Measuring the Effectiveness of Fiscal Policy in Korea

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(Very Preliminary)

Abstract

This paper mainly estimates a trajectory of GDP induced by variations in fiscal expenditure and taxation policy using VAR models. By assigning different combinations of identifying restrictions on the disturbances and measuring the corresponding fiscal multipliers, we compare how robust the estimated values of fiscal multipliers are with respect to the restrictions. Furthermore, empirical analysis into the Korean data (from 1979 to 2000) reveals that the size and the significance of the estimated fiscal multipliers in Korea are very small or they are decaying very fast.

I. Introduction

The purpose of this paper is to empirically test whether fiscal adjustments can contribute to smoothing economic fluctuations. It is well known that there have been two competing views on this issue, one of which known as Keynesian emphasizes the effectiveness of fiscal policy, and the other of which, so called new classical school, refutes it on the ground of crowding out effect and Ricardian equivalence. Considered that these two conflicting arguments stem from the emphasis on the different angles of looking at the reality (such as the bounded rationality and finite lives of economic agents), it would be more appropriate to do empirical analysis rather than continue theoretical debates.

This research mainly concerns a trajectory of GDP induced by variations in

fiscal expenditure and taxation policy[1]. We estimate Vector Auto Regression (VAR) models or Structural VAR models with Korean fiscal data in order to measure the sizes of fiscal multipliers dynamically following changes in fiscal expenditure and taxation. However, the quarterly Korean fiscal and GDP data (covering from 1979 Q1 to 2000 Q4) reveal that expansive fiscal policy has no significant or substantial effect on boosting the economy.

In order to check the robustness of our results, we assign different combinations of identifying restrictions on the disturbances of the tested SVAR systems and measure the corresponding fiscal multipliers. Observing how the estimated values of fiscal multipliers vary with respect to the restrictions, we find that the estimated fiscal multipliers of Korea decay very fast in addition to their small size and low statistical significance.

The contents of the paper are construed as follows: Section 2 surveys the relevant literature (from both Korean and foreign sources) on the issue. Section 3 introduces an analytical tool of the paper, basically a VAR system. Started from the usual Cholesky decomposition, we extend the setup to include other strategies of identification, such as Blanchard and Perotti(2002). Section 4 provides empirical results from applying the methodologies defined in section 3 to the case of Korea. Finally section 5 concludes.

II. Literature

1. Korean Literature

Korean literature on the effectiveness of fiscal policy can be classified in two groups depending on key variables. The first category of literature, focusing on measuring the impact of fiscal policy on income, overall confirm that government spending spurs aggregate income while tax increase reduces it (Kim(2001), Lee and Kim (2004), and Choi(2002)). On the other hand the second category of literature, focusing on the effect of fiscal policy on consumption

[1] In discussing the validity of fiscal policy in reigning business cycles, the importance of timeliness matters as much as the directions of policy effects due to the presence of policy time lags. To rephrase, the effectiveness of fiscal policy would not be achieved unless it is well synchronized with the changes in the economic environments. However, it would constitute another paper beyond the scope of this one to evaluate the stabilizing function of fiscal policy.

report that consumption responds positively or insignificantly to the increase in government spending (Park(1995), Mo and Bong(1996), and Cho(1996)). The next table summaries the existing Korean literature on the issue.

	Methodology	Results
Park, J.(1995)	Single equation approaches (Feldstein(1982) and Kormendi (1983)) and VAR	Positive effect of government spending on consumption
Cho, H. (1996)	Estimation of an Euler equations(Aschauer(1985))	Not able to reject Ricardian Equivalence theorem
Mo and Bong(1996)	Co-Integration(Modigliani and Sterling(1986)) and Two-stage estimation(Geweke and Poter-Hudak(1987))	Small effect of government spending on consumption
Park, H and J. Choi(1997)	VAR	Insignificant impact of fiscal deficit, government debt and spending increase on consumption, interest rate, exchange rate, and current account balance
Cho, H. and K. Park(1997)	Time varying parameter model under the Permanent Income Hypothesis	Government deficit and debt have almost no effect on consumption
Lee, I. And K. Kim (2004)	Input-output analysis in a Keynesian framework	Spending expansion is more appropriate in boosting an economy whereas tax reduction is more effective in diminishing the unemployment rate.
Kim, S.(2001)	Checking fiscal sustainability by estimating Present Value Constraint (Ahmed and Rogers(1995))	-The government spending spurs aggregate income while tax increase reduces it. -Adjustments in investment spending and direct taxes are more effective than those in non-discretionary spending and indirect taxes
Choi, J.(2002)	Asset demand functions and the causality analysis of a VAR system	Insignificant impact of government dent on real GDP, nominal GDP and GDP deflator
Kim, S.(2003)	Structural VAR with dummy variables considering a structural break (Cholesky decomposition)	After the Currency crisis, the impact of government expenditure, government consumption, and investment spending changed signs from (-) to (+).

2. Foreign Literature

Most of the research on the effectiveness of fiscal policy adopts a structural VAR setup. Such popularity of SVAR lies in that it minimizes dependency on the existing economic theory and utilizes a few key economic variables observed in reality. Furthermore, the VAR approach is relatively free from the symptoms of endogeneity, simultaneity and comovement existing among the variables used. Accordingly, it can analyze the dynamic impact of variations in tax revenue and government spending on macro variables from rather a less biased point of view.

On the other hand, an approach of using SVAR in analyzing the fiscal policy is more challenging than its application in monetary policy for several reasons, such as the existence of uncertain or unidentifiable policy lags and the automatic stabilization mechanism. These factors, combined with the frequency of fiscal data (mostly quarterly), cause technical difficulties in identifying sources of correlations or causalities among the disturbances of the VAR system and disentangling the contributions of the built-in stabilization mechanism. Thus, the recent development in analyzing the fiscal policy using the VAR setup naturally has been concentrated on handling those problems as follows:

	Methodology
Ramey and Shapiro(1998), Edelberg, Eichenabum, and Fisher(1999), Burnside, Eichenbaum and Fisher(2001)	VAR models with dummy variables specifying certain episodes
Fatas and Mihov(2000), Favero(2002)	SVAR(Cholesky Decomposition)
Mountford and Uhlig(2002)	VAR with sign restrictions
Blanchard and Perotti(2002), Perotti(2002), Hoppner(2002)	SVAR using institutional information and quarter dependence.
Becker(1997), Krusec(2003)	Structural Vector Error Correction model

III. Methodology

Our model adopts a SVAR system based on Blanchard and Perotti (2002) and De Castro(2004). Hence, it emphasizes the design of a shock identification scheme so that it can allow more realistic contemporaneous relations among key variables in the SVAR equations.

Here we choose three key variables- GDP(Y_t), the government expenditure(G_t), and tax revenue(T_t). All of them are logarized after being divided by population size. A vector consisting of these three variables, $X_t \equiv \begin{pmatrix} T_t \\ G_t \\ Y_t \end{pmatrix}$ is assumed to follow a VAR system:

$$X_t = A(L)X_{t-1} + D_t + U_t \qquad (1)$$

In the above equations, each element of the vector D_t represents the long-term trend of the corresponding variable, which are, in turn, assumed to have no influence on the long-term trends of the other variables. Such long run independence among the variables indicates our implicit assumption that there is no long run effect of fiscal measures on GDP. Thus, our model is focused on evaluating the effectiveness of fiscal policy not in terms of raising the long-run economic growth but in terms of controlling the short-term fluctuations.

Before discussing further about the detrending procedure, we have to consider that all the components in X_t tend to have seasonality. Blanchard and Perotti(2002) introduce quarterly dependency to the estimation of *A(L)* in a form of *A(L,q)* instead of using seasonally adjusted data. Depending on the number of observations available, the use of quarterly dependent version of (1) could be considered. Otherwise, a usual method of eliminating the seasonality, such as X-12, could be applied.

So far the VAR system in (1) has not been fully specified. Detailed assumptions on the disturbance term U_t as well as the long-term trend D_t are added as follows. To begin with, two types of detrending procedures are taken in the paper. One is linearly detrending with respect to time (X^{LD}) and the other is detrending by Hodrick-Prescott filtered data (X^{DHP}).

$$X_t^{LD} \equiv X_t - Dt, X_t^{DHP} \equiv X_t - X_t^{HP}$$

By plugging X^{LD} or X^{DHP}, we represent the VAR system of (1) in a neat way.

$$X_t^{DHP} = A(L)X^{DHP}{}_{t-1} + U_t$$

$$X_t^{LD} = A(L)X^{LD}{}_{t-1} + U_t \tag{2}$$

The long-term time trend D_t disappears in (2) because the vectors X^{LD} and X^{DHP} are consisting of detrended variables.

