking sector, and the overall economy. The tendency of shocks triggered by the insurance industry to spill over into the overall economy is much lower, and its impact tends to be of a much shorter duration. Conversely, shocks originating in the banking sector have measurable effects on the entire economy that appear to be durable. Naturally, shocks that originate in the overall economy tend to predominate.

The reason that the insurance industry plays this role of economic shock absorber has to do with its practice of long-term asset liability management, a point we will return to below.

3. Insurance and micro-economic liquidity

The insurance contribution to micro-economic liquidity can be analysed on the level of the liquidity of the insurance enterprise itself, which is regulated in all the major

industrialized nations, and in terms of policyholder liquidity, which is the ultimate aim of insurance.

3.1. The insurer's liquidity

In order for the net contribution of insurance to liquidity to be effective, insurance enterprises must themselves be liquid. Insurers have four major sources of liquidity: equity capital, premiums paid in by policyholders in return for insurance coverage, the investment quality of the securities in which insurers invest their reserves, and the match between the inflows generated by these assets and the outflows made to meet policyholder obligations under insurance contracts. Liquidity is very much a core concern of any insurance company, and is achieved via asset–liability management, the pooling of insurance risks, the spreading of credit and market risks, and the reinsurance of risks.

The pooling of an insurer's own risks is a three-dimensional process that is critical in ensuring the liquidity of insurance enterprises. The first dimension of risk-pooling results from the fact that a number of insureds are covered for a single risk, with each insured presumed to represent an independent risk. The second dimension results from the fact that insurers cover a number of different risks that are weakly correlated. The third dimension of risk-pooling relates to inter-temporal pooling, i.e. the possibility of smoothing out the impact of claims over several generations of policies. This dimension, which appears to be absent from banking, offers insurers an additional degree of flexibility that strengthens asset liability management policy and improves their ability to deal with unexpected shocks. It entails smoothing out premiums and underwriting results over several generations of policies,[6] primarily through the use of policyholder participation in profits and equalization reserves. The investment policies of French insurers, which generally reflect a long-term perspective and integrate renewal and new business forecasting to no small degree, illustrate this concern for inter-temporal pooling quite clearly (Table 3). For example, French insurers hold equity securities for an average of four years, compared with just over seven months for other investors. The holding periods for bonds are one year and less than one month, respectively.

By way of illustration, Figure 3 shows why it is important for life insurers to be able to practise inter-temporal pooling if they want to be able to guarantee a minimum return to policyholders while also being reasonably certain of their ability to finance this guarantee. To be able to offer a life insurance beneficiary an *ex ante* guarantee of a minimum annual return of 2 per cent (adjusted for inflation), with 95 per cent probability of being able to finance this

Table 3

Apparent holding period in 1999 (France)	**Equities (French)**	**Bonds (French)**
Households	2 years, 10 months, 18 days	7 years, 6 months, 9 days
Non-financial companies	7 years, 2 months	4 months, 8 days
Credit institutions	1 year, 3 months, 18 days	5 days
Insurance companies	**4 years, 1 month, 7 days**	**1 year, 21 days**
Mutual funds	11 months, 13 days	3 months, 5 days
Non-residents	4 months, 2 days	4 months, 19 days
Average	**9 months**	**24 days**

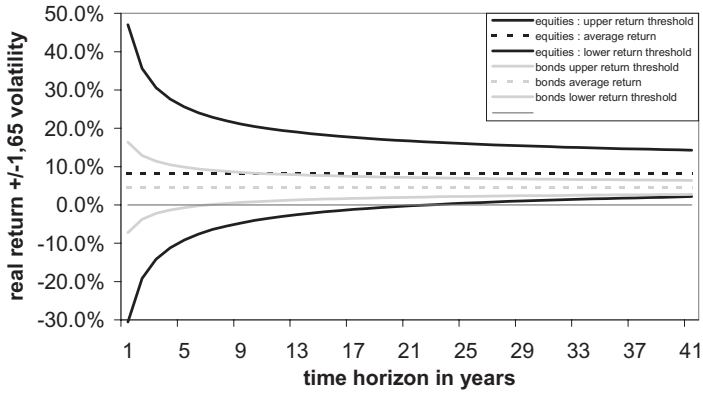

Figure 3: Return on stocks and bonds on the basis of time horizon
Source: INSEE, Datastream, monthly statistics for France, 1949–1999.

