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IS-LM curve in the 2000-2020 period: Some recommendations on macroeconomic policies and digital economic development in Vietnam

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Abstract: The socio-economic development strategy for the 2021-2030 period with a vision to 2045 requires the proactive and flexible governance of the Government, especially in macroeconomic executives and digital economic development policies. The IS-LM model is one of the many approaches of economists in research to make recommendations on economic policies and governance of Governments.

The following research focuses on developing and analyzing the IS-LM curve in the 2000-2020 period of Vietnam to serve as a basis for recommendations and contribute to creating a scientific basis for the macroeconomic executives of the Government. The research results help to point out recommendations related to the direction to operate monetary policy, financial policy and priorities related to sectors / areas that support digital transformation, the development of the digital economy of Vietnam in the coming years.

Keywords: IS-Investment and Saving; LM- Liquidity Preference and Money Supply; Digital economy; Macroeconomic executives.

INTRODUCTION

IS-LM model

The IS-LM model (where IS stands for "Investment and Saving", and LM stands for "Liquidity Preference and Money Supply") is a macroeconomic model of Keynesians showing how commodity markets interact with capital markets or money markets; It is represented graphically including IS and LM curves.

The **IS** curve represents a set of all equilibrias of the commodity market for different interest rates and incomes. The IS curve depends on many different factors and depends on the nature of the open or closed economy and is represented by different equations as follows:

Option 1: Equation of the IS curve: Y = C (Y - T) + I (r) + G; where: Y (income); G (government spending), T (taxes), I (investment), C (personal spending), r (interest rate). This equation is studied under the closed economy conditions.

Option 2: Equation of the IS curve: Y = C + I + G + EX - IM; where: Y (income); G (government spending), I (investment), C (personal spending), EX (exports), IM (imports). This equation is studied in the open economy conditions, with the relationship of import and export of goods and services.

Option 3: Equation of the IS curve: Y = C (Y - T) + I (r) + G + NX (e); where: Y (income); G (government spending), I (investment), C (personal spending), NX (net exports), r (interest rate), e (exchange rate). This equation is studied in the open economy with the relationship between import and export of goods and services, with the influence of exchange rates and interest rates.

LM curve represents a set of equilibrium points in the money market at different interest rates and incomes; depending on money supply (M or MS), price (P), income (Y), interest rate (r), sensitivity of real money balance to income (k) and sensitivity of real money demand to the interest rate (h). The LM curve equation is represented in the following different ways:

Option 1: Equation of the LM curve: M / P = L (Y, r): The r d interest.

Option 2: Equation of the LM curve:

$$r = \frac{1}{h}\left(k.Y - \frac{MS}{P}\right) = \frac{k}{h}.Y - \frac{1}{h}.\frac{MS}{P}$$

The interest rate is understood to depend on money supply (M or MS), price (P), income (Y), interest rate (r), sensitivity of real money balance to income (k) and the sensitivity of real money demand to the interest rate (h).

Option 3: Equation of the LM curve: $r_t = \alpha_0 + \alpha_1 M_t + \alpha_2 Y_t + \alpha_3 M_{t-1} + u_{1\,T}$

The interest rate depends on the income also depends on the money supply (M) of the current period and the previous period.

Using the IS-LM model in macroeconomic executives

Economists combine the IS and LM curves into the same graph with the correlation between interest rates and income to perform policy analysis: In theory, when monetary policy does not change, the loosening of fiscal policy is implemented, the income will increase because the IS curve moves parallel to the right, while the tightening fiscal policy is implemented, the income will decrease because the IS curve moves parallel to the left. Similarly, when the fiscal policy remains constant and the loosening of monetary policy is implemented, the income will increase as the LM curve moves parallel to the right, while the tightening of monetary policy is implemented, the income will decrease because LM curve moves parallel to the left.

However, the effective fiscal and monetary policy depends on the slope of the IS and LM curves, as follows:

Invalid monetary policy: the LM curve is in the horizontal section crossing the IS curve sloping down to the right or the vertical IS curve. These situations are called as liquidity traps. At this time, only the fiscal policy is in effect, and the monetary policy is invalid (the same happens when the LM curve sloping up section crossing the vertical IS curve).

Invalid financial policy: The LM curve is in the vertical section crossing the IS curve sloping down or the horizontal IS curve. At this time, the financial policy is invalid. On the contrary, the monetary policy has maximum effect; The more money supply increases, the more income increases (the same happens when the horizontal IS curve crosses the LM curve on the sloping up section).

Digital economy

The digital/digitalised economy (digital) or digital economy is recognized as part of the national economy, operated on the fundamentals of the market economy and based on a strong application of information and communication technology platform, shown especially in the application of new technology platforms of the fourth industrial revolution (Industry 4.0). Vietnam already has had a digital economic development strategy to guide its development, in which special attention needs to be paid to the main drivers / prerequisites for the rapid development of the digital economy, including: giving priority to the development of information and communication technology; securing and quickly developing the monetary system and payment system; Adequate investment in appropriate research and innovation will be one of the most important competitive platforms for Vietnam's digital economy.

Overview of research

Research by economists John Hicks and Alvin Hansen.