Second, our paper tries three different specifications on the disturbance term $U_t \equiv \begin{pmatrix} t_t \\ g_t \\ y_t \end{pmatrix}$. A general form of U_t could be represented as follows(($e^t{}_t, e^g{}_t, e^y{}_t$) are orthogonal to each other):

$$\begin{pmatrix} t_t \\ g_t \\ y_t \end{pmatrix} \equiv \begin{pmatrix} 0 & \alpha_2 & \alpha_3 \\ \beta_1 & 0 & \beta_3 \\ \gamma_1 & \gamma_2 & 0 \end{pmatrix} \begin{pmatrix} t_t \\ g_t \\ y_t \end{pmatrix} + \begin{pmatrix} 1 & a_2 & a_3 \\ b_1 & 1 & b_3 \\ c_1 & c_2 & 1 \end{pmatrix} \begin{pmatrix} e^t{}_t \\ e^g{}_t \\ e^y{}_t \end{pmatrix} \tag{3}$$

Due to identifiability, (3) requires additional restrictions on the coefficients. As special cases of the above, we consider Cholesky decomposition (in various combinations of ordering variables) and two identification strategies exploiting institutional information,

First, the Cholesky Decomposition restricts the coefficients of (3) in the following way (for example, in the order of tax revenue, expenditure, and GDP):

$$\begin{pmatrix} t_t \\ g_t \\ y_t \end{pmatrix} \equiv \begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix} \begin{pmatrix} t_t \\ g_t \\ y_t \end{pmatrix} + \begin{pmatrix} 1 & 0 & 0 \\ b_1 & 1 & 0 \\ c_1 & c_2 & 1 \end{pmatrix} \begin{pmatrix} e^t{}_t \\ e^g{}_t \\ e^y{}_t \end{pmatrix} \tag{4}$$

Identification of shocks by Cholesky decomposition, though easy to use, is vulnerable to change depending on the order of decomposition, which is

arbitrarily set. Therefore, in case of using the Cholesky decomposition without any prior about the structure of shocks, all the probable shock orderings should be tested and compared for robustness check[2].

Second, as a typical example of institutional identification strategies, we adopt Blanchard and Perotti(2002), whose shock identification is represented as

$$\begin{pmatrix} t_t \\ g_t \\ y_t \end{pmatrix} \equiv \begin{pmatrix} 0 & 0 & \alpha_3 \\ 0 & 0 & \beta_3 \\ \gamma_1 & \gamma_2 & 0 \end{pmatrix} \begin{pmatrix} t_t \\ g_t \\ y_t \end{pmatrix} + \begin{pmatrix} 1 & a_2 & 0 \\ b_1 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} e^t{}_t \\ e^g{}_t \\ e^y{}_t \end{pmatrix} \tag{5}$$

(5) reduces the number of parameters to estimate by borrowing the information on the GDP (or tax base) elasticities of tax revenues from external sources(α_3). In addition, B-P assume the GDP shock has no contemporaneous impact on the government spending ($\beta_3 = 0$). Then, they divide (5) in two cases by setting $a_2 = 0$ or $b_1 = 0$ alternatively.

The third identification strategy, which also depends on the institutional information, borrows the restrictions on β_1 and β_3(=0) from the budget data in addition to α_3, based on the almost common perception that the government of Korea has kept the principle of "Expenditure within Revenue" since 1980s[3] (Koh(2002)). Due to the long tradition of balanced budget, the level of expenditure still tends to be determined within the revenue forecasts. Exploiting such fiscal conservatism, we assign a restriction on β_1 by running a regression of expenditure increment on tax revenue increase and borrowing the coefficient thereof.

$$\begin{pmatrix} t_t \\ g_t \\ y_t \end{pmatrix} \equiv \begin{pmatrix} 0 & \alpha_2 & \alpha_3 \\ \beta_1 & 0 & \beta_3 \\ \gamma_1 & \gamma_2 & 0 \end{pmatrix} \begin{pmatrix} t_t \\ g_t \\ y_t \end{pmatrix} + \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} e^t{}_t \\ e^g{}_t \\ e^y{}_t \end{pmatrix} \tag{6}$$

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[2] De Castro(2004) analyzes a five variable VAR model with varying orders of Cholesky Decomposition. The five variables include price and interest rate in addition to GDP, government spending, and tax revenue. Due to the inclusion of the price variables, the five variable setup could examine the crowding-out effect revealed on them.

[3] [Quoted from Koh(2002)] "One important principle in fiscal management was established in this period. It was the principle of "Expenditure within Revenue," or the balanced budget principle. While not formalized in a law or a regulation, it acted as self-discipline imposed on the budget authorities against imprudent management of the budget."

In the next section we report the results from applying (4)-(6) to (2) sequentially. Impulse response functions are estimated with their 95% confidence intervals [4]. By comparing the results derived from different contemporaneous relations among the shocks, we could check the robustness of the SVAR models.

IV. Empirical Results

1. Data

Our empirical works are based on the data in Monthly Statistical Bulletin published by Bank of Korea. The data set includes the period from 1979Q1 to 2000Q4. However, its time coverage cannot be extended beyond year 2000 because as of 2001 Korean government introduced a new fiscal information system based on the consolidated budget, which is not compatible with the old data. Furthermore, the new data set of consolidated budget is not back- dated prior to 1994. Though the concept of consolidated budget seems more appropriate for the purpose of our research, we choose the Bank of Korea data for its relatively long span of time series.

[Figure1] draws the past trends of the government expenditure, tax revenue, and GDP, all of which are measured in logarized per capita real terms. It shows all the three variables tend to follow certain time trends. In addition, though not apparent in the figure, we observe that strong seasonality is present in all of the three variables. Thus, we process the data by eliminating seasonality (X-12) and the long-term time trend (linear time trend or H-P filtered) sequentially.

In order to check the presence of non-stationarity, Augmented Dickey Fuller(ADF) unit root tests are done for the variables, which are already seasonally adjusted and detrended (X^{LD}, X^{DHP}). The tests report that only the linearly detrended Y_t (the logarized per capita real GDP) seems to follow $I(1)$ [5].

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[4] The confidence level of 95% is used because it is sort of academic norm. However, when the results are reflected on policy making, the level of 95% should not be taken a golden rule.

[5] Rothenberg and Stock(1997) show that the coefficients of a VAR system estimated by OLS are consistent even though some level variables follows $I(1)$.

2. Results

Tested models have common in that all the variables used are logarized and their differences denote change rates of the corresponding variables. Accordingly, the values of impulse responses denote the GDP growth rates over a certain periods following an innovation (of a certain magnitude) in the growth rate of tax revenue, or expenditure, or GDP itself.

In addition the size of innovation to be applied in calculating an impulse response function is set to be 1 standard deviation of each error term in (e_t^t, e_t^g, e_t^y). Hence, the elasticity of per capita GDP with respect to either of fiscal stimulus is defined to be the ratio of logGDP change (GDP growth rate) to the sample standard deviation of the corresponding innovation term(the change rate of the relevant fiscal variable).

Considered that the current government expenditure and tax revenue in Korea is roughly 25-30% of GDP in size, we can convert the elasticity of per capita GDP to fiscal stimulus into a usual fiscal multiplier by multiplying 3-4 to the elasticity.

2.1. Cholesky Decomposition

[Table1] summarizes the estimation results of (4) with the linearly detrended data. The responses of GDP to the impulses of tax revenue and the government spending are either very small or statistically insignificant. Dividing the numbers in [Table1] by the estimated sample standard deviations of innovation terms (e_t^t, e_t^g, e_t^y)=(0.847,0.058,0.016), we can obtain the elasticities of GDP with respect to fiscal stimuli, which can be in turn converted into series of fiscal multipliers. [Figure2] draws impulse response functions for all the three variables

[Table2] summarizes the estimation results of (4) with the data detrended by H-P filter. As in the previous case, the responses of GDP to the impulses of tax revenue and the government spending are either very small or statistically

insignificant[6]. [Figure3] draws impulse response functions for all the three variables.

The above two cases of Cholesky decomposition are done in the order of tax revenue, government expenditure, and GDP. As for other possible orderings, we find the very small and(or) insignificant impulse responses.

2.2. Identification by Using Institutional information (B-P(2002))

B-P(2002), based on (5), borrow institutional information on α_3 from the calculation of GDP or tax bases elasticities of tax revenues. The additional restrictions, such as $\beta_3 = a_2 = 0$ or $\beta_3 = b_1 = 0$, seems rather arbitrary. While repeating the same procedure as in B-P(2002), we adopt the elasticities of tax revenues in Korea from Park and Park(2002)[7] and assign $\alpha_3 = 1.09$.

[Table3] shows the estimation results of the contemporaneous effects using the residuals of the VAR systems in (2). The signs of contemporaneous effects of innovations in tax revenues and spending on the disturbance of GDP (γ_1 and γ_2) are consistent with our anticipation that tax increase reduces GDP while spending spurs it.

[Table 4] compares the indirect contemporaneous effect of the Automatic Stabilization Mechanism and the direct contemporaneous effect of discretionary fiscal policy. The direct contemporaneous effects of fiscal innovations are measured by the estimates of γ_1 and γ_2. However, the changes in GDP influences back the tax revenue and the government spending in the form of t_t and/or g_t, from which the ASM takes over. Summing up the direct and the indirect contemporaneous effects, we obtain the value of total contemporaneous effect following an innovation in the fiscal sector.

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[6] For this case, the estimated sample standard deviations of innovation terms are $(e_t^{\,t}, e_t^{\,g}, e_t^{\,y})$=(0.077,0.056,0.013).

[7] They use the consolidated budget data from 1991 to 2002(annual). They classify the current tax revenues in Korea in 4 groups (income tax, corporate tax, indirect tax, and social security contribution) and calculate the elasticity of tax revenue with respect to tax base for each group. $\alpha_3 = 1.09$ is the weighted average of the four tax elasticities by the proportion of tax revenues to GDP.

