Using Time-Varying Parameter VAR Approach to Assess the Effects of Government Spending Shocks in Korea

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Abstract

We apply Time Varying Parameter Structural Vector Autoregression (TVP-SVAR) model to Korea’s fiscal data from 1986 through 2011 to estimate the effect on output growth of expansionary government spending in Korea. Our estimation results show that the GDP growth has significantly increased for approximately three to four quarters after the shock arrives, suggesting that an increase in discretionary government spending has affected Korea’s economic growth in a favorable way over the sample period. Our fiscal multiplier estimates imply that the stimulating effect of a positive spending shock has declined over time. Furthermore, our regression analysis suggests that the government spending multiplier in Korea appears inversely related to the output gap, the degree of openness, whereas exhibiting positive relationships with the share of government spending on fixed capital formulations as well as the level of household debts.

JEL classification: C5; E6; H5

Keywords: Fiscal policy; Government spending multiplier; Time-varying parameter VAR

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I. Introduction

The outbreak of the recent global financial crisis and the subsequent Eurozone sovereign debt crisis has drawn much attention from both academia as well as policymakers to the stabilizing role of fiscal policy, triggering a huge amount of research efforts to quantify the effect of expansionary fiscal policy. See Kirchner et al. (2010), Christiano et al. (2011), Woodford (2011), Coenen et al. (2012), Auerbach and Gorodnichenko (2012), to name a few, and Ramey (2011a) for a comprehensive survey.

In the literature, most prevailing approach to measure the magnitude of fiscal stimulus is to estimate structural vector autoregression (SVAR) model. Following the seminal work of Blanchard and Perotti (2002), this line of research commonly employs statistical identification schemes in order to recover government spending shocks, e.g.,Fatás and Mihov (2001), Perotti (2005), Galí et al. (2007), while some rely on the so-called “narrative” approach, e.g., Ramey and Shapiro (1998), Ramey (2011b). Thus far, structural identification-based SVAR approach has been predominant in estimating the effect of fiscal expansions while recently facing a criticism of Ramey (2011b) for its potential mistiming issue.

Based upon the SVAR estimates, several relevant studies aforementioned have sought to analyze with government spending multiplier, defined as the ratio of the change in GDP to the change in discretionary government spending, as it has an intuitive interpretation of the dollar increments of GDP in response to a dollar increase in government spending. For empirical studies, such a textbook definition needs to be more concrete according to the length of periods or the point in time considered in analysis: impact multiplier, peak multiplier (Blanchard and Perotti, 2002), cumulative multiplier (Perotti, 2004, 2005; Woodford, 2011), etc. See Spilimbergo et al. (2009) for a survey of the relevant studies.

Overall, it appears the extant literature on fiscal multipliers has agreed that an increase in discretionary government spending has a positive impact on economic growth, but there is no consensus made about the magnitude of the multipliers. According to a survey from IMF Fiscal Monitor (2012), covering 34 major studies published from 2002 through 2012, government spending multipliers in advanced economies (including the U.S., Europe) are estimated as positive, around 0.7 to 0.9. In particular, using SVAR approach yields the multiplier estimates of 0.4 to 2.0 (with the average of 1.0) for the U.S., and 0.5 to 1.5 (with the average of 0.8) for Europe. In contrast, rather less attention has been thus far paid to assessing the effect of expansionary government spending in emerging market economies such as Korea the case of which is of our main interest in this study.
In this article, we seek to quantify the stabilizing effects of expansionary government spending in Korea. The stabilizing role of fiscal policy in Korea has been increasingly utilized since the Asian currency crisis. Indeed, as pointed out in Oh (2012) and Hur and Kim (2012), it has been widely agreed that since the late 1990s Korea’s fiscal policy began to show counter-cyclical behaviors switching from the so-called “Expenditure-Within-Revenue” principle prevalent in the 1980s. Despite the potential existence of structural breaks in Korea’s fiscal policy behavior, the extant studies for the case of Korea thus far have merely focused on estimating the average growth effect of expansionary government spending with presuming time-invariant government spending multipliers.

Although such empirical studies on Korea’s fiscal policy are rather limited, even their conclusions on the effectiveness of its government spending-based stimulus appear mixed, depending on the data span and estimation method. For instance, Hur (2007) argues that using SVAR analysis into detrended quarterly data from 1979 to 2000 the short-term spending multiplier is estimated below 0.4 with no statistical significance whereas Kim (2011) employs a level SVAR approach using data with trends from 1999 to 2010 to conclude that government spending multipliers by items become much higher, ranging from 0.5 to 2.7, than those in Hur (2007). Furthermore, recent studies focusing on the global financial crisis period, e.g., Eskesen (2009), Kim (2012), and Hur and Kim (2012), echo that the fiscal stimulus package in Korea was deemed to be fairly effective in the recovery process.