guarantee through the returns generated by insurance company assets, the figure shows that it is necessary to pool 20 years of bond yields or 40 years of returns on CAC 40 equities. It would be impossible to guarantee this minimum level of return on the basis of a money market investment. The inter-temporal pooling options that are available to insurers offer advantageous liquidity terms compared with other economic agents and reduce substantially, in the short run, the risk of a sudden liquidity crisis that banks face. Unlike banks, solvent insurance enterprises stand very little chance of finding themselves faced with the risk of illiquidity.

There is, however, a downside to the inter-temporal pooling option open to insurers: an insolvent insurance company can remain liquid, possibly for a number of years. This is virtually unthinkable for a bank. Consequently, an insolvent insurance company can do far more serious financial damage than an insolvent bank (leaving aside, for the sake of argument, the macro-economic effects this would produce). This is what makes the minimum solvency requirement placed on insurance companies both extremely important and extremely difficult – the short-term or "snapshot" liquidity of an insurance enterprise is not an accurate yardstick of its financial health. In this respect, insurance companies are diametrically opposed to banks. The solvency requirement placed on insurance companies, which sets minimum capital adequacy levels based on insurance obligations and/or assets, depending on the country, is motivated by the desire to structure explicit or implicit transfers of liquidity over time and limit "free ride" policies that favour the short term. At the same time, it would be dangerous not to regulate the liquidity of an insurance enterprise under the guise of regulating its solvency. A solvent insurance enterprise is above all a liquid enterprise, over the short term as well as over the long (and even very long) term. Solvency, which is measured by applying general rules at a particular moment in time and on the ultimate cushion that equity capital provides insurers in the event of a serious shock, is at best highly approximate compared with what the measurement of long-term liquidity requires, based as it is on sophisticated and disaggregated internal models. Attempts to measure the solvency of an insurance company should increasingly include the measurement of its long-term liquidity.

3.2. Policyholder liquidity

The insurance offering has three effects on policyholder behaviour: a substitution effect, an income effect, and an efficiency effect.

As we have seen, insurance reduces the cost of covering risks through (i) the pooling of risks, (ii) the adoption of a well-informed investment policy, and (iii) the asset–liability management techniques employed by insurers. The reduced cost of acquiring protection against risks encourages policyholders to substitute other products for insurance products, thereby improving their level of coverage. Uncertainty as to policyholder solvency, whether the policyholder is an individual or a business, is therefore reduced, and creditworthiness is improved, which increases the value of the time option, i.e. the option to decide not to postpone investing in them. This in turn enhances micro-economic liquidity and stimulates economic activity.

In addition, the reduced cost of risk coverage also gives insureds greater purchasing power, which translates into an income effect that stimulates spending and demand, to the benefit of all types of products and services, not just those sold by insurers. Independently of any monetary creation, the liquidity of the entire economy is enhanced by the production of insurance services.

Unfortunately, the extent to which any particular economic agent is insured is not a known factor in arm's-length transactions, which means that the other party to a transaction is not able to discriminate between agents who are adequately covered, and hence a safe bet, from other economic agents. Counterparties generally cannot impose mechanisms of the type used by insurers, such as the deductible, which help ascertain the agent's risk level. This market inefficiency has an adverse impact, since it prohibits lenders from adjusting interest rates on the basis of the borrower's intrinsic worthiness measured by the degree to which his insurable property is insured. This forces lenders to ration financing and agent liquidity without taking insurance coverage into account. The end result is a sub-optimal allocation of capital. The question that arises is how to improve market efficiency by reducing this information-driven inefficiency. The International Accounting Standards Committee recommendation of adopting the full fair-value standard in accounting for financial instruments, which is supported at the European level (by both the Commission and the Council), would help resolve the problem by requiring integration of the credit risk into balance sheets. In fact, this credit risk cannot be evaluated independently of the coverage underwritten by the insurance enterprises in question. Information on this coverage would thus be disclosed, at least implicitly, in their financial statements. An alternative would be to introduce an accounting standard that requires businesses to itemize their coverage against large insurable risks in the notes to their financial statements, and in particular their insurance arrangements for low-frequency, high-impact risks.

