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Analysis of Profit Projected Value Due to the Effect of Price Escalations on Construction Projects: Case Study of Ameroro Dam Project, Southeast Sulawesi

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ABSTRACT

This study examines the impact of commodity price escalation—particularly fuel and reinforcing steel—on contract value adjustment and profit margins in long-term construction projects, using the Ameroro Dam Package I (Southeast Sulawesi) as a case study. The main hypothesis tested is that different price indices (the Wholesale Price Index from BPS vs. Pertamina's Economic Index for diesel fuel) yield significantly different contract adjustment projections. A quantitative analysis was conducted through: (1) processing the Bill of Quantities (BoQ) and project cost estimate (RAB), (2) calculating escalation factors based on contract coefficients for fuel and steel, and (3) simulating two projection scenarios: Projection I used BPS indices for both steel and diesel, while Projection II used Pertamina's index for diesel and the BPS index for steel. Escalation scenarios were modeled from 0% to 100%. The results indicate contract adjustments of IDR 15.55 billion (Projection I) and IDR 44.85 billion (Projection II) under the 100% escalation scenario, equivalent to increases of about 2% and 4%, respectively. Pertamina's index produced higher and more realistic adjustments, aligning more closely with field conditions. The findings confirm the hypothesis that the choice of price index significantly affects profit projections in construction projects. It is recommended that multi-year contracts adopt more responsive indices, such as Pertamina's, to mitigate the risk of negative profit margins.
Keywords: *price escalation, bill of quantities, Pertamina economic index, BPS wholesale index, profit margin.*

Abstrak

Kontraktor Indonesia menghadapi tekanan akibat efek domino dari perang Rusia–Ukraina yang memicu lonjakan harga komoditas, termasuk material konstruksi. Inflasi yang tinggi dan kenaikan harga bahan bakar juga berdampak pada PT Wijaya Karya (Persero) Tbk (WIKA). Perusahaan BUMN karya tersebut meminta kepada pemilik proyek untuk melakukan penyesuaian harga kontrak. Pemerintah telah memberikan lampu hijau terkait usulan penyesuaian harga atau eskalasi kontrak untuk proyek infrastruktur yang berjalan pada tahun anggaran 2022. Berdasarkan latar belakang tersebut, penelitian ini merupakan kajian mendalam untuk menganalisis proyeksi keuntungan akibat pengaruh eskalasi dengan studi kasus Proyek Bendungan Ameroro, Sulawesi Tenggara. Strategi penelitian yang digunakan adalah studi literatur dan analisis data Rencana Anggaran Biaya (RAB) Proyek Bendungan Ameroro di Sulawesi Tenggara, yang mencakup: (i) data *Bill of Quantity*, (ii) data Analisis Harga Satuan Pekerjaan (AHSP), (iii) daftar harga material, dan (iv) daftar harga upah kerja. Selanjutnya dilakukan proyeksi nilai penyesuaian dengan proyeksi I menggunakan nilai indeks harga BPS dan proyeksi II menggunakan indeks harga ekonomi Pertamina. Hasil penyesuaian pada proyeksi I sebesar Rp15.548.548.165 dan proyeksi II sebesar Rp44.854.254.042. Dari hasil penyesuaian tersebut diperoleh peningkatan nilai kontrak proyeksi I sebesar 2% dari nilai kontrak menjadi Rp1.016.698.604.665, dan peningkatan nilai kontrak proyeksi II sebesar 4% dari nilai kontrak menjadi Rp1.046.004.310.542. Berdasarkan data proyeksi, terdapat perbedaan nilai harga penyesuaian, dan dapat disimpulkan bahwa data indeks yang digunakan lebih mendekati dengan menggunakan data indeks ekonomi Pertamina.
Kata kunci: Eskalasi, Analisis Harga Satuan Pekerjaan, Industri Bahan Bakar, Baja Tulangan

1. INTRODUCTION

The conflict between Russia and Ukraine has had a significant impact on the global energy market, which experienced price volatility from 2020 to 2022. The conflict has also affected the resilience of global energy commodities and the growth of the world economy. One of the global energy commodities affected by the conflict between Russia and Ukraine is oil. The Russian invasion of Ukraine has not resulted in a total loss of oil supply to the market, but there has been a significant spike in prices. According to data from SKK Migas, crude oil production in Indonesia is around 700,000 barrels per day. Meanwhile, crude oil consumption reaches 1.5 million barrels per day. As a result, crude oil needs to be imported to meet domestic demand (Wicaksana, 2022).

