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Malinvestments: a literature review and expansion over the business cycle recession

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Abstract

Malinvestments play a central role in the business cycle. However, the lack of a complete description (from the expansion to the recession) of what they go through has hampered its understanding. To address this issue this paper firstly reviews the available literature in two well-known scientific databases. It selects works that concentrate on understanding malinvestments, whether from a theoretical, capital budgeting, or corporate finance view. As they focus on the emergence of malinvestments, this paper also expands its rationale to the recession phase. This part uses the previous article's methods combined with the Austrian Business Cycle Theory. The result is an expansion-to-recession description of what malinvestments and the companies undertaking them go through. It also rearranges its content according to the chronology and fields of analysis so the reader can have a clearer understanding of the process. Finally, it concludes by detailing the importance of the adaptation to two factors systematically impacted by business cycles. The first is the change to the projects' profitability, especially the more future-oriented. And the second is the consumers' preferences.

Resumo

Os malinvestimentos desempenham um papel central no ciclo econômico. Entretanto, a falta de uma descrição completa (desde a expansão até a recessão) do que eles passam tem dificultado sua compreensão. Para abordar esta questão, este artigo primeiramente revisa a literatura disponível em duas bases de dados científicos de renome. Ele seleciona trabalhos que se concentram na compreensão dos malinvestimentos, seja do ponto de vista teórico, do orçamento de capital ou das finanças corporativas. Como eles dão mais destaque ao surgimento de malinvestimentos, este trabalho também expande sua lógica para a fase de recessão. Esta parte utiliza os métodos dos artigos anteriores combinados com a Teoria Austríaca dos Ciclos Econômicos. O resultado é uma descrição da expansão à recessão do que passam os malinvestimentos e as empresas que os empreendem. Ele também reorganiza seu conteúdo de acordo com a cronologia e os campos de análise para que o leitor possa ter uma compreensão mais clara do processo. Finalmente, ele conclui detalhando a importância da adaptação a dois fatores sistematicamente impactados pelos ciclos econômicos. O primeiro é a mudança na rentabilidade dos projetos, especialmente os mais orientados para o futuro. E o segundo é a preferência dos consumidores.

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LIST OF ABBREVIATIONS AND ACRONYMS

ABCT	Austrian Business Cycle Theory
ABEPRO	Associação Brasileira de Engenharia de Produção
AE	Austrian School of Economics
APP	Average Period of Production
CB	Central Bank
CF	Cash Flow
EVA	Economic Value Added
FCF	Free Cash Flow
FK	Fixed Capital
IR	Interest Rate
MVA	Market Value Added
NPV	Net Present Value
OMO	Open Market Operations
PV	Present Value
RB	Roundaboutness
REPO	Repurchase Agreement
ROIC	Return Over Invested Capital
TMS	True Money Supply
WACC	Weighted Average Cost of Capital
WK	Working Capital

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1 INTRODUCTION

1.1 Context

"Business Cycle" is the term used to describe the sequence of interspersed periods of expansion and recession economies go through (DICTIONARY, 2021).

The subject is of greater importance in Economics both from entrepreneurs' and governments' perspectives. To be able to better understand it and anticipate its next moves would translate into considerable benefits for both. For the first group would mean the ability to increase profits while reducing risk (KRUK, 2020). And for the second the possibility to define better policies for allegedly helping the economy to grow stabler and recover faster (CACHANOSKY; LEWIN, 2016).

For this importance, different schools of economic thought have theories over business cycles which despite having similarities are based on different premises, and thus would recommend different actions for actors trying to act accordingly. One of the schools of economic thought gaining relevance over the last decades for being able to explain the crisis mechanisms consistently for last centuries' crisis is the Austrian one (NECK, 2014). And the way it approaches the subject is through the Austrian Business Cycle Theory, or ABCT, first addressed as a coherent set of explanations by Mises and soon after by Hayek but further described by many others such as Rothbard. The later over the end of the business cycle expansion stated (ROTHBARD, 1978):

> It is only when bank credit expansion must finally stop or sharply slow down, either because the banks are getting shaky or because the public is getting restive at the continuing inflation, that retribution finally catches up with the boom. As soon as credit expansion stops, the piper must be paid, and the inevitable readjustments must liquidate the unsound over-investment of the boom [...].

Those unsound over-investments Rothbard mentions are the so-called "malinvestments". Malinvestment is a concept from the Austrian School of Economics used to describe a type of bad investment allocation motivated by an increase in money supply and the artificially low cost of capital. They are certainly not the only kind of bad investment one can make, but they are the ones business cycle cause.

It is important to note that the use of the Austrian Economics framework is not guided by blind faith or disregard for other schools of economic thought. Instead, it is the result of the author's deep admiration and perception that it has relevant contributions that deserve to be better explored by the academy. That being said, this work does not

bring a counterpoint to the Austrian views it presents because that would take away the focus from its objective. Maybe this could even become an interesting and insightful work by itself, for in contrasting opposing approaches the science can progress to more solid and truthful explanations.

1.2 Relevance and goal

This work contributes to the academic research for there are some papers describing how and why malinvestments are originated, but none of them concentrates on describing their behavior over the end of the cycle. Maybe this discrepancy in importance happens because from the macroeconomics's perspective - which is the focus of ABCT - the first moment is of more value since it helps to understand the mechanism behind cycles.

Additionally, this paper gathers the available financial malinvestments' analysis to provide a better understanding of the different phases it goes through from the perspective of an individual entrepreneur. That is not to say, though, that entrepreneurs can avoid malinvestments through this knowledge. As (HOLCOMBE, 2017) points, even knowing the mechanisms of the business cycle it is very unlikely, not to say impossible, entrepreneurs could do so.

However, an improved understanding of malinvestments can have some benefits for entrepreneurs as well, especially of their unveiling in the crash phase. Understanding what happens with those projects and the companies which undertake them might help faster and better-sustained decision-making. In this sense, this work contributes by systematizing the academic knowledge over malinvestments in the business cycle bust.

According to ABEPRO's Large Areas of Production Engineering, Production Engineering operates (among other areas) in economic management, which consists of the construction and evaluation of economic results for decision making and tools that simplify financial comparisons (ABEPRO. . . , 2009). Within this area, one of the four main topics is the analysis of investment projects. Since this work has as its main subject the analysis of malinvestments, which are a category of investment projects, it can be considered inside the competencies of the production engineering field. However, though not central to this work it is valid to consider it is related to the other two topics as well: economics and risk management.

This paper's goal is then to explore the consequences of the bust phase changes over malinvestment projects and companies undertaking them as depicted in the available literature. The expected result is a description of those projects behavior both from a theoretical and from financial point of view. It also aims to understand the capital structure impacts of undertaking malinvestments over general classes of companies.

2 METHODOLOGY

In summary, this paper is an expanded literature review of available malinvestment articles. First, it consolidates the findings of its sources, reorganizing them and pointing out how they can complement each other. Nevertheless, those papers focus mainly on the expansion phase despite having a method applicable to the whole cycle. Therefore, this work expands the source papers' rationale from the expansion to the contraction phase describing the general process — when not addressed by the original authors.

The first step to carry on the research was to investigate the academic papers available on the subject of malinvestments (in February of 2021). The search was conducted using two scientific databases: Web of Science and Scopus. In both of them the same keyword within the "Topic" field — which aggregates the title, abstract, and keywords — was used: "malinvestment". The time span was set to include all the available years, starting in 1900 in Web of Science and in 1960 in Scopus. The search returned eight results in Web of Science and thirty in Scopus - which contained all Web of Science's results.

However, many of them did not have the topic as a central part of the research. For that reason, the author read all the thirty papers' abstracts and selected the ones that had malinvestment as a central subject to be fully reviewed. This process resulted in the selection of five initial papers used for the literature review. Additionally, to enrich the sources multiple papers cited on those original articles were also reviewed, which helped to bring contributions equally as valid as the first group of papers did. Nevertheless, in most cases, those additional works had only part of their content relevant to this paper.

The next step was to review all selected articles and extract the parts the author considered more relevant parts and the methods they use to analyze malinvestments in the business cycle's expansion. The review was then reorganized so those methods could be put into blocks of analysis according to their focus.

For the reader to more easily follow this paper along, below its structure is explained detailing what composes each part:

1. Austrian School of Economics: this section briefly explains what is the Austrian School of Economics, where it came from, and what it is based upon. The depth of this revision was kept short since this part is not the focus of this work.

2. Austrian Business Cycle Theory: this is where the aforementioned selected papers' revision begins. The goal of this section synthesizes the theory and the basic concepts one would have to know to follow along with the rest of the paper.

3. Why malinvestments emerge: this section presents a summary of how malinvestments

arise, why they cannot be avoided despite being known, and their classifications as brought by the reviewed papers.

4. How malinvestments emerge: the focus here is to show how the reviewed papers use concepts from capital budgeting to describe the alterations in the macroeconomic conditions that cause entrepreneurs to make the malinvestments preferred over other investments.

5. From the expansion to the crash: using as a base one of the reviewed papers this section describes how companies undertaking investments malinvestments change over the business cycle evolution, and then summarizes it with a didactic flowchart constructed by the author.

After the review, the section of results is where this work expands the reviewed methods' application from the expansion phase to the contraction phase as well, whenever possible and not yet described by the reviewed papers. Therefore this part is a logical deduction of what happens to the malinvestments in the recession phase possible through the combination of the previously explored concepts: Austrian Theory's explanations for the Business Cycle, Capital Budgeting, and Corporate Finance.

3 LITERATURE REVIEW

3.1 Austrian School of Economics

The Austrian School of Economics (AE) originated in the 19th century with Carl Menger, Eugene v. Böhm-Bawerk and Friedrich v. Wieser. In the marginal revolution of 1871[1]Menger published Principles of Economics, its inaugural book of the Austrian School. It explains some fundamental concepts for the later development of this stream of thought such as the temporal distinction between goods of higher and lower orders and the law of marginal utility — which is a order of preference among goods, and not a measure — (MENGER, 2007), (MISES, 1998). Later, in 1890 Böhm-Bawerk describes the time-consuming nature of the production process to add value to resources in his book Capital and Interest (BÖHM-BAWERK, 1890).

AE was then further developed by more well-known names such as Ludwig v. Mises and Friedrich Hayek in the 20th century. They were the ones that began to widely employ the methodological individualism, i.e. that all actions are performed by humans, to analyze the economy and therefore all phenomena result from individual's attitudes. Through that lens they structured the Austrian view for business cycles in what is known as the Austrian Business Cycle Theory (ABCT). Later it was perfected by many other important contributors such as Murray Rothbard, Jesús H. de Soto, Joe Salerno, and Peter Schiff, to account for the changes in the financial system over the century and deepen the understanding of its parts, such as Malinvestments (BOETTKE; COYNE; NEWMAN, 2016).