Appendix 1: Historical variance decomposition of quotation (commentary on Table 2)

In this simulation, I seek to quantify the contribution of three types of independent innovations to the historical variance of quotations of three French insurance companies (AXA, AGF and ASBP), three French banks (BNP, Société Générale and CCF) and French companies overall: innovations originating in the selected insurance or banking organizations, innovations common to the sector, and innovations common to all French companies. The idea behind this simulation is to use quotation figures to test contagion effects

econometrically: the first, originating in other companies in the same sector and affecting the aforementioned companies; the second, originating in the insurance or banking sector and affecting all companies.

For this purpose I use Vector AutoRegressions (VAR), where each variable is expressed as a linear combination of lagged values of itself and lagged values of all other variables in the group. The advantage I see in using the VAR approach is that it is a-theoretical, in the sense that no economic theory is used to specify explicit structural equations between the set of variables, which seems to me to be the most suitable approach for treating interdependencies between quotation variables. The VAR I propose to estimate has the following form:

$$X_t = A_i X_{t-i} + B + \varepsilon_t$$

where X_t is a three-element column vector (company's quotation; sectoral index, either banking or insurance; and synthetic index, either CAC 40 or SBF 250). We use four years of daily data for the decomposition of the historical variance of the company's quotation, and ten years of monthly data for that of the synthetic stock index. A_i is the matrix of coefficient to be estimated. B is a column vector of constants to be estimated. i is the selected lag that was optimal for no more than two periods. ε_t is a vector of white noise process; they are serially uncorrelated but may be contemporaneously correlated, thus the covariance matrix Ω of ε_t is positive definite:

$$E(\varepsilon_t) = 0 \text{ for all } t \qquad E(\varepsilon_t \varepsilon_s') = \Omega \text{ (if } s = t) \text{ or } 0 \text{ (if } s \neq t)$$

The elements of ε_t are the combined product of the innovations that affect simultaneously the three variables composing X_t (company's quotation; sectoral index, either banking or insurance; and synthetic index, either CAC 40 or SBF 250) and that are, by definition, uncorrelated pairwise. Let's call u_t the 3-element vector of these innovations, thus:

$$\varepsilon_t = Pu_t \quad \text{or} \quad u_t = P^{-1}\varepsilon_t \quad \text{or} \quad \varepsilon_{it} = (I - P^{-1}/\{P_i I\})\varepsilon_{jt} - u_t \quad \text{where} \quad j \neq i$$

P is a matrix of coefficient to be estimated econometrically, P_i is the vector corresponding to the first column of P and u_t is supposed to be the residual vector of equations where ε_{it} is the dependent variable and ε_{jt} are the explaining variables. Unfortunately this formula is of no practical use for estimating the vector u_t because there is only one econometric equation linking the three elements of the vector ε_t, whereas we need three independent equations in order to derive estimates of the three elements of the vector u_t. There is a shortage of two constraints in order to get the estimation. There are two widely used solutions to this problem: the first one specifies explicit structural constraints, a solution we excluded from the outset; the second one, corresponding to Choleski factorization, requires that matrix P be triangular, which means that one has to make the following assumption: that two of three innovations have no immediate impact, in the first round, on variance of two of the three variables contained in X_t. Once the constraints have been specified, one can run OLS estimates for estimating the specified equations for ε_{it} and normalize u_t so that they have unit variances. Thereafter, one can derive the contribution of u_t to the retrospective forecast errors e_t during the estimation period, using the variance–covariance matrix for the forecast errors Φ, where:

$$e_t = \Sigma_s(A^{t-s}\varepsilon_s) \quad \text{and} \quad \Phi = \Sigma_s[A^{t-s}\Omega(A')^{t-s}]) \quad \text{for } s = \{0, t\}$$

For the two first columns of Table 2 in the paper, I have assumed that innovations affecting the synthetic stock index have an immediate impact on the three concerned variables (company's quotation; sectoral index, either banking or insurance; and synthetic index, either CAC 40 or SBF 250), that innovations affecting the sectoral index have no immediate impact on the

synthetic index, and that innovations affecting company quotation have no impact on the two other variables. For the third column of Table 2 in the paper, I have assumed that innovations affecting the banking sector index have an immediate impact on all three concerned variables (banking stock index, insurance stock index and global stock index – SBF 250), that innovations affecting insurance have no immediate impact on the banking sector, and that innovations affecting the synthetic stock index have no impact on the two other variables.

