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A Mathematical Approach to the Money Multiplier Analysis on Indonesian 1997–1998 Monetary Crisis

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Abstract

In crisis moments, massive liquidity supports, extensive cash withdrawal, and large reserve hoarding can all lead to the change in monetary base, currency ratio, and reserve ratio respectively. In turn, all these disruptions could cause money supply to change. This research aims to find out which factor (among the change in monetary base, currency ratio, and reserve ratio) became the main causal factor of increasing money supply in Indonesia during 1997–1998 crisis. The method follows mathematical equation models used by Friedman & Schwartz (1963) and Stauffer (2006) in analyzing Great Depression in the US. This research has found that the change in monetary base in Indonesia during 1997–1998 crisis became the main cause of increasing money supply in that period. This result is consistent with what the other literatures had said.

Keywords: currency ratio, monetary base, money multiplier, money supply, reserve ratio

JEL classifications: C02, E51, G01

1. Introduction

Money plays vital roles in the economy. Money functions as a store of value, a unit of measurement, and a medium of exchange in society. Due to its important functions, a change in the amount of money can therefore affect numerous aspects in society, including consumption level, investment, interest rates, exchange rates, and inflation. Considering these broad implications, it is crucial to understand how the amount of money in an economy can change (Friedman 2017).

Particularly in a crisis, the change in money supply will be an interesting discussion because it may generate effects which can either worsen or improve the situation. What causes money supply to change during a crisis should be an important question every time readers think of the crisis. Moreover, during crisis, various factors may lead to the change in money supply. The society will draw their money out of banks; banks hold reserves to avoid collapse; and the central bank will provide liquidity support. Hence, discovering which factor (among these three factors) being the biggest source of change in money supply during crisis will be reasonably intriguing. This paper focuses on the 1997–1998 Indonesian monetary crisis, considering that Indonesia was interestingly the most affected country during the Asian Financial Crisis (Hofman 2022; Juhro & Iyke 2019).

Despite discussing an old topic of the 1997 Indonesian monetary crisis, this paper still contributes two novelties. First, motivated by the neoclassical view of money supply in which money multiplier is assumed constant and the monetary base change is therefore deemed to be the sole cause of money supply change, a great number of monetary papers on crisis position the central bank as the sole agent on stage. Meanwhile, employing a money multiplier analysis, this paper introduces other important agents (i.e. banks and society) on stage,

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whose actions can finally receive equal attention in the crisis.

Second, regardless of money multiplication being a fundamental concept in monetary economics, its theoretical identity equation formats are bound to be deterministic (not stochastic) and thus it is perceived as limiting its empirical application. This paper attempts to demonstrate that, with the proper mathematical methods, money multiplier analysis can actually be employed to explain real-world phenomenon and become a new way to understand monetary crises. When utilized properly, money multiplier is a useful concept to recap the quality of the transmission and effectiveness of the monetary policy (Berk & van den End 2022).

2. Literature Review

2.1. The Theory of Money Supply Creation (Mishkin 2014)

The theoretical relationship between money supply and its three influencing factors (monetary base, reserve ratio, and currency ratio) is summarized in the multiple deposit creation theory. According to Mishkin (2014), the increase in monetary base (because of Open Market Purchase by the central bank) can generate the increase in new deposits in the banking system (or multiple deposit creation). This total deposit increment is the same as the total increment of money supply in the society. In other words, the rise in monetary base (by the central bank) increases money supply via the multiple deposit expansion process.

Multiple deposit expansion can be illustrated as follows. The central bank adds money to an account of a bank in the central bank (for various reasons, but usually because the central bank buys the bond of the said bank), which means that the reserves of the bank in the central bank increase. This bank later lends some of that new money to people. In other words, people borrow money from this bank. People hold some of this borrowed money in currency format, thus the remaining other is put back to another bank in the form of bank deposits. Later, that other bank lends some of that new bank deposits back to people. The same process then repeats. Overall, the total deposits in the banking system multiply.

This process is influenced by three factors; namely the reserve requirement ratio set by the central bank, the willingness of banks to hold excess reserves, and the willingness of society to hold their money in the currency format (and not in deposits).

In addition to higher reserve requirement ratio, greater willingness of banks to hold excess reserves implies lower occurrence of multiple deposit expansion because of the less money that can be lent out by banks and be deposited back to other banks. Hereafter, these two ratios will be combined into one term, namely reserve ratio. Meanwhile, greater willingness of the society to hold their money in currency means less occurrence of multiple deposit expansion due to the less money that can be deposited back to banks.

Therefore, it can be said that the change in money supply is influenced by the decisions of economic agents of the particular country. The change in money supply can originate from the changes in monetary base and money multiplier. The monetary base level is dominantly set under the decision of the central bank while the magnitude of money multiplier is related with the decisions of banks and the society. Two components of money multiplier are reserve ratio and currency ratio. The reserve ratio can change (with the assumption of constant reserve requirement ratio) supposing banks change their decision about the amount of reserves to be hold. The currency ratio can change supposing the society changes their decision about the amount of money to be hold in currency.

2.2. The Typical Decisions of the Three Agents During Crisis

The decisions taken by the central bank, banks, and the society are somewhat typical during crisis.

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Referring to the Great Depression, the 2008 US crisis, and the 1998 Indonesian crisis, uniqueness in these decisions is revealed. The society usually draws their money into currency, while banks reactively hold reserves and the central banks provide liquidity support. These actions lead to higher currency ratio, reserve ratio, and monetary base during crisis.[1] Supposing currency ratio and reserve ratio increase during crisis, then money multiplier will decrease. Supposing money multiplier decreases and monetary base is assumed to be constant during crisis, then lower money supply will be created. In the meantime, supposing monetary base increases and money multiplier is assumed to be constant, then higher money supply will be generated. Whether money supply goes up or down during crisis therefore depends on the extent to which the decrease in money multiplier (as the result of increasing currency ratio and reserve ratio) affects money supply and the extent to which the increase in monetary base affects money supply (Ryan & Whelan 2023).

The direction of money supply movement during crisis depends on the decisions of the society, banks, and the central bank. It is reflected in the changes in currency ratio, reserve ratio, and monetary base. Among these three factors, the factor which impacts money supply the most will determine the final direction of money supply movement. Thus, it will be interesting to analyze the money supply change during crisis from the perspective of changes in currency ratio, reserve ratio, and monetary base during that crisis and to search for the factor that dominantly determines the direction of the change in money supply.

2.3. The 1997 Indonesian Monetary Crisis

During the 1997-1998 monetary crisis, the y.o.y growth of money supply in Indonesia looked different. The y.o.y M2 growth within the January 1998–April 1999 period was consistently above 31%, in which it never reached 31% outside this period (Figure 1). This M2 growth even reached 80% in June 1998. The same applies to M1. The y.o.y M1 growth within the January–November 1998 period was consistently above 31%, whereas it never reached 31% outside this period (Figure 2) except in February 1994. This M1 growth even reached 60% in August 1998. The y.o.y growth patterns of M1 and M2 were both similar during the crisis. They both were distinct from usual, based on the publicly available data on money supply from Bank Indonesia.

This sudden increase in money supply during crisis was caused by the increase in monetary base at that time as the result of the injection of liquidity support by Bank Indonesia (McLeod 2014). The liquidity injection was issued as a response to the imminent threat of bank runs (Hofman 2022; Basri 2018; Apriadi et al. 2017; Agusman et al. 2014). The rise in the monetary base during the crisis can be seen in Figure 3, where its y.o.y growth was persistently high from the end of 1997 until the first quarter of 1999.

During this crisis, not only the monetary base rose (Universitas Kristen Indonesia [UKI] 2021), but people also withdrew money from banks (Hofman 2022; Harum & Suharyanto 2022). Consequently, the growth of currency in the society in 1998 was persistently high. The causes of bank run were self-fulfilling prophecy (triggered by social panic or assymetric information, where at that time the issue of bank closure was highly prevalent and even several banks were already closed without adequate savings guarantee), the fundamental weaknesses of the banking system, and bad macroeconomic situations (Basri 2018; Kasri et al. 2017).