Two economists have launched and developed the IS-LM model (hence it is also called as the Hicks-Hansen model). The IS-LM model has been used to combine different activities of the economy: the combination of financial / monetary markets with the markets of goods and services. Three critical exogenous variables - i.e. external variables - in the IS-LM model are liquidity, investment, and consumption. According to the theory, liquidity is determined by the size and velocity of the money supply. The levels of investment and consumption are determined by the marginal decisions of individual actors. The IS-LM graph shows the relationship between economic output (or GDP) and the interest rate. The whole economy is simplified into two markets, the production market and the money market, and their respective supply and demand characteristics push the economy back to equilibrium. The intersection of the IS and LM curves shows the equilibrium of the interest rate and output when the money market and the economy are actually in equilibrium. The change in the position and shape of the IS and LM curves, representing changes in liquidity preferences, investment and consumption, changes the equilibrium of the income and the interest rate.

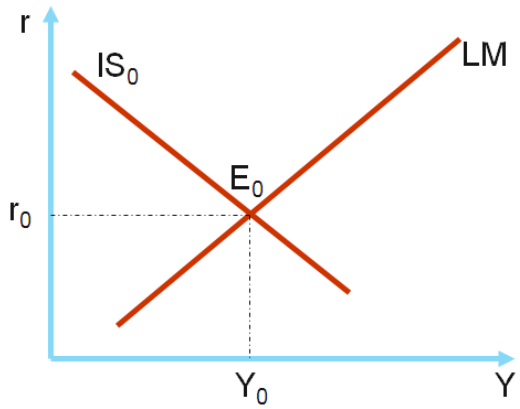


Figure 1: The graph of the combination of IS and LM (The intersection point E between two IS and LM curves is the equilibrium point of both commodity market Y_0 and money market r_0).

Source: Illustration of the author.
Research by economists Robert Mundell and Marcus Fleming.
The Mundell-Fleming model is a theoretical model independently developed by Robert Mundell and Marcus Fleming in the 1960s using two IS and LM curves to analyze the impact of macroeconomic policies implemented in an open economy. Assumptions of the model are: The actual output is less than the potential output, the price in the short term is fixed and the economy is small and open. The main finding of the model is that an economy cannot simultaneously maintain a fixed exchange rate, free capital movement and an independent monetary policy. In the context of a country applying a fixed exchange rate policy, the effects of fiscal, trade and monetary policy on the IS and LM curves will create different income changes.

Figure 2: The effect of an expansionary fiscal policy on the fixed exchange rate

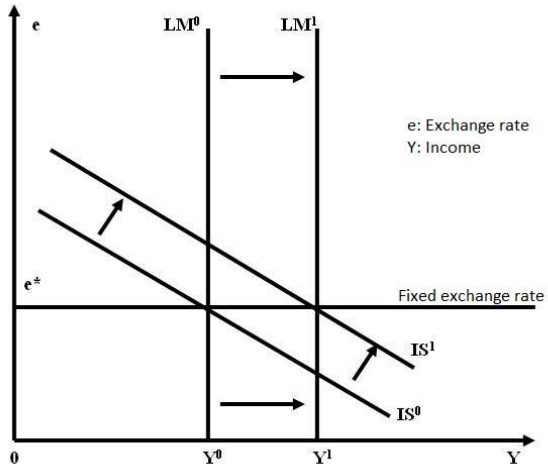
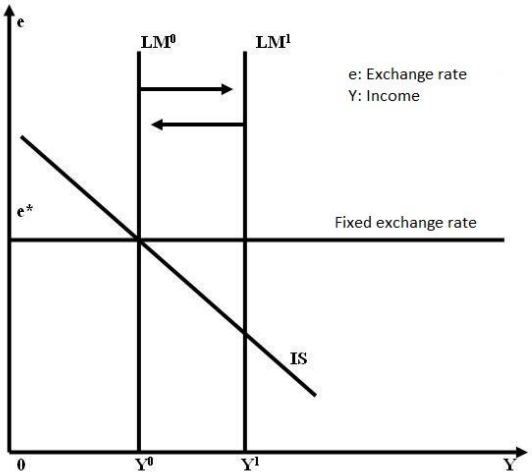


Figure 3: The effect of an expansionary monetary policy on the fixed exchange rate



Source: Illustration of the author.
Research by Nguyen Thuong Lang
The research shows that the process of economic restructuring associated with Vietnam's growth model innovation in recent years has achieved certain results. The economic structure has shifted towards increasing the proportion of added value. Monetary and fiscal policy coordination efforts are ensuring macroeconomic stability, curbing inflation, and spurring growth. Monetary and fiscal policy in Vietnam operates under free moving capital conditions. In the 2010-2019 period, the realized investment capital to GDP increased rapidly pushing IS curve to IS' curve although the disbursement rate is often slow compared to the plan. The LM curve moves to LM' curve and the GDP moves to GDP' showing that the scale of GDP tends to increase. The foundations of economic stability through concerting monetary and fiscal policy efforts in Vietnam are quite effective. The research also shows that any IS or LM curve displacement requires a movement of the remaining curve to ensure balance with the constant assumption of other factors.
Currently in Vietnam, there are no empirical studies on the construction and analysis of the IS-LM curve model for policy recommendations and macroeconomic executives, especially for the 2021-2030 development period, a period when a new development engine appears from the digital economy and growth model transformation.

