# Econometry Modeling in Analyzing the Determinants of Increasing Life Expectation Rate

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**A B S T R A K**

*Modal manusia adalah istilah yang mengacu pada pengembangan diri manusia di bidang pendidikan, kesehatan, dan potensi lainnya untuk meningkatkan produktivitas. Upaya tersebut akan terwujud apabila ada kesadaran, kemauan, dan kemampuan hidup sehat dalam diri setiap orang. Penelitian ini bertujuan untuk menganalisis Model Ekonometrika dalam Peningkatan Angka Harapan Hidup dengan Intervensi Penyehatan Lingkungan, Pelayanan Kesehatan, dan Imunisasi di Nusa Tenggara Barat. Penelitian ini dilaksanakan di 10 Kabupaten/Kota Provinsi Nusa Tenggara Barat, dengan menggunakan pemodelan ekonometrika yaitu melakukan regresi data panel dengan eviews 11 sebagai alat analisis. Hasil pemodelan ekonometrika ditemukan bahwa angka harapan hidup di Nusa Tenggara Barat pada tahun 2035 adalah 0,57 bulan dalam kondisi normal. Setelah dilakukan intervensi dengan variabel penyehatan lingkungan, angka harapan hidup tahun 2035 adalah 1,08 bulan, artinya ada peningkatan 0,4 bulan; Variabel kesehatan khususnya pertolongan persalinan yang dilakukan oleh tenaga kesehatan menjadi prioritas utama dalam model tersebut, yang dapat meningkatkan angka harapan hidup 11 bulan tiga minggu enam hari; dan peningkatan Angka Harapan Hidup di Nusa Tenggara Barat dari aspek perilaku masyarakat.*

**A B S T R A C T**

Human capital is a term that refers to human self-development in the fields of education, health, and other potentials for increasing productivity. These efforts will be realized if there is awareness, willingness, and ability to live healthily in everyone. This study aimed to analyze the Econometric Model in increasing Life Expectancy with Environmental Sanitation, Health Services, and Immunization Interventions in West Nusa Tenggara. This research was carried out in 10 the Regency/City of West Nusa Tenggara Province, using econometric modeling, namely performing panel data regression with eviews 11 as an analytical tool. The results of econometric modeling found that the life expectancy in West Nusa Tenggara in 2035 was 0.57 months under normal conditions. After intervention with the environmental sanitation variable, the life expectancy in 2035 was 1.08 months, meaning there was an increase of 0.4 months; Health variables, especially delivery assistance carried out by health workers, become the main priority in the model, which can increase life expectancy by 11 months three weeks six days; and the increase in Life Expectancy in West Nusa Tenggara from the aspect of community behavior.

## 1. INTRODUCTION

The success of economic development must be supported by human development or the Human Development Index (HDI), a standardized measure that reflects not only in the economic field but also life expectancy to educational achievements. Human capital is a term that refers to human self-development in the fields of education, health, and other potentials for increasing productivity (Kojo et al., 2019; Riyadi & Huseini, 2019). These efforts will be realized if there is awareness, willingness, and ability to live healthily in everyone. The availability of quality Human Resources (HR) also plays a role in the success of development in a nation (Hidayat & Syam, 2020; Purnamawati & Yuniarta, 2021). Quality human resources in question are Human Resources who have physically and mentally strong, excellent, and intelligent (Manik, 2020; Priharjanto, 2020). Health development aims to provide the widest possible opportunity for the community to obtain optimal health degrees. The implementation of health development efforts and its resources is part of the responsibility of the government and the community, which is aimed at meeting the health need so that all residents can live healthy lives that they can realize optimal public health degrees and are carried out in an integrated and sustainable manner to achieve the specified results.

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The Ministry of Health's Strategic Plan emphasizes the Healthy Indonesia Program to improve the community's health and nutritional status through various health efforts and community development, which facilities and infrastructure also support. It follows the fifth National Development Agenda (Nawa Cita), "Improving the Quality of Indonesian Human Life" with the third sub-agenda, the Implementation of the Healthy Indonesia Program. Through this, the government is committed to increasing human data sources so that Indonesia's development will also certainly experience improvement toward sustainable development goals (Li et al., 2020; Purnamawati et al., 2022).

