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Innovation: Asymmetric information and life cycle

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Abstract

The objective of this paper is to examine how each stage of the business life cycle affects differences in growth and development, thereby necessitating an exploration of firms' innovation decisions throughout various life-cycle stages and, in turn, their signaling of debt levels. ANOVA has been employed to analyze the dataset comprising 178 observations from CPO companies listed on the Indonesia Stock Exchange (IDX) during the 2018–2023 period. The analysis identified signals of debt levels from firms transitioning from the growth to the mature stage, and from the mature to the decline stage. The existence of asymmetric information incentivizes managers to issue private signals. During the transition from the introduction to the growth stage, firms are more inclined to avoid innovation and instead replicate competitors' products, which results in the absence of debt-level signaling. In the transition from growth to maturity, firms experience cash inflows exceeding outflows, which motivates them to pursue innovation. The inherent risks associated with innovation drive firms to issue securities; thus, they provide debt-level signals as part of financing innovation. Firms in the decline stage tend to engage in drastic innovation and consequently reduce the signaling of debt levels to the market in order to keep innovation-related information private.

Keywords: Asymmetric information, Firm life-cycle, Innovation.

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1. Introduction

The presence of asymmetric information provides managers with incentives to send private signals about the firm's condition. Due to this information imbalance, managers and insiders typically possess superior information compared to external parties. Therefore, it becomes necessary for them to convey private information to the market, ultimately leading to more symmetric information. Akerlof [1] and Lofgren and Marklund [2] illustrate this concept using the example of used car markets, where sellers of high-quality cars (referred to as "plums") need to signal the quality of their vehicles to potential buyers, as sellers are more informed than buyers. In reality, buyers are often unable to fully observe the quality of the products being offered. The signaling theory Lofgren and Marklund [2] originally developed in Ross [3] emphasizes that information asymmetry can result in mispricing. Firms with high intrinsic quality may be undervalued by the market, while low-quality firms may be overvalued. The degree of asymmetric information varies across different stages of a firm's life cycle. Firms in the introduction stage generally face higher levels of information asymmetry compared to those in later stages. Firms in the growth and mature stages are more likely to engage credible auditors and leverage additional resources to pursue growth opportunities, unlike those in the introduction or decline stages [4, 5]. Accordingly, the aim of this paper is to examine how debt-level signaling differs across various stages of the firm life cycle.

Hutauruk [6] documents and describes various studies showing that oil palm plantations are prevalent in Asia and offer advantages such as requiring less fertilizer and pesticide. Additionally, oil palm cultivation uses nine times less water than other oil crops. The paper also claims that palm oil has a lower production cost per unit compared to other vegetable oils. However, the EU's anti-palm oil campaign and non-tariff barriers imposed by the US and EU governments have significantly affected the sustainability of the palm oil supply chain. As a result, there is a pressing need for innovations in production technology to support new product diversification, ensure sustainability, and enhance firm value.

Innovation refers to the process of adding value to products and creating new offerings with economic significance, primarily carried out by firms. It encompasses both product innovation and process innovation [7]. Due to existing barriers to entry in the crude palm oil (CPO) industry, firms are required to innovate, even though they tend to possess more information about their own activities. There is recognition that information is imperfect, costly, asymmetrically distributed, and influenced by the strategic behavior of agents. Within this framework, economists distinguish between two types of asymmetric information: moral hazard and adverse selection [8]. Asymmetric information refers to the concepts of hidden knowledge and hidden action, which are sources of inefficiency in resource allocation. While moral hazard arises when one party cannot monitor the actions of another, adverse selection pertains to the inability of principals to observe the private information of agents.

Since innovation is inherently tied to product development information, it has the potential to create both moral hazard and adverse selection problems. Because asymmetric information has a greater impact on innovation than on external stakeholders, firms will tend to send private signals regarding their debt levels to the market. Therefore, this research focuses on the impact of asymmetric information embedded in CPO innovation in the context of debt level signaling. Each stage of the business life cycle has implications for differences in growth and business development, making it essential to explore firms' innovation decisions throughout various life-cycle stages.

2. Literature Review

2.1. Innovation and Asymmetric Information

Ross [3] illustrates that under the assumption of asymmetric information, managers with superior information have an incentive to convey private information to the market by signaling through the choice of debt level. Firms with lower expected cash flows face higher costs of taking on debt (due to a greater risk of bankruptcy) compared to firms with higher expected returns. Similarly, Akerlof [1] notes that "lemon" sellers must bear higher warranty costs than "plum" sellers, due to the uncertainty surrounding product quality.