Furthermore, excess liquidity[2] in Indonesian banks was high during this crisis since the central bank provided liquidity supports to these banks, while these banks were facing bank runs (Lubis, Alexiou

[1] Currency ratio and reserve ratio meant in this section are the ones according to Mishkin (2014); i.e. C/D and R/D.

[2] Excess liquidity is the reserves (plus vault cash) which banks put in the central bank, minus reserves that are compulsory by regulation or policy (Baldo et al. 2019).

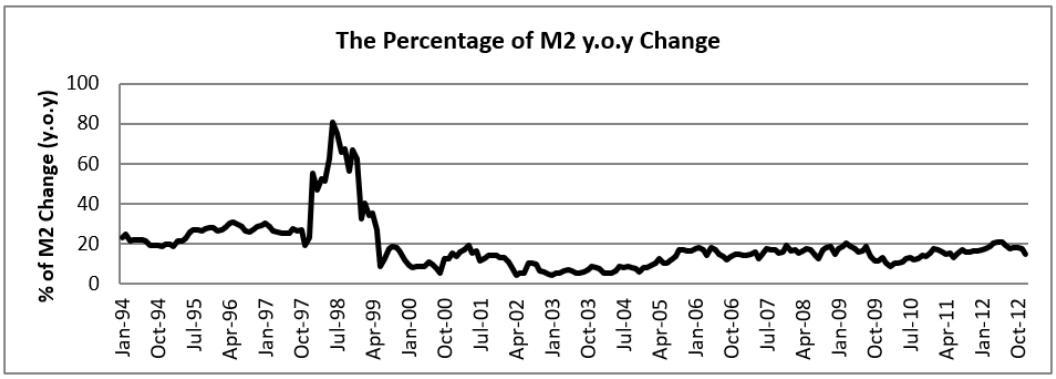

Figure 1. The Percentage of M2 y.o.y Change in Indonesia for the January 1994–December 2012 Period
Source: Bank Indonesia, remodified by author

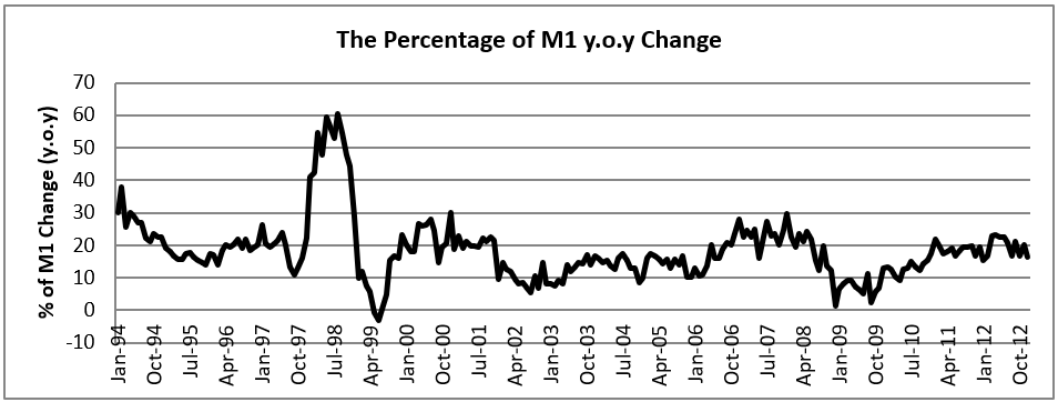

Figure 2. The Percentage of M1 y.o.y Change in Indonesia for the January 1994–December 2012 Period
Source: Bank Indonesia, remodified by author

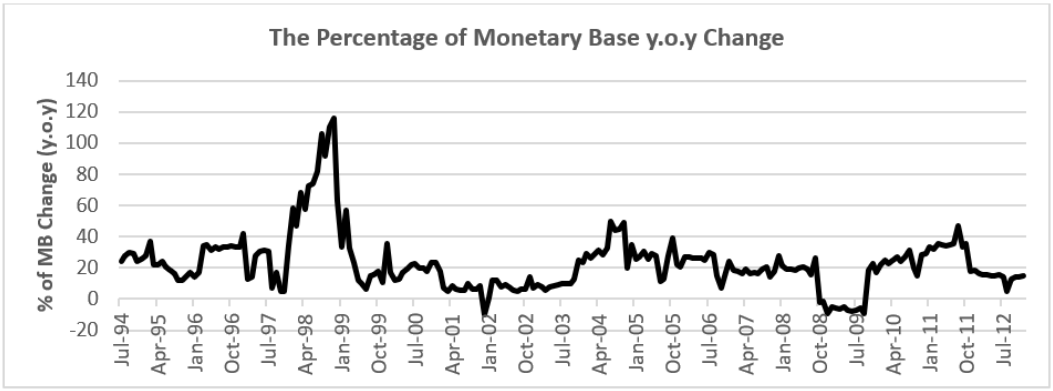

Figure 3. The Percentage of Monetary Base y.o.y Change in Indonesia for the July 1994–December 2012 Period
Source: Bank Indonesia, remodified by author

& Nellis 2019; Wuryandani et al. 2014). The supports given by Bank Indonesia aimed to help banks to deal with high demand for cash when they were short of liquidity (Bank Indonesia 2019; Budiawan 2018; Juhro & Goeltom 2015).

The rises in monetary base, currency level (which

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affects currency ratio), and bank reserves (which affect reserve ratio) in Indonesia during this crisis impacted the money supply trend in this period. However, further research is necessary to identify which factor (among the changes in monetary base, currency ratio, and reserve ratio) became the main cause of the rising money supply at that time.

3. Method

Two studies have been conducted by other researchers with similar research questions. Friedman & Schwartz (1963) deploy a mathematical approach to analyze the extent to which each of the changes in monetary base, currency ratio, and reserve ratio contributed to the change of M2 in the US during the Great Depression. Stauffer (2006) also uses a mathematical approach in investigating the same issue. Additionally, the Stauffer method is built as a more user-friendly alternative to the Friedman-Schwartz method.

The essence of both Friedman-Schwartz and Stauffer methods is about changing the identity equation of $\mathrm{M} = \mathrm{MBxm}$ into the equation of M as the function of MB, currency ratio, and reserve ratio. Then, this new equation will be formed into a dynamic equation format where the separation between each sole effect of the changes in MB, currency ratio, and reserve ratio is generated as explicitly as possible.[3] Another noteworthy point is that the sum of all these effects must be equal to the actual change of M itself. Therefore, the biggest source of the change of M can be traced.

[3]It must be noticed that what is discussed here is not the change of Y due to 1-unit change in X, ceteris paribus. In this paper, what is discussed is the change of Y due to the change in X at the given time period, ceteris paribus. The simple analogy is $\mathrm{Y} = \mathrm{C} + \mathrm{I} + \mathrm{G} + \mathrm{NX}$ equation. The question is not how much Y will increase if there is a $1 increase in C, ceteris paribus. The question is how much Y will increase if there is an increase in C alone at the given time period. The answer for the former question is Y will increase as much as $1. The answer for the latter question is Y will increase as much as the increment of C during that time period. This paper deals with such latter question and answer, for the equation of M as the function of monetary base, currency ratio, and reserve ratio.

The difference between the Friedman-Schwartz and Stauffer methods relies on how they mathematically define currency ratio and reserve ratio. Friedman-Schwartz defines currency ratio as D/C and reserve ratio as D/R, while Stauffer defines currency ratio as C/M and reserve ratio as R/M. In this article, the author used both methods to answer the research questions because, supposing both methods produce one same conclusion, the conclusion will be more justified. Furthermore, with stronger justification, the conclusion will be more acceptable.

3.1. The Friedman-Schwartz Method

Based on the theoretical explanation, money supply (M) is the multiplication of monetary base (MB), in which the magnitude of this multiplication is symbolized by the value of money multiplier (m). The identity equation representing this view is $\mathrm{M} = \mathrm{m.MB}$.

