Macroeconomic Dynamics and the Effects of Fiscal Spending in Uganda

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Abstract

This paper investigates the effects of Government fiscal spending and borrowing on the Ugandan Economy. Towards this end initial analysis is done regarding the measurement of economic activity independent of government spending. A dynamic factor index is proposed alongside with a unified quarterly GDP series, which are compared to various World Bank and survey based activity indicators. This is followed by a decomposition of government spending and a set of growth regressions examining the effect of various forms of fiscal spending on various measures of economic activity while controlling for various forms of private sector borrowing. The final part of the paper conducts an SVAR analysis relating fiscal spending to other leading macroeconomic and financial aggregates. Results imply that only spending in key growth sectors (infrastructure, minerals, trade, industry, ICT, science and tourism) relates significantly to economic activity, where each shilling spent brings an approx. 2-3 fold return in value added over the course of 3 years. All types of fiscal spending raise the T-Bill rate with 3-year elasticities between 0.3 and 1.3, but do not appear to crowd out credit to the private sector. Annecdotal evidence suggests that fiscal spending is significantly procyclical.

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1 Introduction

Fiscal spending is generally supposed to have a positive effect on economic activity, stimulating investment and growth in the economy, while safeguarding and enhancing the wealth of citizens, who in turn contribute to government activity through payment of taxes. However, if government spending is ineffective in stimulating government activity, or if government spending takes place by means of extensive private sector borrowing, then its effects on economic activity may turn out to be negative, and a reduced role of the government would be preferable for economic growth. This paper seeks to provide some empirical evidence on which of the two scenarios is more likely to be the case.

This analysis of fiscal spending in its relation to economic activity requires both a suitable decomposition of fiscal spending into growth enhancing and other components, and suitable measures representing government taxation and borrowing from individuals and the private sector. Furthermore, suitable high-frequency measures of economic activity with significant time-coverage are necessary. In most developed countries, a quarterly real GDP series spanning several decades serves as a suitable outcome measure for such an analysis. In Uganda, the quarterly GDP series published by the Uganda Bureau of Statistics spans 5 years (due to a recent rebasing), and is thus too short for meaningful analysis. Thus other indicators and quarterly GDP estimates need to be constructed to accurately measure economic activity in Uganda over extended periods of time. The first section of this paper is therefore devoted to constructing and reviewing such indicators.

2 Measuring Economic Activity

The main locally issued high-frequency measure of economic activity is a Composite Index of Economic Activity (CIEA) issued by the Bank of Uganda (BOU) (Opolot & Anguyo, 2012). It is obtained as a combination of monthly series of real currency in circulation, real VAT on domestic goods, real exports of goods and services, real imports, real government expenditure, real sales of selected companies, real cement production, real excise taxes, real PAYE and real private sector credit. These 10 series are combined by first using the Henderson Moving Average procedure for seasonal adjustment and separation of irregular components, deriving a trend-cycle component of each indicator. The trend-cycle series are then aggregated into a composite trend-cycle indicator using average weights derived from principal components analysis (PCA) and correlations of individual series with quarterly GDP.