With this background, the scope and contributions of this article are as follows. This article seeks to investigate in a unified framework whether or not Korea’s expansionary government spending shocks have positively affected the output growth since the mid-1980s, and whether, if ever, the stabilizing effects have exhibited time-varying properties such as countercyclicality as Christiano et al. (2011) and Woodford (2011) argue. To this end, we estimate a time-varying parameter structural vector autoregression (TVP-SVAR) model of Primiceri (2005) with a Bayesian approach using Gibbs sampler. To our knowledge, this study is the first attempt to estimate time-varying fiscal multipliers for Korea, contributing to more comprehensive policy discussions reflecting the perspective of emerging market economies. Furthermore, we aim to evaluate which determinants would serve as main drivers of fiscal multipliers in Korea, which might shed some light on identifying the prerequisites for a fiscal stimulus plan to be successful in emerging market economies. In this sense, our study is most relevant to Kirchner et al. (2010), while employing a more simplified approach in identifying those determinants.

We find that the GDP growth has significantly increased for approximately three to four quarters after the shock arrives, suggesting that an increase in discretionary government spending has affected
Korea’s economic growth in a favorable way over the sample period. Our fiscal multiplier estimates imply that the growth effect of a positive spending shock appears temporarily amplified around the three episodes: i) the early 1990s boom when Korean government massively invested on social infrastructures as well as housing constructions; ii) the 1997-1998 Asian currency crisis; iii) the global financial crisis. Moreover, our regression analysis suggests that the government spending multiplier in Korea appears inversely related to the output gap, the degree of openness, whereas exhibiting positive relationships with the share of government spending on fixed capital formulations as well as the level of household debts.

The remainder of this article is organized as follows: Section 2 provides the TVP-SVAR estimation results. Section 3 examines the main determinants of time-varying fiscal multipliers in Korea. Section 4 concludes with policy implications.

II. Estimation

Recent Trends of Korea’s fiscal situation

The last few decades have witnessed qualitative as well as quantitative changes in Korea’s government spending as depicted in Figure 1. Since the early 1990s, the amount of government spending in Korea has steadily increased with the economy’s size, up to roughly 20 percent of GDP. Moreover, in terms of the composition, the share of social welfare-related spending has risen as partly reflecting the nation’s structural factors such as demographical change, income polarization, etc., whereas spending on infrastructure has declined.

According to Oh (2012), Korea’s fiscal policy has begun to show counter-cyclical behaviors since the Asian currency crisis in the late 1990s. Indeed, Figure 2 shows that the contribution of government sector to GDP growth in Korea tends to become much higher in recessions including the global financial crisis in 2008, which is consistent with the assessment of Eskesen (2009) that Korea’s fiscal response at the outbreak of the global financial crisis has fulfilled major prerequisites for effective discretionary policy: timely, sufficient, but temporary stimulus. Moreover, the structural fiscal balance in Figure 3 suggests that the Korean government continue to maintain its expansionary fiscal policy for a while, at least, during the year of 2013.
Figure 1 Long-term trends of government spending in Korea

Sources: Ministry of Strategy and Finance (MOSF); authors’ calculations.
Note: Includes central government’s expenditure & lending minus repayment.

Figure 2 Contributions of government sector to Korea’s GDP growth

Sources: Bank of Korea (BOK); authors’ calculations.
Note: The shaded region shows recessions.

Figure 3 Structural fiscal balance

Sources: BOK; authors’ calculations.
Note: Calculated based on the IMF method.
Methodology

To assess the effectiveness of expansionary government spending in Korea along with the potential time variations taken into consideration, we formulate a tri-variate TVP-VAR model with government spending, GDP, and the policy interest rate. We include three variables in the system to minimize the number of coefficients considering computational burdens in the estimation procedure. In particular, to control the output effects from monetary policy, we include the policy rate in the system. Furthermore, notice that tax revenue variables are not included in the system as we focus on identifying the effects of government spending shocks in this study, by which fiscal shock identification can be readily achieved by applying the Cholesky decomposition. See Auerbach and Gorodnichenko (2012) for the potential difficulties in the shock identification when tax revenue variable is added. Regarding the order of endogenous variables, we follow Galí et al. (2007), Ramey (2011b) to assume that discretionary government spending is exogenous and predetermined, loading it in front of the GDP and the policy rate.