From [Table 4], we see that the positive indirect contemporaneous effects of the ASM dominates the negative direct impact of discretionary fiscal impulse in case of tax shocks and $a_2 = 0$ while the direct effect of a spending shock is always greater than the indirect effect of the ASM followed.

In times of non-intervention, it is known that the built-in ASM smoothes out the fluctuation of a business cycle and reduces the need for government intervention. But in times of government intervention, the presence of the ASM works as friction against a policy maker, who intends to resize her fiscal programs for the purpose of controlling the business cycle. The results from [Table 4] indicate that the adjustment in tax has more to lose than to win at least contemporaneously once it is used whereas that in the government spending still maintains its validity as intended.

[Figure 4]-[Figure 9] display the impulse response functions of GDP with respect to tax revenue, government expenditure, and GDP, using the linearly detrended data, while [Figure 10]-[Figure 15] display the impulse response functions using the data detrended by H-P filter. Comparing these two groups of figures, we infer that the linear time trend may detect (or exaggerate) the persistence of the fiscal shocks on GDP treatment of long-term trends whereas H-P filter detrending may miss (or underestimate) the persistence. Especially, the persistence of tax revenue on GDP varies drastically depending on the treatment of long-term trends[8].

Whichever detrending method may be taken, the figures of impulse responses show that the positive effect of expenditure policy is statistically significant only in the very short-run (no longer than 3 quarters). On the other hand, the effect of tax increase is not significant in any case. Converted into fiscal multipliers, even the significant impulse responses have very small magnitudes less than 0.4. Hence, the effectiveness of fiscal policy is not confirmed under B-P identification strategy[9].

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[8] Tax policy seems to have more persistent effect on GDP than revenue policy under the linear time trend, which tends to leave the non-linear long-term trend. Accordingly, it remains a question whether the tax policy influences the long-term GDP growth or the non-linear long-term trends of tax and GDP incidentally commove in a linear way.

[9] Disregarding the 95% confidence interval and focusing on the fitted line of the impulse responses, we could have obtained the high value of accumulated fiscal multipliers in [Figure 4], [Figure 7], and [Figure 8].

2.3. Identification by Using "Expenditure within Revenue" Principle

The third identification strategy (6) borrows the restrictions on $\beta_1 (= 0.598)$ from the government budget data in addition to α_3, based on the perception of "Expenditure within Revenue" rule prevalent in 1980s and 1990s in Korea. This identification strategy differs from B-P(2002) in that it allows contemporaneous duplex relation between x_t and g_t. Instead it restricts that the errors of the disturbances, (e^t_t, e^g_t, e^y_t), should be orthogonal to each other.

[Table 5] reports the estimated contemporaneous effects of fiscal disturbances on GDP. The signs of the direct contemporaneous effects (γ_1 and γ_2) are consistent with those in [Table 3]. For both detrending methods, the contemporaneous effects from the ASM are much greater than those of the discretionary tax shocks ([Table 6]), which is opposite to the case of spending shocks. Such prevailing effect of the ASM, which works against the intended direction of discretionary revenue policy, is consistent with Keynesian wisdom that tax multiplier is smaller than that of spending.

[Figure 16]-[Figure 18] draw the impulse responses of GDP to tax revenue, expenditure, and GDP with the linearly detrended data and [Figure 19]-[Figure 21] draw the impulse responses with the data detrended by H-P filter. Some notable points from the figures are as follows. First, spending increase has significantly positive effect on GDP for the first 3 to 5 quarters regardless of a detrending method (though their magnitudes are also negligible when converted into fiscal multipliers). Second, tax increase has positive effect (very short-lived), which is opposite to our anticipation. As earlier mentioned, it can be attributed to the dominant contemporaneous effect of the ASM. Furthermore, it seems that the persistence of the counteractive effect from the ASM dilutes the negative effect of tax increase on GDP over a long horizon, leading to insignificant fiscal impulses.

So far we have considered various identification strategies starting from usual Cholesky decomposition in this section. Their results show different predictions on the effects from discretionary fiscal policy not only in terms of magnitudes but also in terms of signs. Though most of them confirm that the expansionary fiscal stance (whether it is tax cut or spending spree) has expansionary effect on the economy, we cannot believe that it demonstrates the

effectiveness of the fiscal policy considering most of the 95% significance intervals covers both negative and positive ranges.

V. Concluding Remarks

Summing up, our paper shows that the effectiveness of fiscal policy is not significantly identified in Korea regardless of policy measures, tax reduction or spending increase as well as regardless of methods of identifying shocks[10]. Though significantly identified in some cases, the effect from the fiscal policy is very small in magnitude and it phases out very quickly. Such low contribution of fiscal policy in economic stabilization[11] casts many points to ponder in steering the future research on this issue.

There are various ways of explaining the low performance of fiscal policy as a vehicle of boosting Korean economy. The first and easiest guess would be to accept the new classical argument. However, it still remains unsolved why the effectiveness of fiscal policy confirmed in other countries is refuted in case of Korea[12].

The second guess is that there may not exist one-to-one correspondence between fiscal stance and the transition of a business cycle, such as matching fiscal expansion with booming or fiscal tightening with landing. In other words, there may be non-linearity between fiscal measures and business cycles. Or there may exist an omitted and unobservable variable, the value of which changes the relationship between the fiscal variables and GDP. In such circumstances, the VAR models would not be able to detect the effectiveness of

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[10] Lee and Sung(2005) compare the estimators for the fiscal responsiveness of Korea to GDP shocks from OLS and IV estimation, and they report that both estimators are almost identical. Their results, mainly intended to eliminate the estimation bias for the fiscal responsiveness, can be interpreted to imply indirectly that fiscal expansion has no substantial effect on GDP.

[11] The use of consolidated budget data instead of the BOK data cannot support the effectiveness of fiscal policy , either.

[12] For one of pretests, we have done cross-country cross-sectional comparisons using World Development Indicator (by World Bank) as a measure to detect the effectiveness of fiscal policy. The result shows that the higher the government sector takes the portion in the aggregate economy the more stable the economy will be. In contrast, it also shows that the fluctuation of fiscal size doesn't have much to do with economic stabilization. Intuition behind this seemingly contradictory phenomenon is that the size of the government sector contributes to economic stability not because it can control business cycles but because it crowds out the private sector, which is more volatile than the government sector.

fiscal policy even if it is effective[13].

Anyway, our paper comes to the findings, which are exactly opposite to the generally accepted Keynesian theory. However, it is still too early to replace it with the new classical theory. Instead, based on the achievements made by this paper, it is more desirable to continue our research on this very old topic.

[13] As another pretests, we ran a VAR model consisting of the estimated conditional volatilities of the growth rates in fiscal expenditures, tax revenues, and per capita real GDP in order to verify the stabilization effect of fiscal policies. The results showed that the increased volatility of fiscal expenditure growth alleviates the volatility of the GDP growth rate, which even partially supports this conjecture.

Reference

(In Korean)

Choi, Jong-Soo, "An Empirical Analysis on the Barro-Ricardo Equivalence Hypothesis", Korean Journal of Public Economics, Vol.7, No.1, The Korean Association of Public Finance and Economics, 2002.5.

Jo, Ha-Hyun, "An Empirical Study on the Ricardian Equivalence Theorem : the case of Korea(1971-1995)", Kyong Je Hak Yon Gu, Vol.44, No.4, The Korean Economic Association, 1996.12.

Jo, Ha-Hyun and Park, Kwang-Woo, "Ricardian Equivalence Theorem and Effect of Fiscal Policy in Korea(1971-1995)", Journal of Korean Economics Analysis, Vol.3, No.2, Korea Institute of Finance, 1997.12.

Kim, Seong-Suhn, "Fiscal Deficit Effects and Sustainability", The Korean Journal of Public Finance, Vol.15, No.2, The Korean Association of Public Finance and Economics, 2001.6.

Kim, Seong-Suhn, "A Study on the Structural Change of Fiscal Policy after Korean Currency Crisis", Quarterly Economic Analysis, Vol.9, No.4, Institute for Monetary & Economic Research The Bank of Korea, 2003.□.

Kook, Joong-Ho, "A Study on the Tax Structure in Korea and Japan Using the Classification of Income, Consumption, and Property Taxation", Korea Institute of Public Finance, 1998.

Koh, Young-Sun, "The Impact of Budget Deficits on Inflation and Private Savings", The KDI Journal of Economic Policy, Vol.22, No.1,2, 2000.

Lee, Kye-Sik and Koh, Young-Sun, "The Macroeconomic Impact of Budgetary Items", The KDI Journal of Economic Policy, Vol.17, No.2, 1995.

Mo, Soo-Won and Bong, Woo-Jong, "Ricardian Equivalence Hypothesis : Integer and Fractional Differencing", Kyong Je Hak Yon Gu, Vol.47, No.2, The Korean Economic Association, 1999.6.

Park, Ha-Seob and Choi, Jong-Soo, "Some Empirical Tests on the Ricardian Neutrality Hypothesis in Korea", The Korean Journal of Public Finance, Vol.12, No.2, The Korean Association of Public Finance and Economics,1997.12.

Park, Ki-baeg, "Korean Fiscal Management - Past Experience", Korea Institute of Public Finance, 2001.

Park, Ki-baeg, and Park, Hyung-soo, "Fiscal role in economic stabilization", Korea Institute of Public Finance, 2002.

Park, Jong-Koo, "Government Spending and Private Consumption", The Korean Journal of Public Finance, Vol.9, The Korean Association of Public Finance and Economics, 1995.3.