RESEARCH METHODS

Research models

On the basis of researching theoretical models, assessing the practical conditions of Vietnam, the research chooses to use the IS-LM model in which the equation of the IS curve and the LM curve in Vietnam is as follows:
LM curve: $i\_rate=c(1)*Gdp+c(2)*M2+c(3)*cpi+u_{1t}$
IS curve: $gdp=c(5)*i\_rate+c(6)*n\_ex+c(7)*g\_cons+c(8)*p\_cons+c(9)*inv+u_{2t}$

Including:
i_rate: Deposit interest rate; m2: money supply; gdp: Nominal GDP; cpi: price index;
n_ex: net exports; g_cons: Government spending; p_cons: private spending;
inv: general social investment (including: inv_state public investment, inv_private private investment, inv_fdi foreign direct investment).
Apply late variable:

The option to apply the late variable M2 (-1) with the assumption that the money supply has effect after a certain period (one year) or in other words is to evaluate the effect of money supply M2 a year earlier on interest rates. Specifically, the LM curve is:

i_rate=c (1) *Gdp+c (2) *M2(-1) +c (3) *cpi +u_{1t}

The option to apply the late variable inv_state (-3), inv_private (-1), inv_fdi (-2) with the assumption that public investment, private sector and foreign direct investment to GDP after a corresponding time period of 3 years, 1 year and 2 years, specifically the IS curve is:

gdp=c(5)*i_rate+c(6)*n_ex+c(7)*g_cons+c(8)*p_cons+c(9)*inv_state(-3) +c(10)*inv_private(-1)+c(11)*inv_fdi(-2) + u_{2t}

In addition, the research also uses the estimation method to assess the impact of factors constituting the driving force for digital economic development in Vietnam as follows:

gdp = c (1) + c (2) *ict + c (3) *f_service + c (4) *r_d(-2)

Including:

gdp: Nominal GDP;

ict: value of industry of information and communication technology;

f_service: value of industry providing financial services, payment;

r_d: investment value in science and technology (using the late variable with the implication that science and technology will have an impact on the digital economic development from innovation with 2 years).

Data and methodology

The Research uses macro data of Vietnam in the 2000-2020 period (Appendix 1) published by the General Statistics Office, State Bank of Vietnam, Ministry of Finance ... on official websites.

Two-Stage Least Squares method and Generalized Method of Moments Data analysis and estimation were performed using Eviews software.

RESEARCH RESULTS

Define the IS-LM model

The results of the first estimation (Appendix 2a) are as follows:

Estimation Command:
==========
GMM (DERIV=AA, +SHOWOPTS)

Estimated Equations:
==========
I_RATE=C (1) *GDP+C (2) *M2(-1) +C(3)*CPI

GDP=C(5)*I_RATE+C(6)*N_EX+C(7)*G_CONS+C(8)*P_CONS+C(9)*INV

Substituted Coefficients:
==========
I_RATE=3.91633248206e-06*GDP-2.04535294523e-06*M2(-1)+0.510235811974*CPI

GDP=16201.6542553*I_RATE+0.457645692633*N_EX+1.3442376293*G_CONS+1.49199566632*P_CONS-0.39201335521*INV

Source: Calculation of the author (details in the attached appendices).

In the 2000-2020 period, besides the positive effects of GDP and inflation (CPI), the control of money supply M2 has a negative impact on the nominal interest rate. Monetary policy tools have come into play for the interest rate adjustment - flexible interest rate policy according to market signals in Vietnam.

Nominal GDP growth in Vietnam comes from the effectiveness of interest rate policy, trade balance, government spending, and private sector spending. However, the negative effect of investment on the nominal GDP growth.

To clarify the impact of investment, the estimation was done directly with investment variables made in detail for public investment, private sector investment and foreign direct investment, resulting in following (Appendix 2b):

Estimation Command:
==========
GMM(DERIV=AA, +SHOWOPTS)

Estimated Equations:

==========
I_RATE=C(1)*GDP+C(2)*M2(-1)+C(3)*CPI

GDP=C(5)*I_RATE+C(6)*N_EX+C(7)*G_CONS+C(8)*P_CONS+C(9)*INV_STATE(-3)+C(10)*INV_PRIVATE(-1)+C(11)*INV_FDI(-2)

Substituted Coefficients:
==========
I_RATE=3.73197677368e-06*GDP-1.90959248194e-06*M2(-1)+0.513368545684*CPI

GDP=15198.2421139*I_RATE+0.606052510271*N_EX+1.28454587831*G_CONS+1.35573982713*P_CONS-0.582808214821*INV_STATE(-3)-0.833582134516*INV_PRIVATE(-1) +1.90755835084*INV_FDI(-2)
Source: Calculation of the author (details in the attached appendices); The application of late variables for investment sources ensures statistical significance of the estimation results.
As a result of the estimation, the negative impact on the nominal GDP growth of Vietnam in this period came from public investment and private sector.