We use quarterly data series for real government spending, GDP (both in per capita terms), and nominal overnight call rate. To obtain the stationarity, we transform both spending and GDP series into growth rates on a year-over-year basis. The sample period covers from the third quarter of 1976 through the fourth quarter of 2011, but the actual estimating period spans from the fourth quarter of 1985 through the fourth quarter of 2011 after removing the initial training period required in setting priors of Bayesian estimation. The data are obtained from the Ministry of Strategy and Finance’s Consolidated Government Finance Statistics and the Bank of Korea’s Economic Statistics Database.

For the model specification, we set up TVP-SVAR model á la Primiceri (2005) as

\[ Y_t = c_t + B_{1t} Y_{t-1} + \ldots + B_{kt} Y_{t-k} + A_t^{-1} \Sigma_t \varepsilon_t, \quad Var(\varepsilon_t) = I_n, \quad t = 1, 2, \ldots, T \]  

(1)

where \( Y_t \) consists of government spending, GDP, and the overnight call rate, \( c_t \) are time-varying coefficients, \( B_{jt} \) are time-varying coefficient matrices, \( A_t \) are contemporaneous response coefficient matrices, \( \Sigma_t \) are covariance coefficient matrices, and \( \varepsilon_t \) are structural disturbances. Notice that this model specification (1) has advantage to capture possible time variations not only in the lag structure of the model and heteroskedasticity of the shocks, but also in the contemporaneous relations among variables (summarized in the matrix \( A_t \)), over other alternatives, e.g., Cogley and Sargent (2005), which do not allow the contemporaneous relations to vary over time.
For estimation, we stack in a vector all the right-hand side coefficients from the TVP-SVAR model (1), formulating a state-space form, which can be readily estimated by the Bayesian method using a Gibbs sampler in the spirit of Kim and Nelson (1999). To save spaces, we abstract the detailed explanation of TVP-VAR estimation procedures. Interested readers are referred to Primiceri (2005).\(^1\)

Estimation results

This subsection discusses TVP-SVAR estimation results. Figure 4 presents impulse response functions obtained from the model estimation. Notice that the horizontal axis in the figure corresponds to the calendar year and the vertical axis indicates how much Korea’s GDP growth rates respond to a positive government spending shock given the quarter of the year. To save spaces, we report only four snapshots taken at the impact, and the three, four, and six quarters after the shock arrival.

On the whole, we observe that the GDP growth rates significantly rise in response to the spending shock whereas the magnitudes vary across time. By periods, in the 1980s and 1990s the GDP growth responds to the spending shock in a significantly positive manner upon the impact whereas in the 2000s it is delayed by about three quarters. During the whole period, it appears that the growth effect of fiscal expansion persists during the initial four quarters until it disappears. Furthermore, we infer that the output effect might be strengthened in the early 1990s and the late 1990s when temporary peaks are observed.

More specifically, we arbitrarily select three specific points in time – 1990:Q1, 2000:Q1 and 2010:Q1 – from the sample period to illustrate a time-varying property of the growth effect from government spending shocks. Figure 5 exhibits that in the first quarter of 2010 the contemporaneous response of GDP growth to a 1 % point increase in government spending has significantly declined, taking longer time to reach the peak response, compared to the previous two points in time. Moreover, on the observation that in response to the spending shock the policy rates had sharply dropped for the first three quarters, we can assess that “crowding-out” effects occurred with delays. The subsample comparisons of the growth responses in Figure 6 echo our finding that since 2000 the growth effect of expansionary fiscal policy has become much weaker along with the peak delayed.

\(^1\) The details in our Bayesian estimation procedures are available upon request.
Figure 4 GDP growth responses to a 1% point increase in government spending

(Source: Authors’ estimates.  
Note: The dotted bands indicate 16th and 84th percentiles of response estimates.)

Figure 5 Impulse responses to a 1% point increase in government spending in 1990:Q1, 2000:Q1 and 2010:Q1

(Source: Authors’ estimates.)
Finally, we adjust the estimated impulse responses with scaling factors to obtain government spending multipliers in Korea. In this article, among a variety of the definitions, we choose to estimate both impact and peak multipliers, which are usually computed with a view to analyzing the short-term effect of expansionary fiscal policy. See Spilimbergo et al. (2009) for the details. Figure 7 presents a key result of time-varying government spending multiplier estimates for Korea. Both of the impact- and the peak- multiplier estimates reveal similar shapes with downward trends as well as multiple peaks. Figure 8 compares the spending multiplier estimates averaged over the two subsample periods: before- and after-2000. That is, before 2000, the peak multiplier is estimated as much as 0.78, while it declines to 0.44 in the second subsample. Interestingly, we notice that temporary peaks observed in the multiplier estimates tend to coincide with i) the early 1990s boom when Korean government actively invested social infrastructures and housing constructions; ii) the periods immediately after the 1997 Asian currency crisis and the 2008 global financial crisis. Given the estimation result, in the section that follows we aim to identify main determinants of government spending multipliers in Korea.
III. Major determinants of fiscal multipliers in Korea

