Risks Assessment in Real Estate Investments in Times of Global Crisis

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Abstract: - Aim of the paper is to provide a novel valuation model to address risk and uncertainty in property investment decisions. When the future is uncertain and investments are durable and illiquid, the decision to invest at a certain point in time and the correct assessment of risks are key issues. In times of global financial crisis, investors need to know how to measure risks and identify the relationship between risks borne and risk premiums demanded. Increases in idiosyncratic and systematic risk lead developers to abandon/delay investments because de facto they feel not confident in projects riskiness and market values assessed by professionals. Risks evaluation is often left to the sensitivity and discretion of valuers. Rigorous risk assessment measures, based on mathematical algorithms, are here presented. We provide an operational framework to address risk and uncertainty by an integrated approach that can be easily understood by third parties and applied to different property types. The algorithms here proposed allow investors to evaluate risks and opportunities taking into consideration all the different phases of property investment projects and related risks. Investors, with different time patterns of income and desired consumption, will be therefore enabled to determine the risks they can tolerate, the return they need and its timing.

Key-Words: - Real Estate Investments, Uncertainty, Risks Assessment.

1 Introduction

The financial crisis that erupted in 2006 in the United States had such a severe impact, still evolving, on the world economy that is considered as the worst economic crisis since the Great Depression. The crisis, according to the "credit boom and busts" theory, began approximately in the second half of 2006, when in the United States the real estate bubble began to deflate and, at the same time, many holders of subprime mortgages became insolvent due to the rise in interest rates. The burst of the subprime mortgage crisis was followed by the decision of some banks to "freeze" the price of their investment funds, suspending sale to prevent depreciation. The continuous rise in interest rates has led to the insolvency of about 2 millions of American families. In August 2007, concerns about a possible collapse of the subprime mortgages led to a sharp fall in stock market indices Nasdaq and Dow Jones, with serious repercussions on the price lists from all over the world. As a consequence the indices of Asian and European stock exchanges experienced a series of record lows.

In Italy, the global crisis affected on a large scale the real estate industry that is still undergoing increasing difficulties as a consequence of the credit crunch worsened by the lack of liquidity. After a decade of strong growth that began in 1997 and ended in 2006, when trades in the residential sector reached a historical peak of 869,308 NTN (normalized number of transactions), in 2007 the volume of trades had a turnaround [14]. The shrinking of the housing market continued until 2009, with an overall decrease of 30% compared to 2006. After a slight recovery in 2010, starting from 2011 the market had a significant decline: in the North East of Italy, where generates 19% of the domestic market is generated, it was registered the highest decline in sales, about minus 3.4% in 2011 compared to 2010 [3] and at national level in 2012 the Italian real estate market registered a decrease in sales of about 24.8% if compared to 2011 [4]. In this respect one puzzling evidence in the residential housing market is that, on the one hand, potential buyers are reluctant to buy because of the lack of financial resources and the credit crunch, but on the other hand owners are reluctant to sell due to the so –called hold out phenomenon" [27] and as a consequence trading volume is low in a declining market.

A big chunk of the Italian real estate market is based on the segment of the credit market: the percentage

of mortgage lending used to finance private ownership of residential property is about 50% in the North and in the Center, while it is less than 35% in the South and in the Islands. Therefore the financial and the real estate crisis had a heavy relapse on loans supply. From 2008 to 2011 the number of new granted mortgages fell by an average of 9.1% annually, compared to an average increase of 8.5% in the previous three years [17]. This decrease is attributable to both supply and demand factors. Demand factors are mainly related to the weakness and decline of the housing market and the negative phase of the economic cycle, characterized by an increase in the unemployment rate and the reduction in household incomes. Supply factors are mainly related to both the "hold out phenomenon" previously mentioned and the deterioration in loan quality independently of a rise in official interest rates[i].

In a worldwide perspective, it is commonly argued that the crisis will start to be overcome when consumers, firms and private investors will feel more confident in the stability of economic policies and financial markets. This stability will in turn lead to an increase in investments, employment rates, salaries and consumer consumption. The existence of a well-functioning capital market allows investors with different time patterns of income and desired consumption to agree on whether real estate investment projects should be undertaken. In order to estimate discount rates for real estate assets, developers firstly need to know how to measure risks, how much risk they can tolerate, the return they need and its timing.

The issue of identifying and assessing risk and uncertainty within the scope of property valuations is currently one of the key concerns in contemporary valuation literature [6, 15, 16, 23, 24]. It is argued that risk and uncertainty are inherent parts of the valuation process because valuers are "unable to specify and price accurately all current and future influences on the value of the asset" [1].