First developed by Mises in 1949 (first edition of Human Action) malinvestment is a concept from the Austrian School of Economics used to describe bad investment allocation investors make lured by an unsustainable increase in money supply (M2[2]or TMS[3]) or artificially low cost of capital (MISES, 1998). As it will be later explained this causes them to mistakenly judge consumer's time preference or the availability of real resources.

And understanding malinvestments is at the core of the ABCT comprehension because their mass failure is the bust that will result in the recession. As the Austrians explain, investments that turn in hindsight not to be profitable are natural to any economy for there are many uncertainties involved in the entrepreneurial task. Nevertheless,

[1] When three authors independently described the concept of marginal utility: Carl Menger, William Stanley Jevons, and Leon Walras, (BOETTKE; COYNE; NEWMAN, 2016)

[3] M2, is a metric that tries to capture the amount of money and its high liquidity substitutes available in a country's economy, and is the most accepted metric of money supply

[3] TMS stands for True Money Supply, a measure of the amount of money inc circulation which tries to fix some of the problems of conventional money supply metrics, and is better accepted by AE advocates (SALERNO, 1987)

systematic malinvestments can only be caused by systematic price distortions, such as the artificial lowering of interest rates (MISES, 1998).

Austrians oppose to the belief some economic schools have that investment in itself without being arranged according to the market process leads to economic growth (MISES, 1953), (ROTHBARD, 2004), (CWIK, 2008); or that consumption can be incentivized to propel economic growth (HAYEK, 1966), (MISES, 1998). Nevertheless that is the policy adopted by many governments and central banks. To do so there are many ways in which modern CBs can lower the market interest rate, and most of them are through inciting commercial banks to lend more. Some of the most popular mechanisms being: (ROCHE, 2016):

- changes in the requirements of reserves, allowing commercial banks to create more credit relative to their deposits
- open-market operations (OMOs), to target a desired interest overnight rate
- repurchase agreements (REPOs), to provide banks more liquidity
- and more recently signaling, as a way to induce the market rates and bank lending

This is considered to be a problem because the lowering in interest rates it causes does not reflect real market time-preferences, i.e. the preference for present consumption over future consumption (savings). Therefore those altered prices, which are the main source of information for entrepreneurial decision-making, suggest a different use of resources from what would be sustainable without CB's intervention (ROTHBARD, 2004). That is why when those interventions cease the bust comes and a great deal of those investments turn out to be in hindsight unprofitable.

Additionally, artificially low interest rates incentivize functional companies to undertake production expansions and less efficient companies to enter the market — for now lower margins are sufficient to justify investments. The new projects, both from established companies and from entrepreneurs who only at this stage take the credit, mobilize existing resources. However, since a greater production did not precede the greater consumption resources will inevitably become demanded and their price will rise. This is the second factor which leads to the failure of malinvestments (MISES, 2008) (ROTHBARD, 2004).

ABCT has put much more effort into understanding the expansion and the crash than the restructuring that has to take place afterward before the economy starts to sustainably grow again (CWIK, 2008). However, as Rothbard himself states, the depression is a necessary phase to liquidates the unsound boom investments and re-balance consumption and investment in the proportion consumers truly desire. He also points out that the

prices need to fall until the restart of plain market relations (HABERLER; ROTHBARD; HAYEK, 1978).

3.2 Austrian Business Cycle Theory

3.2.1 An intro to ABCT

The Austrian Business Cycle Theory was developed when the world was still on a gold standard, so even though its most prominent authors (Mises and Hayek) recognized the possibility of fiat currencies when they talked about monetary fluctuations they were talking mainly about fractional reserve banking. That does not mean the theory is not valid now, rather simply they did not predict so few central bankers would have so much influence over the monetary fluctuations and therefore over the business cycle (HOLCOMBE, 2017).

When a contraction in money supply occurs, whether by fractional-reserve banks or central banks (CBs), the interest rate (IR) consequently rises for there is less money available to borrowers, a process that follows the basic law of supply and demand. The investments undertook when price signals were distorted - distorted meaning different from what they would be without those banks' interventions - which turn out to be unprofitable under the new undistorted conditions (or natural in Mises' words) are the so-called malinvestments. As Mises states about the rate of interest: "The money rate of interest and the natural rate of interest need not to necessarily coincide... [but]... it is certain that the money rate of interest must sooner or later come to the level of the natural rate of interest" (MISES, 1953).

A comparison of the beginning of the 20th century and current institutions elucidates some of the differences as it explains when endogenous causes, the ones self-contained to the system, and exogenous causes, the ones not restricted by the system, apply. In the framework of the banking institutions until the end of the gold standard, the main causes for the monetary expansion were endogenous. This happened because even though exogenous variations were possible if large gold discoveries occurred, they depended on physical gold mines being found and mined, which is not so common. So expansion would end when banks no longer wanted to reduce their reserve ratios, as expected in a scenario of uncertainty. On the other hand, the current money supply's expansion is entirely in control of central bankers and does not have physical limits. Therefore, the current fiat regime makes exogenous causes very relevant and preponderant in many cases. The problem of this change is exogenous factors generate much more uncertainty not only for investors but for all market participants. That is because even though endogenous causes are not fully predictable by investors, they are restricted by the bank's fear of getting without reserves and going bankrupt, whilst the exogenous causes are impossible to forecast or estimate by any investor without access to CB inside information. Thus it is valid to say the CBs add uncertainty to the investor's tasks of making profitable investments (HOLCOMBE, 2017).

3.2.2 Roundaboutness and Average Period of Production

First proposed by Carl Menger (1871) and better defined by Eugene Böhm-Bawerk the time and value relationship captured in the concept of roundaboutness is a fundamental concept of ABCT. It is a measure of how indirect a production process is, which is associated with greater productivity. In other words, a primitive fisherman that makes a fishing rod will not be fishing while he is doing so, but he will be more productive - meaning that he will catch more fishes with the same effort - later when using the rod instead of his bare hands. This increase in productivity results from the use of more complex production methods that produce means of production, or capital goods (the rod) before producing the final consumer good (the fish) (CACHANOSKY; LEWIN, 2016).

Böhm-Bawerk's idea of measuring the average period of production (APP) consists of an average of the distance in time from the periods to the final output emergence weighted by the labor (or other input) employed in that period, as shown in equation 3.1, where n is the total number of periods. t is an index of each period and l_t is the labor cost.

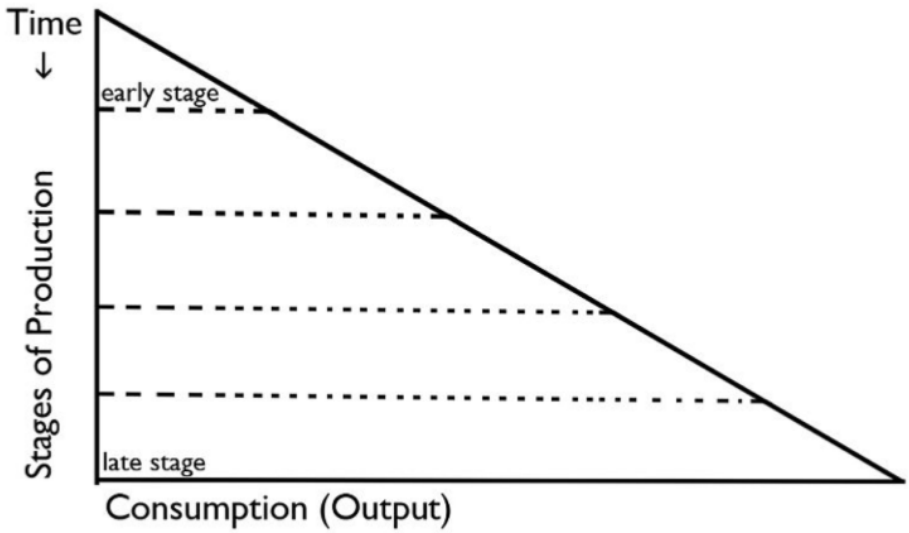
$$APP = \frac{\sum_{t=0}^{n}(n-t)l_t}{\sum_{t=0}^{n} l_t} = n - \frac{\sum_{t=0}^{n} tl_t}{l_t} \tag{3.1}$$

Therefore APP is not a measure of pure time but a measure of input-resource time. In this sense, it is important because it captures not only *what* is produced that matters but also *how* it is produced. It is important to note that the APP is not presented by the author with the pretension to be calculated and used as a real metric for it has a relevant pit-fail: the use of a physical measure (the cost of labor) as the weight. Instead, as it was later shown by Hicks, the adequate formulation is to use the added value captured by the cash flow. However, the concept is a first approach that allows for a more complete understanding of the author's propositions later further developed by the Austrians (CACHANOSKY; LEWIN, 2016).

3.2.3 The Hayekian Triangle

Hayek's triangle evolves previous ideas to conceptually depict the added value instead of the inputs used.

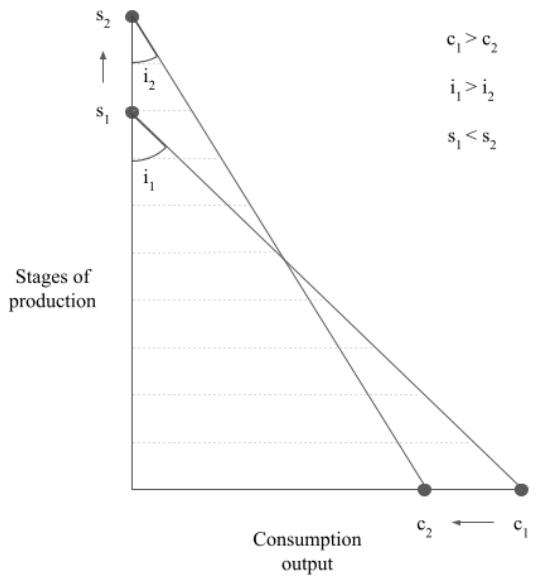
Figure 1 – Hayekian triangle



Source: public domain

Figure 1's representation has in the vertical axis the production stages which evolve over time (downwards) to reach the output to final consumers presented in the horizontal axis (in monetary volume). The width of each stage is the added value, and conceptually the slope (of the hypotenuse relative to the vertical axis) is the interest rate, which is a representation of the opportunity cost (or minimum added value required by each stage). Despite the various limitations arising from its assumptions, it is still a powerful pedagogical tool for it isolates the factors that allow the core comprehension of the relationship between consumption/savings and roundaboutness. According to the ABCT, the triangle enables one to see that a reduction in consumption (i.e. increase in savings) which leads to an interest rate decrease allows for more stages of production to be arranged. And once those stages start to add value (produce) the accumulated value at the output of consumers goods increase. The process is represented in figure 2 below.