We estimated TVP-SVAR model, yielding government spending multipliers with downward trends. In this section, we explore the main determinants of government spending multipliers by regressing our estimates on the selected variables from the existing literature.

*Determinants of government spending multiplier*

Based upon the relevant studies, we select the major driving forces of government spending multipliers in Korea as follows: i) business cycle (output gap); ii) fiscal consolidation (government debt to GDP); iii) dependence on tax revenues in financing (tax revenue/total spending); iv) external openness (import/GDP); v) the level of household debt (household debt / GDP); vi) the ratio of investment spending (Construction & SOC spending / total expenditure). Although they appear selected in an *ad-hoc* manner, we argue the coverage of those determinants is quite comprehensive for our analysis purpose. Table 1 summarizes a group of the selected determinants to explain the dynamics of government spending multipliers, along with the expected signs of regression coefficients as well as the relevant rationales.
We set up a model of the determinants of government spending multipliers as follows:

\[ FMP_t = \beta_0 + \beta_1YGAP_{t-1} + \beta_2GDEBT_{t-1} + \beta_3TXFIN_{t-1} + \beta_4IMP_{t-1} + \beta_5CRDT_{t-1} + \beta_6GINV_{t-1} + u_t \quad (2) \]

where the dependent variable \( FMP_t \) indicates government spending multiplier estimates obtained in the previous section, selected regressors are explained in Table 1, and \( u_t \) indicates the error term.

For the data, we use four-quarter moving averaged series to eliminate irregularities as our regressors consist of the nominal ratios between original data series. Furthermore, taking into account that all the regressors, except for the output gap \( (YGAP) \) and the ratio of imports to GDP \( (IMP) \), exhibit different levels of deterministic trends, we simply remove the trends from those regressors before running regressions. Then, our linear regression model (2) is estimated by the Ordinary Least Squares, and standard errors are calculated using the Newey-West HAC estimates.

**Discussing regression results**

Table 2 reports the OLS estimation results for our regression model (2) of government spending multipliers. The main findings from the regression result are summarized as follows.

First, the output gap appears inversely related to time-varying spending multipliers with significance at the conventional levels, which is consistent with economic theory (e.g., Christiano et al. 2011, Woodford 2011) and empirical evidence in advanced economies as shown in Figure 9.

Second, an increase in the degree of openness is likely to be negatively correlated to the spending multiplier estimates, which implies that the heightened level of openness during the last decade in Korea (as shown in Figure 10) may have worked as an important factor to reduce the growth effect of expansionary government spending.

Third, the ratio of household debt to GDP tends to be positively related to the spending multipliers. It follows that we could infer that Korea’s household debt may be sufficiently so high as to trigger private consumption shrinkage by worsening the liquidity situation.

Fourth, our regression result lends some support to the hypothesis that an increase in the investment-related spending would be more effective in boosting economic growth, compared to government consumptions. However, we can predict that spending on constructions and social infrastructures will be no longer implemented massively as in the early 1990s because Korea’s housing and infrastructure stock has already approached to major advanced countries.
Fifth, the level of government debt is positively related to spending multipliers, but with no statistical significance, implying that the so-called “non-Keynesian effect” does not hold in Korea. Moreover, the growth effect of government spending appears unrelated to its financing decision. We can infer that economic agents may not need to take fiscal-related information variable seriously because Korea’s government debt-to-GDP ratio is maintained relatively low as shown in Figure 11.

