QUARTERLY ANALYSIS

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QUARTERLY II, 2013
Quarterly Report Team, Bank Indonesia

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QUARTERLY ANALYSIS: The Dynamics of Monetary, Banking And Payment System, Quarterly II, 2013
Bank Indonesia Quarterly Report Team

The Economic Growth and The Regional Characteristics: The Case of Indonesia
Yesi Hendriani Supartoyo, Jen Tatuh, Recky H. E. Sendouw

The Import Restriction of Horticultural Product, Domestic Activities, Price Level, and The Welfare
Wisnu Winardi

The Dynamics of Indonesian Inflation: What can We Learn from Inflation Disaggregation?
IGP Wira Kusuma

Monetary Policy Model for Open Economy of Indonesia
Umar Juoro
The national economy showed lower growth than the first quarter of 2013 due to the impact of the global economic slowdown and rising inflation in the country. After registering a growth of 6.0% (yoy) in the first quarter of 2013, Indonesia’s economic growth slowed to 5.8% (yoy) in the second quarter of 2013. Despite positive growth, exports are still not strong enough to support economic growth as a result of the weakening global economic demand. Exports are not strong and the weakening purchasing power due to inflation has increasing influence to slowdown household consumption as well as non-construction investment.

On the external side, the pressure on the national economy continues. Overall, Indonesia’s balance of payments (BOP) in the second quarter 2013 experienced lower a deficit than the previous quarter. The BOP sustained significant surplus on the capital and financial account (CFA) among others things, due to increased direct capital inflows (DCI) and foreign currency government bond issuance.

On the other hand, the deficit in the Current Account (CA) recorded a relatively high increase, primarily driven by a continued decline in exports due to the global economic slowdown and a sharp drop in global commodity prices, in the middle of the high non-oil imports of both oil and gas and in accordance with the seasonal pattern. The deficit in the CA was also affected by large interest payments enough in the second quarter of 2013. Foreign exchange reserves at the end of June 2013 recorded 98.1 billion U.S. dollars, equivalent to 5.4 months of imports and servicing of the official external debt, well above international standards. Looking ahead, with the tightening of monetary and macroprudential policy mix adopted by Bank Indonesia, and the measures of coordination with government policy, the balance of payments is projected to rebound in line with the CA deficit slowdown in domestic demand and adjustments in the exchange rate.

The rupiah in the second quarter of 2013 depreciated in accordance with its fundamental value. In point to point, the exchange rate depreciated by 2.09% (qtq) to Rp9.925 per U.S. dollar, or on average fell 1.03% (qtq) to Rp9.781 per U.S. dollar. Also, as with weakening currencies of countries in Asia, the depreciation of the rupiah primarily affected non-resident ownership in domestic financial assets that triggered a sentiment of reduction (tapering off) of monetary stimulus by the Fed. These developments resulted in the weakening of the Rupiah in line with the trends of currency movements in the countries of the region. Bank Indonesia
views that the exchange rate at the moment describes the condition of Indonesia’s economic fundamentals.

CPI inflation in the second quarter of 2013 was marked by a significant rise in inflation in June, after two months of prior deflation. CPI inflation in June 2013 recorded an increased high of 1.03% (mtm), and from April and May 2013, deflation was 0.10% and 0.03% (mtm), respectively. As a result of this increase, on an annual basis, the CPI inflation was still high at 5.90% (yoy), despite a quarterly mark of 0.90% (qtq) which was lower than the previous quarter of 2.43% (qtq). High inflation was mainly driven by rising fuel prices subsidized at Rp2.000/liter for premium fuel and Rp1.000/liter for diesel, which was announced by the government on June 21, 2013, and was effective as of June 22, 2013. Meanwhile, core inflation remained under control at a low enough level. However, as Bank Indonesia predicted, the effect of the fuel price hike on inflation was temporary, about three months, with a peak in July 2013, then declined in August 2013 and returned to the normal pattern in September 2013.

Financial system stability was also maintained and supported the stability of the banking industry. In the midst of a slowdown in bank credit trends, the resilience of the banking industry remained solid as reflected in the capital adequacy ratio (CAR) which was high at 18%, well above the minimum requirement of 8%, and the ratio of non-performing loans (NPL) with a gross low at 1.9% in June 2013. Overall liquidity conditions were still maintained, although the Loan-to-Deposit Ratio (LDR) was relatively high at 87.2% in June 2013. Meanwhile, credit slowed from 21.0% (yoy) in May 2013 to 20.6% (yoy) in June 2013, in line with weakening economic growth. Bank Indonesia kept close watch on credit growth which was still quite high at some banks and a number of economic sectors, particular those that have a high import content, which was feared to disrupt the performance of the banking industry and financial system stability.

In the second quarter of 2013, the transaction payment system progressed well. There was an increase both in terms of volume and value of transactions compared to the previous quarter. The volume of transactions in the second quarter of 2013 increased by 99.59 million transactions (11.06%) to 999.91 million transactions, from 900.31 million in the previous quarter transactions. As for the value, transactions increased by Rp2.80 trillion (13.82%) to Rp23.024, 54 billion, from the previous quarter of Rp20.228,43 trillion. The increase in the volume of transactions was mainly derived from transactions using the Card Payment (APMK) i.e. ATM card and/or debit cards. This increase shows the growing trend of economic activity and public use of non-cash payment instruments. Meanwhile, the increase in the value of the transaction in the second quarter of 2013 was primarily derived from transactions-i.e., Bank Indonesia Real Time Gross Settlement (BI - RTGS), namely public transactions, monetary management, and interbank money market (interbank).
THE ECONOMIC GROWTH AND THE REGIONAL CHARACTERISTICS: THE CASE OF INDONESIA

Yesi Hendriani Supartoyo
Jen Tatuh
Recky H. E. Sendouw

Abstract

This paper analyzed the regional characteristic and the output growth. Using panel data analysis on 33 provinces in Indonesia, the result shows that the labor growth and net export positively affect the output growth. Surprisingly, the inflation and human capital were found to be insignificant on output growth.

Keyword: economic growth, panel data, regional characteristics

JEL Classification: O47, C23, R11

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I. INTRODUCTION

Development is a process towards continuous change striving to improve the welfare of the community. One indicator of the successful implementation of development that can be used as a measure of economic growth at the macro level is reflected in the changes in Gross Domestic Product (GDP) in the region. A higher the economic growth of a region indicates a better economic activity as obtained from the GDP growth rate at constant prices (Todaro and Smith, 2008).

The quality of economic growth in Indonesia is still low. Although economic growth in Indonesia is quite high, effect is very low in society, where for every 1 percent of Indonesia’s economic growth is absorbs only 250 thousand of new workers (Adi, 2011).

Indonesia’s economic growth is quite high but the effect on its people is low and raises questions about the influence of the regional characteristics on economic growth. The research of Sodik et al (2007) stated that the overall pattern of a region’s capacity is a result of the nature of social and economic environment that determines the pattern of activity in achieving objectives reflected in regional characteristics which influence economic growth in the form of aspects or qualities consisting of regional labor force, population, human capital (education), inflation and net exports.

Employment is a very important aspect to be studied. Countries with a very large number of people and the provision of limited employment opportunities face serious problems with unemployment. Developments in the labor force cannot be separated from the rate of population growth in the region. Tjiptoherijanto (2001) stated that during the period 1997-1999, the total work force in Indonesia tended to increase, either in working or looking for work. When viewed between the number of people working and those looking for work, it turned out the working population was relatively larger than those looking for work, but the increase was much higher for those in the population who are looking for work. In the construction, local residents often serve as a source of labor which addresses the problem of employment. Thus with a population increase in Indonesia from year to year, while the number of jobs available can lead to limited competition, job seekers are threatened by the lack of opportunity and fulfillment of well-being by fear of increased poverty. As revealed by Ngangi (2010), overcoming poverty is not an easy task but it is closely related to life issues such as the state of the environment, a social activity, education level and health status. The quality of labor is reflected in part by the improvement of education. The higher the formal education obtained, the labor productivity tended to be higher as well. This is consistent with the theory of human capital (human capital).

Sendouw (2006) stated that as a country, Indonesia is one country that has the greatest natural resources in the world, but it has not guaranteed improved welfare of its society. Nor is the use of its resources dependent on the age of the country, but reflected in the attitudes and behavior follow the principle - the basic principle of life. Attitudes and behaviors exhibited
by human beings can be formed through a process of learning, especially in formal education, thus human capital follows the basic principles of life.

The phenomenon of inflation in Indonesia has become one of the various “diseases” of the government macroeconomic which is especially troubling for the community. Towards the end of the New Order regime (before the financial crisis) the annual inflation rate could be reduced to the single digits, but in general it still contained vulnerability when seen from the large percentage of poor communities suffering from inflation.

Since 1967, Indonesia tried to open up. Changing from an isolated system to an open system contains a dubious advantage. Indonesian net export value fluctuated over 2 decades and during the period from 2005 to 2010, Indonesia’s trade balance (net exports) experienced a trade surplus. Based on a review of several indicators of regional characteristics, the required study group should have similar characteristics as the region in order to gain an overall understanding of the factors that can be determined and identified through the analysis which presumably can spur economic growth in establishing a region.

This paper attempts to analyze the influence of the labor force growth rate, population growth rate, the growth rate of human capital, the growth rate of inflation, and the rate of growth of net exports to economic growth in Indonesia. This research is expected to contribute to decision-makers in providing information on the factors that affect the economic growth of a region as well as to the field of economics, especially on regional economic growth and development.

The second part of this paper reviews the theory and literature, while the third section outlines the methodology and data used. The fourth section presents the estimation results and analysis and the conclusions and recommendations are presented in the last section.

II. THEORY

Economic growth measures the achievement of the development of an economy. Measurement of the progress of an economy requires precise measuring instruments, such as gauges of economic growth. The Gross Domestic Product (GDP) is such a measure, where at the regional level it is called the Gross Domestic Regional Product (GDP) which measures the amount of goods or services produced by an economy in the run period of one year and expressed in market prices.

According to classical economics, Smith, economic growth is influenced by two main factors, namely total output growth and population growth. Economic growth is strongly influenced by the productivity of sectors in the use of production factors. Productivity can be improved through a variety of means of education, training and better management (Sukirno, 2008).
According to traditional neoclassical growth theory, output growth is always sourced from one or more of three factors, namely the increase in the quality and quantity of labor, capital increase (savings and investment) and technological improvements (Todaro and Smith, 2008).

Mankiw, Romer and Weil (MRW) modified the neoclassical growth model in which they proposed the use of a variable accumulation of human capital (human capital). Thus a source of economic growth comes from the growth of capital, labor and human capital. Estimation results generated from the MRW model turned out better than the neo-classical models (Mankiw, 2006).

The new growth theory provides a theoretical framework for analyzing endogenous growth. Economic growth is a result of the economic system. Technological progress is endogenous, growth is part of the actors’ decisions to invest in the knowledge economy. The role of capital is greater than just a part of growing revenues if capital is not only physical capital but human capital concerns. The accumulation of capital is the main source of economic growth (Mankiw, 2006).

The rate of growth of population and matters related to the increase in total labor force (labor force) has traditionally been regarded as a positive factor in stimulating economic growth. A positive relationship is true where it depends on the ability of the economic system to absorb and productively employ additional workers. Neoclassical theory states that labor is one factor that explains the high and low economic growth. Sodik et al (2007) in his study tried to examine the effect of agglomeration on regional economic growth. The results indicated that regional economic growth is influenced by the labor force. Solow theory (Neo Classic) also stated that the rate of growth of the labor force and a significant positive effect on economic growth, caused by the increasing number of labor force that works, has the ability to produce a higher output. With so much capable output generated, it will push the level of aggregate supply to drive economic growth.

In general, the population growth rate is considered as one of the positive factors that spurs economic growth. However, the role of the rate of population growth on economic development depends entirely on the ability of the economic system to absorb and productively utilize additional labor. The ability itself is further influenced by the type of capital accumulation and availability of inputs or contributing factors such as managerial and administrative skills.

In addition to the total population, the role of labor to GDP growth is also highly dependent on the quality of the workforce. Human Capital Theory explains that a person can increase their income through higher education. In addition to delaying receipt of income, people who continue their education have to pay the cost of continuing education directly. After graduating, there is the expectation of work with a higher income, which can lead to economic growth in the region. The higher the educational level of a population in a region, the greater the positive influence for economic growth. The growth rate of human capital is seen as a major
growth engine that has a role to mobilize and encourage economic growth. The Solow theory states that the rate of growth of human capital has a positive effect on economic growth. This is because human capital is a key input for the basic research of new products or ideas. Thus, countries with a higher initial stock of human capital tend to have economies that grow faster. Thus realizing human capital is an important source of growth in endogenous growth theory. Human capital refers to the stock of knowledge and production skills of a person. Education is one of the ways in which individuals increase their human capital. Arguments supporting this theory state that people with higher levels of education, as measured by their length of time in school, will have a work with a better wage than those people with lower education. If wages reflect productivity, then the more people who have a higher education, the higher the productivity which would result in a higher level of growth for the national economy. With a population higher one’s education, human capital stock is expected to be higher. Human capital has a positive relationship with economic growth implication, and education has a positive relationship with productivity or economic growth.

Export-oriented economy can be understood through export-led growth supported by economic and trade policies to speed up the industrialization process of a State by exporting goods that have a comparative advantage. Export-led growth opens up the domestic market to foreign competition in exchange for market access in other countries. Export-led growth is an economic strategy that is used by some developing countries. This strategy seeks to find a niche in the world economy for the export of certain types of goods. Industries producing export goods can receive government subsidies and better access to local markets. By implementing this strategy, countries hope to gain a stronger currency to import commodities produced cheaper elsewhere. Export-led growth has an important advantage in its ability to generate profits and allow a State to balance their finances, even exceed their debt, as long as the facilities and materials available for export. In addition, a much more important advantage which is debatable is that export growth can lead to greater productivity. The importance of this concept is discussed in the model by JSL McCombie and AP Thirwall (1994) in Economic Growth and the Balance-of-Payments Constraint. There are basically two types of exports that are used in this context, manufactured goods and raw materials.

The balance of trade is a term used to describe the difference between the monetary value of exports and imports. The balance of trade reflects net exports. A positive balance of trade means that the country monetary value of exports exceeds its imports – this is commonly called a trade surplus. Conversely, if the balance of trade shows a negative condition, this means the monetary value of imports exceeds exports – this is referred to as a trade deficit. Countries strive to achieve a trade surplus. A trade surplus, where the amount of exports is greater than imports, brings a positive influence on the country’s economic growth.

Another factor that influences economic growth is the price level. In the economy, the rising prices in general and associated with processes and mechanisms that occur in the market,
affects the decline in currency values. Inflation actually reflects the stability of a currency which in turn reflects the stability of the price level and affects the realization of achieving the goals of economic development of a country, such as the expansion of employment opportunities and economic stability. Empirically according Sodik et al (2007), regional economic growth is influenced by the rate of inflation. Sodik and Nuryadin (2005) concluded that the rate of inflation has no effect on the growth of the regional economy, although observations over the period 2000-2003 (after decentralization) saw a negative growth effect on the Indonesian economy.

Referring to the above description, the role of the rate of population growth, human capital accumulation, the rate of inflation, and exports to economic growth can be briefly illustrated in the following figure:

III. METHODOLOGY

Data and Variables

This research was conducted using secondary data collected from relevant agencies (BPS North Sulawesi) in Manado City, North Sulawesi. This research was carried out in February 2012 until April 2012.

Types of data used included annual data covering the period 2006-2010 from 33 provinces in Indonesia, including the following variables:

- Growth rate of Gross Domestic Product at constant prices of 2000 by province in Indonesia 2006-2010
- Total Labor Force Population aged 15 years and over by Province in Indonesia 2006-2010
- Total Population Growth by Province in Indonesia in 2006 - 2010
- Number of Students in Public and Private Education under the Ministry of National by Province in Indonesia in 2006-2010
- Inflation Rate by Province in Indonesia in 2006-2010
- Value of Export and Import by Province in Indonesia in 2006 - 2010

Estimation Techniques

This study used panel data regression analysis. The F statistic al test (Chow test) and the Hausman test were used to choose between models of common effects or fixed effects, (Hausman, 2001). The empirical model estimateis:

\[ Y_{it} = \alpha_{oi} + \beta_1 x_{1it} + \beta_2 x_{2it} + \beta_3 x_{3it} + \beta_4 x_{4it} + \beta_5 x_{5it} + \epsilon_{it} \]  (1)
IV. RESULT AND ANALYSIS

The research data was tested by using different types of estimate models of common effects with fixed effects models, fixed effects models and random effects models with fixed effect models with weighted least squares. The best results of several tests were used to formulate the conclusions in this study.

From the results of calculation using the common effect model estimation with a fixed effect model, and with the help of software EViews 5.1, the results obtained an equation for economic growth for Indonesia as follows:

\[ Y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \epsilon \]

where \( Y \) is the rate of growth PDRB; \( x_1 \) is the growth rate of labor force; \( x_2 \) is the population growth rate; \( x_3 \) is the growth rate of human capital; \( x_4 \) is the rate of inflation; and \( x_5 \) is the rate of growth of net exports. The notation \( i \) and \( t \) indicate the identifier (in this province) and time.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>8.7143</td>
<td>1.8352</td>
<td>4.7483</td>
<td>0.0000</td>
</tr>
<tr>
<td>INFLATION</td>
<td>-0.1518</td>
<td>0.0780</td>
<td>-1.9457</td>
<td>0.0539</td>
</tr>
<tr>
<td>WORK</td>
<td>0.0688</td>
<td>0.0298</td>
<td>2.3091</td>
<td>0.0226</td>
</tr>
<tr>
<td>EDUCATION</td>
<td>-0.0022</td>
<td>0.0093</td>
<td>-0.2349</td>
<td>0.8147</td>
</tr>
<tr>
<td>NET</td>
<td>0.0008</td>
<td>0.0007</td>
<td>1.1520</td>
<td>0.2515</td>
</tr>
<tr>
<td>POPULATION</td>
<td>-1.1043</td>
<td>0.9193</td>
<td>-1.2012</td>
<td>0.2319</td>
</tr>
</tbody>
</table>

Estimation results in Table 1 illustrates that there is one variable that is significant at \( \alpha = 5\% \), which is the rate of growth of the labor force while the growth rate of inflation is significant at \( \alpha = 10\% \). While three other variables are not significant at \( \alpha = 5\% \) i.e., human capital (education), net exports and population. From the estimation, \( R^2 \) generated from the estimated equation in this study is relatively small which only amounted to 38.74 percent during the period of observation. This may imply that the common effect model analysis method with the fixed effects model, the variation of independent variables in this study were
able to explain only 38.74 percent of the variation of the dependent variable, while the remaining 61.26 percent is explained by other variables not included in the research model.

