# PENGARUH SANITASI TERHADAP TINGKAT MORBIDITAS DI INDONESIA

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**ABSTRAK**

Morbiditas merupakan suatu keadaan dimana seseorang dikatakan sakit apabila seseorang mengalami keluhan kesehatan yang dapat mengganggu kegiatan setiap hari, serta tidak mampu melakukan aktivitas seperti bekerja, melakukan pekerjaan rumah tangga dan aktivitas rutin lainnya seperti biasa. Penelitian ini bertujuan untuk mengetahui apa saja faktor yang mempengaruhi angka kesakitan/morbiditas di Indonesia dan seberapa besar pengaruhnya terhadap angka kesakitan di Indonesia, Penelitian ini mengkaji angka kesakitan di kabupaten/kota di Indonesia selama tahun 2010-2020. Penelitian ini menggunakan metodologi regresi data panel model statis. Sebagai hasilnya, variabel yang mempengaruhi adalah variabel persentase tidak mempunyai akses terhadap sanitasi, pengeluaran per kapita, dan lag DAU. Angka kesakitan akan menurun jika akses terhadap sanitasi membaik, pengeluaran per kapita menurun, dan DAU meningkat (terutama untuk kesehatan). Model yang sesuai untuk data ini adalah model FEM karena adanya kovarians antara efek spesifik individu dan regresi. Melalui penelitian ini kami berharap pemerintah selalu meningkatkan sanitasi di seluruh Indonesia sehingga angka kesakitan dapat menurun. Keterbatasan penelitian adalah data yang dikumpulkan melalui INDO DAPOER tidak lengkap dan terkini. Bagi penelitian berikutnya, beberapa variabel lain yang mempengaruhi angka kesakitan dapat ditambahkan. Semakin lengkap variabelnya maka semakin akurat model yang dibentuk.

Kata kunci : Morbiditas; Sanitasi; Panel; Regresi

***ABSTRACT***

*Morbidity is a condition where a person is said to be sick if a person experiences health complaint that can interfere with daily activities, and is unable to carry out activities such as working, doing household work and other routine activities as usual. This research aims to find out what factors influence morbidity/morbidity rates in Indonesia and how much influence they have on morbidity rates in Indonesia. This research examines morbidity rates in districts/cities in Indonesia during 2010-2020. This research uses a static model panel data regression methodology. As a result, the influencing variables are the percentage variable without access to sanitation, per capita expenditure, and the DAU lag. Morbidity rates will decrease if access to sanitation improves, per capita expenditure decreases, and DAU increases (especially for health). The most suitable model for this data is the FEM model because of the covariance between individual specific effects and the regression. Through this research, we hope that the government will always improve sanitation throughout Indonesia so that morbidity rates can decrease. A limitation of the research is that the data collected through INDO DAPOER is not complete and up to date. For next research, several other variables that influence morbidity rates can be added. The more complete the variables, the more accurate the model formed.*

*Keywords : Morbidity; Sanitation; Panel; Regression*

## INTRODUCTION

Sustainable Development Goals (SDGs) that have been agreed upon by the United Nations (UN) have a main focus, namely improving human welfare in various aspects of life. One aspect that is a tool for measuring the level of human welfare in Indonesia is called the Human Development Index (HDI). Physically healthy Human Resources (HR) are expected to become quality humans who can play a role in development to realize people's welfare. Health is a perfect condition for both physical and mental conditions, as well as social conditions and is free from disease or weakness. Therefore, the health indicators of an area can be seen from the number of residents who experience pain or are infected with a disease.

There are several indicators used to measure the health status of the population, and one of them is morbidity (illness). High morbidity rates indicate poor population health. On the other hand, a low morbidity (illness) rate indicates a good level of population health. The definition of morbidity (illness) is a condition where a person is said to be sick if a person experiences health complaint that can interfere with daily activities, and is unable to carry out activities such as working, doing household work and other routine activities as usual. Based on research conducted by health experts, morbidity (illness) is caused by several diseases such as tuberculosis, neonatal respiratory distress syndrome, and diarrhea. Asthma, tuberculosis and diarrhea have a negative impact on patients' lives, causing school-aged children to often not go to school, making personal and family activities very limited, and causing work productivity to decrease. These diseases arise due to wrong lifestyle and eating patterns, as well as a dirty environment, all stemming from a lack of knowledge about health problems themselves, both regarding nutrition and the environment.