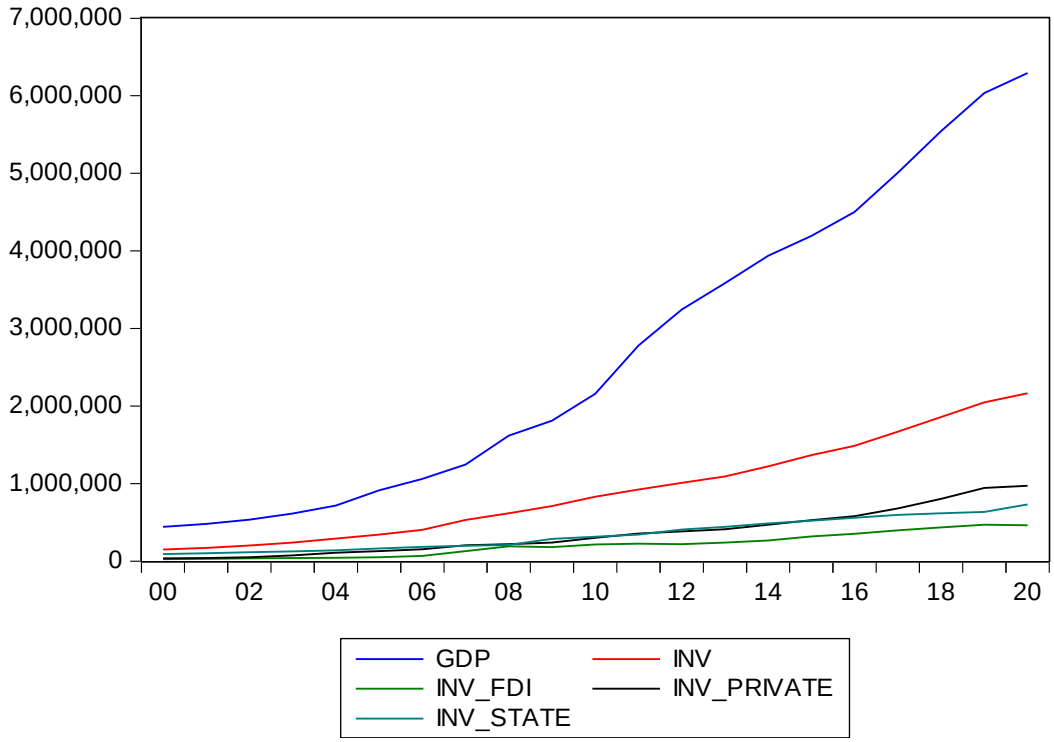


Figure 4: GDP and investment value of Vietnam in the 2000-2020 period.

Source: Calculation of the author (details in the attached appendices)
However, considering the 2000-2015 period alone, all three investment groups positively affected Vietnam's GDP growth according to the following estimated results (Appendix 2c):
Estimation Command:
==========
GMM(DERIV=AA, +SHOWOPTS)
Estimated Equations:
==========
I_RATE=C(1)*GDP+C(2)*M2(-1)+C(3)*CPI
GDP=C(5)*I_RATE+C(6)*N_EX+C(7)*G_CONS+C(8)*P_CONS+C(9)*INV_STATE(-3)+C(10)*INV_PRIVATE(-1)+C(11)*INV_FDI(-2)
Substituted Coefficients:
==========
I_RATE=1.01358185899e-05*GDP-7.61755354786e-06*M2(-1)+0.327515785456*CPI

GDP=9137.48194039*I_RATE+0.58334662304*N_EX+1.13630429378*G_CONS+1.05381035884*P_CONS-0.410754375006*INV_STATE(-3)+1.51406822168*INV_PRIVATE(-1) +1.23536386832*INV_FDI(-2)

Source: Calculation of the author (details in the attached appendices); The application of late variables for investment sources ensures statistical significance of the estimation results.
Estimation results used Two-Stage Least Squares having similar results when the 2000-2020 period investment had a negative effect on the nominal GDP growth, as follows (Appendix 3):
Estimation Command:
==========
TSLS(DERIV=AA, +SHOWOPTS)
Estimated Equations:
==========
I_RATE=C(1)*GDP+C(2)*M2(-1)+C(3)*CPI
GDP=C(5)*I_RATE+C(6)*N_EX+C(7)*G_CONS+C(8)*P_CONS+C(9)*INV(-1)
Substituted Coefficients:
==========
I_RATE=3.95764839246e-06*GDP-2.06924368789e-06*M2(-1)+0.505121199655*CPI
GDP=15154.4452024*I_RATE+0.489469070645*N_EX+1.37972385677*G_CONS+1.51585471559*P_CONS-0.488299160763*INV(-1)
Source: Calculation of the author (details in the attached appendices); The application of late variables for investment sources ensures statistical significance of the estimation results.

Determination of the main driving force of digital economic development in Vietnam
Estimation results show that the information and communication technology (ICT) industry has not really contributed to the nominal GDP as expected; The contribution of payment and financial services as well as scientific and technological activities to GDP growth is clear (however, due to the characteristics of science and technology activities there is a "lag" with 2 years of impact of research results and application to GDP), as follows:

Dependent Variable: GDP				
Method: Least Squares				
Date: 02/01/21 Time: 09:29				
Sample (adjusted): 2002 2020				
Included observations: 19 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	345946.4	105774.4	3.270607	0.0052
ICT	-30.87346	17.22960	-1.791885	0.0933
F_SERVICE	17.38285	2.939500	5.913540	0.0000
R_D(-2)	19.03837	10.53370	1.807377	0.0908
R-squared	0.997350	Mean dependent var		2936404.
Adjusted R-squared	0.996820	S.D. dependent var		1939429.
S.E. of regression	109375.8	Akaike info criterion		26.22763
Sum squared resid	1.79E+11	Schwarz criterion		26.42646
Log likelihood	-245.1625	Hannan-Quinn criter.		26.26128
F-statistic	1881.498	Durbin-Watson stat		1.375954
Prob(F-statistic)	0.000000			

Estimation Command:
==========
LS GDP C ICT F_SERVICE R_D(-2)

Estimation Equation:
==========
GDP = C(1) + C(2)*ICT + C(3)*F_SERVICE + C(4)*R_D(-2)

Substituted Coefficients:
==========
GDP = 345946.393135-30.8734590278*ICT+17.3828505194*F_SERVICE+19.0383654494*R_D(-2)

Source: Calculation of the author; The application of the late variables to science and technology activities ensures statistical significance of the estimation results.