Aim of the paper is to provide a novel valuation model to address risk and uncertainty in property investment decisions. The decision to invest at a certain point in time and the correct assessment of risks are key issues when investments are illiquid and future payoffs are uncertain. In times of global financial crisis, investors need to know how to measure risks and identify the relationship between risks borne and risk premiums demanded. Increases in idiosyncratic and systematic risk lead developers to abandon/delay investments because de facto they feel not confident in projects riskiness and market values assessed by professionals.

Real estate development is a multiphase process: it starts with land development, is followed by residential and/or commercial development and ends with the marketing phase -and the sale or leasing of the completed site. Each stage involves various risks which are differently allocated between landowners, land developers, and homebuilders. More rigorous risk assessment measures within the property investment industry are here designed to operate at the level of the individual asset but might be easily extended to the framework drawn from conventional theory which operates primarily at the portfolio level. Specifically in this paper we propose an operative approach to address risk and help financial managers and investors to cope with risk in practical situations. Our main objective is rather to provide research tools that reveal the riskiness of a property investment than to provide an interpretative model. De facto in the literature the contributions on risk management and interpretative models are numerous and well developed, but, conversely, the valuation of risks in real estate investments is often left to the sensitivity and the discretion of valuers. We then provide mathematical algorithms, adaptable and interpretable, that can be generally applied in real estate investments.

The remainder of the paper is organized as follows. Section 2 focuses on risk assessment and valuation procedures and provides mathematical algorithms to measure risks related to property investments. Section 3 presents a case study on investment in office buildings in Milan to illustrate the results of the algorithms implementation. In Section 4 conclusions are discussed.

2 Risk assessment and risk measures

In order to cope with risk, it is fundamental to define risk in general and risks related to real estate and property investments. Academics have longly debated on the difference and the relationship between risk and uncertainty [7, 8, 22]. It is generally agreed that uncertainty is due to the lack of knowledge and poor or imperfect information about the state variables. Furthermore, the further the analysis is taken into the future, the greater is the uncertainty and the more uncertain are the outputs. On this basis, risk is the measure of the difference between the actual and the expected outcomes: the risk of an asset can be completely expressed by considering all possible outcomes and the probability of each[ii]. Focusing on property investments, Adair and Hutchison [1] define risk

"as the probability that a target rate of return will not be realized" while uncertainty "denotes situations where outcomes and their probabilities are not known". In conventional investments and finance, the risk associated with an asset is usually defined as the volatility, quantified through the variance or standard deviation of its returns. Of course, there is no risk in hindsight, but it is reasonable to assume that securities or portfolios with histories of high variability also have the least predictable future performance. Therefore we can use variance or standard deviation to summarize the spread of possible outcomes and these measures can be considered as natural indexes of risk. Other authors, though, suggest that both risk and uncertainty cannot be defined operationally but only intuitively[23].

Holton [19] argues that uncertainty that is not perceived cannot be defined operationally and valuers can only try to define operationally the perception of uncertainty. Similarly, definitions of risk are likely to carry an element of subjectivity, depending on the nature of risk and to what it applies to [2]. Chen and Khumpaisal [10], investigating the correlation that exists between risk and investment projects in real estate development, underline that risk can strongly influence all related investment performances at all stages of the entire lifecycle of properties, while Chicken and Posner [11] define the constituents of risk analysing the concepts of hazard and exposure.

A large number of contributions in the literature were devoted to risks classification in property assets [1, 5, 18, 20, 21, 34]. Specifically, Chen and Khumpaisal [10] proposed a summary table where the main risks, identified and analyzed in the literature, were classified and broken down by categories. In their paper they proposed a novel approach to risk assessments in commercial real estate development and deeply investigated economic risks that include risks related to interest rate, property type, market liquidity, demand and supply, purchasability, capital exposure, lifecycle value, area accessibility, buyers, tenants and risks related to investment returns[iii].

In this line, in 2012 the European Group of Valuers' Associations [33] provided a systematic classification of risks into: a) market risks; b) property related risks (location risk, construction related property risk, tenants and leases risk); c) fiscal and legal risks; d) financial risks.

Though there has been a long debate in the literature on risk definition and classification, the operators of the real estate market still do not have specific methodologies for measuring risk, differently from other areas of financial investments. This circumstance is not due to lack of interest by real estate operators, but to the difficulties of implementing tools developed for assessing risks in financial investments, which need to be adapted to the specificities of property investments[iv].