Indonesian contractors are currently facing pressure due to the ripple effects of the Russia-Ukraine war, which has triggered a surge in commodity prices, including construction materials. Consequently, contractors are at risk of not being able to continue projects that have already been signed. This is because the contracts still include the old prices (Yanwardhana, 2022).

High inflation and rising fuel prices also have an impact on PT Wijaya Karya (Persero) Tbk (WIKA). The state-owned construction company is requesting contract price adjustments from project owners. WIKA is taking steps to accommodate price increases or new prices for multi-year projects, even if the payments will be made later (vap, 2022).

The government has given the green light for proposed price adjustments or contract escalation for infrastructure projects running in the 2022 fiscal year. This is reflected in the Ministry of Finance Letter Number S-940/MK/2022 regarding the Ministry of Finance Regulation (PMK) proposal for price adjustments (escalation) in construction work contracts for the 2022 fiscal year due to the increase in the prices of fuel oil (BBM) and asphalt, at the Ministry of Public Works and Public Housing (PUPR). The issuance of the letter is a follow-up to the letter from the Minister of PUPR Number HK.0102-Mn/2154 sent on October 26, 2022. The letter states that based on the results of the coordination meeting between the Ministry of Finance, the Ministry of PUPR, and LKPP at the LKPP Building on November 7, 2022, the proposal will be processed by LKPP (Ridwan, 2022).

Previous studies on cost overruns and cost escalation in construction projects show that fluctuations in material and fuel prices are among the main causes of cost swelling (materials price fluctuations) as well as extra work (variation orders, rework, redesign). For example, research in Indonesia by Susanti & Nurdiana (2020) found that material price fluctuations are

one of the 15 most influential factors causing cost overrun. Another study in Malaysia (Shehu, Endut, Akintoye, Holt, et al., 2014) reports that public construction projects often experience cost overruns due to overly optimistic initial estimates and a lack of management of material/commodity price fluctuations. In Asia, Andrić, Mahamadu, Wang, Zou & Zhong (2019) in The Cost Performance and Causes of Overruns in Infrastructure Development Projects in Asia found that besides technical and project-management factors, external risks such as regulatory changes, inflation, and unstable material prices also strongly affect project cost performance. However, there is still limited empirical research specifically comparing national price indices (such as IHPB BPS) with indices specific to fuel pricing (such as the Pertamina Economic Index) within large infrastructure projects in Indonesia.

Based on the background above, this research is an in-depth study to further dissect and discuss the analysis of profit projections due to the impact of escalation reviewed in the Ameroro Dam Project in Southeast Sulawesi. The research focuses on the influence of price escalation on material prices.

2. RESEARCH METHODS

The research stages are designed to determine why this research needs to be conducted and to address the research problem that arises. According to Kumar (2011), the research process consists of three phases with several steps within each phase:

a. The first phase is the phase to decide what will be studied, where there is a step to identify phenomena and issues. After understanding what will be studied based on the existing problems, a research design that aligns with the intended research objectives will be developed.
b. The second phase involves planning the research study by conceptualizing the research methodology. The conceptualization of the research methodology will be useful in determining how to obtain answers to the research problem that has been identified. The next step is to collect data by constructing research instruments.
c. The third and final phase is conducting the research. The steps from the previous phases will be carried out in this phase, including data collection, analysis, data processing, and drawing conclusions. In this research, a research flowchart has been conceptualized to ensure that the research is conducted effectively. Below is the flowchart of the research stages that have been prepared for conducting the research.