A case study on morbidity (illness) was developed by Cucu Sumarni and Mohammad Radiansyah in 2012 who carried out morbidity modeling for the provinces of Bali and Jawa Barat using ZIGP regression. Morbidity has also been developed by many health experts around the world using Poisson regression models such as log-linear, logit, logistic, namely models whose data is in the form of count data, as done by Warouw, Fuhrer and Arola.

Morbidity (illness) indicators are shown in three dimensions, namely the knowledge dimension, the dimension of a decent life, and the dimension of a long and healthy life. The illiteracy rate (adults) is the basis for measuring the dimensions of knowledge. The percentage of the population without access to clean water and the percentage of the population without access to health facilities are the basis for measuring the dimensions of a decent life. Meanwhile, life expectancy is the basis for measuring the dimensions of long and healthy life.

This research aims to explore what factors influence morbidity/morbidity rates in Indonesia and how much influence they have on morbidity in Indonesia.

## LITERATURE REVIEW

There are several journals that explain the relationship between sanitation and reduced morbidity. Healthy environmental sanitation has a significant relationship with morbidity which is an indicator of the nutritional status of children under five and their weight for age (Hidayat & Fuada, 2011). By using the MGWR method, sanitation has a significant effect on morbidity (Hanum & Purhadi, 2013). There is a link between organizational environmental sanitation and toddler morbidity (Safitri, 2015). The reduction in diarrhea morbidity is also closely related to sanitation programs (Makotsi et al., 2016). Lack of sanitation also still causes more than 1000 deaths in the world every day (I et al., 2017). Several sanitation variables such as the type of drinking water source, availability of toilets, and the habit of washing hands after using the toilet are also associated with childhood diarrhea (Bitew et al., 2017). There is a relationship between latrine use behavior, clean water use behavior, hand washing behavior with soap, waste management facilities, and feces disposal with the incidence of diarrhea in toddlers (Susanti, 2018). Diarrhea disease control can also be improved by improving access to better sanitation waste disposal methods and encouraging people to wash their hands with soap and water at critical times (Nwokoro et al., 2020). Infants in households where liquid waste management is less appropriate and hand cleaning activities are less frequent also have a greater risk of infant death related to diarrhea (Mebrahtom et al., 2022). Washing with water can also prevent respiratory diseases and diarrhea, which are the two biggest causes of childhood death in countries with low to medium mortality rates (Sharma Waddington et al., 2023).

There are also several journals which state that sanitation is not significantly related to morbidity. Among them is that there is no connection between the biophysical environment and toddler morbidity (Suharwati et al., 2013). Household sanitation is not closely related to diarrhea and acute respiratory infections in children (Azupogo et al., 2019). There are also estimates that from 1990 to 2015, improved sanitation only contributed to less than 10% of the reduction in child mortality (Headey & Palloni, 2019). Environmental sanitation is also related to diarrhea morbidity in kindergarten children, but the effect is very low and not significant (Ramadhani et al., 2021). Evidence supporting sanitation interventions on diarrhea morbidity rates, especially in toddlers, is still weak (Fischer Walker et al., 2022).

**Morbidity** is a condition where a person is said to be sick if a person experiences health complaint that can interfere with daily activities, and is unable to carry out activities such as working, doing household work and other routine activities as usual. The following is the formula for morbidity rates.

$$MR = \frac{NRHC}{P} x\ 100$$

Information:

MR : morbidity rate

NRHC : number of residents experiencing health complaints and disruption of activities

P : population

**Environmental Sanitation** is the health status of an environment which includes housing, waste/dirt disposal, provision of clean water and so on. Environmental sanitation is carried out to create a comfortable and healthy environmental atmosphere. There are several forms of basic sanitation, including facilities for the disposal of human waste, waste water disposal channels, household waste disposal facilities, and the provision of clean water. Every family must have a facility for disposing of human waste or what is usually called a latrine always well maintained or clean and healthy to prevent environmental pollution from human waste and as a sign that the family does not defecate anywhere. Waste disposal facilities also include basic sanitation efforts because every human being produces waste.

**Average expenditure per capita** is the cost incurred by a household for consumption by all household members for a month. This consumption can come from gifts, purchases, or own production divided by the number of household members in the household.

**Area** is the area covered by the territorial power of a country, both land and sea areas over which the country's jurisdiction applies. The area ends at the boundaries of the area with physical conditions such as rivers, mountains and so on. These territorial boundaries can be land or sea and are legally agreed upon by countries and the world community.

**Residents** are all people who reside in the geographical area of the Republic of Indonesia for six months or more. Residents can also be referred to as people who have lived in Indonesia for less than six months but intend to stay.

