The impact of delay in achieving the affordable housing goals

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Wednesday, 10th February 2021

This Research Project has been submitted for examination with my approval as the Supervisor.

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ABSTRACT

Housing plays an essential role in development of an economy, therefore, its provision is a priority for policy makers in a country. The Kenyan government, through the big four agenda, implemented an affordable housing goal of delivery of one million housing units over five years from 2017. This goal has, however, been faced by delays that have fed into the housing deficit in the country. These delays raise concerns about the completion of the project and the potential economic consequence of continued delays. Therefore, this paper intends to identify the extent of potential economic loss caused by the delay and the possible amounts needed for timely complete the project by evaluating the effects on GDP growth, unemployment, and estimation of the required volume of employment.

To achieve the research objectives data from the Kenya national bureau of statistics was collected from 2007 to 2019 and included the GDP growth, wages, value of completed buildings, informal and formal employment and the value of residential buildings approved in Nairobi county. This data was evaluate using a Koyck model to reveal the relationships between the delay and GDP growth and unemployment, a VAR model was also used to estimate the additional volume of employment needed and the financial implications of this employment.

The analysis revealed that the GDP growth and formal employment had inverse relationships with the delay variable, indicating an increase in these values would decrease the delay. The wages earned and the informal employment had positive relationships with the delay, therefore increases would increase the delay as they affect the labour force and the funds used in the project. The VAR model once used for forecasting suggested the volume of employment needed between 2020 and 2022 to complete the project averages at approximately 294,868. The financial implications of the delay were derived by finding the difference between the values of the variables in 2019 and the averages of the forecasted values to reveal a potential loss of 0.419% in GDP growth.

1 INTRODUCTION

1.1 Background information

Housing, specifically affordable housing that meets the basic standards for provision of sanitary and structural soundness that can be accessed by those in the median range of income, is a significant need for a society. Housing is a pillar of development of an economy as it is a reflection of the true state of the citizen, development has been described as freedom and it has been suggested that it cannot be measured through economic growth alone but also requires the removal of "unfreedoms" such as poverty, poor economic opportunities, systematic social depravation, and neglect of public facilities (Sen, 1999). Economic development is summarized as "a process of creating and utilizing physical, human, financial, and social assets to generate improved and broadly shared economic well-being and quality of life for a community or region" (Seidman, 2005).

It was also observed that children whose parents were homeowners tended to achieve higher levels of education and income, have their own houses sooner and tended to accumulate more wealth which can be interpreted as creating a cycle of financial independence (Wuni et al ,2018). In addition to that, housing provision has a direct effect on developing economies as housing played an important role in urban economies by creating employment, especially for unskilled labour (Arku, 2006).

The governments of countries throughout the world strive to provide this need for their people through public programs or collaboration with private organizations. Singapore, for example, put in place national development strategies to promote economic development, accelerate social integration, and maintain social stability by providing workers housing at low rents and prices thus reducing the pressure on their wages while avoiding lessening the quality of labour (Arku, 2009).

The Kenyan government has similarly implemented an affordable housing program as part of the 'big four' agenda in which they planned to deliver one million housing units over five years from 2017. According to the development framework guide of 2018, the government was to facilitate this project by providing state owned land for free or at low cost, develop or subsidize infrastructure for identified sites, expedite and coordinate statutory approvals from utility providers, make provisions to ensure housing units are

offered at affordable prices and create an environment that mobilizes the private sector resources and encourages their investment.

The affordable housing project would be beneficial to the economy as it would contribute to the growth of the gross domestic product (GDP) especially through the construction industry. In 2016, the total employment in housing construction may have exceeded 575,000 in which more than 90% of this is estimated to be informal (Gardener et al ,2019). Furthermore, the value added in housing construction contributed 2.8% to the GDP, intermediate inputs used in construction contributed 3.6%, and the total domestic production was around 6.3%.

With the implementation of the project there would also be formalization of informal sector of construction. Informal construction became prevalent as the market became more privatized over the years, this shift to formal would create employment in the production and distribution of building materials (Wells & David, 2001). This formalization would also serve as a way for the government to create revenue through tax due to an increase in those going through the formal processes. It would also increase supervision which would reduce the volume of faulty construction that fails to meet the appropriate standards of living.

To solve housing deficit in Kenya the economy would need to provide for 150,000 unhoused people (Delmendo, 2019). The housing market in Kenya is currently facing a fall in consumption due to inaccessibility of affordable housing which can be attributed to constrained credit access, over-supply of high-end residential development and underdevelopment of the mortgage market (Delmendo, 2019). The total annual supply of housing according to the Ministry of housing is 50,000 units which is divided between the high to low-income earners with 83% being available for the high and high-middle income earners. A corporate paper by Cytonn found that the problem is further exacerbated by 74.4% of the working population in need of affordable housing only being able to access 17% of the supply (*Affordable Housing in Kenya*, 2018).

The program, however, faced major delays in completion as only 1% of the goals of the being met in 2020 with the housing sector facing a deficit of two million, which continues to grow at a rate of about 200,000 units a year ("Only 1 Percent of Kenya's Big Four

Agenda Targets Met so Far," 2020). These delays are in land classification, timely disbursals of project finance, delivery of infrastructure and supply chain shortages (Noppen, 2013). With these delays the probability of achieving the goals set out by 2022 are slim though there is still positive conviction from the government and organizations such as the United Nations Office for Project Services which promised to finance the construction of 100,000 of the 500,000 units targeted.

If the gap created by the delay is not covered by 2022, the chances of completion are lowered since the administration in charge of it will have finished its term thus handing over implementation to a new group. This could further slowdown delivery thus there needs to be a change in the implementation strategy.

1.2 Problem statement

The government established the big four agenda with a goal of accelerating the achievement of Vision 2030 goals by taking a new approach to the medium-term planning and focus on issues with the greatest impact on the well-being of the citizens. Through this, the housing goal of providing one million units within five years from 2017 was borne with 20% being social housing, provided to those with highest need, and the rest being affordable housing.