In order to fill the gap in the existing literature and provide real estate practitioners with specific tools to be adopted in risk assessment of property investments, following Chen and Khumpaisal [10], in this paper we are taking into consideration those risks that are classified as economics risks. Risks associated with economic and financial uncertainties are in fact the most crucial factors that might strongly impact the project development process and its vitality[v]. In what follows, we provide an operational framework to address risk and uncertainty by an integrated approach and we illustrate risk assessment procedures and introduce risk measures that can be easily understood by third parties and applied to different property types. We focus on economic risks as classified in Table 1[vi].

CLASSIFICATION	RISKS	
Market Risks	CMr	Capital Market risk
	Vr	Valuation risk
	MG Rr	Market Growth Rate risk
Real Estate Operating Risks	Or	Operating risk
	Dr	Development risk
	Lr	Leasing risk
	LHr	Leasehold risk
	LVr	Leverage risk
	Tr	Tax risk

Table 1 - Risks' Classification

We mainly address Market Risks and Real Estate Operating Risks. It is rather intuitive that the former are affected by financial markets and macroeconomics, while the latter are strongly related to property investments and more specifically to real estate development investment projects.

Market Risks can be grouped into three main categories: Capital Market risk (CMr); Valuation risk (Vr); Market Growth Rate risk (MGRr). While Real Estate Operating Risks can be subdivided into six categories: Operating risk (Or); Development risk (Dr); Leasing risk (Lr); Leasehold risk (LHr); Leverage risk (LVr); Tax risk (Tr).

In what follows we define the above risk components and relative measures.

CMr) Capital Market risk defines the asset's riskiness with respect to market rates and its measure reveals whether the asset under investigation is priced consistently with capital market prices and rates. It is calculated as the ratio between the average market capitalization rate, MCR, and the asset's capitalization rate, ACR:

$$CMr = \frac{MCR}{ACR} \quad (1)$$

When the market capitalization rate (cap rate henceforth) is lower than the property investment's expected cap rate, then the investment is quite conservative. On the contrary, when the project's cap rate is lower than the market's cap rate, then the investment's riskiness is moderate or aggressive (Table 3).

Vr) Valuation risk defines whether an asset is overvalued and will earn less than expected when it matures or is sold by the holder. Factors contributing to Vr include incomplete data, market instability, and poor data analysis performed by the professional assessing the asset value. Overvalued assets might generate losses for their owners. The value of real estate assets can be generally broken down into two components: cash flow from contracts and resale (or residual) price. The former has a higher certainty and presents less risk, the latter is more uncertain. In particular, the greater the reliance on the residual to produce the desired return, the greater the asset's risk. With respect to this second component, we can calculate the Valuation risk as follows:

$$Vr = \frac{NPV_{RP}}{AP} \quad (2)$$

where NPVRP is the Net Present Value (NPV) of residual proceeds and AP is the asset's construction/acquisition cost. When Vr <20% the investment can be considered as conservative; on the contrary when Vr>60% it can be considered as aggressive, otherwise when 20%<Vr<60% it is moderate (Table 3).

MGRr) Market Growth Rate risk is related to the probability that the asset value increases over time. This risk measure is used to compare the asset value growth rate to the overall market growth rate. If the asset growth rate outstrips inflation, then the value increase is reliant upon factors such as capturing below market rents, redevelopment of the site, super-heated rental growth projections, etc. It is necessary to measure the asset growth rate and compare it to the market growth or inflation rate in order to determine whether the asset is being acquired based on above market growth rates. The MGRr can be determined according to (3):

$$MGRr = \frac{UIRR - ACR}{MGR} \quad (3)$$

where UIRR is the unlevered rate of return, ACR is the initial asset cap rate and MGR is the market growth rate. The numerator represents therefore the property investment's growth rate. The risk is aggressive when MGRr>125%, it is conservative when MGRr<75%, otherwise is moderate (Table 3).

Or) Operating risk is related to the probability of incurring losses due to changes in demand, input costs, etc. In order to minimize operating risks exposure, operating and tax expenses should be minimized. In particular the optimal risk management strategy is to minimize any increase in operating expenses, including utilities, taxes, insurance, and other recurring expenses that will reduce the operating income from the property or will offset the increases in rent thereby reducing the cash flow, and consequently the property value. This risk is mitigated when the tenant shares in the expenses and it is ultimately reduced to zero when the tenant absorbs 100% of the expenses in the so called triple net lease[vii]. As an example, the operating risk sharing between the landlord and the tenant in the United States is illustrated in Table 2. Or can be calculated as follows:

$$Or = \frac{OOR}{TOE} \quad (4)$$

where OOR is the sum of operating and other recoveries paid by the lessee[viii] and TOE represents the total operating expenses. If the sharing is above 80%, Or is classified as conservative, otherwise if it is lower than 20% it is aggressive (Table 3).