The Chow test was used to determine the choice of estimation. This test is known to be the more appropriate choice when looking at common effects models with fixed effects model. The null hypothesis is that the model follows the common effect, while the alternative one is fixed effect. Table 2 provide the results.

<table>
<thead>
<tr>
<th>Effects Test</th>
<th>Statistic</th>
<th>d.f.</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cross-section F</td>
<td>2,3828</td>
<td>(32,127)</td>
<td>0,0003</td>
</tr>
<tr>
<td>Cross-section Chi-square</td>
<td>77,5923</td>
<td>32</td>
<td>0,0000</td>
</tr>
</tbody>
</table>

These results demonstrated both the F test and chi-square were significant (p-value less than 0.0003 and 0.0000 $\alpha = 5$ percent) so that Ho was rejected and H1 was accepted, then the fixed effects models to follow. Based on the estimation results, we concluded that a better estimation technique to use in this study is a fixed effects model.

Then tests proceeded with the estimation techniques using random effects models. From the results of the calculations using the estimated fixed effect models with random effects models, with the help of software E Views 5.1 obtained results for Indonesia’s economic growth equation is as follows:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>6,5336</td>
<td>0,9214</td>
<td>7,0902</td>
<td>0,0000</td>
</tr>
<tr>
<td>INFLATION</td>
<td>-0,1092</td>
<td>0,0737</td>
<td>-1,4805</td>
<td>0,1407</td>
</tr>
<tr>
<td>WORK</td>
<td>0,0468</td>
<td>0,0279</td>
<td>1,6719</td>
<td>0,0965</td>
</tr>
<tr>
<td>EDUCATION</td>
<td>0,0027</td>
<td>0,0088</td>
<td>0,3118</td>
<td>0,7555</td>
</tr>
<tr>
<td>NET</td>
<td>0,0005</td>
<td>0,0006</td>
<td>0,8365</td>
<td>0,4041</td>
</tr>
<tr>
<td>POPULATION</td>
<td>-0,0992</td>
<td>0,3564</td>
<td>-0,2784</td>
<td>0,7810</td>
</tr>
</tbody>
</table>

Weighted Statistics

| R-squared   | 0,0348      | Mean dependent var | 3,9819 |
| Adjusted R-squared | 0,0045 | S.D. dependent var | 3,2533 |
| S.E. of regression | 3,2460 | Sum squared resid | 1675,341 |
| F-statistic | 1,1483      | Durbin-Watson stat | 1,9370 |
| Prob(F-statistic) | 0,3372 | | |
Estimates of the fixed effects model with random effects models, showed that there are no significant variables at $\alpha=5$ percent of the work force but significant at $\alpha=10$ percent. From the estimation, R2 generated from the estimated equation in this study was very small as it only amounted to 3.48 percent during the period of observation. This may imply that the fixed effects model analysis method with random effects models has variations in the independent variables in this study which would explain the 3.48 percent variation in the dependent variable for economic growth in Indonesia, while the remaining 96.52 percent is explained by other variables not included in there search model.

The Hausman test determined the choice of estimation to be used. This test determines the more appropriate choice between fixed effect models and random effects models. The Hausman test results indicated that for the observation period 2006 – 2010, test results are significant (p-value 0.0471 is less than $\alpha = 5$ per cent) so that Ho is refused and the H1 is accepted that estimates for the fixed effects model approach is better than the random effects model approach. This also means there is a difference between units that can be seen through the differences in terms the Constants. Fixed effects model is assumed to only focus on a specific individual effect.

Tests performed using the Hausman test as the null hypothesis showed that the model follows the random effects model follow by the fixed effects alternative. The results showed that the more appropriate the model is the Fixed Effects Model (p=0.0471).

In a study using cross sectional data, allowing the presence of heteroskedasticity, the tendency in the research data showed that the estimation technique should be conducted using a fixed effects model with weighted least squares or often referred to as the general least square (GLS).

Based on the results of the processed data for Indonesia’s economic growth equation estimation with the fixed effects model weighted least squares (GLS), obtained better results. The estimation results of the model illustrated that there were two significant variables at $\alpha = 5$ percent, which is the rate of labor force growth and net exports. The estimated model also illustrates that there are 18 provinces that positive economic growth.

The fixed effects model with weighted least squares has different intercepts. In other words, the intercept may be different for each individual. Thought is the basis for the formation of thought fixed effect model. The advantages of this model are its ability to distinguish the individual effects Square (GLS).

Based on the results of the processed data for Indonesia’s economic growth estimation equation with fixed effects model obtained better results with weighted least squares (GLS). The estimation results of the model illustrated that two variables were significant at $\alpha = 5$ percent, namely the rate of labor force growth and net exports. The estimated model also illustrated that there are 18 provinces that have positive economic growth.
In the fixed effects model with weighted least squares the intercept is different. In other words, the intercept may be different for each individual. This is thought to be the basis for the formation of fixed effects model. The advantages of this model is ability to distinguish individual effects.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std.Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
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<td>9.8515</td>
<td>0.0000</td>
</tr>
<tr>
<td>INFLATION</td>
<td>-0.0173</td>
<td>0.0176</td>
<td>-0.9818</td>
<td>0.3280</td>
</tr>
<tr>
<td>WORK</td>
<td>0.0431</td>
<td>0.0117</td>
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<tr>
<td>EDUCATION</td>
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<td>0.0018</td>
<td>0.6726</td>
<td>0.5024</td>
</tr>
<tr>
<td>NET</td>
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<td>0.0001</td>
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</tr>
<tr>
<td>POPULATION</td>
<td>-0.0207</td>
<td>0.3048</td>
<td>-0.0680</td>
<td>0.9458</td>
</tr>
</tbody>
</table>

Weighted Statistics

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Mean dependent var</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-squared</td>
<td>0.8292</td>
<td></td>
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<td>S.E. of regression</td>
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<td>Sum squared resid</td>
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<td>F-statistic</td>
<td>16.6710</td>
<td>Durbin-Watson stat</td>
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<td>Prob (F-statistic)</td>
<td>0.0000</td>
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</table>

R2 is the value of 82.92 means that 82.92 percent of the economic growth variables can be explained by the variables growth rate of inflation, labor force, human capital, net exports, and population. While the remaining 17.08 per cent could be explained by other variables outside the model.
F is the F statistic in E Views count. If the p-value is less than $\alpha$ then the hypothesis is rejected (significantly different from zero). From the test results of the Prob F-statistic obtained that the Prob F-value is statistically significant at $\alpha=1$ percent, indicating that overall, all independent variables were able to explain the dependent variable economic growth.

**Discussion**

The economic interpretation of the obtained equation at a constant value of 5.75 indicates that if the independent variables are considered constant, then the average Indonesian economic growth was at 5.75 percent.

**a. Effect of Labor Force Growth Rate on Economic Growth**

Estimates of panel regression data showed that the positive growth rate of the labor force variable had a significant impact on economic growth in Indonesia in 2006-2010. Where the coefficient of the variable growth rate of the labor force (AK) was 0.0431, then the growth rate of the labor force had a significant positive effect on the growth of the Indonesian economy. If the AK growth rate rose 1 percent, then the Indonesian economy grew by 0.0431 percent. This gives a signal that the contribution of the labor force in Indonesia is significant for Indonesia’s economic growth. This is consistent with the research hypothesis formulated previously and in accordance to the research conducted by Sodik et al (2007). It is also in accordance with the (neo-classical) theory of Solow which states that the rate of growth of the labor force has a significant positive effect on economic growth, which is caused by the increasing number of people able to enter the labor force, thereby increasing the ability to produce a higher output. With so many people capable of generating output, it will push the level of aggregate supply that will drive economic growth. The significant influence of the labor force to economic growth is mainly caused by the position of the labor force as a factor of production that drives the economy in the region.

**b. Effect of Population Growth on Economic Growth**

Estimates of panel regression data showed that the population growth rate variable is negative and not significant to the economic growth in Indonesia in 2006-2010. Where the coefficient of the variable population growth rate is - 0.0207 and this value is negative, the population growth rate tends to negatively affect economic growth in Indonesia which is not significant. The results obtained according to the research conducted by Simamora and Sirojuzilam (2008) showed that the population growth rate has no significant effect on regional economic growth. No significant influence on the population growth rate is due, among other things, to low quality of human capital of the labor force during economic activity. Large populations with low population quality causes the population to burden economic growth and not encourage it. According to the theories, economic growth is determined by the population growth rate. The population growth rate factor does not always give a positive contribution to economic growth.
c. Effect of Growth Rate of Human Capital to Economic Growth

Estimates of panel regression data showed that when the coefficient of the human capital growth rate variable is 0.0012, then the growth rate of human capital tends to have a positive effect on economic growth in Indonesia which is not significant. The Solow theory states that the growth rate of human capital has a positive effect on economic growth. Human capital refers to the stock of knowledge and skills to produce one output. Education is one of the ways in which individuals increase their human capital. The higher one’s education, the human capital stock is expected to be higher. The results obtained according to research conducted by Gama (2007) showed that estimates of the level of education was not significant. These results are also in line with research conducted Bhinadi (2003) which states that the growth rate of human capital to economic growth is not significant. Sodik et al (2007) also conducted a study on the data estimation which showed that variable levels of education did not have a significant effect on economic growth. Sugiarto (2011) in his study stated that the growth rate of human capital has a positive effect on economic growth in Indonesia but not statistically significant so that it can be stated that the growth rate of human capital does not significantly affect Indonesia’s economic growth. Insignificant influence of the growth rate of human capital on economic growth is partly due to the disuse of the lag number of students who are studying in college. This indicates the number of students who have not graduated from college studies lack the proper variables to describe the human capital theory.

d. Effect of Growth Rate of Inflation on Economic Growth

Estimates of panel regression data showed that when the growth rate variable is negative and not significant, inflation prevailed on economic growth in Indonesia in 2006-2010. Where the variable coefficients of the inflation growth rate was -0.0173 and this value was negative, then the growth rate of inflation tended to negatively affect economic growth in Indonesia which was not significant. The results obtained according to research conducted by Sodik and Nuryadin (2005) showed the inflation rate variable with a negative sign has no effect on the growth of the regional economy. The insignificant influence of the growth rate of inflation on economic growth is partly due to inflation (demand pull) at a reasonable rate showed signs of increased revenue. So, since it is not hyperinflation it can be eroded until it there is no growth.

e. Effect of Growth Rate of Net Exports on Economic Growth

Estimates of panel regression data showed that when the rate of growth of the net exports variable were positive, it had a significant impact on economic growth in Indonesia in 2006-2010. When the variable coefficient of the net export growth rate was 0.0003 and this value is positive, then the rate of growth of net exports had asignificant positive influence on Indonesian economic growth. If the rate of growth of net exports rose 1 percent, the Indonesian economy grew by 0.0003 percent. This result is consistent with research conducted by Sodik and Nuryadin (2006) in which the net exports variable was a proxy of openess of the regional economy and its direction is consistent with the hypothesis and theory although it has a relatively
small coefficient. The value of the regression coefficient is small due to the difference of the value of exports which is not too big compared to the value of imports by Indonesia during the study period. That is to say that the level of net exports to one region plays a role in enhancing regional economic growth, although it is not so large role.

V. CONCLUSION

The growth rate of the labor force has a significant positive effect on economic growth so that there is a need to improve the quality of the labor force. Where the population growth rate has no significant negative effect, the need to improve the quality of the population in economic activities was offset by the quantity of the population. Where the growth rate of human capital does not have a significant positive effect on the economic growth, it is necessary to pay attention to the human capital as referred to the use of the lag number of students who are studying in college. Where the growth rate of inflation does not have significant negative effect caused partly because inflation, is at a reasonable stage so as not to erode economic growth, but the government still needs to be able to keep inflation under control. The rate of growth of net exports has a significant positive effect on economic growth so that the government must be able to maintain the pace of net exports in order to keep the surplus.

The above conclusion has several consequences, first it is necessary to have a superior quality workforce that is skilled and reliable, which can be offset by the quantity of the Indonesian population. Secondly, the need to consider human capital refers to the use of the lag number of students who are studying in universities. Thirdly, the inflation rate needs to be anticipated with the importance of maintaining the rate of net exports in order to keep the surplus.

This study has several limitations including a period of relatively short observation period (2006-2010). Secondly, due to the limited time period, the implementation of the human capital theory with the use of a lag in seeing the education productivity of a number student graduates could not be done. It was not possible given the assumption of the future graduating stratum 1 takes 4 years.
REFERENCES


THE IMPORT RESTRICTION OF HORTICULTURAL PRODUCT, DOMESTIC ACTIVITIES, PRICE LEVEL, AND THE WELFARE

Wisnu Winardi

Abstract

This paper analyzes the impact of entry ports reduction on horticultural production on the economic activities, prices and also toward social welfare by using the Computable General Equilibrium (CGE) model. The simulation shows that higher import restrictions on horticultural products will not only increase the income factor (at current value), but will also increase the composite prices. The higher effect of the latter leads to social welfare reduction, but on the other hand favors the agriculture household types. This finding shows import restrictions on horticulture products serves as an income redistribution policy instrument. With regard to this, the monetary authority should take into account this issue, especially in order to anticipate the effect of composite price increases, which could lead to the need of extra efforts in managing price stability.

Keywords: import reduction; prices, inflation, CGE; social welfare; income distribution.

JEL Classification: E25, E27

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I. INTRODUCTION

In September 2012 the Indonesian government established an entry port restriction for horticultural products which came into force on 28 September 2012. This policy was postponement pending of Minister of Trade Regulation No. 30/M-DAG/PER/5/2012 on Horticulture Import Products, which was originally went into effect June 15, 2012. With this provision the government would close some ports for imports of horticultural products, so that imports should only enter into the customs territory of Indonesia through four entrances, namely the Port of Belawan, Tanjung Perak, Makassar and Soekarno – Hatta Airport.

Under this regulation, there will be several other provisions regarding the import of horticulture, particularly those related to health and the environment. The goal is to protect the interests of consumers, especially in terms of controlling the entry of pests and diseases. Furthermore, this policy is expected to provide benefits to the national economy, especially for the general public as consumers and farmers as producers.

Policy restrictions on the entrance of horticultural products often come with restrictions to horticulture imports, since the implementation of this policy will almost certainly reduce the amount of imported horticulture. In a way, the policy response has pros and cons to various parties. Party pro stated that this policy could stimulate domestic producers to increase production. With this policy the income and welfare of farmers as producers of domestic horticulture is expected to increase. But on the other hand, this policy is also being challenged by counter parties both inside and outside the country. These parties are concerned about the availability of domestic horticultural products that have not been fully met from within the country and could impact inflation. Foreign parties or exporters feel this policy is detrimental to domestic production and consider the provisions of these regulations a violation of free trade.

According to the WTO, the United States with the support of the European Union countries, Australia, Chile, Canada, New Zealand and South Africa protest against closing some entrances to Indonesian imports of horticultural products, especially the port of Tanjung Priok (WTO, 2012). The government explained that closing some entrances is due to the very dense traffic of goods, and support facilities and human resources have not been adequate in addressing the issue of food safety protection. But this is still not acceptable to exporting countries, where for example the United States has reacted further by asking the WTO to abort the Indonesian horticultural import restriction policy (ABC, 2013).

The profile of horticultural products in Indonesia in general showed a good condition. Provision of horticultural products mostly come from domestic production. Based on the balance of Foodstuffs (BoF), during the period 2008-2012 Indonesian horticultural imports of the total supply ranged between 8-12 percent. Imports of horticultural products is large and comprises many kinds of fruits such as oranges, apples, grapes, and durian. Types of vegetables include garlic, chillies, onions, and potatoes. The development of the role of imports to total supply
for almost all horticultural products showed a tendency to narrow, except for onion and garlic. The import role to the provision of both products showed an upward trend.

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<td>2.132</td>
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<td>154</td>
<td>191</td>
<td>198</td>
<td>200</td>
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<td>37</td>
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<td>43</td>
<td>12</td>
<td>58</td>
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<td>180</td>
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<td>- Garlic</td>
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<td>304</td>
<td>11</td>
<td>289</td>
<td>9</td>
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<td>2</td>
<td>61</td>
<td>2</td>
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Under these conditions, this study will examine whether the import restriction policies for horticultural products will benefit the Indonesian economy. This study attempts to calculate the impact of restrictions on imports of horticultural products to the public welfare. The study was conducted with a simulation approach for the implementation of import quotas in the CGE model (Computable General Equilibrium). In addition, this study also attempts to calculate the impact of the restrictions on imports of horticultural products to other economic variables, such as the composite price of goods (composite goods), the real factor income, and income institutions.

II. THEORY

In general, the form of protection for domestic products over the competition with imported products can be done with a policy of tariff and non-tariff. Policy restrictions on the
entrance of imports of horticultural products can be categorized as non-tariff policies, because its implementation is expected to be able to reduce imports of commodities without the use of targeted rate instruments. The impact of restrictions on the price of the composite commodity in an economy can be explained by Figure 1. This image describes the changes caused by the partial equilibrium shifting of the supply curve to the left due to reduced imports. In this case the demand curve is considered fixed (Carbaugh, 2008).