Despite this there has been a delay in the achievement of this goal. This delay has contributed to the housing deficit as it has hampered delivery of the housing units leaving a gap in the housing sector. The poor implementation of this project could result in a 14% loss in the contribution to GDP and hamper growth of employment in housing construction which was predicted to be about 750,000 (Gardener et al, 2019).

The economic implications of failure in the affordable housing project would leave thousands of people in housing deficiency both in quality and quantity as well has affect the potential growth of employment within the construction industry. This study intends to identify the extent of potential economic loss caused by this delay and possible amount needed to be rectified to meet the goals set.

1.3 Research objectives

The main objective of the research is to identify how effect of delay is affecting the economy. The questions this paper intends to answer are:

- How the delay in project delivery has affected GDP growth.
- How unemployment rate has been affected by the delay in the project.
- The estimation of required employment volume for timely completion of the project.
- The financial implications of additional employment.

1.4 Significance of the research

This research would add to the discussion on the effect of big four agenda on the Kenyan economy. It will also add to literature on the contributions of the housing construction industry and how to measure these contributions in the job market specifically.

The government could be a potential consumer of the research as it intends to identify the potential economic gap that could be taken advantage of through the proper implementation of the affordable housing project in the time that was allotted avoiding spillover and spreading thin of the available resources.

It would also benefit the housing construction industry since as it will focus on their contribution to the GDP and economic development through the creation of both indirect and direct employment. This research will also highlight the need for the completion of the project which would boost public knowledge and participation of those within the construction industry.

2 LITERATURE REVIEW

2.1 Theoretical framework

2.1.1 Project delay and GDP growth

The most common causes found in research of delays are cost, and time overruns whose effects not only slow down the construction process but also affect its contributions to GDP (Sha et al, 2017). This research done on the Nepali construction industry to identify cause of delay, their root sources and effects used questionnaires to rank the causes they identified. According to this study, this delay could create a white elephant project which would diminish the productivity of the assets put into the project and take up resources that could be used in other areas and generate addition utility in income.

Similarly, research into the existence and impact of cost and time overruns utilized questionnaire whose results were examined and revealed that 40% of building construction projects suffer both cost and time overruns at rates of 75% and 146% respectively which resulted in high cost of public expenditure and slow rate of socio-economic development (Bentil et al, 2017). Cost overruns were described as the amount by which the actual cost of the project exceeds the initially approved cost which would cause an imbalance in the expenditure while time overrun is described as the difference between the original project time and the overall actual contract time at the end of the project which contribute to a spillover of projects and thus spreading thin the available resources.

In addition to this, research done with a focus on construction in sub-Saharan Africa found that constituency development funds of Kenya indicated 48% cost overrun and 87% time overrun. The effects of these overruns were possible loss of economic justification for the project, strain on financing capacity, waste of scarce resources, further delay and cost escalation, contractual disputes and litigation, negative public perception, loss of job and income and eventually total project abandonment (Gbahabo & Ajuwon, 2017).

These studies, however, focus on the causes of the delay and their effects on the construction projects and thus do not extend these effects to the GDP growth at large. To examine this effect on the GDP we look to research done on the delays in public goods. This study considers a closed economy with a representative household-firm that

maximizes utility from consumption over an infinite horizon with the aim of demonstrating how the overruns affect the equilibrium outcomes and dynamics of canonical model of endogenous growth (Chatterjee et al,2017). This is achieved by making the arrival of public capital goods random to proxy for the various lags and delays while being agnostic to the underlying cause. The study used stochastic processes to model steady-state equilibrium for the social planner and the decentralized economy. These equilibriums were found to be respectively the following;

$$dZ_t = dq_t = dC_t = dN_t = 0 \tag{2.1}$$

$$dZ_t = dC_t = dN_t = 0 \tag{2.2}$$

Where dZ_t,dq_t,dC_t,dN_t are the equilibrium dynamics of;

- Z_t the ratio of public to private capital
- q_t the ratio of the shadow price of private and public capital stocks
- C_t the consumption-private capital ratio
- N_t the completion date of the project

These equilibrium dynamics contain the share of public investment and the elasticity of substitution in consumption which when modelled in equilibrium and in contrast with shocks the models due to increases in investment, cost and time overruns and changes in tax policy, it was found that unanticipated overruns generate too much consumption and too little investment which contributes to higher capital-output ratio and lower equilibrium growth compared to the social optimum. The researchers indicate, however, that they were unable to review the implicit effects of these delay in the labour market.

Alternatively, distributed lag models were used to analyze the economic growth of Cameroon (Fouda, 2010). Dynamic models either lag the dependent or independent variables separately or jointly to form the models. The study of Cameroons economic growth used distributed lag model that lagged only the independent variables. The distributed lag model can be further distinguished as polynomial, geometric, and arithmetic and are shown below. The study utilized the geometric distributed lag model using the Koyck transformation since the geometric model solves the issue of

multicollinearity and estimation of few parameters despite its restrictive nature in addition to that they applied the polynomial model through the Almon structure model.

Arithmetic $y_t = F(x_t, x_{t-1}, x_{t-2}, \dots)$ (2.3)

Polynomial $y_t = \alpha + v_0 x_t + v_1 x_{t-1} + v_2 x_{t-2} + \cdots + v_L x_{t-L}$ (2.4)

Geometric $y_t = \alpha + v_0 x_t + v_1 x_{t-1} + v_2 x_{t-2} + \cdots + \varepsilon_t$ (2.5)

Where,

- y_t is the economic output
- x are values of a variable changing with time, t
- L is the order of the equation
- α is the intercept
- v is the distributed lag weight

The geometric model revealed that the speed of adjustment was very high thus the propagation of the variables' effects disappears quickly which in turn harms the long run growth of GDP. The models used showed that in the presence of government expenditure, the effect of investments on growth appeared negative after one year due to the eviction effect. The study concluded that any economic policy to sustain economic growth must boost priority investment and they should pursue policies that stimulate production instead of consumption.

