European Research Studies Journal
Volume XXIII, Issue 3, 2020

pp. 280-295

The Relationship of Cement Consumption and Economic Growth: An Updated Approach

Submitted 30/03/20, 1st revision 20/04/20, 2nd revision 25/05/20, accepted 07/06/20

Effnu Subiyanto[1]

Abstract:

Purpose: *This research aims to make an update how much volume of cement is needed for Indonesia, to disclose cement consumption for Indonesia and the relationship between cement consumption and several variables as inflators that influence cement consumption.*
Design/methodology/approach: *The methodology used is regression analysis and descriptive analytics. The data period taken is primarily within the period of 2010-2018, but cement consumption and other variable inflators have been assessed within a longer period of 2007-2018.*
Findings: *The findings are that national economic growth as inflator for cement consumption is no longer proven as by nature to develop robust models but must access of more than one predictor. Based on findings, by calculating cement consumption based on real consumption at every project are better than rely-on national economic growth.*
Practical implications: *The recent model of cement consumption has been no longer as the inflator of economic growth and vice versa. An update for the cement consumption is urgently needed. Economic growth is no longer a predominantly inflator for the cement consumption. There is no obligation to consume more cements in purposing to drive economic growth.*
Originality/value: *This research has been developed by the author from yearly observations and experiences at the cement sector in Indonesia.*

Keywords: *Cement consumption, economic growth, project infrastructure, regression analysis, Indonesia.*

JEL Code: *O11, O47, E21.*

Paper Type: *Research study.*

Acknowledgments:
I personally thank the UKWM for supporting this research. Thanks also to the anonymous reviewers who provided constructive comments on this article. This study is independently funded.

[1]*Widya Mandala Surabaya Catholic University, Indonesia, e-mail: effnu@yahoo.com*

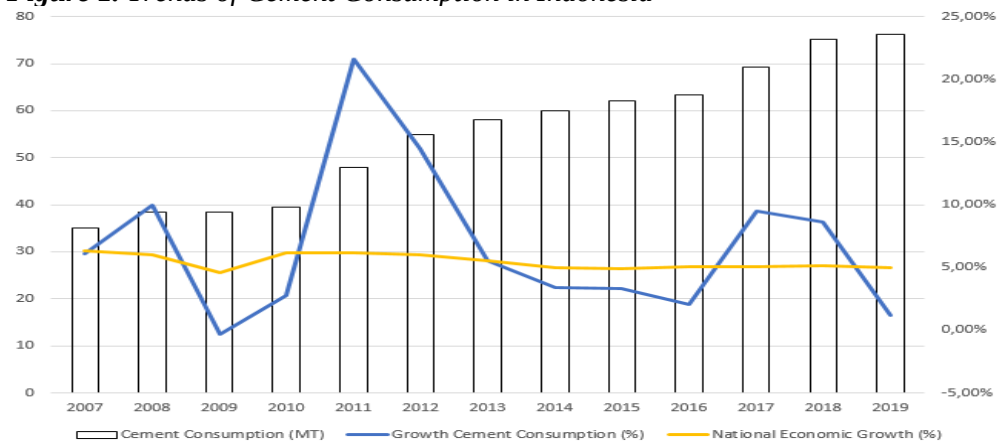
1. Introduction

The consumption level of cement's products in a country is common understanding as representing certain economic growth. A country with low GDP would probably have low cement consumption. As the country develops, cement consumption grows linearly and event more exponentially. It is therefore that the consumption level of cement indeed is believed as an indicator of the economic growth of countries.

The sequential logic behind is that cement needs to be produced, at the starting point must be 0 kilogram/capita by necessity. While economics are developing, they require heavy investment projects of capital goods which demand cement consumption. The heavy investment projects are roads, highways, new buildings, dams, irrigations, many plants of manufactures that all said infrastructure facilities.

In Indonesia, different things happened recently, as spending for infrastructure projects have exponentially soared in the period of 2014-2019 with thousand items of infrastructure projects have been organizing, but the cement consumption was dramatically depressed far below than the level of the national growth. This phenomenon is quite surprising and un-anticipating due to rampant cement projects have been completed to total capacity over than 128.95 million tons annually by 2019, but it is now left of at least 30% capacity idle to be oversupplied. The consequence is at the bitter era ever been for Indonesian's cement sector as previously have shadowed enjoying the huge infrastructure spending, but it is now soon disappearing.

