Investment planning in the firm:

theory and evidence

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Introduction

- Steps in investment planning
- Recommended methods and research on investment planning
- Relevance for the current crisis

Steps in investment planning

- Invest in a need-to-have or an opportunity
- Calculate the profitability
- Handle uncertainty and risk
- Funding of the investment
- Decision making: Implement, postpone or discard project

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Profitable investment?

Maybe the hardest decision for a firm is to calculate the profitability of an investment project.

Discount future cash flow (DCF)

Net present value

$$NPV = -I + \frac{C_1}{(1+r)} + \frac{C_2}{(1+r)^2} + \cdots \frac{C_T}{(1+r)^T} = -I + \sum_{t=1}^{T} \frac{C_t}{(1+r)^t}$$

Decision rule/investment criteria

$$\sum_{t=1}^{T} \frac{C_t}{(1+r)^t} - I \geq 0$$

Tobin's Q-model

Tobin (1969)

$$NPV = d_t + V_t \tag{1}$$

$$d_t + V_t = \sum_{s=t}^{\infty} \left(\frac{1}{1+r} \right)^{s-t} F(K_s, L_s) - C_s^x(I_s, K_s, \chi) - p_s^I I_s - wL_s \tag{2}$$

maximise wrt. K_t, and subject to $K_{s+1} - K_s = I_s$, Obstfeld and Rogoff (1996).

This gives us the Q-model:

$$I_s = \frac{q_s - p_t^I}{\chi} K_s \tag{3}$$

Alternative investment criteria

Internal rate of return (IRR) Conceptually the same as the NPV, but here you find the discount rate given that the $NPV = 0$

Hurdle rate The required rate of return

Payback How many year, T, until $\sum_{t=1}^{T} C_t = I$ or count years until the investment is paid back

Equivalent annual annuity approach (EAA) The annualized benefit of investing in the asset

Rate of return The return of your investment

Investment criteria

Most empirical studies find that NPV and IRR is the most common method (in the US), followed by the payback rule

Graham and Harvey (2001) and Danielson and Scott (2006) find that using a DCF-method is less common among small firms than among large enterprises.

Bounded rationality might explain the use of rule of thumb. If it is cognitive hard or costly information-gathering then it is better to drop the calculation, Baker and Wurgler (2013)

A irrational manager, will become overconfindent and start taking more risk. This leads to higher investment, but might also make managers invest in the wrong projects, Baker and Wurgler (2013)

Discount rate/hurdle rate

Hurdle rate is the risk adjusted alternative cost of investing. The calculation of the hurdle rate strongly affects if your project is profitable.

Weighted Average Cost of Capital

$$WACC = \frac{E}{V} r_E + \frac{D}{V} r_D (1 - t_C)$$

Capital Asset Pricing Model (CAPM)

$$r_E = r_{RF} + \beta (r_m - r_{RF})$$

Hurdle rate - empirical evidence

Jagannathan et al. (2016) find using combination of survey and accounting data that firms report that they use a significantly higher discount rate than accounting data indicate they should.

Graham and Harvey (2001) show that about $1/2$ firms use company-wide return in estimating their WACC. Krüger et al. (2015) find firms using company-wide cost of equity instead of project cost of equity, overinvest in risker projects

The hurdle rate

It is important because

- A higher hurdle rate is associated with reduced investments
- If CAPM modelled with company wide beta – overweight of riskier projects
- Extension of the CAPM, including the Three factor model, Fama and French (1993), tries to take into account other factors than market risk in calculating the cost of equity/expected return of an asset

Which hurdle rate do firms use?

- WACC
- Bank loan rate
- Forward rate agreements (FRA)
- No model/fixed hurdle rate

Uncertainty

"*variance in the distribution of future rates of return from the project*", Carruth et al. (2000)

Rule of thumb: Invest in the project if $E\left[\sum_{t=1}^{T} \frac{C_t}{(1+r)^t}\right] - I_t \geq 0$.

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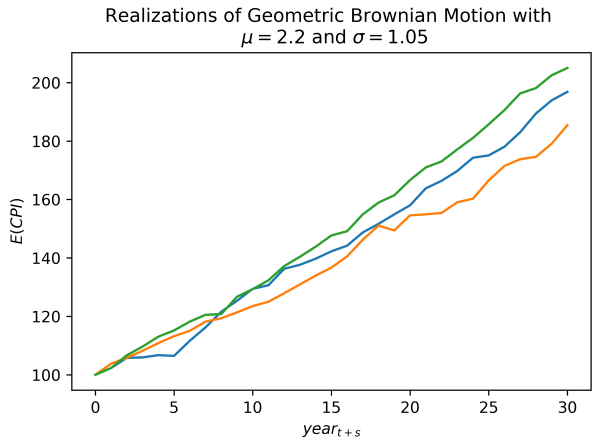
Real Options

A way to model the uncertainty of the cashflow is to let C follow a geometric Brownian motion with drift:

$$dC = \mu C dt + \sigma C dz \tag{4}$$

where μ is the drift parameter, and σ the standard deviation of C. dz is a variable that introduces randomness to the model, more precisely it is the increment of a Wiener process, Dixit and Pindyck (1994).