If the supply line is represented Sdn domestic, the foreign supply is represented by Sw, and demand represented DDN, then the balance of the economy without import restrictions are at the point E0. In this condition the realized price is p0 and goods sold q4, where as many as q0 of which comes from domestic products and as much q4-q0 is derived from imports. Enforcement of import restrictions would shift the balance toward the point E1. In this condition manifested higher prices (p1) and the amount of goods sold will be reduced (q3), where as many as q1 derived from domestic products and as much (q3-q1) is derived from imports.

Import restrictions would lead to higher prices and the quantity of goods sold will be less. Import restrictions would also raise the quota rent in the economy. The quota rent is the surplus value derived from the price increases paid by consumers in the country since the enactment of restrictions on imports. In a partial equilibrium it is not explained who is receiving benefits from the quota rent, so the impact received by individual economic actors (institutions) cannot yet be determined.

According to the theory, the quota rent redistribution effect can be decomposed into (a) the protective effect, (b) consumption effect, (c) and revenue effects/quota rent. The redistribution effect will lead to increased acceptance of domestic manufacturers, the protective
effect (a) and the consumption effect (b) would be the missing piece in the economy (dead weight lost), while the effect of revenue/quota rent income will be received by the acquiring institution benefits from protected markets.

III. METHODOLOGY

The data used to derive most of the parameters of the model were from adjusted social accounting matrix (SAM) of Indonesia in 2008. As for the other parameters in the form of constant elasticity of substitution (CES) and constant elasticity of transformation (CET), the parameters used in the study were adopted from Teguh (2010). CES and CET assumed the value of 0.5 for twenty three sectors, except for food, beverages and tobacco, which is assumed to be 1.5.

Adjusted SAM data was used to fulfill the purpose of analysis and synchronized with the equations used in the model. The adjustment was done by changing the format of SAM:

- Of the transaction based on the price, the buyer of the transaction on the basis of producer prices, and the elimination of trade margins block and transportation costs;
- Combines the production sector, domestic commodities, and commodity imports into a block of sectors;
- Incorporates the construction sector to include the chemical industry, fertilizer, and earth resources of clay, cement, electricity, gas and water, and
- Disaggregation of agricultural crops into agricultural and horticultural crops without the horticultural sector.

The analytical tool used is the CGE static model falls into the neoclassical class. Selection of the CGE model as an analytical tool is based on the consideration that this model is more suitable for the case in developing countries in determining economic policy than economic models such as simultaneous equations and other econometric models in the presence macroeconomic shock (Oktaviani, 2008). The CGE models provide a good framework for analyzing problems associated with structural adjustment: the impact of a shock that works through changes in market prices and incentives that affect the allocation and structure of demand, production, and trade (Robinson, 2006). As for choosing a static CGE, it is due to consider the size and complexity of models that can be handled (Hosoe et al., 2010).
The equation used is largely adopted from research conducted by Winardi (2012). His framework begins with government policy in reducing the number of entry points (ports) of horticultural products, along with other relevant provisions of the health of the environment, and resulting in a decrease in imports of horticultural products. As shown in Figure 2, a decrease in imports leading to a reduction in domestic supply has an affect of raising the prices of the composite horticultural products and other commodities. The price increase would have an affect on domestic demand and sectoral output. Changes in sectoral output will have an affect on the revenue earned by economic actors (institutions) and will hedge on domestic demand and the welfare of society. On the other hand, price increases also affect the real income of the institution. Restrictions on imports may result in a shock in the economy and will impact on all aspects of the economy, including the public welfare.
The public welfare change indicator is calculated based on the difference between the value of *Hicksian equivalence coefficient variation* (EV). EV value measures the utility value changes due to the influence of income, regardless of the price change. The EV value is the transformation of the value of household utility as measured in an ordinal scale of expenditure values in monetary units. The value of household utility is itself an objective function of the CGE model used. The calculation of expenditure and coefficients of EV value use the following formula (Hosoe et al., 2012):

\[
ep(p^q, UU) = \min_{X^p} \{p^q.X^p|UU(X^p) = UU\}
\]

\(ep(.)\) : expenditure function  
\(X^p\) : consumption vector  
\(p^q\) : vector of prices faced by consumers  
\(UU\) : utility value *(given)*  
\(UU(.)\) : utility function

Function to minimize expenditure and consumption rates combined to produce utility value.

\[
EV = ep(p^{q0}, UU^1) - ep(p^{q0}, UU^0)
\]

\(EV\) : *Hicksian equivalence variation*  
\(p^{q0}\) : vector price on condition *base line*
$UU'$ : utility value in the presence of shock

$UU^0$ : utility value on conditions base line

EV results from the difference in household spending generated by the shock conditions and expenditures without shock (base line) to maintain the price at baseline conditions. Graphical illustration of the coefficients for the two commodities EV (X₁ and X₂) are shown in Figure 3, where the value EV/$p^0_2$ is illustrated by the distance between points A and B.

Furthermore, the distribution of income is used to measure the Williamson index which has a value between 0 and 1. The more the index is close to 0, it indicates the more equal distribution of household income; while the closer it is to 1, it indicates high inequality. The Williamson index calculation uses the following formula (Daryanti, 2010; modified):

$$W = \sqrt{\frac{\sum(y_i \cdot \bar{y})^2 - \bar{y}^2}{\bar{y}}}$$

where $W$ : Williamson index

$f_i$ : number of households to population groups -i

$n$ : the total population

$y_i$ : group household income to -i

$\Sigma$ : household income per capita

The impact of restrictions on imports of horticultural against household income distribution is seen from the comparison of the generated Williamson index. When the policy index is
lower than the index at baseline conditions, it can be concluded that the policy will reduce the gap. And vice versa, when the index policy is higher than in the baseline condition, it can be concluded that the policy will increase the gap.

In order for the model to describe the economic realities that occurred and able to answer the research objectives, it is necessary to: make adjustments to the portion of the equation that is adopted, the addition of the new equation, and the addition of several new variables and parameters. These three things are determined by considering how the policy of import restrictions is set forth in the model. Horticulture import restrictions in the model can be described in Figure 4.

If it is assumed that the initial equilibrium price of imported goods is $p^m*$ and the amount of imports is $M^*$, then the imposition of import restrictions would reduce the amount of horticultural imports amounted to $M_{quota}$. In this condition the import price of horticulture rose to $(1+\gamma) p^m$, and quota rentis created by $M_{quota} \times (1+\gamma) p^m$. As Figure 1 and Figure 4 describes the application of the import restrictions in partial equilibrium, so that the institution has not explained who benefits from a reduction in the import policy. In a general equilibrium model like the one used in this study, it is assumed that the quota rent will be received by the farm household (farm workers and agricultural employers) as an institution that produces products in the market are protected horticulture.

Based on these explanations, the equation is adjusted, the new equations are added, and new variables and parameters are:

- The equations in the model is adjusted:

$$M_i = \left[ \frac{\gamma_i \cdot \delta m_i \cdot p^q_i}{(1 + \chi + \tau_i^m) p^m_i} \right]^{\frac{1}{1-\delta}} Arm_i$$

where:

- $M_i$ : imported goods to -$i$
- $Arm_i$ : composite goods (a combination of domestic and imported goods) to -$i$
- $\delta_i$ : scaling coefficient the composite goods to -$i$
- $\gamma_i$ : parameters specified by the function coefficients CES
- $\delta^m_i$ : the ratio of import tax on imported goods to -$i$
- $p^m_i$ : import prices
- $\delta mi$ : input share the Armington composite goods functions ($0 \leq \delta mi \leq 1$)
- $T^d_r$ : direct taxes to households -$r$
- $\delta^d_r$ : the ratio of direct taxes on household income to -$r$
The new equation is added:

\[
T_r^d = T_r^d \left( \sum_h p_h^f \cdot FF_{hr} + trhhr(r) + trhohest(r) + trhohgov(r) 
+ \varepsilon \cdot trhohext(r) + rrt_r \sum_i RT_i \right) 
\]

\[
S_r^p = ss_r^p \left( \sum_h p_h^f \cdot FF_{hr} + trhhr(r) + trhohest(r) + trhohgov(r) 
+ \varepsilon \cdot trhohext(r) + rrt_r \cdot \sum_i RT_i \right) 
\]

\[
X_{ir}^p = \frac{\alpha_{iq}}{p_i} \left( \sum_h p_h^f \cdot FF_{hr} + trhhr(r) + trhohest(r) + trhohgov(r) 
+ \varepsilon \cdot trhohext(r) + rrt_r \sum_i RT_i - T_r^d - S_r^p 
- trhhc(r) - trestoh(r) \right) 
\]
The new variable is added:

\[ \chi_i \]: quota rent  \\
\[ RT_i \]: surplus caused by the application of import quotas

The new parameters added are:

\[ M^{quota}_i \]: import quota  \\
\[ rrt_i \]: share acceptance of quota rent by households to -r

Parameters quotas share rent receipts by farm worker households and agricultural entrepreneurs and re calculated based on a comparison of domestic income factor receipts of agricultural workers and agricultural employers in the baseline condition to the total of both.

This model uses the savings - driven closure, i.e. the value of savings is determined first, and then investments to each sector is adjusted to the amount of savings. These models included in the category of neoclassical class, the production function is assumed to be constant returns to scale, and the market is in perfect competition. The model works on the principle of optimization that maximizes the value of the goal, i.e. the number of each class of household utilities. Selection of total utility as a variable to be maximized is based on the consideration that the measures taken in the economy have a goal to improve the welfare. The total value of utility is considered as an indicator to represent the characteristics of well-being.

To help, computational models used GAMS, software to solve mathematical models, including the CGE. As the solver used is conopt, a solver is commonly used to solve non-linear programming optimization function (non-linear programming, NLP). Simulations are performed to calculate the impact if the entrance import restrictions would reduce the amount of horticultural imports by 5, 10 and 20 percent.

Before analyzing the simulation results, the CGE model used needs to be tested first to ensure appropriate and consistent simulation results. Because CGE models belong to the deterministic model, then there is no statistical tests that were performed on model parameters as done in the models that are stochastic. Tests were conducted in the CGE model to test the sensitivity to parameter potential to provide considerable influence on the results of the calculation. In cases related to international trade as this is done, the sensitivity test can be made to the parameters CES and CET (Hosoe et al., 2010).

The sensitivity test results to parameters CES and CET suggest that used CGE models provide simulation results affect the reduction of horticultural imports by 5, 10, and 15 percent of the value of each class of household EV appropriate and consistent. The test results showed that when the CES and CET parameters of each commodity changes by about forty percent lower or higher than the value of the baseline conditions, the simulation results will remain
IV. ANALYSIS AND RESULTS

The following describes the simulation results of horticultural import declines by 5, 10 and 20 percent on some economic variables, namely: the price of composite goods, the real factor income, revenues institutions, and public welfare.

Impact on Prices of Composites Goods

A reduction of 5 per cent of horticultural imports is expected to have an impact on the increase in the average price of 0.01 per cent composites. Composite price increases is mainly due to the increase in the price of the composite commodity horticultural sector, which rose by 0.6 percent, while commodity prices of other sectors remained unchanged. The magnitude of the impact of a reduction in the price of imported horticultural composites in each sector are shown in Table 2.

As described in Figure 1, a reduction in imports will lower the supply of goods in the market so it will increase the price of the composite and reduce the amount of goods sold. Price changes are localized only to the horticultural sector as the products of the horticultural sector do not have many forward linkages. Horticultural outputs are not used as much the inputs (raw materials or auxiliary) by other sectors to produce goods, so the price increase changes that occurs have no effect on output prices.

The reduction of horticultural imports by 10 and 20 percent of the composite price change is expected to have an impact on changes in higher prices and increasing spread to other sectors. The sectors that were previously not affected react with greater import reduction. The simulation results showed that the reduction of horticultural imports by 10 percent will increase the average price by 0.02 per cent and there are three sectors that experienced price increases while at 20 percent reduction an impact on the increase in the average price is 0.08 percent, and there were seven sectors that experienced price increases. The impact of price increases resulted in more widespread roles (share) in the horticultural sector to changes as the average price was lowered, while the other sectors increased. The role of horticulture sector fell from 100.0 percent reduction in imports by 5 percent to 80.7 percent and 55.7 percent reduction in imports by 10 and 20 percent.

These results also indicate that the import restriction policy horticulture will also have an impact on the monetary policy indicator. The complementary nature of goods and substitution as well as the demand-supply mechanism happen in the market resulting in more widespread...
price changes. Decomposition in the context of inflation, raises commodity prices meaning that the import restriction policy will affect changes in commodity prices that are monitored in the calculation of inflation, both of which are volatile, administered, and at the core.

<table>
<thead>
<tr>
<th>Table 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Effect of Horticulture Import Restrictions Against Change Composite Price of Goods (Percent)</td>
</tr>
<tr>
<td>Sector</td>
</tr>
<tr>
<td>1. Agricultural crops other than horticultural</td>
</tr>
<tr>
<td>2. Horticulture</td>
</tr>
<tr>
<td>3. Other food crops</td>
</tr>
<tr>
<td>4. Other crops</td>
</tr>
<tr>
<td>5. Livestock and results</td>
</tr>
<tr>
<td>6. Forestry and Hunting</td>
</tr>
<tr>
<td>7. Fishery</td>
</tr>
<tr>
<td>8. Coal mining, metal &amp; oil seeds</td>
</tr>
<tr>
<td>9. Other mining and quarrying</td>
</tr>
<tr>
<td>10. Manufacture of food, beverages and tobacco</td>
</tr>
<tr>
<td>11. Spinning industry, textile, apparel &amp; leather</td>
</tr>
<tr>
<td>12. Manufacture of wood and products of wood</td>
</tr>
<tr>
<td>13. Paper industry, printing, transportation equipment and metal goods and industrial</td>
</tr>
<tr>
<td>14. Industry oil refineries, chemical, fertilizer, results from clay, cement, LGA, and construction</td>
</tr>
<tr>
<td>15. Trade &amp; restaurants</td>
</tr>
<tr>
<td>16. Hospitality</td>
</tr>
<tr>
<td>17. Rail transport</td>
</tr>
<tr>
<td>18. land transport</td>
</tr>
<tr>
<td>19. Air transport, water and communications</td>
</tr>
<tr>
<td>20. Transportation support services, and warehousing</td>
</tr>
<tr>
<td>21. Banks and insurance</td>
</tr>
<tr>
<td>22. Real estate and business services</td>
</tr>
<tr>
<td>23. Government</td>
</tr>
<tr>
<td>24. Personal services, and other ruta</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

The price and total composite horticultural sector was inelastic relative to the decline in imports of horticulture. The percentage increase in the price of the composite was lower than the decrease in horticultural imports. This is because the role of the supply and import of horticultural horticultural forward linkages were not great, and its use does not spread to many sectors. The sectors most affected were horticulture itself, followed in other sectors of horticulture such as a raw material input or auxiliary to the production process in large enough quantities.
Impact on Real factor incomes

The reduction of horticultural imports by 5, 10 and 20 percent was expected to have a negative impact on the total amount of income, and the real factor incomes were different for each sector. A greater reduction in horticultural imports will lead to a greater reduction in real factor incomes. The magnitude of the impact of the reduction in imports of horticultural on the real factor incomes by sector is presented in Table 3.

<table>
<thead>
<tr>
<th>Sector</th>
<th>5%</th>
<th>10%</th>
<th>20%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Agricultural crops other than horticultural</td>
<td>0.010</td>
<td>0.020</td>
<td>0.043</td>
</tr>
<tr>
<td>2. Horticultural</td>
<td>-0.032</td>
<td>-0.070</td>
<td>-0.163</td>
</tr>
<tr>
<td>3. Agriculture Horticulture *</td>
<td>1.124</td>
<td>2.314</td>
<td>4.947</td>
</tr>
<tr>
<td>4. Other food crops</td>
<td>0.000</td>
<td>0.000</td>
<td>0.001</td>
</tr>
<tr>
<td>5. Other crops</td>
<td>0.001</td>
<td>0.001</td>
<td>0.004</td>
</tr>
<tr>
<td>6. Livestock and results</td>
<td>0.006</td>
<td>0.013</td>
<td>0.025</td>
</tr>
<tr>
<td>7. Forestry and Hunting</td>
<td>0.005</td>
<td>0.011</td>
<td>0.024</td>
</tr>
<tr>
<td>8. Fishery</td>
<td>0.013</td>
<td>0.027</td>
<td>0.057</td>
</tr>
<tr>
<td>9. Coal mining, metal &amp; oil seeds</td>
<td>-0.006</td>
<td>-0.011</td>
<td>-0.018</td>
</tr>
<tr>
<td>10. Other mining and quarrying</td>
<td>0.002</td>
<td>0.004</td>
<td>0.009</td>
</tr>
<tr>
<td>11. Manufacture of food, beverages and tobacco</td>
<td>-0.002</td>
<td>-0.004</td>
<td>-0.009</td>
</tr>
<tr>
<td>12. Spinning industry, textile, apparel &amp; leather</td>
<td>-0.003</td>
<td>-0.006</td>
<td>-0.005</td>
</tr>
<tr>
<td>13. Manufacture of wood and products of wood</td>
<td>0.002</td>
<td>0.005</td>
<td>0.013</td>
</tr>
<tr>
<td>14. Paper industry, printing, transportation equipment and metal goods and industrial</td>
<td>0.001</td>
<td>0.003</td>
<td>0.009</td>
</tr>
<tr>
<td>15. Industry oil refineries, chemical, fertilizer, results from clay, cement, LGA, and construction</td>
<td>0.002</td>
<td>0.005</td>
<td>0.012</td>
</tr>
<tr>
<td>16. Trade &amp; restaurants</td>
<td>0.000</td>
<td>0.001</td>
<td>0.001</td>
</tr>
<tr>
<td>17. Hospitality</td>
<td>-0.067</td>
<td>-0.140</td>
<td>-0.306</td>
</tr>
<tr>
<td>18. Rail transport</td>
<td>0.011</td>
<td>0.022</td>
<td>0.048</td>
</tr>
<tr>
<td>19. Land transport</td>
<td>0.008</td>
<td>0.017</td>
<td>0.037</td>
</tr>
<tr>
<td>20. Air transport, water and communications</td>
<td>0.008</td>
<td>0.016</td>
<td>0.034</td>
</tr>
<tr>
<td>21. Transportation support services, and warehousing</td>
<td>0.003</td>
<td>0.006</td>
<td>0.015</td>
</tr>
<tr>
<td>22. Banks and insurance</td>
<td>0.005</td>
<td>0.010</td>
<td>0.021</td>
</tr>
<tr>
<td>23. Real estate and business services</td>
<td>0.004</td>
<td>0.009</td>
<td>0.018</td>
</tr>
<tr>
<td>24. Government</td>
<td>-0.024</td>
<td>-0.051</td>
<td>-0.118</td>
</tr>
<tr>
<td>25. Personal services, and other ruta</td>
<td>0.008</td>
<td>0.017</td>
<td>0.037</td>
</tr>
<tr>
<td>Total</td>
<td>-0.0002</td>
<td>-0.0004</td>
<td>-0.006</td>
</tr>
<tr>
<td>Total *</td>
<td>0.017</td>
<td>0.035</td>
<td>0.076</td>
</tr>
</tbody>
</table>

* Revenue factor + quota rent

Reduction would lead to the provision of horticultural imports to be reduced. Reduced availability would result in horticultural needs being met as intermediate inputs by the
production sector which would also to be reduced affecting the production output in some sectors. This, in turn would drop the revenue factor in some sectors. On the other hand, the reduction of horticultural imports would effect the composite price increase which would also suppress demand. Pressure on demand would bring down production, which will also be a factor contributing to revenue decline. The simulation results showed that the reduction of horticultural imports by 5, 10 and 20 percent would result in a decrease in total real factor income amounted to 0.0002 percent, 0.0004 percent, and 0.0006 percent, which is caused by a reduction in the decline in six sectors.