CONCLUSION AND POLICY IMPLICATIONS

On the basis of the estimation results of Vietnam's IS-LM curve in the 2000-2020 period and economic development trends domestically and internationally in the 2021-2030 period (especially growth model transformation, international integration and digital transformation), the author proposes a number of solutions to improve the effectiveness and efficiency of Vietnam's macroeconomic executives as follows:

Firstly, for investment policy: Vietnam needs to pay attention to ensure the efficiency of public and private investment in order to contribute to GDP growth in addition to current effective FDI attraction policies. Moreover, the Government needs solutions to ensure the effectiveness and shorten the preparation time (administrative procedures) of investment sources (the 2000-2020 period has a delay of 1 to 3 years).

Secondly, for fiscal policy: Vietnam needs to uphold the limits on budget deficit and public investment approved by the National Assembly, with special emphasis on improving the efficiency of public investment and public spending; implementing solutions to ensure the aggregate demand from investment and public spending, private sector spending for the coming years.

Thirdly, continue to implement a prudent monetary policy to control inflation, create confidence, ensure long-term and sustainable development conditions of the Vietnamese economy. Measures that affect the money supply M2 continue to have an impact on interest rates will contribute to the good control of inflation, which will gradually reduce interest rates, support economic development and increase aggregate demand (increase consumption and investment).

Fourthly, the policy for the import-export sector, if the trade surplus is maintained, it will help GDP growth in the condition of the current high growth in economic aggregate demand.

Fifthly, to promote digital economic development in Vietnam, in addition to completing the legal corridor, the Government should have policies to ensure the further development of the information and communication industry (increase the proportion in the GDP); promote activities of science and technology in service of innovation, creativity, quick access to new fields of the Industrial Revolution 4.0; continue to both support development and ensure security and safety in the financial services and payment sectors of Vietnam.

In the coming years, although Vietnam's economy is forecasted with good prospects, there are many challenges coming from inside and outside the country, so it requires not only short-term solutions but also a long-term vision of the Government for sustainable development ... In the scope of this article, we apply the quantitative model in the construction of IS-LM in Vietnam to give opinions on macroeconomic executive solutions and hope to receive the exchange opinions of the scientists.

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Appendix 1a: Vietnam macroeconomic data (2000-2020), provided by GSO.

Năm	GDP	INV	INV_STATE	INV_PRIVATE	INV_FDI	M2	I_RATE	CPI	N_EX	G_CONS	P_CONS	ICT	F_SERVICE	R_D
2000	441646.0	151183.0	89417.00	34594.00	27172.00	222882.0	6.000000	-0.600000	-10878.00	293507.0	28346.00	3913.000	8148.000	2345.000
2001	481295.0	170496.0	101973.0	38512.00	30011.00	279781.0	6.000000	0.800000	-10982.00	312144.0	30463.00	4173.000	8761.000	2646.000
2002	535762.0	200145.0	114738.0	50612.00	34795.00	329149.0	7.000000	4.000000	-21471.00	348060.0	33390.00	4469.000	9763.000	3009.000
2003	613443.0	239246.0	126558.0	74388.00	38300.00	411233.0	7.000000	3.180000	-51288.00	406451.0	38770.00	4715.000	10857.00	3694.000
2004	715307.0	290927.0	139831.0	109754.0	41342.00	532346.0	7.000000	7.710000	-65377.00	42510.00	526632.0	8482.000	40415.00	10614.00
2005	914001.0	343135.0	161635.0	130398.0	51102.00	690652.0	8.000000	8.290000	-30306.00	49952.00	598567.0	9997.000	47825.00	12907.00
2006	1061565.	404712.0	185102.0	154006.0	65604.00	922672.0	8.000000	7.480000	-30872.00	58734.00	690953.0	11812.00	55869.00	14449.00
2007	1246769.	532093.0	197989.0	204705.0	129399.0	1348244.	8.000000	8.300000	-169181.0	69247.00	849140.0	13777.00	65861.00	16975.00
2008	1616047.	616735.0	209031.0	217034.0	190670.0	1622130.	13.00000	22.97000	-220495.0	90904.00	1145360.	17592.00	86356.00	21528.00
2009	1809149.	708826.0	287534.0	240109.0	181183.0	2092447.	10.00000	6.880000	-187556.0	104539.0	1239151.	19349.00	100324.0	24291.00
2010	2157828.	830278.0	316285.0	299487.0	214506.0	2789184.	11.00000	9.190000	-177214.0	129313.0	1436289.	19894.00	116515.0	28003.00
2011	2779880.	924495.0	341555.0	356049.0	226891.0	3125961.	13.00000	18.58000	-114887.0	164322.0	1844376.	21089.00	148452.0	35333.00
2012	3245419.	1010114.	406514.0	385027.0	218573.0	3519375.	11.00000	9.210000	113696.0	192362.0	2093260.	22781.00	171172.0	41411.00
2013	3584261.	1091136.	440505.0	410532.0	240099.0	4400692.	8.000000	6.600000	77349.00	220642.0	2346160.	24652.00	195015.0	47398.00
2014	3937856.	1220704.	486804.0	468500.0	265400.0	5179216.	6.000000	4.090000	128965.0	246711.0	2591336.	26973.00	207083.0	51166.00
2015	4192862.	1366478.	519878.0	528500.0	318100.0	6019600.	6.000000	0.630000	33168.00	265544.0	2849540.	29391.00	230148.0	55574.00
2016	4502732.	1487638.	557633.0	578902.0	351103.0	7125800.	6.000000	2.660000	115342.0	293105.0	3086297.	31840.00	248598.0	59761.00
2017	5005975.	1670196.	596096.0	677900.0	396200.0	8194700.	6.000000	3.530000	140282.0	325803.0	3405750.	34293.00	273809.0	64258.00
2018	5542331.	1857061.	618661.0	803298.0	435102.0	9211800.	7.000000	3.540000	186052.0	358591.0	3745063.	37793.00	295443.0	69340.00
2019	6037347.	2046838.	634948.0	942449.0	469441.0	10573700	7.000000	2.790000	126258.0	390050.0	4115186.	40880.00	321305.0	74924.00
2020	6293144.	2164500.	729000.0	972200.0	463300.0	11486210	6.000000	3.230000	183932.0	427452.0	4302221.	42493.00	338150.0	81012.00

