Jurnal Ekonomi dan Studi Pembangunan, 14(2), 2022
ISSN 2086-1575 E-ISSN 2502-7115

Will Demographic Changes Affect Monetary Policy with Interest Rate Shocks in Indonesia?

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Received: April 11, 2022; Revised: June 29, 2022; Accepted: July 13, 2022
Permalink/DOI: http://dx.doi.org/10.17977/um002v14i22022p182

Abstract

Changes in the demographic structure and its impact on the economy are becoming interesting issues in almost all countries in the world, including Indonesia. Until 2030, the working age group dominates almost 60 percent of the total population in Indonesia. This phenomenon is a valuable asset which should be used optimally. Moderate adjustment of interest rate policy is an effort applied by Bank Indonesia to maximize the access to credit and public savings. Therefore, this study aims to determine the effect of demographic aspects and the real sector on the effectiveness of monetary policy in the presence of interest rate shocks. This study employed time series data with a time period of 1987Q1 – 2020Q4 in Indonesia. The analysis was performed by using time varying parameter-vector autoregressive (TVP-VAR) and fully modified-ordinary least square (FM-OLS). The results revealed that the population and the elderly population aspects had significant positive effects on the monetary policy, while the variable of productive age and the number of dependence aspects has significant negative effects. The relationship between the real sector and the monetary policy has a different relationship, such as a positive relationship between the savings and technology variables and the domestic credit variable which has a significant negative relationship with the monetary policy.

Keywords: *Interest Rates; Demographics; TVP-VAR; FM-OLS*
JEL Classification: E49; J11; C11; C32

INTRODUCTION

Macroeconomic stability is a very fundamental factor in maintaining the economic condition of a country. One of the policies aimed at creating a stable economy is monetary policy. The monetary policy is a policy implemented by the monetary authority in order to achieve price stabilization (inflation) and exchange rates through the transmission of interest rate policy (Batini & Haldane, 1999; Clarida et al., 2000; Handa, 2009). The monetary policy can be carried out expansively and contractually.

Interest rates are basically used as an instrument to control the monetary policy in order to stabilize the price level. This policy is in line with the views of the monetarists presented by Friedman (1956) and Brunner (1981) which state that

the price level (inflation) is determined by the money supply (JUB). Likewise, the opinion of Woodford & Walsh (2005) states that the interest rate and inflation variables have a major effect on economic stabilization from the monetary side.

In addition to the monetary policy aspect, the demographic aspect is also an important focus in economy. Population is one of the key variables in the development process and an asset that can be optimized in the long term. This explains that demographic aspects need to be considered in a development planning. Ando and Modigliani (1963) and Fry and Mason (1982) about life cycle hypothesis of saving describes the behaviors that people expect to see in relation to their age and life phase. Modigliani and Brumberg (1954) stated that individuals try to facilitate their consumption throughout their lives by owing when their incomes are low and by saving when their incomes are high. The Life Cycle Hypothesis (LCH) assumes that consumers spend their wealth in old age.

Based on the demographic aspect, Indonesia is a country that has the fourth largest population in the world after China, India and the United States, which is 270.20 million people in 2020 (BPS, 2021). Indonesia is experiencing rapid population growth so that it experiences a demographic bonus. It is called the age structure of the population which is characterized by the increase number of children age (not productive age), the increase of productive age and better life expectancy. Countries with a greater level of dependence on the non-productive age group are expected to experience slowing or negative economic growth. Conversely, if the proportion of the productive age (labor force) is higher, then economic growth tends to be positive due to an increase in productivity in the economy (Bloom et al., 2008; Mason, 2001). Policy steps which encourage research and development of innovation and technological progress can be the most useful and feasible measures to reduce the adverse effects of population aging (Hsu & Lo, 2019). Along with increasingly rapid technological developments and increasingly fierce competition, it is also necessary to accelerate digital transformation which aims to change people's behavior patterns and connect the physical world with the digital world. The advance of digitization will also affect people's activities in accessing financial products which will surely have an impact on economic activities.

Several studies related to demography and monetary policy have been conducted by several previous researchers. Carvalho et al. (2016) explained that demographic development is a natural explanation for the prolonged decline in global real interest rates. Demographics can affect real interest rates by increasing the life expectancy. The relationship between real interest rates and demographics was also presented by Lisack et al. (2017) and Bobeica et al. (2017). Lisack et al. (2017) stated that demographic changes are expected to reduce to 37 bp in 2050. Deflationary pressures from changes in demographics on the balance of interest rates can illustrate that the central bank is more often at the lower limit. Therefore, it requires unconventional steps to overcome the decline in the balance of real interest rates (Bobeica et al., 2017). Research conducted by Leahy and Thapar (2019) stated that the age group under 35 years tends to reduce the effectiveness of monetary policy. Meanwhile, the group aged between 40 – 64 years tend to enlarge the impact of monetary policy. This pattern is in accordance with the life cycle hypothesis. This conformity was also found in research conducted by Chen (2017).