The decline in revenue due to the reduction factor is offset by the emergence of import quota rents generated by the horticultural sector. If the quota rent aggregated with income factors, the reduction of horticultural imports is expected to result in a higher revenue factor. The simulation results showed that the greater the deterioration in horticultural imports, the greater the quota rent. Reduction of horticultural imports by 5, 10 and 20 percent would result in an increase in the income factor at 0.017 percent, 0.035 percent, and 0.076 percent.

### Revenue Impact on Institutions

Reduction of horticultural imports by 5, 10, and 20 percent was expected to have an impact on the increase in institutional revenue (at current values). The entire institution has increased revenue, where a high rise was experienced by household and agricultural employers of agricultural workers. The magnitude of the impact of a reduction of horticultural imports to income institutions is presented in Table 4.

<table>
<thead>
<tr>
<th>Institution</th>
<th>Import Reduction 5%</th>
<th>Import Reduction 10%</th>
<th>Import Reduction 20%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Agricultural labor households</td>
<td>0.077</td>
<td>0.159</td>
<td>0.343</td>
</tr>
<tr>
<td>2. Household agricultural entrepreneurs</td>
<td>0.104</td>
<td>0.216</td>
<td>0.463</td>
</tr>
<tr>
<td>3. Households in rural areas scored lower</td>
<td>2.12E-04</td>
<td>6.76E-04</td>
<td>0.003</td>
</tr>
<tr>
<td>4. Non household labor force in rural areas</td>
<td>2.61E-04</td>
<td>7.88E-04</td>
<td>0.003</td>
</tr>
<tr>
<td>5. Households in rural areas scored above</td>
<td>7.89E-04</td>
<td>0.002</td>
<td>0.005</td>
</tr>
<tr>
<td>6. Households in urban areas scored below</td>
<td>3.33E-04</td>
<td>8.66E-04</td>
<td>0.003</td>
</tr>
<tr>
<td>7. Non household labor force in urban</td>
<td>5.62E-04</td>
<td>0.001</td>
<td>0.004</td>
</tr>
<tr>
<td>8. Households in urban areas scored above</td>
<td>6.64E-04</td>
<td>0.002</td>
<td>0.004</td>
</tr>
<tr>
<td>Total household</td>
<td>0.003</td>
<td>0.007</td>
<td>0.017</td>
</tr>
<tr>
<td>9. Company</td>
<td>0.003</td>
<td>0.007</td>
<td>0.017</td>
</tr>
<tr>
<td>10. Government</td>
<td>5.10E-04</td>
<td>0.002</td>
<td>0.009</td>
</tr>
<tr>
<td>Williamson Index of household difference ^</td>
<td>-0.00028</td>
<td>-0.00058</td>
<td>-0.00125</td>
</tr>
</tbody>
</table>
The reduction of horticultural imports by 5, 10, and 20 percent had an impact on the institutions income rise in the same order. On reducing the horticultural imports by 5 percent, the greatest increase in incomes occurred in households and firms (0.003 percent) and government (0.0005 percent). Households classes that experienced high revenue growth were the agricultural entrepreneur (0.104 percent) and the agricultural workers (0.077 percent). Gains derived by agricultural households was quota rent. Price increases due to reduced supply of horticultural, increase the income of the farmers as horticultural producers.

The amount of quota rent earned by farmers will depend on the size of the owned endowment factor. Household agricultural employers have a larger endowment factor than the agricultural laborers so that the quota rent earned by household agricultural entrepreneurs is greater than the agricultural labor households. The simulation results showed that the reduction of horticultural imports by 5, 10 and 20 per cent would lead to an increase in household income and increased agricultural entrepreneurs respectively at 0.104 percent, 0.216 percent, and 0.463 percent. On the other hand, household incomes of agricultural workers would increase by 0.077 percent, 0.159 percent, 0.343 percent, respectively. In addition to the agricultural employers household and the agricultural workers, the increase in earned institutional income is lower than the composite price increase (see Table 1 and Table 4).

Furthermore, by using the Williamson index, the horticultural imports declined by 5 percent, the index decreased by 0.00028 compared to the baseline conditions. While the decline by 10 and 20 percent of the index value decreased by 0.00058 and 0.00125, respectively. Despite the decline in the index was not too big, it does indicate that the reduction in growing horticultural imports will affect the household income, which contribute to a widening of the distribution gap.

In this context, a policy of reducing horticultural imports is on the one hand according are to be executed when the condition is associated with the more gap of income distribution in Indonesia. Based on the Gini ratio indicators, gaps in Indonesia tend to increase, from 0.31 in 1999 to 0.37 in 2009, and continuously increased up to 0.41 in 2012 (CBS, 2013). This policy is expected to help decrease the gap through increased farm household income; a major issue for a number of poor households in Indonesia.

**Impact on Social Welfare**

Reduction of horticultural imports by 5, 10 and 20 percent was expected to impact on general social welfare. Six groups of households were impaired EV, while the two groups of households increased, agricultural laborers and employers. The magnitude of the horticultural import restriction on social welfare is presented in Table 5.

The effect of decreased imports on the welfare of society according to the sequence of results showed that it is in line with effects to institutional incomes. The increase in the value
received by the EV was high in households, agricultural employers and agricultural laborers, while other households groups decreased, with the highest decline experienced by non-agricultural households in the urban lower class. On the reduction of imports by 5 percent, households of agricultural employers increased by 336 billion rupiah and agricultural laborers increased by 93 billion rupiah, while the non-agricultural households in the urban lower classes fell by 204 billion rupiah.

<table>
<thead>
<tr>
<th>Household Type</th>
<th>Import Reduction 5%</th>
<th>Import Reduction 10%</th>
<th>Import Reduction 20%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>EV</td>
<td>%</td>
<td>EV</td>
</tr>
<tr>
<td>1. Agric. worker</td>
<td>93</td>
<td>0,06</td>
<td>191</td>
</tr>
<tr>
<td>2. Agric. Entrepreneur</td>
<td>336</td>
<td>0,05</td>
<td>674</td>
</tr>
<tr>
<td>3. Lower Rural Household</td>
<td>-78</td>
<td>-0,02</td>
<td>-165</td>
</tr>
<tr>
<td>4. Non labor, rural.</td>
<td>-25</td>
<td>-0,02</td>
<td>-52</td>
</tr>
<tr>
<td>5. High Rural Household</td>
<td>-54</td>
<td>-0,01</td>
<td>-114</td>
</tr>
<tr>
<td>6. Lower Urban</td>
<td>-204</td>
<td>-0,03</td>
<td>-431</td>
</tr>
<tr>
<td>7. Non labor, urban</td>
<td>-51</td>
<td>-0,02</td>
<td>-109</td>
</tr>
<tr>
<td>8. High Urban</td>
<td>-72</td>
<td>-0,01</td>
<td>-153</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>-55</strong></td>
<td><strong>-0,002</strong></td>
<td><strong>-158</strong></td>
</tr>
</tbody>
</table>

On the reduction of imports by 10 percent and 20 percent, the simulation showed results with the same structure. The difference lied only in the magnitude of the impact. The greater reduction in horticultural imports, the further the increase of the EV value of agricultural households, and the more the reduction of the EV for other household classes.

On the reduction of imports by 5 percent, agricultural labor households increased by 0.06 percent and agricultural entrepreneurs increased by 0.05 percent, while the non-agricultural households in the urban lower classes fell by 0.03 per cent. Households that had a relatively high increase were agricultural laborers and agricultural entrepreneurs, while the highest decrease was experienced by non-agricultural households in the urban lower class. Although agricultural entrepreneurs nominally increased higher than the agricultural laborers, but not so when viewed in relative terms. This is due to the value of household consumption of agricultural entrepreneurs in baseline conditions which seem to be more distant than the agricultural laborers.

V. CONCLUSION

Based on the results of the research, the purpose of government policies to protect consumers by applying horticultural import quotas have a trade off in various aspects. Reduction of horticultural imports by 5 percent, 10 percent and 20 percent were expected to give different
results in magnitude, but not too different in structure. The simulation results showed that the greater the impact on the reduction of horticultural imports:

- the higher composite prices rose and spread to other sectors;
- a more decrease in real factor income;
- increase in factor income (at current values), but the increase was lower than the increase in the price of the composite;
- the decline in household income distribution gap, and
- a decline of social welfare in aggregate, but improvement in the welfare of farm households.

Based on these results, horticultural import restriction policies can be referred to as equity-oriented policies (pro-equality) and not growth (pro-growth). A form of equalization that is not caused by an increase in productivity, but more due to higher revenues from the agricultural household quota rent of horticultural products.

For monetary authorities, composite goods price pressure due to import restriction policies calls for more attention. Pricing pressures brings consequences on greater effort to anticipate its effect on price stability and monetary.
REFERENCES


# Appendix 1

## Test sensitivity: Impact Reduction Imports 5, 10, and 15 Percent
EV Group Against Value of Household

<table>
<thead>
<tr>
<th>No</th>
<th>Household Group</th>
<th>Import Reduction of 5%</th>
<th></th>
<th>Import Reduction of 10%</th>
<th></th>
<th>Import Reduction of 15%</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>40% lower</td>
<td>Base line</td>
<td>40% higher</td>
<td>40% lower</td>
<td>Base line</td>
<td>40% higher</td>
</tr>
<tr>
<td>1</td>
<td>Lower classes in urban</td>
<td>-343.39</td>
<td>-203.82</td>
<td>-143.08</td>
<td>-748.75</td>
<td>-430.69</td>
<td>-297.83</td>
</tr>
<tr>
<td>2</td>
<td>Lower classes in rural</td>
<td>-132.20</td>
<td>-78.32</td>
<td>-54.89</td>
<td>-287.40</td>
<td>-165.14</td>
<td>-114.05</td>
</tr>
<tr>
<td>3</td>
<td>Urban elite</td>
<td>-128.33</td>
<td>-71.92</td>
<td>-47.50</td>
<td>-281.24</td>
<td>-152.66</td>
<td>-99.33</td>
</tr>
<tr>
<td>4</td>
<td>Rural elite</td>
<td>-91.84</td>
<td>-53.76</td>
<td>-37.22</td>
<td>-200.58</td>
<td>-113.75</td>
<td>-77.56</td>
</tr>
<tr>
<td>5</td>
<td>Labor force in urban</td>
<td>-87.05</td>
<td>-51.43</td>
<td>-35.95</td>
<td>-189.90</td>
<td>-108.73</td>
<td>-74.85</td>
</tr>
<tr>
<td>6</td>
<td>Labor force in rural areas</td>
<td>-41.66</td>
<td>-24.74</td>
<td>-17.38</td>
<td>-90.54</td>
<td>-52.14</td>
<td>-36.09</td>
</tr>
<tr>
<td>7</td>
<td>Agricultural laborers</td>
<td>154.43</td>
<td>93.18</td>
<td>66.50</td>
<td>327.27</td>
<td>190.72</td>
<td>133.86</td>
</tr>
<tr>
<td>8</td>
<td>Agricultural entrepreneurs</td>
<td>549.01</td>
<td>335.55</td>
<td>242.58</td>
<td>1142.63</td>
<td>674.25</td>
<td>479.47</td>
</tr>
</tbody>
</table>
THE DYNAMICS OF INDONESIAN INFLATION: WHAT CAN WE LEARN FROM INFLATION DISAGGREGATION?

IGP Wira Kusuma¹

Abstract

This paper employs disaggregated data of inflation combined with Factor Augmented Vector Auto Regression (FAVAR) to explore the price behaviour in Indonesia. The main finding of this analysis is that price behaviour in Indonesia exhibits heterogeneity. It is evident not only in terms of the magnitude, but also in the direction and the speed of adjustment to the new equilibrium in response to interest rate shock. Price volatility is mainly related to sector specific shocks instead of macroeconomic shocks. Another finding is, the price puzzle weakens once ITF is adopted.

Keywords: price disaggregation, inflation, FAVAR, price puzzle.

JEL classification: C32, E31, E52

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I. INTRODUCTION

The fundamental question about the extent of price stickiness is one of the central debates in the extensive macroeconomic literature, in which it is agreed that monetary policy changes have transitory effects on the volume of goods and services because of price stickiness. The magnitude and the persistence of the effects vary and depend on the degree of price stickiness. The literature in general uses aggregate data for prices. It finds that aggregate prices do not respond to an unanticipated monetary policy shock immediately, but with some lags.

The conclusions derived from analysis using aggregated and disaggregated prices may be different. For instance, Christiano, Eichenbaum and Evans (1999) recorded, that with various identification in their VAR model, the aggregate price does not respond substantially after an un-anticipated monetary policy shock or monetary contraction, and then starts declining for approximately 18 months. As more detailed price data becomes available, the research that explores these micro data has been growing substantially.

Some support the previous findings; others find contrary results. Bils and Klenow (2004), who examine 350 categories of goods and services, find that prices in the US are much more volatile. Bunn and Ellis (2012), who examine price behavior in the UK using micro data, conclude that the frequency of price changes is not fixed over time. Golosov and Lucas (2007) also use micro data from Bils and Klenow (2004) to calibrate their menu cost model. They again find that prices are more flexible. Using disaggregated data on price indices, Boivin, Giannoni and Mihov (2009) are able to explain why the impulse responses of aggregated and disaggregated prices are different. They conclude that one should distinguish the source of the shocks. The rigidity found at the aggregated level is influenced by macroeconomic shocks, while the flexibility found in the disaggregated level is related to sector specific shocks.

These different explanations imply that it is desirable to use a more detailed data set. A richer and a more thorough analysis should be conducted to provide more accurate policy recommendations. This paper use disaggregated level data to answer the following 3 (three) fundamental questions, first, what is the extent of price flexibility in Indonesia? second, what is the response of inflation at an aggregated and disaggregated level to monetary policy shocks?; and third, what policy implications can be derived from this analysis?

Given the above research questions, the contribution of this paper should be of greatest value for policy makers, as the empirical findings could help to guide them when setting their monetary policy. Moreover, this is the first analysis to use disaggregated Indonesian price data using FAVAR. In terms of the methodology, some modifications and combinations of data also contribute new insights to the literature.

The following section explains the theory and literature studies. Section three discuss the methodology and the data. The empirical findings are presented in section four, while section five provides conclusion and policy implications.
II. THEORY

The fundamental question about the extent of price stickiness is one of the central debates in the extensive macroeconomic literature, in which it is agreed that monetary policy changes have transitory effects on the volume of goods and services because of price stickiness. The magnitude and the persistence of the effects vary and depend on the degree of price stickiness. The literature in general uses aggregate data for prices. It finds that aggregate prices do not respond substantially to an unanticipated monetary policy shock immediately, but with some lags. As more detailed price data becomes available, the research that explores these micro data has been growing substantially. Some support the previous findings; others find contrary results. In this section, we review some of the relevant literature.

We start with Bils and Klenow (2004), henceforth BK, who examine price behaviour in the US. They focus on whether prices are more flexible or rigid. The paper uses unpublished data from the Bureau of Labor Statistics (BLS) covering the period 1995-1997 and divides them into 350 categories of goods and services. The data represent around 70 percent of consumer expenditure. To measure the price changes, they use a simple average of the monthly frequencies of price changes in 1995, 1996 and 1997 of each item. Their research finds that the prices of both durable and nondurable goods change more than the prices of services. Among the seven subgroups of CPI, the most flexible one is transportation. On the other hand, the most inflexible is the price of medical and entertainment subgroups. At the same time, they observe the inflation volatility and persistence of 123 goods by employing an AR (1) process. BK find that many more goods and services witness prices changes and move frequently than in previous studies.