Figure 2 – Impact of a consumption output reduction on the Hayekian triangle



Source: made by the author

A consumption reduction makes the companies adapt and reduce the consumption output from c_1 to $c2$, which allows for the interest rate (slope) to decrease from i_1 to i_2 and consequently an increase in the stages of production from s_1 to s_2.

The ABCT as proposed by Mises and Hayek depicts a production structure lengthening because lower interest rates lure investors into projects further away from consumption goods (HAYEK, 1966)

3.3 Why malinvestments emerge

3.3.1 Why malinvestments are not avoidable

The ABCT has been perfected and updated to better consider the impacts of the modern financial system by authors such as McCulloch, Horwitz, and Garrison, among others. However, there are still critics of the idea that business cycle expansions promoted by distorted interest rates will inevitably generate malinvestments, such as pointed by Tullock and Caplan. Those authors state that if that is the case investors all well should be able to realize they should not invest based upon artificially low IR, which would generate them losses (HOLCOMBE, 2017).

So, why can't entrepreneurs avoid malinvestments (unprofitable investments caused by distorted prices) knowing this theory? This is a question that deserves to be addressed in parts. In the first place, it is valid to remember the original uncertainty inherent in

entrepreneurship is still present. That is, investors can make unprofitable investments even if IR were natural (undistorted). But focusing on the question posed before, it must be said that despite the lowering of the interest rate be the most prominent case, there is no reason to believe investors can also malinvest into a shortening of the production structure (HOLCOMBE, 2017).

That is because, with nowadays financial system complexity and central banks discretionary policies, the price signal transmitted by market interest rate is rather noisy. The monetary policies degrade prices' informational content, including the IR. The problem then turns not to the IR being too low, but whether or not investors are able to perceive its distortion direction and intensity, as stated by Holcombe: "The problem is not that the market interest rate is too low, which investors should be able to perceive, but rather that monetary factors degrade the informational content of prices, including the interest rate." (HOLCOMBE, 2017).

Nevertheless, even if investors know the IR is artificially low (the distortion direction) that does not impede them from making malinvestments. Savvy investors with ABCT knowledge could invest in projects that turn out to be unprofitable in hindsight because it is not sufficient to know conditions are distorted if there is no way for them to know how they will be in the future. That is not to say all investors backed by those reasons will incur into unprofitable investments, but many wills. This impossibility can be detailed in two points.

1. The impossibility of knowing the future interest rate. Mises gave great importance to the natural (or undistorted) rate (MISES, 1998) but what investors really have to forecast is the future market interest rate, independently of it being distorted or not, because this is the rate they will face. Even though investors might know current prices are distorted, they could act assuming a future IR that is higher but not as high as it will in fact be (HOLCOMBE, 2017).

Without central bank intervention, the market IR should eventually converge to natural rates as Mises pointed out. But with CB's power to control it and the monetary base that return can be postponed for an indefinitely long period, therefore there is no way to know what the future IR will be. This brings the second point:

2. IR can stay artificially low for an indefinitely long time. Therefore it's reasonable to expect some investors will take the chance and try to get the returns before the IR rises as a way to have more profits than his competitors (HOLCOMBE, 2017). However, that is a risky endeavor. Some might even say it is riskier than a regular investment because factors manipulated by central banks such as the IR can change much more quickly than consumers' preferences.

Furthermore, the specific way by which artificially low interest rates increase

unprofitable investments is that they incentivize investments that are further away from the final consumption. That results in a longer structure of production, and since they take longer to become net profitable there is a larger time interval investors need to forecast and be prepared for. Additionally, if they use as estimation current conditions they have the risk to misjudge the money available to be lent in the future, as the interest rates are artificially low (HOLCOMBE, 2017).

Inspired by Hayek's paper "The Use of Knowledge in Society" (1945), (HOLCOMBE, 2017) points out that even in a simplified hypothetical economy where (a) all investments return a standard rate of profit if not by a distorted IR and (b) that it is only distorted by changes in the monetary base, there would still not be possible to avoid malinvestments. That is because investors might know the IR is below the real one but not by how much, since they can only observe the market rate of interest and not all the peoples' preferences for lending and borrowing money that determine the undistorted IR. So they can only guess by how much the current distorted rate will differ from the higher future one, and for how long it will remain low. In this hypothetical scenario, it is reasonable to assume some investors will forecast a future IR lower from what it will be and thus will undertake malinvestments, and others will forecast a future IR higher from what it will be, thus not undertaking profitable investments in hindsight. The conclusion is that distorted price signals, even in the simpler hypothetical scenario, introduce noise in the price signal thus increasing the malinvestments and under-investments as well.

In conclusion, the criticism that investors should be able to avoid malinvestments by knowing the ABCT does not hold because the information they would need to do so is not available to them. This is aggravated in today's financial system where CBs have the power to control the economy's IR and act as a powerful exogenous factor (HOLCOMBE, 2017).

3.3.2 Three types of entrepreneurial misjudgments

Two basic types of misjudgments lead to malinvestments: of pure interest rates (related to consumers' time preferences) and of savings volume (related to the real resources' availability). In the real world of course a malinvestment can have any portion of those two errors, however, the distinction helps the understanding of their causes and consequences. The basic differences between them are (HüLSMANN, 2021):

1. misjudgment of pure interest rates: the entrepreneur assumes the artificially lower interest rate corresponds to the undistorted people's time preference, therefore preferring to produce consumer goods (F) for a more distant future in exchange for consumer goods (P) for the present or a nearer future.

2. misjudgment of savings' volume: the entrepreneur launches projects whose resources

are not available or cannot be available on time for the project completion.

To comprehend how those two kinds of projects fail it is key to first perceive what are their differences in terms of production structure's lengthening and resources' use.

The first type of malinvestment consists of reorganizing resources to make the production structure longer and thinner, by adding more stages of production to it, but it does not change the total volume of resources used. Therefore, entrepreneurs that commit those errors sooner or later will realize their projects are not sustainable because they do not reflect people's real time preference. In other words, the investment to increase the production of goods F turns out not to be profitable for there is not sufficient demand for it - possibly requiring low or negative profit sales. The production of goods P the other hand was mistakenly reduced without changes in demand, therefore those projects now (tend to) reap greater profits than before for having a smaller offer for the same demand. It is valid to note that it requires a certain amount of time for those production structure changes to have an impact because the projects take time to be executed and in that meantime consumers' preferences can change. Should this happen in the same proportion that the resources were reorganized then there would be no entrepreneurial mistake. However, even though consumers' preferences change over time there is no reason why they should do so to accommodate precisely the changes generate by the original misjudgment. In fact, there is no a priori reason to believe such change would occur (HüLSMANN, 2021), (ROCHE, 2016). Any company that shifts its production from producing for stages further away from consumers goods fall into this category. Examples would be a company that produces clothes starting to produce the fabric for other companies, or a company that produces electronics for consumers such as notebook starting to produce industry hardware.

The second misjudgment, on the other hand, does not change the length of the production structure but maintaining the market's preferred proportion between current and future production makes them both bigger, thus increasing the volume of used resources. In an undistorted economy, a lower interest rate is the result of an abstention from consumption that increases the availability of financial resources to be borrowed as well as the physical resources to be used. However, the artificial interest rate lowering is not backed up by greater availability of resources. Therefore, when those resources are needed all entrepreneurs cannot find them available within the required time frame. That causes a surge in their prices in a moment where many of the projects needing them cannot bear the rise since they were considered profitable with the original resources' prices and not with the new higher ones. This malinvest is not avoidable in the sense there is no change in consumers' patterns or in the projects that can make them profitable. The only thing left for entrepreneurs to do is to re-evaluate their projects given the new conditions, and from a capital budgeting perspective not considering what was invested up to now but only the investments they still require and the potential revenues (ROCHE, 2016).

Examples consist of any companies increasing production motivated by greater availability of resources (usually financial) such as the clothing company expanding clothes production, or the electronics company increasing notebook's production

Finally, there is the combination of those two types resulting in what Gimenez calls the third type of malinvestment. In this case, the entrepreneur not only expands total production assuming greater availability of real resources but also orients it to the future not reflecting consumers real time-preferences (ROCHE, 2016). As imagined, the examples would be the clothing company shifting to fabric production while expanding its production, and the electronics shifting to hardware production while investing to have a greater output.

It is important to note that those types of entrepreneurial misjudgments are the ones considered cyclical. The difference between the non-cyclical and cyclical ones (malinvestments) is that while the first are made based on market signals (prices) reflecting real or undistorted consumer preferences and availability of resources, the second ones have those signals artificially distorted. Therefore it is reasonable to conclude that some entrepreneurs malinvest because they act with ignorance of the market actual conditions, i.e. they simply do not know the signals they have are altered and do not reflect real market preferences and resources' availability.

However, to assume all malinvestments are caused by ignorance of the real conditions and that entrepreneurs do not learn over time would be a mistake. It must be taken into account that they can actually learn from previous cycles and even anticipate CB policies, therefore trying to position themselves to benefit from the boom (HüLSMANN, 1998) - let's refer to those as savvy investments. Nevertheless, those savvy investments can also turn into malinvestments. That is because it gets increasingly hard for them to quantify how much of the signals are distorted as the interventions continue and the cycle goes on since their reference for the real market structure gets further away in the past and because each one of them only has access to incomplete knowledge about the total reality of the market.

3.3.3 Eleven types of entrepreneurial mistakes

Table 1 displays the classification of the 11 cases of entrepreneurial mistakes found in the literature (ROCHE, 2016). It shows how only 2 of them are caused by sheer ignorance of the business cycle by the entrepreneurs (cases 1 and 2). Of the remaining, 2 cases consider entrepreneurs misjudge despite better knowledge (cases 10 and 11). Finally, 7 of them describe situations where entrepreneurs have strategic misjudgments, whether trying to profit from anticipating the business cycle (cases 3 to 6) or by taking riskier investments (cases 7 to 9).