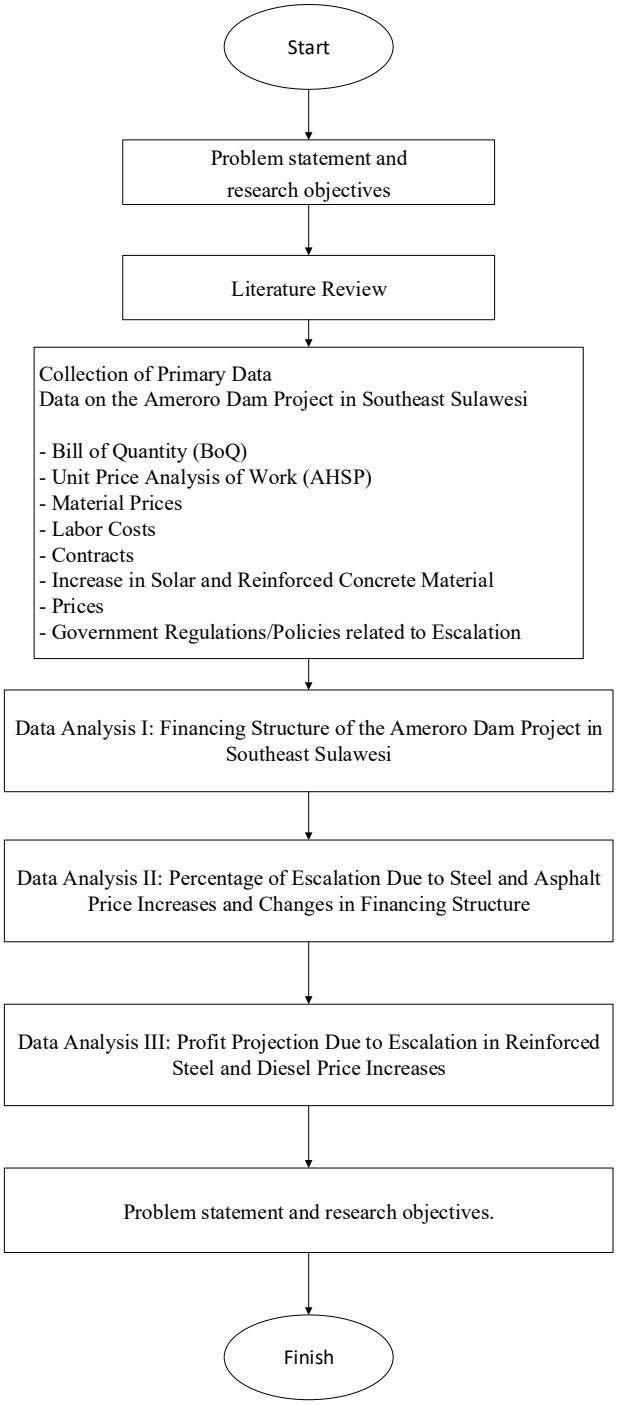

Figure 1. Research design

3. STUDY RESULTS AND DISCUSSION

3.1 Data Analysis

Identification of work items that use iron and diesel fuel involves the creation of a Cost Breakdown Structure (CBS) chart. This chart is used to determine the weight or significance of work items that involve the use of reinforced iron and diesel fuel.

Table 1. Cost Breakdown Struktur

NO	Job Description	Addendum - 4		Diesel and Iron
		Total Cost Rp	Precentage %	Precentage %
I	Preparatory Work	149.657.660.167,51	16,351	0,084
II	Spillway Structure	167.044.165.637,13	18,251	2,753
III	Main Dam	564.564.142.529,3	61,682	97,110
IV	Intake Structure	11.540.227.191,89	1,261	0,053
V	Safety and Construction Management System Maintenance	30.183.500.00	0,330	0,000
VI	Museum and Observation Deck Area	19.456.519.197,69	2,126	0,000
Total		915.281.064.724	100	100
PPn = (11% x A)		98.477.425.195		
Total Amount		1.013.758.489.918		
Rounded		1.013.758.489.000		

3.2 Calculation of Escalation

Based on the primary and secondary data obtained, several price adjustment projection calculations can be made. These projections are conducted with the volume of work from the beginning of the contract to the end of the project. The projections include:

a. Projection 1 uses price indices from BPS for iron and solar items with escalation simulations of 0%, 20%, 40%, 60%, 80%, 100%.
b. Projection 2 uses the price index from BPS for iron and the economic price index from Pertamina for solar items with escalation simulations of 0%, 20%, 40%, 60%, 80%, 100%.

