The savings-growth nexus for Indonesia (1981-2012)

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Abstract

This paper investigates the relationship between economic growth and savings in Indonesia from 1981 – 2012. Foreign Direct Investment (FDI) is added as an extra variable to identify possible spuriousness in the causation. The Johansen test on cointegration is used to search for a long run relationship, a Vector Error Correction (VEC) model is constructed to examine a short run relationship and the Granger test on causality is used to find the direction of the relationship. After performing robustness checks, it can be concluded that there is significant evidence that Gross Domestic Savings (GDS) and Gross Domestic Product (GDP) are cointegrated and therefore hold a long run relationship. Via the Wald test, also a short run relationship is identified. The Granger test indicates that savings are Granger-caused by economic growth. FDI does not play a significant role.

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1. Introduction

Policy makers have long advocated policies that lead to higher savings in order to sustain economic growth. It is often stated that savings facilitate accumulation of physical capital and investments, which generates economic growth through the increase in production (Robinson, 1953). On 1 July 2014, the World Bank decided to grant Indonesia a $500 million loan in order to reform the nation's financial sector and boost the economy. Part of the focus was to initiate and facilitate a savings culture and therefore to improve access to savings instruments and expand the possibilities to enter basic savings accounts with low minimum balance requirements and without fees. These measures were taken to trigger an increase in investment and so lead to higher GDP (World Bank, 2014). If higher savings lead to higher economic growth there might be an incentive to stimulate savings in order to stimulate the economy.

There are many possible ways of logical reasoning and common sense to explain several relationships between the variables savings and economic growth. Scientific research does not provide one outspoken view either. Much research has already been done about the relationship between domestic savings and growth. There are several ways of scientific reasoning with seemingly contradicting conclusions. Theorists like Solow (1956), Harrod (1939) and Domar (1946) stated that higher savings lead to higher investments and therefore to higher economic growth. By using a simplified version of reality, the relationship is explained using logic and economic thinking.

A common way of reasoning states that saving and investment are key components of economic growth. An increase in saving and investment raises the capital stock and thus raises the full-employment national income and product. The national income and product rises, and the rate of growth of national income and product increases (Kaldor, 1961). When a country grows and accumulates savings, funds are transformed into investment and support economic growth and growth of the capital stock. More growth leads to higher income and savings, which in turn means more capital that supports growth (Yueh, 2014). The economy of Indonesia shows significant growth. However, still about half of all Indonesian households live around the poverty line. Employment growth has been slower than population growth. The investment climate is also influenced by malfunctioning of the legal system, shortcomings in infrastructure and uncertainty in wages (World Bank, 2014).

On the other side, scholars like Keynes (1936) and Caroll and Weil (1994) state that national income is a determinant for savings, also using models and economic knowledge. Both ways of reasoning find support. Even though scholars explain the relationship in different ways, the theories are not necessarily mutually exclusive. It is possible that the variables are empirically interdependent or there might not be a significant relationship at all. In order to identify this issue, empirical studies are done for countries and regions. Different results are found, including the absence of a relationship, univariate effects from one to the other variable and bivariate effects where the variables influence each other.

This paper will investigate the relationship between savings and economic growth in Indonesia through empirical research using econometric analyses. Since the World Bank recently chose to stimulate Indonesia's economy by stimulating saving rates, the World Bank and the Indonesian government chose a measure based on certain beliefs. However, empirical information may justify the measure even further or question the measure. The matter is highly relevant for developing economies such as Indonesia, since the effect of certain policy implications can be forecasted in a better way after performing research such as in this paper. Based on the found evidence, the applicable theories will be compared to the

outcome. The time period was chosen based on data availability.
In this paper, many classic economic theories will be explained and compared. By providing a theoretical framework, different angles and perspectives are discussed which gives the reader a proper inside in earlier theoretical and empirical research. Empirical evidence is collected by performing a series of econometric test with time series data. This paper will also investigate the effect of the variable Foreign Direct Investments (FDI) on the relationship between savings and economic growth. Thus, a multivariate setting is created. Afterwards, robustness checks are performed to add reliability to the outcome.

2. Literature review

The relationship and causality between domestic savings and economic growth is widely studied and highly relevant for policy makers.

Harrod (1939) and Domar (1946) created a model that explains economic growth through savings. The output is assumed to be proportional to capital, which can be denoted as:

$$(1) \qquad Y = AK$$

where:
Y = output
A = constant
K = capital

Taking the first derivative with respect to time, this can be denoted as:

$$(2) \qquad dY / dt = AdK / dt$$

Investments equal the change in capital stock plus the depreciation of capital. It is assumed that the total amount of savings equals the total amount of investments.

$$(3) \qquad S = I = sY$$

where:
S = savings
I = investments
s = savings rate

The model implies that the growth rate of output is proportional to investment and is therefore dependent on the savings rate.

$$(4) \qquad dY / dt = AdK / dt = AsY$$

$$(5) \qquad (dY / dt) / Y = (AdK / dt) / Y = As$$

Therefore, economic growth denotes:

$$(6) \qquad (dY / dt) / Y = As = \Delta Y$$

where:
ΔY = difference in Y = economic growth

This Harrod-Domar model does not take labour into account. In the two-factor growth model, labour per unit of output is added in a full employment economy with labour growing at an exogenous rate (Solow, 1956). This choice can be substantiated by the reasoning that developing countries often have unlimited supplies of labour, which makes labour a non-binding factor (Lewis, 1954). Therefore, economic growth would be proportional to the savings rate. Lewis also states that the central factor of development is capital accumulation. Increasing the rate of growth of savings will facilitate a more rapid expansion of the capital stock and therefore higher rates of investment that should lead to higher rates of economic growth. Since developing countries are typically classified as capital scarce, the added value of capital is high (Saltz, 1999).