Based on several previous research results, this research firstly utilized the topic of monetary policy and demography in Indonesia. Discussions related to this topic have taken samples from European countries, the United States of America, the OECD, Australia, and several Asian countries (Japan, Taiwan, Korea, Thailand). Secondly, it linked demographic factors and monetary policy through the transmission of inflation and interest rate variables. Thirdly, it used a combination of TVP-VAR and FM-OLS methods in analyzing the response of monetary policy variables to interest rate shocks. Based on the existing problems and potentials, this study aimed to determine the effect of demographic aspects and the real sector on inflation in the presence of interest rate shocks.

METHOD

This research used secondary data in the form of time series data starting from 1987Q1 – 2020Q4. The research was conducted in Indonesia because Indonesia has a demographic structure that has the potential for demographic changes to occur. The impact of this condition on monetary policy will be identified later. The secondary data needed in this study were obtained from the Central Statistics Agency (BPS), the World Bank, and CEIC. The reason for using this timeframe is the initial implementation of financial and banking deregulation in Indonesia through the Policy Package of 27 October 1988 (Pakto 1988). Policy signals will certainly provide great opportunities for the financial sector to grow and provide wider access to the public, especially to access to credit and savings (Djiwandono, 1988; Mooy, 1988; Nasution, 1991; Permono, 1989). Throughout the research period, Indonesia's demographic structure will dynamically reflect the response to these financial policies. Inflation as the selected variable for Indonesia's monetary policy proxy is strongly related to interest rates on loans, unemployment, savings, credit with demographic factors (demographic bonus) in Indonesia until 2030. This condition will have a large contagion effect on the achievement of monetary policy. Each different age group will give a different response to the monetary policy applied (Bloom et al., 2008; Mason, 2001).

The first model refers to Chen's (2017) model which is later estimated by using time varying parameter-vector autoregressive (TVP-VAR) to determine the response of inflation to shocks from interest rate variables. The selection of the TVP-VAR model in this study provides an empirical illustration using Indonesian macroeconomic data. Indonesia's economic and financial structure is time-varying in terms of monetary policy that occurred from 1987 to 2020. It can be observed that during the three decades of the research sample, the Indonesian economy showed significant macroeconomic performance but was vulnerable to global crisis shocks. Since the implementation of the October 1988 financial liberalization package, the public has been able to access financial services in excess and encourage economic growth in such a way. However, the shocks of the monetary crisis that occurred in 1998 and 2008 showed a fragile economic foundation. The shock of the economic crisis implies the possibility of important structural changes in economic policy over time. Time-varying impulse responses indicate remarkable changes in the relationships between macroeconomic variables.The selection of variables is based on the theory of interest rates developed by the monetarist school of thought (Friedman, 1956). Chen's (2017) model can be written as equations (1) and (2).

$$INF = f(ir, unp) \quad (1)$$
$$INF_t = \alpha_0 + \beta_1 ir_t + \beta_2 unp_t + \varepsilon_t \quad (2)$$

where INF is inflation (CPI_percentage), ir is interest rate (loan interest rate_percentage), and unp is unemployment (workforce/worked_percentage). Notation α describes intercept, β describes coefficient, and t describes the time period.

The second model was analyzed by using a fully modified-ordinary least square (FM-OLS) where the dependent variable was the impulse response generated from the TVP-VAR. The inflation response was calculated based on the cumulative and maximum values. The second model adopts the model from Chen (2017), Anwar & Akbar (2018), Kammoun et al. (2020), and Ikpesu (2021) which can be written as equation (3), (4) for the cumulative value while the maximum value is like equation (5), and (6).

$$cum.ir = f(s, dc, pop, u1, u2, u3, dr, du) \quad (3)$$
$$cum.unp_t = \alpha_0 + \beta_1 s_t + \beta_2 dc_t + \beta_3 pop_t + \beta_4 u1_t + \beta_5 u2_t + \beta_6 u3_t + \beta_7 dr_t + \beta_8 du_t + \varepsilon_t \quad (4)$$
$$max.ir = f(s, dc, pop, u1, u2, u3, dr, du) \quad (5)$$
$$max.unp_t = \alpha_0 + \beta_1 s_t + \beta_2 dc_t + \beta_3 pop_t + \beta_4 u1_t + \beta_5 u2_t + \beta_6 u3_t + \beta_7 dr_t + \beta_8 du_t + \varepsilon_t \quad (6)$$