3.3 Calculation of Projection 1

The purpose of this projection is to determine the amount of price adjustment for solar and iron in the volume of work of the Ameroro Dam Construction Project Package I using the price adjustment calculation method applied in the contract documents of the Ameroro Dam Construction Project Package I. This allows us to determine the magnitude of the price adjustment.

This projection is calculated with the following data:

a. Quantity of work (progress volume) for Ameroro Dam Package I from the beginning of the contract to its end.
b. Price indices from the Indonesian Wholesale Price Index published by BPS for the years 2021 and 2022 and a simulated index for 2023 based on the increases in 2021 and 2022 for the solar item.

c. Price indices from the Indonesian Wholesale Price Index published by BPS for the years 2021 and 2022 and a simulated index for 2023 based on the increases in 2021 and 2022 for the iron item.
d. Coefficient data for contract components for the group activities of the Ameroro Dam Construction Project Package I.

The calculation of the price adjustment value in this simulation is as follows:

a. All work items in the Ameroro Dam Construction Project Package I are considered.
b. The coefficient values for each group activity are inputted into the solar and iron columns based on the contract document.
c. The zero indices for the solar and iron columns are determined from the data indices from the Indonesian Wholesale Price Index published by BPS for the years 2021 and 2022.
d. The current indices are determined using a simulated index for 2023 based on the increases in 2021 and 2022.
e. The price adjustment factor is calculated.
f. The price adjustment value can then be calculated by multiplying the unit price by the contract price for the work in that month.
g. It is then multiplied by the quantity of work items for that month, for the predetermined group activity.

The results of Projection 1, with price adjustments applied to the volume of work for the Ameroro Dam Construction Project Package I using the price adjustment calculation method specified in the contract document, with price indices based on data from the Indonesian Wholesale Price Index published by BPS for the years 2021 and 2022 and a simulated index for 2023 based on the increases in 2021 and 2022 for the iron and solar items, yielded the following price adjustments:

a. Price adjustment of Rp. 15,548,548,165.29 with a 100% escalation simulation.
b. Price adjustment of Rp 12,558,135,928.20 with an 80% escalation simulation.
c. Price adjustment of Rp 9,567,723,691.12 with a 60% escalation simulation.
d. Price adjustment of Rp 6,577,311,454.04 with a 40% escalation simulation.
e. Price adjustment of Rp 3,586,899,216.95 with a 20% escalation simulation.
f. Price adjustment of Rp 596,486,979.87 with a 0% escalation simulation.

Based on the calculated price adjustments, the contract value increased as follows:

a. An increase in contract value of Rp 1,016,698,604,665 with a 2% increase in contract value in the 100% simulation.

b. An increase in contract value of Rp 1,013,708,192,428 with a 1% increase in contract value in the 80% simulation.
c. An increase in contract value of Rp 1,010,717,780,191 with a 1% increase in contract value in the 60% simulation.
d. An increase in contract value of Rp 1,007,727,367,954 with a 1% increase in contract value in the 40% simulation.
e. An increase in contract value of Rp 1,004,736,955,717 with a 0.36% increase in contract value in the 20% simulation.
f. An increase in contract value of Rp 1,001,746,543,480 with a 0% increase in contract value in the 0% simulation.

The results of Projection 1 calculations can be seen in the following table:

Table 2. The Results of Projection 1 Calculation

No	Adjustment Value Simulation	Projection I	Increase in Contract Value	Percentage Increase in Contract Value
1	100%	Rp 15,548,548,165	Rp 1,016,698,604,665	2%
2	80%	Rp 12,558,135,928	Rp 1,013,708,192,428	1%
3	60%	Rp 9,567,723,691	Rp 1,010,717,780,191	1%
4	40%	Rp 6,577,311,454	Rp 1,007,727,367,954	1%
5	20%	Rp 3,586,899,217	Rp 1,004,736,955,717	0.36%
6	0%	Rp 596,486,980	Rp 1,001,746,543,480	0%