This study will utilize the dynamic distributed lag models since the time of completion is known thus the stochastic models would not be applicable as the element of randomness is not relevant to the affordable housing project.

2.1.2 Project delay and unemployment

The introduction of the housing project could potentially take up the work force available and provide formality in the industry which would be instrumental in streamlining the job market as well as protecting the workers. A study of the construction industry in China discusses the nature of employment after the separation of management from field operations which had led to inefficiency in the organization of the industry (Lu & Fox, 2001).

The study found, using surveys and questionnaires, that in large sized enterprises construction of a floor area of over 400,000 m^2 annually and requires approximately 4000 permanent staff. The study also found that the workforce mainly consisted of rural workers who were not well educated with 50% of the 600,000 of the laborers surveyed not having gone past primary school and more than 10% being illiterate or semi-illiterate. The composition of the employment necessitated the introduction of a vocational study law which provided training to those in the construction with the objective of passing on job skills, apprenticeship opportunities and enabling job changes. There has, however, been a fall in the supply of skilled workers since the jobs have lost attractiveness with the youth.

Research done in Kenya revealed that the informal sector absorbs many of the unemployed without a guarantee of long-term employment and job security (Mitullah & Wachira, 2003). The study found that the informal work force lacks social protection due to lack of enforcement of minimum wages and poor terms of employment and found that on average the workers earned 400 Kes a day, which is far below the minimum wage. The industry is dominated by small-scale economic activities such as self-employment which often took place outside of the system of planning and control hindering collection of revenues and regulation of the projects undertaken. The formalization of the industry through training of informal workforce would bring about a means of continuous transfer of technology, which given better regulation would benefit the workers and government.

The papers discussed reveal the nature of employment in the construction industry and the conditions of the workforce under this industry and give insight into how formalization due to affordable housing project implementation would change the industrial organization. Research has been done to examine the lessening effect of public construction on cyclical fluctuation in employment getting an adequate index of the changes in employment instead of estimating the amount of unemployed people (Dickson,1928). The study found that the volume of public construction was sufficient to have prevented most of the factory unemployment if properly allocated.

The study's main purpose is to obtain a measurement of the possible maximum power of public construction to prevent cyclical unemployment by using employment and payroll indices that indicated the ebb and flow of labour demand. The study gives methods to

approach when collecting data on public construction including using financial statistics of states and cities, the amount of bonds sold by municipal, count and state government, use reports of building permits issued and to use data collection agencies. Of the methods suggested the first two were the least reliable as they do not specify the type of construction while the third does not guarantee that the buildings given permits will be completed within the stipulated time and use the estimated amounts.

The research to be undertaken in this paper will rely on some aspects of the paper that describes the best methods of collection of construction data and will look at data from building permits and view the unemployment effect of delay as the changes in the nature of employment as it is formalized and increased or decreased in volume.

2.1.3 Additional employment and its financial implications

Estimation of the potential labor needed for a construction project is difficult especially when trying to assign values since the building industry is composed of different trade workers. However, studies have been done to develop manpower forecasting, the study reviewed utilized linkages between major economic variables focusing on the construction output and economic conditions through a multiplier model which combined econometric regression models and multiplier equations (Sing et al, 2012).

The study separated the model into four stages, the first is synthesis of economic scenario by forecasting the possible economic condition in terms of GDP. The second being a mathematical model forecasting the construction output and the third as labour multiplier approaches which forecast the workload in terms of the number of man days. The final stage is to forecast the manpower demand by forecasting in terms of the number of workers required.

Another study discussed the use of econometric measures to model and forecast unemployment in Sweden, the study found that the unemployment rate is nonstationary nonlinear and has a stationary seasonal nature (Desaling, 2016). The study used both univariate and multivariate time series models that is seasonal autoregressive integrated moving average model (SARIMA), self-exciting threshold autoregressive model (SETAR) and vector autoregressive model (VAR) within which stationarity, causality and cointegration tests were run to analyze the variables used. Unemployment was forecasted

using in-sample and one-step recursive out-of-sample forecasting that were measured on performance measures. They suggest that short-term is better than long-term forecasting since the predicted values of models are placing within the 95% forecasting confidence interval.

This study will utilize a multivariate model since it will capture the effects of the variables that would affect the work force required to fill the gap as well as provide for forecasting of the data in the short term as opposed to the multiplier model which relies on primary data that would be difficult to collect due to cost and time constraints.

2.2 Empirical framework

In measuring the impact of community development initiatives using adjusted interrupted time series (AITS) in three case studies of large-scale projects, it was found that the method was capable of measuring impacts that manifested themselves as changes in either base level prices or the rate of price appreciation in the projects (Galster et al, 2004). In the estimation of the impact, the shortcomings were due to its requirement for substantial number of frequently recurring observations and a well-behaved trend. Despite this, the AITS model has its strength in the ability to deal with comingled problems and making pre and post intervention comparisons of trends in the target outcome indicator of interest.

Research on causality between construction and GDP growth in Turkey found that due to the large number of unskilled workers involved in the activities of construction, it is the fastest sector with which to increase employment (Berk & Biçen, 2018). This study examined the interrelationship between the construction industry and economic growth by examining trends in time series analysis using output and share in GDP of construction. The research used variables such as GDP, inflation, and the construction expenditure in GDP to carry out unit tests and granger causality tests on data from the first quarter of 2000 to the second quarter of 2016.They found that the growth of economy is affected by total construction as well as a parallel relationship between infrastructure provision, job creation and economic prosperity.

These papers give information on the utilization of time series data in modeling the data as well as the use of causality tests to give a better understanding of the nature of relationships among the variables and there long run effects.

