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VIRTUAL CENTRE OF EXCELLENCE FOR RESEARCH SUPPORT AND COORDINATION ON SOCIETAL SECURITY

D5.1 Report On The Theory Of Risk As A Societal Security Instrument

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D5.1 Report on the theory of risk as a societal security instrument

Abstract: This report compares risk methodologies in the fields of finance and security in the light of uncertainty and analyses the consequences for societal security.

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Executive summary

As the first of three deliverables on the relations between the financial system and societal security, this report presents a conceptual overview of finance-security relations with particular focus on risk methodologies. The connections between the fields of finance and security are manifold and complex. The financial sense of security may refer to collateral for a loan, a financial instrument such as bonds, smooth consumption and financial stability respectively. Yet the political sense of security is also implicated with financial markets and logics in the twin processes of the securitisation of finance and the financialisation of security. These increasingly inform regulatory responses to the liberal security problematic of securing circulation. In the 21st century, the global security problem has outgrown territorial conceptions of inside/ outside and implies a cognitive shift of thinking security in terms of circulation, complexity and contingency. This shift is often conceptualised as a move from state actors to transnational risks. Based on an in-depth assessment of risk methodologies in the fields of finance and security, this report argues that probabilistic risk has been a central part of both disciplines in the 2nd half of the 20th century and that the shift is more accurately conceived as non-probabilistic uncertainty. The use of 'risk' for low-probability/ high-impact events may reflect a more general association of risk with governability and calculability. Different epistemic alternatives to probabilistic forms of knowledge have been pursued to optimise security under unpredictable uncertainty although the growing field of security economics continues to rely on predictive models of rational actors. The implications of these developments for societal security are as follows: First, the financial system is an integrative part of society and cannot be conceived as separate entity. In particular the process of financialisation has linked the financial security of citizens to the volatility of global financial markets. Second, securing the financial system as a critical infrastructure presents a peculiar problem since the main operational principle of financial circulation is taking risks. Third, a novel conception of the future as indeterminate and disruptive increasingly moves the emphasis for societal security from quantified prediction of threat to qualitative preparedness.

1. Introduction: Finance-security relations

The task of workpackage 5 is to analyse the diverse points of contact between the financial system and societal security. The first deliverable provides a conceptual overview of finance-security relations, contextualises these in the liberal security problematic of securing circulation and provides an in-depth analysis of the central overlapping concept of risk. As Aitken (2011: 123) has noted, security and finance are "two bodies of knowledge and practice deeply concerned with managing and knowing uncertainty". Hence the calculus and management of risk has been critical to the disciplines of security and finance. Before engaging in depth with the analytical treatment of risk and uncertainty in these two fields, the first section will begin with defining the manifold relations of finance and security.

1.1 Defining financial security

'Finance' as used in this report broadly connotes the management of value over time under conditions of certainty and uncertainty. It thus includes financial instruments such as money, debt and equity, financial markets and the financial system, including public, private and government spaces, as well as the scientific study of these. In the political sciences, 'security' associated with the sovereign state is one of the axioms on which security studies was built in the 2nd half of the 20th century. Yet security also carries a financial meaning that predates this political sense by centuries. Security for a debt – as implied by the Roman *cautio* and the Old French word *mortgage* (English: 'dead pledge') – referred to the deposition of value to secure a contractual agreement. This sense of financial security is still a central element in the operation of financial markets today in the form of **collateral**. But it is only one of four possible understandings of financial security:

1. A security refers to collateral, pledge or **surety** for a loan, implying the right of the holder to seize the property given as collateral to discharge debt in the case of default (security interest).
2. A security in the context of finance also refers to **financial instruments** such as bonds and shares, that is, a contract whereby the issuer of the security commits to pay the holder a future cash flow in accordance with a given timetable. As such it is both a legal claim and a tradable financial instrument.
3. Financial security generally also means **smooth predictable consumption** on the one hand, and increasing wealth while minimizing risk on the other.
4. Finally, financial security relates to **financial stability**, that is, the ability of the financial system to resist stress, turmoil and shocks.

1.1.1 Security as collateral

The meaning of security as collateral originates from the "pledge, promise or caution given in relation to an obligation or debt, reminiscent of Nietzsche's remarks on the pledging of life and wife to the creditor in case of non-payment" (De Goede, 2005: 171). It is equivalent to notions such as bail, token, pawn and warrant. The Oxford English Dictionary records the first entry of security for a loan in 1592: "Without good securitie they will lend Nobody money". But even before the rise of written contracts and monetary transactions security as collateral was an indispensable element of debt relations as far back as Antiquity. Already in Ancient Egypt it was common for a debtor to pledge the mummy of his father, which was deemed of such intense religious concern to satisfy the debt (Squillante, 1982: 618). The function of security as collateral thus derives from the **value** assigned to it, which is required to be larger, or at least equal to, the amount of the loan. Today, sovereign debt of advanced economies is the most common form of collateral and the so-called **safe asset** of the financial system. Security understood in this sense may also exceed the security given for a particular loan to encompass the general creditworthiness, solvency and "quality" of the debtor.

1.1.2 Security as financial instrument

A security is a financial instrument but not all financial instruments are securities. What exactly counts as a security depends on the legal history of a particular country. In the US, the *Securities Act* of 1933, enacted by the US Congress in the aftermath of the stock market crash of 1929, was the first federal act to regulate the offer and sale of securities. The *Securities Act* defines security as follows:

> The term "security" means any note, stock, treasury stock, security future, bond, debenture, evidence of indebtedness, certificate of interest or participation in any profit-sharing agreement, collateral-trust certificate, preorganisation certificate or subscription, transferable share, investment contract, voting-trust certificate, certificate of deposit for a security, fractional undivided interest in oil, gas, or other mineral rights, any put, call, straddle, option, or privilege on any security, certificate of deposit, or group or index of securities (including any interest therein or based on the value thereof), or any put, call, straddle, option, or privilege entered into on a national securities exchange relating to foreign currency, or, in general, any interest or instrument commonly known as a "security", or any certificate of interest or participation in, temporary or interim certificate for, receipt for, guarantee of, or warrant or right to subscribe to or purchase, any of the foregoing.

In economic theory, the issuance of a security is the means by which money is transferred from economic agents with surplus funds to economic deficit agents. Each financial security has an issuer that agrees to make future cash payments to the legal owner of the asset, who is referred to as the investor or holder. A financial security is hence an asset for one party and a liability for the other party. There are two distinct types of financial securities – **debt claims (eg bonds)** and **equity claims (eg shares)**. With a debt claim the holder has a predetermined cash claim via the rate of interest charged which may be fixed or variable. With an equity claim the holder is only entitled to cash payment in the form of dividends once holders of debt claims have been repaid by the issuer, depending on the profit earnings of the issuing company. With an equity claim, therefore, the future cash flow is **uncertain**. A firm may prefer to raise equity finance because if the investment is unsuccessful this will reflect in lower dividend payments.

Financial liabilities are classified into different combinations of the certainty or uncertainty of the amount of the liability and the timing of the liability.

	Amount of liability	Timing of liability
Type I	Known	Known
Type II	Known	Uncertain
Type III	Uncertain	Known
Type IV	Uncertain	Uncertain

Table in Keith Pilbeam (2005), *Finance and Financial Markets*, p. 25

Examples: A commercial bank may have a $1 million deposit that it will have to pay with a fixed interest payment of 8% one year from now (Type I); With a life assurance policy, the assurance company knows that it will have to pay a given amount of money upon the death of the assured, but the timing of the payment is uncertain (Type II); A bank may have deposits on which it has to pay every six months a variable rate of interest according to market conditions; whilst the timing of the payment is known the actual amount to be paid is not (Type III); Many insurance companies have issued insurance policies for health, housing and motoring on which both the timing and eventual outlay are uncertain (Type IV).