Table 1 – Specific Cases of Entrepreneurial Mistakes and Ensuing Malinvestments

Cases of entrepreneurial misjudgment	Description	Resulting malinvestment
1. Naive estimation of profit opportunities (Garrison 2001; Hayek 1933, 1967; Mises 1980; Rothbard 2004)	Entrepreneurs judge the CB-influenced interest rate and financial capital signals as structurally correct, and start new future-oriented projects en masse	Type III
2. Noise trading and marginal entrepreneurship (Evans and Baxendale 2008; Shleifer and Summers 1990)	As financial capital becomes more abundant and cheaper, the number of marginal entrepreneurs enabled to invest increases and includes more incompetent entrepreneurs	Types II and III, depending on the domain of activity and the nature of investment projects
3. Business cycle as strategic advantage to make additional profits (Mises 1998)	The entrepreneur sees the business cycle's expansion phase as an opportunity to make profits because of lower WACC and greater operating cash flows, thus starting an expansion of investments expected to mature before the recession	Types II (necessarily) and III, though present-oriented type II malinvestments are more plausible
4. Flexibility of the structure of production (Hayek 1939; Huerta de Soto 2006)	The entrepreneur sees the expansion phase of the cycle as an opportunity to reduce costs and diversify its range of products with either internal or external funds	Types I and III in the case of improvements and enlargement of the enterprise's current structure of production; Type II is also possible in the case of buyouts of existing enterprises
5. Cheaper working capital finance (Taylor 1995)	The entrepreneur profits from the abundant financial capital to intensify the financing of inventories and accounts receivables	Present-oriented Type II

6. Prisoner's dilemma (Carilli and Dempster 2001)	Enterprises in highly competitive markets find themselves in a non-cooperative game where first use of cheap financial capital is essential for survival	Types II and III, depending on the domain of activity and the nature of investment projects
7. Asset substitution problem (Black and Scholes 1973; Cowen 1997; Gavish and Kalay 1983; Miller 2012)	The entrepreneur uses the availability of the cheaper abundant financial capital to substitute high risk and more profitable assets for low risk and less profitable assets	Types I, II and III, depending on the domain of activity and the nature of investment projects
8. "Austrian" menu costs (Mulligan 2006)	Pre-cycle stagnating enterprises might profit from the expansion phase of the cycle to avoid switching from one project to another thanks to the cheaper abundant financial capital	Types I, II, and III, depending on the domain of activity and the nature of investment projects
9. Liquidation of precautionary assets (Lachmann 1978; Miller 2012)	Enterprises liquidate precautionary assets to invest in riskier, though potentially more profitable, present-oriented investment projects	Present-oriented Type II
10. Agency problem (Jensen 1986; Jensen and Meckling 1976)	Owners are incited to use leverage to "occupy" FCF with interest payments in order to prevent management from using the FCF to incur in empire-building or spending in perks	Types I, II, and III, depending on the domain of activity and the nature of investment projects
11. Government regulation (Hülsmann 1998)	Government regulation either forces or strongly incites enterprises to use the cheaply abundant financial capital in order to adopt risky investment behavior	Types I, II, and III, depending on the domain of activity and the nature of investment projects

Source: (ROCHE, 2016)

3.3.4 Net Present Value and Duration as a metric

The Net Present Value (NPV) is not only a popular indicator but is also endorsed by exponent Austrian economists such as Ludwig von Mises and Murray Rothbard. Its goal is to estimate the current value of future cash flows through the use of a discount factor. The positive factor used to discount future cash flows is aligned with a positive

time preference manifest - i.e. that an amount of money now is worth more than the same amount later (KRUK, 2020). The formulation of the NPV is a sum of the cash flows in each period CF_t divided by one plus the period's discount rate r_t raised to the distance in periods the cash flow is from the current period t.

$$NPV_{r,n} = \sum_{t=1}^{n} \frac{CF_t}{(1+r_t)^t} \tag{3.2}$$

It is clear from the CF's equation 3.2 that interest rate changes have a greater impact on longer projects, for the cash flows are at a more distant future therefore the factor $(1+r)$ is raised to a greater power (number of time-periods). The impact is illustrated in the classic wooden and steel bridge example expanded by (FULLER, 2013). Another important consideration when using NPV as an indicator of a project's profitability is the possibility to reinvest the generated cash flows at the same project or another one maintaining the same level of profitability. Finally, it is helpful to note that NPV tends to reflect the price of a project by the simple arbitrage process of investors competing at the market using NPV to rank their investments (KRUK, 2020).

Joanna Kruk proposes the incorporation of duration, a financial metric first developed by Macaulay in 1938, to the NPV as a way to assess the risk not measured by the NPV alone that especially longer projects pose. This risk is the one caused by the problem that at the NPV calculation cash flows are considered reliable despite being uncertain. That is, when entrepreneurs embark upon new projects they are making a forecast about consumers' demand, therefore the longer the period the harder it is to accurately forecast demands and the greater the error associated. In other words, the percentage of investments that will turn out to be in hindsight unprofitable tends to increase the longer those investments take to generate positive cash flows (KRUK, 2020). The situation is even more accentuated when considering the low interest rate is an incentive to longer and more roundabout projects - which take longer to become profitable.

This difficulty of forecasting future demands together with the changes economy goes through during the project life cycle is part of the bust explanation. In the short term projects more reliably generate profitable cash flows because the conditions are more easily predicted and the scenario has not yet suffered considerable changes - both in terms of consumers preferences and in economic conditions (e.g. resources' availability). Nevertheless, when the scenario changes and the risks embedded in the longer projects start to materialize the projects are perceived as unprofitable and the collapse begins (KRUK, 2020).

Kruk's proposed Duration D for a project with a certain $NPV_{r,n}$ lasting n periods

and having a discount rate r is given by:

$$D_{r,n} = \frac{\sum_{t=1}^{n} \frac{CF_t t}{(1+r_t)^t}}{\sum_{t=1}^{n} \frac{CF_t}{(1+r_t)^t}} = \frac{\sum_{t=1}^{n} \frac{CF_t t}{(1+r_t)^t}}{NPV_{r,n}} \tag{3.3}$$

In her own words: "The formula represents a weighted average of the stream payments, where the maturity of each payment is weighted by the proportion of the total value of an asset accounted for by the payment, so the duration, in a way, represents an average life of an asset." (KRUK, 2020).

It is possible to point out some duration's properties as a way to better understand how it can help risk assessing: (1) the duration of a project with more than one cash flow is always less than the time of the last cash flow, (2) duration is inversely correlated with the discount rate used, (3) the difference between last cash flow's time and duration is greater the longer the project and (4) the longer the project the more sensitive duration is to discount rates variations (KRUK, 2020).

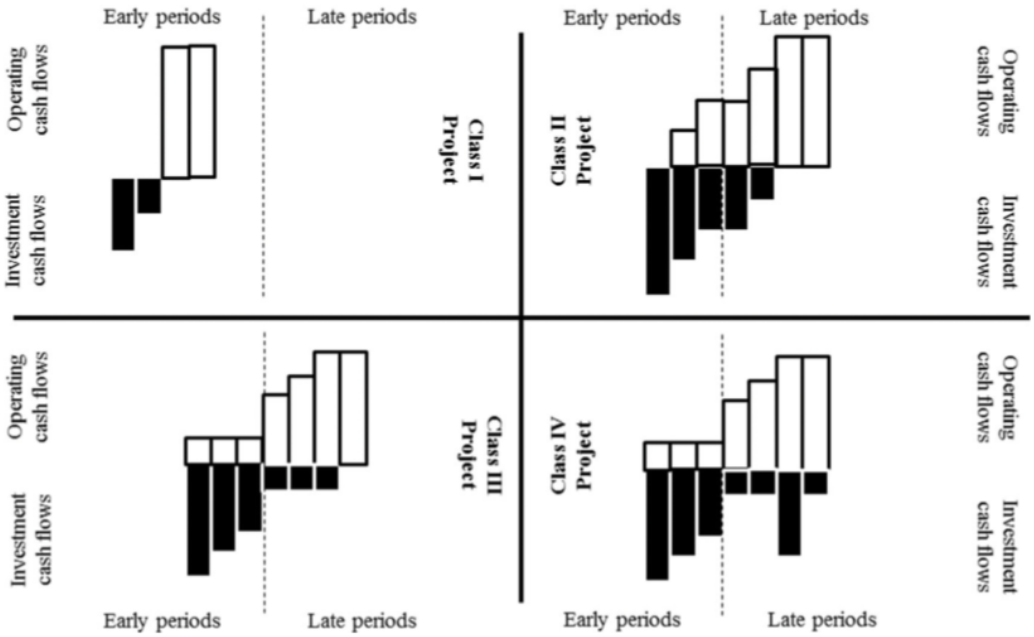
In conclusion, duration is a valid metric to assess the average period of return for present money, a shorter duration meaning the project will generate returns before. Therefore, when comparing projects with similar NPV the one with the shorter duration can be considered the safer project. Alternatively, investors can prefer longer duration (and implicitly riskier) projects if they believe interest rates will decrease because those are projects that will benefit through an NPV increment. Finally, the duration can also be seen as a project's liquidity measure as it reflects the average length of time the project takes to generate its cash flow (KRUK, 2020).

3.4 How malinvestments emerge

3.4.1 Four classes of projects according to their NPV

According to (WOOD, 1984) there are 4 general distributions of cash flow regarding their different magnitudes and temporal distances from the (expected) investments and revenues. Figure 3 presents those distributions and table 2 below details their differences.

Figure 3 – Distribution of Cash Flows Through Time in Different Classes of Investment Projects



Source: (ROCHE, 2016)

Table 2 – Classification of investment projects according to the temporal structure of cash flows

	Early periods		Later periods	
	Investment	Operating	Investment	Operating
Class I	Low to moderate	High	-	-
Class II	Moderate to high	Low to moderate	Low to moderate	Moderate to high
Class III	Moderate to high	Low	Low	Moderate to high
Class IV	Moderate to high	Low to moderate	Interspersed and high	Moderate to high

Source: (ROCHE, 2016)

The interest rate has a great influence on the methods used for calculating projects' viability. Following will be presented a review of the impacts an artificially low interest rate has on those project classes. In general terms, a lower interest rate makes more future-oriented projects' net present value (NPV) more attractive through two effects: primarily the cost of capital but also the cash flow (ROCHE, 2016).

Cost of Capital Effect: is the reduction in the cost of financing those projects because the interest rate directly affects many of the components of companies' weighted averaged cost of capital (WACC)[4]. Therefore, it leads to an under-discounting, that impacts

mainly the most distant cash flows since the rate used to discount them is now lower (ROCHE, 2016).