The derivation used by Friedman & Schwartz (1963) begins from Equation (1) where M is money supply and H is monetary base. According to the theory, the M/H is therefore money multiplier. M (or money supply) consists of currency circulating in the society (C) and their deposits in banks (D). In other words, money is available either in the physical form circulating in the society (i.e. banknotes and coins) and in the virtual form (i.e. money put in the banks). It is worth noting that C and D may or may not be related. In the case that M (or the amount of money in the economy) is constant, the only way to increase C is by liquidating the deposits of the society in the banks (or reducing D). In this regard, C and D are related. However, when M is not constant, the increase in C does not necessarily mean the decrease in D. For example, the central bank simply prints more banknotes and coins for financing wars. C increases, D is constant, and M increases.

Meanwhile, H or monetary base consists of currency circulating in the society (C) and reserves that banks hold in the central bank (R). Monetary base is the same as the liabilities of the central bank. Historically, the central bank was liable to exchange the currency that people returned to the

central bank with gold. Nowadays, the currency is backed by something else instead of gold (i.e. government bonds) and the central bank remains liable to do the same for every currency returned. In addition, the central bank is certainly liable to return the reserves that banks hold in the central bank back to the banks.

It is worth noting that R is smaller than D. R is what banks hold in the central bank, while D is what people hold in the banks. If R increases (because the central bank delivers money to an account of a bank in the central bank, in exchange for the bond of that bank), then D in the banking system will increase with higher increment (due to multiple deposit creation). It is the reason why M is bigger than H.

$$\frac{\mathrm{M}}{\mathrm{H}} = \frac{\mathrm{C}+\mathrm{D}}{\mathrm{C}+\mathrm{R}} \tag{1}$$

The numerator and denominator will be both divided by C.

$$\frac{\mathrm{M}}{\mathrm{H}} = \frac{(\mathrm{C}+\mathrm{D})/\mathrm{C}}{(\mathrm{C}+\mathrm{R})/\mathrm{C}} = \frac{1+\mathrm{D}/\mathrm{C}}{1+\mathrm{R}/\mathrm{C}} \tag{2}$$

Then the numerator and denominator will be both multiplied by D/R.

$$\begin{aligned}\frac{\mathrm{M}}{\mathrm{H}} &= \frac{\mathrm{D}/\mathrm{R}.(1+\mathrm{D}/\mathrm{C})}{\mathrm{D}/\mathrm{R}.(1+\mathrm{R}/\mathrm{C})} = \frac{\mathrm{D}/\mathrm{R}.(1+\mathrm{D}/\mathrm{C})}{\mathrm{D}/\mathrm{R}+\mathrm{D}/\mathrm{R}.\mathrm{R}/\mathrm{C}} \\ &= \frac{\mathrm{D}/\mathrm{R}.(1+\mathrm{D}/\mathrm{C})}{\mathrm{D}/\mathrm{R}+\mathrm{D}/\mathrm{C}}\end{aligned} \tag{3}$$

D/R will be represented by b (reserve ratio) and D/C by p (currency ratio).

$$\frac{\mathrm{M}}{\mathrm{H}} = \frac{\mathrm{b}(1+\mathrm{p})}{\mathrm{b}+\mathrm{p}} \tag{4}$$

$$\mathrm{M} = \mathrm{H}.\frac{\mathrm{b}(1+\mathrm{p})}{\mathrm{b}+\mathrm{p}} \tag{5}$$

Equation (5) shows that the creation of M in economy is influenced by the values of monetary base, reserve ratio, and currency ratio in that economy. Equation (5) will be converted into a logarithmic form.

$$\log\mathrm{M} = \log\mathrm{H} + \log\mathrm{b} + \log(1+\mathrm{p}) - \log(\mathrm{b}+\mathrm{p}) \tag{6}$$

To observe the degree to which M responses to the individual change in H, b, and p (or in other words, the extent to which every individual change affects M), then the log M equation above should be transformed into the equation of $\Delta\log\mathrm{M}$.

$$\begin{aligned}\Delta\log\mathrm{M} &= \Delta\log\mathrm{H} + \Delta\log\mathrm{b} + \Delta\log(1+\mathrm{p}) \\ &\quad -\Delta\log(\mathrm{b}+\mathrm{p})\end{aligned}$$

$$\begin{aligned}\Delta\log\mathrm{M} &= (\log\mathrm{H}_1 - \log\mathrm{H}_0) + (\log\mathrm{b}_1 - \log\mathrm{b}_0) \\ &\quad +(\log(1+\mathrm{p}_1) - \log(1+\mathrm{p}_0)) \\ &\quad -(\log(\mathrm{b}_1+\mathrm{p}_1) - \log(\mathrm{b}_0+\mathrm{p}_0))\end{aligned} \tag{7}$$

Subscript 1 shows the value of a particular variable in timepoint 1. Subscript 0 displays the value of a particular variable in timepoint 0. Timepoint 1 occurs after timepoint 0. To examine the level to which M changes in responding to the sole change in H, it will be assumed in Equation (7) that $\mathrm{b}_1 = \mathrm{b}_0$ and $\mathrm{p}_1 = \mathrm{p}_0$, thus Equation (8) is obtained. To observe the degree to which M changes as the response to the individual change in b, it will be assumed in Equation (7) that $\mathrm{H}_1 = \mathrm{H}_0$ dan $\mathrm{p}_1 = \mathrm{p}_0$, thus obtaining Equation (9). To identify the extent to which M changes in response to the sole change in p, it will be assumed in Equation (7) that $\mathrm{H}_1 = \mathrm{H}_0$ dan $\mathrm{b}_1 = \mathrm{b}_0$, thus Equation (10) is obtained.

$$\text{The effect of } \Delta \text{ H on M} = (\log\mathrm{H}_1 - \log\mathrm{H}_0) \tag{8}$$

$$\text{The effect of } \Delta \text{ b on M} = (\log\mathrm{b}_1 - \log\mathrm{b}_0) - (\log(\mathrm{b}_1+\mathrm{p}_0) - \log(\mathrm{b}_0+\mathrm{p}_0)) \tag{9}$$

$$\text{The effect of } \Delta \text{ p on M} = (\log(1+\mathrm{p}_1) - \log(1+\mathrm{p}_0)) - (\log(\mathrm{b}_0+\mathrm{p}_1) - \log(\mathrm{b}_0+\mathrm{p}_0)) \tag{10}$$

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However, it should be noted that if Equation (7) is subtracted by Equation (8)–(10), it will not be zero because there will still be a residual remaining.

$$\Delta \log M - [\text{equation8}] - [\text{equation9}] - [\text{equation10}] = -\log(b_1 + p_1) + \log(b_1 + p_0) + \log(b_0 + p_1) - \log(b_0 + p_0)) \quad (11)$$

Equation (11) shows that the residual is not zero. In other words, other than the individual change in H, b, and p, Equation (11) contributes to the change of M. Equation (11) includes the b and p components together, thus Friedman & Schwartz (1963) decide to term this equation as the effect of an interaction between b and p. Friedman and Schwartz therefore choose not to merely consider this as a residual or discrepancy.

It should be noticed that the Friedman and Schwartz method produces the result in the context of $\Delta \log M$ (which will be denoted as x below). To make it easier, the result (x) can be converted into a relative change in the M form (which will be denoted as y below).

$$\Delta \log M = \log M_1 - \log M_0 = \log\left(\frac{M_1}{M_0}\right) = x$$

$$\text{Anti log } x = \frac{M_1}{M_0}$$

The relative change in M will be denoted as y as defined in the following:

$$y = \frac{M_1 - M_0}{M_0}$$

$$y = \frac{M_1}{M_0} - \frac{M_0}{M_0}$$

$$y = \frac{M_1}{M_0} - 1$$

Then to change the result from the $\Delta \log M$ form (x) into a relative change in the M form (y), the following formulation can be exercised:

$$y = \text{anti log } x - 1$$

Supposing the values of x and y are already known, then the way to change the results of Equations (8)–(10) into a relative change in M (where the sum of these three results plus the result of Equation (11) will be the same as the value of y) is by multiplying the result of each of these equations with the ratio of y/x. To generate the percentage form, multiply it by 100.