Bils and Klenow (2004) treat sales prices as price changes. As a result, across the whole consumer price index they find the median duration of price changes is around four months. On the other hand, Nakamura and Steinson (2008) find that the median duration is around nine months if sales are excluded. This difference raises the question on how great the effect of monetary policy should be on real variables, since this effect depends on price stickiness. Meanwhile, price stickiness depends on the treatment of sales. Guimaraes and Sheedy (2011) build a DSGE model with sales to examine whether monetary policy matters when normal prices are relatively sticky amid frequent price changes due to sales. Their initial model has two household types: loyal customers who have low price elasticity and bargain hunters who are very sensitive to price changes. They compare the results with a standard sticky price model without sales. In general, the real effects of monetary policy in both models are similar. The cumulative response of output in the model with sales is around 89 percent of that of the standard model. To accommodate the fact that sales are frequent in one sector and very rare in another, they also develop their model with two sectors: one sector features sales, while the other features standard pricing without sales. Again, the results are similar in comparison to the standard model. They conclude that sales do not matter for the analysis of the effect of monetary policy.
Golosov and Lucas (2007) support the view that prices are more flexible in facing shocks. They construct a menu cost model and use micro data for calibration purposes. The data are the same as in BK (2004), covering seventy percent of the US CPI. The calibration is based on some moments of these micro data. Their model incorporates aggregate inflation shocks as well as idiosyncratic productivity shocks. The introduction of the idiosyncratic shocks mimics the frequency of price changes in the data, which cannot be explained by the aggregate shocks only. Their model predicts that the impulse responses of output, employment and prices are short-lived when facing these two shocks, that they are less persistent. Regarding prices, a positive aggregate shock that leads to a higher price will adjust the boundary of the firms that want to reset their prices. This asymmetric feature changes the number of firms that reset their prices; more firms want to increase their prices after the positive aggregate shocks. As a result, the aggregate price will increase, and this happens very quickly. On the other hand, the same shocks in the Calvo model do not generate similar impulse responses. The explanation is that the number of firms that want to change their prices is fixed, regardless of different conditions. As a result, the aggregate prices will not change as much as in the menu cost model.

As regards a suitable model to explain price behaviour, Bunn and Ellis (2012) examine this behaviour in the UK. In particular, they investigate the frequency of price changes, using two sources of data, to examine whether a time dependent or a state dependent model can better explain price behaviour. The first data set is monthly prices quoted to construct CPI and the Retail Price Index (RPI). The second type of data is weekly supermarket data. To observe whether the frequency of price changes is fixed over time, as implied by a time dependent model, they calculate the magnitude of changes with different samples of their micro data. They find that the strict time dependent model is inconsistent with the data, as the frequency of price changes varies over time. However, from the magnitude of price changes they also suggest that a single state dependent model, whether a menu cost model or a quadratic cost model such as that of Rothemberg (1982), may be unable to explain the price setting behaviour of most firms. Bunn and Ellis further construct hazard functions that are calculated from the ratio of share of price changes observed in the current period to share of price that has not changed in the previous period. If this function is flat, this implies consistency with the prediction of the time dependent models; if not, with those of state dependent models. Their hazard functions exhibit heterogeneity. For instance, the hazard function of goods prices is downward sloping, while that of service prices is relatively flat. In short, they conclude that the price setting behaviour is heterogeneous, so as a result no single existing price setting model can perfectly capture price behaviour at an economy-wide level.

Another paper that supports price stickiness is that of Boivin, Giannoni and Mihov (2009), hereafter BGM, who conduct their research on US consumer and producer price data. The data set used in this research is a balanced panel of 653 monthly series, including prices, for the period from 1976M1 to 2005M6. To examine the disaggregated prices, they employ the Factor Augmented Vector Auto Regressive (FAVAR) technique. This methodology is an extension of
the VAR model, based on the work of Bernanke, Boivin and Eliasz (2005), hereafter BBE. With this technique, they disentangle the effect of a common component from an idiosyncratic component of the respective prices. The indicator data used to construct the latent factors in their FAVAR are the same as in BBE. However, for prices, BGM use disaggregated ones instead solely aggregated prices. Another difference is that BGM only use a two-step FAVAR.\footnote{In Bernanke, Boivin and Eliasz (2005) two FAVAR models are employed: one step, which uses a Bayesian technique, and two step, which uses a principal component to generate the factors.}

They document that the volatility of aggregated prices measured by its standard deviation is related to the common component. The result is dramatically different when it comes to disaggregated prices. On average, most of the volatility in disaggregated prices is related to the idiosyncratic component. Overall, the disaggregated prices are more volatile than the aggregated prices and are less persistent. There is therefore a negative correlation between volatility and persistence, a finding which conflicts with what BK found.

BGM measure the persistence of common and idiosyncratic components of the prices using an AR model. They conclude that the persistence is highly varied across individual prices and mostly due to persistence in the common component. Meanwhile, the specific sectors display almost no persistence.

BGM also documents the response of the sectoral price level to a shock, specifically its own sector-specific shock, aggregate macroeconomic shock and monetary shock. The prices show different responses given different shocks. By and large, aggregate macroeconomic shocks have a significant and permanent influence on prices. Meanwhile, sector specific shocks only affect prices once and for all.

To analyse the effect of monetary policy shock, BGM apply an identification in their FAVAR system. They assume that the unobserved components or the latent factors do not respond contemporaneously to the change in the Fed Fund rate. The result shows the persistence of inflation across sectors. The prices tend to decline steadily for a couple of years following the monetary policy shock. Interestingly, the price puzzle that usually occurs in a VAR model disappears in this FAVAR model.

BGM can disentangle the source of a shock, whether it is macroeconomic, including monetary policy shocks, or sector specific shocks. The disaggregated prices respond sluggishly to the former shock; on the other hand, they tend to be flexible in response to the latter. This research therefore provides evidence for the fact that the volatility apparent in disaggregated prices as shown in BK is mostly related to a sector specific shock. It is not because of macroeconomic shocks, especially a monetary policy one.

Mumtaz, Zabczyk and Ellis (2009), hereafter MZE, follow the ideas of BGM and apply them to UK data. MZE use disaggregated consumer expenditure data and sixty sets of macroeconomic UK series data between 1977Q1 and 2006Q3. Technically, they enhance the
way of constructing the factors in FAVAR. In their baseline model, they construct them using all the data and without separating them into particular blocks. In their alternative model, they separate the data into certain blocks: real activity, inflation, money and asset prices. In order to do this, they apply sign restrictions using Bayesian estimation. For the benchmark, they also estimate a standard five-variable VAR with CPI inflation, GDP growth, M4 growth, the UK sterling exchange rate index (ERI) and Bank Rate. Their baseline model consists of eight factors and uses Cholesky decomposition. Using this model, they find, in contrast to the BGM results, that the price puzzle still exists: the mean of CPI increases after a monetary contraction. The delay in the reaction of median inflation is almost two years. This is also different from the structural model of the UK, which shows a one to two year lag. Based on this, they check the robustness of the result using sign restriction in their FAVAR model. With this technique, the price puzzle disappears. Other than that, their findings are similar to those of BGM. The volatility for most disaggregated prices is mainly influenced by sector-specific shocks, rather than macroeconomic ones. Their findings also suggest that there is no relationship between persistence in the aggregate consumption deflator and the average persistence of the related component disaggregated deflator. Persistence in either aggregate or disaggregated prices is less influenced by sector-specific factors. In other words, the persistence in prices is mainly due to macroeconomic shocks, such as activity or policy changes.

III. METHODOLOGY

3.1. Estimation Technique

There are many methodologies for evaluating inflation at an aggregate level. Meanwhile, evaluation of inflation data at a disaggregated level requires a specific methodology. We employ a Factor Augmented Vector Autoregressive model, henceforth FAVAR, for various reasons. One main advantage is that FAVAR allows us to include many variables without worrying about the curse of dimensionality.

FAVAR models are Vector Autoregressive (VAR) ones that are augmented (A) by latent dynamic factor (F) variables. Dynamic factor models are used when macro-econometricians face a degrees of freedom problem because the number of series exceeds the number of observations. The premise of dynamic factor models is that a large number of series can be represented by a few latent factors and idiosyncratic disturbances. These latent factors represent co-movement of the series and follow time series processes, usually VAR processes. Meanwhile, idiosyncratic disturbances are any factor that is specific to a single series. This also includes measurement errors of the series. Mathematically, a dynamic factor model is represented as follows:

3 Cholesky decomposition is a restriction to identify a VAR system. This restriction decomposes the residual in a triangular fashion that determines which shock affects another contemporaneously (Enders, 2004).
\[ X_t = \lambda(L)F_t + e_t \]  \hspace{1cm} (1)

\[ F_t = \Psi(L)F_{t-1} + \eta_t \]  \hspace{1cm} (2)

\( X_t \) is the vector of the \( N \) series and \( e_t \) are the idiosyncratic disturbances, so both are \( N \times 1 \). There are \( K \) latent factors \( f_t \), so that \( f_t \) and \( \eta_t \) are \( K \times 1 \). As a result, \( \lambda(L) \) and \( \psi(L) \) are \( N \times K \) and \( K \times K \) respectively. The \( i \)th lag polynomial \( \lambda_i(L) \) is the dynamic factor loading of the \( i \)th series \( X_{it} \). The common component of the \( i \)th series \( X_{it} \) is \( \lambda_i(L)f_t \). The processes in equations (1) and (2) are assumed to be stationary. The idiosyncratic disturbance \( e_t \) and the factor innovation \( \eta_t \) are also assumed to be uncorrelated at all leads and lags, so that \( E(e_t \eta_{t-1}^t) = 0 \) for all \( j \), positive or negative.

The main issue in this framework is how to estimate the factors. According to Stock and Watson (2010), there are three generations of factor models. The first generation approach deals with the low dimension of series. It uses Maximum Likelihood and Kalman filter to generate the factors. These estimate optimal factors under the model, and with the assumed parameters. However, this entails nonlinear optimization, which restricts the number of parameters, and hence the number of series. The second generation approach deals with a large number of series and uses a non-parametric averaging method such as principal components and related methods. The third generation approach combines the consistent non-parametric estimation in the second generation with the first generation approach. It employs Bayesian methods to solve the dimensionality problem faced by the first generation approach.

This paper uses principal component analysis to estimate the factors, as adopted in BGM. Principal component analysis estimates the factors by identifying the patterns of a large number of series and expressing them based on their similarities. The factors generated summarize all the series, while capturing most of their variation. Once one has estimated the latent factors, one can use these for forecasting, using them as instrumental variables, or estimate a FAVAR model.

The FAVAR model was initially proposed by BBE (2005). This model follows a VAR model and uses observable variables and factors as variables in the VAR. The augmented term refers to the factors that are included in the VAR system. BBE (2005) apply two approaches in estimating their FAVAR: one step, which employs Bayesian techniques; and two steps, which uses principal component analysis to estimate the factors.

BBE (2005) use FAVAR to measure the effects of monetary policy, instead of the VAR that is commonly used to measure this effect. BBE (2005) note that there are three disadvantages of VAR models. First, a VAR model may not include all the variables used by the central banks or private sector. Due to the problem of degrees of freedom, a VAR model usually only employs a few variables. On the contrary, central banks or private agents usually watch a large number of indicators. As a result of the use of only a few variables, a shock to a policy variable can
be contaminated. For instance, policy tightening is not purely an exogenous shock. It is partly because of anticipation of inflation pressure in the future that is not controlled for in a VAR model. This creates what is widely known as a price puzzle; monetary contraction is followed not by declining prices but rising ones (Sims, 1992). Second, a VAR model typically uses variables that are observable with some degree of error or that can only be approximated. For instance, real economic activity may be not precisely captured by observable variables such as production indices or real GDP. It is also justified by some assumptions such as measurement error, real time data and revisions. This is even true for variables such as CPI and GDP. Given this, we need an approach to capture these unobservable variables in a more comprehensive and precise way. The third caveat of VAR is that it can only generate a limited number of impulse responses of the variables, as only a few variables are included. Meanwhile, policy makers usually want to see the impulse response of many variables so that their decisions can be more comprehensive.

BBE (2005) propose FAVAR to address these drawbacks. By employing a few factors that can summarize a large number of series, it can address the degree of freedom problem. These factors also solve the non-observable problem by using many variables that approximate the unobservable ones. The third problem is also answered; by employing many variables, impulse responses of many variables are provided to the policy makers. A FAVAR model can be formulated as follows:

$$\begin{bmatrix} F_t \\ Y_t \end{bmatrix} = \Phi(L) \begin{bmatrix} F_{t-1} \\ Y_{t-1} \end{bmatrix} + \nu_t$$

where $F_t$ is the $K \times 1$ vector of unobservable factors and $Y_t$ is the $M \times 1$ vector of observable variables. The error term $\nu_t$ is i.i.d. with mean zero. Equation (3) is a reduced form of a VAR equation with $\Phi(L)$ as the lag polynomial. A FAVAR model refers to this equation. It nests a standard VAR but is augmented with additional information contained in the factors. If the true system is a FAVAR but we estimate a standard VAR, which is equation (3) consisting of $Y_t$ only, we end up with spurious estimators.

However, we cannot solve equation (3) directly without knowing the unobservable factors. We need to generate them. As already mentioned, the factors are the summaries of a large number of series. Hence, we can generate the factors from those series. Suppose we have a vector of informational variables $X_t$, $N \times 1$, where $N$ is the number of series included. The relationship between the series $(X_t)$, the factors $(F_t)$, and the observable variables can be formulated as follows:

$$X_t = \Lambda \begin{bmatrix} F_t \\ Y_t \end{bmatrix} + e_t$$
where \( \Lambda \) is the \( N \times (K + 1) \) matrix of the loading factors. The first part of the right hand side of this equation is the common component of the series and the last part \( (e_t) \) is the \( N \times 1 \) matrix of the idiosyncratic component. The series of common components are uncorrelated with those of idiosyncratic components. Equation (4) allows us to extract the factors, given the indicator series and the observable variables. The general term of equation (4) may involve the lags of the factors, as in equation (2) of the dynamic factor model.

The shocks imposed on these two components are macroeconomic shocks and sector specific shocks respectively. By definition, a sector specific shock refers to a shock that is only imposed on one series. For example, a shock to a certain world commodity price might only influence a certain domestic commodity price. At least it should not influence other domestic commodity prices directly or significantly. Meanwhile, a macroeconomic shock could influence all prices, hence it is called a common shock. A shock to a macroeconomic variable such as the exchange rate or a policy change could influence the movement of all individual prices.

As in BGM, we shall focus on the behavior of disaggregated prices. Hence we shall involve disaggregated price series in \( X_t \). In addition to this, we are interested in the effect of monetary policy shock on the disaggregated price series. For that, we replace \( Y_t \) with the interest rate \( (R_t) \) as the observable variable. We follow a two-step approach, as in BGM. First, we extract the series using principal component analysis to obtain the latent or common factors \( F_t \). In the second step, we add policy rate \( R_t \) and estimate the system VAR as in equation (3). We follow recursive identification with the order \([F_t, R_t]\); with this identification the interest rate \( R_t \) is influenced contemporaneously by the common factors \( F_t \). Meanwhile, the common factors react to the interest rate with a lag. We can interpret the last equation of the VAR as a contemporaneous interest rate rule.

We follow Bai and Ng’s (2002) information criteria to determine how many factors are properly included. This method is suitable for a large number of series and observations. This method also allows for both limited time series and cross-section dependence, and for heteroskedasticity in the time series and cross section in the idiosyncratic component. For the lags, we employ information criteria commonly used to estimate a VAR model.

3.2. Data

The data employed in some research consist of data for individual prices that are collected and used to calculate CPI; these are called micro data. We do not employ these micro data, but follow BGM, who use disaggregated of CPI. We use monthly data from 2002 to 2011, which are based on the 2007 cost of living survey. We back cast the 2007 data to the 2002 base year, based on month-to-month growth of the data of the 2002 base. Given the two cost of living surveys (2002 and 2007) during the period of estimation, we do not use all the disaggregated prices, but all price data in the 2007 base that are also present in the 2002 base. Unlike BGM,
we group the series into the CPI that includes all individual, core and non-core prices. These generate monthly headline inflation, core inflation and non-core inflation respectively. The reason for this is that we can identify the impulse responses of these groups. In particular, we can observe the impulse responses of core inflation in facing monetary policy shocks. By definition, core inflation is influenced more by fundamental factors such as monetary policy. Overall, the disaggregated prices included cover around 96 percent of the components of the CPI, comprising 63.6 percent of core prices and 32.4 percent of non-core prices.

In addition to disaggregated prices we also use certain indicators to construct the factors. These indicators include demand factors such as sales data; production factors such as the production index; exports and imports; monetary data; world commodity prices; interest rates and exchange rates. Some data are interpolated if the available data are quarterly. These include real GDP and its components. We include this combination of disaggregated CPI and indicators to construct the latent factors using Principal Component Analysis in the spirit of equation (5.8). In total we use data on 663 individual prices and 92 indicators, with 118 observations within the period 2002M3 to 2011M12. For comparison, BGM use 111 indicators, 154 PPI series, 194 PCE deflator series and 194 PCE deflator quantities; in total 653 series, with 353 observations for each one.

We seasonally adjust the data for the individual prices and transform many of them. The transformations include the difference of the logarithms of the variables and first differences. Some of the data are not transformed.

**IV. RESULT AND ANALYSIS**

We run the estimations using the MatLab code created by BGM with some modifications to permit consistency with our case. For the information criteria in Bai and Ng (2002) we use the MatLab code created by Schumacher and Breitung (2008). Bai and Ng’s (2002) criteria shows if we only include price data, the factor are only one. If we only include the indicators, we obtain four factors to represent them. However, if we include both the price data and the indicator data we obtain one factor. Our guess is that this is because of the domination of price data. We have data on 663 prices and 92 indicators. This domination is also evident when we estimate only certain groups of prices. If we only use one factor, that factor may represent the prices closely, but may display no link with other indicators. Based on this, we have chosen five factors. As a result, in the system of equations (5.7) and (5.8) we have five factors and one observable variable.

The Likelihood Ratio test (LR), the Final Prediction Error test (FPE) and the Akaike Information Criterion (AIC) point to 4 lags. The Schwarz Criterion (SC) and Hannan-Quin (HQ) show 2 lags. We choose 4 lags based on the result of these five criteria. Moreover, with 4 lags we can capture the dynamics between quarters. However, we also estimate the model using a
different number of factors for the sake of robustness. We try 4, 6 and 8 factors with four lags. For the lags, we also try 2 lags with five factors; the results are not significantly different. We do not try one lag since no information criteria justify the use of only one in this estimation.