Solow (1956) extended the Harrod-Domar model by adding labour as a factor of production. This way, the growth of productivity of labourers is taken into account. Given a fixed stock of labour, decreasing marginal returns to capital are assumed. Contrary to the Harrod-Domar model, it states that savings rates will only influence economic growth in the short run due to the law of diminishing returns. The model allows for substitution between capital and labour consequently the increase of capital intensity as a result of technological progress can be considered. Every economy will work towards the steady state equilibrium, which identifies a point where capital per worker is constant over time. Here, the savings are no longer a determinant of growth. The matching output depends on inter alia savings rate, depreciation rate, population growth and technological progress. Economic growth will eventually smoothen but economies with higher saving rates enjoy a higher steady state income. Savings are being invested and will lead to an increase in production capacity. The change in investment is explained by a change in savings rate.

Rostow (1960) developed a Stages of Growth model, which states that economic growth occurs in basic, consecutive stages. Industrialization requires capital accumulation and becomes a crucial phenomenon in economic development. To come to this stage, sufficient amounts of loanable funds have to be available. An increase in savings and investment is a pre-condition for economic development.

Other theories state that there is a reverse relation between the variables. Keynes (1936) states that growth of output, which equals growth of income, causes growth of savings. Depending on the income, a certain amount of money will be saved by households. Keynes states that income is the sum of consumption and savings; all income that is not consumed is saved and vice versa. Both consumption and savings depend on income, says Keynes. Saving is the excess of income over consumption expenditure. He also states that savings might be harmful to the economy, since a higher savings rate implies lower consumption. Consumption is the main drive for aggregate demand. Keynes proves mathematically that the aggregate demand equals output and GDP. Savings that exceed planned investment lead a country into recession, since higher savings indicate lower consumption. This indicates that the aggregate demand and therefore the economic growth falls.

The life-cycle hypothesis as stated by Modigliani (1970) is occupied with consumption smoothing and implies that people will choose to maintain the same lifestyle over their lifetime. Current saving decisions of households are therefore a consequence of an act to distribute their consumption equally over the years. Therefore, higher growth accompanies higher savings, because the same living standard is the ideal over time. However, Tobin (1967) states that individual saving rates will only remain unchanged if individuals suffer from myopic expectations of their future income. If workers expect that their income will grow in the future, according to the life-cycle model they want to consume more today. Thus, higher growth could lead to a drop in saving by households.

Carroll and Weil (1994) confirm that lagged values of increases in income growth seem to explain higher saving rates. Usual consumption models are not sufficient or adequate enough to provide a proper explanation due to liquidity constraints or uncertainty. They advance a theory about consistency of habits in stead, where income, savings and increases in income growth are used together. The past value is a determinant of the current value. In the hypothesis of habit persistence it is stated that temporarily higher income leads to higher rate of consumption. It takes some time before the consumption will lower after the income falls back.

Next to theoretical research, the relationship between savings and growth is also studied empirically. Unfortunately it is not possible to capture all research done so far, due to the limited time and length of this paper. Therefore, a selection of various countries is made with research from various moments in time using various techniques. Noteworthy is that most countries of which the relationship between savings and growth is investigated are developing and emerging economies rather than first world countries. An explanation for this might be that the relationship between savings and growth is relevant for development economics and therefore for developing economies. An overview An overview of this empirical research is to be found in table 1.

Table 1

Author	**Investigate area**	**Found effect**	**Technique**
Khan et al (2011)	Malaysia	Savings → growth	Granger test on causality
Zeren & Akbas (2013)	Turkey	Bidirectional effect	Granger test on causality
Saltz (1999)	Argentina, Taiwan Bolivia, Costa Rica, Korea, Guatemala, Honduras, Hong Kong, Nicaragua, Panama, Thailand Dominican Republic, Mexico Peru, Colombia, Philippines Jamaica	Savings → growth Growth → savings Bidirectional effect No causality	Granger test on causality
Bankole & Fatai (2014)	Sub-Saharan Africa	Savings → growth	Granger test on causality
Abu (2010)	Nigeria	Growth → savings	Granger test on causality
Sinha & Sinha (1998)	Mexico	Savings → growth	Granger test on causality
Singh (2009)	India	Savings → growth	ECM
Odhiambo (2007)	Kenya	Growth → savings	ECM
Alguacil et al (2001)	Mexico	Savings → growth	VAR
Agrawal & Sahoo (2009)	Bangladesh	Bidirectional effect	VAR
Agrawal (2001)	Singapore, Thailand, India Indonesia, Malaysia, Taiwan Korea	Growth → savings Bidirectional effect No causality	VAR, VEC
Anoruo & Ahmad (2001)	Ghana, Kenya, Nigeria, Zambia Congo Ivory Coast, South Africa	Growth → savings Savings → growth Bidirectional effect	VEC
Greyling et al (2013)	South Africa	No causality	VEC
Tang & Tan (2013)	Pakistan	Savings → growth	VEC

Khan et al (2011) write a rather simple paper. He finds an effect of savings on growth in Malaysia. Zeren & Akbas (2013) observe a bidirectional effect in Turkey. This indicates that the variables influence each other. Saltz (1999) investigates several countries and finds different effects for different countries. Bankole & Fatai (2014) investigate Sub-Saharan Africa and find an overall effect of savings on growth. Abu (2010) finds an effect of growth on savings in Nigeria. Sinha & Sinha (1998) asserted that increases in saving result in increases in output for Mexico. These papers all rely on the basic Granger test on causality, which is a rather simple technique making use of t-tests and F-tests. The Granger test examines whether a value or its lagged value is useful in predicting the other variable. The test also investigates the direction of the relationship (Granger, 1969). All papers express savings and growth data as GDP and GDS in constant terms, except Zeren&Akbas (2013) who make use of the percentage of savings and percentage of change in real GDP per capita. None of the papers take other variables into consideration. Therefore, these papers are comparable. However, the results are not homogenous.

Singh (2009) finds that savings cause growth in India, where Odhiambo (2007) finds the opposite effect for Kenya. Both papers make use of the Error Correction Model (ECM) that is used to distinguish between long run Granger causality and short term ECM causality, through the assumption that the series exhibit an equilibrium. A proportion of the disequilibrium from one period is corrected in the next period (Engle & Granger 1987).