Figure 1. *Trends of Cement Consumption in Indonesia*



Source: *Author (2020).*

As presented in Figure 1, we can see a sharply declining of cement consumption in 2019 as continuing from the highest level in 2017. Interestingly, although the national economic growth as source of inflator to the cement consumption even at the stagnant line, the cement consumption is otherwise sharply declining. At the

opposite in the period of 2010-2013 when the economic growth was at the stagnant trend the cement consumption was hiking and then gradually decreasing after. In the period 2010-2013, Indonesia government invited almost all international cement makers to make investment projects to fulfil million tons of cement that was predicted on shortage.

The new cement plants then built in almost every island in Indonesia within the period of 2010-2018. At least 15 new cement plant projects have been executed and major parts of them have started operations. There are now leaving a big problem as the cement consumption is not according the previous estimation but remain un-utilized. The infrastructure projects with enormous budget of about US$ 27.59 billion annually is consuming only in a tiny volume of cement. It is surprisingly below the prediction. There are at least several marks that must be urgently updated as following: (1) is economic growth relevant to the mainly inflator for the cement consumption? (2) how to define total volume of cements in a country? (3) what is the best suggestion to investors to make investments in the country?

These questions are important to be a valuable learning lesson for designing adequate volume of cement required to adapt the planned economic growth in a certain country. The link and match of these two factors is evidently hard to be compromise and remaining unsolved until today.

2. Literature Review

Cement products have been deemed as one of the important indicators determining the economic development of a country. Dougherty (1973) stated at his research that after investigating that cement consumption he noticed that it has high correlation with GDP in the less developed economies, the data can be more easily collected and perhaps accurate, and can be calculated simply to the math equation that explains the product been measured by the calculation per capita consumption in the country.

A more comprehensive research conducted by Cao *et al*. (2016) has examined five variables namely population, GDP, intensity of cement consumption, investment, and urbanization level in China within the period of 2005-2013 to observe relationship with cement consumption. The research indicates that investment and GDP are good drivers for cement consumption, while these findings had been supported by Bildirici (2020) in India for the period of 1960-2017. Furthermore, Chao *et al*. (2017) conduct a research to establish new model of cement consumption. Three variables have been used namely buildings, infrastructure and agriculture facilities that have been exploited to be tested within a period longer than the period used by Cao *et al*. (2016), e.g., 1920-2013. Chao *et al*. (2017) showed that all determining variables are completely significant as predictors for the cement

consumption. The importance of investment to absorb large volumes of cement has also found by Raventos and Zolezzi (2016).

At a little bit deeper, a research investigating the use of concrete cement for construction materials has been performed by Woodward and Duffy (2011) to observe cement consumption in Ireland in 2007. The research shows that concrete cement is a major significant predictor for cement consumption. Concrete is generally used for making foundations, and or for construction. A major part of concretes more than 80% consists of cement. Meunier *et al*. (2015) acknowledged that the cycle demand and supply for cement is uncertain. Domestic capacity and the need for import are hard to be modeled based on his research in the US, therefore it concluded and suggested to keep build more cement plants to anticipate surprise demands. One of the basic arguments that marginal cost between domestic production and imports varies across local US markets, is because cement is costly to transport over land. As the cement product is bulky corresponding to weight, transportation cost is about 18% or the highest among other products.

Hussain (2012) studied the relationship of construction and cement makers and found that it is intertwined with each other. In this study infrastructure is introduced as catalyst to drive economic growth, while infrastructure itself is highly demanded to stabilize cement products in terms of quality and quantities. Hussain (2012) in this case is only considering the theory of small-open-economy where the country must be independent to fulfill its needs without intervened by export-import activities to compensate unbalance.

Considering other researches concerning GDP as the primarily inflator to the cement consumption we mention the works by Dougherty (1973), Woodward and Duffy (2011), Hussain (2012), Meunier *et al*. (2015), Cao *et al*. (2016), Raventos and Zolezzi (2016), Chao *et al*. (2017), and Bildirici (2020). They claimed that GDP can be a source in determining cement consumption. In chronological order the percentage of GDP will be posted as allocation to infrastructure budgets and then the post will require volume of cement. The higher GDP will open a chance to obtain bigger percentage of infrastructure budget allocation, and finally will demand more bigger capacity of cement plants to produce higher volume of cement. These linkage close-loop relations will drive the economic growth, but in a previous level the economic growth had also driven the cement consumption.