Appendix 2: Inter-temporal pooling of returns (commentary on Figure 3)

Figure 3 has been constructed from annual data on stock and bond returns, including realized and unrealized capital gains and losses, over a 50-year period (1949–1999). Thus the figure shows the total return on these assets. The benchmark used for bonds is the ten-year government bond (ten-year OAT) or the most similar securities in cases where ten-year OAT data was unavailable. For stocks, I have used CAC 40 stock prices and dividend payout estimates provided by the INSEE (see *Bulletin Mensuel de la Statistique* for the most recent years). In order to homogenize the treatment of interest income and capital gains, for which the percentage with respect to the overall return differs for the two categories, I have assumed that both interest and dividends were always reinvested.

Then I extracted the expected value of return on these securities from the empirical data for the 50-year period (1949–1999) as well as its standard deviation for the various investment holding periods used, which range from one to 40 years. While the expected value of return is, by definition, constant over the period, its standard deviation decreases statistically as the investment holding period increases (this finding is discussed in reliable statistical manuals). The probability that the return will be situated in the interval of a standard

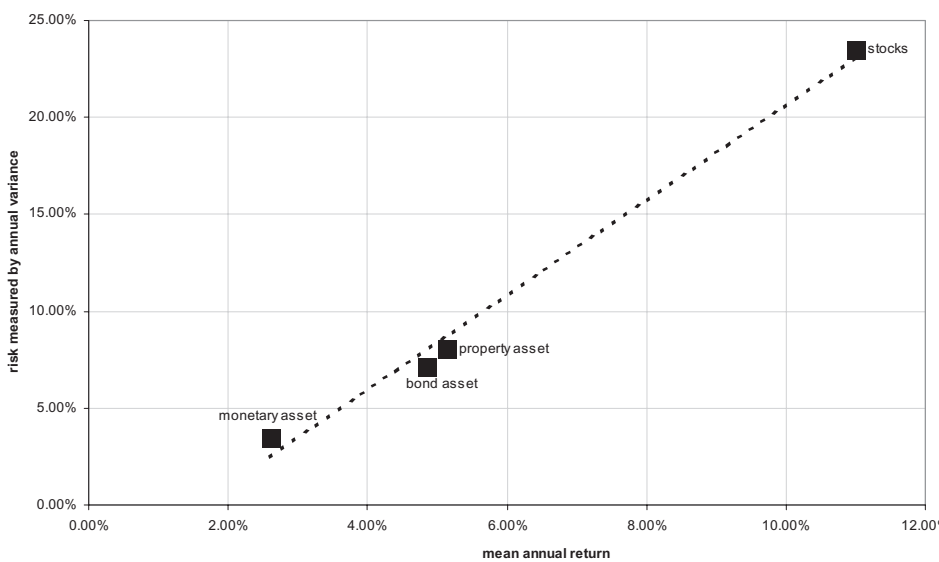

Figure 4: Correlation between risk and return

deviation of $+/-1$ compared with the mathematical expectation is 70 per cent if the return obeys the normal law. The probability that the return will be situated in the interval of a standard deviation of $+/-1.65$ compared with the mathematical expectation is 90 per cent. This interval is presented in Figure 3.

Figure 4, which gives the empirical mean and the standard deviation of real annual returns, shows that the risk/real return pair is perfectly illustrated by the data used. Figure 3 in the text presents the same result differently: it shows, for example, that to obtain 95 per cent probability of a positive return, funds must be invested over a horizon that exceeds six years (in the case of bonds) and over 21 years (in the case of equities). While this observation supports the wisdom of smoothing returns over time for insureds, it is nonetheless important not to underestimate the practical difficulty of smoothing out returns. Indeed, while the last five years may have furnished the best indicators of the future trend of returns than the last year alone, on the other hand, the period comprising the last ten years was a less reliable indicator of the same trends than the period comprising the last five years.