

# Facets and Financial Risk

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**Abstract.** If we take the earlier discussion of the components of financial risk, what principles of classification can help us to analyze these risks and their relation to one another? If we try to consider the goals of corporate finance in order to define risk, we quickly realize that financial goals in an organization are integrally tied to the goals of the organization itself. So, we might instead consider the ways that an organization uses corporate finance to help it to meet its goals and then consider the major risks that come from such uses. The results point to the possibility that there are different facets we may want to consider.

**Keywords:** Risk, classification theory, facets, risk ontology

## 1 Overview

If we take the earlier discussion of the components of financial risk, what principles of classification can help us to analyze these risks and their relation to one another? If we try to consider the goals of corporate finance in order to define risk, we quickly realize that financial goals in an organization are integrally tied to the goals of the organization itself. So, we might instead consider the ways that an organization uses corporate finance to help it to meet its goals and then consider the major risks that come from such uses. The results point to the possibility that there are different facets we may want to consider.

## 2 Business and Financial Risk

The concept of risk in business is essentially teleological: there must be a defined system with a defined goal or goals. Risks are then defined as events which can affect the system's ability to meet its goals. Sometimes only negative events which affect goal attainment negatively are considered but sometimes both negative and positive events are part of the risk assessment. Events which can positively affect goal attainment are often called opportunities and are fed into the goal setting subsystem of the system. Only the negative risks are considered in this paper. Once a risk is identified then its likelihood and impact (loss) are assessed. Impact is often measured in terms of the local currency. The risk can be managed in four ways. First, it can be avoided. This method involves changing the goal or the system so that the risk is no longer present. The second method of managing risk is to share it. The most common example would be insurance. If there is a risk of fire damage to a system or organization, the organization can buy insurance. In the case of the risk being materialized, the insurance company will help cover the loss. The third method of managing risk is to control the risk. In this method, an investment is made in a control system which operates such as to reduce the risk. Investing in a sprinkler system which would activate in case of a fire is an example of a control. A cost-benefit analysis is usually performed to ensure that the cost of the control is outweighed by the risk reduction the control achieves, often referred to as risk

mitigation. The last method of managing risk is to accept it. In this method, the risk is acknowledged and monitored only.

Risk is identified through an assessment process. This process involves having the people responsible for attaining the goals assess what events may prevent the goals from being achieved. The assessment usually includes assigning likelihood and impact values onto the risks. What results is a large set of potential risks which are then managed by applying one of the four methods mentioned above to each of them. The organization managing its risks will have finite resources to expend on risk management. Because of that, a concept of a risk portfolio is used to manage the risks. The portfolio is the collection of risks which are either being insured against, controlled or accepted. That is, they have not been avoided. This portfolio is conceived as having a mean risk and risk variance associated with it. That is to say that the risks that the organization is accepting or controlling each have their own "riskiness." The collection of the riskiness of the parts is the riskiness of the portfolio. Upper management of the organization sets the overall shape of the risks in the portfolio. The mean of the portfolio is called the risk appetite and the variance is called the risk tolerance.

If we take the earlier discussion of the components of financial risk, then they are asset-backed risk, credit risk, foreign investment risk, liquidity risk, market risk (including equity, interest rate, currency and commodity risks), operational risk, reputational risk, legal risk and information technology risk. What principles of classification can help us to analyze these risks and their relation to one another? If we try to consider the goals of corporate finance in order to define risk, we quickly realize that financial goals in an organization are integrally tied to the goals of the organization itself. So we might instead consider the ways that an organization uses corporate finance to help it to meet its goals and then consider the major risks that come from such uses. Finance is basically concerned with raising capital and applying capital as needed to further an organization's goals. What does an organization need to do in order to manage the process of raising and applying capital? First it must be able to access markets. Capital is usually raised from other organizations outside the firm. The firm can also self finance to the extent that it achieves and retains profits. We can then break capital down into four activities: raising capital, using capital, maintaining capital and distributing capital. These activities can be tested to see if they provide a good facet for classifying financial risk. Recall that a facet requires the application of a principle or principles in classifying concepts. The principle here is that the financial risks occur in one of the four activities. Each financial risk can be evaluated in turn. Asset-backed risk refers to the risk that capital held in an asset will lose value. This would be classified into the maintaining capital activity. Credit risk is the risk that capital lent to another organization will not be paid back. This can be classified as part of the using capital activity. Foreign investment risk is obviously part of using capital as well. Liquidity risk is the risk that the organization will not have enough liquid capital (cash) to pay its obligations. This can be classified as part of the capital maintenance activity. For market risks, first equity risk is the risk that capital held in the equities (stocks) of other organizations will lose value. This again is part of the maintenance of capital activity. Interest rate risk is the risk that capital raised or used will be done using an inappropriate interest rate. This would be part of both the raising capital and using capital activities and so would violate the independence of the partitions requirement of the facet. Currency risk is the risk that assets held in other currencies will lose value and can be classified as a capital maintenance risk. The final market risk is commodity risk which is the risk of value loss when holding commodities. This again can be classified as a capital maintenance risk. Operational risk is the risk of capital loss while using capital in production settings and so is again a capital maintenance risk. Reputational risk is the risk of the loss of firm reputation in the marketplace and so could be applied to any of the activities. Again, we see a lack of independence of the facet for this risk. Legal risk and information technology risk can also be seen to apply to all four activities and so also violate independence. If we analyze the partition violations then we see that the first, for interest rates, is driven by the fact that interest rates are