According to Wang (2019) GDP is statistically proven as the originating element for allocating in infrastructure. The higher the percentage of GDP in infrastructure will assure to the higher volume of cement consumption. Wang (2019) has shown that China has again placed the biggest percentage of its GDP for infrastructure, about 8.3%. This is not surprisingly why China today has thousand cement plants with total capacities being about 2.5 billion tons. These are to meet the cement needs of China, as economic growth of the country is generally at a double-digit rate as the highest in the world. China is also declaring the super project *"one belt one road"* as

the much-demanded cement project (Subiyanto, 2019). At this point, GDP is placed as the originating factor to calculate cement consumption.

In Indonesia, the statement that every person consumes cement products has been widely accepted. Based on comparison of several countries as benchmark, every capita of Indonesian has just consumed 200 kilograms of cement annually that is far below the average in countries at the peer region. Based on the assumption, several cement projects were rampant invited by Indonesia's government to drive supply production. The goal of it, when the time came and needed, is that cement supplies will be no longer handicaps for the country' development. Estimated by Indonesia Cement Association (ISI, 2013), the need of cement products would reach 1,000 kilograms per capita of Indonesia which mean the total installed of all cement plants should be 270 million tons annually by the year 2020. Table 1 below indicates this rapid rise in both cement production and consumption in Indonesia.

Table 1. *Cement Production and Consumption in Indonesia*

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Cement Production in million tons	51.8	52.9	60.49	65.8	78.01	95.95	108.80	117.4	117.65	128.95
Cement Consumption in million tons	39.48	48	54.96	58.01	60	62	63.25	69.24	75.23	76.14

Source: *Updated by Author (2020).*

Beside the early prediction that Indonesia's cement product will be in shortage, the distribution is also leaving serious problems that remain unsolved. Cement plants are concentrating to build in the popular island of Java while smaller capacities in other islands. It is not surprisingly because the economic epicenter in Indonesia is generally coming from Java island and therefore the biggest amount of cement's needs will be from this island. Java island consumes at least 54% of total cement consumption in Indonesia and therefore at least 15 national cement trademarks exist and operate today in Java.

Considering un-equal amount capacity distributed in Indonesia based-on cement consumption, triggering by infrastructure projects have caused Indonesia's cement production and consumption numbers to soar in recent years. Indonesia witnessed an exponential increase in cement producers (from China), while established companies

are expanding through optimizing production capacity in their manufacturing plants. The list of cement makers in Indonesia is shown in Table 2.

Table 2. *The List of Cement Makers in Indonesia*

No	Lists of Indonesia's Cement Makers	Market Share (%)
1	Semen Indonesia	30.27
2	Indocement Tunggal Prakarsa	23.48
3	Holcim Indonesia	11.39
4	Anhui Conch	8.64
5	Semen Merah Putih	5.89
6	Semen Bosowa	5.65
7	Semen Baturaja	4.55
8	Semen Andalas	2.51
9	Ultratech Mining Indonesia	1.49
10	Siam Cement Group	1.41
11	Jhui Sin	1.18
12	CNBM	0.94
13	Semen Imasco (Puger)	0.79
14	Semen Serang	0.79
15	Semen Jakarta	0.47
16	Semen Kupang	0.39
17	SDIC	Construction
18	China Triumph	Construction
19	China Trio International Engineering	Construction
20	Panasia Cement	Construction
21	Semen Hippo	Construction
22	Hongsi Holding Group	Construction
23	Semeru Kalimantan	Construction
24	Sinar Tambang Arthalestari	Construction

Source: *Author (2020).*

Although the uncertainty in figuring cement markets Thomas (2020) expressed optimism to the future for cement makers. A comprehensive report has been presented detailing the outlook of consumption prospects around the world, as well as a review of key risks, competitive pressures, and trading flows. Amidst economic tension as following trade-war in 2018 and worsen by the outbreak of Covid-19 but several rooms offer optimism. There is a balanced tension to get a new equilibrium between Chinese consumption, Middle East, Western Europe, North America, Asia, Africa, and Latin America.