**General Allocation Funds (DAU)** are funds obtained from APBN revenues which are distributed to all regions with the aim of ensuring that financial capacity in all regions is equal to finance various decentralization activities in the region. DAU aims to reduce disparities in financial capacity between regions. This is done by applying a formula that considers regional needs and potential

**Special Allocation Funds (DAK)** are funds obtained from APBN revenues allocated to certain regions. The purpose of this DAK is to help fund special activities that are the business of a region and the provision is in accordance with national priorities.

**Poverty** comes from the word "poor" which means having no possessions and lacking everything. The Statistics of Indonesia defines it as a person's inability to fulfill their minimum basic needs so that they can be said to have a decent life. For further explanation, poverty is a condition where a person is below the standard minimum needs, both for food and non-food. This minimum standard limit is called the poverty line or also known as the poverty threshold.

**Panel data** is a combination of cross section data (between individuals/rooms) and time series data (between times). To briefly describe panel data, for example in cross section data, the values of one or more variables are collected for several sample units at one time. In panels data, the same cross section unit was surveyed several times (Gujarati, 2003). Regression using panel data provides several advantages compared to standard cross section and time series approaches.

The simplest first model is the CEM (Common Effect Model) estimation or often called pooled least squares estimation. According to this approach, the intercept value for each variable is assumed to be the same. The slope coefficients for all cross section and time series units are also assumed to be the same (Sukendar and Zainal, 2007).

From the assumptions above, the CEM model can be stated as follows (Widarjono, 2007)

$$y_{it} = \alpha + \beta' x_{it} + u_{it} \qquad i = 1,2, ..., N;\ t = 1,2 ... T \quad (1)$$

This assumption offers convenience, the true picture of the relationship between Y and X between cross section units may be distorted by the model formed.

The second is Fixed Effect Model (FEM). The model is known as a FEM because even though the intercept is different for each cross-section unit, it still assumes a fixed coefficient slope. The FEM model can be expressed with a formula

$$y_{it} = \alpha + X_{it}^{'} \beta + u_{it} \qquad i = 1,2, ..., N;\ t = 1,2 ... \quad (2)$$

The third is Random Effect Model (REM). In the REM model, it is assumed that the random variable is with a symbol $\alpha_i$ and the mean is with a symbol $\alpha_0$ so that the intercept can be expressed as $\alpha_i = \alpha_0 + \varepsilon_i$. $\varepsilon_i$ is a random error that has mean 0 and variance $\sigma_\varepsilon^2$. $\varepsilon_i$ is not directly observed, or also called latent variables. So, the REM model equation is as follows:

$$y_{it} = \alpha + \beta' x_{it} + w_{it} \qquad i = 1,2, ..., N;\ t = 1,2 ... T \quad (3)$$

With $w_{it} = \varepsilon_{it} + u_{it}$. The combined error term $w_{it}$ contains two error components, namely $\varepsilon_{it}$ the cross-section error component and $u_{it}$ which is a combination of the cross-section and time series error components. Because of this, REM is also called Error Components Model (ECM).

To find out the most suitable method, you can use the Hausman Test. This test is used to choose between Fixed Effect Model (FEM) or Random Effect Model (REM). The hypothesis of the Hausman test is:

$H_0$ : consistent random estimator

$H_1$: the random estimator is inconsistent

Where $H_0$ is accepted, it means REM is better to use than FEM, and vice versa.

So if: $X_{tab}^2 > X_{count}^2$ then $H_0$ is accepted or if $X_{tab}^2 < X_{count}^2$ then $H_0$ is rejected.

To get the value of $X_{hit}^2$ , it is taken from the difference in beta and covariance values for each method. The Hausman statistical test that can be carried out is (Hausman, 1978):

$$W = \frac{(\beta_{FEM} - \beta_{REM})^2}{(v(\beta_{FEM}) - v(\beta_{REM}))} \sim X^2 \qquad (4)$$

And for *multivariate*,

$$W = (\bar{\beta}_{FEM} - \bar{\beta}_{REM})\left(V(\bar{\beta}_{FEM}) - V(\bar{\beta}_{REM})\right)^{-1}(\bar{\beta}_{FEM} - \bar{\beta}_{REM}) \sim X^2(k) \quad (5)$$

This Hausman statistical test follows the chi-square ($\chi^2$) distribution with k degrees of freedom where k is the number of independent variables. If the Hausman statistical value is greater than the critical value then the appropriate model is FEM, whereas conversely if the Hausman statistical value is smaller than the critical value then the appropriate model is REM. According to Judge (1985), there are several things that must be considered to determine which approach to choose (FEM or REM) in estimating panel data, namely:

- If there is correlation between ε and $\chi^2$, then it is better to use FEM, and if there is no correlation between ε and $\chi^2$, then it is better to use REM.