The percentage increase in contract value based on index adjustment simulations can be seen in the following image

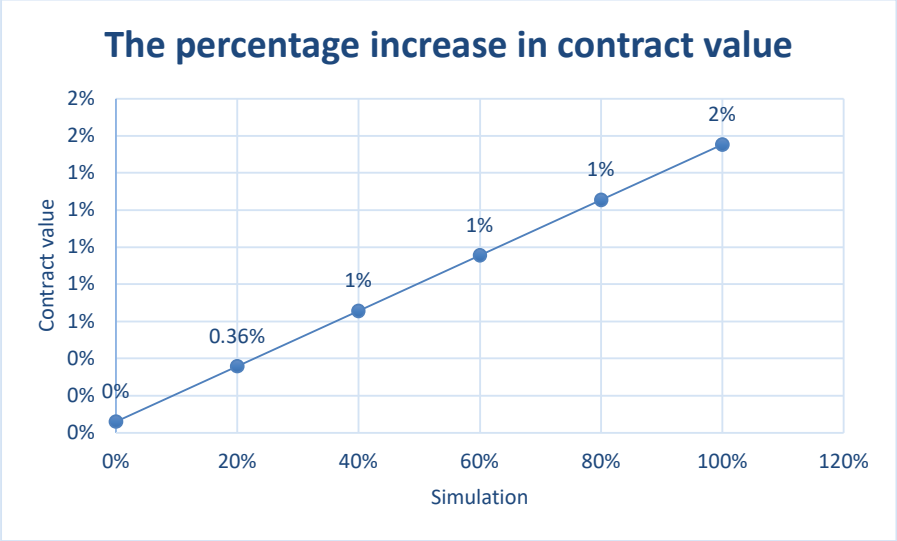

Figure 2. The Percentage Increase in Contract Value Based on Index Adjustment Simulation

3.4 Calculation of Projection 2

This projection aims to determine the amount of price adjustment for solar and iron in the volume of work for the Ameroro Dam Construction Project Package I using the price adjustment calculation method applied in the contract documents of the Ameroro Dam Construction Project Package I. This allows us to determine the magnitude of the price adjustment.

This projection is calculated using the following data:

a. Quantity of work (progress volume) for Ameroro Dam Package I from the beginning of the contract to its end.
b. Price indices from the Economic Price Index published by Pertamina for the years 2021 and 2022 and a simulated index for 2023 based on the increases in 2021 and 2022 for the solar item.
c. Price indices from the Indonesian Wholesale Price Index published by BPS for the years 2021 and 2022 and a simulated index for 2023 based on the increases in 2021 and 2022 for the iron item.
d. Coefficient data for contract components for the group activities of the Ameroro Dam Construction Project Package I.

The calculation of the price adjustment value in this simulation is as follows:

a. Consider all work items in the Ameroro Dam Construction Project Package I.
b. Input the coefficient values for each group activity into the solar and iron columns based on the contract document.
c. Determine the zero indices for each component column from the Economic Price Index published by Pertamina for the years 2021 and 2022 for the solar item and from the Indonesian Wholesale Price Index published by BPS for the years 2021 and 2022 for the iron item.
d. Determine the current indices using a simulated index for 2023 based on the increases in 2021 and 2022.
e. Calculate the price adjustment factor.
f. The price adjustment value can then be calculated by multiplying the unit price by the contract price for the work in that month.
g. Multiply it by the quantity of work items for that month for the predetermined group activity.

The results of Projection 1, with price adjustments applied to the volume of work for the Ameroro Dam Construction Project Package I using the price adjustment calculation method

specified in the contract document, with price indices based on data from the Indonesian Wholesale Price Index published by BPS for the years 2021 and 2022 and a simulated index for 2023 based on the increases in 2021 and 2022 for the iron and solar items, yielded the following price adjustments:

a. Price adjustment of Rp. 44,854,254,041.90 with a 100% escalation simulation.
b. Price adjustment of Rp 36,002,700,629.50 with an 80% escalation simulation.
c. Price adjustment of Rp 27,151,147,217.09 with a 60% escalation simulation.
d. Price adjustment of Rp 18,299,593,804.68 with a 40% escalation simulation.
e. Price adjustment of Rp 9,448,040,392.28 with a 20% escalation simulation.
f. Price adjustment of Rp 596,486,979.87 with a 0% escalation simulation.