Thomas (2020) insisted that the Western Europe possibility to gain cement demand growth from 1.5% to 2% in 2020 or to the near year future. The US expects to get an increase of 2%, the same predicted for the Latin America regions. Africa has been projected to get a growth of 2% to 3%. China as they made several closures of their plants, but still expects to contribute with a growth of 1% to 2%. India and other Asian countries are still promising an increase despite of the outbreak Covid-19.

3. Methodology

Indonesia is recently showing a disappointed trajectory in cement consumption. Thousands of project infrastructures have been started and several projects are undergoing but cement consumptions are surprisingly decreased instead of previously estimated to absorb larger volumes of cement. Based on this phenomenon, employing regression analysis, this research tries to disclose relationship between economic growth, infrastructure budgets, capital budgets, private external debts, total Indonesia's external debt to define what are the most significant inflators influencing the cement consumption.

At first, to define what factors predominantly weighed for cement consumption, this research separately examines only one variable that is widely assumed by people as the only inflator for the cement consumption. The primarily variable is national economic growth as the independent factor to the cement consumption as the dependent variable. Second, as the findings of the first model assessed the results, we check the goodness of fit for this model and continue further. If the goodness of fit is not quite confidence or at the level that will be easily influenced by other factors, then further tests must be performed.

Third, we add several inflators to test the model and recheck again the significant factors that influence the dependent variable. Specify the other variables that are relevant to be examined. In this paper the following variables have been considered, the infrastructure budget, the budget of capital, the growth of population, the external private debt, and the external debt of Indonesia. Fourth, we offer an alternative perspective to address cement consumption by empirical data at various projects in Indonesia. In the case the type of selected projects are housing projects, infrastructure projects, and the heavy cement projects. Each of the projects has distinctive value and great interest to be considered. Fifth, we calculate normal volume of cement that should be prepared for Indonesia to anticipate further development. The portion of infrastructure allocation is obtained from empirical data and by professional judgements, the amount then divides with market recent prices of cement while the model presents total amount of volume cement needed.

4. Results and Discussion

At the global level, the cement consumption is not coming from economic growth. Therefore, it is hard to acknowledge the assumption scientifically. The following Table 3 shows the revised evidence and found that the p-value is over than the ceteris paribus case of 95% confidence level or α=0.05. It found that p-value of the world economic growth is 0.479 that is higher than α=0.05. The worst is the causal effect between the independent factor and the dependent factor, based on the result of the test. It can be read that every increase of the world economic growth of 1%, the cement consumption will be decreased by 1.98%. The conclusion at the world

sector, is that the model is either un-significantly proven or on a contrary relationship. Table 3 shows the regression results of the model considered in this study.

Table 3. *Regression of the Cement Consumption and the Economic Growth (World)*

	Coefficients	Standard Error	t Stat	P-value
Intercept	0.093639059	0.079726257	1.174507163	0.273965916
Economic Growth	-1.980780496	2.672949684	-0.741046683	0.479849389

Note: Data taken for the period of 2010-2019.
Source: *Author's calculations.*

Indonesia is showing a major difference compared to world. It is significantly regressed proving the independent factor of economic growth as inflator to the variable of cement consumption, but it is only prevailing for single parametric analysis while denied in all examinations for more than one variable. Table 4 is showing p-value for the independent variable of 0.035 that is smaller than $\alpha = 0.05$. It proves the significance of the model and supports that economic growth is a variable inflator for the cement consumption. The causal relation between the two variables is also convincing with positive sign for the corresponding coefficient (5.966) and negative sing for the intercept (-0.258). It means that for every increase of economic growth by 1%, it will drive the cement consumption for 5.966%.

Table 4. *Regression of the Cement Consumption and the Economic Growth (Indonesia)*

	Coefficients	Standard Error	t Stat	P-value
Intercept	-0.25818136	0.137209231	-1.88166176	0.086593544
Economic Growth	5.966987963	2.497149713	2.389519511	0.035891879

Note: *Data taken for the period of 2007-2019.*
Source: *Author's calculations.*

If the model is more deeply assessed the goodness of fit is not quite convincing as the adjusted R square representing the stability of the model, being influenced by the inserted factor is only 0.2818587. It is quite weak caused only 28.19% built from the single factor while the rest of 71.81% could be come from other factors that are not inserted in the model. It means, if other factors were inserted to the model the goodness of fit will be changed. The direct problem is that the only variable to be tested is easily rejected as the minimal number of variables do not meet. The goodness of fit for the single model is presented in the following Table 5.