Life Expectancy (AHH) is one of the important indicators that act as a measuring tool for government performance in planning and evaluating national development, especially expenditures in the health sector. AHH describes the number of years that a newborn baby is expected to achieve to live, in a given year, in a mortality situation prevailing in his community. Newborns in premature conditions are largely determined by environmental factors and health care carried out by medical personnel (Rojas et al., 1996). Immunization (vaccination) affects the health of mothers and babies who have not yet been born and has an impact on the population (Trawicki, 2017). The high life expectancy can be seen from the birth of healthy babies. The data on Life Expectancy (At Birth), Sickness Rates in the Provinces of Bali, NTB, and NTT in 2019 illustrates that the Life Expectancy (At Birth) in West Nusa Tenggara is still below the national standard, even below East Nusa Tenggara and Bali, which is 65.48. The morbidity rate is still high, above the national level, in urban areas 20.04 and rural areas 21.39 (Pinho, 2015). In contrast, the morbidity rate based on gender in NTB is still high compared to Bali and NTT, namely male 21.17 and female 20.46. High morbidity rates can affect family health, especially the health of mothers and children.

There are at least four approach methods in policy modeling: econometrics, input-output analysis, optimization analysis, and system dynamics (Chofyan, 2014). In this study, the modeling used is econometric modeling and system dynamics. Econometrics analyzes panel data with the help of software eviews. At the same time, Modeling System dynamics is a systems thinking method that can analyze aspects and explain structurally the phenomenon of still high maternal and infant mortality rates. Compared to others, the advantages of this modeling are that each element and relationship in the model has an identifiable equivalent in the real world, and it assumes that the world consists of a closed system dominated by feedback, stock, and flow, non-linear and has a grace period. The policy of increasing life expectancy using the system dynamics model is expected to provide policy alternatives that are effective in reducing maternal and infant mortality so that life expectancy increases, namely by identifying the factors that make up a phenomenon and the interrelationships between these elements.

The novelty in this research is the use of the dynamic system method in analyzing health economic problems. The explanations above can provide an overview of the importance of the problem of life expectancy, so it is very necessary to study in depth the structure of phenomena such as what can explain the low life expectancy and its impact on the population, which in turn results in the provision of budgets and health status. in West Nusa Tenggara and what kind of policy scenarios are needed to increase life expectancy in West Nusa Tenggara.

## 2. METHODS

The method used in this research is econometrics and system dynamics simulation. Econometric modeling is done by performing panel data regression combining time series data for the 2008-2019 period with cross-sectional data from 10 districts/cities in West Nusa Tenggara. System dynamics modeling was developed from systems thinking. The system dynamics method was chosen to build the model that will be used based on the background, problem formulation, and framework because the Life Expectancy in West Nusa Tenggara has a dynamic nature, and the phenomenon structure contains more than one feedback structure (Busienei et al., 2019).

This research was conducted in West Nusa Tenggara, using Time Series data in 10 (ten) districts/cities in NTB for 12 years from 2008-2019. The data used in this study are qualitative and quantitative. The primary data sources in this study are data obtained from observations and in-depth interviews. In this study, documentation and questionnaires are secondary data sources. Data collection techniques used in this study (Sugiyono, 2011) are observation, interview, and Focus Group Discussion. Variable and the operational definitions are presented in Table 1.

This study uses regression analysis which can be used to analyze the relationship between variables. This study uses panel data, a combination of cross-sectional and time series data for each cross-section. The selection of panel data in this study is closely related to the research objectives and to obtain a larger number of observations due to data limitations. The aim is to estimate ten districts and cities in West Nusa Tenggara Province during 2008-2019. The equation that will be used is a linear regression equation model. To determine the best estimation model for the model equation, whether with fixed effects or

random effects, the Hausman Specification Test is carried out. Evaluation of this model is intended to decide whether the estimates of the parameters are theoretically meaningful and statistically significant.