where *cum.ir* is the cumulative response of inflation to interest rate shocks, *max.ir* is the maximum response of inflation to interest rate shocks, *s* is savings (saving rate per year_Rupiah), *dc* is domestic credits (total domestic credit per year_Rupiah), *pop* is the population (total population_million), *u1* is the young population (million), *u2* are working-age people (million), *u3* is the old population (million), *dr* is dependency ratio (percentage) and *du* is financial technology (dummy; 1=2015-2020; 0=1987-2014). The reason for using a dummy variable is that technology in the financial sector emerged in Indonesia since 2015. Notation α describes intercept, β describes coefficient, and t describes the time period. The second model used demographic and non-demographic aspects (real aspects) to determine the effectiveness of monetary policy. The use of the demographic aspect adopts Chen's (2017) research which discusses the effect of demographic changes on the effectiveness of monetary policy. While the non-demographic aspect (real aspect) adopted research from Anwar and Akbar (2018), Kammoun et al. (2020), Ikpesu (2021). The technology dummy variable was also used in the model to determine the effect of the technology variables on the effectiveness of monetary policy, where 0 represents conditions before 2015 and 1 represents conditions after 2015.

The analysis of the TVP-VAR model was carried out in several stages. First, it used descriptive statistical analysis to determine the central tendency on the variables of inflation, unemployment and interest rates. Second, determining the optimum lag was used as a basis for further analysis. The determination of the optimum lag was carried out to find the best lag length in the model and able to avoid the model from autocorrelation and heteroscedasticity problems (Wardhono *et al.* 2019; 2021). The methods were Schwarz Information Criterion (SC), Akaike Information Criterion (AIC), Hannan-Quinn Information Criterion (HQ). Third, unit root testing aimed to evaluate the stationary or non-stationary properties in the data, especially to determine whether the trend is stochastic through the presence of unit roots (Phillips & Perron, 1988). Stationarity test was done by using the Augmented Dickey Fuller (ADF) method. Fourth, parameter stability test was

needed to test whether the TVP-VAR model specification is appropriate or not. The methods in the parameter stability test were ave-F, supF, and exp-F tests where those three methods refer to the steps from Andrews (1993) and Andrews & Ploberger (1994). After passing the parameter stability test, the last testing was conducting the estimation of time varying parameter-vector autoregressive (TVP-VAR).

The stages in the estimation of the fully modified-ordinary least square (FM-OLS) model consist of four stages; descriptive statistical analysis, determination of the optimum lag, stationarity test, and the estimation of the FM-OLS model. In this equation model, the dependent variable was used from the previous TVP-VAR estimation results.

RESULTS AND DISCUSSION

Data analysis was performed by using two methods, time varying parameter-vector autoregressive (TVP-VAR) and fully modified-ordinary least square (FM-OLS). The TVP-VAR method is used to determine the effectiveness of monetary policy, while the FM-OLS method is used to verify the relationship between demographic changes and the real sector on the effectiveness of monetary policy.

TVP-VAR Estimation Results

The TVP-VAR test model begins with identifying the descriptive statistical results as described in Table 1. Based on the descriptive statistical analysis, it is known that the inflation variable has a data distribution that is not good compared to the other two variables, unemployment and interest rates. These results are obtained from the value of the standard deviation of inflation which is greater than the average.

Table 1. Descriptive statistics of the TVP-VAR model

	Inflation	Unemployment	Interest rate
Minimum	0.590	2.550	9.24
Median	6.830	5.840	16.29
Mean	8.843	5.992	17.08
Standar Deviasi	9.915	2.410	5.545
Maximum	76.61	10.75	35.20

Source: processed data, 2021

Based on the optimum lag test on the TVP-VAR model, it is known that the optimum lag is in the 2nd lag (Table 2). These results are proven by the minimum value of the Schwarz Information Criterion (SC) which is 1.529. Neath and Cavanaugh (2012) explain that SC has an aspect of consistency in model selection. Therefore, the model selection is more likely to be selected compared to SC.

Table 2. Lag optimum model TVP-VAR

Lag	AIC	HQ	SC
1	-0.3843055	-0.2745633	-0.1141834
2	-2.0023392	-1.8102904	-1.5296255*
3	-2.0304479	-1.7560925	-1.3551427
4	-2.1626668	-1.8060048	-1.2847700
5	-2.37338241	-1.93441385	-1.29289406
6	-2.69060489*	-2.16932973*	-1.40752498
7	-2.6758171	-2.0722354	-1.1901456
8	-2.63258166	-1.94669330	-0.94431862
9	-2.54818522	-1.77999025	-0.65733061
10	-2.53331837	-1.68281680	-0.43987220

Note: *) lag optimum

The next test is the unit root test. Stationarity results are obtained by looking at the comparison between the probability value and alpha. Based on the stationarity test (Table 3), it is known that the stationary variable at the level is only the inflation variable, while the unemployment and interest rate variables show non-stationary results. Therefore, the stationarity of the TVP-VAR model is derived at the first difference level, probability value are less than 0.05. It shows that all variables are stationary at the first difference level.