Table 5. *The Goodness of Fit for Single Regression in Indonesia*

Regression Statistics	
Multiple R	0.584554368
R Square	0.341703809

Adjusted R Square	0.2818587
Standard Error	0.051641654
Observations	13

Note: *Data taken for the period of 2007-2019.*
Source: *Author's calculations.*

The weak model of Table 5 is re-examined in the following Table 6 after more parametric tests have been added. The adjusted R square is going to deteriorate to a lower level of 7.7676021%.

Table 6. *The New Goodness of Fit after 5 More Variables Inserted*

Regression Statistics	
Multiple R	0,734055863
R Square	0,538838011
Adjusted R Square	0,077676021
Standard Error	0,058524396
Observations	13

Note: *Data taken for the period of 2007-2019.*
Source: *Author's calculations.*

Table 7 well explains that none of the 5 new variables inserted have significant impact as inflators for the dependent variable of the cement consumption. The economic growth previously stated as a confidence factor to drive the cement consumption has no longer survived. These are the explaining "other factors" concerned in Table 5 that majorly impacted to the model.

Table 7. *The Recent Regression Figure after 5 Variables Introduced*

	Coefficients	Standard Error	t Stat	P-value
Intercept	-0.44589	0.299865	-1.48695	0.187585
Economic Growth	8.190807	4.020652	2.037184	0.087786
Infrastructure Budget	-9.6E-05	0.000647	-0.14848	0.886826
Capital Spending	0.001007	0.000854	1.178404	0.283249
Population Growth	-3.34659	27.22094	-0.12294	0.906168
External debts of Privates	-1.1E-06	2.87E-06	-0.36788	0.725589
Total External Debts of Indonesia	4.1E-07	1.97E-06	0.208501	0.841736

Note: *Data taken for the period of 2007-2019.*
Source: *Author's calculations.*

The additional factors inserted is based on professional judgements supporting the structuring allocation of the State-budget annually. The State-budget in Indonesia is consisting of budget for infrastructure and budget for capital spending, while the external debt of Indonesia is determined from the amount of deficit and the justification to acquire additional external debt. The growth of population is taken to avoid autocorrelation as well as the variable of the private external debt. We

conclude that the economic growth to influence the cement consumption based on statistical tests is not approved because of the low projective ability of the proposed model, therefore an update robust model is urgently required to be developed.

Indonesia is a special case and more interestingly as un-common and un-predictable case to address cement consumption. Based on nature, cement product is required for the activities incorporating with physical construction, renovation, buildings, projects, infrastructure, and more. At the simplest example, a person to build a new home uses cement. Persons who would like to renovate their houses are also using cement' products. At complexed, project teams to build dams, ports, airports, highways, roads, rail train or housing complexes are using much more of cement's products. The material is known to guarantee physical, strength, and keeping the art of design, all for comfortable and the fulfilment needs of human beings. As far as the substitute materials have not been yet found to replace cement, the traditional cements which are ordinary also pozzolan cements will play important role to develop countries or even more the world.

The problem is how to predict or develop a model to detect the amount of cement needed in the world, in regions, in countries, or in certain projects. The best thing according to this research is by empirical findings. The findings can be elaborated to justify cement consumption generally and then it can be customized to the min-moderate-max consideration. To define these specific projects that consume cement of min-moderate-max it highly demanded to understand the nature of every project. Based on empirical findings, the cement projects, housing projects are categorized as max cement consumption, while infrastructure projects are min-moderate, and the least to consume cement is other projects that indirectly incorporating with physical projects such as renovation projects. The other projects of the least cement consumptions will be services projects, electrical projects, telecommunication projects and others that easily found.

Further, to not ignoring the single model associated with significant results to the cement consumption at the economic growth, the gross domestic product (GDP) is being explored. From the GDP a normal percentage for cement consumption is obtained. After that, the portion of the GDP calculated to procure cement is based on the normal price at the markets, then the normal volume of cement annually has been defined. From this point, we will know the percentage of idle, normal utility of cement plants, and normal volume of cement consumption required annually. Starting from this point, this research tries to make an update recent model of the cement consumption that has no longer influenced and correlated with the previously assumed. It has not based on equations, but it is based on studies on real projects in Indonesia by the data taken within the period of 2010-2018. The projects taken are considering of three types based on cement consumption:

(1) Cement projects that normally are excessive in large volumes of cement due to the nature of the projects. At these projects, concrete absolutely demanded to

build strong foundation to place down big machineries as kiln shells, mills, crushers, and thousands of dynamic machines. Cement to make concrete is used for construct silos, storages, and civil constructions. This is a max cement consumption but as these projects are generally incidental not continuous activities therefore to include them in the calculation is better to be avoided.