3.2. The Stauffer Method

The derivation of the Stauffer method begins from the same identity equation, but monetary base is now denoted as MB (and not H).

$$M = m.MB$$

$$\frac{M}{MB} = m$$

Money multiplier in one point of time is the ratio of money supply (M) at that time over monetary base (MB) at that time. Therefore, money supply and monetary base in timepoint 0 (namely M_0 and MB_0) will constitute the value of money multiplier in timepoint 0 as well (m_0). Similarly, money supply and monetary base in timepoint 1 (namely M_1 and MB_1) will constitute the value of money multiplier in timepoint 1 as well (m_1).

$$\frac{M_0}{MB_0} = m_0 \quad \text{and} \quad \frac{M_1}{MB_1} = m_1$$

If there is a change in money multiplier between two timepoints, it can be expressed as:

$$m_1 - m_0 = x \quad (12)$$

where x is not zero. Equation (12) is then expanded as follows.

$$
\begin{aligned}
&\mathrm{m_1} - \mathrm{x} = \mathrm{m_0} \\
&\frac{\mathrm{M_1}}{\mathrm{MB_1}} - \mathrm{x} = \frac{\mathrm{M_0}}{\mathrm{MB_0}} \\
&\frac{\mathrm{M_1}}{\mathrm{MB_1}} = \frac{\mathrm{M_0}}{\mathrm{MB_0}} + \mathrm{x} \\
&\mathrm{M_1} = \mathrm{MB_1}.\left(\frac{\mathrm{M_0}}{\mathrm{MB_0}} + \mathrm{x}\right) = \frac{\mathrm{MB_1}.\mathrm{M_0}}{\mathrm{MB_0}} + \mathrm{MB_1}.\mathrm{x} \\
&\mathrm{M_1} = \mathrm{M_0}.\frac{\mathrm{MB_1}}{\mathrm{MB_0}} + \mathrm{MB_1}.\mathrm{x}
\end{aligned}
$$

Both sides of the equation are subtracted by $\mathrm{M_0}$.

$$
\begin{aligned}
\mathrm{M_1} - \mathrm{M_0} &= \mathrm{M_0}.\frac{\mathrm{MB_1}}{\mathrm{MB_0}} + \mathrm{MB_1}.\mathrm{x} - \mathrm{M_0} \\
\mathrm{M_1} - \mathrm{M_0} &= \mathrm{M_0}.\frac{\mathrm{MB_1}}{\mathrm{MB_0}} - \mathrm{M_0} + \mathrm{MB_1}.\mathrm{x} = \mathrm{M_0}.\left(\frac{\mathrm{MB_1}}{\mathrm{MB_0}} - 1\right) + \mathrm{MB_1}.\mathrm{x} = \mathrm{M_0}.\left(\frac{\mathrm{MB_1}}{\mathrm{MB_0}} - \frac{\mathrm{MB_0}}{\mathrm{MB_0}}\right) + \mathrm{MB_1}.\mathrm{x} \\
&= \mathrm{M_0}.\left(\frac{\mathrm{MB_1} - \mathrm{MB_0}}{\mathrm{MB_0}}\right) + \mathrm{MB_1}.\mathrm{x} = \mathrm{M_0}.\frac{\Delta\mathrm{MB}}{\mathrm{MB_0}} + \mathrm{x}.\mathrm{MB_1} = \frac{\mathrm{M_0}}{\mathrm{MB_0}}.\Delta\mathrm{MB} + \mathrm{x}.\mathrm{MB_1} \\
&= \mathrm{m_0}.\Delta\mathrm{MB} + \mathrm{x}.\mathrm{MB_1} = \mathrm{m_0}.\Delta\mathrm{MB} + (\mathrm{m_1} - \mathrm{m_0}).\mathrm{MB_1} = \mathrm{m_0}.\Delta\mathrm{MB} + \mathrm{m_1}.\mathrm{MB_1} - \mathrm{m_0}.\mathrm{MB_1} \\
&= \mathrm{m_0}.\Delta\mathrm{MB} - \mathrm{m_0}.\mathrm{MB_1} + \mathrm{m_1}.\mathrm{MB_1} \\
\mathrm{M_1} - \mathrm{M_0} &= \mathrm{m_0}.\Delta\mathrm{MB} - \mathrm{m_0}.\mathrm{MB_1} + \mathrm{M_1}
\end{aligned}
$$

The third term in the right side (namely $\mathrm{M_1}$) is multiplied by $(\mathrm{M_0}/\mathrm{M_0}).(\mathrm{MB_0}/\mathrm{MB_0})$, which is equal to one.

$$
\begin{aligned}
\mathrm{M_1} - \mathrm{M_0} &= \mathrm{m_0}.\Delta\mathrm{MB} - \mathrm{m_0}.\mathrm{MB_1} + \mathrm{M_1}.\left(\frac{\mathrm{M_0}}{\mathrm{M_0}}.\frac{\mathrm{MB_0}}{\mathrm{MB_0}}\right) = \mathrm{m_0}.\Delta\mathrm{MB} - \mathrm{m_0}.\mathrm{MB_1} + \frac{\mathrm{M_1}.\mathrm{M_0}.\mathrm{MB_0}}{\mathrm{M_0}.\mathrm{MB_0}} \\
&= \mathrm{m_0}.\Delta\mathrm{MB} - \mathrm{m_0}.\mathrm{MB_1} + \frac{\mathrm{M_0}}{\mathrm{MB_0}}.\mathrm{MB_0}.\frac{\mathrm{M_1}}{\mathrm{M_0}} = \mathrm{m_0}.\Delta\mathrm{MB} - \mathrm{m_0}.\mathrm{MB_1} + \mathrm{m_0}.\mathrm{MB_0}.\frac{\mathrm{M_1}}{\mathrm{M_0}} \\
\mathrm{M_1} - \mathrm{M_0} &= \mathrm{m_0}.\Delta\mathrm{MB} - \mathrm{m_0}.\left(\mathrm{MB_1} - \mathrm{MB_0}.\frac{\mathrm{M_1}}{\mathrm{M_0}}\right)
\end{aligned}
$$

Considering the definition of $\mathrm{MB} = \mathrm{R} + \mathrm{C}$, then:

$$
\begin{aligned}
\mathrm{M_1} - \mathrm{M_0} &= \mathrm{m_0}.\Delta\mathrm{MB} - \mathrm{m_0}.\left(\mathrm{MB_1} - (\mathrm{R_0} + \mathrm{C_0}).\frac{\mathrm{M_1}}{\mathrm{M_0}}\right) = \mathrm{m_0}.\Delta\mathrm{MB} - \mathrm{m_0}.\left((\mathrm{R_1} + \mathrm{C_1}) - \mathrm{R_0}.\frac{\mathrm{M_1}}{\mathrm{M_0}} - \mathrm{C_0}.\frac{\mathrm{M_1}}{\mathrm{M_0}}\right) \\
&= \mathrm{m_0}.\Delta\mathrm{MB} - \mathrm{m_0}.\left(\mathrm{R_1} + \mathrm{C_1} - \mathrm{R_0}.\frac{\mathrm{M_1}}{\mathrm{M_0}} - \mathrm{C_0}.\frac{\mathrm{M_1}}{\mathrm{M_0}}\right) \\
\mathrm{M_1} - \mathrm{M_0} &= \mathrm{m_0}.\Delta\mathrm{MB} - \mathrm{m_0}.\left(\mathrm{R_1} - \mathrm{R_0}.\frac{\mathrm{M_1}}{\mathrm{M_0}} + \mathrm{C_1} - \mathrm{C_0}.\frac{\mathrm{M_1}}{\mathrm{M_0}}\right) \\
&= \mathrm{m_0}.\Delta\mathrm{MB} - \mathrm{m_0}.\left(\mathrm{R_1}.\frac{\mathrm{M_1}}{\mathrm{M_1}} - \mathrm{R_0}.\frac{\mathrm{M_1}}{\mathrm{M_0}} + \mathrm{C_1}.\frac{\mathrm{M_1}}{\mathrm{M_1}} - \mathrm{C_0}.\frac{\mathrm{M_1}}{\mathrm{M_0}}\right) \\
&= \mathrm{m_0}.\Delta\mathrm{MB} - \mathrm{m_0}.\left(\frac{\mathrm{R_1}}{\mathrm{M_1}}.\mathrm{M_1} - \frac{\mathrm{R_0}}{\mathrm{M_0}}.\mathrm{M_1} + \frac{\mathrm{C_1}}{\mathrm{M_1}}.\mathrm{M_1} - \frac{\mathrm{C_0}}{\mathrm{M_0}}.\mathrm{M_1}\right)
\end{aligned}
$$