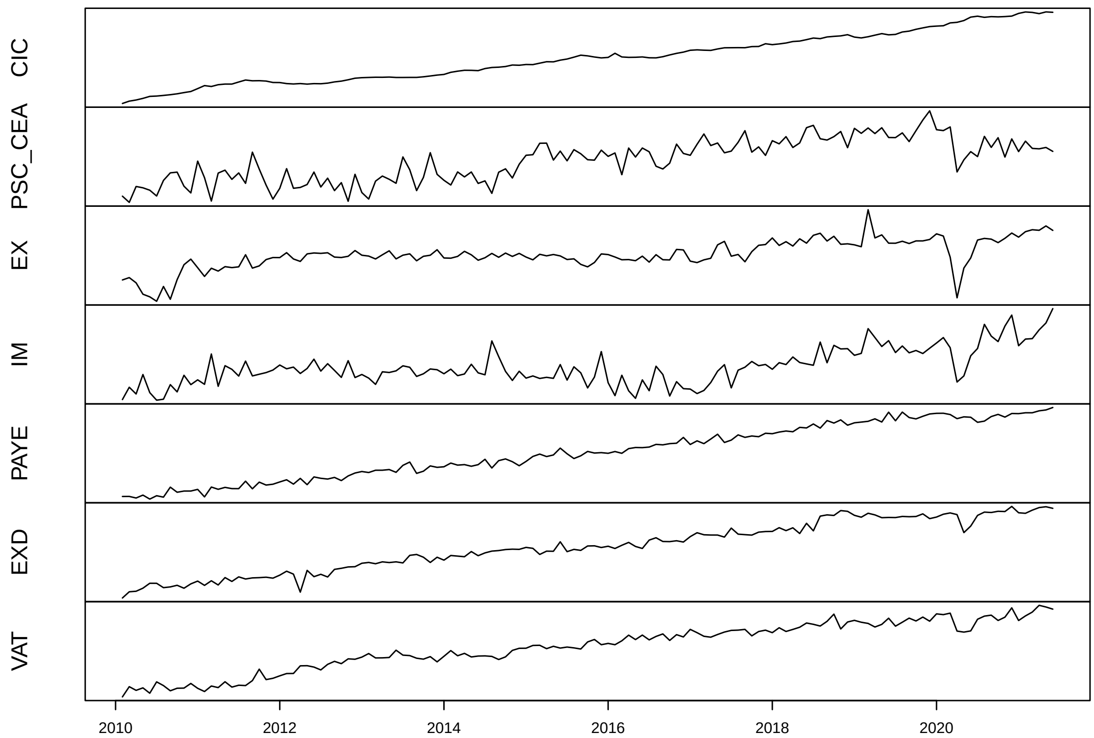
Since the CIEA contains real government expenditure, it is not a suitable outcome measure for analysis seeking to quantify the impact of government spending on economic activity. Thus an alternative high frequency indictor resembling the CIEA, but without government spending, and ideally without extended data processing such as trend-cycle decomposition, is needed.

2.1 A Dynamic Factor Index of Economic Activity

I propose an index based on a dynamic factor model combining 7 CIEA components: currency in circulation (CIC), private sector credit extensions (PSC), VAT on domestic goods, excise taxes (EXD), PAYE, exports (EX) and imports (IM) of goods and services. Sales of selected companies and cement production are not publicly accessible, and government expenditure was deliberately excluded. These 7 indices are combined in nominal terms, since government expenditure is also a nominal variable and deflators are not readily available at monthly level[1]. To combine them, I first seasonally adjust series exhibiting seasonal variation using the X-13 ARIMA SEATS software developed by the US Bureau of Census (Sax & Eddelbuettel, 2018). Then, the variance of all series is harmonized by first applying a Box-Cox Transformation (Box & Cox, 1964; Sakia, 1992; Hyndman & Khandakar, 2008), and then scaling and centering all series to have a mean of 0 and a variance of 1. The resulting series are shown in Figure 1.

[1] Opolot & Anguyo (2012) mention the use of monthly deflators ("appropriate price indices") to create real monthly series, but the construction of these deflators is not explained in the paper, and they are unlikely to be the result of extensive primary data sources.

Figure 1: Input Series for Dynamic Factor Index



These seasonally adjusted, Box-Cox transformed and standardized series are then combined using a dynamic factor model[2] given by