(2) Infrastructure projects to build facilities for human beings as highways, roads, ports, airports, dams, power plants and other physical projects. This is a min cement consumption. This is relevant to be applied as these activities are generally continuing with the support from the State budget.

(3) Housing projects to build housing complexes, the transit-oriented development (TOD), apartment projects, retail projects, and many others including private projects as traditionally conducted by Indonesians following the seasons. This is a min-moderate cement consumption. This type of projects are also relevant to be applied in the model as a generally behavior of Indonesian while they afford, they will make renovation to their houses but continuing throughout the years.

Due to the innovations so far for building housings as such inventions on light bricks, mortars, modular systems that plug-and-play and many others cement sachets that are more practicable, the usage of cement in these sectors have far below impressed. Conventionally, the cement consumption for building housings a decade ago consumed nearly 30% to the total cost but recently by collecting data from the real projects in Indonesia is about 3.57%. It is also happening at the project infrastructures in Indonesia. Though, as the projects are branded name with infrastructure that should tightly correlated with physical construction, a major portion of total costs entitled to proceed land clearing that are widely the most hurdle in Indonesia. In these infrastructure projects, total cement absorbed is not significant comparing with the total costs allocated. For every kilometer with standard width of the highway in Indonesia 50 meters, the total cement consumption is about Rp 11.25 billion or the level of cement consumption is 1.78% to total budget for infrastructure. Table 8 and Table 9 explain the recent findings based on real calculation for the type sectors of housing projects and infrastructure projects.

Table 8. *Cement Consumption in Indonesia 2010-2018*

Factor	Meaning	M^2	Total bags cement	Total costs per unit of measurement (Rp	Cost cement (Rp)	% cement consumption to total
Housing projects						
2.5	every squared meter time to 2.5	100	250	350	12,500,000	3.57%
Infrastructure projects: highways, ports, airports, dams, roads, etc						
5	every squared meter time to 5	50,000	250,000	633,663.37	11,250,000,000	1.78%

Note: *Data taken for the period of 2007-2019.*
Source: *Author's calculations.*

The different issues found at the cement projects are widely rampant in Indonesia within the period of 2010-2018. Total projects executed at this period are 8 projects in several islands in Indonesia with total new additional capacities of 24 million tons. These projects naturally consume higher volume of cements and have been proven as preliminary considered. Due to the fact that every cement plant requires strong construction for at least 25-year of operation as it is generally designed at the feasibility study, the cement consumption reaches about 4.74% averages to the total costs of projects. Table 9 completely figuring the findings for cement projects in Indonesia.

Table 9. *Cement Consumption at the Cement's Projects*

Project's name	Capacity (MT yearly)	Volume of concrete (Tons)	Total project value (Rp million)	Value of concrete (Rp million)	% Cement consumption
Rembang	3,00	344,238.75	5,410,442.31	275,391.00	5.09%
Indarung	3,00	297,793.30	4,330,014.00	238,234.64	5.50%
INTP	4,40	217,141.79	3,227,372.02	173,713.43	5.38%
Holcim	3,00	165,862.12	5,809,308.07	132,689.69	2.28%
SMP	3,00	179,858.50	4,147,802.68	143,886.79	3.47%
Bosowa	3,00	218,524.56	4,299,115.35	174,819.65	4.07%
Panasia	3,00	223,619.04	3,580,442.31	178,895.23	5.00%
Anhui	1,60	404,328.95	3,799,441.36	323,463.16	8.51%
Total Cement Consumption	24,00	2,051,367.01	34,603,938.11	1,641,093.61	4.74%

Note: *Data taken for the period of 2007-2019.*
Source: *Author's calculations.*

Based on Table 8 and Table 9, it can be concluded what is the ideal volume for meeting the cement's needs of Indonesia. But considering that the cement consumption for cement projects is 4.74% and for the housing projects is 3.57% it seems ambitious and over confidence, that this study chooses the moderate option to apply the least value of infrastructure projects of 1.78%. It means that the cement consumption shall be at about 1.78% of the Gross Domestic Product (GDP) of Indonesia. This value is far pessimistic than Wang's (2019) research stated that Indonesia should be incorporating 3.4% as percentage of GDP to infrastructure allocation.