Securities are **fungible**, meaning that the redelivery is equivalent and not *in specie* (identical).

1.1.3 Security as smooth consumption

A common understanding of financial security also relates to **individual welfare** and implies a sense of security as being debt-free, being able to afford one's lifestyle, and in extreme interpretations, being independent from a labour-earned contingent income. In microeconomic theory, this idea corresponds with the **utility preference of smooth consumption**, enabled by the **de-synchronisation function** of financial markets. As Danthine and Donaldson (2005: 3) remark in their textbook on *Intermediate Financial Theory*, this sense of financial security in fact constitutes the main *raison d'etre* of the financial system as a set of institutions and markets: "to permit the exchange of contracts and the provision of services for the purpose of allowing the income and consumption streams of economic agents to be desynchronised." Financial markets are said to provide versatile and diverse instruments to accommodate the widely differing needs of savers and borrowers in terms of size, timing and maturity. Financial security can thus be understood as smooth continuous consumption regardless of discrete, contingent income, business cycles, and life cycle patterns (such as expense-heavy in the first and third tier, and income-heavy in the middle tier).

A controversial question is whether financial security in the sense of smooth consumption necessarily implies **growth**. Solow's steady state model of 1956 illustrated the possibility that the value of quantitative amassment of capital may be neutralised by qualitative depreciation. The goal to increase the level of economic activity is always counter-balanced by the goal to keep inflation in check (this hence being a way that financial security is governed by central banks). One way to break out of a steady state is technological progress or financial innovation, which however implies increasing the amount of risk, which in turn increases insecurity. This problematic will be expanded on in **Section 2** *Securing circulation*: the liberal problematic of security.

1.1.4 Security as financial stability

Finally, financial security may refer to **systemic risk** and the resilience and robustness of the financial system when confronted with stress. The stability of financial markets is supported by standardisation, transparency and prudential oversight by national and supranational bodies on the one hand, and regulated through monetary policy by national and supranational central banks on the other.

Prior to the financial crisis of 2007-2010, financial instability was primarily attributed to exogenous factors, such as political risk, corruption and other non-financial elements. At the same time, the new practices of **financial securitisation** – creating new securities out of illiquid cash flows such as mortgage payments and credit card receivables – was assumed to reduce systemic risk by distributing it to those most willing and able to bear it, such as hedge funds. Securitisation was thus assumed to promote an efficient distribution of risk and put an end to “stop and go” economies and the Keynesian business cycle in which the stable economy is the exception not the norm. Post-financial crisis it is evident that financial instability was caused **endogenously** by risk management practices and securitisation channels.

These various meanings of financial security are highly interrelated: for example, government bonds (‘securities’) are the most common form of collateral and as such a central mechanisms of securing financial stability. Financial stability on the other hand crucially affects the ‘smooth consumption’ streams of individuals. The relations between finance and security however exceed these different definitions of financial security. Recent analyses have marked an increasing mutual influence also between financial circulation and political security. This influence both takes the form of a **securitisation of finance** (in the Copenhagen sense of the term) and a “**financialisation” of security**.

1.2 Securitisation of finance

The securitisation of finance needs to be distinguished from the financial sense of securitisation. Where the latter refers to the process of taking an illiquid asset, or groups of assets, and transforming them into a new security through financial engineering (eg. a mortgage-backed security), securitisation has also become a prominent term in security studies. In this so-called Copenhagen sense of the term, it describes the process of state actors transforming subjects into matters of ‘security’ and thus legitimising the use of extreme measures in the name of security. For example, a framing of migration in terms of security changes migrants from an economic labour force to a threat to society. With regard to finance, this type of securitisation has been observed in two different respects: First, the fight against terrorist finance has led to the increased policing of the financial system in regimes of **financial surveillance** (Amicelle, 2011; de Goede, 2012). Second, the 2007-2010 global financial crisis has been argued to not primarily have been governed as a crisis of the economy but as a crisis of security (Langley, 2013; 2015). The US Fed TARP programme’s re-assigning of funds from absorbing ‘toxic assets’ to recapitalising banks can be seen as indication of a shift from risk-based regulation to a logic of **preparedness** and **resilience**. Financial turbulence was not simply governed as a crisis of the financial markets, the banks and Wall Street, but also understood in terms of security. Not only with Obama’s framing of the financial crisis as a threat to national security but also in the Eurozone political security and sovereignty have been reframed as effects and functions of financial stability (This aspect will be further developed in deliverable 5.2). The increasing influence of the logic of resilience on conceptions and regulations of financial stability may also be seen as converging of finance and security in a common paradigm of crisis governance.

1.3 Financialisation of security

At the same time there has been an increasing influence of financial logics in the field of security. In most general terms, financialisation refers to "the increasing role of financial motives, financial markets, financial actors and financial institutions in the operation of the domestic and international economies" (Epstein, 2005: 3). These logics have however not only increased vis-à-vis the economy but also become more pronounced in the governance of security. For example, Amoore (2011) observed that UK border security is governed by algorithmic programmes that follow the logic of **financial derivatives**. The US War on Terror has been argued to emulate the **financial logic of risk** management (Martin, 2007). Finally, the increasing use of **political predictions markets** is seen as an attempt to employ the logic of the market as best possible coordinator of knowledge under uncertainty (Aitken, 2011).

Both of these developments - the securitisation of finance and the financialisation of security – can be seen as expressions of the demands posed by the central liberal security problematic of **securing circulation**, which will be described in the next section.

2. *Securing circulation*: the liberal problematic of security

Societal security may be seen as part of a sea change in security studies that has identified a new landscape of security issues and actors in the post-Cold War and post-9/11 era (Burgess, 2010: 2). A central defining aspect has been a shift from a state-centred concept of security to a society-centred one, reflected in a clear trend in official policy documents as the FP7 project ETTIS has documented (WP1.1, p.8). Yet the contemporary security problematic does not simply entail a shift in the referent object of security from the state, or national security, to a range of other objects from the environment, to human and societal security, and not only problematizes conventional distinctions between the national and international and internal and external security. It also entails a **cognitive shift** in how security needs to be thought about defined by the variables of **circulation, complexity and contingency**.

Circulation emphasizes the problems posed by **interdependencies and flows** rather than problems posed by demarcations between internal and external affairs. It extends to "every conceivable kind of circulation or flow of peoples and things, of energy and of finance, of water and food, of capital and information, of images and discourses, of science and technology, of weapons and ideas, of drugs and of sex (AIDS to prostitution), of microbes and diseases" (Dillon, 2005: 2). In a systematically interdependent world "everything is connected, or in principle, able to be connected, to everything else" (ibid). *Complexity* entails that small disturbances in one system can quickly escalate into large-scale crises in other local and global systems of circulation. The very **connectedness** of complex global infrastructures poses dangers in terms of the speed and ferocity with which perturbations can cascade into major disasters, meaning that **'catastrophic events'** are produced *from within*. Complex interdependence is further characterized by **socio-technical systems** and adaptive entities that behave more like 'ecological' than 'mechanical' systems. Intelligent evolving systems increase both complexity and contingency over time, that is,

> the more things circulate the more complex they become. The more complex things become, in the organic way described here, the more contingent becomes their operation. Contingency does not mean pure arbitrariness, it means being critically dependent upon the detailed correlations of time and space (ibid).