Given the formulation of equation (5), we can analyze inflation behavior at a disaggregated level. Equation (5) implies:

\[ \pi_{it} = \lambda_i'C_t + e_{it} \]  

This equation states that inflation (\( \pi_{it} \)) can be explained by its common component (\( \lambda_i'C_t \)) and its sector specific component (\( e_{it} \)). FAVAR allows us to separate these two components of inflation and analyze their behavior.

### 4.1. Volatility and the Persistence of Inflation

First, we compare the statistics of aggregate and disaggregated inflation in terms of volatility and persistence. These two statistics are fundamental in assessing price behavior, in particular as to whether prices are more rigid or more flexible and how they respond to shocks. This behavior is important for the monetary policy aspect; in particular, it can give illuminate the role of monetary policy in inflation.

Table 1 summarizes these two statistics. Using standard deviation as a proxy of volatility, we find that the volatility of disaggregated inflation is higher than that of aggregate inflation. The standard deviation of CPI inflation is 0.791, while that of disaggregated CPI inflation is 2.453 on average. This can be explained by the fact that sector specific volatilities tend to cancel each other out, so the volatilities in aggregate inflation decline. The main factor in inflation volatility is the volatility of the sector specifics. This is a fact in both aggregate and disaggregated inflation. \( R^2 \) statistics, which measure the ratio of variance of the common component to that of inflation, show that the common components only explain less than 50 percent of the volatility of inflation. If we compare the \( R^2 \) statistics for core and non-core inflation, they are higher for core inflation. This implies that the common component plays a greater role in core inflation than in non-core inflation volatility. In other words, the shocks to macroeconomic variables play a more important role in core inflation volatility than non-core inflation volatility.

Table 1 also shows heterogeneity in terms of volatility across the inflation sector. The range is from 0.003 to 25.809 percent, with an average of 2.453 percent. If we examine the group of core and non-core inflation, the volatility is higher in non-core inflation, as expected. This relates to the inflation rate for food, transportation and cigarettes (which are among the administered prices). Increased excise on cigarettes and reductions in fuel subsidy in the period of investigation are the causes.
The strong relationship between the volatility of inflation and its sector specific volatilities are also exhibited in table 2. The correlation between standard deviation of inflation and its sector specific is almost one. This happens to CPI and core and non-core inflation, as shown in Table 3 and Table 4.

Sector specific volatility can be interpreted in two ways. First, it is a reflection of structural disturbances. Second, sector specific volatility could also be interpreted as measurement or sampling error in each price sector. To clean up the individual price from this error is difficult. However, the empirical framework adopted here is suitable for this condition, as mentioned in BGM (p.358): “It is important to note, though, that the empirical framework adopted here is

| Table 1 |
|-----------------|-----------------|-----------------|-----------------|-----------------|
| | Volatility and Persistence of Monthly Inflation Series | | |
| | Standard Deviation (in percent) | Persistence | |
| | Inflation | Common Components | Sector Specifics | R^2 | Inflation | Common Components | Sector Specifics |
| **Aggregated CPI** | | | |
| CPI | 0.791 | 0.251 | 0.750 | 0.101 | 0.234 | 0.855 | 0.134 |
| Core | 0.308 | 0.137 | 0.276 | 0.198 | 0.358 | 0.833 | 0.567 |
| Vol. Food | 1.345 | 0.481 | 1.256 | 0.128 | 0.196 | 0.728 | 0.906 |
| Adm. Prices | 2.421 | 0.674 | 2.325 | 0.078 | 0.085 | 0.951 | 0.893 |
| **Disaggregated CPI** | | | |
| - Average | 2.453 | 0.837 | 2.256 | 0.202 | 0.003 | 0.430 | -0.119 |
| - Median | 1.260 | 0.529 | 1.100 | 0.153 | 0.034 | 0.508 | -0.095 |
| - Minimum | 0.003 | 0.000 | 0.003 | 0.008 | -2.192 | -1.043 | -1.590 |
| - Maximum | 25.809 | 6.914 | 24.991 | 0.866 | 0.853 | 0.897 | 0.724 |
| - Standard deviation | 2.967 | 0.894 | 2.869 | 0.167 | 0.396 | 0.345 | 0.338 |
| **Disaggregated-Core** | | | |
| - Average | 1.271 | 0.511 | 1.132 | 0.231 | 0.114 | 0.459 | -0.038 |
| - Median | 0.814 | 0.364 | 0.692 | 0.195 | 0.120 | 0.541 | -0.019 |
| - Minimum | 0.053 | 0.030 | 0.044 | 0.008 | -1.291 | -0.870 | -0.970 |
| - Maximum | 7.489 | 3.315 | 7.446 | 0.866 | 0.770 | 0.897 | 0.642 |
| - Standard deviation | 1.244 | 0.455 | 1.188 | 1.188 | 0.308 | 0.341 | 0.284 |
| **Disaggregated-Non Core** | | | |
| - Average | 4.309 | 1.347 | 4.020 | 0.155 | -0.171 | 0.384 | -0.247 |
| - Median | 3.226 | 1.109 | 2.968 | 0.094 | -0.101 | 0.437 | -0.230 |
| - Minimum | 0.003 | 0.000 | 0.003 | 0.008 | -2.192 | -1.043 | -1.590 |
| - Maximum | 25.809 | 6.914 | 24.991 | 0.832 | 0.853 | 0.862 | 0.724 |
| - Standard deviation | 3.819 | 1.142 | 3.725 | 0.158 | 0.453 | 0.347 | 0.375 |
particularly well suited to characterize the effects of aggregate disturbances on disaggregated price series in the presence of measurement error, to the extent that such errors are series specific. In this case, measurement error does generally not distort the estimates of the common components and the estimated effects of aggregate disturbances, even in the extreme situation in which the sector specific components of inflation are entirely driven by measurement error”.

We regress the volatility of the idiosyncratic component on that of the common component, and find a positive and robust relationship between the two. The gradient is 2.945, significant at one percent level. The $R^2$ is also high at 0.71, implying a high goodness of fit. This relationship implies that the sector specific volatility is influenced strongly by the common components that reflect the structural disturbances. Had the volatility of sector specific been mostly influenced by measurement errors, it would have been difficult to find this strong relationship.

![Figure 1. Volatility of the Common Component and Idiosyncratic Component](image)

We also compute the inflation persistence using an AR model as in BGM as follows.

$$w_t = \rho(L)w_{t-1} + \epsilon_t \quad (6)$$

where $w_t$ refers to the individual price series, their common component and their specific component. We use 4 lags to be in line with the lags chosen by the information criteria in FAVAR. The degree of persistence is measured here by the sum of the coefficients of all lags. Table 1 show that the inflation persistence of aggregate inflation is higher than for disaggregated inflation. This implies that aggregate inflation is more rigid than disaggregated inflation. At the aggregate level, core inflation is more persistent than non-core inflation, at 0.358 compared to 0.196 and 0.085 respectively. Meanwhile, at a disaggregated level, on average inflation shows almost no persistence.
According to the Calvo models, price stickiness implies a negative relationship between volatility and persistence. This model predicts if the prices are less volatile or stickier, they are less responsive to exogenous shocks. As a result, they become more persistent. Tables 2, 3, and 4 show the coefficients of correlation between inflation persistence and the standard deviation (as a proxy of volatility of inflation). We find the coefficient is negative for CPI, core, and non-core inflation, as predicted by Calvo models. Even for CPI and non-core inflation, the coefficient correlation is strongly negative: -0.558 and -0.538 respectively. Meanwhile, it is -0.372 for core inflation. This finding is in line with the findings of BGM and does not support the findings of BK.

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Coefficient Correlation for the Volatility and Persistence of CPI Inflation</th>
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<tr>
<td><strong>CPI</strong></td>
<td><strong>Standard Deviation</strong></td>
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<tr>
<td></td>
<td>Inflation</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>Inflation</td>
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<td></td>
<td>Common component</td>
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<td>Sector specific</td>
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<tr>
<td>Persistence</td>
<td>Inflation</td>
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<td></td>
<td>Common component</td>
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</tbody>
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According to the Calvo models, price stickiness implies a negative relationship between volatility and persistence. This model predicts that if prices are less volatile or stickier, they are less responsive to exogenous shocks. As a result, they become more persistent. Tables 2, 3 and 4 show the coefficients of correlation between inflation persistence and the standard deviation (as a proxy of volatility of inflation). We find that the coefficient is negative for CPI and core and non-core inflation, as predicted by the Calvo models. Even for CPI and non-core inflation,
the coefficient correlation is strongly negative: -0.558 and -0.538 respectively. Meanwhile, it is -0.372 for core inflation. This finding is in line with the findings of BGM and does not support the findings of BK.

If we examine common components and sector specifics, there is also a negative relationship between volatility and persistence. The strength of the relationship is higher for CPI and non-core inflation. If we compare common component and sector specifics, the coefficient correlation is more negative for the latter. This is in contrast to what BGM find based on the US data. They find that the negative correlation is stronger for the common component. Based on their findings, BGM argue that this makes the Calvo models more successful in describing volatility and persistence inflation in response to macroeconomic shocks rather than sector specific shocks. Meanwhile, in our case, the Calvo models seem suitable for explaining the volatility and inflation persistence in response to sector specific shocks. Further research is needed to address this issue.

### 4.2. Impulse Responses of Prices to Macroeconomic and Sector Specific Shocks

We construct an AR model of the two components of inflation: the common component () and the sector specific component (). We use 4 lags in order to be consistent with the lags of the FAVAR framework in this exercise. We impose shocks of minus one standard deviation, and observe the impulse responses of disaggregated prices in terms of their common and sector specific components. We interpret these as the impulse responses of disaggregated prices to the macroeconomic and idiosyncratic shocks.
Figure 2 shows the impulse responses of prices (in percent) to macroeconomic shocks, measured by a minus one standard deviation shock to its common component. The figures consist of three panels: the first panel shows the responses of all disaggregated prices, the second panel the responses of disaggregated core prices and the third panel the responses of disaggregated non-core prices. The red curves are the impulse responses of disaggregated prices and the solid black curve is the average of the impulse responses. Here, the weight of each price is equal, and is not based on the actual expenditure weights.

The panels show the heterogeneity of price behavior, given a macroeconomic shock. The magnitudes and the periods of responses are different across prices. The average impulse responses show that most of the prices fall moderately in the first few months and continue to fall slowly until they reach their new equilibrium. The speeds of adjustment also exhibit heterogeneity. Some prices reach their new equilibrium in less than 12 months, while others need more than 12 months to reach this. Comparing the core and non-core prices, the core ones are less responsive than the non-core. On average, the magnitudes of the impulse responses of core prices are less than those of non-core prices. The speed of adjustment of non-core prices is also more heterogeneous.

Figure 3 shows the impulse responses of disaggregated prices (in percent) to sector specific shocks. Unlike the previous figure, this figure shows the immediate responses of disaggregated prices to the sector specific shocks, with prices falling immediately to their new equilibrium in the first few months after the shocks. The impulse responses also exhibit heterogeneity among the prices. Some prices deviate by less than five percent, while others deviate more than five percent from their initial level. As in the previous figure, the non-core prices are also more responsive. The magnitude of their impulse responses to sector specific shocks is on average higher than that for the core prices.
A comparison between figures 2 and 3 illuminates the difference in the speed of adjustment of prices to different types of shocks, with this speed reflecting how flexible the prices are. Both macroeconomic and sector specific shocks affect disaggregated prices immediately. On average, disaggregated prices are more flexible in the face of sector specific shocks, as the new equilibrium of prices is reached immediately. The magnitudes of impulse responses are also greater. In contrast, disaggregated prices respond more sluggishly to macroeconomic shocks, still responding gradually after the macroeconomic shocks for several periods until approaching their new equilibria. The differences show that the source of shocks matters.

This finding is also found in BGM. Prices in the US are sluggish in response to macroeconomic disturbances. The difference from the Indonesia data is that there are a greater number of prices that are more flexible to macroeconomic disturbances. Figure 1 shows that the disaggregated prices fall immediately in the first few months. After that, the prices are sluggish as the impulse responses move slowly. In general, prices in Indonesia are more flexible than in the US in response to macroeconomic shocks. One possible explanation for this is that Indonesia as a small open economy is more exposed to fluctuations in the world economy than the US. The trade ratio of Indonesia, measured by the sum of exports and imports to GDP, is higher than for the US in the period of estimation. Its exchange rate also fluctuates following the dynamics of the world economy. Meanwhile, since January 1985, the nominal effective exchange rate of the USD has displayed low volatility. The higher volatility of the rupiah, a macroeconomic variable, may be reflected in prices that are also more flexible, given the exchange rate pass through to prices.
4.3. Impulse Responses of Prices to Policy Rate Shocks

In the previous sections, we have compared the volatility and persistence of disaggregated prices and evaluated the impulse responses of disaggregated prices to sector specific and macroeconomic shocks. Macroeconomic shocks represent disturbances that happen to a group of macroeconomic variables. These involve a shock to a macroeconomic variable such as the exchange rate or interest rate. Hence the impulse responses generated are not caused by a specific shock such as a change in the policy interest rate. We cannot disentangle macroeconomic shocks into a set of specific shocks.

Here, we need to know the behavior of prices given a specific shock, in particular monetary policy shocks, to observe the role of monetary policy. In order to do this, we impose a shock on the observable variable \( R_t \) in equations (3) and (4). We use policy rate as a proxy for monetary policy and identify the monetary policy shock by assuming that policy rates respond contemporaneously to a shock to the latent factors \( F_t \). In contrast, the latent factors can respond to an unanticipated policy rate shock after a month. There is a lag between an unanticipated policy rate shock and the response of the latent factors. The FAVAR framework then allows us to examine the impulse response of disaggregated prices to an unanticipated policy rate shock.

This unanticipated shock is a 25 basis point policy rate increase, which imposes monetary policy contraction. Theoretically, the inflation rate should decrease following monetary contraction. However, we find different results. Figure 4 shows the impulse responses of disaggregated prices (in percent) for all prices, core and non-core.

![Figure 4. Impulse Responses of Prices to Policy Rate Shocks](image-url)
We again find heterogeneity of the responses, not only in terms of magnitude and speed of adjustment, but also in direction. Some prices decrease, but others increase. If we give an equal weight to each individual price, on average the responses increase slightly. If we compare the responses of core and non-core prices, we find that the core prices are less responsive. Compared to what BGM found based on the US data, the impulse responses are similar. Some prices decrease following monetary policy contraction. The difference is that in BGM the average of impulse responses is negative for the US data, while we find, on average, slightly positive impulse responses for the Indonesian data. In other words, Indonesia displays a greater price puzzle. In addition, this puzzle is persistent; the average impulse responses do not decrease in the long run.

There are some possible explanations for the price puzzle. From a modelling perspective, Sims (1992) suggests that misspecification in VAR models, in particular the omission variable problem, is the cause. Comparing OECD countries, he finds that France and Japan experience a price puzzle, and that this positive relationship between monetary policy shock (contraction) and price is significant and persistent. One possible explanation is that the policy makers have anticipated the future inflation and consequently contract the monetary policy variable. As predicted, prices increase, though less than if the policy rate had not been raised. This anticipated inflation is not accommodated in the model, so generates a price puzzle. Furthermore, a policy rate increase may signal to firms that inflation would otherwise rise more than the firms had anticipated. And if price adjustment costs are convex (as in Rotemberg, 1982), firms may already have embarked on a gradual sequence of price increases, from which deflation will take time.

Christiano, Eichenbaum and Evans (1994, 1996), henceforth CEE, propose that commodity prices be included in VAR models. These prices can capture future inflation and supply shocks and therefore the omission problem can be avoided. The order is output, aggregate price, commodity price and policy rate. This can solve the puzzle for the full sample of 1960-1990 US data. Balke and Emery (1994) replicate the VAR model of CEE (1994) but with a different period. They demonstrate that the puzzle is not resolved before the 1980s and test other variables to solve the puzzle. One variable that can solve it is the spread of short and long-term interest rates. Including this variable can solve the puzzle in the pre-1980s.

When the FAVAR technique is applied, the omission problem should be avoided or the possibility of its presence should be reduced, as many variables are included. Hence, there could be other explanations for this puzzle.

Theoretically, there are two main effects of monetary policy on the economy: demand side effects and supply side effects. The study of the monetary policy transmission mechanism is mostly related to the former. There are various channels already studied which relate to the demand effect: the interest rate channel, the exchange rate channel, the expectation channel, the credit channel (bank lending and balance sheet) and the asset price channel. Generally,
the research concludes that monetary contraction will reduce aggregate demand and that the economy will end up with lower price levels. The supply side views support the notion that the effect of monetary changes will affect the cost of production, hence it is also called the cost-side effect. Unlike the demand effect, which shifts aggregate demand, the cost-side effect shifts aggregate supply. In the case of monetary contraction, both aggregate demand and aggregate supply will shift to the left. Whether the price will be higher or lower depends on the dominance of one of these two effects. The price puzzle that occurred in our case may not have been because of misspecification problems, but because of the economic conditions in Indonesia during the estimation period. This may explain the dominance of supply side effects.

There are some possible explanations for such supply side effects. Interest rate increases may raise the cost of production through tightened credit conditions. For instance, firms face costs such as wage payments, which they incur before selling their products. As they finance these costs through credit, tight monetary policy worsens their credit condition. As a result, the firms reduce their labour demand and hence their production. Moreover, the monetary contraction may exacerbate the supply side effect through a reduction in demand. The firms may face internal financing difficulties as fewer products are sold or there are increasing inventory costs and account receivables, so turn to external financing (Barth and Ramey, 2001). Both direct and indirect effects compel the firms to increase the price of their products. Another explanation is market concentration. When demand decreases as a result of monetary contraction, many firms may exit the market. The fewer firms who stay in the market may enjoy increased oligopoly power and raise their prices.