We therefore calculate the following Table 10.

Table 10. *A Model to Predict Cement Consumption in Indonesia*

	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Indonesia GDP (US$ billion)	755.00	893.00	918.00	915.00	891.00	861.00	933.00	1,015.00	1,059.00	1,099.576
Cement consumption declared (MT)	39.48	48.00	54.96	58.01	60.00	62.00	63.59	65.00	69.00	76.14
Average Selling Price (US$/tons)	90.00	81.00	72.90	65.61	59.05	58.93	58.81	58.70	58.58	58.46
Costs to procure cement (US$ billion)	3.55	3.89	4.01	3.81	3.54	3.65	3.74	3.82	4.04	4.45
% to the GDP	0.47%	0.44%	0.44%	0.42%	0.40%	0.42%	0.40%	0.38%	0.38%	0.40%
% Undisbursed normal budget to 1.78%	1.31%	1.34%	1.34%	1.36%	1.38%	1.36%	1.38%	1.40%	1.40%	1.38%
Costs should for procuring cement (US$ billion)	9.89	12.01	12.33	12.48	12.32	11.67	12.87	14.25	14.81	15.12
Equal to procure cement (MT)	19.77	24.01	24.67	24.96	24.63	23.34	25.73	28.50	29.62	30.24
Total cement consumption should be (MT)	59.25	72.01	79.63	82.97	84.63	85.34	89.32	93.50	98.62	106.38
Capacity installed (MT)	51.80	52.90	58.69	70.21	80.31	98.26	111.10	119.70	119.95	128.95
% Utility	1.14	1.36	1.36	1.18	1.05	0.87	0.80	0.78	0.82	0.82
Idle capacity (MT)	(7.45)	(19.11)	(20.94)	(12.76)	(4.32)	12.92	21.78	26.20	21.33	22.57

Note: *Data taken for the period of 2007-2019.*
Source: *Author's calculations.*

According to the above model presenting in Table 10, it is surprisingly coincidental with the recent condition at the cement markets in Indonesia at the terms of total volumes of idle. The idle capacity reaches 12.92 MT to 22.57 MT starting from 2015 and continuing today. Shortages of cement happened within the period 2010-

2014 and Indonesia was experiencing a surprising cement consumption of 21.60% or the highest ever in 2011. By this period, a tenth of cement investors have been invited to Indonesia with several investments' incentive policies and tax holiday to urgently produce high volume of cement needed for the goal to support infrastructure projects.

However, based on this model, it is found that cement consumption declared by government is far below the normal of 69.80% during 2010-2019. It was equal to 19.77 MT of cement at the lowest to 30.24 MT at the highest annually. Many perspectives easily rose to response this phenomenon, such as the government has invalid update data about all cement makers in Indonesia or the act of smuggling has occurred so far undetected. By the calculation that every sub-modern vessel recently can carry about 30,000 MT, there will be about 2 vessels everyday entering in one of the 2,600 unregistered ports in Indonesia today.

5. Conclusion

Beyond our expectations the cement consumption previously has been examined as resulted from the national economic growth is no longer significant for Indonesia's cases. The model might be confident and significant for single parametric but none for multi-parametric version that accordingly must be performed to develop robust and consistent models. Based on the findings an update model for cement consumption is urgently needed.

During the waiting for an update version, the conventional thing is accordingly able to adapt a better model soon. Cement consumption can be calculated and collected from the real projects that have been organizing in modern Indonesia. Thousands of infrastructure projects have been executed and secondary data can be assessed and treated. The percentage of infrastructure spending is resulted from the GDP of the country, the higher GDP potentially has the bigger amount of infrastructure allocations then will consequently drive the demand of cement. This is a close-loop model that intertwined and cannot be excluded from the analysis of the study problem.

It is known that infrastructure projects consume cement but at the least volume than other physical projects. The higher the cement consumption is evidently consumed by housing projects, and finally the highest volume of cement has been consumed by the cement projects. Retailing market of cements are bigger volumes consumed than the amount volume of cement for a purpose to meet projects' need.