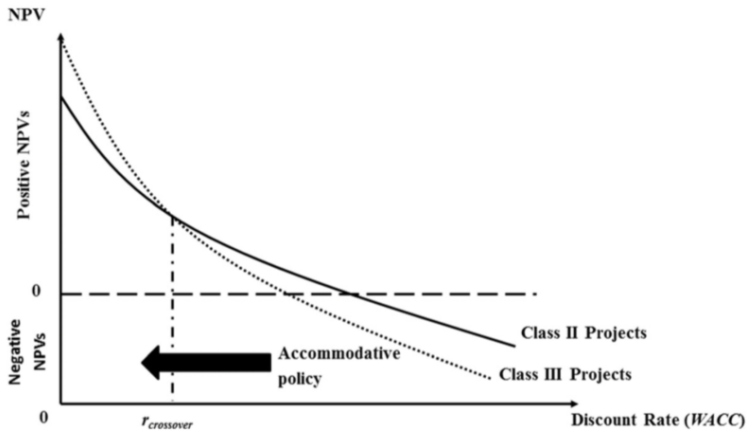
The cost of capital effect naturally impacts projects differently depending on their cash flow distribution class. Class I projects are not much affected by this effect since they are short-term. Class IV projects are affected both positively and negatively. On one hand they benefit from a lower discounting of their future operating cash flow, on the other the same happens for their interspersed investments. Therefore they can be reduced to class II or III projects depending on the magnitude of their interspersed investments. Finally, the most affected projects are class II and III. They have the most dramatic changes in their capital budgeting metric as the interest rates change, being class III projects even more benefited than class II. That is because class III projects have their positive cash flows more concentrated in a further away future, or in other words a higher duration (KRUK, 2020). However, it is not until the interest rate reaches the crossover rate that class III projects become more profitable than class II projects [4].

Regarding the types of malinvestments, the cost of capital effect can affect all three of them. Companies committing to more future-oriented projects (types I and III) tend to be more affected by a lower cost of capital since those are the projects that take longer to be profitable, but an expansion of current production (type II) even when estimating correct consumer's time preferences demands resources and takes time to be completed, therefore also are benefited from the effect.

Finally, the cost of capital effect might reduce the cost of opportunity — the base of comparison entrepreneurs have for evaluating the profitability — therefore making those projects even more attractive. That happens because as there is more money available the price of securities tends to rise, reducing their implicit return yield on the secondary market. So a lower base market rate increases the difference between itself and what the projects can return (ROCHE, 2016).

[4] A lower market interest rate can reduce the firm's cost of debt for it gets cheaper to raise money, and reduce the firm's cost of equity because a lower IR means a lower opportunity cost thus equity holders expect a lower rate of return.

Figure 4 – NPV Investment Profiles of Class II and III Projects.



Source: (ROCHE, 2016)

Cash Flow Effect: The effect is not a change in market signs in itself, but rather a feeling of over-optimism manifested in entrepreneurs and observed at the expansion phase of business cycles. The better economic scenario leads them to overestimate their future cash flows, which drives capital budgeting metrics even more profitable. There is no rule in which class of project is more favored, II or III, so this effect can push the crossover rate in any direction (ROCHE, 2016).

Both effects contribute to more attractive capital budgeting metrics as they can increase companies' profitability index and internal rate of return, and also reduce the payback period. This last one, being directly associated with risk perception, can lead cautious entrepreneurs to invest in projects with shorter paybacks, which they believe is a safer investment but in reality is a malinvestment for the conditions they base their reasoning upon are distorted (COWEN, 1997), (MILLER, 2012).

3.4.2 A quantitative approach to Roundaboutness

Later, a reformulation of Böhm-Bawerk's APP is created by John Hicks (1939). The difference relies on that he does not recur to the input's cost, but to output value measured by the market - which is much more aligned with the Austrian Economic School's principles. His formulation of market value added (MVA) is essentially a free cash flow (FCF): the sum of each period's cash flow multiplied by the period's discount factor f, which is $\frac{1}{(1+r_t)^t}$, and where r_t is the appropriate period discount rate (CACHANOSKY; LEWIN, 2016). The difference, however, is that Hicks also calculates the elasticity E of

the MVA with respect to f, for a number of periods n which is:

$$E_{MVA_f} = \frac{\sum_{t=1}^{n} f_t CF_t t}{MVA_{f_t}}, \text{ where } f_t = \frac{1}{(1+r_t)^t} \tag{3.4}$$

It is then possible to note that E apart from being a measure of the project value's sensitivity to changes in the discount rate (through f), is also a better APP. As pointed out by Cachanosky and Kicks himself, E is a measure of the average length of time for the cash flows weighted by the discounted cash flows.

Macaulay also calculates his APP (3.5), which he calls duration and is identical to Hicks's, but allows some additional insights because it segregates the CF term as the difference between the return over invested capital ROIC and the percent weighted average cost of capital WACC (which he calls EVA, for economic value added) times the financial invested capital K (CACHANOSKY; LEWIN, 2016).

$$MVA = \sum_{t=1}^{n} \frac{(ROIC_t - WACC_t)K_{t-1}}{(1 - WACC_t)^t} \tag{3.5}$$

The concepts of roundaboutness and average period of production are powerful tools to help the understanding of the ABCT. When CBs lower the interest rate artificially they incentivize a roundaboutness level above the sustainable one (given by the real resources and market time preferences). However, as interest rates cannot be kept low indefinitely, its rise reveals the investments that were thought profitable but in hindsight are not, the malinvestments (CACHANOSKY; LEWIN, 2016).

Cachanosky uses two examples to separate the dimensions of roundaboutness: (1) time and (2) capital, shown in table 3. The first example consists of three projects requiring the same capital investment, increasing length and decreasing ROICs; and the second of three projects of the same length, increasing capital investment and decreasing ROICs. In both cases, the projects of greater roundaboutness that initially had the lowest MVA (equivalent to present value) are the most benefited by the interest rate increase and become the ones high the highest MVA (CACHANOSKY; LEWIN, 2016).

Table 3 – How projects with different Roundaboutness (RB) are affected by an IR rise.

		Periods	Capital Investment	ROIC	MVA at r = 10%	MVA at r = 6%
Example 1	Low RB	5	100$	26%	61$	92$
	Medium RB	10	100$	20%	61$	116$
	High RB	20	100$	17%	43$	125$
Example 2	Low RB	10	100$	30%	123$	193$
	Medium RB	10	200$	20%	123$	232$
	High RB	10	500$	12%	61$	270$

Source: adapted from (CACHANOSKY; LEWIN, 2016)

Through those examples, he shows that projects with the same Macaulay Duration or (correctly understood) APP can have different degrees of roundaboutness and concludes that the concept depends on the combined effects of time and financial capital. It is valid to note that this conclusion is only possible through the use of the framework first developed by Hicks and Macaulay, which allows splitting those two dimensions, which is not possible through the standard FCF approach (CACHANOSKY; LEWIN, 2016).

3.4.3 A quantitative approach to Duration

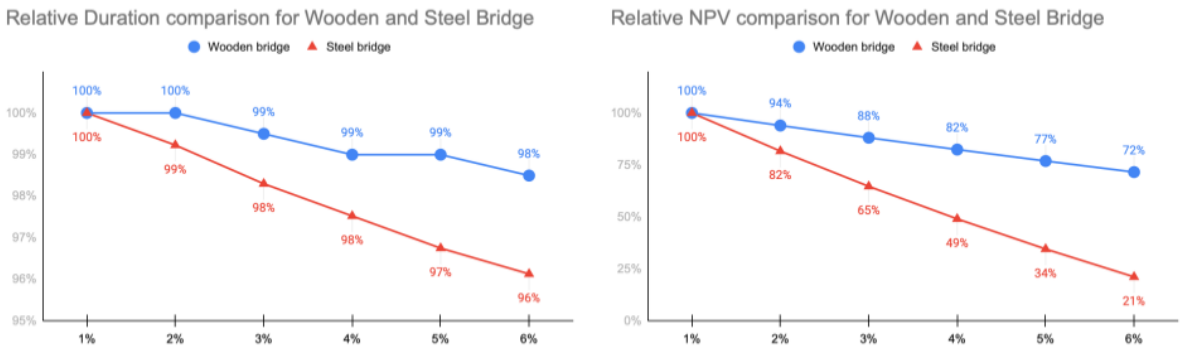
As the lower interest rate influences investors to turn to longer projects it makes projects on average riskier, as one can see for their duration's increase. By analyzing how interest rate changes can affect projects' duration and NPV it is possible to perceive the risks acknowledged by the former and not by later. Kruk shows those differences by expanding on the classic wooden and steel bridge example. The charts graphed (figure bellow can summarize the main effects of IR increases in the projects which are the decrease in NPV - obviously - and in duration, both due to an increase in the present value of closer cash flows (KRUK, 2020).

Table 4 – NPV and Duration Schedule for the Wood and Steel bridge example

	Wooden bridge		Steel bridge	
Interest rate	**Duration**	**NPV**	**Duration**	**NPV**
1%	1.99	941.0	6.45	2500.9
2%	1.99	883.9	6.40	2041.0
3%	1.98	828.6	6.34	1616.7
4%	1.97	775.1	6.29	1224.8
5%	1.97	723.2	6.24	862.3
6%	1.96	673.0	6.20	526.7

Source: adapted from (KRUK, 2020)

Figure 5 – Comparison of relative duration and relative NPV by interest rate for wooden and steel bridge examples



Source: graphs made by the author

More interesting, however, is to notice how the duration can be used to measure which projects are more sensitive to those changes even if they have similar NPVs for a determined IR. In the example above at approximately 5.48% of interest rate both projects have the same NPV. But, a raise to 7.0% causes a decrease of about 11% in the one with a 1.96 duration (the shorter) and 61% in the one with a duration of 6.22 (the longer).

Lastly, the author presents the risk-adjusted net present value, a metric that incorporates risk as measured by duration to NPV. While the details can be found in the author's paper (KRUK, 2020) it is worth noting that the combined use of different financial tools can help entrepreneurs to better assess the risk they engage in when embarking upon new projects, especially at times of cheap credit.

3.4.4 The use of fixed and working capital

Interest changes' impacts on fixed capital are much more significant than on working capital. That is because while the percentage variation on fixed capital is a function of the interest rate powered by the number of periods taken into account (the time the fixed capital will generate revenues), on the working capital it is a function of the interest rate alone (CWIK, 2008). The table below shows the present value P of both working and fixed capital, where P_{input} is the present value of the inputs, T is the turnover rate of

working capital, R is a cash flows of recurrent and identical value over all the n periods it lasts, and its percentage change when r becomes r' is P'.