Alguacil et al (2001) make use of a Granger test on causality and the Vector Auto Regression (VAR) model that is used in order to capture the linear interdependencies among multiple time series. The VAR model is used in order to be able to include a third variable, Foreign Direct Investments (FDI), for which a VAR model is suitable (Hatemi, 2004). An effect from savings on growth is found for Mexico. Agrawal & Sahoo (2009) investigate Bangladesh using a VAR model to detect the dynamics between several variables and find a bidirectional effect between savings and growth. The VAR model is one of the most flexible and easy to use models for economic forecasting making use of multivariate time series (Stock & Watson, 2001).

Agrawal (2001) examines seven Asian countries using VAR models and Vector Error Correction (VEC) models. For different countries, different effects are found. Anoruo & Ahmad (2001) make use of VEC models for seven African countries, where it is found that overall growth influences savings. Greyling et al (2013) use the VEC model and finds no causality within South Africa. Tang & Tan (2013) find that a long and short run equilibrium exists and found evidence that savings cause growth in Pakistan using the VEC. The VAR model is used for variables that are integrated to the order 0, whereas the VEC model is used for variables that are integrated to the order of 1. The order of integration, or degree of stationarity, is a characteristic of a time series and will be elaborated on further in this paper. Both the A VAR and VEC model can be used to investigate the dependency of two or more variables (Watson, 1994). A VAR in differenced variables omits the error correction term. Cointegrated systems represent both autoregression and error correction. Therefore, the VAR is not compatible for differenced values, where a VEC is. The idea of an error correction model is that the disequilibrium of one period is corrected in the next period (Engle & Granger, 1987).

It is not possible to draw a clear conclusion about the relationship between economic growth and savings from these papers. The effect within the country differs from paper to paper. Where Saltz (1999) finds a bidirectional causal effect between the variables for Mexico, Alguacil et al (2001) find that savings influence growth in the same country. Where Agrawal

(2001) finds a bidirectional causal effect for Malaysia, Khan (2011) finds that savings influence growth in the same country. This indicates that the research method also influences the outcome of the research As indicated above, the papers indeed use different methods and econometrics.

Also, other factors could be involved and influence the outcome of the research. The introduction of a third important variable in the model can change the outcome of the bivariate model. The third variable might influence the deduction and magnitude of the results and therefore imply a spurious relationship between the two variables. The exclusion of relevant variables might identify inefficient estimates. When the omitted variables are correlated with the included ones, the non-causality test will be misspecified (Gujurati, 1995; Canova, 1995).

As stated above, savings create funds for investments. However, the source of savings in an open economy can come from both inside and outside the country. Domestic savings provide local funds where international capital provides the country with extra sources. Foreign capital might supplement domestic savings and therefore create a bigger pool of loanable funds for investment. Foreign Direct Investments might therefore help the country to a state of higher investment and growth. Drawing on further, economic growth is an indicator of higher expected profits which attracts new domestic and foreign capital. FDI have a highly beneficial effect on domestic investment (Bosworth & Collins, 1999). FDI may also accelerate growth though the transfer knowledge in business management and technology (Borensztein et al, 1998) (Balasubramanyam & Sapsford, 1996). Theoretically, a vicious circle describes the relationship between savings, growth and FDI, where the variables are determinants of each other and accelerate their growth. This is why this paper also investigates the effect of the variable Foreign Direct Investments (FDI) on the relationship between savings and economic growth.

3. Data

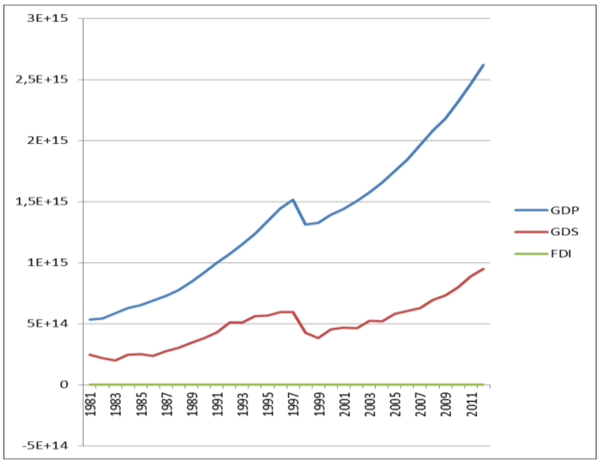
All data is obtained from the World Bank Data Bank. The variable used for economic growth is Gross Domestic Product (GDP) in constant local currency unit[1]. The variable used for domestic savings is Gross Domestic Savings (GDS) and is also expressed in constant local currency unit[2]. FDI data is expressed as net inflows in percentages of the GDP[3].

GDP and GDS are expressed in constant local currency. This indicates that all numbers are corrected for inflation. GDP and GDS are transformed into natural logarithms.

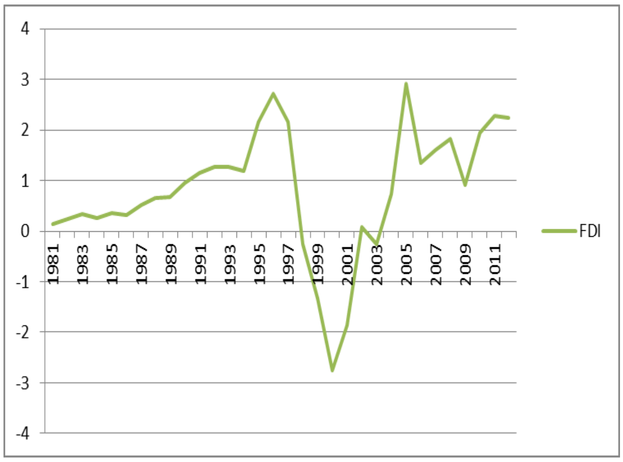
All data ranges from 1981 - 2012.