$$\mathbf{x}_t = \mathbf{c}f_t + \mathbf{e}_t \tag{1}$$

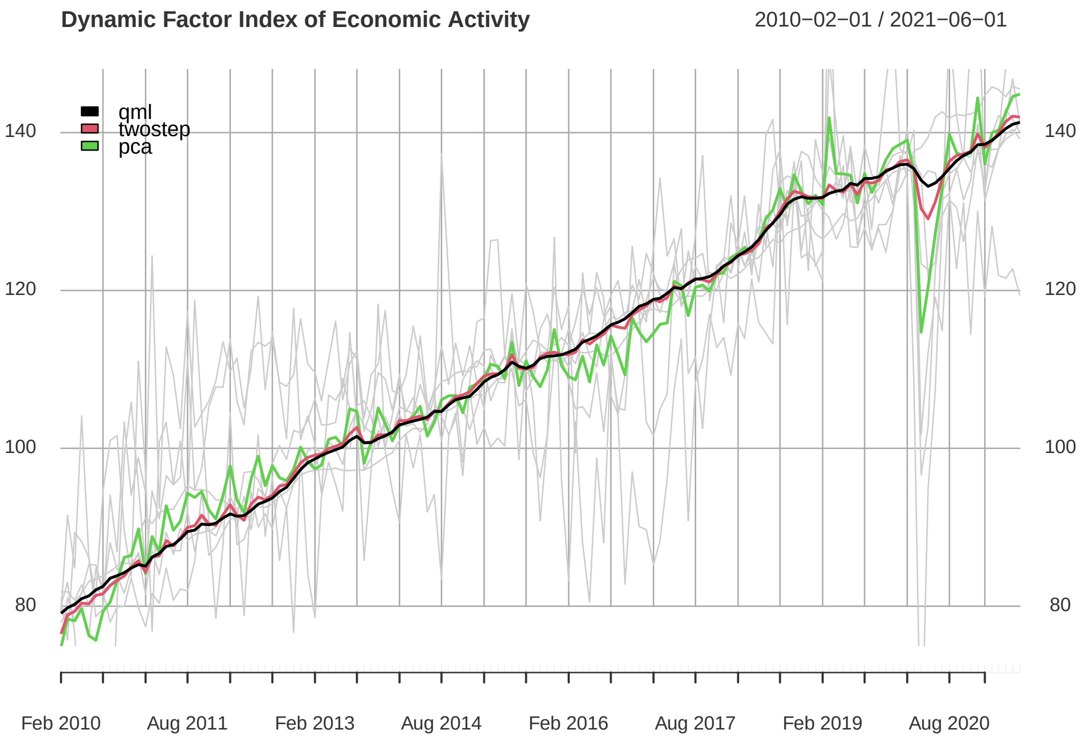
$$f_t = af_{t-1} + u_t, \tag{2}$$

where Eq. (1) is called observation or measurement equation relating the data vector $\mathbf{x}_t$ at period t to a single dynamic factor f_t which evolves according to an autoregressive process of order 1 as specified in in Eq. (2), called state or transition equation. This model is estimated using a quasi-maximum likelihood approach following Doz et al. (2012), implemented in R by Krantz & Bagdziunas (2021), where the Kalman Filter and Smoother (KFS) is first run with estimates of the model parameters obtained using PCA factor estimates. The factor and parameter estimates are subsequently refined through repeated KFS until convergence of an Expectation Maximization (EM) algorithm. Preliminary examination of the data suggests that 1 factor lag in the transition equation is sufficient to account for most of the autocorrelation in the data, without smoothing away too much volatility or running into some EM convergence problems encountered at higher lag orders.

Figure 2 shows the results, where 7 input series are in grey, the green line denotes the initial PCA factor estimate which is very volatile, the red line denotes the factor estimate obtained by running the KFS once - as earlier proposed in Doz et al. (2011) - and the black line denotes the factor obtained by iteratively KFS this estimate until EM convergence. All series were scaled ex-post to have the same mean and variance as the CIEA index by BOU.

[2] See e.g. Durbin & Koopman (2012), Stock & Watson (2011), and Stock & Watson (2016) for boader theoretical and practical references on dynamic factor models and their applications in macroeconomics and forecasting.