Contingency is one of the main reasons that the modern global security problematic has become preoccupied with **risk**. But different from threat, risk carries a double valence as **source of profit and source of loss**. For if insurance "allows most people most of the time to survive the contingency of the world, putting people and things back into circulation" (2005: 3), the larger part of financial circulation is "explicitly designed to turn the world's contingency to advantage by exploiting the circulation of contingency and risk" (ibid). The calculus of risk thus both drives circulation and seeks to insure against its adverse effects. The guiding regulatory question becomes how to separate 'good' circulation (economic goods, financial products, skilled workers, passengers, social media communication) from 'bad' circulation (viruses, terrorists, terrorist funds, toxic assets, pollution). How can circulation be secured without collapsing circulation as such?

If this problematic defines critical infrastructures as such, the financial system constitutes a *peculiar kind of infrastructure*: one that needs to be protected and at the same time encourages and to some extent **requires risk-taking as its operational principle**. In the central liberal goal of securing circulation, **finance and security can no longer be thought separately**. Both the securitisation of finance and the financialisation of security can be seen as expressions of this regulatory dilemma.

The historical basis for risk as the decision-making tool in the governance of circulation has since Leibniz and Pascal been the **probability calculus,** translating contingency, or uncertainty, into calculable risk. Yet since the new millennium, risk is increasingly questioned by a horizon of 'low-probability/ high-impact' events. While the governance of security and finance has converged in a common vocabulary and epistemology of risk, this technology of governing the future is currently undergoing critical epistemological changes that imply these in new relationships (Boy, Burgess & Leander, 2011: 115). Uncertainty is re-evoked as a major obstacle to risk management.[1] A thorough assessment of these changes requires a detailed analysis of the calculation and management of risk in finance and security respectively. The next section will in particular focus on the following questions:

- **To what extent does risk in finance and security discourses correspond in conceptual and methodological terms?**
- **How has risk management in the fields of finance and security been affected by radical uncertainty?**

[1] E.g. *The Economist* August 9th 2008: 12 "We are all Keynesians again"

3. Risk methodologies in finance and security

3.1 Risk and uncertainty

The conceptual discussion of risk and uncertainty was conducted in the discipline of economics long before security studies was established as a discipline and still informs discussions of uncertainty in security today (cf. Walker and Cooper, 2011). The following section will thus provide an overview of the principal analytical distinctions between risk and uncertainty. The differentiation between these two terms is often traced back to Knight (1921), whose distinction between risk as numerically measurable, and uncertainty as immeasurable, has become commonplace in the modern literature on risk and uncertainty (Wakker, 2006). Knight states: "A measurable uncertainty, or "risk" proper, as we shall use the term, is so far different from an unmeasurable one that it is not in effect an uncertainty at all" (1921: 20).

Classical economics had defined its subject as a riskless system that always produced optimal results (Bernstein, 1998: 216). Seizing upon the concept of rational action developed in political philosophy, Smith claimed that the market, consisting of rational entrepreneurs, performed the social task of coordinating scarce resources and clashing preferences in remarkable perfection. The interest rate would ensure the coordination and regulation of savings and investment. Although individual firms and investors took risks, the economy as a whole was risk-free. In the first half of the 20th century however economists began to critically examine the possibility of measuring uncertainty, resulting in the two antithetical approaches of 'risk as uncertainty' and 'risk versus uncertainty'[2]. The critical question was whether uncertainty was calculable in terms of probability, or whether the lack of valid predictive basis of any kind rendered in non-quantifiable.

3.1.1 Probability

Since Poisson's famous distinction in 1837 between probability as "reason to believe" and probability as "chance", scholars have tended to see probability as a "Janus-faced concept, with objective and subjective sides" (Gigerenzer *et al*, 1989: 274). Carnap (1945) identified these sides with **relative frequencies** and **degrees of belief**, respectively, and held the dualism to be irreducible. A closer study of the history of probability in the context of its applications however reveals that the situation is considerably more complex than this simple binary opposition suggests. In particular the subjective/ objective distinction does not hold, as can be seen from the table below. On the 'reason to believe' side, degrees of certainty have both subjective representatives, such as Savage's personal probabilities, as well as objectivist forms, such as the logical probabilities of Keynes, defined as degree of rational belief. This contrast is also evident in subjective and objective forms of Bayesianism (see Chalmers, 2003 [1978]: Ch.12). As for the 'chance' side of probability, Popper argues that "the danger with this "objective approach" consists in what may be described as its

[2] These different approaches do not correspond to the antagonistic economic policy recommendations that characterize the 2nd half of the 20th century: after Knight, both Hayek and Keynes were among the first economists to identify uncertainty as a central concern for economics, distinct from risk.

undisclosed subjective moment – the choice of the length of the n-series” (in Caygil, 1999: 3). The lack of epistemic criteria for this choice makes us prone to “speculative metaphysics”, that is, so extending the n-series to explain “any regularity we please” (Popper, 1982: 197). Another notable aspect of probability theories is the definition of the descriptive claim of reality as complete or incomplete. Einstein famously sought after the ‘missing variable’ that would reconcile the results of his experiments with an objective reality.

Table 1 Philosophical positions of probability*

Knowledge	**Methodology**	**Descriptive status**	**Nature of reality**	**Representative**	**Summary of view**
Probability as frequency	subjective	complete	indeterminate (agnostic)	Heisenberg	Random events as reflection of limits of subjective understanding of reality
	objective		indeterminate (realist; contingency *in re*)	Popper von Neumann	Non-epistemic or objective chance: Mathematical propensities as dispositional properties of a physical situation
	objective		realist/ instrumentalist	Rational expectation hypothesis (Lucas)	Material world characterised as distributional but concerned with predicting outcomes rather than with real processes
	objective	incomplete	deterministic, independent of measurement	Einstein, Schroedinger	Blurred model for representing reality', 'God does not throw dice', missing variable
	objective		indeterminate	Knight	Non-quantifiable uncertainty radically different from measurable risk
Probability as degree of belief	subjective	complete	epistemic probability/ instrumentalist	Savage, Friedman, Expected utility	Preferences represented in terms of a probability measure over states and a utility measure over consequences
	objective	incomplete	epistemic probability	Keynes	Probability is relational and signifies degree of rational belief ; uncertainty is absence of probabilistic knowledge

*(modified version of Tony Lawson (1988), extended by the criteria subjective/ objective and complete/ incomplete)

3.1.2 Risk vs uncertainty

Following Knight, in particular Keynes and Hayek developed conceptions of uncertainty that were not amenable to the probability calculus. A famous passage by Keynes reads:

> By 'uncertain' knowledge, let me explain, I do not mean merely to distinguish what is known for certain from what is only probable. The game of roulette is not subject, in this sense, to uncertainty…The sense in which I am using the term is that in which the prospect of a European war is uncertain, or the price of copper and the rate of interest twenty years hence…About these matters there is no scientific basis on which to form any calculable probability whatsoever. We simply do not know (1937: 213-14).

But where Knight defined probability as empirical frequency and "real indeterminateness" of reality, Keynes condemns this ontological view as "one of the most dangerous disillusions" (1907) and instead advances an objective epistemic account of probability as degree of belief. His position is sometimes characterized as subjectivist (cf. Caygill, 1999), but as Keynes himself makes clear:

> Probability is not subjective. It is not […] subject to human caprice […]. When once the facts are given which determine our knowledge, what is probable or improbable in these circumstances has been fixed objectively, and is independent of our opinion. The Theory of Probability is …concerned with the degree of belief which it is *rational* to entertain in given conditions (1921:3-4).