2.3 Conceptual framework

The neoclassical and indigenous models of estimating growth give insight into economic growth and will thus guide the research. Using these models, further forecasting and relationship models will be built to examine the objectives set out by this research. In addition to this, to measure the effect of changes in the projects the study will use econometric models in estimation.

To explore the objectives set out in this research, the variables of interest will be the GDP growth rate, the employment indices, and building permit amounts. The employment indices will include the wages and number of employed in skilled and unskilled labor the construction rates will be determined using the value of residential building permits issued and the values of completed buildings reported. These would then be utilized to examine the impact of delay in the delivery of the project since project delay will cause a reduction in productivity thus affecting the GDP. These variables will also be used to forecast and thus find the amount that would fill the economic gap thus readjusting the employment and GDP growth rates.

2.4 Research gap

The analysis done in this research intends to fill the gap in research on the causal relationship between project delay and GDP growth. Research has been done on the effect of time delays and lag on GDP in an economy and the causes and effects of delays in the construction process and the nature of employment within the construction industry.

These studies, however, do not investigate the effect of project delays on GDP or forecast the potential loss in employment and the potential GDP effect. They also give potential policy adjustments that would mitigate these delays and ways to manage the potential effects but do not investigate the input required to achieve a state of relative equilibrium in overrun situations.

Thus, the view of the effects of project delay on economic growth and unemployment has not fully exhausted empirically. Thus, this study intends to use econometric models to model the data as time series data to examine and analyze its statistical properties and thus understand the nature of their relationship to each other and make the use of forecasting models to find the potential volumes that could be generated through the project.

3 METHODOLOGY

3.1 Research design

The research will have a causal design since it is trying to measure the impact of the delay on GDP and employment and the subsequent effects of this impact. Additionally, using this design, the study intends to reveal whether and how variation in the GDP due to the delay leads to variation in employment or lack thereof in the construction industry. This is appropriate since from previous research there is empirical association among the variables and there is evidence of a relationship between delay, economic development, and unemployment.

Further, this design helps to better understand why there is an impact on the economy due to delay. It also lends itself to replication for future comparison and amendments. This design contains internal validity as well since there is systemic subject selection and equity of the variables being compared.

3.2 Population and sampling

The data needed to fulfill the objective of the research will be populated by the construction industry and GDP. It will be sampled from the residential housing construction and the GDP of Kenya through quota and purposive sampling. This will allow for collection of data that can be specified to the needs of this research.

This data will be sample from the years during the implementation of the affordable housing project to review the development from before the conception of the big four plan in order to determine the effect if any of the introduction of the development project and forecasting of the progress.

3.3 Data collection

The data to be used will be quantitative, continuous and time series since this type of data is flexible and allows for effective forecasting and analysis. The data will be sourced from secondary sources available for public use from the government and open-source institutions.

The data will be collected through documents and record made available to the public. This data is peer reviewed thus preventing likelihood of misleading or biased data. The

instruments for the collection of data will be archival documents and government sources. These sources are accessible and have an abundance of current and historical data.

The data used for this study was collected from the Kenya national bureau of statistics. These sources provided data on the GDP growth, wages, employment, value of the completed buildings, informal employment and the value of residential building plans approved for in Nairobi city county. The committee in charge of the housing project also provide data on the projections for construction to be completed by the end of the set goal. The data will be collected from the years 2007 to 2019 to allow for estimation before and during implementation of the housing project.

3.4 Data analysis

The data will be analyzed inferentially, this will help to put the objectives into better perspective empirically and help in description of the potential findings of the research. The research will be done utilizing R to carry out the models required since it accessible and provides opportunity to share work for replication. To further explain the analysis, the way to achieve each objective is discussed below.

3.4.1 Project delay and GDP growth

The geometric model as described in research would be the best to use in the analysis of the relationship between the GDP's growth and project delay as it incorporates speed of adjustment which would point to important information on the nature of the relationship. A Koyck transformation will be used to model the lags due to delay since it transforms a geometric lag model to an autoregressive model and uses the formula and model coefficients directly. The transformation also allows for causality tests which will determine the nature of the relationship between the variables.

The Koyck transformation can be represented as,

$$y_t = \alpha(1 - \lambda) + \lambda y_{t-1} + v_0 x_t + v_t \qquad (3.1)$$

Where,

- y_t is the dependent variable
- α is an intercept

- $1 - \lambda$ is the speed of adjustment
- λ is the rate of decay
- v_0 is a scale factor
- x_t is the independent variable
- $v_t = (\varepsilon_t - \lambda\varepsilon_{t-1})$ is the error term

The model formed using this transformation will allow for analysis of the effect of lags in the cases of delay effect on GDP growth. Additionally, the rate of decay and speed of adjustment variables will give insight to the impact of the explanatory variable and whether these effects disappear.

3.4.2 Project delay and unemployment

Using the knowledge on the methods of data collection and the approach to analysis given in previous research the data on residential building permits and unemployment data will be used to find the potential changes in employment as suggested in the research on the cyclical unemployment effect of public construction. The analysis will be carried out using the Koyck transformation as discussed above and causality teste will be run to find the long run effects of the delay on unemployment.

3.4.3 Additional employment and the financial implications

VAR, a multivariate econometric time series model, includes the past lags of the dependent and independent variables and would be useful in analyses since it predicts multiple time series using a single model. This will give better insight into the nature of the data through statistical tests. Forecast will give values that can be used to determine the potential volume of employment needed and determine how this volume may affect the economy.

A VAR(p) model with one variable can be written as,

$$A_0 y_t = A_1 y_{t-1} + \cdots + A_p y_{t-p} + \mu_t \quad t = 0, \pm 1, \pm 2, \ldots, \tag{3.2}$$

Where,

- $A_0, A_1, \ldots, A_p$ are $K \times K$ autoregressive parameter matrices
- μ_t is a white noise process

This process can be adapted into a multivariate model and used to forecast by utilizing a linear predictor, MSE (minimum mean squared error) h-step forecast. This will be obtained using a chain-rule of forecasting. Since as discussed in the literature review, short term forecasting is more effective the data will be forecasted to the year of completion as suggested by the big four agenda, 2022.