Table 5 – Comparison in the present value and percentage change of working and fixed capital

	Working Capital (WK)	Fixed Capital (FK)
Present Value (P)	$P_{WK} = P_{input}(1 + \frac{r}{T})$	$P_{FK} = (R - P_{WK})(\frac{(1+r)^n - 1}{r(1+r)^n})$
% change when r → r'	$P'_{WK} = \frac{r'-r}{T+r}$	$P'_{FK} = (\frac{r}{r'})(\frac{(1+r)^n}{(1+r')^n})(\frac{(1+r')^n - 1}{(1+r)^n - 1}) - 1$

Source: adapted from (CWIK, 2008)

Therefore, from a capital budgeting perspective, the lower interest rate incentivizes companies to take projects with more intense use of longest living capital goods (fixed capital) (CWIK, 2008). This is usually the case for malinvestments types II and (especially) III since the production expansion generally demands investments that take time to mature and start to generate net positive cash flows.

After the malinvestments are built up the competition for resources drives input prices up. Central Banks have to decide to expand the money supply at a faster rate or stop it. In the first case (if successfully done) input prices will continue to rise getting closer to a real resource crunch. In the second the credit crunch will stop the expansion (CWIK, 2008).

From the capital budgeting point of view, the effects of interest rate and real resources' prices rise will again affect more the fixed capital than the working capital. However, the greater impact lies on the firm's profitability. Assuming the fixed capital is already paid upfront the present value profit is the same as the present value of the fixed capital, which is a function of the working capital expenditures, the revenues, and the interest rate (CWIK, 2008).

Finally, Cwik compares the impact of input prices and interest changes in his hypothetical project's present value to show that in a scenario of interest rate rise and input price rise, the latter is responsible for most of the project's present value decrease (CWIK, 2008).

3.5 From the expansion to the crash

3.5.1 Existing company types before the expansion

The decision of how to finance new projects can be rather complex for firms since they can finance themselves by internal capital, debt, or equity, and decide upon it by adopting different strategies such as following a pecking order or a trade-off analysis. They

also have to consider their balance sheets, valuation, expectations, and projects. That is why many firms do not take the market interest rate, but rather use their WACC as the discount rate to be considered. Additionally, the differences between types, sizes, and situation of firms cause the same signal (the lowering of market interest rate) to lead to heterogeneous investment decisions (ROCHE, 2016).

When it comes to receiving the bank credit derived from central banks' stimuli policies a distinction about the types of companies must be made for it impacts the order in which they will receive credit. The first companies to receive banks' credit are the ones more likely to pay back their loans, typically displaying positive free cash flow, strong liquidity, high profitability, good valuation ratios, and low leverage or high cover ratios. Then companies that are not so strong in those aspects follow in the line of bank's lending preferences and therefore receive credit later. In doing so banks try to target more solid companies that are more likely to pay dividends, increase their asset value, and pay back their loans, therefore maximizing the bank's gains and minimizing its losses (ROCHE, 2016). Table 6 summarizes the company types.

Table 6 – Typology of Enterprises According to Financial Situation

Enterprises	Free Cash Flow (FCF)	Liquidity	Turnover	Profitability	Structural leverage	Cover leverage	Valuation
alpha	Highly positive	High	High	Highly positive	Low (equity finanance) or high (debt finance)	High	High
beta	Negative or lowly positive but growing fast	Low but increasing fast	Low but increasing fast	Lowly positive but increasing fast	Low but increasing fast (start-ups) / High but afalling fast (existent enterprises)	Low but increasing fast	Low but increasing fast
gama	Negative or lowly positive but growing slow	Low but increasing slow	Low but increasing slow	Lowly positive but increasing slow	Low but increasing slow (start-ups) / High but afalling slow (existent enterprises)	Low but increasing slow	Low but increasing slow
delta	Positive or negative	Ambiguous	High	Ambiguous	High	Low	Increasing fast
omega	Highly negative	Low	Low	Highly negative	High	Low	Low

Source: (ROCHE, 2016)

The alpha-enterprises are the bank's first target. They are solid and have the greatest expectation to pay back their loans since they can cover their leverage through cash flow generation. Type beta-enterprises involve more risk than alpha since they have an estimated growth potential yet to be realized. They are typically promising start-ups and enterprises rapidly recovering from previous problems. Type gamma-enterprises are the ones recovering slower or not so promising start-ups. Because they represent an even higher risk they usually are only targeted by banks and investors when the expansion is already at full speed. Type omega-enterprises are the ones close to bankruptcy and therefore are very unlikely to have access to financial capital. Finally, type delta-enterprises

are which emerge at the end of the cycle. They typically have high-valued assets but a poor financial condition, for they cannot generate FCF (ROCHE, 2016).

This order, apart from being logical from the point of view of a bank or investor trying to reap the greatest profits minimizing risk-taking, is backed up by empirical findings, such as from (FRANK; GOYAL, 2003) and (FRANK; GOYAL, 2004). And it is in that order that credit spreads igniting business cycles, going from alpha, then beta, gamma, and lastly omega-enterprises.

It is important to note that banks operating in competitive markets do not decide only by themselves whether or not to make loans, they must take into account the competition as well. To illustrate this situation imagine if cautious banks afraid of defaults decide to stop lending. Then other more speculative banks which continue to do so will increase their market share at the expense of the first ones. It is only at the boom's peak that all banks become more apprehensive due to an overall slowdown in business activity and increased fear of defaults. However, since the cycle phase's changes are not easy to predict, it is not until they realize loans in their own portfolios are not performing they stop giving new loans. And this lending reduction is what terminates the boom (SOTO, 2006).

3.5.2 The expansion process

Bellow the mechanism for the ignition of business cycles based on the logical consequences of the greater availability of credit not backed up by real savings or greater production is explained. The process is organized according to the steps it takes for the credit to flow among the enterprises of each type and generate the malinvestments of each type described previously, according to (ROCHE, 2016).

1. Alphas enterprises are the ones most likely to take credit, thus initiating the business cycle.

   The ones that most use working capital see their WACC reduction as an opportunity to increase FCF. They might choose to expand production processes incurring into type II malinvestments for implicitly misjudging the availability of real resources.

   The high leveraged ones might use the situation to reduce the cost of their liabilities which positively impacts their market value. However, the cost of capital effect can lead those companies to shift from Class I and II projects to Class III. This would be a misjudgment of time preferences resulting in malinvestments of Type I and/or Type III - if the sift is accompanied by expansion.

[4] A lower WACC reduces their cost of working capital, which assuming the same revenues increases their FCF generation.

The ones with greater FCF generation having more projects than can fund with internal equity might resort to external financing. The consequences will differ but unless they resort to equity financing their capital structure will become less solid.

2. Those alphas taking scriptural credit will set the path for becoming gamma enterprises as their financial situation begins to deteriorate. The initiated projects are not producing profits (if they will at all). Therefore their liquidity reduces as their FCF decreases gradually and their debt ratios (such as coverage leverage) start to fall.

3. The expansion ignited by alphas then spreads to other sectors of the economy and their suppliers, which might be betas and gammas enterprises as well. The cash flow effect that was not so strong for them as for alphas begins to increase as they receive more orders, improve their financial ratios and approach more solid enterprise-type status. Therefore, they also become more likely to go through the same path described for alphas, given the changes are enough for this status change.

4. If the companies that received additional orders cannot meet the demand or do not have sufficient inventory they will most likely expand their production recurring to external financing. Depending on the time it takes to expand - i.e. the length of their projects' class - they will incur Type II or Type III malinvestments.

5. Once those betas and gammas use additional external financing and use FCF up, they tend to go through the same path as alphas approaching the delta enterprise status - step (2). The difference is that since they had worse initial financial ratios they tend to go through it faster.

6. The financial capital transmission also occurs via the owners of resources: labor, capital goods, and real state (resource-owners financial capital transmission channel). Since the business expansion leads to more people hired, more machinery employed, and more raw and processed materials ordered, those resource owners receive additional FCF. Whether it goes to consumption or savings, both ways it fuels the business cycle - for it continues to boost companies' FCF generation without liberation or production of real resources.

7. Once the expansion takes place upward pressure on resources' prices starts for the greater consumption incentivized by credit expansion is not supported by real savings.

8. Companies who can supply those resources are then more valued, which in turn reinforces the cash flow effect, makes them more likely to invest and take the described path to approach delta enterprises faster.

9. Another channel for capital transmission is the equity one. If the influx of financial capital is maintained the market value of enterprises, in general, tends to appreciate

as they improve their financial situation. This is especially true for those companies owing highly demanded resources, which in turn is an incentive for raising external equity. The problem in this process is that as there are, still, no real savings - for people's time preference has no reason to change - that external equity has to be provided by banks. The result is an ever-increasing bank leverage presence in the economy, as well as increased shifting of alpha, beta, and gamma into delta enterprises (MISES, 1998).

10. The malinvestments Types II and III resulting from leveraging and increasing investment on production expansion cause a competitive pressure for companies to reduce their margins at production structure's both ends. The competition for resources pressures costs upwards - because there are no real resources available as demanded - and the competition for consumers pressures prices downwards - because they have less buying power after prices are (re)adjusted (MISES, 1998).

11. This is the point where delta enterprises emerge. From the deterioration of alphas, betas, and gammas' balances, as they rely on leverage in a scenario of margins getting ever smaller, all the way to generating operational losses. So their main characteristic is ambiguity, for in one hand they have high valued assets but on the other high leverage ratios and low to no FCF.

12. The only way those enterprises could lower costs would be to increase their productivity. However, that would require investing in projects that involve even more resources, which would worsen their ration and fuel the cycle by pressuring resources' prices.

13. As banks realize companies' balances are worsening, they become less eligible for credit. The banks (and lenders in general) perceive the default threat and reduce, or even cut, financial capital supply both for being riskier and to increase their liquidity reserves.

14. The available financial capital then decreases, forcing enterprises to revisit their plans and readjust. That is the beginning of the contraction.