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$$\mathrm{M_1 - M_0 = m_0.\Delta MB - m_0.}\left(\left(\frac{\mathrm{R_1}}{\mathrm{M_1}} - \frac{\mathrm{R_0}}{\mathrm{M_0}}\right).\mathrm{M_1} + \left(\frac{\mathrm{C_1}}{\mathrm{M_1}} - \frac{\mathrm{C_0}}{\mathrm{M_0}}\right).\mathrm{M_1}\right) \quad (13)$$

The author abbreviated these two terms as:

$$\left(\frac{\mathrm{R_1}}{\mathrm{M_1}} - \frac{\mathrm{R_0}}{\mathrm{M_0}}\right).\mathrm{M_1} = \$\mathrm{R}$$
$$\left(\frac{\mathrm{C_1}}{\mathrm{M_1}} - \frac{\mathrm{C_0}}{\mathrm{M_0}}\right).\mathrm{M_0} = \$\mathrm{C}$$

thus Equation (13) can be rewritten as:

$$\begin{aligned}\mathrm{M_1 - M_0} &= \mathrm{m_0.\Delta MB - m_0.(\$R + \$C)}\\ &= \mathrm{m_0.\Delta MB - m_0.\$R - m_0.\$C}\end{aligned}$$

$$\mathrm{\Delta M = m_0.(\Delta MB - \$R - \$C)} \quad (14)$$

To transform Equation (14) into a relative change in the M form (not the absolute change form), the left side should be changed into $\Delta\mathrm{M}/\mathrm{M_0}$ and the right side should be divided by $\mathrm{M_0}$. Hence, to observe the degree of the effect of the individual change of MB, R/M, and C/M on M, these three equations below can be used.

$$\text{The effect of } \Delta\mathrm{MB} \text{ on } \mathrm{M} = \frac{\Delta\mathrm{MB} \times \mathrm{m_0}}{\mathrm{M_0}} \quad (15)$$

$$\text{The effect of } \Delta(\mathrm{R/M}) \text{ on } \mathrm{M} = -\frac{\$\mathrm{R} \times \mathrm{m_0}}{\mathrm{M_0}} \quad (16)$$

$$\text{The effect of} \Delta(\mathrm{C/M}) \text{ on } \mathrm{M} = -\frac{\$\mathrm{C} \times \mathrm{m_0}}{\mathrm{M_0}} \quad (17)$$

Since m can be written as the ratio of $1/(\mathrm{MB/M})$, any change of m can be viewed as the change in the ratio of MB/M. Considering that MB consists of R and C, then the change in the MB/M ratio can be further examined as the changes in the R/M ratio and C/M ratio. These two changes reflect the change in money multiplier, where R/M is reserve ratio and C/M is currency ratio. Positive changes in both R/M and C/M will dampen the effect of the rise in MB, as presented in Equation (14) (Stauffer 2006).

3.3. Data Source

To answer the research questions of this paper using the two aforementioned methods, the author needs monetary data from the central bank of Indonesia (or Bank Indonesia). Table 1 shows the list of data sources, which provide the needed data in monthly format.

These sources are chosen because they contain the data needed in the calculation in this paper. Those data are M1 (narrow money), M2 (broad money), MB (monetary base), C (currency outside commercial and rural banks), D1 (rupiah demand deposits), D2 (quasi money and rupiah demand deposits), and R (all components in MB except C). D1 is also M1 minus C. Meanwhile, D2 is also M2 minus C and R is also MB minus C.

3.4. Determining the Research Period

The y.o.y M2 change in Indonesia was consistently above 31% between January 1998 and April 1999, in which it never reached this level outside this period. Therefore, this unique period should be determined as the research period for M2. However, the chronology of the crisis began after Bank Indonesia abandoned the fixed exchange rate regime in August 1997. Considering this, the author decided to start the research period for M2 from August 1997, hence August 1997 to April 1999.[4] The same reason is applied for determining the research period for M1. The M1 research period would be August 1997 to November 1998. After November 1998, the y.o.y M1 change went back to below 31%.

[4] Enoch et al. (2001) state that Bank Indonesia had started providing emergency funding to Bank Danamon since August 1997. Rusdiana, Nurfalah & Laila (2021) also noted that the 1997 Indonesian monetary crisis can be considered to start in August 1997. This information strengthens the reason for the author to set the research period starting from August 1997.

Table 1. Data Source

Data	Source	Table Source
M (i.e. M1 and M2)	The Table of Broad Money and Its Affecting Factors	
MB	Analytical Balance Sheet of Monetary Authority	
C	Analytical Balance Sheet of Monetary Authority	Indonesian Financial Statistics (Bank Indonesia)
D (i.e. D1 and D2)	The Table of Broad Money and Its Affecting Factors	
R	Analytical Balance Sheet of Monetary Authority	

Having set the period, now the author can clearly state the main purposes of this paper as follows:

a. To discover which factor (among the changes in currency ratio, reserve ratio, and monetary base) became the main cause of the increasing M2 in Indonesia during August 1997–April 1999.
b. To reveal which factor (among the changes in currency ratio, reserve ratio, and monetary base) became the main cause of the increasing M1 in Indonesia during Agustus 1997–November 1998.

4. Results and Analysis

4.1. Main Findings

The main findings tell the readers the variable in which the change became the main cause of the end-to-end change in money supply in the research period. The end-to-end change means the change from the first month directly to the last month in the research period.

Table 2. The Percentage of the M1 Change from August 1997 to November 1998 and the Effect of the Individual Change in Each of Its Three Factors

Variable	How much would M1 have changed if only this single variable changed?	
	By the Friedman-Schwartz Method	By the Stauffer Method
Monetary Base	98.50%	119.35%
Currency Ratio	-3.49%	-5.59%
Reserve Ratio	-42.26%	-58.98%
Discrepancy	2.03%	
M1	54.78%	54.78%

M1 in Indonesia changed by 54.78% from August 1997 to November 1998. As presented in Table 2, the Friedman-Schwartz method shows that the individual change in monetary base from August 1997 to November 1998 caused M1 to change by 98.50%. Still in the same period, the individual changes in currency ratio and reserve ration caused M1 to change by -3.49% and -42.26%, respectively.

Meanwhile, the Stauffer method reveals that the sole change in monetary base from August 1997 to November 1998 caused M1 to change by 119.35%. The changes in currency ratio and reserve ratio, on the other hand, caused M1 to change by -5.59% and -58.98%, respectively. The actual final direction and magnitude of the change of M1 is the sum of these three effects. Utilizing both methods, the decomposition of the source of the change of M1 can be observed.

As shown in Table 2, the changes in currency ratio and reserve ratio affected M1 negatively. It is evident from Table 3 that it is because currency ratio and reserve ratio increased. According to the multiple deposit creation theory, any increase in currency level and bank reserves reduce the money formation.

Table 3. Currency Ratio and Reserve Ratio (by Stauffer Definition) of M1 in Indonesia

Time	C/M1	R/M1
August 1997	0.37445	0.13625
November 1998	0.39289	0.33084

Back to Table 2, the Friedman-Schwartz method reveals that the effect of the sole change in monetary base was already higher than the combined effects of the changes in the remaining variables. It caused the direction of the change of M1 to follow the effect of the change in monetary base that was going up. The Stauffer method shows a similar finding. The main driver for the change of M1 was the change in monetary base, causing M1 to move

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upward (McLeod 2014).

Table 4. The Percentage of M2 Change from August 1997 to April 1999 and the Effect of the Individual Change in Each of Its Three Factors

Variable	How much would M2 have changed if only this single variable changed?	
	By the Friedman-Schwartz Method	By the Stauffer Method
Monetary Base	113.94%	126.38%
Currency Ratio	5.87%	7.99%
Reserve Ratio	-30.38%	-46.24%
Discrepancy	-1.30%	
M2	88.13%	88.13%

M2 in Indonesia changed by 88.13% from August 1997 to April 1999. As displayed in Table 4, the individual change in monetary base from August 1997 to April 1999 caused M2 to change by 113.94%. Furthermore, the individual changes in currency ratio and reserve ratio, still in the same period, caused M2 to change by 5.87% and -30.38%, respectively.