It can be represented as, $Y_{T+H|T} = c + \pi_1 Y_{T+h-1|T} + \cdots + \pi_p Y_{T+h-p|T}$ (3.3)

Where,

- π are the parameters of the VAR process
- $Y_{T+h-p|T}$ are the future values
- c is a constant

4 RESULTS AND DISCUSSION

4.1 Project delay and GDP growth

To evaluate the relationship between the project delay and growth in the GDP, a Koyck model was utilized as discussed above. To represent the project delay, the spread between in the value of building plans approved and the reported building works completed was used. This spread value was used as the independent variable while the GDP growth was used as the dependent variable, therefore the model will tell us how the GDP growth is affected by its own lags and the project delay. The results of this model are in Table 4.1 below.

Table 4.1

Koyck model of project delay and GDP growth

	α	y_{t-1}	x_t
y_t	-28759.826	-2.366	-42012036.600

Note. Adjusted R-squared=.5505

The results suggest that the rate of decay of the lag of the GDP growth is negative, therefore, the effect of previous values of GDP growth diminish slowly and will carry into the current values. Therefore, lower GDP growths in the previous years will still have an effect in the future and vice versa.

The results also indicate that the speed of adjustment of the GDP growth variable is very high and negative. This points to low GDP growth being difficult to recover from as it deepens. Furthermore, the GDP growth has a large, inverse relationship with the spread as well, suggesting that all other factors held constant, an increase in the spread will greatly damage the GDP growth as it has a substantial contribution to the GDP.

4.2 Project delay and unemployment

To evaluate the relationship between the delay in the project and unemployment, the number of employed, the number of workers in the informal sector and the wages were used as the dependent variables and the spread as described above was used as the

independent variable in each model. The results are represented in Table 1.2,1.3 and 1.4 below.

Table 4.2

Koyck model of project delay and employment

	α	y_{t-1}	x_t
y_t	12.6892248	-1.3017508	-0.0001227

Note. Adjusted R-squared=.3258

Table 4.3

Koyck model of project delay and informal employment

	α	y_{t-1}	x_t
y_t	-4.4726368	-1.0918241	0.0001243

Note. Adjusted R-squared=.7488

Table 4.4

Koyck model of project delay and wages

	α	y_{t-1}	x_t
y_t	3996.44716	-1.03878	0.04322

Note. Adjusted R-squared=.1182

Table 4.2 shows the results of the Koyck transformation of the spread, as defined above and the number of workers employed in the construction sector. The results suggest that there is a positive speed of adjustment of moderate strength thus, the spread values react to changes easily, implying high elasticity, therefore there is need for less inputs to reduce the gaps in the project.

The rate of decay is negative but relatively low thus the previous lags have a smaller effect on the project delay in this case, indicating that the high deficits in previous years would take have effects that would diminish at a slow rate. Employment is inversely related to the spread, suggesting that an increase in the number of people employed would decrease the spread in the building values, therefore increasing the scope of employment will contribute to covering the gaps in the project faster.

From Table 4.3, it can be inferred that the speed of adjustment is low and negative, thus suggesting that the delay in the project is more difficult to correct the more it progresses when the informal sector is considered. The rate of decay in this case is low and negative, indicating that previous lags of the delay cause the spread to diminish at a slower rate as was seen in the model of employment and the delay.

The relationship between the delay and informal employment is positive but has a small value thus the effects of increase in informal employment would not be major but would cause the spread to increase. This is contrary to the inverse relationship of formal employment and spread since an increase in the informal employment would indicate a portion of employment scope that would not be utilized in the project. Those informally employed would not be able to contribute effectively to the project and could potentially contribute to an increase in the construction gaps if not utilized effectively.

Table 4.4 represents the values derived from a Koyck transformation of the delay and wages. The speed of adjustment is a large positive value indicating that the spread of the building values can adjust to changes very efficiently in this case. However, the rate of decay is negative indicating an inverse relationship with the previous lags in the spread though small and would cause diminishing values in the spread. The relationship between the wages and the delay is positive but small thus an increase in the wages offered might increase the spread since an increase in the wages paid to employees would increase the budget of the project, this suggests that as the time to completion increases and more wages are required, the spread in the values will rise and inflate the budgets.

4.3 Additional employment and the financial implications

The table below represents the VAR model run on the employment as the dependent variable and the lags of employment, wage, informal employment, GDP growth and spread as the independent variables.

Table 4.5

VAR model

	$employment$
c	141.3
	(2.391)*
$wage_{t-1}$	0.003236
	(3.237)*
$employment_{t-1}$	−1.762
	(−2.379)*
$informal\ emp_{t-1}$	0.004941
	(0.9809)
$GDP\ growth_{t-1}$	−106.8
	(−0.592)
$spread_{t-1}$	0.0002587
	(2.504)*

Note. Figures in parentheses are t-statistics.

The results presented in Table 4.5 indicate that the lags of wage, employment, spread and the constant value have a significant effect on the number of people employed. The effect on employment holding all other factors constant as represented by the constant's value is large which indicates that the employment in the construction industry would increase despite other factors.

The lags of wage and spread also have a positive effect on the employment values, though they are relatively small, suggesting that an increase in either of these values would increase the number of employees in the construction industry. However, the lag of employment itself has a negative effect on employment, suggesting that increase in employment in previous years reduces the number of employees in prevailing years.

Table 4.6 represents the correlation matrix of the variables in the VAR model and gives insight into the relationship between the variables.