As can be seen in the following graphs with the year on the horizontal axis and the value on the vertical axis, GDP and GDS tend to follow the same path, whereas FDI shows an aberrant pattern. Original data is used.

Graph 1



Graph 2



[1] World Bank definition: GDP at purchaser's prices is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in constant local currency.

[2] World Bank definition: Gross domestic savings are calculated as GDP less final consumption expenditure (total consumption). Data are in constant local currency.

[3] World Bank definition: Foreign direct investments are the net inflow of investment to acquire a lasting management interest (10 percent or more of voting stock) in an enterprise operating in an economy other than that of the investor. It is the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital as shown in the balance of payments. This series shows net inflows (new investment inflows less disinvestment) in the reporting economy from foreign investors, and is divided by GDP.

4. Model specification

The theoretical models explained above can be shaped into a model, which is a simplified version of reality. These models will be the basis of the following econometric tests.

When savings are a function of economic growth, as stated by e.g. Solow (1956), the following equation is applicable:

$$S = \alpha_0 + \alpha_1 Y + \mu_1$$

Where:

S	= savings
Y	= GDP
α_0	= constant
α_1	= savings to economic growth sensitivity coefficient
μ_1	= disturbance term

When economic growth is a function of savings, as stated by e.g. Keynes (1936), the following equation is applicable:

$$Y = \beta_0 + \beta_1 S + \mu_1$$

Where:

S	= savings
Y	= GDP
β_0	= constant
β_1	= economic growth to savings sensitivity coefficient
μ_1	= disturbance term

Both macro-economic models state that savings and economic growth are related. However, the direction of the relationship differs between the models. These models are theoretical and are defined in its simplest form without taking other variables into consideration.

The theories are not necessarily mutually exclusive or applicable. By empirically testing data using various econometric models and calculations it can be researched if these models are applicable to the researched area. This means that the direction of the effect, if there are significant results at all, leads to identifying if zero, one or two of the two models above are applicable to the researched area.

When the third variable FDI is added, there are three new possible equations:

$$S = \alpha_0 + \alpha_1 Y + \alpha_2 FDI + \mu_1$$

$$Y = \beta_0 + \beta_1 S + \beta_2 FDI + \mu_1$$

$$FDI = \gamma_0 + \gamma_1 Y + \gamma_2 S + \mu_1$$

These models do not take lagged values into consideration.

5. Econometrics

In this section, the relationship between savings and economic growth will be tested empirically. During the tests, FDI will be added in order to investigate a possible spurious regression.

5.1 Stationarity

First, the data will be tested on stationarity. In order to be able to carry out further tests, the data must be stationary. If this is not the case, data can be easily transformed by using the value in its first or second difference. Instead of the absolute value the difference between two values will be used as data.

The variables must be tested on stationarity before running the causality test in order to avoid spuriousness. A stationary series is said to be integrated of order *d* if it achieves stationarity after being differenced *d* times. Using data that is not stationary in an econometric model may lead to identifying spurious causation. When the data not appears to be stationary in their levels, the data has to be transformed to its first difference, or if necessary to its higher difference. The original time series data provides information about the trend components and its long run relationship. Differencing data may lead to a loss of information about these characteristics. Therefore, the Granger test on causality will need to include an error correction term in the stationary model in order to still be able to track the short run deviations of its long run equilibrium.

Both the Augmented Dickey Fuller (ADF) test and the Phillips-Perron (PP) test are run in order to find out whether the data is stationary. For both tests, the null hypothesis states non-stationarity whereas the alternative hypothesis states stationarity (Dickey & Fuller, 1981; Phillips & Perron, 1988).

5.2 Cointegration

Second, a test on cointegration will be run. This is done to test for the existence of a long-run relationship between the variables. In order to be able to run the cointegration procedure, the time series have to be non-stationary in their levels. Likewise, it is required that all variables are in the same order of integration. If there exists a stationary linear combination of non-stationary random variables, the variables combined are said to be cointegrated.

The Johansen test on cointegration is used in order to investigate cointegration. It can determine whether there is a long-term relationship among the variables. The Johansen maximum likelihood technique is used to test for the existence of cointegration as well as the number of cointegrating vectors. The test is run in a multivariate system where GDP, GDS and FDI are included as variables. The null hypothesis of the test is that there are r cointegration vectors whereas the alternative hypothesis states the presence of $r+1$ cointegration vectors (Johansen, 1988).

5.3 VAR/VEC
Third, a Vector Auto Regression (VAR) or Vector Error Correction (VEC) model, depending on the order of integration of the variables, will be created to test for short-run dynamics. The model allows for more than one evolving variable. For each variable an equation can be constituted as a dependent variable of its own lags and the lags of other variables in the model. In a VAR model, all variables are considered endogenous to allow causality in all directions. The disturbances are uncorrelated at different time periods (Sims, 1980).

A VAR of order p can be written as:

(7) $$X_t = \Pi_1 X_{t-1} + ... + \Pi_k X_{t-K} + \mu + e_t$$ (for t=1,…,T)

Where X_t, X_{t-1}, … , X_{t-K} are vectors of current and lagged values of P variables which are integrated to the first order in the model. Π_1, …, Π_K are matrices of coefficients with PXP dimensions. μ is an intercept vector and e_t is a vector of random errors.

In order to be able to use a VAR model all data is supposed to be stationary. If this is not the case, the data can be transformed into its first (or if necessary second or further) difference in order to become stationary. Due to the data transformation, it is useful to reparameterize the model to the equivalent Vector Error Correction Model (VECM). The equations will then be written as follows:

(8) $$\Delta X_t = \Gamma_1 \Delta X_{t-1} + ... + \Gamma_{K-1} \Delta X_{t-K+1} + \Pi X_{t-K} + \mu + e_t$$

The VEC model allows causality to emerge even if the coefficients lagged differences of the explanatory variables are not jointly significant.

The Wald test provides information about the short-run relationship (Engle & Granger, 1987).