Probability for Keynes thus is a logical relation between two sets of propositions relative to given evidence or background knowledge, or in other words, the "the art of reasoning from inconclusive evidence" (van den Hauwe, 2007: 18). In addition to rational calculation, the formation of entrepreneurial expectations on investment in an uncertain environment depends on conventional judgments and the famous term of "animal spirits", making long-term expectations exogenous and their influence entirely arbitrary.

Similar to Keynes, Hayek makes uncertainty a principal theme and point of departure of his economic analysis. Hayek distinguishes from scientific knowledge the crucial body of "very important but unorganized knowledge, the knowledge of the particular circumstances of time and place, which by its nature cannot enter into statistics" (1945: 5). Statistics, "by abstracting from minor differences between things, by lumping together…items which differ as regards location, quality, and other particulars" is not the kind of knowledge relevant for the countless daily decisions: the "constant deliberate adjustments…made every day in the light of circumstances not known the day before" (ibid). Hayek's solution to the problem of dealing with uncertainty is presented in form of the **price system**. By constructing 'rates of equivalence', or values, the price system attaches to each kind of scarce resource "a numerical index which cannot be derived from any property possessed by that particular thing but which reflects …its significance in view of the whole means-end structure" (1945: 9). The kind of calculation effected by the price system in the form of the numerical transposition and abstraction of dispersed, partial and local knowledge, is however very different from the statistical calculus. As an objectification of subjective estimates, the calculation of prices is able to take into account constant change. Where for Keynes uncertainty is a problem the market cannot accommodate and requires government intervention, Hayek on the contrary holds that the market and not government are solely capable of dealing with uncertainty efficiently and ensure the continuous flow of goods and services.

3.1.3 Risk as uncertainty

The political influence of Keynes and Hayek notwithstanding, from the mid-20th century onwards, economics as a discipline began to treat uncertainty as risk, i.e. as numerically determinate probabilistic knowledge (Lawson, 1988: 50). Von Neumann and Morgenstern's *Theory of Games and Economic Behavior* (1944) formally incorporated risk into economic theory and offered the first consistent and predictive theory of choice under uncertainty. In 1738, Bernoulli had redefined expectation as ***outcome x probability***, later known as **utility**. Von Neumann and Morgenstern axiomatically proved Bernoulli's notion of expected utility as the sum of utilities from outcomes weighted by the probabilities of outcomes, and thus suggested a way to numerically measure utility. The human and psychological elements of economics were not regarded as incompatible with a mathematical treatment of human behaviour under uncertainty.

Where the expected utility hypothesis assumed objective rational expectation, Savage (1954), as alluded to earlier, developed a subjective approach to expected utility, employing the Bayesian definition of subjective probability as degree of belief. Savage drew on Ramsey (1926) and de Finetti (1937), who claimed to master the questionable derivation of numerical probabilities for personal beliefs by inferring probabilities from the observation of people's actions. As Hirshleifer and Riley (1982: 10) argue, Savage's subjective axiomatic approach allows to "disregard Knight's distinction, which has proved to be a sterile one. For our purposes risk and uncertainty mean the same thing". When defined as probabilities assigned to subjective degrees of belief, the ontological implications for reality can be disregarded.

3.2 Risk methodologies in finance

If the definition of uncertainty as risk became entrenched in economics with the increasing mathematisation of the discipline, modern finance theory can be seen as consecutive endeavours of the **precise definition, measurement and management of risk**. As unavoidable input to generate return, risk is the main resource for financial investment. The "emancipation" of finance as a theory of its own rather than a minor specialized part of economics accompanied and in part laid the premise for the phenomenal rise of financial markets *vis-à-vis* the real economy after Reagan ended the Bretton Woods regime of fixed exchange rates in 1973. The practical applications of modern finance theory have "revolutionalised investment management, the structure of markets, the instruments used by investors, and the behaviour of the millions of people who keep the system working" (Bernstein, 1998: 246). The following sections will present the main models of modern finance theory with particular focus on the conceptualisation of risk.

i. 3.2.1 Modern portfolio theory

Markowitz's (1952) article *Portfolio Selection* laid the ground for the theoretical edifice of finance by introducing a **systematic** approach to investment: the **portfolio** as the investor's total capital was unchartered territory in the 1950s (Bernstein 2005: 54). The originality of his contribution consisted in distinguishing between the riskiness of individual stocks and the riskiness of the entire portfolio. Markowitz's insight was that an **efficient portfolio**, that is, one that yielded the highest expected return for any given degree of risk, or alternatively, the lowest degree of risk for any given expected return, did not simply combine assets evaluated individually for their riskiness and expected return, nor was it defined by the **average** riskiness of all its assets. It crucially depended on the **covariance** of individual assets: how they moved in relation to one another. Thus a combination of very risky stock can still comprise a low-risk portfolio so long as they have low covariance (ibid). With perfect negative correlation it is in theory possible to completely eliminate portfolio risk. Markowitz's two-asset model mapped out the **efficient frontier**, that is, the combination of two risky securities with the optimum risk-return trade-off for different levels of risk and return. It represented the scientific version of the old principle of **diversification** of not putting all one's eggs into one basket. Yet in practice the calculation effort in determining all possible covariances between securities in the market was extremely high both in time and cost.

ii. 3.2.2 The Capital Asset Pricing Model (CAPM)

The Capital Asset Pricing Model (CAPM) continued the project of optimising risk-return efficiency by introducing a number of simplifications and variations. Based on the empirical observation that shares tend to move in varying degrees in line with the market itself the **market portfolio** was introduced as benchmark for risk-return calculations (Sharpe, 1963). The market portfolio is made up of all the assets of the financial market with each asset weighted in proportion to its relative presence, or **market capitalisation**. It was based on the assumption of investors as rational risk-return optimisers who shared the same estimates of the probability distribution of future cash flows and thus preferred to hold identical risk/return combinations. Instead of calculating how each security co-varies with each other the market model reduced the effort to an estimation of how each security varies in relation to the market as a whole (Bernstein, 1998: 258). This relation is called a security's **beta**. The beta of the portfolio is the weighted average of all individual betas that make up the portfolio. A beta above 1 implies an aggressive, or risk-seeking, portfolio; a beta below 1 signifies a defensive, or risk-averse, portfolio. The CAPM reduced the calculation effort for 100 securities from nearly 5000 in Markowitz's model to 302.

The market model introduces a distinction between **market risk** (or **systematic risk)**, and **specific risk** (or **unsystematic risk**). Market risk is due to factors that affect the overall performance of the financial market, such as a major natural disaster, recessions, political turmoil, strikes, changes in interest rates or terrorist attacks. Specific risk refers to the firm- or industry-specific risk inherent in each investment: any fluctuation in an asset's return that is not caused by or correlated with the movements in the overall market. A drop of a firm's share price by 10 percent due to bad earnings is specific risk; a drop caused by a plunge of the stock market is market risk (Chambers, 2010). Specific risk can be diversified away by owning stocks in different companies and industries, different asset types and a portfolio with low overall correlation. Yet unless assets are perfectly negatively correlated, diversification cannot eliminate the market risk attached to holding the asset. The effect of portfolio theory is to show that **the market prices only market risk**, and does not reward the bearing of risk that could have been diversified away.