Table 4.6

Correlation matrix

	wage	Employment	Informal employment	GDP growth	Spread
Wage	1.0000	0.8461	0.2159	0.2151	0.7829
Employment	0.8461	1.0000	0.3377	0.2855	0.8974
Informal employment	0.2159	0.3377	1.000	0.2310	0.3675
GDP growth	0.2151	0.2855	0.2310	1.0000	0.2567
Spread	0.7829	0.8974	0.3675	0.2567	1.0000

The correlation matrix reveals that the number of people employed has a strong positive correlation with the wages earned, the GDP growth and the spread of the value of buildings, therefore a change in those variables have an effect on the number of those employed formally. Therefore, the delay in the project would have a significant effect on the employment within the construction industry.

A Granger causality test and an instantaneous causality test of the spread of the values of the buildings on the other variables in the model was run and suggested that the null of no causality was rejected in both cases, suggesting that the delay in the project has a causal relationship with the wages, employment, GDP growth and informal employment.

Table 4.6 Contains the values of the forecasted values of the variable used in the VAR model. Figure 4.1 is a visual representation of the forecasted values. These are used to analyze the potential implications of the employment changes.

Table 4.7

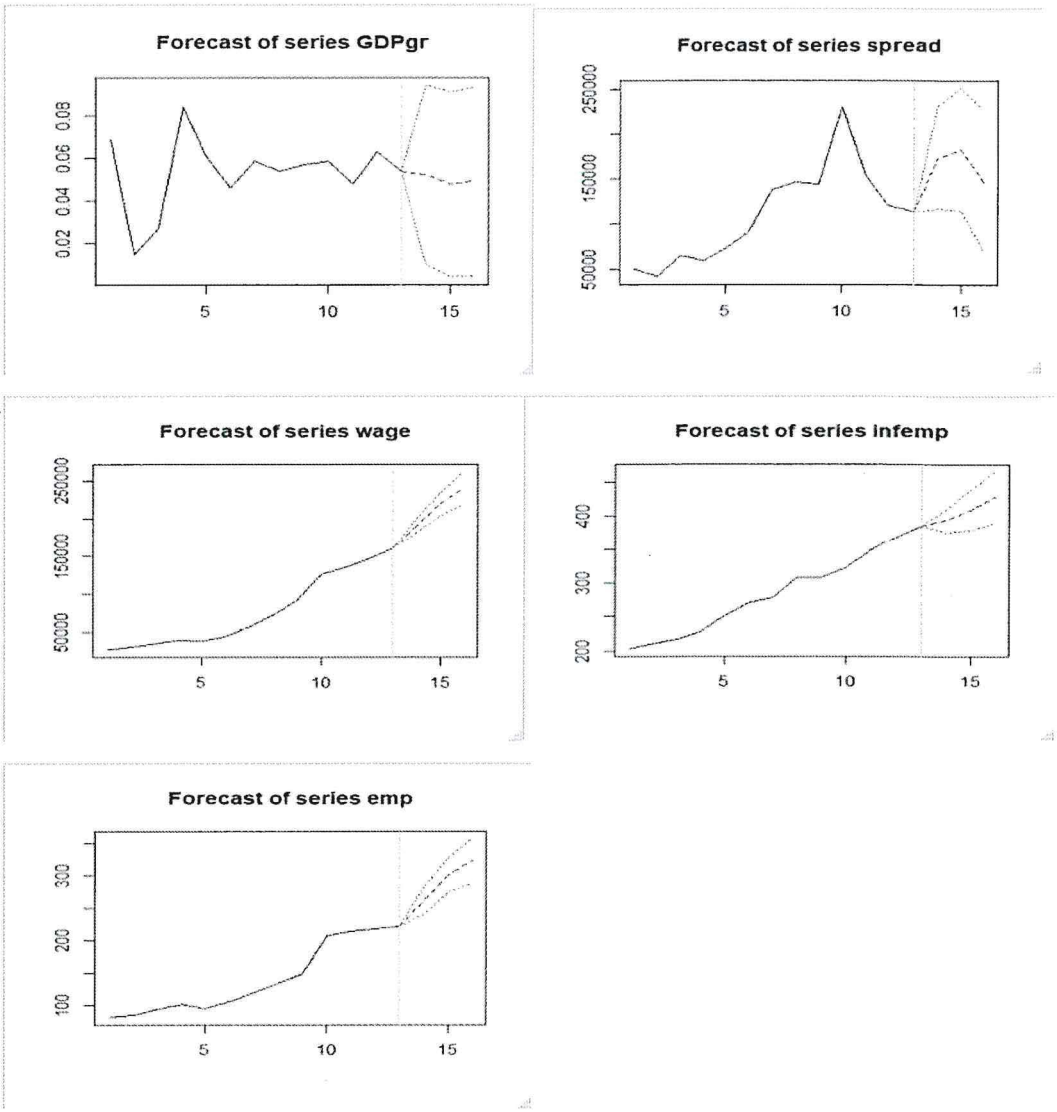
Forecasts of the variables

Year	2020	2021	2022
wage	190622.8	220042.9	240579.4
employment	261.0736	300.5211	323.0079
informal emp	393.8052	408.8938	428.2167

GDP growth	0.05217694	0.04797691	0.04926177
spread	173968.0	182819.0	145766.6

Figure 4.1

Plots of the forecasts of the variables



The forecasted values suggest that employment and wages will experience relatively normal increases in value with time. The changes in informal employment are less drastic and could be attributed to the volatile nature of this type of employment. The values of GDP growth are also very drastic since it would not only be affected by the variables used

in modelling. The spread's forecasted minimums and maximums vary greatly from the median and it is forecasted to increase with time.

The table below represents the historical values as of 2019 of the variables, the average forecasted variables, and the average change in the variables from 2019 to 2022. These historical values can be used in comparison with the forecasted values to find the potential additional employment and the gap that could be created.

Table 4.8

Historical values forecast average and average change.