5.4 Causality
Fourth, the direction of the relationship will be investigated by running a Granger test on causality. A variable X Granger-causes variable Y if and only if Y is predicted in a better way using the past values of X compared to not using the past values of X. Also, past values of Y are taken into account. The cause has to occur prior to its effect and has unique information in forecasting in order to ascertain causality. As its name implies, Granger causality does not necessarily identify true causality. If both variables are driven by a common third process with different lags, the Granger test might suggest Granger causality. However, since both variables are influenced by the same variable, the causation is spurious and therefore actual causation is not present. The Granger test on causality is designed to investigate the relationship between two variables and might show misleading outcomes when the true relationship involves three or more variables (Granger, 1969). Therefore, the test will be run several times in order to invest the effect on GDP, GDS and FDI on each other in pairs. The Granger test makes use of a t-test to conclude about the significance of the test. Two series that are individually stationary in their first level and the existence of a cointegration vector of the two variables, indicates the present of a Granger causal relationship in at least one direction. However, the direction of the relationship has to be identified by running the Granger test on causality (Engle & Granger, 1987).

6. Results
Correlation does not imply causation, but is a condition for the phenomenon. The correlation between Gross Domestic Savings (GDS) and Gross Domestic Product (GDP) in Indonesia over time period 1981 - 2012 is strong: the Pearson correlation coefficient denotes 0.958 and is significant at the 0.01 level. The correlation between the natural logarithms of the variables is 0.960 and is also significant at the 0.01 level. Therefore, there is a motive to investigate the relationship further.

6.1 Stationarity
The results of the ADF unit root tests and the PP tests are presented in table 2. The tests show similar results. The null hypothesis of non-stationarity of GDP, GDS and FDI is tested against the alternative hypothesis of stationarity. The results indicate that none of the three time series is stationary in their levels. After transforming the data into its first difference, the null hypothesis of no unit root is rejected in all of the cases. The results indicate one order of integration I(1) for all variables.

Table 2

Variable	Level	T-statistic ADF	T-statistic PP	Probability ADF	Probability PP
GDP	At level	-0.7003	-0.6803	0.8322	0.8373
GDP	First difference	-3.9963	-3.9963	0.0045*	0.0045*
GDS	At level	-0.2980	-0.3523	0.9142	0.9055
GDS	First difference	-4.7674	-4.7492	0.0006*	0.0006*
FDI	At level	-1.9872	-2.2181	0.2906	0.2042
FDI	First difference	-4.7636	-4.7435	0.0006*	0.0007*

** denotes rejection at the 0.05 level*

6.2 Cointegration
The next step is to test for the existence of a cointegration relationship between the variables. The Johansen test on cointegration is used. Variables are cointegrated if they share a common trend. The test is applicable since all data is stationary in their first level. If cointegration between the variables is detected, Granger causality is implied. If the null hypothesis of zero cointegrating vectors is rejected, there is significant indication of at least one cointegrating relationship.

The result of running the test including all variables can be found in table 3. Both the Trace and Maximum Eigenvalue statistic are used. The null hypothesis can be rejected at the 0.01 significance level. However, there is significant proof that there is not more than one cointegrating relationship. Since the three variables are tested together, it is not clear yet between which variables the cointegration is present.

Table 3

FDI, GDS, GDP

Hypothesized number of Cointegrating Equations	Eigenvalue	Maximum Eigenvalue Statistic	Trace Statistic	Probability Maximum Eigenvalue	Probability Trace Statistic
None	0.5097	21.383	31.013	0.0461*	0.0361*
At most 1	0.2370	8.1149	9.6300	0.3672	0.3103
At most 2	0.0492	1.5151	1.5151	0.2184	0.2184

** denotes rejection at the 0.05 level*

When running the test including two variables at a time, there is significant proof that compared with a 0.05 significance level there is one cointegrating vector for GDS and GDP. The results are to be found in table 4. As table 5 and table 6 indicate, this is not the case for GDP and FDI nor GDS and FDI.

Table 4

GDS GDP

Hypothesized number of Cointegrating Equations	Eigenvalue	Maximum Eigenvalue Statistic	Trace Statistic	Probability Maximum Eigenvalue	Probability Trace Statistic
None	0.3809	14.3863	15.6098	0.0478*	0.0481*
At most 1	0.0400	1.2234	1.2234	0.2687	0.2687

** denotes rejection at the 0.05 level*

Table 5

FDI GDP

Hypothesized number of Cointegrating Equations	Eigenvalue	Maximum Eigenvalue Statistic	Trace Statistic	Probability Maximum Eigenvalue	Probability Trace Statistic
None	0.2974	10.5902	12.3088	0.1760	0.1427
At most 1	0.0557	1.7186	1.7186	0.1899	0.1899

Table 6

GDS FDI

Hypothesized number of Cointegrating Equations	Eigenvalue	Maximum Eigenvalue Statistic	Trace Statistic	Probability Maximum Eigenvalue	Probability Trace Statistic
None	0.2294	7.8160	8.8031	0.3977	0.3839
At most 1	0.0324	0.9871	0.9871	0.3204	0.3204

The presence of one cointegration vector between GDS and GPD implies the long run relationship and the existence of causality in at least one direction.