Leland and Pyle [9] propose an alternative signal of firm quality through insider ownership. Managers of high-quality firms signal their confidence by retaining a larger ownership stake, in contrast to managers of low-quality firms. Thus, insider ownership in firms with high expected returns serves as a credible signal, communicated through both debt level choices and ownership retention, whereas firms with lower expected returns lack such incentives.

When one party has superior information over another, this asymmetry may result in mispricing during external financing. Securities issued by high-quality firms may be underpriced, while those issued by low-quality firms may be overpriced. On one hand, bondholders and stockholders may be concerned about dilution of ownership due to undervaluation; on the other hand, potential investors fear overpaying for overvalued securities.

There are two out of three key issues concerning asymmetric information and innovation management. The first is contracting for innovation; the second is financing innovation; and the third issue, developing innovation, represents a compromise between the two [10]. The perspective on contracting for innovation is based on agency theory [11], which views an organization as a nexus of contracts among various parties. A contract serves as an instrument that acts as a mediator within the firm and between firms, forming the basis of corporate governance. Contracts exist between the firm's management and other stakeholders, including suppliers, debtholders, and stockholders. The authors explain that contractual relationships among these parties require enforcement because management possesses superior information about the firm compared to other parties, resulting in asymmetric information.

Since innovation is a private process within the firm [12] in which internal parties are more informed than external ones, signaling mechanisms to the market are needed to reduce the impact of asymmetric information. Firms engaged in radical or drastic innovation have incentives to conceal information about their activities in order to protect against imitation and to fully exploit their commercial rights. Conversely, firms with lower levels of innovation tend to disclose

more information compared to those with radical innovation. Clearly, contractual enforcement related to innovation, such as patents or research and development activities, is more necessary in firms with radical innovation to reduce asymmetric information and the problem of adverse selection.

According to the perspective of Ross [3], firms that undertake radical innovation need to provide stronger signals of their debt levels compared to firms with lower levels of innovation in order to reduce the problem of adverse selection. The first hypothesis is that firms with radical innovation tend to have less incentive to signal their debt level to the market, indicating a negative relationship, in order to preserve private information about their innovation activities. The financial innovation perspective explains that under the assumption of a perfect capital market, research and development activities generate asymmetric information between the firm and investors, leading to market failure. The study by Aboody and Lev [13] describes how the unique characteristics of research and development investment allow external parties to better understand and evaluate the productivity and value of a firm's research and development compared to other firms, thereby contributing to asymmetric information. This situation requires greater contractual enforcement than in firms that do not engage in research and development.

The paper by Stiglitz [14] examines the phenomenon of credit rationing in capital markets as a result of asymmetric information. The author explains that banks may prefer to reject certain borrowers due to the negative effects of the adverse selection problem. For specific types of collateral, an increase in interest rates leads to adverse selection, as only borrowers with riskier investments will apply for loans with higher interest rates. Consequently, charging higher interest rates creates incentives for investors to select projects with a higher probability of default. In this context, firms with superior information and greater levels of innovation might be tempted to retain the returns from their projects and default on their debt. When such contractual risks are recognized, lenders tend to reduce the negative impact of asymmetric information by prioritizing credit for innovative firms, particularly those holding patents or other indicators of feasibility.

The second hypothesis is that firms engaging in innovation have incentives to disclose more information, in other words, to signal a higher level of debt compared to firms without innovation, indicating a positive relationship. This strategy aims to reduce asymmetric information in situations where external funding is needed. The perspective of developing innovation refers to the creative combination of resources to generate greater value. Innovation opportunities arise in situations where new products, services, raw materials, or methods can be introduced, thereby enhancing the value of the product compared to its previous state [15, 16]. Firms can exploit innovation opportunities due to differences in information among individuals and between organizations.

Asymmetric information can serve as a positive source of energy for innovative firms. The worse the quality of information in the market, the greater the opportunity for firms to leverage it as a competitive advantage. Since the firm holds private information that is not available to external parties or the market, it can exploit that information as a source of monopolistic strength. According to David and David [17], several benefits arise from holding innovation-related information. These include patent protection, copyrights, maintaining proprietary knowledge, selectively distributing information, and strategically timing the disclosure of information. This reflects a controlled approach to managing information about the characteristics of innovation in order to mitigate competitive threats and ensure sustainable profitability. The third hypothesis is that innovation, as a producer of asymmetric information, does not send signals to the market.