Based on the calculated price adjustments, the contract value increased as follows:

a. An increase in contract value of Rp 1,046,004,310,542 with a 4% increase in contract value in the 100% simulation.
b. An increase in contract value of Rp 1,037,152,757,130 with a 4% increase in contract value in the 80% simulation.
c. An increase in contract value of Rp 1,028,301,203,717 with a 3% increase in contract value in the 60% simulation.
d. An increase in contract value of Rp1,019,449,650,305 with a 2% increase in contract value in the 40% simulation.
e. An increase in contract value of Rp 1,010,598,096,892 with a 1% increase in contract value in the 20% simulation.
f. An increase in contract value of Rp 1,001,746,543,480 with a 0% increase in contract value in the 0% simulation.

The results of Projection 2 can be seen in the following table

Table 3. The Results of Projection 2 Calculation

No	Adjustment Value Simulation	Projection I	Increase in Contract Value	Percentage Increase in Contract Value
1	100%	Rp 44,854,254,042	Rp 1,046,004,310,542	4%
2	80%	Rp 36,002,700,630	Rp 1,037,152,757,130	4%
3	60%	Rp 27,151,147,217	Rp 1,028,301,203,717	3%
4	40%	Rp 18,299,593,805	Rp 1,019,449,650,305	2%
5	20%	Rp 9,448,040,392	Rp 1,010,598,096,892	1%
6	0%	Rp 596,486,980	Rp 1,001,746,543,480	0%

The percentage increase in contract value based on index adjustment simulations can be seen in the following diagram:

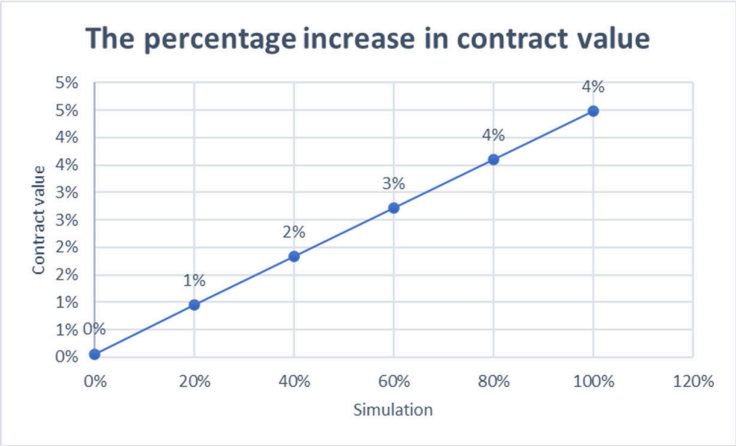

Figure 2. The Percentage Increase in Contract Value Based on Index Adjustment Simulation

3.5 Analysis of Escalation Calculation Results

Based on the analysis of Projection I and Projection II data, the price adjustment difference between Projection I and Projection II can be seen in the following table.

Table 4. Price Adjustment Difference between Projection I and Projection II

No	Adjustment Value Simulation	Projection I	Projection II	Difference
1	100%	Rp 15,548,548,165	Rp 44,854,254,042	Rp 29,305,705,877
2	80%	Rp 12,558,135,928	Rp 36,002,700,630	Rp 23,444,564,701
3	60%	Rp 9,567,723,691	Rp 27,151,147,217	Rp 17,583,423,526
4	40%	Rp 6,577,311,454	Rp 18,299,593,805	Rp 11,722,282,351
5	20%	Rp 3,586,899,217	Rp 9,448,040,392	Rp 5,861,141,175
6	0%	Rp 596,486,980	Rp 596,486,980	Rp -

The difference in percentage between Projection I and Projection II is due to the difference in index values used and can be seen in the following diagram