While the postulation of the market portfolio reduces the amount of variables and calculations necessary to determine the efficient portfolio, Tobin's (1958) *Liquidity preference as behaviour toward risk* provided a crucial new ingredient to the management of risk by introducing the **riskless asset** into the portfolio model. His work elaborated on Keynes' liquidity preference theory, which held that the attitude to the future was crucial in determining the choice of asset to invest in: Cautious, or risk-averse people tend to choose a risk-free asset like cash which can be exchanged (and its value retained) regardless of future market developments. Risk-seeking investors tend to choose risky assets with higher returns that remain liquid during a boom but risk becoming illiquid (and losing value) during a downturn. Tobin argued that it was not necessarily an either-or decision, and that a portfolio combining more liquid (riskless) and less liquid (risky) assets was in fact the most effective way of dealing with **uncertainty**. The surprising effect of the inclusion of the risk-free asset in Markowitz's model is that "the efficient set become[s] a linear line known as the capital market line" (Pilbeam, 2005: 178) that dominates the positions of the efficiency frontier. The riskless asset thus allows a **more efficient risk-return trade-off for both risk-averse and risk-seeking investors**. Investors allocating a share of their portfolio to bonds (lending to the government) could hereby lower their overall portfolio risk, while investors borrowing at the risk-free rate could achieve an excess market return according to the model (see *Figure 1*: both the risk-averse investor A and risk-embracing investor B achieve a better risk-return trade-off when lending/ borrowing at the risk-free rate, corresponding to the points A* and B* on the capital market line).

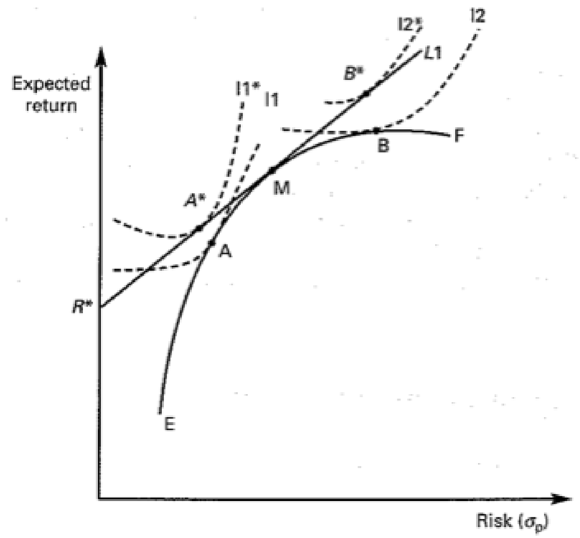

Figure 1 The Capital Market Line and the Market Portfolio (Pilbeam, 2005: 194)

Tobin thus separated the investment decision into two components where the identical 'objective' choice of the market portfolio – invariant to individual preferences about risk – is subsequently altered by 'subjective' risk profiles as risk-averse or risk-seeking. By increasing the efficiency of the risk-return trade-off through taking on debt, the risk-less asset gives an **explicit rationale for taking on leverage**, which has been one of the main factors fuelling the 2007-2010 financial crisis.

iii. 3.2.3 Black-Scholes Option Formula

The Black-Scholes-Merton option pricing formula resulted from efforts to apply the CAPM to assets other than stocks, in particular the growing importance of **derivatives**, that is, contracts that derive their value from the performance of an underlying entity. A **call (or put) option** entitles the right, but not the obligation to buy (or sell) an underlying commodity or asset for a specified amount at a specified future date[3]. In their efforts to find a formula to determine how much the option to buy or sell a specific quantity of an asset in the future was worth, Black and Scholes found that "neither risk nor expected return, the two integral elements of CAPM, belonged in the equation… because they cancelled each other out " (Bernstein, 2005: 213).[4] Instead, the basic idea of the derivation of the model is that the combination of a stock and a put option (the right to sell it in the future for a certain amount), where any loss in the stock is precisely offset by the gain from the put option, constitutes a **perfect hedge** with no risk and as such should earn the same as the risk-free rate, which is known. This equation of positions was possible due to the 'no arbitrage' stipulation of the **efficient market hypothesis**, where any price difference would be eliminated by market participants: If the combination of stock and option offered more than this risk-free rate, investors would compete for the opportunity to own it and bid the opportunity away. If it offered less, investors would shun it and its value would fall to a point where it once again offered the riskless rate of return.

The primary function of an option is to give investors some control over how changes in the market will affect their portfolios: for a small cost, buyers of options can limit losses without placing any limits on their profits. It is thus a **tool of risk management**, but can also be used for speculation. The Black-Scholes-Merton formula was a crucial element in fuelling the tremendous post-Bretton Woods growth in derivatives trading and is one of the most important and widely applied formulas in the world (2005: 205).

iv. 3.2.4 Value at Risk (VaR)

[3] An example for a call option would be a home mortgage with a pre-payment privilege where the family has the right to repurchase the mortgage (eg pay it off) from the bank should interest rates decline (Bernstein, 2005: 206). An example for a put option is buying insurance for your car: without an accident the option will be worthless but in the case of damage you have the right to sell the car to the insurance company.

[4] Two stocks of different risk and expected return can have the same price today because although one of them has a much higher expected return than the other it also has higher risk so that the price will be the same as that of a stock with lower expected return and lower risk. The expected return on the stock is thus irrelevant for pricing an option. (2005: 213)

The growing complexity of financial markets over the 1980s and 1990s and a risk environment defined by **securitisation** and **derivatives** prompted a group of 'quants' at the investment bank JPMorgan to develop a method to evaluate the **total risk of a financial institution**. This method was called **Value at Risk** and expressed the risk of the positions taken in the firm-wide portfolio in one single number. Value at Risk (VaR) calculates the maximum expected loss (or worst case scenario) on an investment, over a given time period and given a specified degree of confidence. A VaR of USD 100 million, for example, means that over the course of the specified time frame there is a 95% chance that the portfolio will not lose more than USD 100 million.

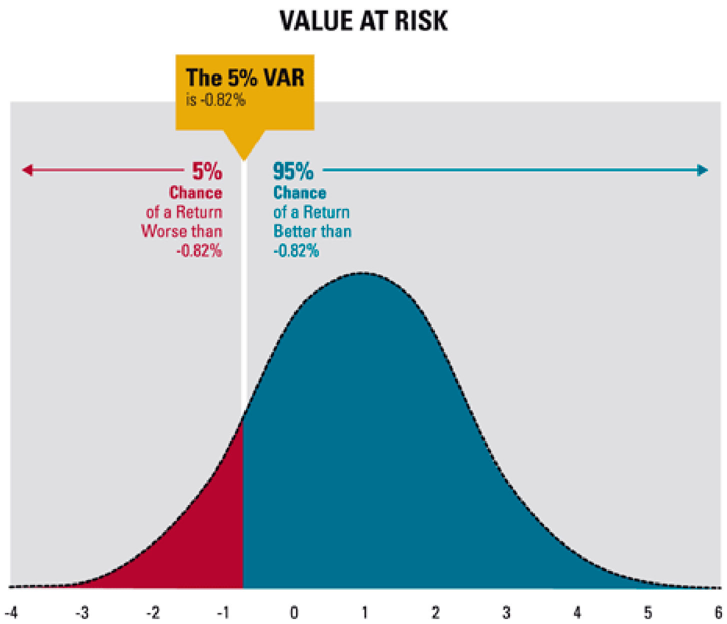

Figure 2 Value at Risk (VaR). Available at http://www.r3analytics.com/blog/exposing_downsides_var

VaR quickly became the market standard: in 1997 the Securities and Exchange Commission mandated that the amount of risk that derivatives posed should be disclosed to investors and VaR became the *de facto* measure. After extensive financial sector lobbying, the Basel Committee on Banking Supervision also agreed that firms and banks could rely on their internal VaR calculations to set their capital requirements, effectively awarding VaR the status of a **measure of systemic risk**.

