An Empirical Investigation of Global Output Gap Hypothesis in Pakistan

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Abstract
This study has empirically investigated Global Output Gap Hypothesis (GOGH) for Pakistan using annual time series data from 1982 to 2012. Augmented Dickey Fuller (ADF) and Phillips Perron (PP) tests showed that dependent variable inflation (INF) was I(1), whereas, independent variables domestic output gap (YGAP) and global output gap (GYGAP) were I(0) and I(1) respectively. In this situation, Ordinary Least Squares (OLS) was not applicable. Because of different orders of integration of variables, Engel Granger and Johansen’s approaches of cointegration were also inapplicable, whereas, Autoregressive Distributive Lag (ARDL) approach was an appropriate option. The Bounds test results showed existence of long run relationship among variables and Error Correction Model (ECM) results reconfirmed long run relationship because coefficient of lagged ECM term was found significant with negative sign. All relevant diagnostic tests were also performed to check the validity of results. The results indicated that GYGAP significantly and positively affected inflation in the long run and short run models, however, YGAP appeared with correct sign but insignificant coefficients thus confirming the existence of GOGH in Pakistan. Policy implication of the current study is that monetary authorities should target activity directly instead of believing that stable inflation represents actual output close to its potential level.

Keywords: Output Gap, Phillips Curve, ARDL Approach, Error Correction Model

I. Introduction
According to traditionally thought positive relationship between inflation and output gap, inflation was expected to come down in the years following 2008 crisis due to prevailing output slack and high unemployment. However, evidence shows that the relationship between inflation and output in advanced economies has been different than
it used to be in the past. Blanchard et al. (2013) have argued that high inflation at the time of slowdown in many economies may reflect weakened relationship between output gap and inflation. To solve the puzzle of weakening relationship between domestic output gap and inflation, recent literature highlights growing importance of global output gaps along with domestic output gaps in affecting domestic inflation (Monsef et al., 2013; Calza, 2008). Rising integration of international goods and financial markets imply that inflation rate in each country is also determined by world conditions rather than solely by domestic factors. This phenomenon is popularly known in the literature as Global Output Gap Hypothesis (GOGH).

THE ECONOMIST (2005) argued that “increased global competition has thus limited room for firms to pass on higher prices. Forecasting inflation central banks now need to pay less attention to domestic shifts in unemployment and capacity utilization and much more to the global balance between supply and demand.” While the debate in BUSINESS WEEK (2006) concluded that global factors may end up the issue of examining domestic factors for inflation determination. “The era of a purely domestic monetary policy is over.”

Examining the influence of global economic conditions on domestic prices has been an important area of concern for policy makers in Pakistan for effective formulation and implementation of demand management policies. A large body of empirical literature has found evidence of positive effect of domestic output gap on inflation in Pakistan, (Jaffri et al., 2012; Nabila et al., 2013). However, no previous study has empirically investigated GOGH for Pakistan. The main objective of this study is to empirically test the GOGH for Pakistan to check whether global output gap is equally important as compared to domestic output gap in affecting inflation. In the remaining part of the paper, Section II reviews recent literature on the topic and Section III briefly presents methodology and results. Finally, Section IV concludes the paper based on results along with presenting policy implications.

II. Literature Review

Phillips (1958) examined the relationship between rate of change of money wage rate and unemployment using the data from 1861-1957 of United Kingdom. Phillips introduced the concept that unemployment gap affects inflation negatively. Later on the relationship between rate of inflation and output gap was derived by substituting the original Philips curve relationship in the Okun’s Law. Positive output gap points towards an excess aggregate demand in the economy and this has a propensity to put an upward pressure on prices. While negative output gap indicates excess capacity in the economy which exerts persistent downward pressure on prices.

Rogoff (2006) examined the impact of globalization on lowering inflation in domestic economy. Globalization provides favorable circumstances for maintaining low inflation by output inflation trade-off faced by Phillips Curve. Greater competition contributes to greater price and wage flexibility and decreases the output gains arising from accommodative monetary policy. At the same time, increased competition steepens the output inflation trade off.
Ball (2006) estimated the Phillips curve equation using pooled data of 14 industrial
countries. The study concluded that domestic output gap was highly significant and
foreign output gap was less significant. Thus foreign output gaps had secondary
importance in determining inflation rate.

Borio and Filardo (2007) estimated a Phillips Curve for 16 OECD countries. Study
found global slack as benchmark measure in inflation rate equation and found significant
increase in explanatory power. The study found decline in the coefficient of output gap
from 0.13 to 0.09 for USA during two periods (1980 to 1992) and (1993 to 2005). This
has provided the justification for estimating GOGH in recent times.