6.3 VAR/VEC
Since the data is integrated in order 1, the VEC is preferred over a VAR. The lag selection is based on the minimisation of the Akaike Information Criterion (AIC), resulting in an applicable lag length of 2. The models are specified in the following equations:

(9) D(GDP)=D(1)*)*[DGDP(-1) - 0.4078*DGDS(-1) + 0.0152*DFDI(-1) - 0.0304]
+ C(2)*D[DGDP(-1)] + C(3)*D[DGDP(-2)] + C(4)*D[DGDS(-1)]
+ C(5)*D[DGDS(-2)] + C(6)*D[DFDI(-1)] + C(7)*D[DFDI(-2)] + C(8)

(10) D(DGDS) = C(9)*[DGDP(-1) - 0.4078*DGDS(-1) + 0.0152*DFDI(-1) - 0.0304]
+ C(10)*D[DGDP(-1)] + C(11)*D[DGDP(-2)] + C(12)*D[DGDS(-1)]
+ C(13)*D[DGDS(-2)] + C(14)*D[DFDI(-1)] + C(15)*D[DFDI(-2)] + C(16)

(11) D(DFDI) = C(17)*[DGDP(-1) - 0.4078*DGDS(-1) +0.0152*DFDI(-1) - 0.0304]
+ C(18)*D[DGDP(-1)] + C(19)*D[DGDP(-2)[+ C(20)*D[DGDS(-1)]
+ C(21)*D[DGDS(-2)] + C(22)*D([DFDI(-1)] + C(23)*D[DFDI(-2)] + C(24)

The Wald test is performed on the model specification to investigate the short-run dynamics. The null hypothesis is that C(n)=C($n+1$)=0. Table 7 shows the results. Both the F-statistic and the Chi-square indicate significant evidence for several rejections of the null hypothesis and therefore imply short-run dynamics.

When GDP is the dependent variable, GDS is of significant impact only according to the Chi-square statistic. When GDS is the dependent variable, GDP is of significant impact. When FDI is the dependent variable, both GDS and GDP are of significant impact.

Table 7

	F-statistic	Chi-square	Probability F	Probability Chi-square
C(4) = C(5) = 0	3.4803	6.9605	0.0505	0.0308*
C(6) = C(7) = 0	2.3881	4.7762	0.1175	0.0918
C(10) = C(11) = 0	5.4920	10.9840	0.0126*	0.0041*
C(14) = C(15) = 0	1.7976	3.5953	0.1914	0.1657
C(18) = C(19) = 0	6.9014	13.8029	0.0053*	0.0010*
C(20) = C(21) = 0	6.2243	12.4485	0.0079*	0.0020*

** denotes rejection at the 0.05 level*

6.4 Granger causality
In the Granger causality test the direction of the relationship is investigated. The results of the bivariate test are presented in table 8. Compared to the 0.05 significance level, there is significant proof for a Granger causal relationship from GDP to GDS. No other significant causal effects are identified.

Table 8

Pairwise Granger Causality Tests
Lags: 2

Null Hypothesis:	F-Statistic	Probability
DGDP does not Granger Cause DFDI	1.5796	0.2267
DFDI does not Granger Cause DGDP	0.1913	0.8271
DGDS does not Granger Cause DFDI	3.2706	0.0555
DFDI does not Granger Cause DGDS	1.7672	0.1923
DGDS does not Granger Cause DGDP	0.8560	0.4374
DGDP does not Granger Cause DGDS	5.4808	0.0110*

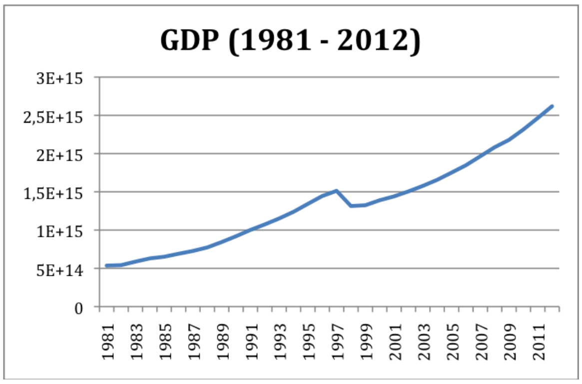
** denotes rejection at the 0.05 level*

7. Robustness
The results will be tested on robustness by performing robustness checks, in order to test the outcomes on reliability.

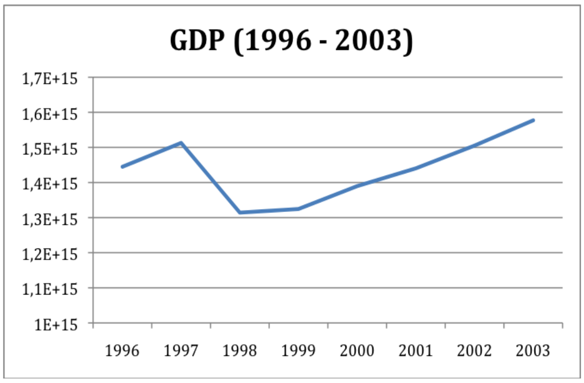
7.1 Asian crisis
Halfway 1997, a period of financial and economic collapse, contracting economic growth rates and bankrupting companies started, also known as the Asian Financial crisis. Indonesia was hit hard (The Economist, 2007). As a robustness check, these crisis years will be left out.

The crisis started in 1997, meaning that in a part of 1997 no crisis was observed. As can be seen in the following graphs, with the year on the horizontal axis and the value on the vertical axis, the crisis showed its major effects from 1998 onwards.

Graph 3



Graph 4



It took five years before the GDP was back to the level it had before the crisis in 1997. Therefore, 1998 – 2002 will be left out during the robustness check.

Leaving out values leads to the problem of a time series with missing data. There are three possible ways to deal with this problem:
1. Ignore the gaps
2. Replace the gaps with the last available observation
3. Fill the gaps with a linear interpolation method

Ignoring gaps in time series data with missing observations produces unit root tests that are more powerful than the other two approaches that are considered according to Ryan & Giles (1999). Therefore, this method is chosen.

As table 9 indicates, all data is stationary in its first difference using the ADF test.

Table 9

Variable	**Level**	**T-statistic**	**Probability**
GDP	At level	-0.4266	0.8893
GDP	First difference	-4.7836	0.0008*
GDS	At level	0.0152	0.9518
GDS	First difference	-4.7132	0.0010*
FDI	At level	-2.8017	0.0718
FDI	First difference	-5.1082	0.0005*

** denotes rejection at the 0.05 level*

As indicated in table 10, there are at most 2 cointegrating equations using the Johansen test on cointegration which is used to test for long run relationships. Both the Maximum Eigenvalue and the Trace statistic show significant proof.