Table 3. Unit root test on TVP-VAR model

Variables	Level		First Difference	
	Probability	Statistics	Probability	Probability
Inflation	-4.0729	0.01*	-5.8391	0.01*
Unemployment	0.0535	0.6309	-3.4492	0.01*
Interest rates	-1.1982	0.232	-5.6237	0.01*

Note: *) stationary on alpha 0,05

The next stage is parameter stability test by using ave-F, supF, and exp-F test methods. The results show that all variables are appropriate in the application of TVP-VAR to produce findings in the form of inflation response to unemployment and interest rates. These results are obtained from the probability value of each variable, which is smaller than alpha (5%) in each method (Table 4).

Table 4. Parameter stability test on the TVP-VAR model

	Inflation		Unemployment		Interest rates	
	Statistic	P-value	Statistic	P-value	Statistic	P-value
aveF Test	12.189	0.00000*	8.4233	0.000278*	124.75	0.00000*
supF Test	16.156	0.00079*	56.425	0.00000*	264.17	0.00000*
expF Test	6.7888	0.00000*	24.385	0.00000*	128.22	0.00000*

Note: *) significant on alpha 0,05

A study conducted by Nakajima (2011) states that stochastic volatility in the TVP-VAR model will play a role in controlling structural changes in dynamic relationships between macroeconomic variables which will improve estimation

performance. Figure 1 describes the estimation results of stochastic volatility on the TVP-VAR model from the period 1987Q1 – 2020Q4. Stochastic volatility from inflation, unemployment, and interest rates experienced the highest spike in the 1987 – 2000 period. This occured because during that year or more precisely in 1997, the Asian financial crisis happened. Tarmidi (1999) explained that the prolonged monetary crisis in 1997 was caused by the use of foreign exchange system that was too free without adequate supervision, the depreciation of the rupiah which was relatively low below the actual exchange rate, and the increase of short and medium term private foreign debt. This has an impact on higher inflation. This was caused by imported inflation. In addition, the rate of layoffs has increased so that the unemployment rate during the crisis period has increased. Many companies have closed or reduced their production. The low investment was due to high imports of capital goods. When a crisis occurs, the government increases interest rates to hold funds abroad and invite people to deposit their funds in rupiah. However, this also has a negative impact that the foreign private debt will be higher.

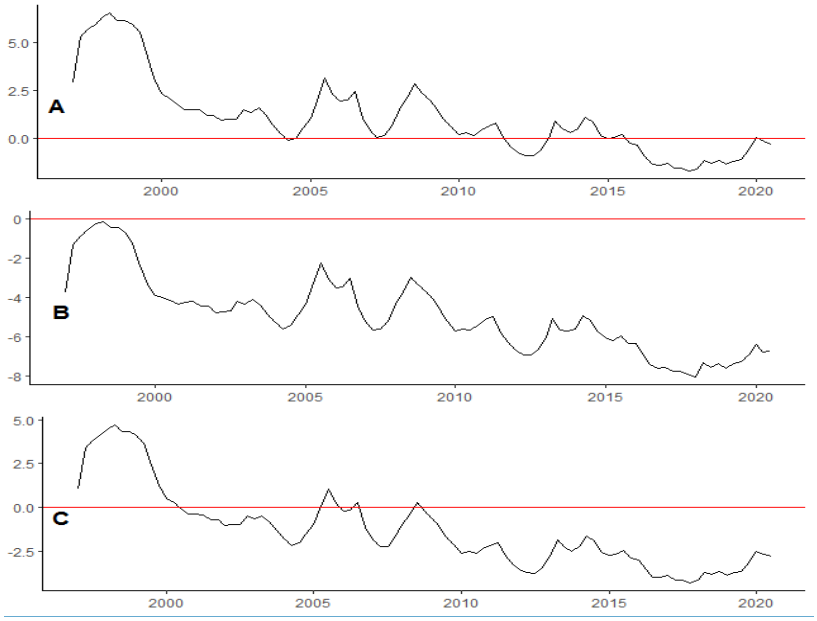

Figure 1. Estimation of stochastic volatility from TVP-VAR. (a) error variance in the inflation equation, (b) error variance in the unemployment equation, (c) The error variance in the interest rate equation

The movement of stochastic volatility from inflation, unemployment, and interest rates during the 1987 – 2020 period shows a downward trend. This illustrates that economic conditions began to improve with a stable economy. The time-varying pattern on stochastic volatility in Figure 1 illustrates the ability of the TVP-VAR model that can be used to combine structural changes between inflation, unemployment, and interest rates.