US contract	**A-Gross**		**B-Partial Net**			**C-3 Net**	
Landlord exposure	**100%**					**0%**	
	Hotel-	Residential	-Office	-Retail	-Industrial	-Bonded	lease
Utilities							
Taxes							
Insurance							
Operating costs							
Cleaning							
Mechanical maintenance							
Structural cost							

Table 2 – Operating Costs risk sharing between tenant (grey) and landlord (white) in the United States.

Dr) Development risk is related to land development. It identifies to some extent the probability that any capital expenditure will earn the required rate of return to compensate the investor for the added risk taken, when additional capital is committed to the asset[ix]. This risk is incurred when new development is contemplated and when a major redevelopment or expansion is anticipated. Since investing new capital for the expansion or development of an asset should always generate a profit (that in turn should be in line with the risk taken in construction), in terms of risk management, whenever the profit appears low, the optimal hedging strategy is to renegotiate the cost of construction or require an increase in income to generate an appropriate level of development profit[x]. Development risk can be determined as in (5):

$$Dr = \frac{(NOI - ACR)/CC}{CC} \quad (5)$$

where NOI is the net operating income and CC is the construction/renovation cost. It is worth noting that the numerator in (4) is the investment's Net Present Value, being ACR the asset cap rate. When Dr<10% the risk is aggressive, when Dr>20% it is conservative otherwise it is moderate (Table 3).

Lr) Leasing risk measures the asset's share of overall market absorption, by comparing the asset performance to the overall market trend. In other words, it is the risk that the vacant space will be absorbed at a rate which is slower than projected during the acquisition underwriting of the asset. It is significantly affecting the overall investment riskiness whenever the property is not keeping pace with the market or absorbing its fair share of the market leasing activity. The leasing risk can be determined according to (6):

$$Lr = \frac{LU_{1y}/MA_{1y}}{BV/MV} \quad (6)$$

where LU_{1y} represents the square meters of rented space in a specific year (1 year Lease Up), MA_{1y} is the market demand's absorption relative to that year, BV is the property vacancy and MV is the property's sector-specific market vacancy. When Lr<75% the asset is in the conservative range, when Lr>110% it is in the aggressive range, otherwise the risk is moderate (Table 3).

LHr) Leasehold risk accounts for the probability that the tenant lease terms are above market and that the purchase price is therefore inflated to reflect both the intrinsic real estate value plus the above market leasehold interest. In other words, it is the risk to value the above market rent at a higher discount rate than the core asset: if the market rents are lower than the project's ones, in order to ensure that the investment well performs and mitigate risk, it might be necessary to adopt an higher capitalization rate, to adjust the asset's value to market values. Alternatively, it is possible to capitalize the average market rent and add the spread between the average market rent and the actual rent paid by the lessee capitalized for the estimated number of years that the contract terms (i.e. the project's rent) are above market. LHr is measured by the ratio between the expected contract value, (i.e. the Gross Rental Income) and the average market rents (M.R.).

$$LHr = \frac{GRI}{MR} \quad (7)$$

where GRI is the gross rental income and MR is the market average rent. In other words GRI is the expected contract value. When LHr<85% the risk is conservative, while when LHr>115% is aggressive, otherwise moderate (Table 3).

LVr) Leverage risk occurs when the cost of debt exceeds the return on the asset to be acquired. Leverage creates risk as the lender has a priority position in the repayment of the outstanding loan balance, upon sale or liquidation of the asset and it is related to the percentage of equity and debt and the related cost of capital:

$$LVr = \frac{UIRR}{KD} \quad (8)$$

where UIRR is the unlevered internal rate of return and KD is the cost of leverage. When LVr>115% the asset is in the conservative range, when LVr<100% it is in the aggressive range, otherwise the risk is moderate (Table 3). LVr may also arise when the cost of debt, including the amortization of the debt, exceeds the cap rate upon acquisition. In this case there is negative leverage in the early years of the property operations, but negative leverage may run out as the annual income an annual cap rate from the property increases and exceeds the loan constant. In this case KD will be less than the Internal Rate of Return (IRR) expected from the asset operation. Whenever a loss occurs, the deficit becomes magnified based on the ratio of leverage, or debt, added to the trade. Vice versa, whenever the trade is successful, the payoffs are similarly amplified. The ratio of financial leverage and risk can be determined based on the size of the loan in relation to the value of total assets overseen by an investor. Consequently leverage may amplify the rate of return for an asset, in a positive or negative direction. The risk is to depress the return on equity and is evident when the cost of the debt expressed in constant terms exceeds the return on the asset. The optimal investment strategy is to lever or amplify the return by the use of debt when there is a positive leverage.