Ihrig et al. (2007) estimated the Phillips Curve equation for 11 countries and found
that the global slack hypothesis is not strong enough to the specification of the measures
of global slack. Results indicated that the estimated effect of foreign output gap is
insignificant, and that there is no evidence of trend decline in the sensitivity of inflation
to domestic output. Furthermore, no increases in the sensitivity of inflation to import
prices were found.

Calza (2008) has examined the proposition that globalization has led to greater
sensitivity of domestic inflation to the global output gap (global output gap hypothesis)
for the euro area by using quarterly data over the period 1979-2003. Study has estimated
different specifications of global output gap and found very weak evidence that global
capacity restraint have any predictive power for domestic inflation in the Euro area.

Engel (2011) found that the foreign output gaps are important for determining
home inflation because the foreign output gaps influence domestic marginal cost. Two
direct channels through which world economy can affect domestic inflation include
foreign output gaps and exchange rate changes. An increase in the foreign output gap will
in general increase domestic inflation by increasing demand for home goods, which
consequently drives the home real wage move upward.

Monsef et al. (2013) checked the effects of globalization through global output gap
on domestic inflation using panel data for the time period 1998 to 2007. Study found
foreign output gap affects inflation significantly but the coefficient was found low.

Jaffri et al. (2012) using Autoregressive Distributed Lag (ARDL) modeling found
positive and significant impact of domestic output gap on inflation in Pakistan. Positive
output gap is pushing the economy towards rising inflationary pressure. In order to limit
the size of volatility in prices, the study recommended a careful coordination of fiscal and
monetary policy.

Asghar et al. (2013) have also empirically estimated the determinants of inflation
in Pakistan by applying ARDL approach on time series data from 1972 to 2010. The
study found positive and significant effect of output gap on inflation rate in Pakistan.

Ahmed et al. (2013) examined the determinants of inflation in Pakistan using
annual time series data from 1971 to 2012. By applying Johnson’s cointegration
technique study found that M2, import and current government expenditure, output gap and adaptive expectations are most important determinants of inflation in Pakistan.

Above reviewed literature highlighted GYGAP as an important determinant of inflation in open economies like Pakistan. Most of the reviewed studies supported the argument that global output gap has become an important determinant of inflation\(^1\). Whereas, a few studies also supported the view that global output gap is not as such important factor in affecting domestic inflation\(^2\). In Pakistan, various studies have been conducted where the influence of domestic output gap in determining inflation has been examined. The present study will augment the empirical literature by investigating GOGH hypothesis for Pakistan.

### III. Methodology and Results

The modeling approach in this study follows Borio and Filardo (2007) in specification of following model:

\[
INF_t = \lambda_0 + \lambda_1 YGAP_t + \lambda_2 GYGAP_t + DUM2008 + \epsilon_t
\]

Where,

- \(INF_t\) is annual CPI inflation rate,
- \(YGAP_t\) is domestic output gap calculated as the difference between actual and potential GDP,
- \(GYGAP_t\) is global measure of output gap calculated as the difference between actual and potential global GDP and \(\epsilon_t\) is a random error term. Potential output has been estimated by applying Hodrick Prescott (HP) Filter technique.

YGAP affects positively to domestic inflation. Positive output gap occurs when actual output is greater than potential or capacity output. This situation arises when aggregate demand is very high and workers and factories go beyond their working capacity and general price level goes up. On the other side, negative output gap refers actual output is below the potential or full capacity. This situation arises as aggregate demand is very low, people do not demand for the goods and services, workers and factories produced less, so price level decreases [Jaffri et al. (2012); Nabila et al. (2013)].

GYGAP can also affect the domestic inflation usually referred in the literature as Global Output Gap Hypothesis (GOGH). A blooming world economy can put positive demand pressure in the domestic economy leading to price pressure in the domestic economy and if the world economy is facing any depression (producing less than capacity) will ultimately transfer slowness in demand in domestic economy. [Borio and Filardo, (2007); Ball, (2006), Milani, (2009)].

DUM 2008 represents a dummy variable for 2008 crisis which has value ‘one’ for the year 2008 and ‘zero’ for other years. The purpose of incorporating DUM2008 is to isolate the impact of financial crisis 2008 in our model.

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To estimate above model, annual time series data from 1982 to 2012 has been used. Data on CPI, GDP and global GDP was collected from International Financial Statistics (IFS) and Annual reports of State Bank of Pakistan (SBP).