Bank of Korea, Monthly Statistical Bulletin, various issues.

(In English)

Agenor, P-R., C. J. McDermott, and E.S. Prasad, "Macroeconomic Fluctuations in Developing Counttries: Some Stylized Facts," *IMF working paper*, 1999.

Becker, T., "An Investigation of Ricardian Equivalence in A Common Trends Model", *Journal of Monetary Economics*, 1997, pp405-431.

Bernanke, B., "Alternative Explanation of the Money-Income Correlation", *Carnegie-Rochester Conference Series on Public Policy*, 1986, pp49-100.

Blanchard, O. J. and R. Perotti, "An Empirical Characterization of the Dynamic Effects of Changes in GOvernment Spending and Taxes on Output," *Quarterly Journal of Economics*, V.117, 2002, pp.1329~1368.

Burnside, C., M. Eichenbaum and J. Fisher, "Assessing the Effects of Effects of fiscal Shocks", Northwestern University, mimeo, 2000.

De Castro, F, "The Macroeconomic Effects of Fiscal Policy in Spain," *Banco de Espana working paper*, 2004.

Edelberg, W., M. Eichenbaum and J. Fisher, "Understanding the Effects of Shocks to Government Purchases," *Review of Economic Studies*, 1999, pp166-206.

Fatas, A. and I. Mihov, "The Effects of Fiscal Policy on consumption and Employment: Theory and Evidence", INSEAD, mimeo, 2000.

Favero, C., "How do European Monetary and Fiscal Authorities Behave?", *CEPR working Paper* No. 3426, 2002.

Hemming, R., M. Kell, and S. Mahfouz, "The Effectiveness of Fiscal Policy in Stimulating Economic Activity - A Review of the Literature," *IMF working paper*, 2002.

Hoppner, F., "Fiscal Policy and Automatic Stabilizers: A SVAR Perspective", Institute for International Economics, University of Bonn Lennestr, 2002.

Koh, Y., 2002, Public Expenditure Management in Korea, mimeo.

Kormendi, R., "Government Debt, Government Spending and Private Sector Behavior", *American Economic Review*, 1983, pp994-1010.

Krusec, D., "The Effects of Fiscal Policy on Output in a Structural VEC Model Framework: The Case of Four EMU and Four Non-EMU OECD", European University Institute Florence, Italy, 2003.

Lee, Y. and T. Sung, "Fiscal Policy, Business Cycles, and Economic Stabilization: Evidence from Industrial and Developing Countries", working paper, 2005.

Mountford, A. and H. Uhlig, "What are the Effects of Fiscal Policy Shocks", *CEPR working paper* No. 3338, 2002.

Perotti, R., "Fiscal Policy in Good Times and Bad," *Quarterly Journal of Economics*, V.114, 1999, pp.1399~1436.

Ramey, V. and M. Shapiro, "Costly Capital Reallocation and the Effects of Government Spending", *NBER working paper* 6283, 1998.

Rothenberg, T. and J. Stock, " Inference in a Nearly Integrated Autoregressive Model with Non-normal Innovations", Journal of Econometrics, 1997, pp 269-286.

[Table1] Impulse Response Functions of Key Variables (linearly detrended) by Cholesky Ordering (in the order of tax revenue, expenditures, GDP)

Quarter	OIRF(1)	Lower(1)	Upper(1)	OIRF(2)	Lower(2)	Upper(2)
0	0.0034	-0.0001	0.0068	0.0042	0.0009	0.0076
1	0.0011	-0.0037	0.0058	0.0054	0.0008	0.0101
2	-0.0013	-0.0073	0.0047	0.0067	0.0011	0.0123
3	-0.0033	-0.0102	0.0037	0.0075	0.0010	0.0141
4	-0.0049	-0.0121	0.0023	0.0042	-0.0027	0.0112
5	-0.0064	-0.0139	0.0010	0.0038	-0.0036	0.0113
6	-0.0084	-0.0160	-0.0008	0.0031	-0.0046	0.0108
7	-0.0089	-0.0167	-0.0011	0.0021	-0.0059	0.0100
8	-0.0087	-0.0166	-0.0008	0.0016	-0.0065	0.0096
9	-0.0088	-0.0168	-0.0008	0.0011	-0.0071	0.0093
10	-0.0088	-0.0169	-0.0008	0.0003	-0.0080	0.0087

Note: 95% lower and upper bounds reported

(1) impulse = lpr_rev, and response = lpr_gdp
(2) impulse = lpr_spe, and response = lpr_gdp

[Table2] Impulse Response Functions of Interest Variables (detrended by H-P filter) by Cholesky Ordering (in the order of tax revenue, expenditure, GDP)

Quarter	OIRF(1)	Lower(1)	Upper(1)	OIRF(2)	Lower(2)	Upper(2)
0	0.0053	0.0023	0.0082	0.0039	0.0011	0.0067
1	0.0042	0.0005	0.0080	0.0038	0.0002	0.0074
2	0.0033	-0.0010	0.0077	0.0025	-0.0017	0.0067
3	0.0027	-0.0019	0.0072	0.0020	-0.0024	0.0065
4	0.0022	-0.0024	0.0067	-0.0023	-0.0068	0.0022
5	0.0002	-0.0031	0.0035	-0.0025	-0.0064	0.0013
6	-0.0013	-0.0039	0.0014	-0.0034	-0.0068	-0.0001
7	-0.0019	-0.0044	0.0006	-0.0036	-0.0067	-0.0006
8	-0.0017	-0.0043	0.0009	-0.0025	-0.0051	0.0001
9	-0.0014	-0.0039	0.0011	-0.0016	-0.0040	0.0009
10	-0.0009	-0.0032	0.0013	-0.0006	-0.0030	0.0018

Note: 95% lower and upper bounds reported

(1) impulse = c_rev, and response = c_gdp
(2) impulse = c_spe, and response = c_gdp

[Table 3] Estimation of Contemporaneous Effect ($\alpha_3 = 1.09$ and $\beta_3 = 0$)

(1) Linearly Detrended

	γ_1	γ_2	$a_2 (b_1 = 0)$	$b_1 (a_2 = 0)$
estimate	-0.086***	0.129***	0.659***	0.656***
t-value	-2.73	4.03	7.90	7.90

(2) Detrended by H-P filter

	γ_1	γ_2	$a_2 (b_1 = 0)$	$b_1 (a_2 = 0)$
estimate	-0.037***	0.110***	0.603***	0.655***
t-value	-1.37	4.1	7.32	7.32

Note: *** denotes the significance level of less than 1%

[Table 4] Decomposition of Contemporaneous Effects as a Sum of the Direct Effect from Discretionary Policy and the Indirect Effect from Automatic Stabilization Mechanism(ASM) ($\alpha_3 = 1.09$ and $\beta_3 = 0$)

(1) Linearly Detrended

	$a_2 = 0$		$b_1 = 0$	
	Tax	Spending	Tax	Spending
Discretionary Policy	-0.086	0.129	-0.086	0.129
ASM	0.087	-0.016	0.012	-0.064
Contemporaneous Effects	0.001	0.113	-0.074	0.065

(2) Detrended by H-P filter

	$a_2 = 0$		$b_1 = 0$	
	Tax	Spending	Tax	Spending
Discretionary Policy	-0.037	0.110	-0.037	0.110
ASM	0.081	-0.014	0.018	-0.025
Contemporaneous Effects	0.044	0.096	-0.019	0.085

[Table 5] Estimation of Contemporaneous Effect ($\alpha_3 = 1.09, \alpha_2 = 0$, $\beta_1 = 0.598, \beta_2 = 0$)

(1) Linearly Detrended

	γ_1	γ_2
estimate	-0.056*	0.082***
t-value	-1.84	2.67

Note: * denotes the significance level of less than 10%
*** denotes the significance level of less than 1%

(2) Detrended by H-P filter

	γ_1	γ_2
estimate	-0.014	0.075**
t-value	-0.55	2.86

Note: ** denotes the significance level of less than 5%

[Table 6] Decomposition of Contemporaneous Effects as a Sum of the Direct Effect from Discretionary Policy and the Indirect Effect from Automatic Stabilization Mechanism(ASM)
($\alpha_3 = 1.09, \alpha_2 = 0$, $\beta_1 = 0.598, \beta_2 = 0$)

(1) Linearly Detrended

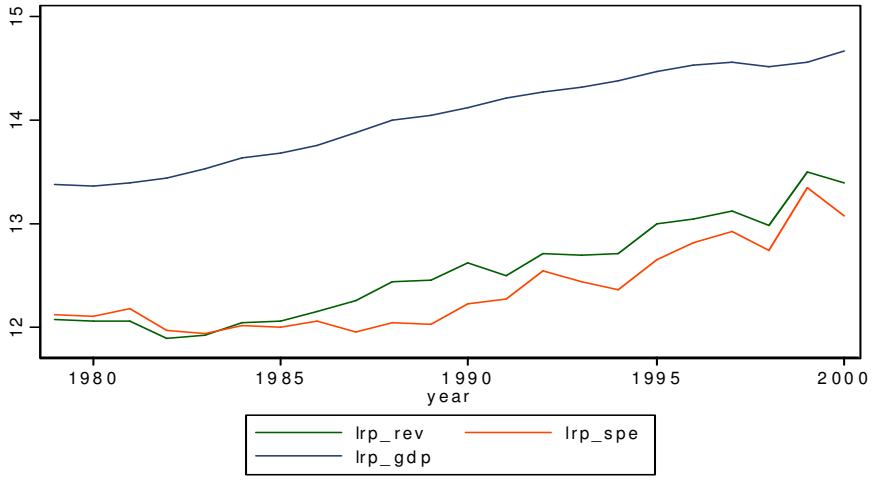
	Tax	Spending
Discretionary Policy	-0.056	0.082
ASM	0.062	-0.076
Contemporaneous Effects	0.006	0.006