**Table 1.** Variables and Operational Definitions

| No | Variable | Symbols | Operational Definitions | Data Sources |
|---|---|---|---|---|
| 1 | Life expectancy | AHH | The estimated average length of life of the population with the assumption that there is no change in mortality patterns by age | BPS |
| 2 | Immunization | Im | Coverage level of basic immunization | Dikes NTB |
| 3 | Health services | PK | The level of coverage of deliveries assisted by health workers, and postpartum maternal health services | Dikes NTB |
| 4 | Environment sanitation | SL | Level of access to proper sanitation facilities (healthy latrines) | Dikes/ DLH NTB |

## 3.  RESULTS AND DISCUSSIONS

**Results**

Life expectancy is a tool to evaluate the government's performance in improving the welfare of the population in general and improving health status in particular. Estimates of the average length of life of the population with the assumption that there is no change in the pattern of morality according to age with the calculation of the ratio of life expectancy in districts/cities in West Nusa Tenggara Province can be seen in Table 2.

**Table 2.** Ratio of Life Expectancy in Regencies/Cities in West Nusa Tenggara Province in 2007 – 2019 (in Percentage)

| Reg/City | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MATARAM | 64.01 | 65.66 | 66.15 | 69.16 | 69.45 | 69.73 | 70.03 | 70.18 | 70.43 | 70.70 | 70.98 | 71.24 | 71.59 | 70 |
| LOMBOK BARAT | 58.31 | 59.97 | 60.40 | 63.41 | 63.73 | 64.04 | 64.36 | 64.50 | 65.10 | 64.55 | 65.78 | 66.16 | 66.64 | 64 |
| LOMBOK TIMUR | 58.17 | 59.70 | 60.26 | 63.03 | 63.32 | 63.61 | 63.90 | 64.04 | 64.44 | 64.73 | 65.01 | 65.33 | 65.74 | 64 |
| LOMBOK TENGAH | 58.71 | 60.24 | 60.66 | 63.42 | 63.72 | 64.00 | 64.30 | 64.45 | 64.75 | 65.01 | 65.28 | 65.59 | 65.99 | 64 |
| LOMBOK UTARA | 57.66 | 59.80 | 60.16 | 64.13 | 64,45 | 64.74 | 65.04 | 64.19 | 65.59 | 65.88 | 66.17 | 66.50 | 66.92 | 64 |
| SUMBAWA | 58.34 | 60.51 | 60.61 | 64.63 | 64.96 | 65.25 | 65.58 | 65.72 | 66.02 | 66.30 | 66.58 | 66.90 | 67.31 | 65 |
| SUMBAWA BARAT | 58.95 | 60.94 | 61.11 | 64.80 | 65.10 | 65.39 | 65.69 | 65.85 | 66.35 | 66.66 | 66.98 | 67.34 | 67.80 | 65 |
| DOMPU | 59.14 | 60.83 | 60.94 | 64.03 | 64.33 | 64.62 | 64.92 | 65.06 | 65.36 | 65.62 | 65.89 | 66.20 | 66.60 | 65 |
| BIMA KOTA | 60.03 | 62.74 | 62.86 | 67.99 | 68.29 | 68.58 | 68.88 | 69.03 | 69.12 | 69.35 | 69.58 | 71.24 | 70.20 | 68 |
| BIMA KAB. | 61.71 | 62.31 | 62.62 | 63.53 | 63.82 | 64.10 | 64.42 | 64.56 | 64.86 | 65.13 | 65.40 | 65.71 | 66.11 | 64 |
| **NTB** | 59.50 | 61.27 | 61.58 | 64.81 | 65.12 | 65.41 | 65.71 | 65.76 | 66.20 | 66.39 | 66.77 | 67.22 | 67.49 | 65 |

Based on Table 3, it can be seen that the results of the ratio calculation from 2007 – 2019 in 10 districts/cities show that only five districts have a low average life expectancy ratio, namely West Lombok, with a life expectancy ratio of 64 percent. Hausman model test if the probability value of F and Chi-square > = 5 percent, then the panel data regression test uses the Random Effect model. If the probability value of F and Chi-square < = 5%, then the panel data regression test uses the Fixed Effect model or the hypothesis.