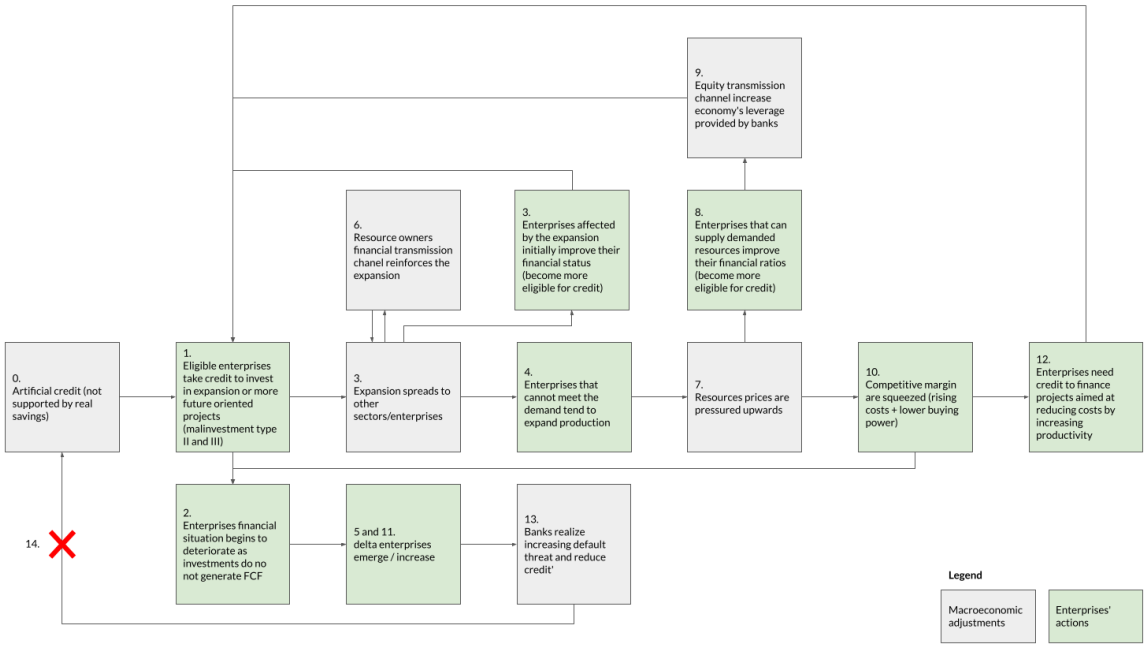
At this stage which companies will survive despite their malinvestments depends on their ability to adapt to how consumers' preferences changed during this period and to the new economy's financial situation. The bust can last for as long as central banks can expand the monetary base and maintain the market's trust in them — which as seen over the last expansions could mean periods from some years to decades. Therefore, there is plenty of time for significant changes in consumers' preferences to happen. I.e., after the expansion different products from different sectors can be preferred over the ones that were previously (ROCHE, 2016).

For alphas, betas, and gammas on those preferred sectors survival is likely. For deltas, it requires deleveraging and abandoning more costly and risky projects in favor of the profitable and safer ones. However, companies outsides those sectors also have to shift production, which besides being a significant business change requires resources. There is no rule, but the change will obviously be easier for alphas than for betas than for gammas than for deltas. Those who cannot adapt will continue to worsen their financial situation. Deltas on that path will become omegas (if they have not failed already), but there is no reason not to think even alphas could not fail (ROCHE, 2016).

Lastly, it is crucial to add two remarks: (i) because of the resources constraint and consumers' purchase power decrease (see step 11 of the list above) there is no room for all enterprises to finance the required adjustments. That is why Austrian School reinforces that some companies might succeed but all cannot. And (ii) due to preferences changes not necessarily the alpha, beta, and gamma enterprises before the expansion will be the same as the post-expansion ones (ROCHE, 2016).

The flowchart of figure 6 simplifies the process described before by making explicit the causes and the relationship among the aforementioned steps.

Figure 6 – Simplified flowchart of the boom cycle ignition steps



Source: Based on (ROCHE, 2016) and elaborated by the author

4 RESULTS

This section consists of two parts. Firstly is a continuation of the rationale described in the reviewed papers from the expansion to the recession business cycle phase, so all subsections concern this phase. Apart from the papers themselves, this part is supported by the AE's methods and concepts. The depth of this description varies depending on the depth the reviewed paper's authors addressed the recession's impact in their works.

Second, are the general results the author could collect after this research. This part focuses on findings that are not comprised in any of the previous section but still are relevant. They aim to present an overview that highlights the interconnections among the previous parts and places the entrepreneur as the central subject of the malinvestment — adopting the AE's methodological individualism.

4.1 The recession and its impacts on malinvestments

4.1.1 Malinvestment mistakes' behavior

When the crash arises each malinvestment to a certain extent suffers different consequences depending on the entrepreneurial mistakes involved. After having understood the impacts of the real resources' shortage, the mismatch between the production structures built and consumer's time preference, and the inevitable IR's rise, it is possible to distill what would happen with them, using as a reference the different entrepreneurial misjudgments from table 1. Table 7 below summarizes those consequences.

Table 7 – Recession's impact over different entrepreneurial mistakes.

Cases of entrepreneurial mistakes & possible types of corresponding misjudgment	**General behavior of each malinvest mistake in the recession phase**
1. Naive estimation of profit opportunities (type III)	Projects started over artificially low interest rate turn in hindsight to not be profitable. From a financial standpoint, they should be judged according to the remaining cash flows and current macroeconomic conditions (current NPV). Additionally, production should be reoriented according to consumers' current time preference.

2. Noise trading and marginal entrepreneurship (types II and III)	As financial capital becomes more scarce, entrepreneurs which are not able to meet consumers' demands are pushed out of the markets. This is beneficial for the overall economy as it frees up resources needed to re-adequate production structures to consumers' demands and time preference.
3. Business cycle as strategic advantage to make additional profits (type II and III)	Entrepreneurs need to re-adequate their cash flow expectations based on a weaker economy - if the investments do not mature before the recession. Hopefully, they were able to lock his WACC in the previous moment, otherwise, the investment might turn out to have a negative NPV. In this case, the investor might have to scrape whatever possible to reduce its debts.
4. Flexibility of the structure of production (types I, II and III)	Since the entrepreneur diversified its range of products based on a distorted economy, it is unlikely they will reflect consumers' preferences over the new business cycle phase. As with entrepreneurial mistake 1, the investments should be re-evaluated and production re-orientated.
5. Cheaper working capital finance (type II)	Assuming the inventory was not yet sold the entrepreneur has to liquidate goods that he cannot sell for profit. The reasons for this are the lack of demand for consumers preferences' change and the reducing buying power consumers have after the inputs price's rise. And assuming accounts receivables were not yet paid the entrepreneur has to deal with the lack of liquidity, especially prejudicial in the moment of widespread credit need.
6. Prisoner's dilemma (types II and III)	The reason why companies took cheap credit does not affect how they will have to deal with this debt or the projects it turned into, over the recession phase. Since the options are many, depending on what they did, and even if those projects are or not unprofitable in hindsight, they will have to deal with it differently.
7. Assets substitution problem (types I, II and III)	Those less profitable projects entrepreneurs preferred have their profitability reduced still, potentially going under the opportunity cost or even becoming straight unprofitable. Entrepreneurs will have to re-evaluate these projects' current NPV and liquidation might be the best decision from a financial stand.

8. "Austrian" menu costs (types I, II and III)	With the higher IR, those stagnating enterprises will not have the option to stay still and not adapt. As with previous malinvestments, they will have to adapt their production structure according to consumers current demand for different outputs and time preference.
9. Liquidation of precautionary assets (type II)	Assuming those riskier investments do not become profitable the enterprises which undertook them will, as with the other cases, have to re-evaluate them based on their current expected cash flows and cost of capital.
10. Agency problem (types I, II and III)	The FCF not saved during the previous business cycle phase can make a big difference for those companies considering the new phase is marked by a widespread lack of liquidity. Despite having lost an opportunity to buy other firms' projects at discounted prices, they will also have to face the debts generated by the projects they spent their credit on.
11.Government regulation (type I, II and III)	As with misjudgment 6, the reason why companies undertook cheap credit does not change the financial recommendations for how to deal with the debt they incurred and the potentially unprofitable projects they currently have. In this case in particular, nevertheless, it is not uncommon for those companies, because of being closer to politicians on the government, to be the first ones to be helped with subsidized credit thus benefiting from being the first takers as explained by Richard Cantillon[1]

Source: Table made by the author

Overall all those types of entrepreneurial mistakes have a similar path. They should first and foremost reevaluate their project's present value as expected future cash flows are probably not the same as they were at the expansion. This analysis might reveal the investments are not sufficiently profitable anymore and therefore should be liquidated — if only the financial viewpoint is considered. And second, the production has to be reoriented to meet consumer's demands. This is an ongoing concern of the entrepreneurial activity,

[1] The Cantillon Effect described by Richard Cantillon in the 18th century explains that when money is injected into the economy there is a disparity because the first receivers get to spend it at non-readjusted prices. However, the last receivers will be harmed because they will see their buying power decrease as the prices are readjusted before the injected money circulates in the economy and reaches them (SIEROŃ, 2019)

but it gets even more important when entrepreneurs have been systematically lured to undertake investments that do not reflect it correctly.

4.1.2 A brief comment over the Duration metric

The duration changes projects go through over the bust are very well explained by (KRUK, 2020), so there is no need to repeat her conclusions.

The only thing worth complementing though is that extrapolating her conclusion it is possible to see how an artificially low IR is more prejudicial to longer projects. That is because not only they are more susceptible not only to NPV changes but also to the uncertainties a longer time poses. The biggest difference is that while the latter is much more subjective and as described by Mises has to be determined by entrepreneurs speculative anticipation (MISES, 2008) the former can be quantified by metrics such as duration. In fact, the duration metric can show entrepreneurs that not all long projects (class III) have the same risk (KRUK, 2020).

4.1.3 Impact over projects of different NPV classes

Regarding the NPV project's classes impacts, the same way in the expansion the majority of the effects are explained by the cost of capital effect, in the recession what causes the most relevant changes can be called the cost of capital *reversed* effect. The most interesting part, however, is to analyze its consequences in the different project classes.

In the recession the opposite of the expansion happens. As the IR increases all projects' NPVs are reduced, but the less future-oriented ones (or more present-oriented) have the smaller reduction - as one can easily see in the present value formula - and become more attractive to investors. As the IR passes through the crossover rate on the contrary direction, class II projects are the ones preferred in detriment of class III.

This analysis is very simple for non-initiated projects, where Wood's classification remains unchanged. However, for projects that were started before the recession an important part of it is to assess those investments and determine which class they belong to after a certain period has elapsed. That is, they have to be classified based on the cash flows (both positive and negative) that are still expected to come and not considering the past ones.