(2) Detrended by H-P filter

	Tax	Spending
Discretionary Policy	-0.014	0.075
ASM	0.022	-0.070
Contemporaneous Effects	0.008	0.005

[Figure1] Trends of Government Expenditure, Tax Revenue, and GDP

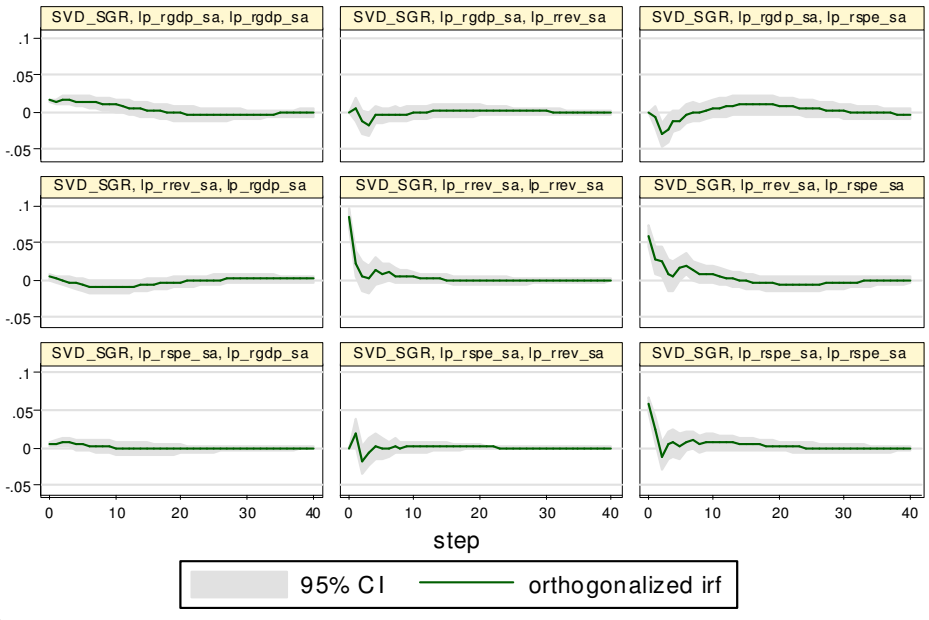
(Quarterly data from 1979Q1-2000Q4))



- Source: Monthly Statistical Bulletin (Bank of Korea)
- The above variables are measured in logarized per capita real terms

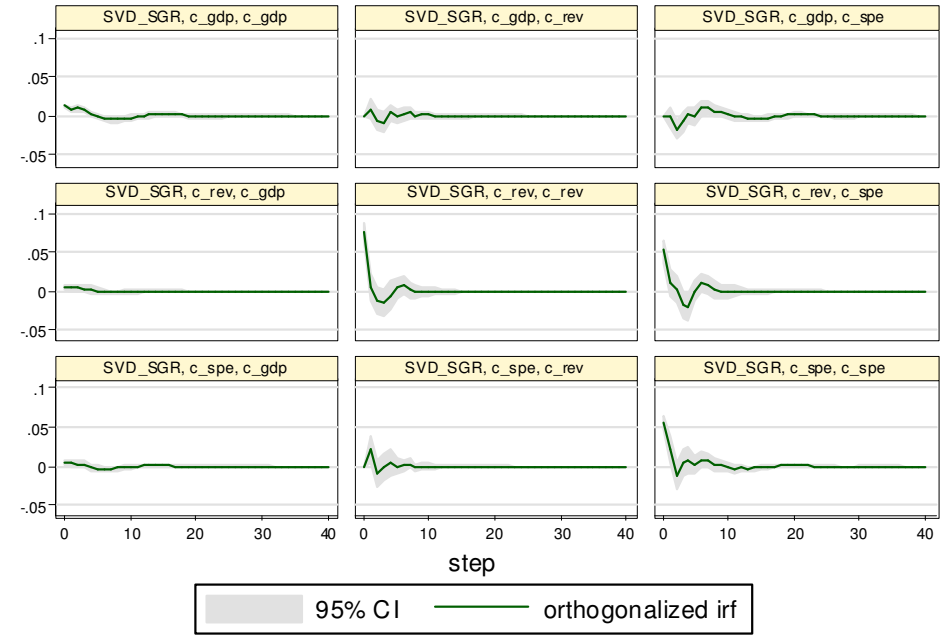
[Figure 2] Impulse Response Functions of Key Variables (linearly detrended)

by Cholesky Ordering (in the order of tax revenue, expenditures, GDP)

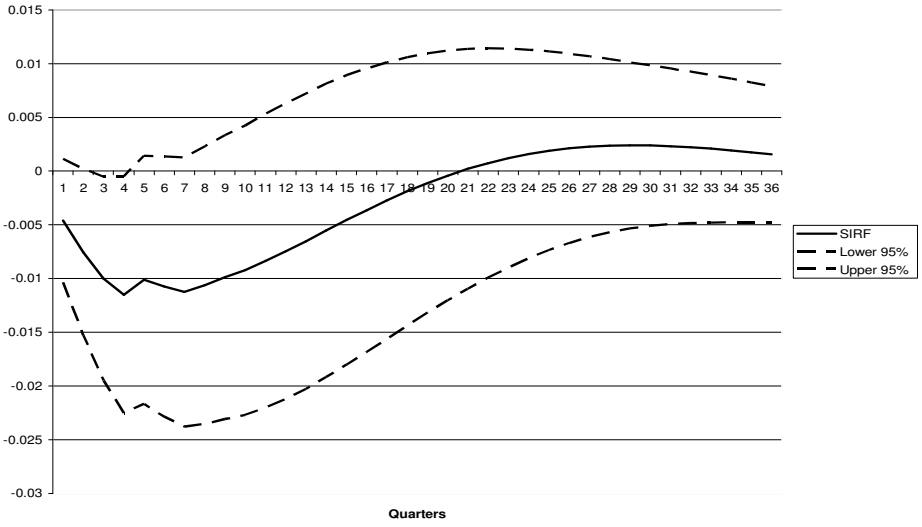


Graphs by irfname, impulse variable, and response variable

[Figure 3] Impulse Response Functions of Interest Variables (detrended by H-P filter)
by Cholesky Ordering (in the order of tax revenue, expenditure, GDP)

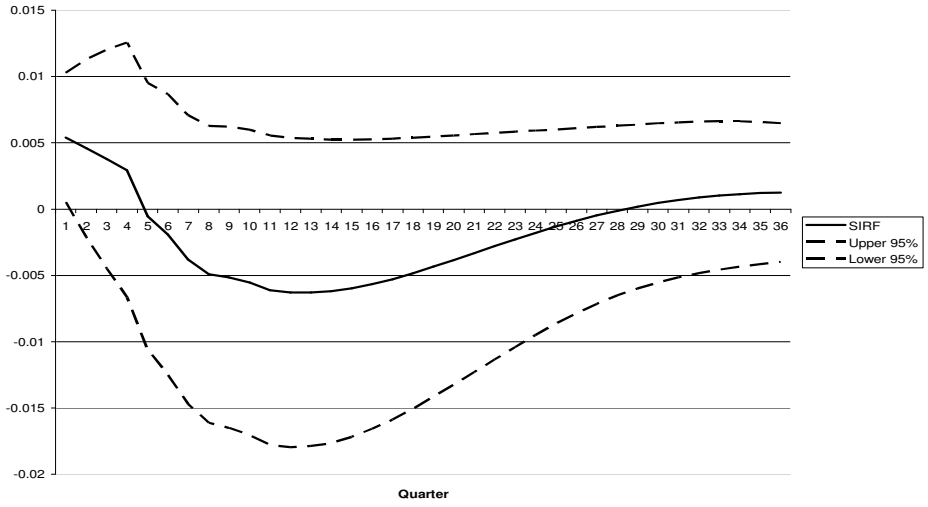


[Figure 4] Impulse Responses of GDP to Tax Revenue Estimated by B-P(2002)
(linearly detrended and setting $b_1 = 0$)



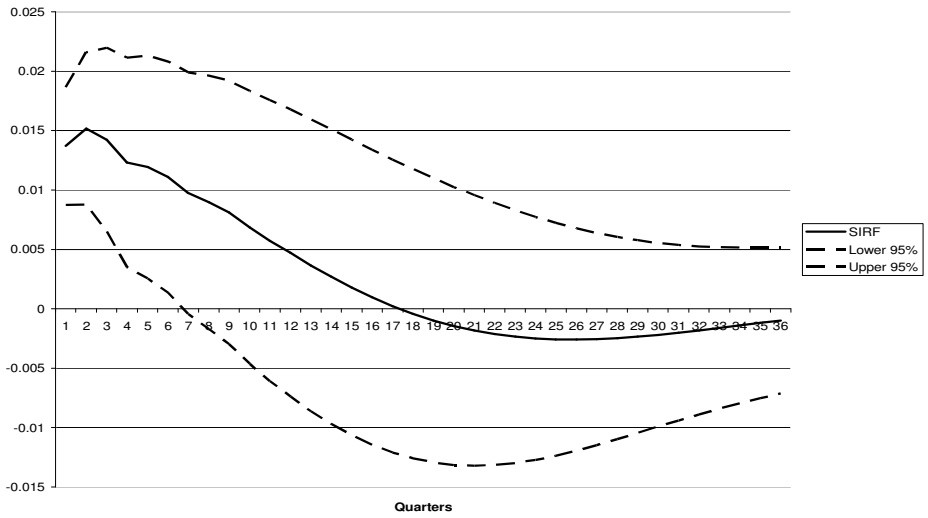
[Figure 5] Impulse Responses of GDP to Expenditure Estimated by B-P(2002)