Appendix 1b: Statistical description of Vietnam macroeconomic data (2000-2020).

	GDP	INV	INV_STATE	INV_PRIVATE	INV_FDI	M2	I_RATE	CPI	N_EX	G_CONS	P_CONS	ICT	F_SERVICE	R_D
Mean	2700696.	920330.3	345794.6	365569.3	208966.3	3813227.	7.952381	6.336190	692.2381	228092.5	1761726.	20493.24	141898.5	34316.10
Median	2157828.	830278.0	316285.0	299487.0	214506.0	2789184.	7.000000	4.090000	-10982.00	246711.0	1436289.	19894.00	116515.0	28003.00
Maximum	6293144.	2164500.	729000.0	972200.0	469441.0	11486210	13.00000	22.97000	186052.0	427452.0	4302221.	42493.00	338150.0	81012.00
Minimum	441646.0	151183.0	89417.00	34594.00	27172.00	222882.0	6.000000	-0.600000	-220495.0	42510.00	28346.00	3913.000	8148.000	2345.000
Std. Dev.	1984812.	645460.8	206022.6	292330.3	151819.6	3635770.	2.290768	5.645571	126589.8	127555.2	1419295.	12438.04	111098.2	26000.87
Skewness	0.430986	0.507139	0.326597	0.756144	0.329786	0.808088	1.133693	1.591995	-0.184547	-0.066972	0.350601	0.229720	0.339220	0.316751
Kurtosis	1.803956	2.046849	1.716847	2.491209	1.872935	2.366021	3.039400	5.386266	1.894994	1.647893	1.841545	1.914809	1.762492	1.748236
Jarque-Bera	1.901829	1.695098	1.814001	2.227650	1.492147	2.637212	4.499767	13.85305	1.187610	1.615368	1.604489	1.215135	1.742743	1.722209
Probability	0.386388	0.428464	0.403733	0.328301	0.474225	0.267508	0.105412	0.000981	0.552222	0.445890	0.448322	0.544674	0.418377	0.422695
Sum	56714619	19326936	7261687.	7676956.	4388293.	80077774	167.0000	133.0600	14537.00	4789943.	36996250	430358.0	2979869.	720638.0
Sum Sq. Dev.	7.88E+13	8.33E+12	8.49E+11	1.71E+12	4.61E+11	2.64E+14	104.9524	637.4495	3.20E+11	3.25E+11	4.03E+13	3.09E+09	2.47E+11	1.35E+10
Observations	21	21	21	21	21	21	21	21	21	21	21	21	21	21

Appendix 2a:

System: SYS_INV				
Estimation Method: Generalized Method of Moments				
Date: 02/01/21 Time: 22:44				
Sample: 2001 2020				
Included observations: 20				
Total system (balanced) observations 40				
Estimation settings: tol=0.00010, derivs=analytic (linear)				
Initial Values: C(1)=3.7e-06, C(2)=-1.9e-06, C(3)=0.51898, C(5)=15639.6, C(6)=0.50871, C(7)=1.37477, C(8)=1.51791, C(9)=-0.49488				
Kernel: Bartlett, Bandwidth: Fixed (3), No prewhitening				
Linear estimation after one-step weighting matrix				
	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	3.92E-06	3.25E-07	12.04397	0.0000
C(2)	-2.05E-06	2.00E-07	-10.23219	0.0000
C(3)	0.510236	0.033694	15.14342	0.0000
C(5)	16201.65	780.0356	20.77040	0.0000
C(6)	0.457646	0.045020	10.16538	0.0000
C(7)	1.344238	0.041416	32.45718	0.0000
C(8)	1.491996	0.035714	41.77653	0.0000
C(9)	-0.392013	0.077774	-5.040434	0.0000
Determinant residual covariance		7.74E+09		
J-statistic		0.362107		
Equation: I_RATE=C(1)*GDP+C(2)*M2(-1)+C(3)*CPI				
Instruments: C M2 M2(-1) INV CPI G_CONS P_CONS N_EX				
Observations: 20				
R-squared	0.180598	Mean dependent var		8.050000
Adjusted R-squared	0.084198	S.D. dependent var		2.305029
S.E. of regression	2.205856	Sum squared resid		82.71862
Durbin-Watson stat	0.871310			
Equation: GDP=C(5)*I_RATE+C(6)*N_EX+C(7)*G_CONS+C(8)*P_CONS+C(9)*INV				
Instruments: C M2 M2(-1) INV CPI G_CONS P_CONS N_EX				
Observations: 20				
R-squared	0.999490	Mean dependent var		2813649.
Adjusted R-squared	0.999354	S.D. dependent var		1965909.
S.E. of regression	49952.26	Sum squared resid		3.74E+10
Durbin-Watson stat	1.743488			