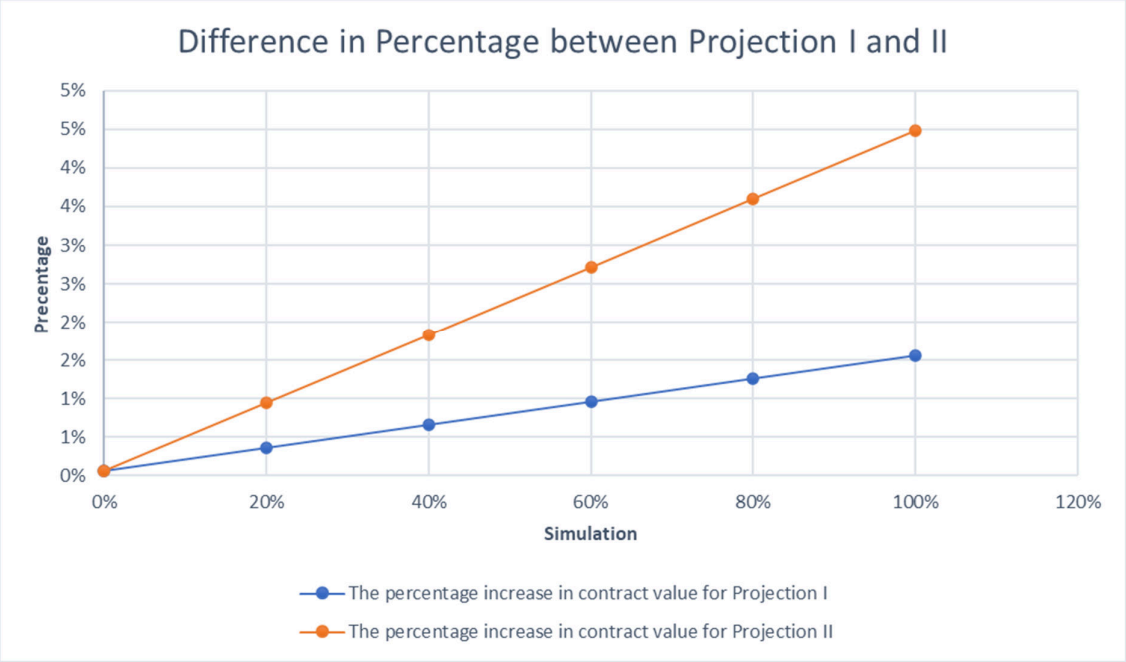

Figure 3. Difference in Percentage between Projection I and Projection II

Based on the analysis of Projection 1 and Projection 2 data, it can be concluded that Projection 2, using the economic price index values from Pertamina, is closer to the actual field conditions. Therefore, the author recommends using the economic price index values from Pertamina for calculating escalation values.

3.6 Profit Projection Analysis

With the increase in solar and iron fuel prices, there is a decrease in profit by 2.25%, resulting in a margin decrease from 8.27% to 6.02%. The increase in margin due to escalation based on Projection 1 and 2 can be seen in the following table.

Table 5. Increase in Margin in Projection 1

No	Adjustment Value Simulation	Margin	Reduction in margin due to the effects of solar and iron price increases	Margin after the increase in solar and iron prices	Percentage of margin after escalation	Difference in RAB margin and escalation margin
1	100%	8.27%	2.25%	6.02%	7.98%	-0.29%
2	80%	8.27%	2.25%	6.02%	7.69%	-0.58%
3	60%	8.27%	2.25%	6.02%	7.39%	-0.88%
4	40%	8.27%	2.25%	6.02%	7.10%	-1.17%
5	20%	8.27%	2.25%	6.02%	6.80%	-1.47%
6	0%	8.27%	2.25%	6.02%	6.51%	-1.76%

Based on the data above, it can be analyzed that using index data from the Indonesian Wholesale Price Index published by BPS cannot restore the margin affected by the increase in iron and solar prices