used as a parameter in risk calculations. For the last three, reputational, legal and information technology risk, they are all about the organization itself. These results point to the possibility that there are different facets we may want to consider.

One alternative facet might be the risk assessment itself. If we apply the risk assessment process as a facet to financial risks then we see that asset-backed risk, foreign investment risk, equity risk and commodity risk all involve the loss associated with what gets impacted by the risk, that is, where the loss may be. Credit risk, liquidity risk, interest rate risk and currency risk are associated with the likelihood of events occurring. An example is the likelihood of fluctuations in currency exchange rates. Operational risk and reputational risk are classified under involving the responsible parties to analyze risks. Legal risk and information technology risk are both classifiable under the risk portfolio concept since they are managed across the population of risks that the organization has identified.

### **3 Using facets to classify financial risk**

Types of facets could be types of event, types of impact and risk is impact x likelihood where Impact can be loss, or exposure which itself is some other risk. So, that is two facets, one of which includes risk itself in its subject matter (the subject matter by which we classify the thing). Another wrinkle is that the likelihood is not always precisely quantified as a percentage probability, e.g., it is often measured as high, medium and low. So, what are the fundamental categories in which the values belong? This will help us determine how to build faces in which the values of the facets are homogenous.

We categorize the number side of it in terms of whether these are well-researched mathematical probabilities or hi/med/lo estimates which (to calculate risk) are turned into numbers (where e.g. a risk with a probability of 1 is simply an issue!) Is this a provenance category? Consider the case where we have a qualitative valuation, e.g. low - 0.3 and we have other qualitative assessments translated into probabilities. If these are multiplied together, what's the precision in that number? The broader question is what are we trying to classify in financial risk in order to turn risks into guidance for action. There are implications as to what methods are used. Probabilities also have a probability distribution and confidence levels. Consider it more like a decision aid, leading to a final judgement.

Now consider the case of classifying the quality of the knowledge e.g. liquid markets versus mark to model etc. Even here, most of what feeds into this is data about the instruments, parties, markets and so on, including the portfolio itself. Recall that the aim of having a portfolio is to balance the risk in the first place. An efficient portfolio is designed to remove some of the risk (hedging, etc.). This is a difficult problem for reasoning with uncertainty. The probability of something is impacted by the probability of something else. How do we know what is correlated in the problem space? Can we use facets to structure the problems around confidence, e.g., correlations known and unknown? Facets need to be somewhat independent of one another. So, if we had facets which had correlation, this would be an issue. So, for instance, we might have two separate facets based on things we think are not correlated, but later learn that there is some real world correlation between the figures. If two things are the same they should be the same facets. But even when the figures track one another, if the concept is distinct, then we still need to be able to classify them as distinct things in order to be able to draw a relationship between them in the first place.

So, we can talk of facets theory with correlation. What happens when the values correlate but the meanings are recognizable distinct? What will the faces look like on the numbers side of things - e.g. confidence levels, is that a useful facet? The difference may be between a point estimate and a distributional estimate. What this means is for instance if I say my likelihood of a risk is 5%, versus when I say that the mean of the likelihood is 5% with an SD of 1% and is normally distributed - that's a distribution estimate. More sophisticated approach to

ris uses a distributional analysis. If you refine the model using distributional analysis. Bearing in mind the end result is a decision aid. Does what you have contribute to making good decisions?