**Table 4.** Hausman Model Test Results

| No. | Model | *Housman Test* | Sig. (α) | Best Model |
|---|---|---|---|---|
| 1 | $PK_{it} = ƒ(PP_{it})$ | 0.0003 | 0.05 | FEM |
| 2 | $SL_{it} = ƒ(JP_{it}, PP_{it})$ | 0.2544 | 0.05 | REM |
| 3 | $Im_{it} = ƒ(PK_{it}, KOV_{it})$ | 0.0828 | 0.05 | REM |
| 4 | $AHH_{it} = ƒ(RKB_{it}, PP_{it}, TP_{it}, KDRT_{it})$ | 0.0052 | 0.05 | FEM |
| 5 | $RIH_{it} = ƒ(Im_{it}, PK_{it}, SL_{it}, AHH_{it-1})$ | 0.6855 | 0.05 | REM |

Based on the results of data analysis, a regression model can be made for the Previous Year's Life Expectancy (AHH-1), Environmental Sanitation (SL), Health Services (PK), and Basic Immunization

Coverage (Im), on the Risk Level of Maternal Death (RIH) in regency/City of West Nusa Tenggara in the 2008-2019 period with the following equation.

The magnitude of the effect of the previous year's Life Expectancy (AHH-1), Environmental Sanitation (SL), Health Services (PK), and Basic Immunization Coverage (IM) is 0.271836 or 27.18 percent, and other variables influence the rest. While the effect of the probability of the number of life expectancy in the previous year (AHH-1), Environmental Sanitation (SL), Health Services (PK), and Basic Immunization Coverage (Im), had a significant simultaneous effect on the Risk Level of Maternal Mortality (RIH). It is evidenced by the F statistic below 0.05.

**Discussion**

Variable Basic Immunization Coverage (IM) has a negative but insignificant effect on the Risk Level of Maternal Mortality (RIH). This result rejects the proposed hypothesis, meaning that increasing Basic Immunization Coverage (IM) has no significant impact on reducing the Risk Level for Maternal Mortality (RIH) in the Regency/City of West Nusa Tenggara in the 2008-2019 period. This study is in line with the findings that maternal immunization can improve maternal and child health worldwide by reducing maternal and infant morbidity and mortality associated with diseases caused by pathogens in the perinatal period and early in life (Munoz, 2018). Therefore immunization is an alternative prevention strategy effective in the long term. Another previous study found the results of a survey of obstetricians in the United States regarding their vaccination practices and perceptions during the H1N1 outbreak in 2009 (Link-Gelles et al., 2011). Most (84 percent) of respondents stated that their practice would give pregnant patients the H1N1 vaccine. While the majority (98 percent) of the service providers who responded felt childhood vaccination was important, relatively few (47 percent) felt that they could influence mothers' vaccination choices for their children. Discussions about routine childhood immunizations between obstetricians and their patients are an area for future improvement in maternal and child vaccination.

The Health Service (PK) variable has a positive but insignificant effect on the Risk Level of Maternal Mortality (RIH). This result rejects the proposed hypothesis, which means that the decline in Health Services (PK), especially health workers who assist in the delivery process, has no significant impact on reducing the Risk Level for Maternal Death (RIH) in the Regency/City of West Nusa Tenggara in the 2008-2019 period. This study is in line with the findings that the number of available health workers did not necessarily reduce Maternal Mortality in Uganda (Namazzi et al., 2017). It was due to a lack of knowledge due to the minimal training provided by the government, and transportation facilities were also a determining factor. Intervention through training can reduce maternal mortality by 41.3 percent to 77.4 percent after training, and to 79.9 percent, 1 (one) year after training and by being given additional transportation money to improve service performance. Previous study found that health workers who provide health services to pregnant women and children do not have a satisfactory impact in reducing maternal and child mortality due to low monitoring (evaluation) of health workers providing services and the low health budget provided by the government in the Kaushambi district of Uttar Pradesh, India (Prinja et al., 2018).