VaR is the only commonly used risk measure that can be applied to any asset class, taking into account diversification, leverage and price volatility. VaR allows to aggregate the risks of different position into an overall measure of portfolio risk and in doing so take account of the ways in which different risk factors interact with each other (Dowd, 2007: 12). It is thus **holistic** whereas many traditional approaches either only look at risk factors one at a time (such as beta) or resort to simplifications to collapse multiple risk factors into one (for example, the CAPM simplifies different equity returns into a single 'market' return). While probabilistic like all of the previously discussed risk models, VaR specifies the **probability of loss amounts.** The level of confidence with which probable loss is determined corresponds to the probability distribution of past losses and can also be calculated for a 99% confidence level.

Yet VaR is unable to account for the remaining 1% or 5%, i.e. the **tail risk,** or so-called 'black swans'. Taleb, in 2009, testified to US Congress asking for the banning of VaR on two grounds: the first being that "tail risks are non-measurable" scientifically and the second being that VaR leads to higher risk-taking[5]. David Einhorn, founder of the hedge fund Greenlight Capital, similarly compared VaR to "an airbag that works all the time, except when you have a car accident" (Nocera, 2009).

v. 3.2.5 Summary of changing conceptions of risk in modern finance theory

The range of risk models presented here are not substitutions of one another and in part serve different purposes and asset classes. Yet they still have implications for the definition, measurement and management of risk. *Portfolio theory* defines risk as the statistically measured **standard deviation of the return** of an asset based on the **normal distribution**: positive and negative deviations from the expected value contribute *equivalently* to the measure of variability (Pilbeam, 2005: 15). That is, gain and loss are weighted equally. The portfolio approach prepared the ground for measuring and managing risk in terms of **quantified diversification,** based on the number and covariances of the individual securities. In the *Capital Asset Pricing Model*, the market portfolio – the **most diversified portfolio** comprised of all risky assets in the economy – becomes the idealized benchmark from which to calculate the risk-return trade-off. As the market only prices market risk that cannot be diversified away, the risk-return trade-off of an individual security or portfolio is assessed in terms of its relative volatility to the market portfolio: its beta. The risk-free asset however represents a second benchmark which does not only reduce or increase overall risk but optimises the efficiency of the risk-return ratio for all investors. **Government debt thus comes to play a crucial theoretical and practical role** in the efficiency of investments returns. Where CAPM prices an asset according to its risk, the *Black-Scholes formula* seeks to calculate the price of a **risk management tool**. That is, derivatives are at the same time a **financial product** and **a form of risk management.** As Esposito (2013) has argued, the commodity traded in derivatives is *risk itself*. *Value at Risk* calculates risk in terms of **maximum likely loss**. The reason for VaR being "more intuitive and (arguably) easier for laypeople to grasp" (Dowd, 2007: 11) than the standard deviation of portfolio theory is a conception of risk in purely negative terms - akin to the field of security - as the **possibility of damage**. Even if VaR explicitly focuses on the downside risk there is however still an element of compensation, in particular from a regulatory perspective, in that potential loss has to be covered by sufficient capital. VaR is also not radically different from risk-adjusted value and probabilistic approaches and borrows from both. Because of its flexible application to individual assets, portfolios

[5] For example, VaR does not take account of leverage employed through the use of options: if an asset manager borrows money to buy shares of a company, the VaR would usually increase. But if instead he enters into a contract that gives someone the right to sell him those options at a lower price at a later time (a put option) the VaR will remain unchanged. From the outside he would look as if he were taking no risk but in fact he is: if the share price of the company falls steeply, he will have lost a great deal of money (Nocera, 2009).

and firms, VaR is said to take account of specific risk as well as aggregate the risk profiles of different assets that are otherwise incomparable (Alexander, 2001: 256). Yet VaR **only captures short-term risk in normal circumstances** and does not distinguish between different liquidities of market positions.

vi. 3.2.6 Model risk and self-reference

As Esposito (2011, 2013) has pointed out, risk models in finance do not take account of their own application. The very fact of their application and thus generation of expectations can produce a different future than expected. The failure of the hedge fund Long Term Capital Market – founded by Nobel Prize winning economists - in 1998, for example, has been interpreted as a "reaction to its own success, which triggered an imitation process that falsified the (correct) calculations that were guiding it" (2013: 107). Model risk, or the fact that reality reacts to the way it is observed, can have a destabilising effect on the financial system: Taleb (1997) argues that VaR players are dynamic hedgers, and need to revise their positions in the face of changing market prices. If everyone uses VaR there is a danger that this hedging behaviour will **make uncorrelated risks very correlated** – a risk not shown by VaR (Dowd, 2007: 14). VaR can also *induce* risk-taking: a VaR cap gives risk managers an incentive to protect themselves against mild losses, but not against larger ones in excess of VaR. Even VaR regulatory constraints can exacerbate cyclical effects and so aggravate financial crises or even bring them about (ibid). This criticism applies to varying extents to other risk measures as well.

3.3 Risk methodologies in security

vii. 3.3.1 Risk analysis

Traditional statistical risk analysis in the field of security first grew in the context of safety management, insurance, and other applications. The risk matrix assigns risks to a discrete grid of probability and consequence, or impact, and then typically suggests focusing risk management on the 'northeast' where both probabilities and consequences are very high. Probability, or likelihood, is here defined in terms of statistical frequency. Low-probability risks are generally dropped in the subsequent analysis.

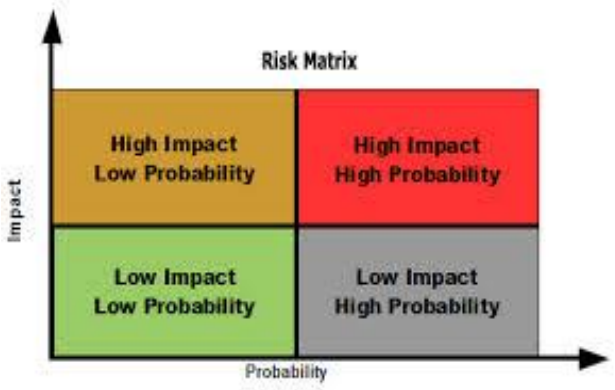

Figure 3 Risk matrix. Available at http://www.buzzle.com/articles/risks-and-dangers-of-change-management.html

viii. 3.3.2 Risk in security studies

It was especially the low-probability/ high-impact risks however that sparked the prominent entry of risk into **international relations** following the end of the Cold War and the 9/11 terrorist attacks. Established realist theories of the balance of power, Mutually Assured Destruction (MAD) and instrumental rationality were seen as inadequate to makes sense of these events and the ensuing US-led War on Terror. Drawing on sociological theory such as Beck's **risk society** (1986, 1991) risk and risk management appeared as apt concepts for the growing awareness of transnational non-state actors and threats, including terrorists, environmental disaster and pollution. From a conceptual point of view however, what these analyses (cf. Aradau and van Munster, 2007) referred to was **not (probabilistic) risk but (non-probabilistic) uncertainty** (Kessler, 2011). Low probability/ high impact risks correspond precisely to the 1% or 5% that statistical analysis cannot account for (cf. the criticism of VaR), and are thus more adequately captured as uncertainty *different* from risk.

At the same time, probabilistic risk played a fundamental – if somewhat unnoticed – role for the discipline of security studies in the form of **game theory**. In particular through its promotion by the RAND Corporation game theory acquired great practical influence in strategic studies during the Cold War. The opposition of 'state actors' and 'risk' is thus partially misleading. Like traditional risk management, game theory assumes that an uncertain future can be described in possible states of the world and probability distributions (Kessler, 2007: 115). Game theory's notion of uncertainty does not reside in the unpredictability of the future or our imperfect knowledge of it, but can be reduced to the **calculated intentions of others** (Bernstein, 1996: 232). Although, for example, the possibility of a nuclear attack during the Cold War was deemed catastrophic, this catastrophic risk was paradoxically insured against by the principle of mutually assured destruction (MAD) because such attack was deemed **irrational** by **self-interested rational actors** (Cooper, 2004).