Estimation Command:
==========
GMM(DERIV=AA, +SHOWOPTS)

Estimated Equations:
==========

I_RATE=C(1)*GDP+C(2)*M2(-1)+C(3)*CPI

GDP=C(5)*I_RATE+C(6)*N_EX+C(7)*G_CONS+C(8)*P_CONS+C(9)*INV

Substituted Coefficients:
==========
I_RATE=3.91633248206e-06*GDP-2.04535294523e-06*M2(-1)+0.510235811974*CPI

GDP=16201.6542553*I_RATE+0.457645692633*N_EX+1.3442376293*G_CONS+1.49199566632*P_CONS -0.39201335521*INV

Appendix 2b:

System: SYS_INV				
Estimation Method: Generalized Method of Moments				
Date: 02/01/21 Time: 22:34				
Sample: 2001 2020				
Included observations: 20				
Total system (unbalanced) observations 38				
Estimation settings: tol=0.00010, derivs=analytic (linear)				
Initial Values: C(1)=2.5e-06, C(2)=-1.1e-06, C(3)=0.50199, C(5)=14542.3,				
C(6)=0.82085, C(7)=0.75935, C(8)=1.64566, C(9)=-1.71284, C(10)=				
-0.51165, C(11)=0.32509				
Kernel: Bartlett, Bandwidth: Fixed (3), No prewhitening				
Linear estimation after one-step weighting matrix				
	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	3.73E-06	5.55E-07	6.724852	0.0000
C(2)	-1.91E-06	3.70E-07	-5.156354	0.0000
C(3)	0.513369	0.046156	11.12250	0.0000
C(5)	15198.24	1812.725	8.384196	0.0000
C(6)	0.606053	0.055349	10.94966	0.0000
C(7)	1.284546	0.069389	18.51217	0.0000
C(8)	1.355740	0.037542	36.11224	0.0000
C(9)	-0.582808	0.287572	-2.026650	0.0523
C(10)	-0.833582	0.170784	-4.880903	0.0000
C(11)	1.907558	0.437277	4.362358	0.0002
Determinant residual covariance		7.65E+09		
J-statistic		0.342139		
Equation: I_RATE=C(1)*GDP+C(2)*M2(-1)+C(3)*CPI				
Instruments: C M2 M2(-1) INV_STATE INV_PRIVATE INV_FDI CPI				
G_CONS P_CONS N_EX				
Observations: 20				
R-squared	0.178214	Mean dependent var		8.050000
Adjusted R-squared	0.081533	S.D. dependent var		2.305029
S.E. of regression	2.209063	Sum squared resid		82.95931
Durbin-Watson stat	0.876358			
Equation: GDP=C(5)*I_RATE+C(6)*N_EX+C(7)*G_CONS+C(8)				
*P_CONS+C(9)*INV_STATE(-3)+C(10)*INV_PRIVATE(-1)+C(11)				
*INV_FDI(-2)				

Instruments: C M2 M2(-1) INV_STATE INV_PRIVATE INV_FDI CPI G_CONS P_CONS N_EX				
Observations: 18				
R-squared	0.999457	Mean dependent var		3069773.
Adjusted R-squared	0.999161	S.D. dependent var		1903892.
S.E. of regression	55148.36	Sum squared resid		3.35E+10
Durbin-Watson stat	1.133066			

Estimation Command:
==========
GMM(DERIV=AA, +SHOWOPTS)

Estimated Equations:
==========
I_RATE=C(1)*GDP+C(2)*M2(-1)+C(3)*CPI

GDP=C(5)*I_RATE+C(6)*N_EX+C(7)*G_CONS+C(8)*P_CONS+C(9)*INV_STATE(-3)+C(10)*INV_PRIVATE(-1)+C(11)*INV_FDI(-2)

Substituted Coefficients:
==========
I_RATE=3.73197677368e-06*GDP-1.90959248194e-06*M2(-1)+0.513368545684*CPI

GDP=15198.2421139*I_RATE+0.606052510271*N_EX+1.28454587831*G_CONS+1.35573982713*P_CONS-0.582808214821*INV_STATE(-3)-0.833582134516*INV_PRIVATE(-1)+1.90755835084*INV_FDI(-2)

Appendix 2c:

System: SYS_INV				
Estimation Method: Generalized Method of Moments				
Date: 02/01/21 Time: 22:36				
Sample: 2001 2015				
Included observations: 15				
Total system (unbalanced) observations 28				
Estimation settings: tol=0.00010, derivs=analytic (linear)				
Initial Values: C(1)=3.7e-06, C(2)=-1.9e-06, C(3)=0.51337, C(5)=15198.2, C(6)=0.60605, C(7)=1.28455, C(8)=1.35574, C(9)=-0.58281, C(10)=-0.83358, C(11)=1.90756				
Kernel: Bartlett, Bandwidth: Fixed (3), No prewhitening				
Linear estimation after one-step weighting matrix				
	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	1.01E-05	4.24E-07	23.91629	0.0000
C(2)	-7.62E-06	3.77E-07	-20.21011	0.0000
C(3)	0.327516	0.021793	15.02825	0.0000
C(5)	9137.482	988.9427	9.239648	0.0000
C(6)	0.583347	0.062110	9.392114	0.0000
C(7)	1.136304	0.062793	18.09615	0.0000
C(8)	1.053810	0.100958	10.43811	0.0000
C(9)	-0.410754	0.167857	-2.447049	0.0249
C(10)	1.514068	0.694921	2.178764	0.0429
C(11)	1.235364	0.090058	13.71746	0.0000
Determinant residual covariance		2.09E+09		
J-statistic		0.364967		