Figure 2: Dynamic Factor Index of Economic Activity



It is evident in Figure 2 that the EM estimate is a lot smoother than the PCA or two-step approach, but the two-step factor also appears attractive as an economic activity proxy because it preserves some of the strong impact of the first COVID-lockdown in mid-2020. The estimated autoregressive parameter from the EM method is $a = 0.996$, indicating that some of the input series have random walk characteristics and the model ought better to be estimated on first-differenced data[3]. The estimated observation matrix $\mathbf{c}$ is reported in Table 1, and indicates that the dynamic factor is a quite equitable combination of the 7 indicators, with slightly lower loadings on exports and imports and slightly higher loadings on CIC, VAT, PAYE and excise duty collections.

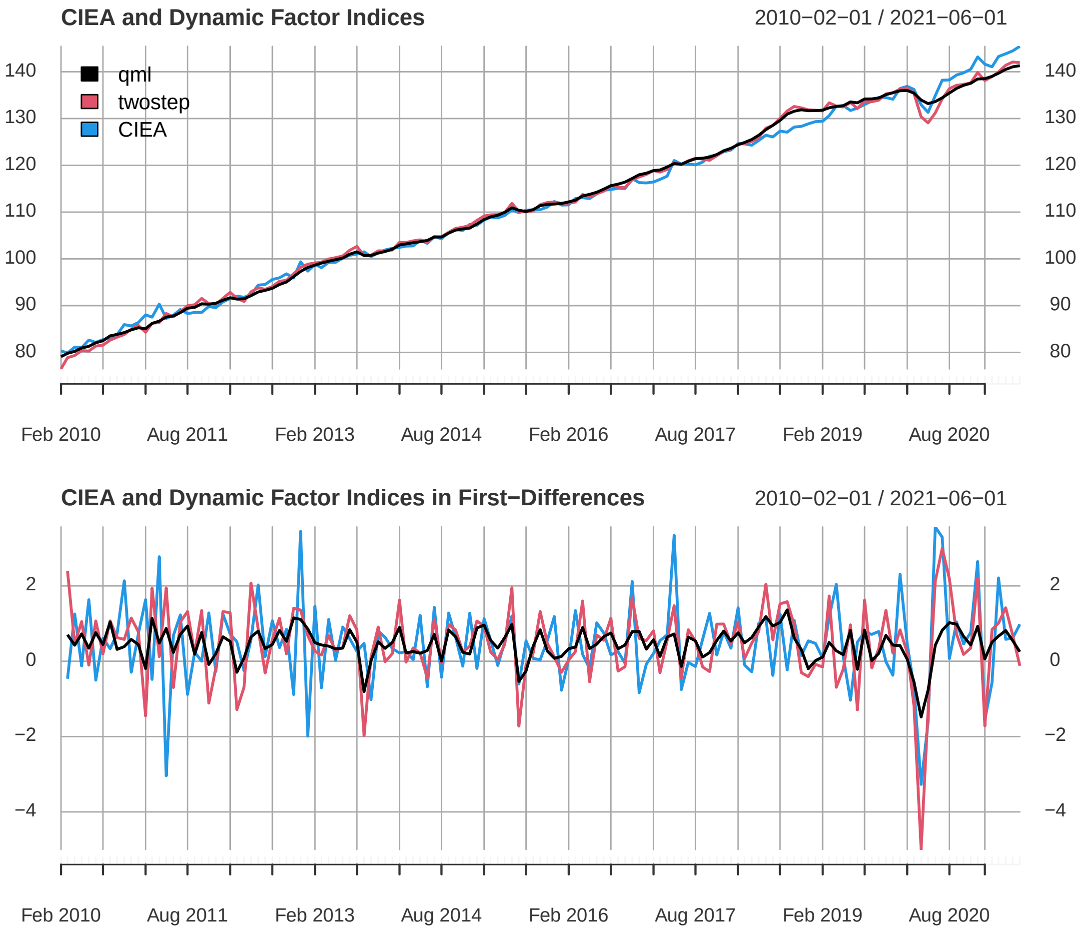
Table 1: Observation Matrix $\mathbf{c}$

Series	QML Factor
CIC	0.398
PSC_CEA	0.334
EX	0.296
IM	0.262
PAYE	0.403
EXD	0.400
VAT	0.395

It remains to examine how these dynamic factor estimates compare to the CIEA reported by BOU. Figure 3 provides a comparison in levels and in first-differences.