Meanwhile, utilizing the Stauffer method, the individual changes in monetary base, currency ratio, and reserve ratio from August 1997 to April 1999 caused M2 to change by 126.38%, 7.79%, and -58.98%, respectively. The actual final direction and magnitude of the change of M2 is the sum of these three effects. Employing both methods, the decomposition of the source of the M2 change can be observed. Table 4 illustrates that the change in currency ratio affected M2 positively while the change in reserve ratio affected M2 negatively. Observed from Table 5, it is likely because currency ratio decreased while reserve ratio increased.

Table 5. Currency Ratio and Reserve Ratio (by Stauffer Definition) for M2 in Indonesia

Time	C/M2	R/M2
August 1997	0.07495	0.02727
April 1999	0.07061	0.05240

Back to Table 4, the Friedman-Schwartz method reveals that the effect of the individual change in monetary base was already higher than the combined effects of the changes in the remaining variables. It caused the direction of the change of M2 to follow the effect of the change in monetary base that was going up. The Stauffer method generates a similar finding. The main driver for the change of M2 was the change in monetary base, causing M2 to move upward.

Observed from Table 2 and 4, the consistency of the results obtained from using both methods is evident. The effect of the change in monetary base was bigger than that of reserve ratio, and the effect of the change in reserve ratio was bigger than that of currency ratio. Regarding the magnitude and direction of the effect of the change in each variable, one method produces close results with the other method.

4.2. Supporting Findings

The supporting findings tell the readers the factor which most frequently became the main source of the monthly change in money supply in the research period. In other words, the focus now shifts to the change in money supply every month within the research period. The research period for M1 is from August 1997 to November 1998 (or 16 months), totaling 15 monthly changes of M1. Subsequent to formulating a similar table to Table 2 for every of these 15 changes, then the same analysis as one in Section 4.1 was conducted to every result obtained. Furthermore, the research period for M2 is from August 1997 to April 1999 (or 21 months), amounting to 20 monthly changes of M2. Similarly, following the formation of a similar table to Table 4 for every of these 20 changes, then the same analysis as one in Section 4.1 was conducted again to every result obtained. The purpose of carrying out this analysis is to acquire the justification for the conclusion obtained in Section 4.1.

After using both Friedman-Schwartz and Stauffer methods, the author concludes that 7 of 15 M1 monthly changes within the research period were each driven mainly by the MB change, 6 of 15 by the reserve ratio change, and 2 of 15 M1 by the combination of MB and currency ratio changes.[5]

[5]Several M monthly changes were mainly driven by the si-

Table 6. Summary of the Supporting Findings, with the MB Frequency of Becoming the Main Driver for M Monthly Changes

Summary for ΔM Each Month in Its Research Period	The Most Frequent Source of M Monthly Changes	
	The Friedman-Schwartz Method	The Stauffer Method
M1	MB (= 9/15 monthly changes)	
M2	MB (= 13/20 monthly changes)	

The detailed result is provided in Appendix A and B.

Regarding M2, following the implementation of both Friedman-Schwartz and Stauffer methods, the author discovers a similar conclusion for every M2 monthly change, except for 1 monthly change (May–June 1998). According to the Stauffer method, the main driver of this particular change was the change in currency ratio, while referring to Friedman-Schwartz, it was reserve ratio. Despite this difference, the change in MB generally remain the most frequent main driver for these 20 M2 monthly changes. The result is provided in Appendix C and D.

According to both methods, many monthly changes in money supply (both M1 and M2) were driven by the monetary base changes. The following are the examples of the months in which the monetary base change was the significant factor in driving the money supply change, accompanied by the information of events that (very likely) caused them.

- The monetary base change drove the money supply change in August 1997. In that month, rupiah left the fixed exchange rate regime (Bank for International Settlements 2022) and Bank Indonesia provided liquidity support to the banking industry (to Bank Danamon) for the first time (Enoch et al. 2001).
- That happened every month between November 1997 and March 1998. Within this period, numerous relevant events happened. Bank Indonesia agreed on the first IMF-supported program on 31 October 1997 (Arner, Avgouleas & Gibson 2021). Then, Indonesia announced bank resolution packages on 1 November 1997 (Enoch et al. 2001). Moreover, the USD10 billion standby facility with IMF was approved on 5 November 1997 (Hofman 2022; Arner, Avgouleas & Gibson 2021). By mid-January 1998, the value of rupiah worsened. As a response, Bank Indonesia continued providing liquidity support to banks (Enoch et al. 2001), while IMF announced the second IMF program on 15 January 1998 (Arner, Avgouleas & Gibson 2021) and Indonesian Bank Restructuring Agency (IBRA) was established (Basri 2018). On 14 February 1998, Indonesian Bank Restructuring Agency (IBRA) provided unpublicized intervention to 54 banks (Enoch et al. 2001). Finally, Bank Indonesia introduced new regulations on liquidity supports in March 1998 (Enoch et al. 2001).
- Another example was in May 1998. Bank Central Asia (BCA) sought a considerably large liquidity support (amounted to Rp31 trillion) between 15 May to 5 June 1998 as a protective measure against the May 1998 riots (Enoch et al. 2001). On 28 May 1998, BCA was eventually taken over by IBRA (BCA 2022).

Of 15 M1 monthly changes in the research period, 9 monthly changes were positive (or M1 increased). Supposing the research merely focuses on these 9 monthly changes (as this paper seeks the reason of the M1 increase during crisis), it will still reveals that MB was the most frequent and biggest source

multaneous changes in two variables. It was because there was no single variable whose change was sufficiently strong to boost M to move to one direction, or because its effect on M was small relative to others. For instance, M1 changed by 1.568% from August 1997 to September 1997. According to the Stauffer method, the individual change in MB from August to September 1997 caused M1 to change by 9.974%, that of reserve ratio by -11.09%, and that of currency ratio by 2.684%. It is obvious that there were two forces driving M1 upward from August to September 1997. The two forces were the changes in MB and currency ratio. The sole change in MB, although affecting M1 positively and most significantly compared to another change (currency ratio), was not sufficient to drive M1 upward because the effect of the individual change in reserve ratio would have sufficiently negated it. Therefore, the contribution of currency ratio to driving M1 upward cannot be neglected.

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Table 7. Summary of the Supporting Findings, with the MB Frequency of Becoming the Main Driver for M Positive Monthly Changes Only

Summary for ΔM Each Month in Its Research Period	The Most Frequent Source of M Positive Monthly Changes	
	The Friedman-Schwartz Method	The Stauffer Method
M1	MB (= 7/9 positive monthly changes)	
M2	MB (= 11/15 positive monthly changes)	

for these 9 M1 monthly changes.

Of 20 M2 monthly changes in the research period, 15 monthly changes were positive. Supposing the research merely focuses on these 15 monthly changes, it will still discovers that MB was the most frequent and biggest source for these 15 M2 monthly changes. Despite the difference for the result of one M2 monthly change (May 1998–June 1998), it does not alter the general conclusion about the dominant effect that the monetary base had imposed.

4.3. Related Findings

Since rupiah left the fixed exchange rate regime in August 1997, its value deteriorated significantly during the crisis, as it lost 85% of its value (Australia-Indonesia Partnership for Economic Governance [AIPEG] 2017). The value of one dollar (as measured in rupiah) increased considerably, rendering the value of Net Foreign Asset (NFA) in the asset side of the balance sheet of Bank Indonesia increased significantly as well. Figure 4 displays that rupiah depreciation correlates clearly with the increase in NFA. In addition, of 20 M2 monthly changes in the research period, 13 monthly changes were driven by the sole change in NFA (see Appendix E).

Furthermore, other findings indicate an accumulation of reserves that the banks hoarded during this inflationary crisis (where the inflation rate reached 77.63% in 1998 (Sipahutar 2021)) for protective measures. Based on the Stauffer method, the reserve ratio is defined by R/M1 (for narrow money) or R/M2 (for broad money). From August 1997 to April 1999, R/M1 increased from 0.13 to 0.31, and R/M2 increased from 0.02 to 0.05. Meanwhile, using the Friedman-Schwartz method, the reserve ratio is defined by D1/R (for narrow money) or D2/R (for broad money). Within the same period, D1/R decreased from 4.59 to 1.78, and D2/R decreased from 33.9 to 17.7. Both methods indicate the increase in R.