Assuming a company started a class II and a class III projects of equal initial NPVs, it is likely that after some time has elapsed the class III project will have the greater PV. That happens for how those projects were defined:

- Class III projects have their investments more concentrated in their early periods and operating incomes over their late periods. So after the initial periods have gone

by it will no longer have most of its expenses and its expected incomes will suffer a lower discounting for they are closer in time.

- Class II projects have not so concentrated initial investments and more uniform operational incomes. Therefore, after the initial periods have gone by they will still have pending investments to be considered and some of its operational incomes will already be received.

Of course, a basic NPV calculation can decide at the very moment which project is more attractive to the enterprise. But to understand in which class they fit into and how those classes behave when the IR varies can be very helpful for them. To illustrate that one can imagine a hypothetical situation where a company has two initiated projects of the same duration and comparable PVs, one currently assessed as class II with the lower PV and the other as class III with the higher PV. In this situation the economy is receding, thus the company decides to stop one of the projects (an irreversible decision) to increase its liquidity. Considering their PV alone and assuming the current conditions will not change for the duration of those projects the logical decision would be to stop the class II project (lower PV). Nevertheless, if the company believes the IR might rise still above the crossover rate it should choose to stop the class III project instead as it is has the more distant cash flows.

4.1.4 A brief comment over the roundaboutness reduction

The impact IR's rise has on projects with different roundaboutness can be seen using the same example previously explained in table 3, just by reversing the order in which the MVAs (NPVs) are analyzed, going now from the lower to the higher IR. Therefore, it is possible to perceive that, the same way the projects with higher roundaboutness are the ones most benefited by the IR decrease, they are the ones whose MVAs deteriorate the most when the IR increases.

Conceptually, when the IR rises the roundaboutness level (the number of stages of production) tends to decrease for consumer's time preference does not allow sufficient savings to sustain such a long production process. In other words, the part of their income consumers want to spend on immediate consumption versus what they want to save for future consumption is such that the resulting availability of credit is not enough for longer production processes to use the credit they require and sell their production at a profit. This could also be didactically illustrated by Hayek's triangle by reversing the process depicted in figure 2.

4.1.5 Impact over fixed and working capital changes

Regarding the impact real resources prices and interest rate rises have on both working and fixed capital (CWIK, 2008) has already a clear representation of the outcomes.

At the moment of inputs prices' rise firms can reduce their usage of inputs and working capital. However, the fixed capital by definition is not so liquid, therefore they must reevaluate the investment. If the new situation with higher input prices and interest rates makes the investment's present value lower than the opportunity cost, strictly from a capital budgeting perspective the best decision is to liquidate the fixed capital investment. Otherwise, the firm would be losing ground to its competitors. The firms who take the liquidated fixed capital see it as an investment, and therefore pay the present value of its expected future cash flows. Because those buying firms have purchased those assets at a price that considers current market conditions (higher input prices and interest rate), the investment has a lower cost and therefore can be profitable at the current market opportunity cost. On the other hand, the firms selling the assets will incur economic losses and might go out of business. It is possible that no firm can profit from the fixed capital, in which case it would have to be scrapped to attenuate losses. However, as said before, the liquidation process is important because it allows resources to be reorganized into a capital structure that responds to the real market's (i.e. consumer's) time preference and the real availability of resources. Only then the economy can sustainably resume its growth (CWIK, 2008).

Finally, regarding the malinvestments, he presents two main conclusions (CWIK, 2008):

1. Since input prices have a greater influence on a project's profitability, an increase in interest rates without an increase in the input prices might not be sufficient to cause an economic downturn.

2. Savings are needed so the firms buying the fixed capital have the resources to do so. Nonetheless, those resources if not originated from consumer's consumption abstention but created credit will only reignite the business cycle.

4.2 General remarks

4.2.1 Types of misjudgments

Although malinvestments derived from different types of entrepreneurial mistakes suffer distinguishable consequences at the recession phase, there are underlying aspects among all of them that have to do with the basic type of misjudgment involved. In the cases involving the misjudgment of consumer's time preferences (types I and III) entrepreneurs are producing goods further away from the final consumer's consumption and will find

out the demand is lower than they thought. Thus they will need to re-adequate their production to the real time preferences. However, this "real" time preference could only be observed in an undistorted market, which is not possible in the current fractional reserve system (HAYEK, 1966).

Given that the malinvestments are unavoidable while the current fractional reserve financial system exists, one might mistakenly conclude entrepreneurs are fated to fail despite that clearly not being the case. The answer is to go back to the definition of malinvestment presented in the previous chapter, where it is possible to see that malinvestments are not the only type of unprofitable investments and entrepreneurial mistakes. The business cycle fluctuations are certainly among the most influential, but still are only one of the multiple sources of uncertainties entrepreneurs have to face. And the change both in consumers' demand for different products and in their time preference is never-ending. Thus entrepreneurs have to constantly adjust to those changes and the business cycles are one additional variable for them to deal with, and even though a more stable financial system would benefit all entrepreneurs it would not eliminate unprofitable investments.

In the cases where the entrepreneur invested in the expansion of production, he will have incurred the misjudgment of real resources availability (types II and III). Since the shortage is unaccounted for at the moment of new projects undertaking, the entrepreneur only after already having invested a portion of the required investments finds out that his margins are squeezed by an increment in inputs' costs and lower than expected consumption. At this moment there are not many alternatives for him. Of course, if the entrepreneur was able to create a business with sufficient high margins he could still maintain profitability levels above the opportunity cost. However, if his margins do fall below it the change is imperative - from a financial perspective. On all of the entrepreneurial mistakes involving this misjudgment, the entrepreneur will have to face the decision to withstand the losses supported by a strategic reason or free up the resources to attenuate losses.

4.2.2 Uncertainty over longer projects

The classes of NPV first brought by (WOOD, 1984) and further explored by (ROCHE, 2016), the Macaulay's Duration incorporated into the NPV by (KRUK, 2020), and the Roudaboutness metric presented by (CACHANOSKY; LEWIN, 2016) are all metrics that capture projects' uncertainty. The key is to perceive that by evaluating some specific factors, such as the interest rate and inputs prices, they are (at least partially) accounting for all the factors that generate uncertainty and can change a projects' outcome. Thus their contribution is to make quantifiable for decision-makers a rather intuitive assumption, which is that longer periods carry a higher risk for individual projects.

The greater takeaway for investors, entrepreneurs, and decision-makers alike is to be mindful of the uncertainties involved in projects in all projects that have cash flows

(both positive and negative) over a non-negligible time frame. They should remember all metrics are imperfect in the sense that they cannot outright indicate what is the best decision. Nevertheless, having a more complete set of metrics can provide a more complete description of the situation. Thus the entrepreneurs willing to include new and better metrics in their assessment tend to be in a position to make better-informed decisions and are more likely to endure the market selection.

5 CONCLUSION

5.1 Over this paper

Despite its acknowledged importance, to the best of the author's knowledge, there is no complete description of the malinvestments' behavior from the expansion all the way to the recession phase of the business cycle. Therefore this work serves a double purpose.

Firstly it details the available literature over malinvestments through the review of the main papers found in the two scientific databases the author could have access to. As a supplement, some of the papers cited in the first group were also analyzed, though in lesser depth. In doing so the author rearranges their content conceptually, so one can have all the required concepts to comprehend what is presented, and chronologically, so one can follow the explanation as it takes place in the business cycle. Additionally, it simplifies concepts and explanations to their core and highlights how what is proposed in different reviewed papers interconnects to form a complete view of the available ABCT financial foundations.

Then, it broadens its contribution by continuing what is proposed in the reviewed papers from the expansion to the recession phase of the business cycle. To do so it constructs over their foundation and the knowledge of Austrian Economics provided by (other) renowned authors of the field. Here again, the interconnections among the different parts are pointed out and some conclusions are presented being the most relevant ones the following:

- In the same way longer and more future-oriented projects — exemplified by projects classes (III), greater roundaboutness, and greater duration — are the ones most benefited in the expansion they are the ones that suffer the most in the recession. That can help companies assess them in periods of uncertainties, such as the business cycle phase changes, to make better-informed decisions.

- That brings the second point which is the importance of looking for ways to consider the uncertainties a longer period inherently has but that are amplified by the business cycles. Entrepreneurs must not forget that and take the expected cash flows for granted since they are only a forecast. The ones which can do it better will have more chances to succeed and stay on the market.

- Finally, there is the ongoing importance to re-adequate to consumers' time preference which is again amplified by the business cycle. As systematic central banks' interference leads to systematic (and unavoidable) malinvestments, entrepreneurs

> need to be watchful to identify when their production stops meeting consumers' demand and willing to change it accordingly (to the best of their effort).

In the end, those conclusions are a highlight of what is one of the most important of entrepreneurs abilities: adaptation. The business cycles becomes one more factor that requires adaptation as do changes in the production process (e.g. better and cheaper technologies), random factors (e.g. weather extreme events and accidents), and consumers' culture (e.g. new trends and preferences). Finally, the presented conclusions are a brief attempt to connect this paper's findings, which can be too theoretical for decision-makers, with their reality. This way it can be more relevant not only to the ones interested in Economics but with Production Engineering as well.

5.2 Next steps

Bearing in mind its limitation this paper provides a descriptive summary of malinvestments, not only theoretically but also applied to capital budgeting and corporate finance. However, there is substantial room for this paper to (i) be detailed and especially (ii) embrace more practical examples.

The former (i) could be considered by some, notably the fiercer advocates of the Austrian School, of lesser importance. That is because, according to them, a more detailed mathematical description would not elucidate new findings but only better describe what is already know. As Carl Menger himself said to Leon Walras in a letter dated 1883 (GLORIA-PALERMO, 1999):

> The object of my research is to reduce complex and economic phenomena to their true causes [...]. The results of my research may be represented by mathematical formulae. Mathematical representations nay help with the demonstrations: however, the mathematical method of representation is in no way the essential part of the task I have undertaken.

The latter (ii) is where a deeper investigation would be of greater help, especially concerning what could be useful to individual entrepreneurs. A possible continuation would be to study concrete cases of malinvestments of the types described in table 1. Of course, the study would be done after they had already happened but a *posthumous* examination could lead to interesting findings as from the financial changes and projects' evaluations it would be possible to see precisely where and why decisions were made in a concrete case.

In that case, it would be worth having a remark in mind. The point described by Holcombe and explained in this paper is that knowing what were the precise mistakes and the situations involved does not mean the malinvestments are avoidable, because the

information necessary for them to be avoided is not available to them at the moment of the malinvestment, but only after it turns to be unprofitable (HOLCOMBE, 2017).

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