Tr) Tax risk is related to the potential that a chosen action or activity, or the failure to take an action or pursue an activity, will lead to a tax outcome that is different than initially expected. This risk can obviously be determined whenever the valuer knows the taxation level of the entrepreneur who is involved in real estate investment. Researchers, managers, and practitioners recognize that varying levels of risk accompany tax strategies. This is the reason why we cannot formalize it in a generic way and we are not addressing the issue in this paper.

Table 3 summarizes for each risk component the relative value ranges according to which risks can be classified as Conservative, Moderate or Aggressive. Specifically, we derived these classification ranges based on judgments by real estate institutional investors and industry experts with respect to the contingent crisis affecting the Italian property market.

Risk	Riskiness value ranges		
	Conservative	**Moderate**	**Aggressive**
CMr	<90%	90-110%	>110%
Vr	<20%	20-60%	>60%
MGRr	<75%	75-125%	>125%
Or	>80%	20-80%	<20%
Dr	>20%	10-20%	<10%
Lr	<75%	75-110%	>110%
LHr	<85%	85-115%	>115%
LVr	>115%	100-115%	<100%

Table 3 – Classification of risks value ranges into three main classes: conservative, moderate, aggressive

3. Property investment in office buildings in Milan: a case study

In this section we present a numerical example to clarify applications of the above algorithms on a stylized case study[xi].

We consider the case where an investor has the opportunity to invest in a real estate development project and needs to determine related risks to make the decision. The project consists of the construction of a new office building, placed in Milan Hinterland. The building is structured into eight floors and each floor has a surface of about 650 m^2 (in total 5,500 m^2), and the overall volume is 15,600 m^3. The buildings includes an underground parking garage of about 2,000 m^2 (whose 700 m^2 are rentable) and the building is surrounded by a green area and a park of about 1,800 m^2.

In what follows the basic assumptions related to the investment timing and business plan are described. Construction costs amount to 5.5 Million € and total investment costs to 8.9 Million €[xii]. The construction phase will last for two years, therefore the project will not generate any income for the first two years. Afterwards the tower will be leased, but at year 10 from the beginning of construction the building will be sold in the real estate market. A bank has already applied for the lease of the ground floor in the new building. According to the contract provisions, during the first year of lease the bank will lease 50% of the space and then it will lease the entire floor. The estimated annual rent is 168 €/m^2. After three years from the beginning of

construction, the rest of the tower, which consists of units sized 150 m^2 (Type S) and units sized 300 m^2 (type L), will be leased to a number of different companies. During the first year of lease 60% of Type S and 30% of Type L will be leased, during the 2nd year of lease they will be leased respectively at 85% and 60% afterwards the Type S will be fully leased at 85% and the Type L at 80%, until the sell. The estimated monthly rent is between 15 and 16.5 €/m^2 (i.e. 180-198 €/m^2 per year). After two years from the beginning of construction, 25% of parking lot will be leased, the following year the percentage of parking space leased will increase to 70% and afterwards the garages will be fully rented at 90%. The estimated monthly rent is 10 €/m^2 (i.e. 120 €/m^2 per year). After four years from the beginning of construction, the property vacancy is assumed to be equal to 11.25% (i.e. the property is 88.75 percent leased). Table 4 summarizes the investment's technical and economic data.

Data	
Overall Volume	15,600 m^3
Construction Cost	5.5 Million €
Investment Costs	8.9 Million €
Financial structure	70% Debt- 30% Equity
Bank lease	168 €/m^2 per year; 650 m^2
Unit A lease	15 €/m^2 per month; 3,300 m^2
Unit B lease	16,5 €/m^2 per month; 1250 m^2
Parking space lease	10 €/m^2 per month; 700 m^2
Operating expenses[xiii]	613,000 € per year
WACC[xiv]	4.24%
UIRR[xv]	9.96%
Property sale price (Market Value, year 10)[xvi]	11.8 Million €
Capital market rate	7.0%

Table 4 - Investment's technical and economic data.

Based on the above assumptions, we framed the investment decision problem according to the risk assessment model presented in the previous section. The results of the implementation of the algorithms above introduced to assess the project's risks are listed below.