Table 6. Increase in Margin in Projection 2

No	Adjustment Value Simulation	Margin	Reduction in margin due to the effects of solar and iron price increases	Margin after the increase in solar and iron prices	Percentage of margin after escalation	Difference in RAB margin and escalation margin
1	100%	8.27%	2.25%	6.02%	11%	2.60%
2	80%	8.27%	2.25%	6.02%	10%	1.73%
3	60%	8.27%	2.25%	6.02%	9%	0.86%
4	40%	8.27%	2.25%	6.02%	8%	-0.01%
5	20%	8.27%	2.25%	6.02%	7%	-0.89%
6	0%	8.27%	2.25%	6.02%	7%	-1.76%

Based on the data above, it can be analyzed that using the index data from Pertamina's economic price index for the solar item and using the index data from the Indonesian Wholesale Price Index published by BPS for the iron item can restore the margin affected by the increase in solar prices.

Based on the analysis of profit projections in Projection 1 and Projection 2, the use of index data based on Pertamina's economic price index in line with the actual increase in solar prices in the field is recommended. This is evident from the data analysis, as using the economic price index data can restore the cut-off profit caused by the increase in solar prices, unlike Projection 2, which resulted in a negative profit. This means that the index data for the solar item in Projection 2 does not align with the actual situation in the field. The author recommends using index data for the solar item based on Pertamina's economic price index because the index values align with the real-world conditions.

The findings of this study, particularly that the projection using Pertamina's Economic Index for diesel fuel yields contract value adjustments much higher than those using the BPS Wholesale Price Index (IHPB), align with and extend previous literature on cost escalation in construction contracts. Welde & Dahl's (2021) work in Cost Escalation in Road Construction Contracts showed that contract cost escalation often arises from inaccurate initial assumptions about input prices and inadequate allowances for external risks especially for volatile inputs such as fuel and materials. In their study, change orders for scope adjustments and other external factors accounted for a significant portion of cost deviations from the original contract.

Furthermore, Choi, Kim, & Kim's (2006) *A Study on the Price Escalation System in a Construction Contract* argues that a robust escalation mechanism should include a base date

matching the tender, specific indices for volatile inputs, and a fair sharing of risk between the owner and contractor. Their framework suggests that using aggregated indices for all inputs may mask the dynamics of particularly volatile cost components, a critique that supports our result: employing a fuel-specific index (Pertamina) better captures real market fluctuations than a general wholesale index.

From a project risk management perspective, if a long-term contract fails to account for an index sensitive to fuel price volatility, the contractor bears disproportionate risk of a negative margin when fuel costs spike. Our findings demonstrate this: the projection based on the less responsive index underestimated the adjustment, exposing contractors to margin compression. This underscores the theoretical imperative for escalation clauses that distinguish and isolate highly volatile inputs rather than applying a single blanket index to all cost components.

4. CONCLUSION

Based on the analysis of Projection 1 using index data from BPS for iron and solar items, it can be concluded that there is an increase in contract prices of up to 2% based on the applied simulation.

Based on the analysis of Projection 2 using index data from BPS for iron and index data from Pertamina's economic price index for the solar item, it can be concluded that there is an increase in contract prices of up to 4% based on the applied simulation.

In the analysis of profit projections in Projection 1 and Projection 2, it is recommended to use index data based on Pertamina's economic price index in line with the actual increase in solar prices in the field. This is evident from the data analysis, as using the economic price index data can restore the cut-off profit caused by the increase in solar prices, unlike Projection 2, which resulted in a negative profit. This means that the index data for the solar item in Projection 2 does not align with the actual situation in the field.

This study has demonstrated that the choice of price index for volatile inputs—particularly diesel fuel—substantially influences the magnitude of contract value adjustments and profit margin projections in long-term construction projects. The findings confirm the hypothesis: using Pertamina’s Economic Index for diesel yields significantly higher and more realistic escalation estimates compared to relying solely on the aggregated IHPB BPS index.

From a practical standpoint, the results suggest that contractors and project owners should incorporate fuel-specific escalation clauses into their contracts, establishing baseline indices, clear adjustment formulas, and risk-sharing mechanisms. This approach helps mitigate the exposure to margin erosion when fuel prices spike. Policymakers and procurement agencies

should also reconsider standardized practices that default to broad indices, especially in infrastructure projects sensitive to energy price fluctuations.

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