(linearly detrended and setting $b_1 = 0$)



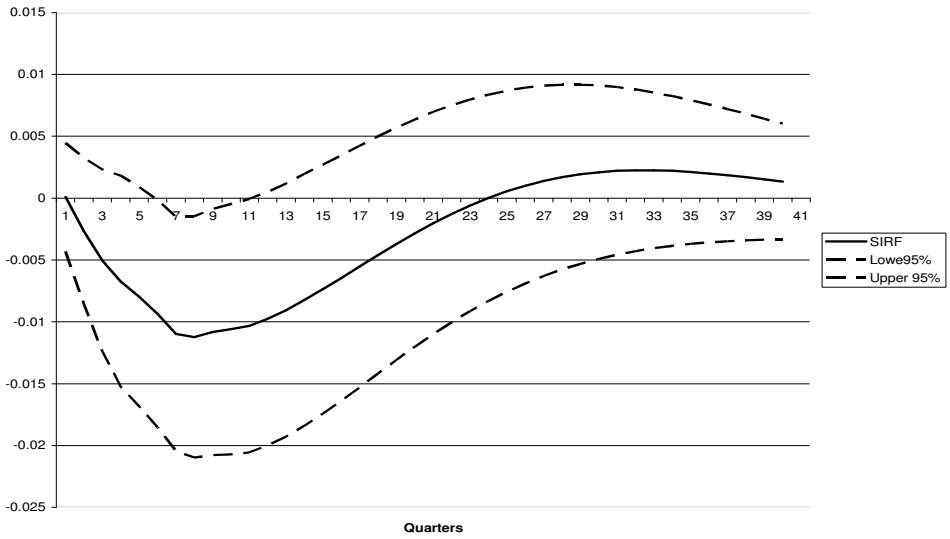
[Figure 6] Impulse Responses of GDP on GDP Estimated by B-P(2002)

(linearly detrended and setting $b_1 = 0$)



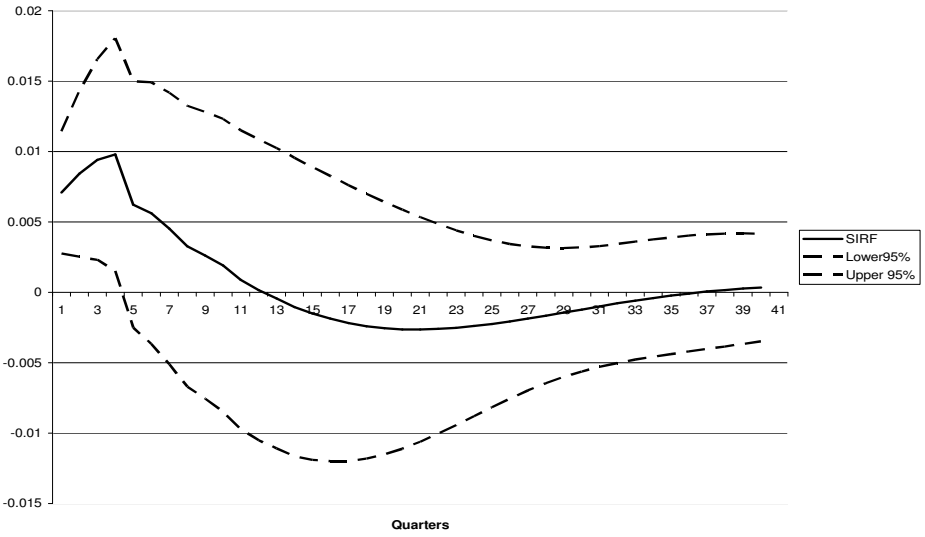
[Figure 7] Impulse Responses of GDP to Tax Revenue Estimated by B-P(2002)

(linearly detrended and setting $a_2 = 0$)



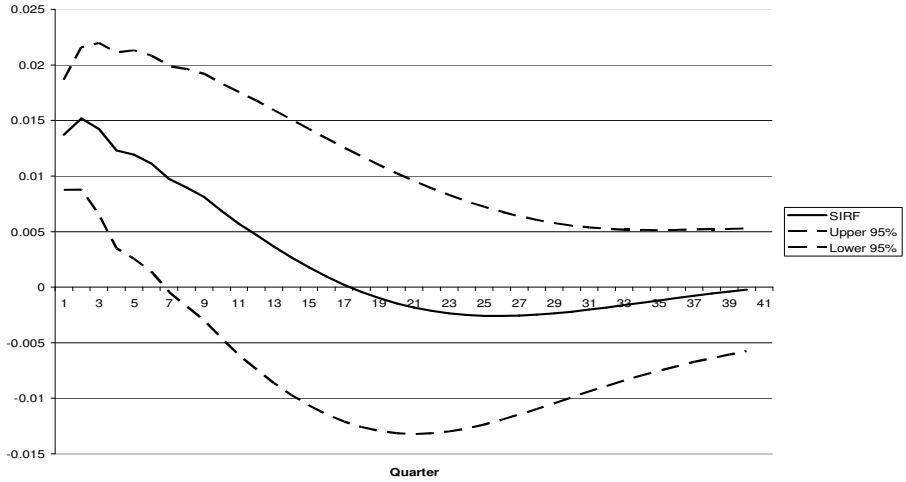
[Figure 8] Impulse Responses of GDP to Expenditure Estimated by B-P(2002)

(linearly detrended and setting $a_2 = 0$)



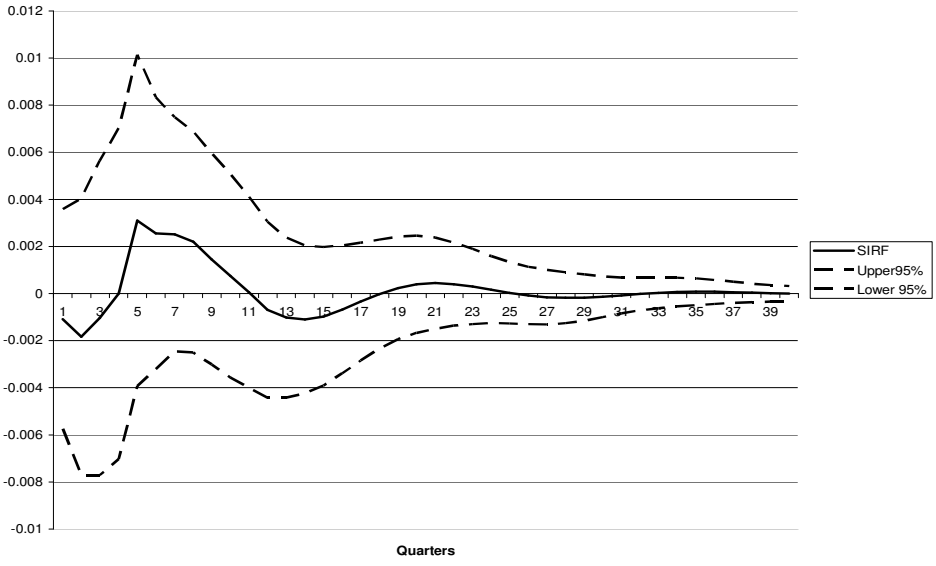
[Figure 9] Impulse Responses of GDP on GDP Estimated by B-P(2002)

(linearly detrended and setting $a_2 = 0$)



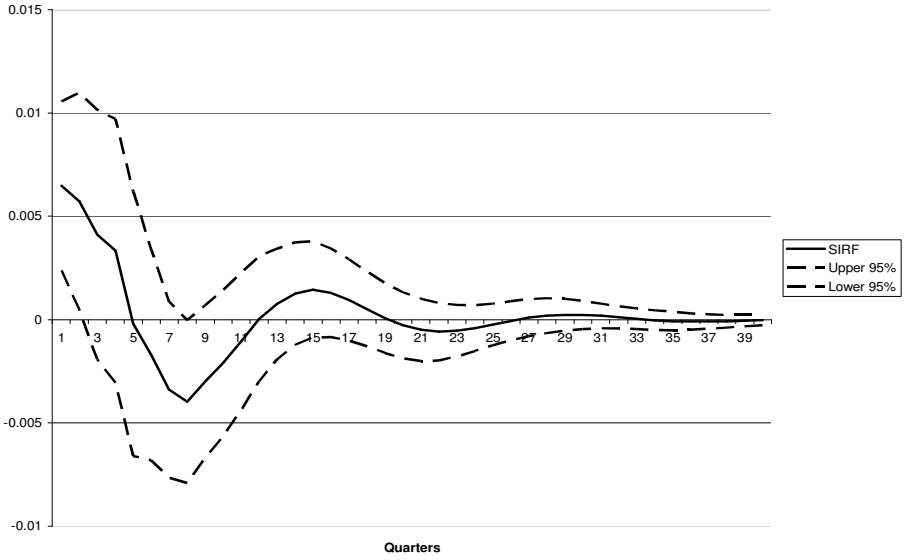
[Figure 10] Impulse Responses of GDP to Tax Revenue Estimated by B-P(2002)