It can be shown the firm will take on the investment project when, the cash flow, C is equal to or greater than C^*

$$C^* = \frac{b}{b-1} I \tag{5}$$

where $b = b(\sigma, \mu, \cdot)$

The uncertainty of the future cashflow brings in a wedge > 1 which depends on the drift parameter and the standard deviation

Sensitivity analysis

A sensitivity analysis may shed light on the uncertainty

- Break-even analysis
- Stress test important variables included in the DCF-analysis (prices, costs, sales etc.)
- Scenario analysis: High/low, possible outcomes

Sensitivity analysis

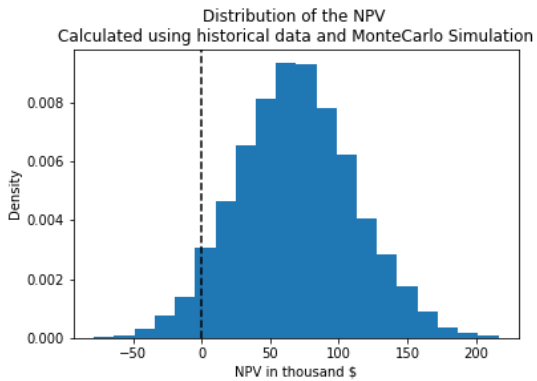
Graham and Harvey (2001) find that about 50 percent US firms use sensitivity analysis to shed light on the uncertainty of investment project.

Brounen et al. (2004) find that sensitivity analysis is less common in continental Europe (10-42 %), a finding supported by Grisar and Meyer (2015)

Grisar and Meyer (2015) study the use of simulation methods in controlling department, they find that 60 percent are familiar with the method, but it is used by about 20 percent of the firms.

MonteCarlo-analysis

- Inputs calculated using historical moments and modelled as a AR(k) with noise, then calculate NPV
- Draw new realisations of the random errors and calculate the NPV again
- Based on the estimated NPV from several simulations, calculate the mean and the variance to study the risk involved in the project



Funding and capital structure

To understand how firms should and do fund their investments one have to take into account their existing capital structure and strategies for updating their capital structure.

Firms have the choice of using:

1. Internal equity
2. Debt
3. External equity

The cost of external funding – equity and debt – is normally higher than internal funds. Reduces the share of investment funded with external funds.

Funding and capital structure

Capital structure theories

- Trade-off theory
- Pecking order theory
- Market timing theories

Baker and Wurgler (2013) study what they call the “irrational managers approach” – they argue that managers may have a behavioural bias making the managers believe that their firm is undervalued. Hence, overconfident managers prefer to fund investments with internal funding

Risk

Tversky and Kahneman (1991) highlight the importance of loss avoidance. And in Tversky and Kahneman (1992) discusses their prospect theory, which was developed based on experiments.

> *... complex problems, people employ a variety of heuristic procedures in order to simplify the representation and evaluation of prospects. – Tversky(1969)*

Olsen (1997) survey portfolio managers and individual investors, and find that the perception of risk is associated with:

1. Knowledge (-)
2. Below-target return (+)
3. Ability to control losses (-)
4. Potential for large losses (+)

Risk mitigation

If the future is uncertain, the solutions might be to mitigate the risk.

- Diversify
- Hedge

Interestingly, Doshi et al. (2018) find that large firms to a greater extent chooses to hedging to control its risk

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Decision making

Execution

- Agency problem - Conflict of interest
- Asymmetric information - Information gap between the management level

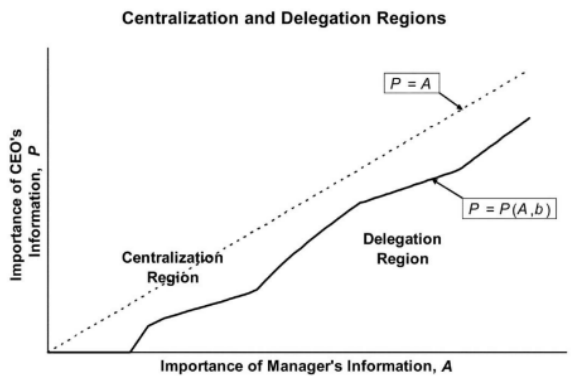

Figure 1. Regime choice as a function of A and P.

Harris and Raviv (2005) present a model for CEO delegation of investment decisions: The CEO delegates if the manager have an information advantage. And investment decisions made by the manager are smaller than those made by the CEO

Malenko (2019) argue that agency problem can be handled by dividing the investment projects based on a threshold that splits the investment into a share financed by the manager and on share financed by the top management

Roper and Ruckes (2012) suggest that one have to wait to initialize a new project when a project has been approved and funded.

Graham et al. (2015) find that “CEOs are more likely to delegate decision-making authority down through the corporate hierarchy when their firms are large or complex”

A short note on the disease control measures and the effect on investment

The typical economic crisis reduces private demand. And under normal circumstances the right fiscal policy is to increase public demand or reduce taxes and the monetary policy decrease interest rates (and increase money supply).

In this crisis, this is not enough.

Due to the disease control; firms are forced to close and customers are hindered from buying good and services. Hence, it is not possible to stimulate demand as before.

A short note on the Corona virus and investment

Now it is all about liquidity, risk, and uncertainty.

In a paper by Kang et al. (2014) the role of policy uncertainty on firm-level investment is discussed – they show that there is a significant effect of policy uncertainty on firm investment.

If they are right, then avoiding uncertainty is a key advice to policymakers. “Expectations have long played an important role in modern economics”, Gonzalez-Paramo (2007)

Draghi (2012)

> *The ECB is ready to do whatever it takes...*
> *And believe me, it will be enough.*
>
> *– Mario Draghi*

A short note of Corona virus and investment

It is time for credible measures related to disease control and economic stimulus, in order to reduce uncertainty and risk. Only then can fiscal policy motivate firms to invest in profitable projects during this crisis.

So far this is not a banking crisis, but if bankruptcies start increasing – it is of utmost importance that there are measures ready to increase liquidity in the banking sector and improve business funding.

– *15th of June the Fed announced that they will start buying corporate bonds in the secondary market*

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