What we want to say here is that you would design this model to a level of refinement that is necessary for a given kind of decision support. For the high / medium / low type of assessment, these would be defined as a range. Precision goes to the lowest precision of the various figures you are putting together. Implications for interpreting the outputs of the model depends on the decision situation but also depends on the maturity model (e.g., the Capability Maturity Model)

#### **4 Issues in classifying financial subject matter using facets**

The principle is that the properties of things may be used to divide and subdivide things in a hierarchy. Properties are the intension behind the hierarchical structure. When to continue to subdivide the taxonomy - do you use properties that haven't been used yet. Also, you need to consider what the atomicity of your thought space or world (problem domain) is. Once you get to a single individual object, is that an instance? Actually, you can have an intensional definition, whose extension happens to be only one individual - that simply tells you that the category is not very useful as a category. Then there is the idea of classifying things based on statuses over time - for example George Washington as a child or loans in different phases. We originally modeled these in FIBO as if phase was another facet of the classification, but this didn't feel neat in the absence of some formal representation of the facet. Also, maybe we need some clarity on the temporal classification facets.

What of instances? All properties can be used to create sub-classes of a thing. All things can be looked at in terms of a broad set with the properties, and / or a narrower set of sub class each differing by one or another property. In principle, a sub-class can be defined by one property but realistically we tend to define classes with a number of properties. We might use example from automobiles - number of doors, gasoline versus diesel and so on. Yet there are many other properties we don't use to classify them e.g. things about the interior, optional extras versus features installed as standard. Meanwhile we don't classify green cars versus red cars and so on. So in the market, there are broader sets of cars that can be characterized by a range of features, to give us e.g. the GT versus XT version of a given make and model. So, similarly with finance, some attributes are bundled in the categories we think about and so are not used to carve out those instruments into classes.

Then there is a temporal side of this. In the auto example, during the model year; at the start of the model year, can make a case that you have to pay for the extras on this auto, but later in the year when the excitement of the new version has worn off, they may start to collect together some of the features, and either make them part of a standard model or in some cases, marketing might consider that that feature was not really of interest. It is still there but no longer spoken of in the marketing literature. Similarly, in financial instruments, given that these are a bundle of attributes, there are people out there looking for things with a given attribute. Overall, as soon as there is something with a bundle of attributes, and people care about that bundle as a kind of thing (for example when they give it a name) then you have a class of thing in the domain of interest. Example: you might have a portfolio of various things you've purchased over the years, and you might have categorized them in one way or another when you bought them. A new regulation comes along which would cause a firm to divest of some category of thing, and now you have to classify the stuff in your portfolio according to the new classification in order to sell it.

What is interesting about this model is that there are some properties that are perhaps not "necessary" for inclusion in the class, but are expected. For example, the properties of the interiors of cars. No one would say that those properties are an essentially part of the make or model. Instead, they are \*known\* to be associated with the properties that are essential. That may be the case with most branding. Consider a pair of Nike shoes: the "essential" properties

are the ones that Nike will never not include in a pair of shoes. However, there are also a lot of stylistic features that identify the shoes as the Nike brand. Nike may phase these properties out as tastes change. But for now, they allow the user to identify the shoes as being Nike's.

Another example is XBRL "extensions." Other accounting anecdotes: Account table in German Standard Accounting model versus US GAAP in the ability under US GAAP to develop your own rules for accounting classifications. Or consider XBRL SEC requirements in US. The use of FIBO ontology versus standard reporting or standard way of talking about risks in Financial Instruments. This is similar to making everyone choose the same Dewey Decimal number. The question is: are there black and white distinctions or is there some ambiguity here. Some properties might not be required for reporting purposes but might be useful for management information. The issue is also around how people interpret a document, how they characterize the topic of the document. There seem to be two variables in play here: how you choose to prioritize the different facets in a monohierarchical taxonomy, and how you interpret the subject matter of something in the first place, in order to allocate those facets at all.

An anecdote: four indexers, same training and background but assigned different categories to a thing. So, there are different priorities and different constituencies. What about finance? Given an ontology, this takes account of the interpretation question, but the prioritization of categories / properties remains. In the absence of an ontology, the issue of interpretation probably remains (but given well-defined contractual terms in the instrument contract, the legal basis of these should deal with most ambiguity?) Is it that simple? How we categorize things in internal controls, for accounting of risk. Again, you still need to interpret the framework itself in order to know how to categorize instruments for risk itself. See e.g. Basel - developing measures first, get firms to report the agreed measures of risk. This is a bottom up approach.

So, the interpretation problem has not gone away. Evolution of regulations e.g. Basel goes from I to II to III and so on - the problem of interpretation has not been resolved. This is a result of this bottom up approach. If we use the top down approach, we are asking: "What is the definition of 'Global Economy', that we are trying to control?" But today, we are not seeing the discussion at that level. That is, we can talk about statistical correlations between unrelated concepts. This is the kind of patterns you see developing once you add the actual data about the things. If red paint were more expensive than yellow paint, then these would not be as orthogonal as we thought (gold paint). So, some care is needed when we allow for a gold-plated Cadillac. It comes down to concept formation, so here we need to consider how we form concepts.

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