By considering all physical projects that in nature and commonly understanding must require cement products, this research presents a calculation model to predict volume of cement consumption in Indonesia and can be adapted to apply in other countries while possible. The model exploited GDP in the country, specifies its percentage to allocate in infrastructure budget based on empirical techniques,

divides with market prices of cements at the time, and finally the total amount volume of cement can be obtained. From these results policy makers can determine how many cement plants should be built and the right place, as cement's product is bulky that the transport costs is generally going to be most concerned.

Based on Indonesia's cases, it comes to conclude that misleading decision of the Indonesia's government had been proved since 2015-2019. Based on the model, within the period it has shown an excess capacity and becoming bigger and higher to the date. A progressive action of Indonesia's government is needed to assertively suspend various investments related to the new cement projects.

It was a big question to the authorities, new investments are not everything, but sustain that every national cement maker should be prioritize all-in-all. Failure to anticipate this situation will push down about 10 cement plants to be bankrupt and endanger from about 10,000 workers to 15,000 workers to be potentially unemployed.

The model presented in this paper is a recent updated to evaluate the relationship in the cement consumption as first founded in the research of Dougherty (1973).

Declarations:
Competing interests: The author assures that there are no competing interests to be mentioned.
Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.
Author' contributions: This is an original article from the author. The author construct, develop, test, taking sample and treat data by his own. The author read and approved the final manuscript.

References:

Bildirici, M.E. 2020. The relationship between cement production, mortality rate, air quality, and economic growth for China, India, Brazil, Turkey, and the USA: MScBVAR and MScBGC analysis. Environmental Science and Pollution Research, 27, 2248-2263, https://doi.org/10.1007/s11356-019-06586-w.

Cao, Z.L., Shen, L.L., Zhong, S. 2016. Analysis on major drivers of cement consumption during the urbanization process in China. Journal of Cleaner Production, 133, 304-313, https://doi.org/10.1016/j.jclepro.2016.05.130.

Chao, Z.L., Shen, L.L., Zhao, J., Zhong, S., Kong, H., Sun, Y. 2017. Estimating the in-use cement stock in China: 1920–2013. Resources, Conservation and Recycling, 122, 21-31, https://doi.org/10.1016/j.resconrec.2017.01.021.

Daugherty, K.E. 1973. Cement as an indicator of economic development. Cement and Concrete Research, 3(2), 163-183, https://doi.org/10.1016/0008-8846(73)90045-8.

Hussain. 2012. Pakistan Today. https://www.pakistantoday.com.pk/2012/01/22/ cement-consumption-a-barometer-of-progress/.

Meunier, G.J., Ponssard, P., Thomas, C. 2015. Capacity Investment under Demand Uncertainty: The Role of Imports in the U.S. Cement Industry. Journal of Economics and Management Strategy, 25(2), 455-486, https://doi.org/10.1111/jems.12135.

Raventos, P., Zolezzi, S. 2016. Cement in Central America: Global players in a local industry. Journal of Business Research, 69(2), 388-394, https://doi.org/10.1016/ j.jbusres.2015.06.043.

Subiyanto, E. 2019. OBOR: A New Hope for Future Indonesia or A New Trap? Case Study in Indonesia. In Foreign Business in China and Opportunities for Technological Innovation and Sustainable Economics, by A. Visvizi, M. Lytras, X. Zhang and J. Zhao, 143-156. Hershey PA, IGI Global.

Subiyanto, E., Rini, H.P. 2020. Developing Model of Logistics Costs in Indonesia's Cement Projects: A Literature and Empirical Study Approach. Journal of Economics and Business, 3(2), 697-718, DOI: 10.31014/aior.1992.03.02.232.

Subiyanto, E. 2020. Assessing Total Logistics Costs: Case Study during the Execution of Cement Projects in Indonesia. International Journal of Applied Logistics, (10)2.

Thomas, E. 2020. Special-reports. https://www.worldcement.com/special-reports/15012020/2020-vision/.

Wang, T. 2019. Heavy Construction. https://www.statista.com/statistics/566787/ average-yearly-expenditure-on-economic-infrastructure-as-percent-of-gdp-worldwide-by-country/.

Woodward, R., Duffy, N. 2011. Cement and concrete flow analysis in a rapidly expanding economy: Ireland as a case study. Resources, Conservation and Recycling, 55(4), 448-455, https://doi.org/10.1016/j.resconrec.2010.12.006.