From the impulse response above we notice that not all price series exhibit a puzzle. Many prices also decrease following monetary contraction. This heterogeneity suggests that different effects work dominantly on different prices. In the subsequent sections, we elaborate on some estimates to establish whether the puzzle in terms of aggregate prices diminishes or even disappears.

4.4. Impulse Responses of Prices to Deposit and Loan Rate Shocks

Regarding monetary policy shock, we have used the policy rate as the proxy of monetary policy. We imposed the shock on the policy rate to picture the monetary policy contraction. We now try other observable variables: the three month deposit rate and working capital loan rate. The deposit rate and loan rate are two representatives of market rates, which are closer to the real sector. Generally, the changes in policy rate should be transmitted to these retail rates.

We impose a 25 bps increase on the deposit and the loan rates, which reflects monetary policy contraction. The pictures are similar in terms of heterogeneity, as shown in figures 4, 5 and 6. Some prices rise following the increase in the deposit or loan rate while others fall. However, in terms of average prices, the pictures are quite different. In the two last figures, the
impulse responses show that prices rise after the increase in the deposit and loan rates, up to twelve months later. After that, on average, prices fall. This means that after twelve months more prices fall following the increase in deposit and loan rates. The puzzle is no longer persistent.

Up to this point, we can see different pictures given different proxies of monetary policy. The closer the proxy to the market rate, the more the puzzle tends to be reduced. The increase in deposit and loan rates has more impact on the fall in prices than the impact of a policy rate increase. Given that we examine the effect of the change in interest rate on prices using deposit rate as a proxy of market rate.
4.5. Impulse Responses of Prices: Pre and Post Inflation Targeting

In the previous sections we have observed the varying impact of monetary contraction on prices. Some prices demonstrate a price puzzle, while others do not. In this section, we shall investigate what the impact of monetary contraction, represented by an increase in the deposit rate, is on prices; in particular, whether the impact is stronger or weaker after the implementation of the ITF.

![Figure 7. Impulse Responses of Prices to Deposit Rate Shocks: Pre (upper) and Post (lower) ITF](image)

For the period after the ITF, we obtain five factors to represent the data based on Bai and Ng’s (2002) approach. We apply one lag, based on the Schwarz information criterion (SC). Even though some information criteria suggest two lags, we choose one. If using more than one lag, the impulse responses are more volatile, given the limited number of observations. For the period before July 2005, we use two factors and one lag based on the same procedure and reasoning. We find the impact of the changes in deposit rate is stronger after the implementation
of ITF, as shown in the lower panels of figure 7. On average, prices decrease after 12 months. In contrast, before the ITF is implemented formally, the average of prices is more inert after a monetary contraction. Comparing the groups of prices, on average non-core prices decrease more than core ones.

![Figure 8. Impulse Responses of CPI: Pre (left) and Post (right) ITF](image)

If we examine the comparisons across the aggregate CPI, the unweighted average and the weighted CPI as shown in the right panel of figure 8, the price puzzle disappears in the period of ITF for all CPI definitions. Before full implementation, the weighted CPI still exhibits the puzzle. Moreover, the impact of interest rates on CPI is more apparent after the implementation of ITF. CPI decreases significantly for up to 24 months following the deposit rate increase and reaches its new long run equilibrium after that. Meanwhile, the decrease in CPI before the ITF is not as marked as in the ITF period.

A possible explanation is revealed by Castelnuovo and Surico (2010). Using a VAR model, they find a price puzzle before the Paul Volcker era (pre-1979) for the US data. They support the argument that price puzzles typically emerge in the sub sample associated with weak central bank responses to inflationary pressure. During a weak monetary policy response, inflation expectations are remarkably high. This is not captured by a VAR model and creates a price puzzle.

In our case, before the ITF, monetary policy was eclectic, in the sense that the instruments used varied, such as base money and interest rates. The mixed monetary instruments make the signal unclear. One instrument may generate monetary contraction, while another may result in expansion. In contrast, after the ITF the economic agents may have accepted the interest rate as the main instrument of monetary policy. The stance of monetary policy is clearer, the monetary transmission of the interest rate is stronger, and as a result the effects on prices are more marked during the ITF period.
The absence of a price puzzle also suggests that the supply side effects become weaker after ITF implementation. In the more recent period, financial institutions have been more innovative and developed. This result in more alternative sources of funds, so monetary contraction has less influence through the cost channel. Even though credit will shrink after monetary contraction, firms may have more access to sources of finance other than credit. Another possible explanation is that the influence of the interest rate on exchange rates strengthens. As the interest rate increases, the exchange rate appreciates more significantly. As a result, imported material becomes much cheaper, which helps counterbalance the interest cost faced by firms. Overall, the supply side effect is weaker and the demand effect is dominant and leads to lower prices. This is also US evidence that the transmission of the cost channel was weaker after the Volcker era (Barth and Ramey, 2001).

4.6. Impulse Responses of Disaggregated Prices and Some Macroeconomic variables to Monetary Policy Shock: Post Inflation Targeting

As previously noticed in figure 8, there are differences between the impulse responses of aggregate and disaggregated prices in both pre- and post ITF. The different magnitude of the impulse responses between the aggregate prices and the average of unweighted disaggregated prices demonstrates the importance of weighting. Moreover, the aggregate CPI consists of all CPI prices, while the disaggregated prices cover 96 percent of CPI prices. In this section we shall examine the difference between these impulse responses. We shall also focus on the post ITF period, when the change in interest rate, in particular the deposit rate, had more impact on prices.

From table 5 we can see, in terms of aggregate prices, that the CPI decreases by 0.173 percent after 12 months. Subsequently, it is -0.28 percent and -0.291 percent after 24 and 48 months respectively. Meanwhile, the unweighted average prices of disaggregated CPI decreases by 0.109 percent after 12 months, while after 24 and 48 months, the impulse responses are -0.203 percent and -0.216 percent.

The aggregate for core prices still exhibits a puzzle up to the 6th month. The aggregate for core prices falls 0.025 percent after the 12 months. After 24 and 48 months, it decreases by 0.066 percent and 0.073 percent respectively. Compared to the CPI, the responses are weaker. In both aggregated and disaggregated prices, the impulse responses of non-core prices are stronger than those for core prices.

Some other macroeconomic variables also change. The nominal exchange rate appreciates following the increase in the deposit rate. The increase of 25 basis points in the deposit rate appreciates the nominal exchange rate by as much as 0.5 percent after 18 months. Broad money also decreases following the monetary contraction, although not significantly. Unlike the CPI, which is rigid or only reacts after two months, the components of GDP react immediately after
the changes in monetary policy. Total consumption decreases by up to 0.4 percent from its initial level. This is also significant (within a 90 percent confidence interval) for up to 24 months. The 25 bps contraction also significantly affects investment, exports and imports. Exports fall by as much as 0.6 percent after the twelfth month from their initial level following the appreciation of the exchange rate, while total investment also decreases significantly by around 0.4 percent at the twelfth month and subsequently. Imports also fall because of the decrease in domestic demand, despite the exchange rate appreciation. However, this combination makes real GDP fall only slightly, and is not significant. In line with GDP, the production index also slightly decreases, but not significantly.
A combination of significant price decreases and relatively stable output may reflect greater price flexibility (or a steeper aggregate supply curve). From the impulse responses of prices to macroeconomic shocks and specific sector (figures 2 and 3), greater price flexibility is also confirmed as prices react immediately after the shocks, even macroeconomic ones. The persistence of inflation, both aggregated and disaggregated, is also relatively small, at less than 0.5, compared to what is found in the US data (BGM, 2009).

4.7. The Impulse Responses of Specific Group of Prices To Monetary Policy Shock: Post Inflation Targeting

The previous results demonstrate the heterogeneity of price responses to monetary shocks. In order to examine this heterogeneity, we shall examine which groups of prices increase or decrease following monetary contraction. As in the previous section, we shall focus on the period after the implementation of ITF for the same reasons.
We aggregate the impulse responses based on specific groups of core and non-core prices using the 2007 weight as the base. We divide core prices into seven groups: food and beverages (16.3), housing (19.1), clothing (6.95), health (4.37), education (4.45), entertainment (2.62) and transportation, communication and financial services (9.8). Meanwhile, we divide non-core prices into two groups: food and beverages (19.62) and others (12.87). The values in brackets are index weights.

Figure 10. Impulse Responses of Core Price Groups

Figure 10 shows the impulse responses of four groups of prices in the core price group. On average, this set of prices falls after an increase in the deposit rate. These prices account for 52 percent of CPI. The puzzle still appears, in particular in food and beverage prices. These prices also respond more, falling by more than 0.015 percent after 24 months. On the other hand, clothing prices are steady.

Figure 11. Impulse Response of Core Price Groups (continued)
Three other groups of prices rise following monetary contraction, as shown in figure 11. Those are the health, education and entertainment groups of prices, which account for 11.4 percent of CPI. The impulse responses are smaller than for the former group; this hints at the dominance of the cost channel in this case. If we observe the items in these groups, the producers are most likely to face enhanced credit-financing costs. These items include costs for hospital care, medicine, school and course tuition fees, and entertainment products such as music equipment and cinema. One might think that most of the firms involved in price setting in these groups are large ones, with more access to bank loans and hence more dependent on bank financing. These firms optimise the present value of their future prices in consideration of the interest rate. As the market interest rate increases, so does the interest cost. As a result, these firms set their prices higher.

Another explanation is that there may be many small firms which supply parts to those larger ones. These small firms are more sensitive to fluctuations in the loan rate. As a result, these producers cover the increase in interest costs by increasing their prices, except when service for their client is major commitment. On this case the service for client becomes a fixed cost for the firm, and they will not raise their prices even when the fixed costs have risen.

Another possible explanation is the price setting in these groups (Rotemberg, 1982). For example, the firms in these three sectors, which are non-traded, respond to the shocks by increasing their prices gradually given the price adjustment is convex. Suppose there is an exchange rate depreciation that makes policy maker reacts by increasing policy rate. As the firms have already embarked on a gradual sequence of price increase, it takes more time to see the effect of policy rate increase.
As previously mentioned, the impulse responses of non-core prices are stronger than core prices. If we observe figure 12, both groups of non-core prices exhibit falls and there is no price puzzle. The magnitudes are also bigger. Food and beverage prices, which account for 19.62 percent of the CPI, fall by up to 0.08 percent in the non-core prices. This is higher relative to the core ones, which fall less than 0.02 percent. Others prices fall even more by -0.14 percent starting from 24th month.

Assuming that the deposit rate strongly influences aggregate demand in the economy, the above figures demonstrate that prices in the housing sectors, food sectors and all non-core prices are sensitive to demand factors. On the other hand, prices in health, education and entertainment are more sensitive to cost factors. As interest rates increase, the costs of production in these sectors also increase and hence prices rise. The larger group of prices, the larger it falls following interest rate increases. As these prices have more weight, the CPI in aggregate also decreases. The above figure shows the CPI, either the non-weighted, weighted, or the aggregate one decline with similar path.

V. CONCLUSION

The effect of monetary policy on inflation, which involves changes in policy rate, is not immediate and demonstrates distributed lags. A major challenge is to identify the response speed of inflation due to shock from policy rate as well as from other macroeconomic variables. It is therefore crucial to investigate the lag structure for inflation in following policy rate changes. Furthermore, many econometricians have discovered that the movement of inflation is perverse after the policy rate changes. They usually use a broad measurement index such as CPI to examine the dynamic of inflation. Understanding the forces behind the lag and the initial perverse effect is greatly assisted by scrutinizing the dynamics of individual components of this index. By that, we can have a better understanding how prices respond differently across sectors to monetary policy changes.

This paper scrutinizes the inflation dynamics in Indonesia using disaggregated CPI data. We use FAVAR, as in BGM. This technique allows us to analyze both aggregate and disaggregated prices with the same framework simultaneously. By employing disaggregated data, we deal with the combination of a large number of data with a limited number of observations. FAVAR provides a solution for this condition.

The first finding of this paper is that price behavior in Indonesia exhibits heterogeneity. It is evident not only in terms of the magnitude, but also in the direction and the speed of adjustment to their new equilibrium. This heterogeneity becomes clearer when we examine the behavior of groups of prices in the period after full implementation of ITF. We find that monetary policy shocks have varying impacts on these groups of prices. More sectors respond by lowering their prices following a deposit rate increase, which reflects the dominance of demand factors.
These sectors are food and beverages; housing; transportation, communication and financial services; clothing, and others. They also respond to different degrees. Meanwhile, prices in the entertainment, health and education sectors respond by rising. This may be because the supply side effect is dominant in these groups of prices. Another possible explanation is price adjustment costs in these sectors, which are non-traded, are convex (as in Rotemberg, 1982). The firms may already have embarked on a gradual sequence of price increases, from which deflation will take more time following a policy rate increase.

The second finding of this paper is that the source of the shock matters. Our estimation results show that the volatility of inflation mainly comes from the volatility of sector specific shocks rather than macroeconomic ones in both aggregate and disaggregated inflation, and both in core as well as non-core inflation. The heterogeneity is therefore not only in terms of the magnitude of the responses and the speed of adjustment, but also which factors are more dominant within group of prices. This result is different from Boivin, Giannoni and Mihov (2009) who showed that the source of the volatility of aggregate inflation in the US was different from disaggregated inflation. For them, the volatility apparent in disaggregated inflation, as shown in Bils and Klenow (2004), is mostly related to sector specific shocks, and is not attributed to macroeconomic shocks, particularly a monetary one. On the contrary, the volatility of aggregate inflation is mostly related to macroeconomic shocks.

The third finding is that disaggregated prices are more flexible in response to sector specific shocks, since they reach their new equilibrium more rapidly. The magnitudes of impulse responses are also larger. Disaggregated prices are more sluggish in response to macroeconomic shocks; although they also react instantaneously but take longer time to reach a new equilibrium. The speed of adjustment due to macroeconomic shocks is slower than that of sector specific shocks. This conclusion is in accordance with that of BGM who used US data.

The fourth finding of this paper is that the deposit and loan rates have more impact on prices relative to policy rate. A positive shock on the deposit or loan rate can lower prices, albeit with lags, given the puzzle in the initial period. Using recursive identification, we firstly impose a shock on the policy rate and find a persistent price puzzle, where prices tend to increase in response to monetary contraction. We replace the policy rate with three-month deposit rate and loan rate, but the puzzle still exist even though no longer persistent.

Related to ITF implementation, the fifth finding of this paper is that the implementation of ITF is successful in leading prices through movements in the deposit rate. We separate the sample into two periods based on the full implementation of ITF and find that the puzzle weakens once ITF is adopted, even disappearing if we impose one lag after the ITF.

The sixth finding is that monetary contraction squeezes the components of GDP. Given the stronger effect of the deposit rate on prices under ITF, we also examine the impulse responses of various macroeconomic variables during this period. Exports decrease as the exchange rate
appreciates and consumption and investment also fall. Imports also decrease significantly as
domestic demand falls. Overall, the decrease in aggregate prices is stronger than in output,
which may suggest a steep aggregate supply curve or more flexible prices.

The policy implication, especially related to the second the third finding, is that the
pursuit of price stability calls for careful inspection of specific aspects of prices in addition to the
movement of macroeconomic variables. For instance, policy makers should watch and predict
the movements of some indicators that are closely associated with some prices that have high
weights on the CPI. This provides a way of anticipating the movement of those prices in the
future.

Related to future research, this paper has found a negative correlation between the
persistence and the volatility of inflation, in both core and non-core inflation. This matches
the prediction of the Calvo model and might suggest that this model is suitable for capturing
the inflation volatility and persistence in Indonesia. As this negative correlation is stronger in
the sector specific component, the Calvo model might be more suitable on explaining the
fluctuations in inflation volatility and persistence in facing sector specific shocks. Confirming
this possibility is important.

Furthermore, at least two interesting questions follows; first, which class of model can best
mimic price behavior in Indonesia: a time dependent or a state dependent model? Even though
there is an indication that time dependent models such as the Calvo one are not inconsistent
with price behavior in Indonesia, it would be worth confirming this. Second, related to the
price puzzle, it would be interesting to explore whether demand or supply factors are more
influential in price behavior.
REFERENCES


MONETARY POLICY MODEL FOR OPEN ECONOMY OF INDONESIA

Umar Juoro

Abstract

This paper explains stylized facts about the monetary economy in Indonesia covering the Bank Indonesia (BI) policy on the exchange rate, lending rates, inflation, real effective rate (REER), and growth. This is done to get an understanding on the impact of foreign policy (influenced by the Fed) on Indonesia’s monetary economy, with some attention to the fund rate. An empirical model of VAR (Vector Auto Regression) was developed to capture the impact of an increase in fund rate to Indonesia’s monetary sector. Furthermore, a theoretical model was developed to capture the result from empirical model. The theoretical model shows that the increase of fund rate influenced the increase of BI rate, lending rate, inflation, while reducing REER and growth.

Keyword: monetary policy, lending rate, inflation, exchange rate.

JEL Classification: E52, F41

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I. INTRODUCTION

Indonesia’s monetary policy is focused on inflation. Notwithstanding, the foregoing aspects of growth remains a concern. With an open economy, monetary policy also has implications for the exchange rate. On this regard, monetary policy by raising or lowering the BI not only will affect inflation, but also economic growth and exchange rate.

The main developments in the monetary sector of Indonesia in the period 2000-2013 can be described in five observations (or stylized facts). First, in July 2005 the BI rate was employed as an instrument of monetary policy, which also set inflation as the goal of monetary policy. Second, high inflation in 2005 resulted in a price hike of more about 130%, leaded the central bank to raise his rate as high as 12.75% in December 2005. Third, the global financial crisis in December 2008 forced the central bank to raise the BI rate at the level of 9.50%, following previous declining trend in 2006-2007. Fourth, the period 2010-2012 showed loose monetary policy, with the lowest BI rate followed by the lowest lending rate in Indonesian economic history. Fifth, an increase in the BI rate as response against the stimulus reduction (tapering) of the Federal Reserve in June of 2013. Sixth, lending rate quickly response to the increase in BI rate, but decrease slowly as the BI rate was lowered.