Figure 2 describes the inflation response to interest rate shocks and leads to a positive value. The results apply to the cumulative and maximum values. The cumulative response showed a positive direction since the beginning of period, but did not continue because of the stagnation in the next period until 2000. On a different segment, the maximum response, a stagnant process has started from the beginning of period until 2008. Then, in 2009 until the next years, it showed a

positive response for changes in interest rates. However, in general it can be concluded that inflation responds positively to interest rate shocks. The inflation can be used as a representation to the effectiveness of monetary policy. It can produce findings on the influence of demographic aspects and the real sector on the effectiveness of monetary policy in Indonesia.

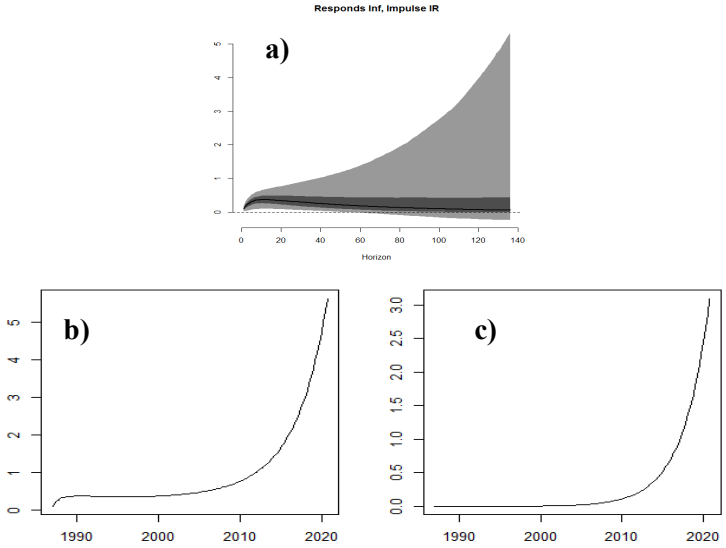

Figure 2. Impulse inflation response to interest rate shocks and unemployment. (a) inflation response to 1 SE interest rate shocks, (b) cumulative response value of inflation to 1 SE interest rate shocks, (c) maximum inflation response value to 1 SE interest rate shocks

Demographic Aspects and Real Sector of Cumulative Inflation with Interest Rate Shocks

The size of the inflation variable through interest rate shocks will be represented by two models, the cumulative response to inflation and the maximum response to inflation. The cumulative response to inflation is the result of the average response of inflation on changes in interest rates. Table 5 describes the results of descriptive statistics on the cumulative response model of inflation. Also, it shows that the variables with good data distribution are savings, domestic credit, population, young age, productive age, old age, and dependency rates. While the variables with poor data distribution are cumulative inflation and the use of technology.

Table 5. Descriptive statistics of the cumulative response model of inflation to interest rate shocks

	cum.ir	S	dc	pop	u1	u2	u3	dr	Du
Min.	0.1045	23.73	30.80	18.95	17.99	18.40	15.64	41.00	0.0000
Median	0.4444	24.94	34.55	19.21	18.01	18.78	16.18	53.67	0.000
Mean	1.0068	25.23	34.33	19.21	18.03	18.76	16.14	55.94	0.1765
Stand.Dev	1.1572	0.967	1.589	0.138	0.031	0.183	0.279	7.433	0.383
Max.	5.6171	26.64	36.57	19.42	18.08	19.05	16.63	72.86	1.0000

Then, the optimum lag in the cumulative response model of inflation is lag 5 (Table 6). This is known from the lowest SC value. The choice of SC is compared

to AIC and HQ because SC has an aspect of consistency in model selection (Neath & Cavanaugh, 2012).

Table 6. Optimum lag test results for the cumulative inflation model on interest rate shocks

Lag	AIC	HQ	SC
1	-8.282351e+01	-8.200044e+01	-8.079759e+01
2	-8.767727e+01	-8.611344e+01	-8.382803e+01
3	-9.819383e+01	-9.588925e+01	-9.252127e+01
4	-9.986429e+01*	-9.681895e+01*	-9.236841e+01
5	-1.081925e+02	-1.044064e+02	-9.887326e+01*
6	-1.080182e+02	-1.034914e+02	-9.687569e+01
7	-1.082782e+02	-1.030106e+02	-9.531235e+01
8	-1.085323e+02	-1.025239e+02	-9.374308e+01
9	-1.092612e+02	-1.025121e+02	-9.264874e+01
10	-1.117622e+02	-1.042723e+02	-9.332642e+01

At the stationarity test stage by using the Augmented Dickey-Fuller method, it was found that all variables were stationary at the second difference level (Table 7). This is known through the probability value which is smaller than alpha (0.05). The decrease to the second difference level is due to the non-stationary variable at the level and first difference level.