One reason for the somewhat misleading use of 'risk' for non-probabilistic uncertainty by a number of studies in security studies is a differentiation of risk and uncertainty not in terms of **probability** and **predictability**, but in broader terms of **governability**. While Beck had argued that the non-probabilistic nature of modernisation risks exceeded their insurability, this literature pointed out that the **limits to knowledge**, most famously expressed in Donald Rumsfeld's famous 'unknown unknowns', have given rise to a range of new guiding principles of security governance (Aradau and van Munster, 2007; de Goede, 2008). The attempt to govern security in spite of the unpredictability of the 'low probability/ high impact event' has sparked new security logics of **pre-emption** and **preparedness** that seek to eliminate the potential threat prior to its manifestation while preparing a capacity for its inevitable occurrence (Walker and Cooper, 2011). Security actions are no longer made on the basis of collected data and causal relations, but based on "a different kind of abstraction that is based precisely on an absence, an what is not known, on the very basis of uncertainty" (Amoore, 2011: 27).

While adjusting security governance to uncertainty, different **epistemic alternatives** to the classical actuarial and probabilistic forms of knowledge are also being pursued to optimise epistemic security: among these are **political prediction markets** (Aitken, 2011), **threat enactment** (Collier, 2008) and, most prolifically, **scenario-planning** (Tellmann, 2009). At the same time, and in contrast to these analyses, the more technically oriented literature of the growing field of **security economics** has reverted to the increased use of game theory and the modelling of so-called Adversarial Risk Analysis (ARA) (cf. SECONOMICS D5.1). Here uncertainty is still understood as calculable and the decisions of rational actors are still conceived as **predictable**. The next sections will contrast the new rationales of anticipatory security action in the face of radical uncertainty with a continuing methodology of uncertainty as risk.

ix. 3.3.3 Pre-emption, Scenario planning, Threat enactment

As Anderson (2010) notes, the extraordinary proliferation of anticipatory action in the governance of security implies a novel conception of the **future as disruption**. In contrast to risk, where past frequencies provide the predictive basis for future induction, the view of future threat as both uncertain and immanent changes the cause of action in the present. Logics of **pre-emption** and **preparedness** are thus fundamentally different from earlier modes of **prevention** and **deterrence**. The doctrine of *prevention* assumed the ability to assess threats empirically and identify their causes. Uncertainty was merely a lack of information in an objectively knowable world, and the realisation of threats could be avoided or mitigated through improved knowledge. *Deterrence*, the guiding principle of security politics of the Cold War, also assumed the knowability and objective measurability of threat. Akin to the resource management of neo-classical economics, deterrence is equilibrium-seeking, based on a 'balance of terror' between rational actors (Walker and Cooper, 2011). In contrast, **pre-emption** assumes that epistemic uncertainty is not a lack of knowledge (a 'known unknown') but that the future is in principle **indeterminate** and **unpredictable**. Security action in these conditions must become **proactive** and **anticipatory**, in order to "make the enemy emerge from the state of potential and take actual shape to which the state can respond to" (Massumi, 2007). Preemption stresses the urgency of political **action in the absence of evidence**, where the possibility of serious and irreversible damage is deemed intolerable.

The practice of **scenario planning** reaches back to the Cold War (Hermann Kahn at the RAND Corporation already advocated 'thinking the unthinkable') and has long been part of civil defence and emergency planning. Yet in the face of epistemic uncertainty, scenario-planning has acquired unprecedented use in the 21st century. In particular the company Shell "helped inform the shift from the first generation of probabilistic, model-based scenarios developed by the Intergovernmental Panel on Climate Change towards the stories and simulation approach that characterizes the current generation of socio-economic scenarios" (Wilkinson & Kupers, 2014: 22). Perceived as the proper tool for a world that is complex and irregular, scenario planning is regarded as superior to risk, marked by the 'tyranny of the past' and 'illusion of certainty'. Against the perils of 'narrow thinking' and dominant perceptions, scenario-planning seeks to counter the unknown by means of the **imagination**. Scenarios are not predictions but **plausible narrative accounts of the future.** While not claiming the precision of risk assessments they nonetheless seek to legitimate decision-making on the basis of their **emotional salience** and an appropriate number of possible futures (Tellmann, 2009: 18). To seek a balance between 'paralysis and denial' the number of scenarios needs to be limited to remain meaningful and actionable, the norm being three (Ertel and Walton, 2006).

A further anticipatory technique of security governance is the rise of **threat enactment** in the proliferation of contingency planning exercises held at public and private agencies protecting vital societal systems. Based on different scenarios, these exercises simulate decision-making challenges and generate **experiential knowledge** of the vulnerabilities to the object secured (Anderson, 2010). The use of the creative capacities of **embodiment** is at the same time intended to be 'realistic', preparing staff for emergency, while not expecting future threats to materialize precisely as enacted. Like pre-emption, threat enactment generates a sense of urgency and galvanizes **decisive action** in the face of an imperative potentiality.

x. 3.3.4 Resilience and Societal security

All of these different anticipatory security techniques have become part of the contemporary security paradigm of **resilience,** which to considerable extent informs conceptions of societal security. The concept of resilience is derived from engineering, ecology and psychiatry. In engineering, it refers to the robustness of materials and technical systems. In ecology, resilience means the self-reproduction of organisms and life systems, and in psychiatry it signifies the resilience of individuals and their interactions with social systems (Comfort *et al,* 2010: 7). Resilience thus signifies the ability of materials, eco-systems and individuals to withstand stress and bounce back after shock. The crucial requirement here is not the **precise capacity to predict** the future, but the **qualitative capacity to absorb** events in whatever unexpected form (Walker and Cooper, 2011).

Applied to society, resilience becomes the **organising principle** of **societal security**. Moving the focus from the territorial state to society and culture, societal security is defined as the "ability of society to persist in its essential character under changing conditions and possible or actual threats" (Wæver, 1993: 23). The essential character of societies is not limited to physical and material aspects but crucially includes 'complex moral and social aspects such as confidence, trust, belonging and loyalty' (Burgess, 2011). Societal security thus strives to maintain the well-being of people and ***meaningful existence*** (ibid). As Deliverable 4.1 points out, societal security shares a complex lineage with the nexus of social security/ welfare, but rather than a rights-based definition it takes a **functional approach to security** (Burgess, 2011). Like the resilience of an ecosystem, societal security is to be judged on whether it remains **cohesive even while undergoing extreme perturbation**, that is, on the ability of social systems to absorb changes of state and driving variables and still persist.

xi. 3.3.4 Security economics

Contrary to the epistemology of incalculable uncertainty, a more mathematical literature attests not only to the continued but **increased relevance** of game theory in the context of terrorist threats. Where traditional statistical risk was governed by chance rather than the malicious (or self-interested) actions of intelligent actors, game theory's modelling of decision-making of *all* participants has renewed its perceived relevance. The so-called **Adversarial Risk Analysis (ARA**) (Ríos Insua *et al*., 2009) may be classically game-theoretic, with (non-cooperative) Nash equilibria as core concept (see Myerson, 1997), or it might be more psychological, reflecting either a decision-analytic formulation (Kadane and Larkey, 1982) or empirical studies of game behaviour (Camerer, 2003). ARA aims at "providing one-sided prescriptive support to one of the intervening agents, the defender, based on a subjective expected utility model, treating the adversary's decisions as uncertainties" (SECONOMICS D 5.1: 8). It is **predictive** in modelling the adversary's actions, his decision problem and assessing his probabilities and utilities. The basis of prediction is an assumption of the adversary as **expected utility maximizer**: his decision is argued to be predicted by finding his maximum expected utility action.

xii. 3.3.5 Summary of changing conceptions of risk in security studies

In conceptual terms, the post-Cold War and post-9/11 entry of **risk** into security studies is more accurately understood as **non-probabilistic uncertainty** or **contingency**. Yet, to the extent that risk implies an aspiration of **governance**, including new anticipatory epistemic alternatives of threat enactment and scenario-planning, this terminology confusion can be explained. At the same time, game theory and probabilistic risk have underwritten security studies from its inception. While no longer exclusively state-centric, game theory has recently regained influence through its predictive claim to modelling terrorist action. This is fundamentally opposed to the limits to knowledge that are principally assumed by rationales of anticipatory security governance such as pre-emption and resilience.