Table 10

FDI GDP GDS

Hypothesized number of Cointegrating Equations	**Eigenvalue**	**Maximum Eigenvalue Statistic**	**Trace Statistic**	**Probability Maximum Eigenvalue**	**Probability Trace Statistic**
None	0.7709	36.8419	60.8882	0.0002*	0.0000*
At most 1	0.5859	22.0427	24.0462	0.0024*	0.0020*
At most 2	0.0770	2.0035	2.0035	0.1569	0.1569

** denotes rejection at the 0.05 level*

The data is integrated in order 1, meaning a VEC is preferred over a VAR. The models are specified in the following equations:

(12) D(DFDI) = C(1)*[DFDI(-1) - 3.9077*DGDP(-1) + 0.8262*DGDS(-1) + 0.1059]
+ C(2)*D[DFDI(-1)] + C(3)*D[DFDI(-2)] + C(4)*D[DGDP(-1)] + C(5)*D[DGDP(-2)]
+ C(6)*D[DGDS(-1)] + C(7)*D[DGDS(-2)] + C(8)

(13) D(DGDP) = C(9)*[DFDI(-1) - 3.9077*DGDP(-1) + 0.8262*DGDS(-1) + 0.1059]
+ C(10)*D[DFDI(-1)] + C(11)*D[DFDI(-2)] + C(12)*D[DGDP(-1)] + C(13)*D[DGDP(-2)]
+ C(14)*D[DGDS(-1)] + C(15)*D[DGDS(-2)] + C(16)

(14) D(DGDS) = C(17)*[DFDI(-1) - 3.9077*DGDP(-1) +0.8262*DGDS(-1) + 0.1059]
+ C(18)*D[DFDI(-1)] + C(19)*D[DFDI(-2)] + C(20)*D[DGDP(-1)] + C(21)*D[DGDP(-2)]
+ C(22)*D[DGDS(-1)] + C(23)*D[DGDS(-2)] + C(24)

The Wald test is performed on the model specification to investigate the short-run dynamics. Table 11 shows the results. There is significant proof for several short run dynamics. When GDP is the dependent variable, GDS is of significant impact and vice versa.

Table 11

	F-statistic	**Chi-square**	**Probability F**	**Probability Chi-square**
C(4) = C(5) = 0	1.3344	2.6689	0.2928	0.2633
C(6) = C(7) = 0	0.2065	0.4129	0.8157	0.8134
C(10) = C(11) = 0	0.9857	1.9713	0.3961	0.3732
C(14) = C(15) = 0	5.3101	10.6201	0.0180*	0.0049*
C(18) = C(19) = 0	2.7855	5.5711	0.0936	0.0617
C(20) = C(21) = 0	4.7335	9.4671	0.0255*	0.0088*

** denotes rejection at the 0.05 level*

In the Granger causality test the direction of the relationship is investigated. The results of the bivariate test are presented in table 12. Compared to the 0.01 significance level, there is significant proof that GDS and GDP are linked by a Granger causality relationship.

Table 12

Pairwise Granger Causality Tests
Lags: 2

Null Hypothesis	F-Statistic	Probability
DLNGDP does not Granger Cause DFDI	0.7466	0.4874
DFDI does not Granger Cause DLNGDP	0.1235	0.8846
DLNGDS does not Granger Cause DFDI	0.1653	0.8488
DFDI does not Granger Cause DLNGDS	0.9329	0.4107
DLNGDS does not Granger Cause DLNGDP	8.1531	0.0028*
DLNGDP does not Granger Cause DLNGDS	16.4585	0.0000*

** denotes rejection at the 0.05 level*

7.2 Gross Savings

Gross Domestic Savings (GDS) are calculated as GDP less final consumption expenditure (total consumption). Gross savings (GS) on the other hand are calculated as GDP less total consumption, plus net transfers. The difference between the variables is therefore that GS takes transfers into account whereas GDS does not. Gross savings is therefore a more accurate variable. As robustness check, GS replaces GDS.

As table 13 indicates, GS is stationary in its first difference.

Table 13

Variable	Level	T-statistic	Probability
GS	At level	-0.9999	0.7408
GS	First difference	-6.2449	0.0000*

** denotes rejection at the 0.05 level*

As indicated in table 14, there are at most 2 cointegrating equations using the Johansen test on cointegration. Both the Maximum Eigenvalue and the Trace statistic show significant proof.

Table 14

Hypothesized number of Cointegrating Equations	Eigenvalue	Maximum Eigenvalue Statistic	Trace Statistic	Probability Maximum Eigenvalue	Probability Trace Statistic
None	0.6449	31.0637	50.5142	0.0015*	0.0001*
At most 1	0.4503	17.9518	19.4506	0.0125*	0.0120*
At most 2	0.0487	1.4987	1.4987	0.2209	0.2209

** denotes rejection at the 0.05 level*

The data is integrated in order 1, meaning a VEC is preferred over a VAR. The models are specified in the following equations:

(15) D(DFDI) = C(1)*[DFDI(-1) + 13.0437*DGDP(-1) - 11.1123*DGS(-1) - 0.0846]
+ C(2)*D[DFDI(-1)] + C(3)*D[DFDI(-2)] + C(4)*D[DGDP(-1)] + C(5)*D[DGDP(-2)]
+ C(6)*D[DGS(-1)] + C(7)*D[DGS(-2)] + C(8)

(16) D(DGDP) = C(9)*[DFDI(-1) + 13.0437*DGDP(-1) -11.1123*DGS(-1) - 0.0846]
+ C(10)*D[DFDI(-1)] +C(11)*D[DFDI(-2)] + C(12)*D[DGDP(-1)] + C(13)*D[DGDP(-2)]
+C(14)*D[DGS(-1)] + C(15)*D[DGS(-2)] + C(16)

(17) D(DGS) = C(17)*[DFDI(-1) + 13.0437*DGDP(-1) -11.1123*DLNGS(-1) - 0.0846]
+ C(18)*D[DFDI(-1)] +C(19)*D[DFDI(-2)] + C(20)*D[DGDP(-1)] + C(21)*D[DGDP(-2)]
+ C(22)*D[DLNGS(-1)] + C(23)*D[DLNGS(-2)] + C(24)

The Wald test is performed on the model specification to investigate the short-run dynamics. Table 15 shows the results. There is significant proof for several short run dynamics. When FDI is the dependent variable, GS is of significant impact. When GS is the dependent variable, GDP is of significant impact.