Environmental Sanitation (SL) variable has a positive and insignificant effect on the Risk Level of Maternal Mortality (RIH). This result rejects the proposed hypothesis, meaning that increasing the coverage of Environmental Sanitation (SL), especially access to healthy latrines, has a non-significant impact on reducing the Risk Level for Maternal Mortality (RIH) in the Regency/City of West Nusa Tenggara in the 2008-2019 period. This study is in line with the findings found the lack of utilization of latrine facilities built by the government due to low knowledge about health is a factor causing disease transmission in pregnant women in poor and developing countries (Campbell et al., 2015). Using water contaminated with chemicals in the toilet can endanger the mother's health, such as phosphate ammonia which can cause stomach cramps. Using water contaminated with chemicals in the toilet can harm the mother's health, such as phosphate and ammonia which, can cause stomach cramps and even death (Benova & Cumming, 2014).

The variable life expectancy in the previous year (AHH-1) had a negative but insignificant effect on the Risk Level of Maternal Mortality (RIH). This result rejects the proposed hypothesis, which means that the increase in life expectancy in the previous year (AHH-1) had no significant impact on decreasing the Risk of Maternal Mortality Rate (RIH) in the Regency/City of West Nusa Tenggara in the 2008-2019 period. This study is in line with the findings that life expectancy at birth in sub-Saharan Africa is less modifiable through specific short-term interventions to reduce maternal mortality due to the low availability of health resources and sexual violence in the form of illegal abortions (Brabin et al., 2013). It means that although life expectancy increases, it cannot guarantee a significant reduction in maternal mortality due to low health resources and illegal abortions. Although life expectancy has increased, maternal mortality is also unavoidable. The specific factor causing injury and death is unintentional and violent in 363 cities in nine Latin American countries.

The classical theory of Hendrik L. Bloom states that environmental factors have an influence and role of 45 percent. The environment in this study uses Environmental Sanitation as seen from access to healthy latrines. The results of modeling life expectancy by intervening the environmental sanitation variable show an increase for the next 15 years or to be precise, in 2035, namely 0.4 months, from 67.49 years to 67.89 years. This result is still far from the national standard of 73.7 years in 2035. Some causes are water quality, population density, and the behavior or habit of defecating in the river. According to Hendrik L. Bloom's theory, Health Service Factors influence 15 percent. Health service factors affect the degree of public health because the existence of health facilities is very decisive in health recovery services, disease prevention, treatment and nursing, and community groups that require health services. Health variables, especially delivery assistance carried out by health workers, are the main priority in the model, which can increase life expectancy. Furthermore, nutritional adequacy becomes the second priority, the variable coverage of vaccination/immunization is the third priority and the variable level of coverage of the distribution of drug/vaccine availability throughout.

## 4. CONCLUSION

This study succeeded in finding several important findings, namely as follows: the attitude of "Abot-Kasaga-Lemang" or a reluctance to do something. This attitude causes pregnant or giving birth mothers not to come to health service facilities provided by the government to carry out immunizations. It has changed the pattern of health services for mothers and babies by bringing supplies of drugs/vaccines from the Puskesmas and visiting the places where the mothers and babies live. This pattern can increase the Life Expectancy of Mothers and Infants in the Regency/City of West Nusa Tenggara. This research is a development of Hendrik L. Bloom's classical theory of health status, where health status is an indicator of community welfare, as seen from the increase in life expectancy. In addition, this study provides an in-depth analysis of the factors of health status, both with the econometric method of panel data regression and with continuous analysis techniques, namely the dynamic system, so that it can be used as reference material for further researchers. The results of this study can be used as a basis or reference material in making policies by the Regional Government, especially the Regency/City in West Nusa Tenggara in improving the health status of the community so that policy interventions are more measurable in increasing Life Expectancy in West Nusa Tenggara.

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