(detrended by H-P filter and setting $b_1 = 0$)



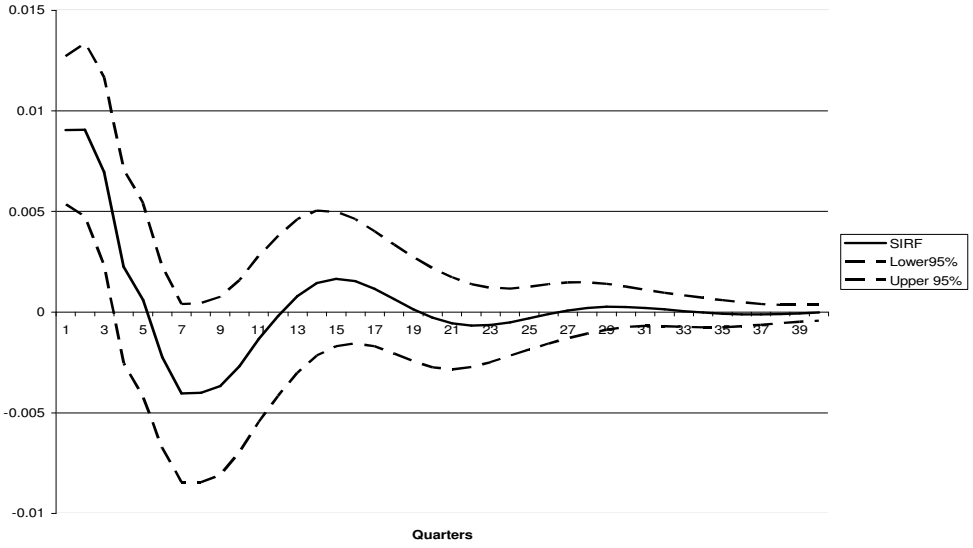
[Figure 11] Impulse Responses of GDP to Expenditure Estimated by B-P(2002)

(detrended by H-P filter and setting $b_1 = 0$)



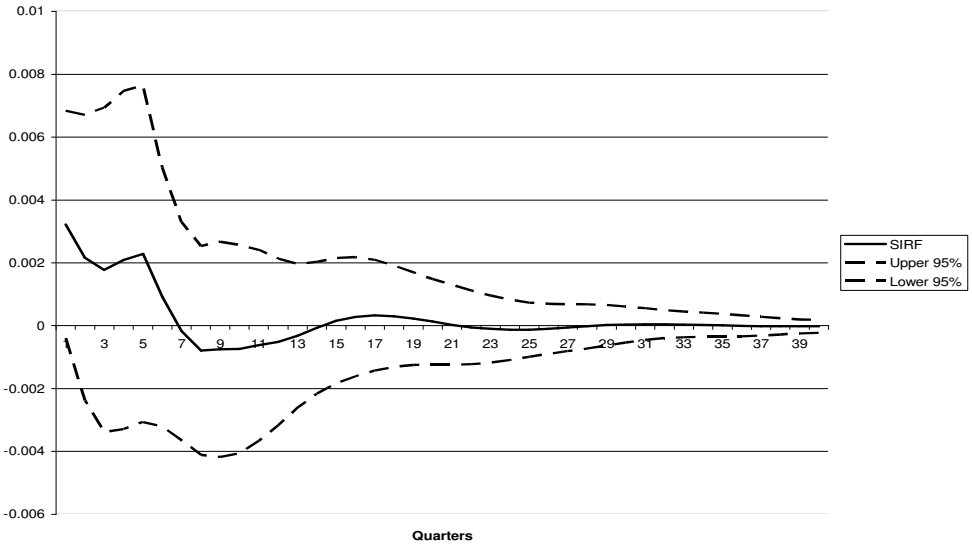
[Figure 12] Impulse Responses of GDP on GDP Estimated by B-P(2002)

(detrended by H-P filter and setting $b_1 = 0$)



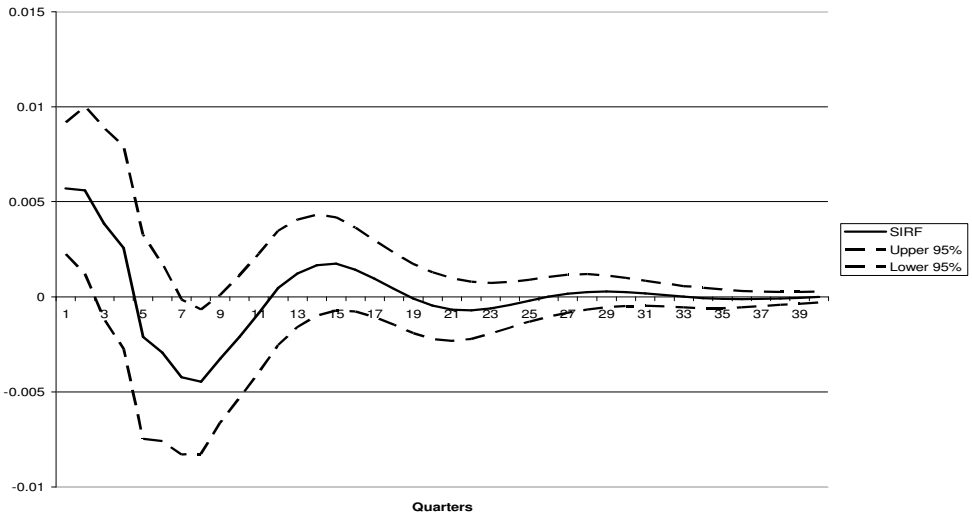
[Figure 13] Impulse Responses of GDP to Tax Revenue Estimated by B-P(2002)

(detrended by H-P filter and setting $a_2 = 0$)



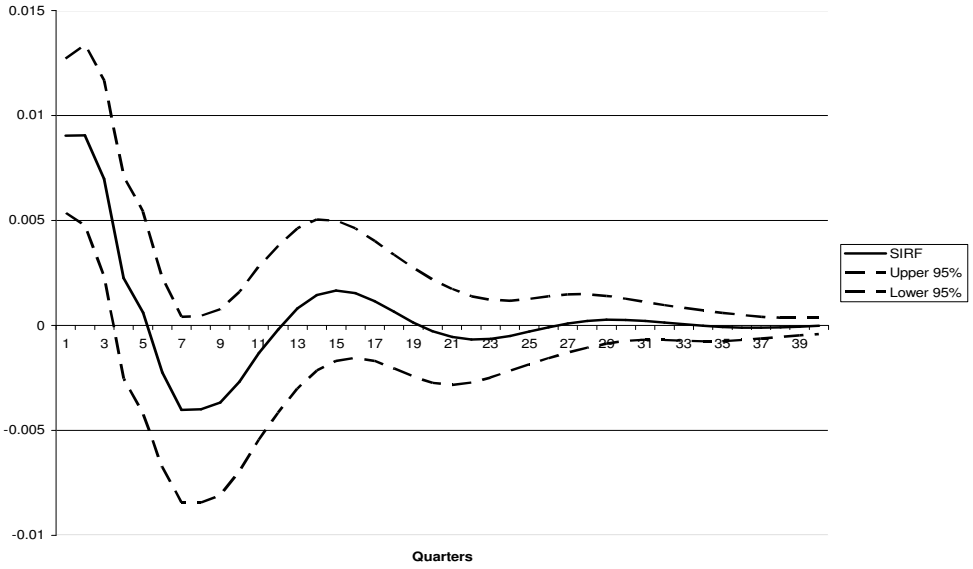
[Figure 14] Impulse Responses of GDP to Expenditure Estimated by B-P(2002)

(detrended by H-P filter and setting $a_2 = 0$)



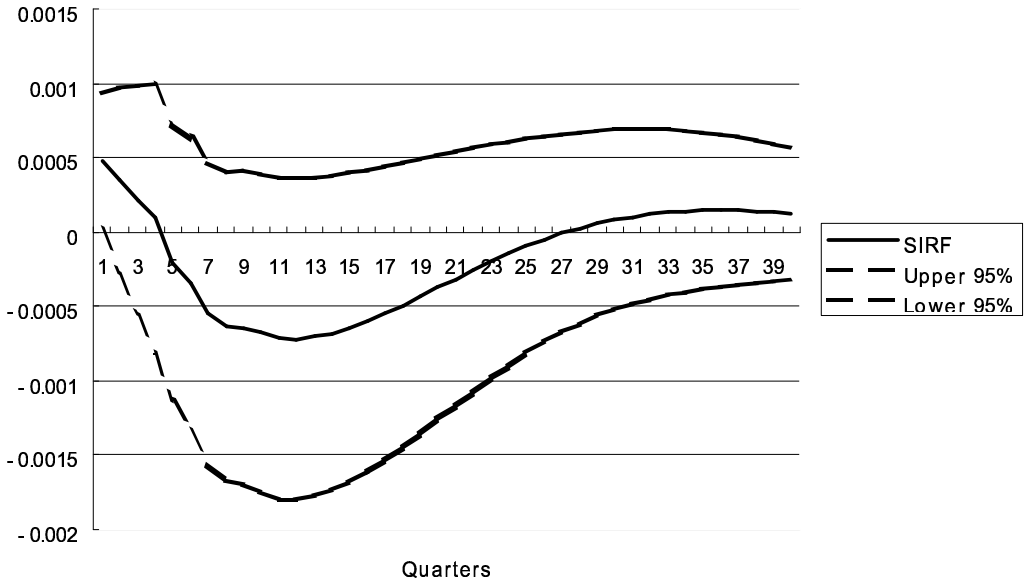
[Figure 15] Impulse Responses of GDP on GDP Estimated by B-P(2002)