2.2. Signaling and Firm Life-cycle

The level of debt has long functioned as an important signaling mechanism used by firms to convey their growth prospects. While issuing debt can send a positive signal about future opportunities, it can also be interpreted negatively by the market as an indication of increased default risk. From the perspective of the firm life cycle, the need for signaling varies across different stages. Each stage requires different types of signals to address varying degrees of information asymmetry and growth potential [18]. According to Dickinson [19], the firm life cycle consists of four stages: introduction, growth, maturity, and decline. the transition between these stages is nonlinear, and studies have found that stock price reactions, dividend policy, profitability, growth, and debt policy differ across each stage of the life cycle.

Each stage is characterized by unique factors. These include strategic orientation, resources, and the competitive environment, all of which shape organizational structures, systems, and agency problems, thereby influencing the process of information disclosure [19]. This dynamic provides a basis for comparison across firms at different stages of the life cycle. Firms in the maturity stage typically have well-established organizational structures, stronger internal controls, and more skilled employees, all of which facilitate the preparation of high-quality financial reports. Furthermore, stable cash flows and profitability enable managers in mature firms to forecast future revenues and expenses more accurately, enhancing comparability with industry peers.

Firms in the introduction and growth stages may also have incentives to produce financial reports that are comparable to those of mature firms. However, they tend to face more severe asymmetric information problems and limited access to external funding. These firms often operate with underdeveloped accounting systems and weaker internal controls, which act as barriers to effective information disclosure. More specifically, internal inefficiencies, technological obsolescence, and the erosion of products, business concepts, and managerial strategies can prevent these firms from allocating resources to build robust accounting systems. Consequently, firms in the growth and maturity stages are likely to experience lower levels of information asymmetry compared to those in earlier stages. Growth opportunities are also more predictable for firms in the growth and maturity stages [20].

Signaling theory clearly focuses on the existence of asymmetric information between two actors, where one party possesses more information than the other. A signal is a characteristic of a market participant that is intentionally or

unintentionally conveyed to the market, with the objective of altering market perceptions. In turn, the market interprets and responds to these signals.

3. Research Method

This study adopts a quantitative research approach using a descriptive and causal-comparative research design to investigate how debt-level signaling varies across different stages of the firm life cycle. The research focuses on companies engaged in the crude palm oil (CPO) industry that are listed on the Indonesia Stock Exchange (IDX) during the period 2018 to 2023. The sample consists of 178 firm-year observations, selected using a purposive sampling method based on the availability of complete financial data and consistent listing during the observation period. Secondary data were obtained from audited financial statements, company annual reports, and IDX official records. Key variables include firm age, total debt, total assets, and other financial indicators relevant for classifying the life cycle stage and analyzing debt-level signaling behavior. To categorize firms into life cycle stages, the study employs the model developed by Abuhommos [21], which classifies firms into four stages: introduction, growth, maturity, and decline. The classification is based on a quartile analysis of firm age, measured by the number of years each company has been listed on the IDX. This proxy is used in line with previous studies that link firm age to developmental stages. The analysis proceeds with descriptive statistics to summarize the characteristics of firms in each stage, followed by analysis of variance (ANOVA) to test for statistically significant differences in debt-level signaling behavior across the life cycle stages. This enables the identification of patterns and variations in how firms utilize debt as a signaling mechanism depending on their stage of development.

4. Result and Discussion

We classify firms into four life-cycle stages: introduction, growth, maturity, and decline. Table 1, Panel A shows that across all stages, the majority of firms (more than 50% of the total observations) have a debt-to-equity ratio (DER) below the average. In the introduction stage, the average DER is 1.12, and more than 50% of firms in this stage have a DER below 1.12. The presence of asymmetric information encourages managers to send signals to the market through debt levels, evidenced by the fact that in some cases, debt exceeds equity. However,

Table 1a.
Descriptive Statistics of Debt-to-Equity Ratio (DER) Across Business Life Cycle Stages.

Independent: DER	Introduction	Mature	Growth	Decline
Panel A				
N-Obs	45	44	44	45
Min	0.138	0.1	0.0004	0.1
Q1	0.71	0.6425	0.8875	0.345
Mean	1.12	1.25	3.06	0.99
Median	1.09	1.069	1.59	0.79
Q3	1.4	1.6	2.3	1.45
Max	1.81	2.96	4.94	3.65

Table 1, Panel B, indicates that firms in the introduction through mature stages do not appear to send strong debt signals, even though these stages are typically characterized by higher levels of asymmetric information [18].

Firms tend to prefer internal financing over external sources to minimize the risk of mispricing by the market, which can occur when issuing either debt or equity. Clearly, firms favor internal funding due to its lower sensitivity to market perception compared to external financing. From the mature to growth stage, average debt levels increase (to 1.81), but then decline sharply from the growth to decline stage (by -2.07). Firms in the mature to growth transition are likely to estimate growth opportunities and, in response, signal their quality by increasing debt levels [22]. However, as firms age, particularly newer entrants to the industry, growth opportunities tend to diminish. As a result, these firms reduce their debt levels or shift toward issuing equity, especially when internal funding becomes limited.