	Historical values(2019)	*Forecast average*	*Average change*
wage	159832.5	217081.7	57249.2
employment	221.5	294.8675	73.36753
informal emp	385.2	410.3052	25.10523
GDP growth	0.054	0.050	0.00419
spread	113642	167517.9	53875.87

The average change was calculated by subtracting the historical value from the average of the forecasted values and represents the amount that would have been gained or lost within the duration before the completion of the project. Using the forecasted values, the average change in the wages from 2019 to 2022 was found to be 57,249.2 million shillings which would be the potential loss in wages if the project were not carried to completion. Additionally, there would be approximately 73,368 jobs lost in the formal sector, these unfilled jobs in combination with the average wage could have great damage on the contribution to GDP as indicated by the potential loss of an average of 0.419% in GDP growth. There is also an implication of loss of unskilled labour if the current policies are to prevail.

5 CONCLUSION

5.1 Research conclusion

The main objective of the study is to identify how the effect of delay is affecting the economy by answering the following questions,

- How the delay in project delivery has affected GDP growth.
- How unemployment rate has been affected by the delay in the project.
- The estimation of required employment volume for timely completion of the project.
- The financial implications of additional employment.

While carrying out the study the main challenge was the scarcity of data on the construction industry country-wide, to remedy this the difference between the value of building plans in Nairobi and the reported value of completed buildings were used to approximate the delays in construction. These values were then used to model the effects of the delay on the GDP growth and unemployment rate using Koyck models.

The effects of the delay on GDP were modelled with the spread between the value of buildings as the independent variable to enable the data to better portray the nature of GDP growth in the country and introduce the effects of the delay. The model revealed that the GDP has a negative speed of adjustment and rate of decay thus it is heavily affected by previous declines and is likely to take a long time to recover from shocks. The delay is inversely related indicating an increase having a decreasing effect on the GDP's growth.

To model the effect of the delay on the unemployment rate, the number of those in formal employment, informal employment, and the value of the wages in the construction sector were used as independent variables in their respective Koyck models with the spread. The data on unemployment in the sector was not available at the time of analysis, therefore the number of employees both formal and informal were used to infer the number of jobs that could be potentially lost because of the delay.

The Koyck models of all three relationships returned negative rates of decay, suggesting that in all cases the spread of the value of the buildings would diminish given changes in its previous values. The models of formal employment and wages displayed negative

speeds of adjustment indicating recovery from changes easily while the model of informal employment returns a negative speed of adjustment indicating a longer recovery from shocks. The informal employment and wages have positive relationships with the spread which suggest that an increase in their values could have an inflammatory effect on the delay, as increase in wages would represent a financial burden and increase in informal employment would represent in workforce not captured by the project. The formal employment has an inverse relationship with the spread, since an increase in those formally employed in the construction industry would decrease the construction gap created by the delay.

To estimate the employment volume required to achieve timely completion of the project, a VAR model was used to model and then forecast the values of the variables used. The model revealed that formal employment had a positive relationship with the lags of wages, informal employment, and the spread, suggesting that an increase in any of these variables would increase the number of those employed. On the other hand, employment had an inverse relationship with the lags of itself and GDP growth, thus an increase in these values would decrease the number of people employed.

Correlation tests were run that indicated positive relationship between the employment and wage, GDP growth and the spread values, additionally a granger causality test was run that reported that the spread granger causes all the variables used in the model. These tests verified the validity of the relationships between the variables, thus allowing for forecasting. The forecast revealed that the volume of employment required would average approximately 294,868 between the years 2020 and 2022.

To evaluate the financial implications of the delay the average of the forecasted values and the historical values were used to calculate the average in the variables which would represent the gains or losses to the time of the completion of the project. This revealed a loss in unskilled labour as they are not incorporated into the project. It also suggested that if not completed in a timely manner, the project could fail to capture 0.419% of GDP growth, 73,368 in formal employment and 57,249.2 million shillings in wages. Therefore, the timely completion of this project is an important goal as the opportunity cost could be high.

5.2 Limitations

When conducting the analysis, the data used reflects the construction industry in Nairobi county but does not directly reflect the data on the affordable housing program. The data used gives an approximation of the effects of the delay but would not show the direct effects of the delay in the project.

Additionally, the methods of analysis used were linear thus lacked in robustness as compared to multilinear models that would allow for comparison and further discussions of the effect of the delay.

5.3 Recommendations for further studies

Future studies could utilize data directly from the project to evaluate the effects of the delay in the economy specifically the construction and housing sectors. This future research could collect the relevant data from the companies involved in the project as well as the government to get a more in-depth view of the effects of the project as well as its delays.

The research done investigated the short-term forecasts of the variables, this leads to restrictions on evaluation of the long-term effects of the delay past the date of proposed completion. Further study can be done into the longer-term effects by incorporating more historical data on the construction industry.

In the analysis a linear model was used which restrict the research in terms of robustness, this could be improved using multilinear models that include other counties in the country or compare the project in Kenya to similar projects in other countries. This could be achieved by implementing panel data analysis or pooled OLS modelling which would improve the scope of the study.

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APPENDICES

APPENDIX A: R CODES

Load packages

```
library(tidyverse)

library(forecast)

library(ggseas)

library(tseries)

library(dLagM)

library(lmtest)

library(tsm)

library(vars)
```