To investigate the stationarity of the variable, ADF and PP tests were used in the study. In order to apply suitable econometric technique it was important to know that either series were stationary or non-stationary. If time series was non-stationary its behavior could be studied only for the time period under consideration.

### Table 1: Augmented Dickey Fuller Test

<table>
<thead>
<tr>
<th>Variable</th>
<th>Level Test Statistics (Prob)</th>
<th>First Difference Test Statistics (Prob)</th>
</tr>
</thead>
<tbody>
<tr>
<td>INF</td>
<td>-2.575(0)</td>
<td>-2.5918(0) -6.691(0)*** -6.586(0)***</td>
</tr>
<tr>
<td>YGAP</td>
<td>-3.480(0)***</td>
<td>-3.4026(0)**</td>
</tr>
<tr>
<td>GYGAP</td>
<td>-2.6033(0)</td>
<td>-2.5638(0) -4.8026(1)*** -4.6938(1)***</td>
</tr>
</tbody>
</table>

*The asterisks *** and ** showed that the coefficient is significant at 1% and 5% level of significance respectively.*

### Table 2: Phillip-Perron (PP) Test

<table>
<thead>
<tr>
<th>Variable</th>
<th>Levels Test Statistics (Prob)</th>
<th>First Difference Test Statistics (Prob)</th>
</tr>
</thead>
<tbody>
<tr>
<td>INF</td>
<td>-2.6238(3)</td>
<td>-2.6689(3) -6.7861(2)*** -6.6785(2)***</td>
</tr>
<tr>
<td>YGAP</td>
<td>-3.4045(3)**</td>
<td>-3.3224(3)</td>
</tr>
<tr>
<td>GYGAP</td>
<td>-2.7964(1)</td>
<td>-2.7611(1) -5.2932(1)*** -5.747(12)***</td>
</tr>
</tbody>
</table>

*The asterisks *** and ** showed that the coefficient is significant at 1% and 5% level of significance respectively.*

Table 1 and 2 showed that INF and GYGAP were non-stationary I(1), while YGAP was I(0) with intercept and trend at 1 percent level of significance. OLS was not applicable as it required stationarity of all variables as a prerequisite for finding Best, Linear and Unbiased Estimator (BLUE). Similarly, EG and Johansen’s cointegration approaches were also inapplicable as they required all I(1) variables. Thus ARDL was suitable approach of cointegration to be applied.

### Table 3: Lag Selection Criteria

<table>
<thead>
<tr>
<th>Lag</th>
<th>AIC</th>
<th>SIC</th>
</tr>
</thead>
</table>

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In Table 3, AIC and SIC based on Vector Autoregressive (VAR) estimation show 1 lag as optimal lag length. The procedure of Bounds test involved investigating the existence of a long-run relationship in the form of following model following Pesaran et al. (2001):

$$\Delta\text{INF} = \gamma_1 + \gamma_2\Delta\text{INF}(-1) + \gamma_3\Delta\text{YGAP} + \gamma_4\Delta\text{GYGAP}(-1) + \gamma_5\Delta\text{GYGAP} + \gamma_6\Delta\text{GYGAP}(-1) + \gamma_7\Delta\text{INF}(-1) + \gamma_8\Delta\text{YAP}(-1) + \gamma_9\Delta\text{GYAP}(-1) + \gamma_{10}DUM2008 + \varepsilon.$$  (2)

$H_0 = \gamma_7 = \gamma_8 = \gamma_9 = 0$ (No cointegration)

$H_1 = \gamma_7 \neq \gamma_8 \neq \gamma_9 \neq 0$ (Existence of long run relationship)

If F-Statistics is greater than Upper Bounds: then we reject the $H_0$, if F-Stat is less than lower bounds: Then do not reject $H_0$ and if F-Stat is between lower and upper bounds than results would be inconclusive.

<table>
<thead>
<tr>
<th>Critical bound values</th>
<th>Lower Bound Value</th>
<th>Upper bound values</th>
<th>F-Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1%</td>
<td>8.74</td>
<td>9.63</td>
<td>8.0606</td>
</tr>
<tr>
<td>5%</td>
<td>6.56</td>
<td>7.30</td>
<td></td>
</tr>
<tr>
<td>10%</td>
<td>5.59</td>
<td>6.26</td>
<td></td>
</tr>
</tbody>
</table>

The calculated $F$-Statistics is $\text{8.0606}$ which is higher than upper critical bound at 5 percent level of significance which confirms the presence of cointegration or long run relationship among dependent and explanatory variables in the model. If the presence of cointegration among the study variables is confirmed, next step is to estimate long run relationship as reported in Table 5.