Figure 5 corroborates the previous findings by showing that there is indeed a significantly positive y.o.y. growth of bank deposits at Bank Indonesia. Furthermore, Agung et al. (2001) express that this reserve accumulation by the Indonesian banks (which means higher lending capacity[6] of the Indonesian banks) is unfortunately not followed by higher credits disbursed by the banks. This excess liquidity may mean that the liquidity support provided by Bank Indonesia was unneccessarily excessive. AIPEG (2017) reports that this Indonesian banking crisis is the most expensive crisis in history, costing 50% of the GDP.

5. Conclusion

Based on the main findings, employing both methods, it is consistently revealed that the increases of M1 (during August 1997–November 1998) and M2 (during August 1997–April 1999) in Indonesia were dominantly caused by the change in monetary base.[7]

Hence, the answers for the research questions of this paper are as follows.

1. The change in monetary base was the main cause of the increase in M2 in Indonesia during August 1997–April 1999.

[6] Lending capacity is the total liabilities of a bank, minus capital, required reserve, and vault cash (Shetta & Kamaly 2014).

[7] Since M1 is part of M2, it can be said that the factor raising M1 (monetary base) becomes the factor raising M2 as well.

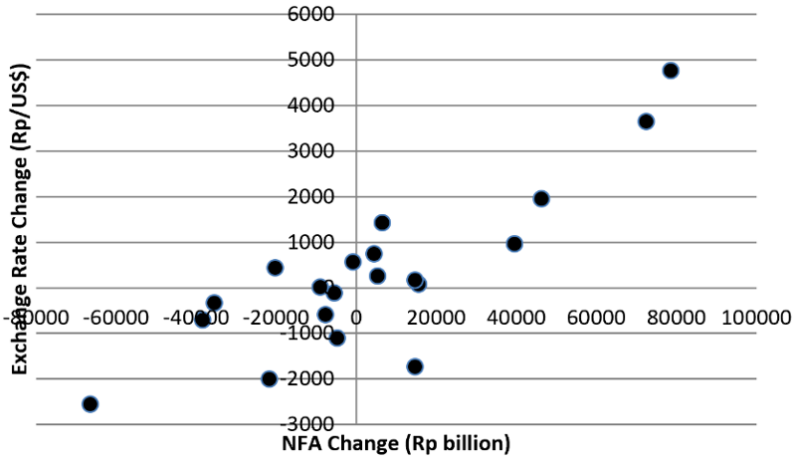

Figure 4. Correlation between Rupiah Depreciation and the NFA Increase during the 1998 Crisis
Source: Bank Indonesia, remodified by author

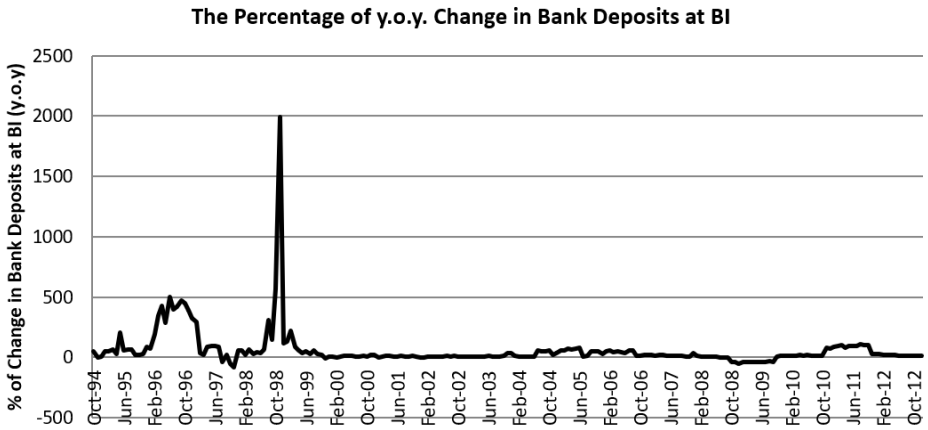

Figure 5. The Percentage of y.o.y. Change in Bank Deposits at Bank Indonesia for the October 1994–October 2012 Period
Source: Bank Indonesia, remodified by author

2. The change in monetary base was the main cause of the increase in M1 in Indonesia during August 1997–November 1998.

Even if the focus shifts to the monthly changes of M1 and M2 within their respective research periods, the same conclusion still applies. The monthly change in monetary base was the most frequent factor in determining the direction of the monthly changes of M1 and M2, including the positive monthly changes. This result meets the expectation. Other literature have commonly stated that the money supply in Indonesia was rising during the 1998 crisis because of the rising monetary base. It was due to the intervention of the central bank at that time in the form of liquidity support.

The rise of bank reserves, however, was not followed by the rise of credits given by those banks to the economy. This affected reserve ratio, yet the change in reserve ratio had a smaller impact (and smaller frequency) in dictating the money supply movement at that time, compared to monetary base. It is later argued that the fund injection to banks was reportedly too great in amount to face bank runs.

The findings of this paper may remind Bank Indonesia of the importance of controlling reserve

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ratio and currency ratio, particularly during a crisis environment. These two variables can affect money multiplier, which in turn can affect money supply and inflation changes. Unlike monetary base, these two variables are less controllable by the central bank. One method to control these two variables is credibly managing the expectation of the people about (1) how the government can bring inflation under control, (2) how the government can keep exchange rate steadily, and (3) how the government can ensure the safety of the money of the people in the banks. How government can meet these expectations will depend on various aspects, such as the interest rate and foreign reserve policies of Bank Indonesia, the readiness of Indonesian deposit insurance agencies, and the proper fiscal budget management of the Finance Ministry. In essence, public expectation is crucial to consider to avoid the self-fulfilling prophecy of bank runs.

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Appendices

Appendix A

The following table identifies the biggest factor (among the individual changes in monetary base (MB), currency ratio (c), and reserve ratio (r) that determines the direction of every M1 monthly change within the August 1997–November 1998 period, based on the Stauffer method.

Change Between:		% M1 Change and Individual Effect of Change in ...				Strongest Factor(s) in Determining the Direction of ΔM1
t = 0	t = 1	M1	MB	Reserve Ratio (r)	Currency Ratio (c)	
1997: M8	1997: M9	1.568	9.974	-11.090	2.684	MB, c
1997: M9	1997: M10	1.650	-8.409	11.600	-1.541	r
1997: M10	1997: M11	3.719	0.805	4.556	-1.642	r
1997: M11	1997: M12	12.149	36.240	-27.427	3.336	MB
1997: M12	1998: M1	18.453	21.542	5.156	-8.245	MB
1998: M1	1998: M2	-0.314	-11.415	7.375	3.726	MB
1998: M2	1998: M3	6.228	19.734	-12.023	-1.483	MB
1998: M3	1998: M4	-2.953	2.774	-5.624	-0.103	r
1998: M4	1998: M5	8.989	11.313	1.076	-3.400	MB
1998: M5	1998: M6	5.329	3.443	2.054	-0.168	MB
1998: M6	1998: M7	-3.341	3.266	-3.744	-2.863	r
1998: M7	1998: M8	-1.171	-5.465	2.772	1.522	MB
1998: M8	1998: M9	-1.931	2.436	-4.700	0.333	r
1998: M9	1998: M10	-2.886	0.330	-3.232	0.016	r
1998: M10	1998: M11	1.373	3.595	-5.595	3.373	MB, c

Appendix B

The following table identifies the biggest factor (among the individual changes in monetary base (MB), currency ratio (c), and reserve ratio (r) that determine the direction of every M1 monthly change within the August 1997–November 1998 period, based on the Friedman-Schwartz method.