(detrended by H-P filter and setting $a_2 = 0$)

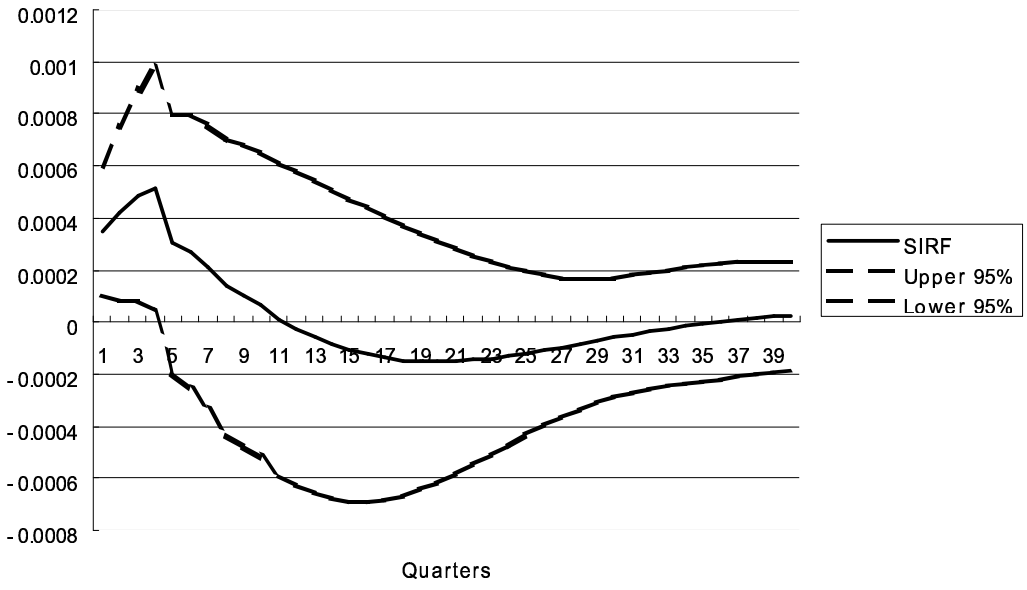


[Figure 16] Impulse Responses of GDP to Tax Revenue Estimated

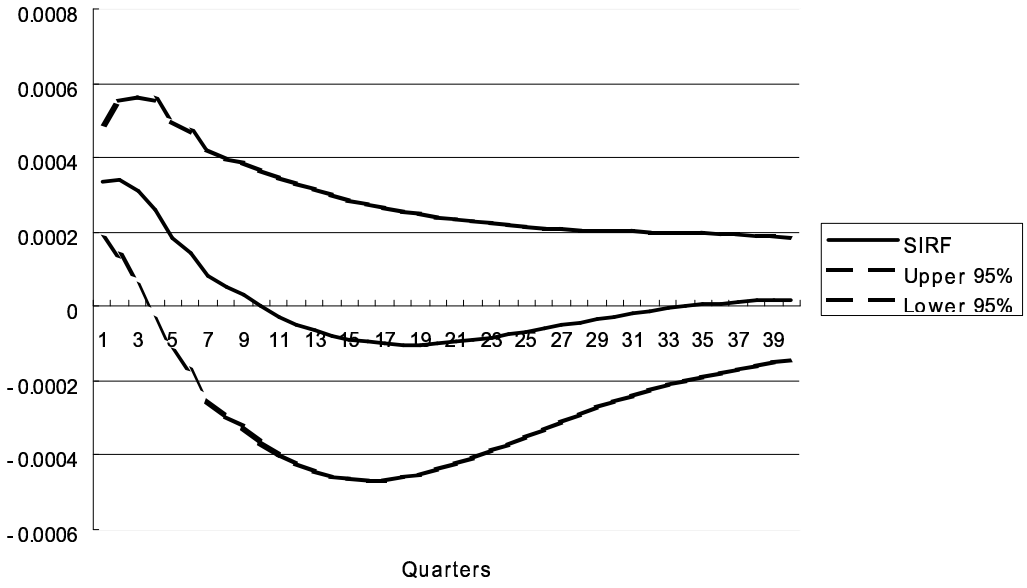
by Alternative Institutional Identifying Restrictions (linearly detrended)



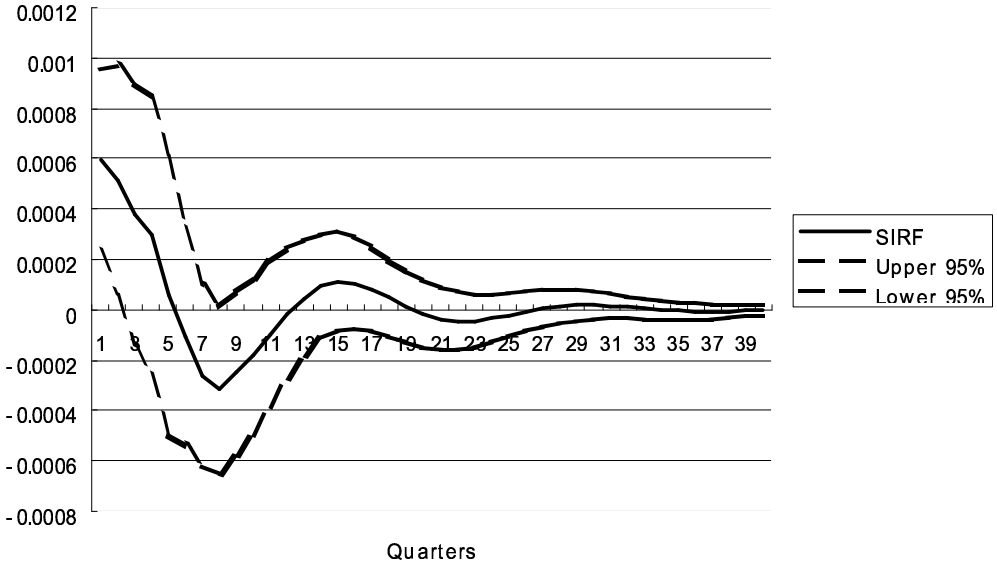
[Figure 17] Impulse Responses of GDP to Expenditure Estimated by Alternative Institutional Identifying Restrictions (linearly detrended)



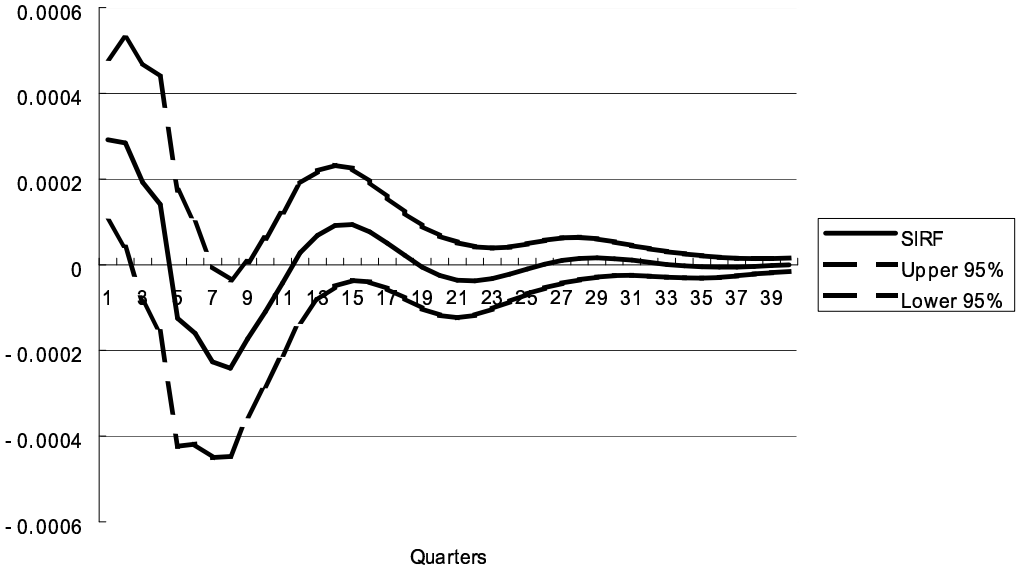
[Figure 18] Impulse Responses of GDP on GDP Estimated by Alternative Institutional Identifying Restrictions (linearly detrended)



[Figure 19] Impulse Responses of GDP to Tax Revenue Estimated
by Alternative Institutional Identifying Restrictions (detrended by H-P filter)



[Figure 20] Impulse Responses of GDP to Expenditure Estimated
by Alternative Institutional Identifying Restrictions (detrended by H-P filter)



[Figure 21] Impulse Responses of GDP on GDP Estimated

by Alternative Institutional Identifying Restrictions (detrended by H-P filter)