**Table 4: ARDL Bounds Test**

<table>
<thead>
<tr>
<th>Dependent Variable (INF)</th>
<th>Selected Lag Length (Criteria)</th>
<th>AIC, SIC</th>
<th>K=1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Pesaran et al. (2001)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>Lower Bound Value</td>
<td>Upper bound values</td>
<td><strong>F-Statistic</strong></td>
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<td>5.59</td>
<td>6.26</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TABLE 5: Long Run Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Variable</strong></td>
</tr>
<tr>
<td>--------------</td>
</tr>
<tr>
<td>Constant</td>
</tr>
<tr>
<td>INFI(-1)</td>
</tr>
<tr>
<td>YGAP</td>
</tr>
<tr>
<td>YGAP(-1)</td>
</tr>
<tr>
<td>GYGAP</td>
</tr>
<tr>
<td>GYGAP(-1)</td>
</tr>
<tr>
<td>DUM2008</td>
</tr>
</tbody>
</table>

**Diagnostic Tests**
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<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>t-statistic</th>
<th>Prob</th>
</tr>
</thead>
<tbody>
<tr>
<td>DINF (2, 2)</td>
<td>-0.27413</td>
<td>-0.69</td>
<td>0.4924</td>
</tr>
<tr>
<td>DINF (-1)</td>
<td>0.10353</td>
<td>1.15</td>
<td>0.2625</td>
</tr>
<tr>
<td>DINF (-2)</td>
<td>0.03755</td>
<td>0.45</td>
<td>0.6533</td>
</tr>
<tr>
<td>DINF (-3)</td>
<td>0.20161*</td>
<td>2.07</td>
<td>0.0504</td>
</tr>
<tr>
<td>DINF (-4)</td>
<td>0.11047</td>
<td>1.13</td>
<td>0.2696</td>
</tr>
<tr>
<td>DINF (-5)</td>
<td>11.50294***</td>
<td>4.91</td>
<td>0.0001</td>
</tr>
<tr>
<td>ECM (-1)</td>
<td>-0.611454**</td>
<td>-2.12</td>
<td>0.0459</td>
</tr>
<tr>
<td>R²</td>
<td>0.7290</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adj. R²</td>
<td>0.6516</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S.E of Regression</td>
<td>2.0105</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The results in table 6 showed that YGAP is positively but insignificantly related to INF, in short run. The coefficient of GYGAP was also positively but significantly affecting domestic inflation, 1 percentage point increase in dGYGAP will lead to 0.201 percentage point increase in dINF. As our results clearly indicate that the coefficient of dGYGAP (0.2016) is significant whereas the coefficient of domestic output gap dYGAP is insignificant, which can be interpreted as that global output gap has significant role in determining domestic inflation. These findings are consistent with Milani (2010) and Borio & Filardo (2007), who concluded that global output gap is more important and significant determinant of domestic inflation.

The coefficient of lagged error term (ECMt-1) in our results is negative and highly significant and the coefficient is between zero to one. The coefficient of -0.6115 indicates a high rate of convergence to equilibrium, which implies that deviation from the long-term equilibrium is corrected by 61.15% over one year. The lag length of the short-run model is selected on basis of the AIC and SIC.

To ascertain the goodness of the ARDL model, diagnostic tests are conducted. The diagnostic tests examined the possibility of serial correlation, normality, and heteroscedasticity associated with the error term. The test statistics of the diagnostic tests concluded that there is no serial correlation and autoregressive conditional heteroscedasticity is also not present in the short run model. The structural stability test is conducted by employing the CUSUM and the CUSUMSQ tests, results confirm that short run model is stable.

**IV. Conclusion and Policy Recommendation**

The results showed that in both long run and short run models signs of the coefficients of domestic output gap, global output gap and lagged inflation were positive as expected. However, in both long run and short run models global output gap had significant and positive effect on domestic inflation in comparison with positive and insignificant effect of domestic YGAP on inflation in Pakistan. Another important finding of the study is that dummy variable generated for 2008 global economic crisis positively and significantly affects inflation in Pakistan.

Based on above empirical findings of the study, it is concluded that global output gap hypothesis holds in Pakistan. Our findings are consistent with Borio and Filardo (2007) as they have found that for the most of the countries incorporated in their sample for period 1985-2005 Global Output Gap has become significant determinant of inflation.
For guidance regarding policy implications of the study, recent research (Blanchard et al., 2013; World Economic Outlook, 2013) has recommended policy options in countries experiencing weak relationship between inflation and domestic output gap. Policy implication of the current study is that monetary authorities should target activity directly instead of believing that stable inflation represents actual output close to its potential level.

References