- If T (number of time series) is large and n (number of individuals/units) is small, the difference between the two is relatively small, then FEM is the better model.

- If n is large and T is small, FEM is used if the units are not random from a large sample and REM is used if the units are taken randomly

- If n is large and T is small and if the REM assumptions are met, the REM estimator is more efficient than FEM

## RESEARCH METHODS

Method is a method of work that can be used to obtain something. While the research method can be interpreted as a work procedure in the research process, both in searching for data or disclosing existing phenomena (Zulkarnaen, W., et al., 2020:229). This research examines morbidity rates in regency /municipality in Indonesia during 2010-2020. The data source used is data available online compiled by the World Bank and included in INDO DAPOER (Indonesia-Database Policy and Economic Research). In general, the data for each regency /municipality in INDO DAPOER is not complete, so the data year used is the year where the data for each variable for each regency /municipality is most complete.

This research uses methodology static model panel data regression analysis. The analysis begins by presenting the determinants of morbidity levels using several variables that are considered influential. The analysis model formed can be seen in the following estimation model:

$$Morb_{it} = \alpha + X'_{it}\beta + e_{it}$$

In this equation, the notation $Morbit$ is the average morbidity/illness level in regency /municipality i incite year t. Next is the notation ′ which represents the availability of infrastructure access in the form of the percentage of the population in the regency /municipality that has access to sanitation; average expenditure per capita, area, population, Special Allocation Fund (DAK), General Allocation Fund (DAU), and poverty level.

## RESEARCH RESULTS AND DISCUSSION

The descriptive statistics of the data in this research will be presented in Table 1. In table 1, it can be seen that access to sanitation is very unequal in Indonesia (it has a very wide range, namely from 2,82 to 99,48). This is clearly visible from the infrastructure inequality between regencies /municipalities in Indonesia. The variables per capita expenditure, area, population, DAU, and DAK are treated with ln (natural logarithm) to facilitate interpretation as an estimate of proportional differences. The DAU and DAK variables are given a lag in processing because in reality, the use of DAU and DAK this year is usually only realized in the following year.

Table 2 shows the coefficient results and standard errors for each model tried. For the sanitation variable, we inverted the variable into the percentage who do not have access to sanitation to simplify data interpretation. The method is to subtract the number 100 from the existing sanitation variable. For the PLS model, the significant variables are the percentage who do not have access to sanitation, per capita expenditure, DAU lag, and poverty level. For the FEM model, the significant variables are the percentage who do not have access to sanitation, per capita expenditure, and the DAU lag. Meanwhile, for the REM model, the significant variables are the percentage who do not have access to sanitation, per capita expenditure, DAU lag, and poverty level.

Several tests can be carried out to select the best model for this data, namely the Chow Test, Hausman Test, and LM Test (Lagrange Multiplier). For the Chow Test, the hypotheses used are $H_0$ = Common Effect Model (CEM) and $H_1$ = Fixed Effect Model (FEM). In this test, the results obtained were P-Value (Prob > F) = 0,000 and Alpha = 0,05. Because P-Value < Alpha, this test rejects $H_0$ (accepts $H_1$) which means the recommended model for this data is the **FEM**.

For the Hausman Test, the hypotheses used are $H_0$ = Random Effect Model (REM) and $H_1$ = Fixed Effect Model (FEM). In this test the results were obtained: P-

Value (Prob > chi2) = 0,000 and Alpha = 0,05. Because P-Value < Alpha, this test rejects $H_0$ (accepts $H_1$) which means the recommended model for this data is the **FEM**.

From the two tests above, it was found that the most suitable model is the FEM (Fixed Effect Model). In fact, if there is still a difference in the choice of the best model from the two tests, there is still the LM (Lagrange Multiplier) test which chooses between the CEM and REM models. If an LM test is carried out for this data, the model selected is the REM model with P-Value (Prob > chibar2) = 0,000.

From Figure 3, it can be seen that there are no correlation values above 0,75, which means that the FEM model does not have multicollinearity problems.

For the heteroscedasticity test, the hypothesis used is $H_0$= there is no heteroscedasticity problem and $H_1$ = there is a heteroscedasticity problem. In this test the results obtained were: P-Value (Prob > chi2) = 0,06 and Alpha = 0,05. Because P-Value > Alpha, this test accepts $H_0$, which means there is no heteroscedasticity problem.