Probabilistic and non-probabilistic assessments of the future are not always regarded as incompatible. For example, Aitken (2011) describes the use of prediction markets to assess future uncertainties as a mix form where experts statistically interpret prices generated from disparate non-rational everyday knowledge in the Hayekian sense. Scenario-planning has also been sought to be combined with probabilistic assessment. As Groves & Lempert note,

> Current scenario practice… leaves unresolved the question of whether and how to best incorporate probabilistic information. Following recommendations in the scenario literature […], the SRES developers chose not to include any likelihood estimates with their scenarios. Rather the SRES team labelled all the scenarios as 'equally sound,' language intended to suggest that policy makers should seriously consider each scenario. This decision, however, has generated considerable debate, and [it has been] argue[d] that the probability issue remains central to concepts of how scenarios ought to be developed, interpreted, and used to support decision makers (2007: 74).

Probabilistic and "**possibilistic"** approaches to the future are thus not always seen as alternatives, or irreconcilable. Nonetheless the increased importance of these techniques demonstrates a growing understanding of the future as 'deeply' or 'radically' uncertain. Efforts to calculate the future continue in practices of complexity modelling, impact assessments, data mining and 'catastrophe models' that seek to quantify unpredictable disorder by generating multiple possible futures (Andersen, 2010: 784). Yet novel techniques of visualisation and "narrativisation" make the future present in ways different from calculation: scenarios organize and categorise while maintaining an essential openness and indeterminacy of the future. Scenarios **evoke** without predicting.

4. Conclusions for societal security: Uncertainty, risk and value

Having outlined the treatment of risk and uncertainty in the fields of finance and security, it becomes clear that risk as **rational choice under (calculable) uncertainty** has been central to the evolution of the disciplines of economics/ finance and security in the 20th century. In economics, an initial concern with genuine uncertainty gave way to game theory, which provided the epistemological and methodological foundation for the evolution of the discipline until today. The various models of finance theory equally rest on a conception of uncertainty as risk. In security studies, game theory defined the identity-giving debate between realism and liberalism within the discipline of international relations in terms of varying degrees of conflict and cooperation under equilibrium (see, for example, Viotti and Kauppi, 1987). While there is renewed emphasis on game-theoretical approaches in the field of security economics, large parts of the literature attest to a new concern with **radical uncertainty** that is conceptually different from risk.

If the fields of finance and security thus seem to display opposite trajectories, their close entanglement in the liberal security problematic of securing circulation also means a mutual influence that has only increased in the wake of the global financial crisis. Although no sector has been more representative of the 'risk as calculable uncertainty' approach to the future, even the financial system is to some extent coming under the sway of the crisis governance of radical uncertainty that has come to define a number of fields since the 9/11 terrorist attacks. One example of this is the introduction of system-wide stress-testing of financial institutions: a strategy driven by the logic of **resilience and anticipatory governance**. In particular Andrew Haldane, former Director of Financial Stability at the Bank of England, has promoted a regulatory approach to the financial system as a **complex system**, characterized by feedback loops, self-reference and disequilibrium (to be developed in D5.2). At the same time, as noted above, the algorithmic management of UK border security based on the logic of financial derivatives constitutes a new type of security governance where "technology opens the border, rather than closing it" (Amoore, 2011: 37).

This report will conclude with some remarks on the consequences of this discussion for the concept of **societal security**. Traditionally, liberal societies have been said to be marked by a **trade-off between liberty and security** (Buzan, 1983). 'Open societies' with regard to migration, free market policies and personal liberties are said to be more susceptible to threats arising from circulation and contagion. At the same time their prosperity, social capital and liberties rest on the principle of open circulation. Financial circulation is thus not to be seen as separate from, or outside of, societal security but constitutes a **vital and integral system** of liberal societies. Nonetheless, the growing volume and speed of financial transactions, fuelled by financial securitisation and derivatives, have been argued to transform the function of financial markets from a coordination mechanisms of saving and investment in the 'real economy' to an increasingly self-referential and self-propelling motor of 'virtual' value generation, severed from industrial and productive capacities. The above-described models of modern finance theory have thus not only been instrumental in transforming life's contingencies into calculable and tradable risk (MacKenzie, 2006; de Goede, 2010), but also begun to change the fabric of society. This process of **financialisation** has not only reconceived citizens protected by social welfare safety nets as risk-taking investors whose pensions, mortgages and insurance schemes are tied up with and exposed to the volatility of global financial markets (Martin, 2002; Langley, 2009). It has also had distinct effects on the conception of **economic value** and the **value of security** respectively.

Risk is inextricably linked to **value** in both financial and security contexts. In finance, risk is a function of expected return, with higher risk-taking increasing prospective gain. Similarly, in the field of security, "a threat to security is implicitly linked to what has value for us" (Burgess, 2011: 13). At first glance however, value – like risk – seems to be defined in different terms in the two fields: economic value is conceived of as profit and quantified as utility, based on the general equivalent of money, while societal and aesthetic concepts of value tend to be less materialistic and less universal. It thus seems evident to "differentiate between an economics-based notion of value and a culturally or socially based notion" (2011: 15): the first measures value **quantitatively**, the second defines value **qualitatively**. By contrast, game-theoretical approaches to security define value quantitatively: losses are "assumed to be able to be monetised as costs associated with interventions" (SECONOMICS D5.1: 10). At the same time, the paradigm of resilience implies a shift from quantitative, predictive security governance to **qualitative methods of anticipation** as well as the **qualitative capacity to adapt and thrive** in the face of crisis. Since the threat cannot be quantified, the imperative of permanent, open-ended responsiveness of material and psychological infrastructures stresses qualitative elements of societal security such as **confidence** and **experiential knowledge**.

Security and uncertainty seem to carry distinct, if not opposite, values in the political and economic realm: In finance, security (as in the *certain* return of government bonds, for example) is associated with low yield, conservatism and **stagnation** (except in conditions of market turmoil where investors rush into 'safe havens'). Uncertainty in finance is less seen as threat than as opportunity for profit. In the political sphere on the other hand, danger is normally not considered an opportunity to increase profit, and **protection** is the explicit goal. Yet in the financialisation of security and securitisation of finance these different valuations of security are becoming less distinct. The liberal security problematic of circulation implies a concept of societal security where threats no longer originate externally but from within the social fabric (Burgess, 2014: 10). Threat is **endogenous** and crisis originates from **within**. Societal security therefore implies the permanent adaptability in and through crisis, securing vital circulations increasingly through preparing for their collapse.

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