Change Between:		% M1 Change and Individual Effect of Change in ...					Strongest Factor(s) in Determining the Direction of ΔM1
t = 0	t = 1	M1	MB	Reserve Ratio (r)	Currency Ratio (c)	Discrepancy	
1997: M8	1997: M9	1.568	9.582	-9.720	2.105	-0.399	MB, c
1997: M9	1997: M10	1.650	-8.856	11.864	-1.063	-0.295	r
1997: M10	1997: M11	3.719	0.816	4.286	-1.274	-0.109	r
1997: M11	1997: M12	12.149	32.768	-22.282	2.643	-0.980	MB
1997: M12	1998: M1	18.453	21.259	2.224	-4.794	-0.236	MB
1998: M1	1998: M2	-0.314	-12.102	8.690	2.513	0.585	MB
1998: M2	1998: M3	6.228	18.565	-11.509	-1.073	0.245	MB
1998: M3	1998: M4	-2.953	2.695	-5.591	-0.067	0.010	r
1998: M4	1998: M5	8.989	11.193	-0.317	-1.902	0.015	MB
1998: M5	1998: M6	5.329	3.474	1.956	-0.096	-0.005	MB
1998: M6	1998: M7	-3.341	3.159	-4.990	-1.751	0.241	r
1998: M7	1998: M8	-1.171	-5.587	3.474	0.846	0.096	MB
1998: M8	1998: M9	-1.931	2.384	-4.488	0.199	-0.026	r
1998: M9	1998: M10	-2.886	0.325	-3.218	0.009	-0.002	r
1998: M10	1998: M11	1.373	3.556	-3.664	1.690	-0.209	MB, c

The readers may notice that the conclusion about the main determinant of each M1monthly change is similar, either using the Stauffer method or the Friedman-Schwartz method.

Appendix C

The following table illustrates the biggest factor (among the individual changes in monetary base (MB), currency ratio (c), and reserve ratio (r) that determine the direction of every M2 monthly change within the August 1997–April 1999 period, based on the Stauffer method.

Change Between:		% M2 Change and Individual Effect of Change in ...				Strongest Factor(s) in Determining the Direction of ΔM2
t = 0	t = 1	M2	MB	Reserve Ratio (r)	Currency Ratio (c)	
1997: M8	1997: M9	0.971	9.974	-11.249	2.246	MB, c
1997: M9	1997: M10	3.546	-8.409	12.258	-0.303	r
1997: M10	1997: M11	-2.989	0.805	2.821	-6.615	c
1997: M11	1997: M12	7.588	36.240	-28.435	-0.217	MB
1997: M12	1998: M1	26.727	21.542	8.327	-3.142	MB
1998: M1	1998: M2	-4.539	-11.415	5.976	0.9	MB
1998: M2	1998: M3	4.552	19.734	-12.508	-2.674	MB
1998: M3	1998: M4	0.794	2.774	-4.286	2.306	MB, c
1998: M4	1998: M5	8.935	11.313	1.055	-3.433	MB
1998: M5	1998: M6	14.552	3.443	5.504	5.605	c
1998: M6	1998: M7	-1.632	3.266	-3.127	-1.771	r, c
1998: M7	1998: M8	-2.819	-5.465	2.156	0.49	MB
1998: M8	1998: M9	1.764	2.436	-3.362	2.69	MB, c
1998: M9	1998: M10	-3.348	0.330	-3.413	-0.265	r
1998: M10	1998: M11	3.564	3.595	-4.693	4.662	MB, c
1998: M11	1998: M12	4.800	2.797	1.755	0.248	MB
1998: M12	1999: M1	3.318	-0.413	1.715	2.016	c
1999: M1	1999: M2	1.027	3.891	-1.313	-1.551	MB
1999: M2	1999: M3	0.109	1.323	1.100	-2.314	MB, r
1999: M3	1999: M4	1.627	-4.227	3.169	2.685	r, c

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Appendix D

The following table identifies the biggest factor (among the individual changes in monetary base (MB), currency ratio (c), and reserve ratio (r) that determine the direction of every M2 monthly change within the August 1997 – April 1999 period, based on the Friedman-Schwartz method.

Change Between:		% M2 Change and Individual Effect of Change in . . .					Strongest Factor(s) in Determining the Direction of ΔM2
t = 0	t = 1	M2	MB	Reserve Ratio (r)	Currency Ratio (c)	Discrepancy	
1997: M8	1997: M9	0.971	9.554	-10.531	2.192	-0.244	MB, c
1997: M9	1997: M10	3.546	-8.939	12.813	-0.285	-0.043	r
1997: M10	1997: M11	-2.989	0.789	2.736	-6.324	-0.190	c
1997: M11	1997: M12	7.588	32.084	-24.339	-0.204	0.047	MB
1997: M12	1998: M1	26.727	22.014	7.535	-2.616	-0.206	MB
1998: M1	1998: M2	-4.539	-11.844	6.352	0.884	0.069	MB
1998: M2	1998: M3	4.552	18.417	-11.676	-2.490	0.301	MB
1998: M3	1998: M4	0.794	2.747	-4.054	2.203	-0.102	MB, c
1998: M4	1998: M5	8.935	11.190	0.829	-3.056	-0.028	MB
1998: M5	1998: M6	14.552	3.626	5.543	5.064	0.319	r
1998: M6	1998: M7	-1.632	3.187	-3.195	-1.684	0.060	r, c
1998: M7	1998: M8	-2.819	-5.541	2.237	0.472	0.013	MB
1998: M8	1998: M9	1.764	2.428	-3.139	2.566	-0.091	MB, c
1998: M9	1998: M10	-3.348	0.324	-3.427	-0.255	0.010	r
1998: M10	1998: M11	3.564	3.595	-4.224	4.403	-0.210	MB, c
1998: M11	1998: M12	4.800	2.824	1.744	0.227	0.005	MB
1998: M12	1999: M1	3.318	-0.420	1.823	1.876	0.039	c
1999: M1	1999: M2	1.027	3.837	-1.393	-1.440	0.023	MB
1999: M2	1999: M3	0.109	1.315	0.963	-2.145	-0.024	MB, r
1999: M3	1999: M4	1.627	-4.354	3.348	2.533	0.100	r, c

It can be noticed that the conclusion about the main determinant of each M2 monthly change is the same, either applying the Stauffer method or the Friedman-Schwartz method, except for one monthly change (May–June 1998).

Examined from Appendix A–D, it is concluded that the change in MB plays a frequent role in determining the direction of M1 and M2 monthly changes, including the positive monthly changes, during this period. These findings strengthen the conclusion of the main findings.

Appendix E

The following table illustrates the frequency of the Net Foreign Asset (NFA), as opposed to the Net Domestic Asset (NDA), in determining the direction of every M2 monthly change within the August 1997–April 1999 period. The sum of NFA and NDA is equal to the asset side of the balance sheet of Bank Indonesia.

From	To	M2 Change (Rp billion)	NFA Change (Rp billion)	NDA Change (Rp billion)	Strongest Factor in Determining the Direction of
Aug-97	Sep-97	3,163	5,344	-2,181	NFA
Sep-97	Oct-97	11,67	-729	12,399	
Oct-97	Nov-97	-10,185	-5,499	-4,326	NFA
Nov-97	Dec-97	25,084	6,582	18,142	
Dec-97	Jan-98	95,054	78,706	16,348	NFA
Jan-98	Feb-98	-20,456	-38,308	17,852	NFA
Feb-98	Mar-98	19,583	4,547	15,036	
Mar-98	Apr-98	3,572	14,725	-11,153	NFA
Apr-98	May-98	40,513	46,359	-5,846	NFA
May-98	Jun-98	71,876	72,543	-667	NFA
Jun-98	Jul-98	-9,233	-20,137	10,904	NFA
Jul-98	Aug-98	-15,691	-21,632	5,941	NFA
Aug-98	Sep-98	9,543	-4,7	14,243	
Sep-98	Oct-98	-18,427	-66,427	48	NFA
Oct-98	Nov-98	18,959	-7,657	26,616	
Nov-98	Dec-98	26,445	15,673	10,772	NFA
Dec-98	Jan-99	19,16	39,558	-20,398	NFA
Jan-99	Feb-99	6,125	-8,995	15,12	
Feb-99	Mar-99	659	14,749	-14,09	NFA
Mar-99	Apr-99	9,815	-35,399	45,214	

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