Add data and organize

```
"Year"<-c(2007,2008,2009,2010,2011,2012,2013,2014,2015,2016,2017,2018,2019)

"Wages (ksh millions)"<-
c(27559.5,31439.3,36075.5,40656.4,39078.8,44351.9,57238.2,73542.8,92157.8,126629.
3,135292.7,147152.0,159832.5)

"No. of employed('000)"<-
c(81.3,84.8,93.4,101.2,95.6,106.0,119.1,133.1,148.1,207.1,213.4,218.4,221.5)

"No. of workers in informal sector('000)"<-
c(202.8,211.4,217.5,228.9,251.7,270.4,277.9,307.3,307.2,322.9,348.6,367.8,385.2)

"Value of Building Plans Approved (ksh million)"<-
c(59765.1,52073.0,78303.7,93574.8,112842.8,135128.2,190646.5,205423.9,215211.0,3
08361.4,240752.0,210296.7,207624.9)
```

```
"Reported Building Works Completed(Ksh Million)"<-
c(9786.7,11018.2,13574.2,34707.5,39849.9,43574.2,52276.0,59056.7,70867.4,77749.7,
86128.4,90127.4,93982.3)

"Annual GDP growth"<-
c(0.069,0.015,0.027,0.084,0.061,0.046,0.059,0.054,0.057,0.059,0.048,0.063,0.054)

"Deficit"<-
c(49978.4,41054.8,64729.5,58867.3,72992.9,91554.0,138370.5,146367.2,144343.6,230
611.7,154623.6,120169.3,113642.6)

trial1<-data.frame(Year,`Value of Building Plans Approved (ksh million)`,`Wages (ksh
millions)`,`No. of employed('000)`,`No. of workers in informal sector('000)`,`Reported
Building Works Completed(Ksh Million)`,`Annual GDP growth`,`Deficit`)

dt1<-trial1

is.ts(dt1)

dts1<-as.ts(dt1,start=c(2007),end=c(2019),frequency=1)

is.ts(dts1)
```

Make the variables stationary

```
emp<-dt1$`No. of employed('000)`

is.ts(emp)

empts<-as.ts(emp)

is.ts(empts)

Empts<-as.ts(empts,start=c(2007),end=c(2019),frequency=1)

#check for stationarity

adf.test(Empts)

#make it stationary
```

```
emplts<-diff(Empts,diff=4)

adf.test(emplts)


def<-dt$`Deficit`

is.ts(def)

dets<-as.ts(def)

is.ts(dets)

dts<-as.ts(dets,start=c(2007),end=c(2019),frequency=1)

#check for stationarity

adf.test(dts)

#make it stationary

defts<-diff(dts,diff=4)

adf.test(defts)


infemp<-dt1$`No. of workers in informal sector('000)`

is.ts(infemp)

ints<-as.ts(infemp)

is.ts(ints)

infts<-as.ts(ints,start=c(2007),end=c(2019),frequency=1)

#check for stationarity

adf.test(infts)

#make it stationary

infempts<-diff(infts,diff=4)
```

```
adf.test(infempts)


wage<-dt1$`Wages (ksh millions)`
is.ts(wage)
wagets<-as.ts(wage)
is.ts(wagets)
wagests<-as.ts(wagets,start=c(2007),end=c(2019),frequency=1)
#check for stationarity
adf.test(wagests)
#make it stationary
wats<-diff(wagests,diff=4)
adf.test(wats)


valb<-dt1$`Value of Building Plans Approved (ksh million)`
is.ts(valb)
valbts<-as.ts(valb)
is.ts(valbts)
vbts<-as.ts(valbts,start=c(2007),end=c(2019),frequency=1)
#check for stationarity
adf.test(vbts)
#make it stationary
valuebts<-diff(vbts,diff=4)
adf.test(valuebts)
```

```
compb<-dt1$`Reported Building Works Completed(Ksh Million)`
is.ts(compb)
compbts<-as.ts(compb)
is.ts(compbts)
cbts<-as.ts(compbts,start=c(2007),end=c(2019),frequency=1)
#check for stationarity
adf.test(cbts)
#make it stationary
complbts<-diff(cbts,diff=4)
adf.test(complbts)

gdpgr<-dt1$`Annual GDP growth`
is.ts(gdpgr)
gdpgrts<-as.ts(gdpgr)
is.ts(gdpgrts)
ggts<-as.ts(gdpgrts,start=c(2007),end=c(2019),frequency=1)
#check for stationarity
adf.test(ggts)
```

Calculate the spread between the building values

```
spread<-complbts-valuebts
adf.test(spread)
```

```
sprd<-diff(spread,diff=4)

adf.test(sprd)
```

Make the variables numeric to use in Koyck model

```
s<-as.numeric(sprd)

g<-as.numeric(ggts)

inf2<-as.numeric(infempts)

em1<-as.numeric(emplts)

wa<-as.numeric(wats)
```

Run Koyck models

```
model.koyck1 – koyckDlm(x –s,y –g)

summary(model.koyck1, diagnostics = TRUE)

model.koyck1

res1<-residuals(model.koyck1)

coef(model.koyck1)

fit1<-fitted(model.koyck1)

plot(density(res1))

plot(fit1,res1)

abline(0,0)


model.koyck2 = koyckDlm(x =s,y =diff(em1))

summary(model.koyck2, diagnostics = TRUE)
```

```
res2<-residuals(model.koyck2)

coef(model.koyck2)

fit2<-fitted(model.koyck2)

plot(density(res2))

plot(fit2,res2)

abline(0,0)

model.koyck3 = koyckDlm(x =s,y =inf2)

summary(model.koyck3, diagnostics = TRUE)

res3<-residuals(model.koyck3)

coef(model.koyck3)

fit3<-fitted(model.koyck3)

plot(density(res3))

plot(fit3,res3)

abline(0,0)


model.koyck4 = koyckDlm(x =s,y =wa)

summary(model.koyck4, diagnostics = TRUE)

res4<-residuals(model.koyck4)

coef(model.koyck4)

fit4<-fitted(model.koyck4)

plot(density(res4))

plot(fit4,res4)

abline(0,0)
```

Run VAR model

```
vdata<-cbind(wagests,Empts,infts,gdpgrts,dts)

colnames(vdata) <- c("wage", "emp","infemp","GDPgr","spread")

vdata

vardat <- VARselect(vdata, lag.max = 10, type = "const")

vardat$selection

vard <- VAR(vdata, p = 1, type = "const", season = NULL,exog = NULL)

summary(vard)

ww<-causality(vard, cause = "spread")

ww
```

Forecast the values

```
predvard<-predict(vard,n.ahead=3,ci=0.95)

predvard

plot(predvard,name="emp")

plot(predvard,name="wage")

plot(predvard,name="infemp")

plot(predvard,name="GDPgr")

plot(predvard,name="spread")
```