For the autocorrelation test, the hypothesis used is $H_0$ = there is no autocorrelation problem and $H_1$ = there is an autocorrelation problem. In this test the results were obtained: P-Value (Prob > chi2) = 0,000 and Alpha = 0,05. Because P-Value < Alpha, this test rejects $H_0$ (accepts $H_1$), which means there is an autocorrelation problem.

To provide results that are resistant to outliers, the robust FEM model will be presented in Table 3. The $R^2$ value from FEM is 0,218, which means that 21,8 percent of the morbidity rate is explained by the variables in the model. The remainder (78,2 percent) was influenced by other factors/variables which came outside the model. This is quite natural considering that the sample processed is quite large.

For the variable percentage who do not have access to sanitation, if this variable increases by 1 percent, the morbidity rate will increase by 0,13 percent (with a significance level of 1 percent). This is certainly in line with the general phenomenon because poor sanitation will increase morbidity rates.

For the per capita expenditure variable, if this variable increases by 1 percent, the morbidity rate will increase by 11,23 percent (with a significance level of 1 percent). These results are understandable, where currently the proportion of people's expenditure on unhealthy food (junk food) is quite large so that nutrition is inadequate and of course this leads to increased morbidity/illness rates.

For the DAU lag variable, if this variable increases by one percent, the morbidity rate will decrease by 0,76 percent (with a significance level of 1 percent). This is in accordance with the phenomenon that DAU for health will certainly improve the quality of public health such as providing adequate health workers and medicines. With good health, the number of illnesses will certainly decrease.

## CONCLUSIONS

Many variables influence morbidity rates in Indonesia. In the study, the influencing variables are the percentage variable that does not have access to sanitation, per capita expenditure, and the DAU lag. Morbidity rates will decrease if access to sanitation improves, per capita expenditure decreases, and DAU increases (especially for health). The most suitable model for this data is the FEM model because of the covariance between individual specific effects and regressors.

Data collected through INDO DAPOER is not complete and up to date. For next research, several other variables that influence morbidity rates can be added. The more complete the variables, the more accurate the model formed.

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## FIGURES AND TABLES

Table 1. Descriptive Statistics

| Variable | Number of Observations | Average | Standard Deviation | Min | Max |
|---|---|---|---|---|---|
| Morbidity | 5.089 | 29,79 | 9,01 | 5,31 | 77,12 |
| Sanitation Access | 5.105 | 39,14 | 18,45 | 2,82 | 99,48 |
| Per capita Expenditure | 4.633 | 12,90 | 0,53 | 11,53 | 14,63 |

| | | | | | |
|---|---|---|---|---|---|
| Area | 2.600 | 7,45 | 1,61 | 2,78 | 11,69 |
| Total Population | 4.720 | 12,57 | 1,04 | 8,72 | 15,46 |
| DAU Logs | 3.834 | 0,14 | 0,54 | -7,56 | 7,10 |
| DAK Logs | 3.687 | 0,19 | 0,77 | -7,12 | 7,93 |
| Poverty | 5.143 | 16,10 | 9,73 | 1,33 | 54,95 |

Table 2. Data Processing Results for Three Models

| Data component | PLS | FEM | REM |
|---|---|---|---|
| | Morbidity Rate (%) | Morbidity Rate (%) | Morbidity Rate (%) |
| % do not have access to sanitation | 0.074*** | 0.131*** | 0.095*** |
| | (0.015) | (0.037) | (0.019) |
| log of per capita expenditure | 6.600*** | 11.232*** | 9.455*** |
| | (0.743) | (0.879) | (0.679) |
| log of area | 0.056 | 1.731 | 0.156 |
| | (0.161) | (1.197) | (0.230) |
| log of population | 0.127 | -2.354 | 0.197 |
| | (0.246) | (2.258) | (0.344) |
| lag log of DAU | -1.012** | -0.763** | -0.879** |
| | (0.443) | (0.367) | (0.344) |
| log lag of DAK | -0.270 | -0.200 | -0.258 |
| | (0.289) | (0.219) | (0.212) |
| poverty level (%) | 0.133*** | 0.067 | 0.130*** |
| | (0.028) | (0.081) | (0.037) |
| Constant | -59.201*** | -99.917*** | -97.682*** |
| | (10.930) | (28.951) | (10.788) |
| Adjusted R-squared | 0.077 | -0.152 | |
| | | | |
| Observations | 1381 | 1381 | 1381 |