Table 7. Stationarity test of the cumulative response model of inflation with interest rate shocks

Variables	Level		First Difference		Second Difference	
	Statistics	Probability	Statistics	Probability	Statistics	Probability
cum.pi	-0.8643	0.3384	137.0501	0.99	193.5218	0.99
s	1.8582	0.9835	-4.1399	0.01*	-8.9587	0.01*
dc	1.9782	0.9882	-1.7127	0.08514	-9.3419	0.01*
pop	2.6901	0.99	-6.3761	0.01*	-30.9055	0.01*
u1	-1.1509	0.2471	-4.5279	0.01*	-13.3479	0.01*
u2	3.0232	0.99	-3.8576	0.01*	-25.4424	0.01*
u3	2.4302	0.99	-2.4282	0.01701*	-20.4089	0.01*
dr	-1.2441	0.2174	0.0806	0.6396	-8.0809	0.01*
du	0	0.6139	-8.0932	0.01	-13.9642	0.01*

Note: *) stationary on alpha 0,05

The final stage is FM-OLS estimation (Table 8). In the cumulative response model of inflation, it is known that there are demographic aspects that are not significant to the effectiveness of monetary policy, the young age variable. This is because the young age range of 0-14 years has not been able to make economic choices and has a high dependency rate. Therefore, when the variable of young age changes, it does not have any significant effect on the effectiveness of monetary policy.

All variables such as the real sector, such as savings, domestic credit, and the use of technology have significant effects on the effectiveness of monetary policy, especially with the maximum measure of inflation. Domestic savings and credits have significant effects on the effectiveness of monetary policy because fluctuations in these variables depend on changes in interest rates. The changes in

interest rates are used as independent variables in determining the effectiveness of monetary policy with a cumulative measure of inflation. While technologies can have significant effects on the effectiveness of monetary policy because the use of technology will affect the pattern of people's economic activities which will later be used to determine the effectiveness of monetary policy. Each variable has a different direction of relationship, such as the savings and technology variables which have a significant positive relationship to the effectiveness of monetary policy. This also applies to the technology variable. Negative significance occurs in the domestic credit variable on the effectiveness of monetary policy with a cumulative measure of inflation.

Table 8. Estimated FM-OLS cumulative response model of inflation with interest rate shocks

Variables	Coefficient	t-value	Probability
s	0.397204	9.3605	0.00000 *
dc	-1.284065	-10.4836	0.00000 *
pop	21.973855	5.1844	0.00000 *
u1	0.914889	0.2456	0.806418
u2	-33.898180	-7.9811	0.00000 *
u3	14.985539	9.8265	0.00000 *
dr	-0.170475	-3.8149	0.000211*
du	1.064026	12.3644	0.00000 *

Note: *) significant on alpha 0,05

Based on those five demographic aspects, there are two variables that have a significant negative relationship to the effectiveness of monetary policy, the productive age variable and the dependency ratio. The dependency rate has the same direction as the productive age because the productive age population has an important role in determining the dependency rate. Demographic aspects that have a significant positive relationship to the effectiveness of monetary policy during interest rate shocks are population and old age.

Demographic Aspects and Real Sector of Maximum Inflation With Interest Rate Shocks

The maximum response to inflation is the maximum value of the inflation response in the face of changes in interest rates. This model is analyzed to determine the effect of demographic aspects and the real sector on the effectiveness of monetary policy with a maximum measure of inflation. The results of the descriptive statistical analysis are written in Table 9. It shows that good distribution of data occurs in the variables of savings, domestic credit, population, young age, productive age, old age, and dependency rates. This is proven by the standard deviation value, which is smaller than the average value. While the bad distribution of data occurs in the maximum variable of inflation and the use of technology.