Table 15

	F-statistic	Chi-square	Probability F	Probability Chi-square
C(4) and C(5)	1.038258	2.076516	0.3724	0.3541
C(6) and C(7)	3.790382	7.580764	0.0402*	0.0226*
C(10) and C(11)	0.565422	1.130844	0.5769	0.5681
C(14) and C(15)	0.425257	0.425257	0.6594	0.6536
C(18) and C(19)	0.301406	0.602813	0.7431	0.7398
C(20) and C(21)	4.040413	8.080827	0.0336*	0.0176*

** denotes rejection at the 0.05 level*

In the Granger causality test the direction of the relationship is investigated. The results of the bivariate test are presented in table 16. Compared to the 0.05 significance level, there is significant proof that GS Granger causes FDI and that GDP Granger causes GS.

Table 16

Pairwise Granger Causality Tests
Lags: 2

Null Hypothesis:	F-Statistic	Probability
DLNGDP does not Granger Cause DFDI	1.5796	0.2267
DFDI does not Granger Cause DLNGDP	0.1913	0.8271
DLNGS does not Granger Cause DFDI	9.0554	0.0012*
DFDI does not Granger Cause DLNGS	5.1064	0.0142
DLNGS does not Granger Cause DLNGDP	0.1550	0.8572
DLNGDP does not Granger Cause DLNGS	9.0347	0.0012*
*		

** denotes rejection at the 0.05 level*

8. Conclusion

8.1 Research

This paper examined the relationship between savings and economic growth and possible spuriousness by adding FDI as extra variable in Indonesia for time period 1981 - 2012. By adding a third variable, this paper tries to deliver a better found outcome of the relationship between savings and growth. Because an econometric framework was created step-by-step, with a clear function for every part of this framework, the outcomes of the research are specific and precise. Because two robustness checks are performed and the results have been adjusted to these checks, the outcomes have become more reliable.

8.2 Findings

The study finds that GDP and GDS are cointegrated meaning that the variables hold a long run relationship. There is no proof that FDI plays a role in this. After concluding so, a VEC model including all three variables was constituted. The outcome indicates significant proof for a short run relationship for GDP as independent and GDS as dependent variable and vice versa, and for a short run relationship for GDP and GDS as independent variable and FDI as dependent variable. Significant proof is found that GDP Granger causes GDS.
It can be concluded that there is significant proof for a strong relationship between GDP and GDS. FDI plays no significant role in this relationship and therefore does not identify a spurious relationship. However, there is still a possibility for the presence of a common determinant other than FDI.

When leaving out data from during the Asian crisis (1998 – 2002), the results are modestly different. Instead of one, there are two cointegrating equations. There is still significant proof for a short run relationship for GDP as independent and GDS as dependent variable and vice versa, however, no other short run relationships are found. Significant proof is found for GDS and GDP Granger causing each other. It can also be concluded that there is significant proof for a strong relationship between GDP and GDS. FDI plays no significant role in this relationship. This time series contains 28 observations instead of 33 and is therefore less reliable. However, since the data leaves out a shock and focuses more on ongoing data, these results need to be taken into account when valuating earlier results. Both tests with and without the years of the Asian crisis indicate Granger causality from GDP to GDS, however, the first test does not reject the null hypothesis of Granger causality from GDS to GDP.

When using GS instead of GDS, two cointegrating vectors are found. There is significant proof for short run dynamics for FDI as dependent variable and GS as independent variable, and GS as dependent variable and GDP as independent variable. Significant proof is found that GS Granger causes FDI and GDP Granger causes GS. It can be concluded that there is a strong relationship between GS and FDI and a strong relationship between GDP and GS. GS takes transfers into account where GDS does not, leading to the difference that savings influence FDI when using GS and do not when using GDS.

Overall, it can be concluded that there is significant proof for short and long run dynamics for savings and economics growth and Granger causality from economic growth to savings. The outcome of this paper aligns with Keynes theory that growth is a determinant of savings. The outcome of this paper is relevant for development policy, since economic growth is often a key focus. By examining the relationship between economic growth and other variables, a scientific base for policy implications can be formed.

According to these results, saving is not a determinant of economic growth and therefore is not a medium to accelerate economic growth through.

8.3 Limitations

An important limitation of this paper is inadequate data availability. Data on GDS and GDP is available from 1960 onwards, however for FDI data was only available from 1981. The longer the data reaches, the more reliable the outcome of the research. Another shortcoming of the paper is that several statements are based on single tests. It is possible to test stationarity using the ADF test and PP as done is this paper. However, this is also possible when using e.g. the KPSS test. Next to the Johansen test, also for instance a Pesaran and Shin test would be applicable. A third shortcoming is that only FDI is implemented as third variable, whereas other variables such as dependency ratio, interest rate and financial development might also fulfil a role as common determinant of savings and economic growth.

Further research in this area is therefore recommended. Both theoretical as empirical research do not seem to find a clear answer to the question what the relationship between savings and growth is. First, econometric techniques need to be improved and innovated further in order to find more specific and precise empirically supported evidence. Second, . In order to be able to get a proper picture of the differences and similarities between countries, the same procedure should be followed for several countries. Therefore it might be interesting to run the exact same procedure as done in this paper for other South-East Asian countries and afterwards for the entire world. At this moment there is a lack of perfectly comparable papers. Third, the influence of other possible third variables should be investigated in order to identify possible spurious regression between savings and growth.

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