CMr) Capital Market risk

For determining the capital market rate we referred to recent market analyses [13, 30], which identify for office buildings a rate in between 6.1% and 7.2% (mainly depending on the percentage of equity and debt). In what follows we assume a capital market rate equal to 7%. By implementing (1), we obtain that at year 5 from the beginning of construction, the project's Capital Market risk amounts to 81.69% and falls to 70.51% afterwards, remaining constant until the property is sold[xvii]. Except for the initial four-year period, the investment's Capital Markets risk is conservative. The sudden decrease in the level of capital market risk between year 4 (in this year the capital market risk is about 159.29%) and year 6, might suggest that incomes from rent are overestimated and consequently that the asset is overvalued.

Vr) Valuation risk

The expected sale residual is about 12.4 Million €[xviii] and the present value of this residual corresponds to about 10.9 Million €. Investment costs are about 8.3 Million €, therefore valuation risk is 123.14%. This level of reliance upon the residual is very aggressive, and determines on the one hand an aggressive investment with respect to Valuation risk and, on the other hand, an excessively low reliance on cash flows to produce the expected returns. The high value of the property is perceived as speculative and therefore the asset is perceived as risky. A possible strategy to hedge this risk is to use the information on the value distribution to negotiate a lower risk through rental income support or lower reliance on the residual through sale participation.

MGr) Market Growth risk

According to the simulation results, as the UIRR (equal to 9.96%) is slightly higher than the maximum cap rate (9.93%)[xix], Market Growth risk is very low and conservative. The asset's growth rate is positive and equal to 0.03%. Assuming a market growth rate equal to 1.2%, according to the market inflation, the Market Growth risk is about 2.59%, and the investment's risk is highly conservative in this respect. It is worth noting that if the project cap rate decreases by about 1.5 percent points (i.e. the cap rate decreases from 9.93% to 8.4%), the Market Growth risk will become aggressive (about 130%). This reveals that MGr is highly sensitive to the project cap rate, therefore it's extremely important to pay attention to income estimates. The MGr is sensitive to the market growth rate as well, therefore especially in times of financial crisis and down market it is fundamental to

estimate it correctly and properly address the issue of its volatility. Whenever the Market Growth risk is in the aggressive range, the best approach to hedge MGr is to challenge the growth rate assumptions in the context of the market, to reduce the offering price and to adopt a management plan to ensure the investor achieve such an increase in value.

Or) Operating risk

The property contract lease is a partial net and the landlord and the tenant share in the operating risk. We determined operating costs by comparison with similar assets for which operating expenses where known. By this comparison approach, we estimated[xx] that operating costs are equal to 147 €/m^2, or equivalently about 612,000 € per year. Operating risk depends on the lease agreement between the landlord and the tenant. As an example, if we make the assumption that the landlord shares in the operating cost, as soon as the property is fully leased (at the 6^{th} year), the risk dramatically decreases. In particular the risk for the landlord is higher when the property is partially rented. In the fourth year from the beginning of construction, assuming that projections on total operating costs are about 660,000 € and the landlord pays 220,000 €, then the asset's risk is approximately 33%. This is a moderate risk that might be easily hedged by negotiating different lease terms (e.g. *triple net lease*).

Dr) Development risk.

The developer faces the need to renovate some units of Type S and L at year 6 from the beginning of construction, because some tenants are moving out and others are coming in and they requires greater open spaces. Renovation costs are estimated[xxi] about 100 €/m^2, and the total expenditure is 250,000 €, as the renovated space is about 2.500 m^2. The new tenants are going to pay a higher rent: the total rent will increase by 20,000 € per year, therefore the additional value is about 266,000 €[xxii]. The renovation additional net profit is positive (266,000 € - 250,000 €) and development risk is equal to 6.67%. This implies that the property renovation generates an aggressive risk.