[3]Estimating the DFM on first-differenced data results in a very different and significantly more volatile index of economic activity, that is not reconcilable with the CIEA which also combines series in levels.

Figure 3: Dynamic Factor Index vs CIEA

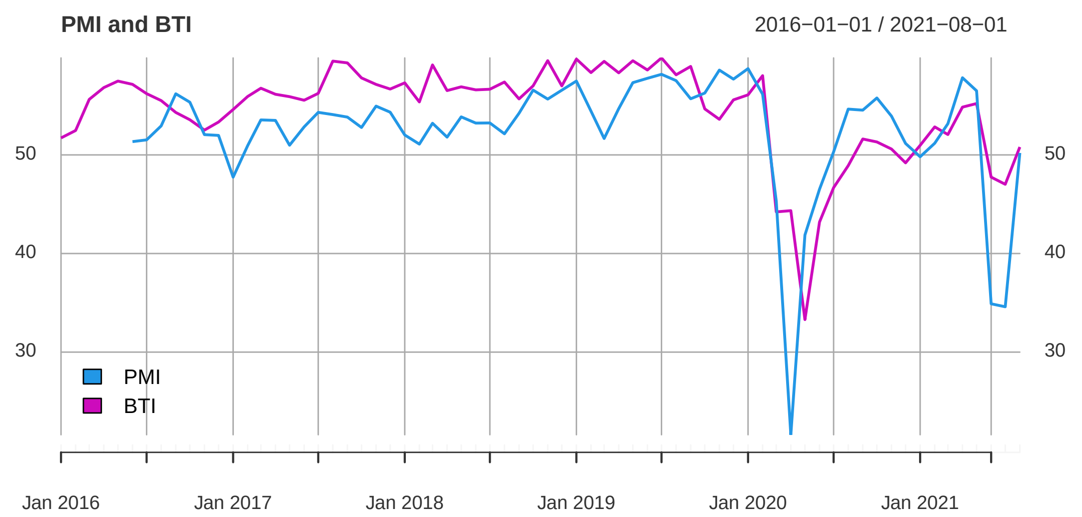


It is evident from Figure 3 that the dynamic factor indices capture broadly the same trend as the CIEA. Some differences are visible in the May 2018 - February 2019 period where the DFM indices record a higher level of economic activity than the CIEA, and in the post-first-lockdown period where the CIEA records a sharp recovery whereas the other indices remain at a lower level. The first-difference graph shows that the 3 indices are broadly aligned for major events such as the lockdown, but exhibit some differences in the higher frequency dynamics. The QML factor clearly provides the smoothest estimate, and could be lacking some of the volatility exhibited by the CIEA and the twostep factor. In first-differences, the correlation with the CIEA is $\rho = 0.34$ for the twostep factor and $\rho = 0.24$ for the QML factor. Both factor estimates are strongly correlated with $\rho = 0.86$. It remains to ascertain how these indices relate to other high-frequency indicators and quarterly GDP.