Standard errors in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Table 3. Results of robust FEM data processing

| Data component | FEM (vce(robust)) |
|---|---|
| | Morbidity Rate (%) |
| % do not have access to sanitation | 0.131*** |
| | (0.043) |
| log of per capita expenditure | 11.232*** |
| | (0.946) |
| log of area | 1.731* |
| | (0.928) |
| log of population | -2.354 |
| | (2.339) |
| lag log of DAU | -0.763*** |
| | (0.291) |
| log lag of DAK | -0.200 |
| | (0.202) |
| poverty level (%) | 0.067 |
| | (0.078) |
| Constant | -99.917*** |
| | (30.299) |
| Adjusted R-squared | 0.218 |
| | |
| Observations | 1381 |

Standard errors in parentheses
* p<0.1, ** p<0.05, *** p<0.01

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```
R-sq:                                         Obs per group:
     within  = 0.2218                                      min =          1
     between = 0.0309                                      avg =        3.1
     overall = 0.0504                                      max =          4

                                              F(7,932)          =      37.96
corr(u_i, Xb)  = -0.4664                      Prob > F          =     0.0000
```

| morbid | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| access_unimp_sanitation | .1305298 | .0372588 | 3.50 | 0.000 | .057409 | .2036506 |
| lncapita | 11.23235 | .8794428 | 12.77 | 0.000 | 9.506436 | 12.95827 |
| lnarea | 1.730505 | 1.196897 | 1.45 | 0.149 | -.6184205 | 4.07943 |
| lnpop | -2.354305 | 2.258163 | -1.04 | 0.297 | -6.785979 | 2.077369 |
| dnlndau | -.7633628 | .3671231 | -2.08 | 0.038 | -1.483846 | -.0428791 |
| dnlndak | -.1996298 | .2193282 | -0.91 | 0.363 | -.6300641 | .2308046 |
| poverty | .0669743 | .0814775 | 0.82 | 0.411 | -.0929264 | .2268749 |
| _cons | -99.91746 | 28.95087 | -3.45 | 0.001 | -156.7339 | -43.10101 |
| sigma_u | 8.2070739 | | | | | |
| sigma_e | 5.5966674 | | | | | |
| rho | .68257922 | (fraction of variance due to u_i) | | | | |

```
F test that all u_i=0: F(441, 932) = 4.95                  Prob > F = 0.0000
```

Figure 1. Chow Test

```
. hausman fe re
```

| | Coefficients (b) fe | (B) re | (b-B) Difference | sqrt(diag(V_b-V_B)) S.E. |
|---|---|---|---|---|
| access_uni~n | .1305298 | .095351 | .0351789 | .0318581 |
| lncapita | 11.23235 | 9.454664 | 1.777689 | .5590131 |
| lnarea | 1.730505 | .1564013 | 1.574104 | 1.17468 |
| lnpop | -2.354305 | .1971056 | -2.551411 | 2.231827 |
| dnlndau | -.7633628 | -.879483 | .1161202 | .1281748 |
| dnlndak | -.1996298 | -.258043 | .0584132 | .0554572 |
| poverty | .0669743 | .1299478 | -.0629735 | .0727422 |

```
                 b = consistent under Ho and Ha; obtained from xtreg
  B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                chi2(7) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                        =       36.51
              Prob>chi2 =      0.0000
```

Figure 2. Hausman Test

| | morbid | a~unim~n | lncapita | lnarea | lnpop | dnlndau | dnlndak | poverty |
|---|---|---|---|---|---|---|---|---|
| morbid | 1.0000 | | | | | | | |
| access_uni~n | 0.1088 | 1.0000 | | | | | | |
| lncapita | 0.1530 | -0.4047 | 1.0000 | | | | | |
| lnarea | 0.0564 | 0.4285 | -0.2873 | 1.0000 | | | | |
| lnpop | -0.0531 | -0.1907 | -0.0627 | -0.0728 | 1.0000 | | | |
| dnlndau | -0.1099 | -0.0154 | -0.1309 | -0.0015 | -0.0814 | 1.0000 | | |
| dnlndak | -0.0831 | -0.0113 | -0.1136 | -0.0233 | 0.0322 | 0.4139 | 1.0000 | |
| poverty | 0.0861 | 0.4315 | -0.4706 | 0.3986 | -0.1583 | 0.0459 | 0.0264 | 1.0000 |

Figure 3. Multicollinearity Test Result