Table 1 Major determinants of government spending multipliers

<table>
<thead>
<tr>
<th>Determinants</th>
<th>Proxy variables</th>
<th>Expected signs</th>
<th>Justifications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Business cycle</strong></td>
<td>Output gap (YGAP)</td>
<td>Negative(-)</td>
<td>In recessions, the crowd-out effect diminishes due to the presence of economic slack; Christiano et al. (2011), Woodford (2011)</td>
</tr>
<tr>
<td><strong>Fiscal consolidation</strong></td>
<td>Government debt/GDP (GDEBT)</td>
<td>Negative(-)</td>
<td>As government debt level rises, agents tend to concern about their future tax burdens; Giavazzi and Pagano (1990)</td>
</tr>
<tr>
<td><strong>Dependence on tax revenues in financing</strong></td>
<td>Tax revenue/Total expenditure (TXFIN)</td>
<td>Negative(-)</td>
<td>Under the non-Ricardian world, agents may prefer debt-financed government spending.</td>
</tr>
<tr>
<td><strong>External openness</strong></td>
<td>Import/GDP (IMP)</td>
<td>Negative(-)</td>
<td>As a country’s trade openness becomes higher, government spending injection is more likely to leak out via purchasing import goods; Perotti (2005), Beetsma et al. (2008)</td>
</tr>
<tr>
<td><strong>Household debt</strong></td>
<td>Household debt/GDP (CRDT)</td>
<td>Negative(-)</td>
<td>When the debt ratio is relatively low, an increase in household debt improves the liquidity conditions.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Positive(+)</td>
<td>When the debt ratio reaches a threshold level, an increase in household debt dampens consumption.</td>
</tr>
<tr>
<td><strong>Shares of government investment spending</strong></td>
<td>Construction-SOC spending/Total expenditure (GINV)</td>
<td>Positive(+)</td>
<td>Government spending on capital expenditure tends to influence the GDP growth much more compared to the purchase of goods and services.</td>
</tr>
</tbody>
</table>


Table 2 Result of OLS regression estimation

<table>
<thead>
<tr>
<th>Regressors</th>
<th>Coefficients</th>
<th>t-values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-0.743</td>
<td>***</td>
</tr>
<tr>
<td>Output gap (YGAP)</td>
<td>-0.014</td>
<td>**</td>
</tr>
<tr>
<td>Government debt/GDP (GDEBT)</td>
<td>0.015</td>
<td></td>
</tr>
<tr>
<td>Tax revenue / Total expenditure (TXFIN)</td>
<td>0.006</td>
<td></td>
</tr>
<tr>
<td>Import/GDP (IMP)</td>
<td>-0.010</td>
<td>**</td>
</tr>
<tr>
<td>Household debt/GDP (CRDT)</td>
<td>0.026</td>
<td>***</td>
</tr>
<tr>
<td>Construction-SOC spending / Total expenditure (GINV)</td>
<td>0.027</td>
<td>***</td>
</tr>
</tbody>
</table>

| No. of observations | 104          |
| Adjusted R²         | 0.413        |

Source: Authors’ estimates
Notes: ** significant at 5%; *** significant at 1%.

Figure 9 Fiscal multipliers in G-7 economies


Figure 10 Openness and fiscal multiplier

Sources: BOK; authors’ estimates.
Figure 11 Government debt level by major countries

Source: IMF Fiscal Monitor (October 2012).
Note: As of the end of 2011.

IV. Concluding remarks

In this article, we apply TVP-SVAR model to the case of Korea in order to estimate how expansionary government spending shock has influenced the output with the data from 1986 through 2011. Our estimation results show that the GDP growth has significantly increased for approximately three to four quarters after the shock arrives, suggesting that an increase in discretionary government spending has affected Korea’s economic growth in a favorable way over the sample period. It follows from our estimates for fiscal multipliers that the growth effect of a positive spending shock appears temporarily amplified around the three episodes: i) the early 1990s boom when Korean government massively invested on social infrastructures as well as housing constructions; ii) the 1997-1998 Asian currency crisis; iii) the 2008 global financial crisis.

Furthermore, we examine the major driving forces of our fiscal multiplier estimates. Our regression analysis suggests that the multiplier estimates appears inversely related to the output gap, the degree of openness, whereas showing positive relationships with the share of government spending on fixed capital formulations as well as the level of household debts.

Based upon our empirical findings, we can draw some implications for Korea’s fiscal policy as follows. First, expansionary fiscal policy might be an effective option to boost the economy, in particular when it continues to suffer from sluggish recovery in growth. However, taking into account that Korea is currently going toward an aging society and its fiscal sustainability might be threatened in
the near future, it would be desirable that fiscal expansions should be executed temporarily. Second, providing targeted government transfers to liquidity-constrained households, partly due to high debt burdens (low income families, aged people, etc.), is recommended to boost the private demand in recessions. Third, considering that Korea’s infrastructure or fixed capital has been formulated to a sufficient level and its values added to the economy are expected to significantly decline, it would be advisable that the main focus of government’s investment expenditure should be redirected to build intangible assets including copyrights and patents for creating newly added-values to the Korean economy.
References