Table 1b.
Descriptive and Analytical Statistics.

Independent: DER	Introduction	Mature	Growth	Decline
Panel B				
Mean Difference		0.13	1.81	-2.07
t-test		0.45076	0.025*	0.011*
F-value	6.060*			

CPO firms in the introduction to the mature stage do not send signals regarding debt levels. They are in the early stage and have less effective corporate governance than those in the later stage. After sending private information to the market, they may engage in moral hazard behavior [23].

An interesting finding is that the presence of asymmetric information at each stage of the life cycle significantly influences the issuance of securities, as indicated by an F-test result of 6.060. Ross [3] predicted that asymmetric information can be mitigated if firms, particularly managers, send signals regarding their level of debt. Innovation is a

unique process that is better understood by the internal parties within a firm compared to external ones. Therefore, it becomes necessary for firms to disclose information related to debt levels to the market as a way to signal that the firm possesses growth opportunities through innovation.

The transition from the introduction stage to the growth and maturity stages does not significantly impact the signaling of debt levels. During this phase, firms experience cash outflows exceeding cash inflows, limiting their capacity to invest in innovation. Crude palm oil (CPO) firms in this transitional phase tend to replicate processes and product innovations due to limited resources. In contrast, during the transition from the growth to the maturity stage, firms begin to generate more cash inflows than outflows. At this stage, there is a need to finance innovation, and firms are required to send debt-level signals as a mechanism to reduce asymmetric information. By this stage, firms generally have more available resources than in the introduction phase. During the transition from maturity to decline, firms often engage in contracting innovation by implementing drastic innovations to maintain their industry position. These innovations are typically unique, and firms have incentives not to disclose details of innovation management to the market in order to prevent imitation by competitors.

Thus, asymmetric information plays a dual role. On one hand, it increases transaction costs and contributes to market failure; on the other hand, it creates market opportunities and provides incentives to develop innovation through the creation of new ventures. The first approach views asymmetric information as a form of market failure, requiring specific arrangements for the financing of research and development activities, the allocation of control among stakeholders (such as inventors, funders, and users), or the distribution of ownership rights [24].

In this view, information is assimilated into a tradable commodity through market mechanisms, compelling stakeholders to negotiate contractual arrangements aimed at reducing transaction costs. The second approach considers asymmetric information as a primary source of competitive advantage. This perspective emphasizes the role of asymmetric information arising from differences in individual knowledge and cognitive abilities. In this context, asymmetrically distributed cognition becomes the primary source of differentiation among individuals, enabling certain individuals or organizations to create, identify, and exploit business opportunities.

5. Conclusion

Signaling theory Ross [3] originally introduced by Akerlof [1] is evident across different stages of the firm life cycle, particularly in the transitions from maturity to growth and from growth to decline. When firms move from the maturity to the growth stage, they typically possess stronger expected cash flows and signal their quality to the market by increasing their level of debt. These firms have both the capacity and the capability to generate expected returns that exceed their debt obligations at maturity. However, as firms enter the decline stage, they tend to reduce their reliance on debt financing in pursuit of operational efficiency. The signal sent to the market is a reduction in bankruptcy risk, which reflects declining expected cash flows and leads to a lower level of debt. During the transition from maturity to decline, firms have incentives to reduce the disclosure of debt-level information to the market. This strategy is intended to prevent competitors from replicating their drastic innovations.

Clearly, there are significant differences in debt-level signaling across the stages of the firm life cycle. In the early stages, firms face higher levels of asymmetric information and resource constraints. Dickinson [19] explores how firms at this stage typically experience cash outflows that exceed cash inflows, which reduces their incentives to engage in innovation. This, in turn, implies that signaling of debt levels is not undertaken, as there is little or no innovation to signal.

The transition from the growth to the maturity stage involves the financing of innovation. Since firms in this stage experience cash inflows exceeding cash outflows, they begin to invest in innovation to enhance their competitiveness within the industry. These innovations, while not necessarily drastic, are disclosed to the market. The purpose of this disclosure is to reduce asymmetric information, thereby enabling the firm to access external funding. In the transition from maturity to decline, firms adopt a contracting innovation strategy. At this stage, they aim to sustain their position in the industry and often engage in drastic innovation. However, they deliberately withhold information regarding such innovation from the market, resulting in lower levels of debt signaling.

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