Table 9. Descriptive statistics of the maximum inflation model with interest rate shocks

	max.ir	s	dc	pop	u1	u2	u3	dr	du
Min.	0.0000636	23.73	30.80	18.95	17.99	18.40	15.64	41.00	0.0000
Median	0.0164676	24.94	34.55	19.21	18.01	18.78	16.18	53.67	0.0000
Mean	0.3048761	25.23	34.33	19.21	18.03	18.76	16.14	55.94	0.1765
Stand.Dev	0.6325647	0.9672	1.5893	0.1377	0.0314	0.1832	0.2790	7.4326	0.3826
Max.	3.0953299	26.64	36.57	19.42	18.08	19.05	16.63	72.86	1.0000

Then, table 10 shows the optimal lag test results that are right at lag 2 for the maximum inflation model. These results are obtained from the lowest SC value to obtain the optimum lag value. At the stationarity test stage, the results obtained that the stationary variable is at the second difference level (Table 11).

Table 10. Optimum lag test results for the maximum inflation model with interest rate shocks

Lag	AIC	HQ	SC
1	-9.481389e+01	-9.399082e+01	-9.278797e+01
2	-9.742216e+01	-9.585834e+01	-9.357293e+01*
3	-9.750495e+01	-9.520037e+01*	-9.183239e+01
4	-9.715638e+01	-9.411104e+01	-8.966049e+01
5	-9.704587e+01	-9.325976e+01	-8.772666e+01
6	-9.692885e+01	-9.240198e+01	-8.578631e+01
7	-9.679588e+01	-9.152826e+01	-8.383002e+01
8	-9.737157e+01	-9.136319e+01	-8.258239e+01
9	-9.854665e+01	-9.179750e+01	-8.193414e+01
10	-9.958052e+01*	-9.209062e+01	-8.114469e+01

Note: *) optimum lag
Source: processed data, 2021

The stationary test stage was carried out using the Augmented Dickey-Fuller method at several levels. The results of the analysis show that all variables are stationary at the second difference (Table 11). At the level and first difference, there are several variables that are not yet stationary, so they are reduced to the second difference. Stationarity of the data can be known through the probability value which is smaller than the alpha value (0.05).

In the final stage, FM-OLS estimation is impelemented to determine the effect of demographic aspects and the real sector on maximum inflation with interest rate shocks. Table 12 explains that the variable of young age has no significant effect on the effectiveness of monetary policy with a maximum measure of inflation. The estimation results on the young age variable in the inflation maximum response model have the same findings in the inflation cumulative response model.

Table 11. Stationarity test of the maximum inflation model with interest rate shocks

Variables	Level		First Difference		Second Difference	
	Statistics	Probability	Statistics	Probability	Statistics	Probability
max.pi	5.7357	0.99	11.5905	0.99	15.2533	0.99
s	1.3031	0.9509	-4.1399	0.01*	-8.9587	0.01*
dc	1.8877	0.9847	-1.7127	0.08514	-9.3419	0.01*
pop	15.9547	0.99	-6.3761	0.01*	-30.9055	0.01*
u1	-0.266	0.5291	-4.5279	0.01*	-13.3479	0.01*
u2	11.33	0.99	-3.8576	0.01*	-25.4424	0.01*
u3	6.9762	0.99	-2.4282	0.01701*	-20.4089	0.01*
dr	-0.8877	0.331	0.0806	0.6396	-8.0809	0.01*
du	0	0.6139	-8.0932	0.01*	-13.9642	0.01*

Note: *) Stationary on alpha 0.05

The real sectors including savings, domestic credit, and technology, have a significant effect on maximum inflation with disturbances in interest rates. Savings and the use of technology have a positive direction on the effectiveness of monetary policy. Domestic credit variable as part of the real sector has a different direction of relationship to the effectiveness of monetary policy, which is in the form of significant negative.

Table 12. Estimated FM-OLS model for maximum response to inflation with interest rate shocks

Variables	Coefficient	t-value	Probability
s	0.182735	6.8265	0.00000 *
dc	-1.020061	-13.2020	0.00000 *
pop	13.149998	4.9182	0.00000 *
u1	1.656608	0.7048	0.4822
u2	-21.286345	-7.9446	0.00000 *
u3	9.653922	10.0351	0.00000 *
dr	-0.147896	-5.2465	0.000211*
du	0.593237	10.9279	0.00000 *

Note: *) significant on alpha 0,05

Demographic aspects that have a significant positive relationship to the effectiveness of monetary policy are population and old age variables. This also applies to the variable of old age population. A significant negative relationship was also found in the demographic aspect, especially the variables of productive age and dependency ratio. The variable of productive age has an important role in determining the number of dependence. Therefore, the number of dependence on the effectiveness of monetary policy has the same direction as the productive age, which is significantly negative.