Lr) Leasing risk

According to a recent research report on property investments [25] the expected market absorption relative to offices in Milan is equal 300,000 m^2. We assume absorption equal to this forecast during year 3 from the beginning of construction. Marton [25] observes 800,000 m^2 of competitive space vacant in Milan. Consequently Leasing risk is high, as we projected that the property is 88.75 percent leased. This latter is indeed an optimistic projection being the market vacancy about 72.73%. Between the third and the fourth year the asset has 4,875 m^2 of vacant space and the projections include lease of 2,390 m^2 of the buildings vacancy. This means a 0.79 percent ratio between the lease up and the market absorption. Being the market share (i.e. the ratio between the building vacancy and the market vacancy) equal to 0.61%, we obtain a Leasing risk of 130.74%. For the following years we assumed that the market will absorb more space of our project so the algorithm will increase this risk's aggressiveness, as the investment is projected to outperform the market. Between the fourth and fifth year, in fact, the property has 2,810 m^2 of vacant space and the projections include lease of 3,693 m^2 of the buildings vacancy. Projecting a 0.35 percent market share[xxiii], consequently the Leasing risk is equal to 350.42%. In the following year it will still increases to 769.93%. This risk is definitely high as we assumed a very optimistic scenario. This result suggests that the projected lease up is too aggressive and the capitalizable income is too high. In this case it might seem appropriate to modify the optimistic scenario by suggesting a slower lease up and a lower income stream. This would turn in a lower asset value. Anything over the market share is de facto an aggressive assumption.

LHr) Leasehold risk

According to market analyses (Marton, 2013; Scenari Immobiliari, 2013; D'Alpaos and Canesi, 2013) we estimated the office average market rent is equal to 14.5 €/m^2. The project generates an Average Gross Rental Income of 15.2 €/ m^2, and therefore Leasehold risk equals 104.7%. It is a moderate risk, because the contract is above market. As far as the parking lot is concerned, the market offering average rent is 9.5 €/m^2, and the asset's Gross Rental Income is 10 €/m^2. Consequently, the related Leasehold risk is moderate being equal to 105.3%. We are potentially overestimating the asset as the contract lease will not be above market forever. As long as the lease terms are above market, the property's value is greater than other assets in the market by 4.5%. Whenever this favorable condition changes, the profit loss might be greater than expected as the assessed property value is greater than its market value.

LVr) Leverage risk

Assuming that 30% of capital is Equity and 70% is debt, and the cost of leverage is 1.51%, the UIRR is 9.96%, therefore Leverage risk is equal to 661.31%. This percentage implies a very conservative investment as far as Leverage risk is concerned. But in case of high risk the investor could reduce purchase price to a level that would eliminate negative leverage in order to insulate the investment from the effects of negative leverage and to smooth out cash flows. Alternatively, the investor could change the debt structure to include lower rate floating debt, participating mortgages, cash flow mortgages, and purchase money mortgages.

RISK	%	Moderate range		Level
		Cons. %	Agg. %	
CMr	70,51	<90	>110	Conservative
Vr	123,14	<20	>60	**Aggressive**
MGRr	2,59	<75	>125	Conservative
Or	33,33	>80	<20	Moderate
Dr	6,67	>20	<10	**Aggressive**
Lr	769,93	<75	>110	**Aggressive**
LHr	104,71	<85	>115	Moderate
LVr	661,31	>115	<110	Conservative

Table 5 - Asset risks values.

Table 5 summarizes the risks measures determined with reference to the above case study. Although the overall investment riskiness can be considered fairly moderate, due to the financial crisis currently affecting the real estate market, the investor decided not to proceed and to delay the decision to invest, because Dr and Lr are in the aggressive range. In this respect the investor decided that though the investment proved to be a positive Net Present Value project, he considered these two risks unacceptable according to his risk attitude. It was therefore decided to investigate further risk management strategies aiming at reducing Dr and Lr before committing to invest.

4 Conclusion

Real estate development is a dynamic multiphase process where each stage involves various risks, differently allocated between stakeholders. In times of global financial crisis the decision to invest at a certain point in time and the correct assessment of risks are key issues: investors need to know how to measure risks and identify the relationship between risks borne and risk premiums demanded according to their attitude towards risk. The primary risk to investors is that the investment, ex-post, may be a negative Net Present Value project. Risks evaluation is often left to the sensitivity and discretion of valuers. Rigorous risk assessment measures, based on mathematical algorithms are here presented in order to enable investors to evaluate risks and opportunities taking into consideration all the different phases of property investment projects and related risks.

A numerical example was then presented to test the risks assessment measures on a stylized case study. The results may enhance the decision-making process and highlight that, though an investment may prove to be ex-ante a positive Net Present Value project, ex-post this might not be the case because some of the investment risks are aggressive and not conservative. The risk assessment measures here proposed may have interesting effects in terms of risk management strategies. Each investment criteria (e.g. market impact, value distribution, etc.) can be in fact related to a specific risk measure, therefore the investor can revise or adapt investment and management strategies in order to reduce a specific risk component to acceptable reliance level (in accordance to his risk attitude) and in turn increase the economic performance of the investment. In times of scarce financial resources and uncertainty on future payoffs, developers may decide to abandon real estate investments when they do not rely on robust and transparent risk assessment procedures. This in turn may cause a further collapse of the real estate market and have negative effects at both micro and macro-economic level. In this respect, the paper aims to provide an operational framework to address risk and uncertainty by an integrated approach, that encourages the use of analytical tools to define a transparent risks scoring that can be easily understood and interpreted by real estate investors and practitioners.