Equation: I_RATE=C(1)*GDP+C(2)*M2(-1)+C(3)*CPI				
Instruments: C M2 M2(-1) INV_STATE INV_PRIVATE INV_FDI CPI				
G_CONS P_CONS N_EX				
Observations: 15				
R-squared	0.379619	Mean dependent var		8.600000
Adjusted R-squared	0.276223	S.D. dependent var		2.414243
S.E. of regression	2.053920	Sum squared resid		50.62306
Durbin-Watson stat	0.904584			
Equation: GDP=C(5)*I_RATE+C(6)*N_EX+C(7)*G_CONS+C(8)				
*P_CONS+C(9)*INV_STATE(-3)+C(10)*INV_PRIVATE(-1)+C(11)				
*INV_FDI(-2)				
Instruments: C M2 M2(-1) INV_STATE INV_PRIVATE INV_FDI CPI				
G_CONS P_CONS N_EX				
Observations: 13				
R-squared	0.999540	Mean dependent var		2144184.
Adjusted R-squared	0.999079	S.D. dependent var		1270564.
S.E. of regression	38554.71	Sum squared resid		8.92E+09
Durbin-Watson stat	2.096006			

Estimation Command:
==========
GMM(DERIV=AA, +SHOWOPTS)

Estimated Equations:
==========
I_RATE=C(1)*GDP+C(2)*M2(-1)+C(3)*CPI

GDP=C(5)*I_RATE+C(6)*N_EX+C(7)*G_CONS+C(8)*P_CONS+C(9)*INV_STATE(-3)+C(10)*INV_PRIVATE(-1)+C(11)*INV_FDI(-2)

Substituted Coefficients:
==========
I_RATE=1.01358185899e-05*GDP-7.61755354786e-06*M2(-1)+0.327515785456*CPI

GDP=9137.48194039*I_RATE+0.58334662304*N_EX+1.13630429378*G_CONS+1.05381035884*P_CONS-0.410754375006*INV_STATE(-3)+1.51406822168*INV_PRIVATE(-1)+1.23536386832*INV_FDI(-2)

Appendix 3:

System: SYS_INV				
Estimation Method: Two-Stage Least Squares				
Date: 02/01/21 Time: 22:42				
Sample: 2001 2020				
Included observations: 20				
Total system (balanced) observations 40				
Estimation settings: tol=0.00010, derivs=analytic (linear)				
Initial Values: C(1)=1.0e-05, C(2)=-7.5e-06, C(3)=0.33302, C(5)=4541.64,				
C(6)=0.70503, C(7)=0.84558, C(8)=0.89583, C(9)=1.16421				
	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	3.96E-06	1.10E-06	3.607849	0.0010

C(2)	-2.07E-06	7.41E-07	-2.791187	0.0088
C(3)	0.505121	0.091471	5.522175	0.0000
C(5)	15154.45	3980.216	3.807442	0.0006
C(6)	0.489469	0.195919	2.498324	0.0178
C(7)	1.379724	0.180378	7.649053	0.0000
C(8)	1.515855	0.132290	11.45853	0.0000
C(9)	-0.488299	0.315418	-1.548103	0.1314
Determinant residual covariance		7.25E+09		
Equation: I_RATE=C(1)*GDP+C(2)*M2(-1)+C(3)*CPI				
Instruments: C M2 M2(-1) INV_STATE INV_PRIVATE INV_FDI CPI				
G_CONS P_CONS N_EX				
Observations: 20				
R-squared	0.180774	Mean dependent var		8.050000
Adjusted R-squared	0.084395	S.D. dependent var		2.305029
S.E. of regression	2.205619	Sum squared resid		82.70086
Durbin-Watson stat	0.849283			
Equation: GDP=C(5)*I_RATE+C(6)*N_EX+C(7)*G_CONS+C(8)				
*P_CONS+C(9)*INV(-1)				
Instruments: C M2 M2(-1) INV_STATE INV_PRIVATE INV_FDI CPI				
G_CONS P_CONS N_EX				
Observations: 20				
R-squared	0.999523	Mean dependent var		2813649.
Adjusted R-squared	0.999395	S.D. dependent var		1965909.
S.E. of regression	48339.95	Sum squared resid		3.51E+10
Durbin-Watson stat	1.448503			

Estimation Command:
==========
TSLS(DERIV=AA, +SHOWOPTS)

Estimated Equations:
==========
I_RATE=C(1)*GDP+C(2)*M2(-1)+C(3)*CPI

GDP=C(5)*I_RATE+C(6)*N_EX+C(7)*G_CONS+C(8)*P_CONS+C(9)*INV(-1)

Substituted Coefficients:
==========
I_RATE=3.95764839246e-06*GDP-2.06924368789e-06*M2(-1)+0.505121199655*CPI

GDP=15154.4452024*I_RATE+0.489469070645*N_EX+1.37972385677*G_CONS+1.51585471559*P_CONS-0.488299160763*INV(-1)