The results of this study indicate that the working age group (*u2*) shows a negative and significant relationship to the cumulative response model of inflation and the maximum response. This indicates that in aggregate the working age group does not entirely allocate their income for consumption. The need for health, education and the level of dependency ratio which is classified as increasing, will also have an impact on consumption behavior and purchasing power. In addition, even though Indonesia is experiencing a demographic bonus period, it is still a low-

middle-income country. The integration of minimum wage policies and the general price level still leaves a complex problem in almost all regions. In addition, the unemployment rate is quite acute and the labor market mechanism has not shown a significant balance.

Discussion

The results of this study have similarities with several previous studies, such as the influence of demographic aspects on the effectiveness of monetary policy. The results of this study indicate that the population has a significant effect on monetary policy. This is in accordance with the research conducted by Yoon et al. (2018) which states that a large population describes a lot of aggregate demand. Based on the theory of supply and demand, it is known that inflation occurs due to an increase in aggregate demand. It causes prices to rise, which is then followed by a shift in aggregate supply so that prices will rise higher (Djambak, 2011).

The negative relationship of productive age and positive relationship of old age to monetary policy is also relevant to research by Broniatowska (2019), Juselius and Takats (2018), and Kalafatcılar and Özmen (2021). People of productive age are more likely to save for preparing all their needs in retirement so as not to support inflation. Meanwhile, in old age, people will consume, especially for health financing. Another variable that is also part of the demographic aspect is the dependency ratio. The results of this study explain that the dependency ratio has a negative effect on monetary policy in Indonesia. These results confirm the results of Gajewski's (2014) research that aging will be disinflationary.

In addition to demographic factors, this research also reviews the influence of the real sector on the effectiveness of monetary policy. The real sector used in this research includes savings, domestic credit, and the use of technology. The positive significant relationship that occurs in the savings variable on monetary policy is not in accordance with research conducted by Taye (2017). Taye's (2017) research explains that inflation and savings only have a one-way causal relationship, inflation to savings. Then, domestic credit has a significant negative relationship to monetary policy. These results are not in line with research by Anwar and Akbar (2018) and Ikpesu (2021).

Credit can increase inflation because credit can push the increase on liquidity which will put pressure on the money supply so that it can lead to an increase in inflation. Based on this research, technology has a significant positive relationship to the effectiveness of monetary policy. Kammoun et al. (2020) explained that fintech lending can support inflation because the credit process will increase aggregate demand and cause in price increases. Based on these conditions, technology is inflationary if it is used to make credit.

Based on the theoretical framework of the Life Cycle Hypothesis, at a productive age an individual tends to set aside some of the wages received and not all of it is consumed. This theory applies if the assumption is that each individual has a wage above the average price level in general. So that the purchasing power of basic goods will be purchased. Of course, the theory is different for individuals who receive below the minimum wage. The powerlessness of facing basic needs is certainly a serious problem. Wage ranges that vary in each district, city and province have shown unequal purchasing power as well. Likewise, inflation varies in each region with the average unemployment rate in Indonesia is still relatively

high. So, the author concludes that as long as the average wage level is able to cover basic and secondary needs, it is possible to set aside a portion of the wage it will be realized.

CONCLUSION

The effectiveness of monetary policy can be influenced by demographic aspects and the real sector. The demographic aspect variables that have a significant positive effect on monetary policy are population and old age. This condition illustrates that the population is still a supporting factor in economy through consumption behavior. Then, the majority of the old age population uses their income for consumption or allocates savings in their youth for consumption in old age. Meanwhile, the demographic aspects that have a significant negative effect on monetary policy are working age (productive) and dependency ratio. The productive age population allocates their income to save for life in their old age. This is in accordance with the results of the variable dependency rate in Indonesia, which is relatively high. The productive age group bears the burden of economic life for the old and young age groups.

The real sectors which have a positive relationship to monetary policy are the savings and the use of technology variables. Savings can boost inflation because the accumulation of savings can increase the supply of financial institutions to be channeled through credit. In this process, interest rates are still a fundamental factor in increasing interest in saving. A positive relationship was also found in the technology variable. This condition makes clear that technological advances will provide convenience and speed, but also have a negative impact. Therefore, management is needed to balance the existence of technological developments. The domestic credit variable shows different results, which is significantly negative. This reveals that the increase in credit is allocated more for investment activities and capital goods compared to consumption.

Interest rate policy with an inflation target remains a fairly effective policy. This is because interest rates are closely related to people's activities to save and access credit. The number of people in the age group who access activities in the financial sector will affect the amount of credit disbursed and the interest rate set. So that this will have implications for adjusting the amount of interest rates and their impact on the economic development of the community. Bank Indonesia as the monetary authority still needs to pay attention to moderate interest rates in order to maintain inflation and economic stability, considering the huge potential of the population and the direction of economic behavior of people of every age group will become a serious concern and will affect future economic movements.

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