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[i] De facto, loan interest rates and the opportunity cost of capital have a strong influence on the performance of the real estate market.

[ii] According to the Royal Society[28], risk is the probability that a particular adverse event occurs during a stated period of time, or results from a particular challenge.

[iii] They identified risk assessment criteria for commercial real estate development: environmental risks, social risks, economic risks and technological risks. They broke down each criteria into sub-criteria. As example environmental risks are subdivided into adverse environment impact and climate change while social risks are disaggregated into workforce availability, cultural compatibility, community acceptability and public hygiene. For a complete discussion see Chen and Khumpaisal[10].

[iv] Another stream of the plentiful national and international literature concerns the relationship between the riskiness of an investment and its performance-return. It is imperative but not related to this article.

[v] Most of professionals and academics in the real estate paid their attention to the assessment of economic risks due to the variation of interest rate, loan, and developer credit[9, 26, 29, 32]. In this respect, TEGoVA[33] recommended that investments volatility due to changes in any of the underlying valuation model assumptions on rent, yield, cost and timing must be clarified to the lender, as part of risk assessment procedures.

[vi] The determination of these risks must be obviously accompanied to market analyses and feasibility studies in order to determine the whether the investment is profitable. Risk analysis can be considered as part of feasibility analyses[31].

[vii] A *triple net lease* (3 Net) is a lease agreement on a property where the tenant agrees to pay all real estate taxes, building insurance, and maintenance (3 Nets) on the property in addition to any normal fees that are expected under the agreement (rent, utilities, etc.). In such a lease, the tenant or lessee is responsible for all costs associated with the repair and maintenance of any common area. Vice versa a *gross lease* is a commercial lease where the landlord pays for the building's property taxes, insurance and maintenance.

[viii] In other words OOR is there is the total amount of the expenses paid by the lessee to the landlord: e.g. operating expenses, taxes and other recoveries.

[ix] Whenever the developer invests new capital in a property whether it is for a ground up development or an expansion or a significant capital improvements (e.g. renovating the lobby of an office building), he is taking several risks (construction risk, lease up risk and timing risk in particular). In order to be sure to be compensated for these risks, it is necessary to determinate the amount of potential profit from the new development. Determination of the profit requires and understanding of the value after completion of the improvements as compared to the preconstruction value.

[x] This is to some extent an interpretation of the Return on Equity (ROE) where the costs are renovation costs.

[xi] In this stylized numerical example we do not take into consideration tax risk. Tax risk is de facto strongly related to the investor's tax level, to fiscal policies and tax regimes that vary across different countries.

[xii] Investment Costs here considered count for land acquisition price, design expenses (including professional fees), interests on debt, planning fees and permits.

[xiii] Utilities, insurance and other recurring expenses.

[xiv] The weighted average cost of capital (WACC) was deflated with Fischer Algorithm, starting from the returns on Bonds Btp - 5 years, Euribor - 12 months and risk premiums determined implementing the Capital Asset Pricing Method. Details on the estimate of the WACC are available on request to the authors.

[xv] Unlevered internal rate of return.

[xvi] The present market value amounts to 7.8 Million €.

[xvii] The project's cap rate at year 5 is equal to 8.57%, and at year 6 is equal to 9.93%. At year 5 the property is partially leased and incomes are about 764,000 € while at year 6 the property is fully leased and incomes are about 885,000 €.

[xviii] This value includes 855,000 € from rent incomes and 11.8 Million € from the asset's sale value.

[xix] The maximum cap rate is the cap rate under the hypothesis that the property is fully rented, according to our forecasts.

[xx] We estimated renovation costs referring to *Prezzi e Tipologie Edilizie*[29] and to personal interviews to industry experts. We updated the costs listed in *Prezzi e Tipologie Edilizie* according to construction costs variation indexes published by the Italian National Institute of Statistics (ISTAT).

[xxi] We evaluated the costs referring to *Prezzi e Tipologie Edilizie*[29]and to industry experts. We updated the costs listed in *Prezzi e Tipologie Edilizie* according ISTAT indexes.

[xxii] We adopted the asset cap rate to capitalize the rental gain.

[xxiii] And a ratio between the lease up and the market absorption equals to1.23%.