The development of the real exchange rate (REER) is strongly associated with inflation and the funds rate. At the time of high inflation and funds rate, the REER has depreciated, as in 2001, and 2008. At the time of low inflation and low funds rate, the REER appreciated, as in the years 2009-2012 (Figure 1).

Figure 1. The development of the BI rate, lending rate, Inflation, and the Fed Funds Rate

Figure 2. The development of the Real Effective Exchange Rate (REER) and Nominal Effective Exchange Rate (NEER) in the log
In relation to inflation, high economic growth corresponds with a low inflation rate. This high growth rate also occurs when the funds rate and BI rates are low (also funds rate), as was the case in 2000, 2004 and 2010. In contrast, when the BI (and the funds rate) were high, growth declined sharply during the high inflation, such as in 2001 and 2008 (Figure 3).

Empirical picture above shows that the monetary policy conducted by Bank Indonesia, had an influence on the economy. Thus measuring the impact of monetary policy is necessary to consider various factors outside the correlative relationship of the two directions above. This is the underlying premise of the research outlined in this paper.

The second part of this paper reviews the theoretical models of monetary policy in an open economy, within the context of the Indonesian economy. The model used adopts the stickiness of prices (price rigidities), the premise that price adjustment takes time, Taylor ‘s rule, where monetary policy is the main target although inflation is also considered along with the growth and development of endogenous technology in improving productivity through a reduction in the marginal cost. By using computational methods of the program MATLAB, the IRF can be obtained from the theoretical model, and is contrasted with empirical VAR models which is reviewed in the third section. The fourth section of this paper presents the results and analysis, while the fifth section provides the conclusions and policy implications.

II. THEORY

Model Set Up

To develop a model of monetary policy that captures the empirical analysis of monetary policy in an open economy, the model was adopted from Monacelli (2005) which was further
modified by Kuang Tai Ho (2008) to adapt to the characteristics of economic, Indonesia.

This theoretical model to maximize household utility function is as follows:

\[ E_0 \sum_{t=0}^{t=\infty} \beta^t U(C_t, N_t) \]  

(1)

where \( N_t \) is the work time, \( C_t \) is a composite index of household consumption. Maximizes household utility is faced with budget constraints, wages, and portfolio and transfer taxes greater than the expenditure of domestic and imported goods. In the meantime, companies face a stiff price (price rigidities) as formulated by Calvo (1983). The next specification is domestic inflation, REER, cover interest rate parity, and technology. The production function is

\[ Y(j) = A_t N_t(j) \]  

(2)

where \( A_t = \log(A_t) \) follows the process AR(1)

To get the dynamic balance model of a small open economy with a flexible exchange rate, it is necessary to lower the 22 equations with 22 variables. The equation for the domestic economy consists of market clearing, the terms of trade - REER, Philipp's curve, marginal cost, complete market (linking domestic and international), uncovered interest parity, monetary policy (Taylor’s rule), inflation producer, output gap, surprise (shock) productivity, monetary shock, and the shock of exchange rate stabilization. Meanwhile, the international economy is a function of aggregate demand specifications, the aggregate supply curve, marginal cost, monetary policy (Taylor’s rule), the output gap, productivity shock and monetary shock.

**Calibration and Simulation Models**

Calibration of the model using the scale parameters are presented in Table 1. Basic calibration for each parameter refers to the estimations outside the model, and also refers to a range of previous studies.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Value</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \beta )</td>
<td>0.99</td>
<td>Discount factor</td>
</tr>
<tr>
<td>( \Sigma )</td>
<td>1</td>
<td>Inverse elasticity of intertemporal substitution</td>
</tr>
<tr>
<td>( A )</td>
<td>1.5</td>
<td>Elasticity of subs. Domestic and foreign good</td>
</tr>
<tr>
<td>( \Phi )</td>
<td>1</td>
<td>Elasticity of subst. of labor supply</td>
</tr>
<tr>
<td>( \Phi_{xs} )</td>
<td>1.5; 0.5</td>
<td>The coefficient of inflation and the output gap in the Taylor rule abroad</td>
</tr>
<tr>
<td>( \Phi_{hs} )</td>
<td>0.75</td>
<td>The level of price stickiness</td>
</tr>
<tr>
<td>( \Phi_{p} )</td>
<td>0.65</td>
<td>Persistence parameters</td>
</tr>
<tr>
<td>( \Phi_{ps} )</td>
<td>0.1</td>
<td>Shock (shock) domestic productivity</td>
</tr>
</tbody>
</table>
Figure 4 (a) shows the increase in the BI rate (25 bps) above the steady state which causes an increase in lending rates by 20 bps above the steady state and gradually returns to a steady state. Inflation, and economic growth decreases, and gradually returns to a steady state. Inflation was back in two quarters and REER in 7 quarters to steady state.²

Figure 4 (b) shows the exchange rate stabilization can quickly stabilize inflation, interest on a loan, and the exchange rate back to a steady state in just two quarters, and with positive economic growth.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Value</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>ρₚ</td>
<td>0.6</td>
<td>Foreign productivity shock</td>
</tr>
<tr>
<td></td>
<td>0.3</td>
<td>Part of imported goods</td>
</tr>
<tr>
<td>ρᵣ</td>
<td>0.38</td>
<td>Degree of interest rate smoothing domestic, Taylor rule,</td>
</tr>
<tr>
<td>ρᵣₛ</td>
<td>0.8</td>
<td>Degree of interest rate smoothing foreign, Taylor rule</td>
</tr>
<tr>
<td>Φᵞ</td>
<td>1.2</td>
<td>Inflation coefficient in the Taylor rule domestic</td>
</tr>
<tr>
<td>Φₓ</td>
<td>0.35</td>
<td>The coefficient of the output gap in the Taylor rule domestic</td>
</tr>
<tr>
<td>ρ₂</td>
<td>0.9</td>
<td>Domestic productivity shock</td>
</tr>
<tr>
<td>ρ₂ₛ</td>
<td>0.9</td>
<td>Foreign productivity shock</td>
</tr>
<tr>
<td>ρₕ</td>
<td>0.6</td>
<td>Stability of the exchange rate shock</td>
</tr>
</tbody>
</table>

Figure 6. The increase in the BI policy rate and funds rate and Implications to Economic and Exchange Rate Stabilization Policy

² Chapter IV analyzes the results and it will be shown that these results are similar to the results of the VAR model used.
Figure 4 (c) shows that the increase in the funds rate followed by a rise in borrowing raised the BI rate, but lowered inflation, growth and the REER. Exchange rate took a longer time to move back to the steady state than if only there was a BI rate hike. There was also no increase in funds rate.

Figure 5 (a) shows the stimulative monetary policy by lowering the BI rate (25 bps) from the steady state which is immediately followed by a decrease in interest on loans, rising inflation, REER, and growth. Figure 5 (b) shows a decrease in the funds rate followed by a decrease in
the BI rate and increase domestic economic growth. Meanwhile, the loan interest, inflation, and the REER had increased.

Figure 5 (c) shows an increase in domestic productivity, and increased growth higher than the decrease in BI Rate. Inflation and interest on loans decreased, while the REER rose. Figure 5 (d) shows an increase in productivity abroad had a negative effect on the domestic economy with declining growth, while inflation, interest on loans, and REER were lower.

III. METHODOLOGY

VAR model assumes Indonesian economy can be explained by the following structural equation:

\[ A(L)Y_t = B(L)X_t + \varepsilon_t \]  \hspace{1cm} (3)

\( A(L) \) is the polinominal matrix \( n \times n \) is the operator lag, and \( B(L) \) is the polinominal matrix \( n \times k \) with the operator lag. \( Y_t \) is the endogenous variable that consists of \( q_t \) is economic growth, \( \pi_t \) is inflation, \( q_t \) is log (REER), \( b_t \) is the BI rate, and \( f_t \) is the fund rate. \( X_t \) is \( k \times 1 \) vector of exogenous overseas variables (fund rate), \( \varepsilon_t \) is the vector of structural distribution \( n \times 1 \), where \( \text{var}(\varepsilon_t) = \Omega \) which is the diagonal matrix.

To determine the implications of monetary policy abroad (the Fed) the Indonesian economy, then the next VAR model is in the form of a first-order VAR is:
identification of the empirical model is done by setting limits to the matrix where A is lower triangular with unit diagonal elements. Because \( b_t \) and \( f_t \) appear at the bottom of the system, the identification strategy is that the innovation of BI rate \( \varepsilon_t^d \) and the innovation fund rate \( \varepsilon_t^f \) effect the domestic endogenous variables with one period lag.

Another limitation is that the estimated VAR system is \( f_r \) follows the simple univariate process AR(1). The Simple univariate process is to set limits \( A_{s1} = B_{s1} = 0 \), for all \( i \) that are not the same as \( S \). The purpose of adopting this limitation is due to the assumption that disorder from developing countries, in this case Indonesia, has a very small effect on the major nations such as the U.S.

**IV. ANALYSIS AND RESULTS**

The following section will present the results of the estimation model described in the previous section.

**4.1. Impulse Response Function**

Figure 6 presents the impulse response function of a surprise increase in the BI rate. This figure shows that the BI rate hike was followed by a rise in lending rates \( \text{ltrate} \). The increase in the BI rate to reduce inflation \( \text{inf} \) was done only after the third-quarter \( \text{lag} \) and the back to steady state after eight quarters \( \text{lag} \). The REER raised the BI rate hike back to the steady state only after the three quarters \( \text{lag} \). The BI rate hikes reduced economic growth. So the BI rate hike was quickly followed by a rise in lending rates and a lowering of economic growth with declining consumption. Meanwhile, the decline in inflation and a strengthening in currency took time to be effective \( \text{lag} \).

While the increase in the funds rate was immediately followed by an increase in the BI rate, interest loans, and inflation (with a lag). The increase in funds rate also implied a weakening of the exchange rate and the decline in economic growth (with a lag). This is understandable because of the increase in funds rate was followed by an increase in the BI rate which has implications for the endogenous variables (Figure 7).
Figure 6.
Variable response to the increase in the BI rate with the exogenous variables Funds Rate
Figure 7.
Impulse response function increased funds rate to endogenous variables
4.2. Granger Causality Test

The Granger Causality Test was used to determine the variables affecting other variables (Table 1). From the estimation results, by examining the t-statistics, it appears that inflation affects the BI rate, where the BI rate and the central bank lending rate affect each other; and the central bank inflation rate affects the BI rate and the REER; the BI rate affects the growth, the funds rate affects inflation, as well as the REER. The REER affects lending and growth, and the lending and growth affects each other.

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Granger Causality Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample: 2000Q1 2013Q2</td>
<td></td>
</tr>
<tr>
<td>Lags: 2</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Null Hypothesis:</th>
<th>Obs</th>
<th>F-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>FRATE does not Granger Cause BIRATE</td>
<td>52</td>
<td>3.21691</td>
<td>0.0490</td>
</tr>
<tr>
<td>BIRATE does not Granger Cause FRATE</td>
<td>52</td>
<td>0.08269</td>
<td>0.9208</td>
</tr>
<tr>
<td>LRATE does not Granger Cause BIRATE</td>
<td>52</td>
<td>2.50859</td>
<td>0.0922</td>
</tr>
<tr>
<td>BIRATE does not Granger Cause LRATE</td>
<td>52</td>
<td>9.70918</td>
<td>0.0003</td>
</tr>
<tr>
<td>INF does not Granger Cause BIRATE</td>
<td>52</td>
<td>3.09954</td>
<td>0.0544</td>
</tr>
<tr>
<td>BIRATE does not Granger Cause INF</td>
<td>52</td>
<td>7.98482</td>
<td>0.0010</td>
</tr>
<tr>
<td>LOG(REER) does not Granger Cause BIRATE</td>
<td>52</td>
<td>7.39518</td>
<td>0.0016</td>
</tr>
<tr>
<td>BIRATE does not Granger Cause LOG(REER)</td>
<td>52</td>
<td>1.38538</td>
<td>0.2603</td>
</tr>
<tr>
<td>GROWTH does not Granger Cause BIRATE</td>
<td>52</td>
<td>1.10661</td>
<td>0.3391</td>
</tr>
<tr>
<td>BIRATE does not Granger Cause GROWTH</td>
<td>52</td>
<td>3.08633</td>
<td>0.0550</td>
</tr>
<tr>
<td>LRATE does not Granger Cause FRATE</td>
<td>52</td>
<td>0.16020</td>
<td>0.8524</td>
</tr>
<tr>
<td>FRATE does not Granger Cause LRATE</td>
<td>52</td>
<td>1.89368</td>
<td>0.1618</td>
</tr>
<tr>
<td>INF does not Granger Cause FRATE</td>
<td>52</td>
<td>0.57138</td>
<td>0.5686</td>
</tr>
<tr>
<td>FRATE does not Granger Cause INF</td>
<td>52</td>
<td>3.50136</td>
<td>0.0382</td>
</tr>
<tr>
<td>LOG(REER) does not Granger Cause FRATE</td>
<td>52</td>
<td>0.26765</td>
<td>0.7663</td>
</tr>
<tr>
<td>FRATE does not Granger Cause LOG(REER)</td>
<td>52</td>
<td>2.93240</td>
<td>0.0631</td>
</tr>
<tr>
<td>GROWTH does not Granger Cause FRATE</td>
<td>52</td>
<td>1.10998</td>
<td>0.3380</td>
</tr>
<tr>
<td>FRATE does not Granger Cause GROWTH</td>
<td>52</td>
<td>1.89279</td>
<td>0.1620</td>
</tr>
</tbody>
</table>
4.3. Variance Decompositions

To understand the contribution of shock increase to the BI rate and funds rate from the empirical models used, the analysis of variance decomposition of the variables contained in the VAR system of equations (1) and equation (2) was used. Table 1 shows that according to the estimates of the VAR system in equation (1), innovation in the BI rate, $\varepsilon_d$, provides approximately 40% change in the aggregate variables in the Indonesian economy, most of it is inflation and the REER about 15%, which is relatively low at around 5% interest on the loan, and the economic growth of about 4%.

<table>
<thead>
<tr>
<th>Null Hypothesis:</th>
<th>Obs</th>
<th>F-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>INF does not Granger Cause LRATE</td>
<td>52</td>
<td>0.32414</td>
<td>0.7248</td>
</tr>
<tr>
<td>LRATE does not Granger Cause INF</td>
<td></td>
<td>2.58781</td>
<td>0.0859</td>
</tr>
<tr>
<td>LOG(REER) does not Granger Cause LRATE</td>
<td>52</td>
<td>17.2285</td>
<td>2E-06</td>
</tr>
<tr>
<td>LRATE does not Granger Cause LOG(REER)</td>
<td></td>
<td>0.73871</td>
<td>0.4832</td>
</tr>
<tr>
<td>GROWTH does not Granger Cause LRATE</td>
<td>52</td>
<td>0.26624</td>
<td>0.7674</td>
</tr>
<tr>
<td>LRATE does not Granger Cause GROWTH</td>
<td></td>
<td>4.86701</td>
<td>0.0120</td>
</tr>
<tr>
<td>LOG(REER) does not Granger Cause INF</td>
<td>52</td>
<td>1.76167</td>
<td>0.1829</td>
</tr>
<tr>
<td>INF does not Granger Cause LOG(REER)</td>
<td></td>
<td>1.04978</td>
<td>0.3581</td>
</tr>
<tr>
<td>GROWTH does not Granger Cause INF</td>
<td>52</td>
<td>0.50295</td>
<td>0.6080</td>
</tr>
<tr>
<td>INF does not Granger Cause GROWTH</td>
<td></td>
<td>1.24195</td>
<td>0.2981</td>
</tr>
<tr>
<td>GROWTH does not Granger Cause LOG(REER)</td>
<td>52</td>
<td>4.03464</td>
<td>0.0242</td>
</tr>
<tr>
<td>LOG(REER) does not Granger Cause GROWTH</td>
<td></td>
<td>2.64905</td>
<td>0.0813</td>
</tr>
</tbody>
</table>

Source: Processed Data
Table 3 shows that the VAR model based on the estimation of equation (2), where innovations in the funds rate, $\varepsilon_f$, provides approximately 58% aggregate changes in the Indonesian economy, mostly in the BI rate about 23%, then approximately 13% growth, and about 12% interest on the loan. Meantime, the influence of inflation and the REER is relatively low. This finding is surprising because it was an external shock that was greater than internal shocks to the Indonesian economy. The explanation is that the Indonesian economy is very open to external shocks, in this case the funds rate, greatly affected the flow of capital in and out of Indonesia. This influence was also felt for growth.

V. CONCLUSION

From the observations (stylized facts), the empirical VAR models and the theoretical models, it is clear that the Fed’s monetary policy of raising or lowering the funds rate has a major impact on the Indonesian economy. The increase in funds rate is followed by an increase in the BI rate, then interest on the loan, the decline in inflation and economic growth with a delay (lag). The decline in growth is greater when the fund rate and BI rate hikes together, compared to when only the BI rate is raised. The REER takes a long time (lag) to return to a steady state. Exchange rate stabilization policy can bring down inflation and strengthen the REER quickly, and induce positive economic growth. Theoretical models according to the empirical VAR models, increase in inflation in the empirical models, while the theoretical models of inflation decreases inflation when there is an increase in the funds rate.

The theoretical models that captured the empirical models performed well enough where the funds rate decreased, which was followed by a decline in the BI rate resulting in a lowering and raising of lending rates of economic growth, and the REER. But inflation also increased. The increase in domestic productivity growth is higher than the decrease in the BI rate, amid declining inflation and appreciating REER. While the increase in productivity abroad has negative implications on the domestic economy in lowering growth and weakening the REER, inflation is decreased.
REFERENCES


Vegh, C. 2013, Open Economy Macroeconomics in Developing Countries. Cambridge, MA: MIT Press.
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   - Theory and review of literatures
   - Methodology (quantitative methodology is preferred)
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