2.2 Other High-Frequency Indicators

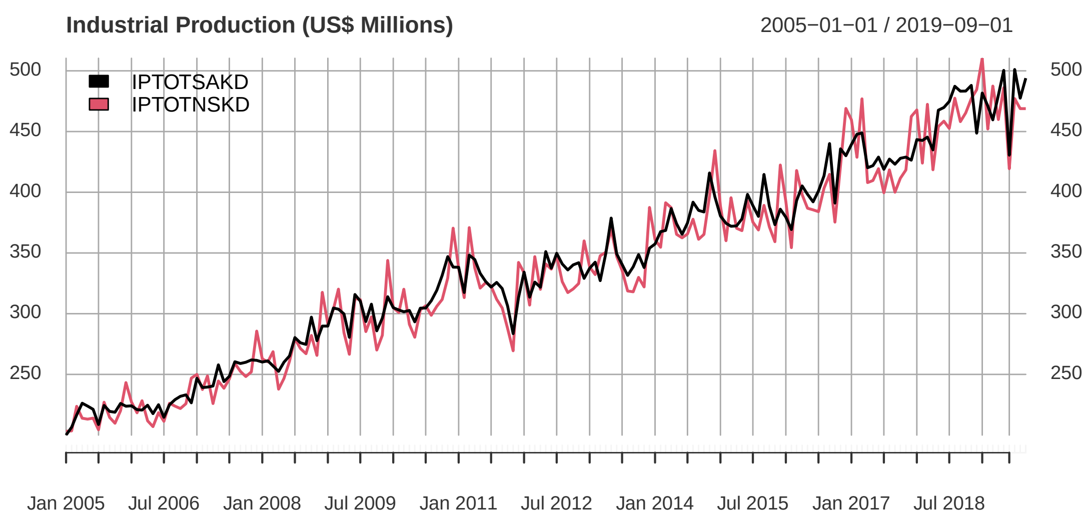
Other high-frequency indicators cited by Ugandan media are the Purchasing Managers Index (PMI) compiled by Stanbic Bank, and the Business Tendency Indicators (BTI) compiled by BOU. Both indices are based on surveys, and only available for a shorter time frame: the BTI is availabe from July 2012, and the PMI from June 2016. Figure 4 shows both indices from January 2016.

Figure 4: Purchasing Managers and Business Tendency Indices



A final high-frequency option is a monthly measure of industrial production (IP) issued by the World Bank as part of the Global Economic Monitor database. This series is available in constant dollars[4], either seasonally adjusted or not seasonally adjusted. Figure 5 shows these indicators, where the black line is the seasonally adjusted version. Data is available from January 2005 to September 2019, thus the indicator has a greater historical coverage but a significant publication lag compared to the domestic indices.

Figure 5: World Bank Industrial Production



2.3 Gross Domestic Product

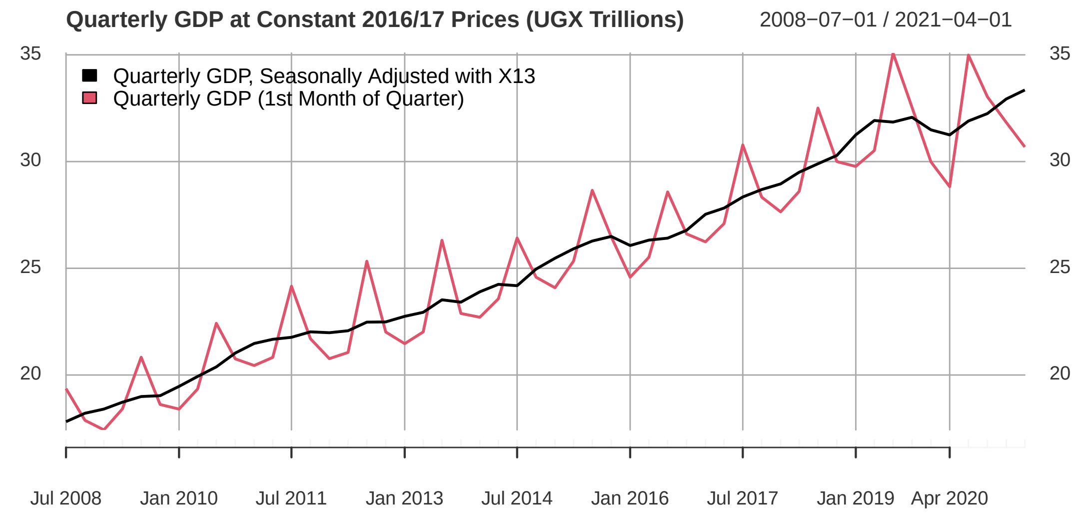
Quarterly GDP in billions of constant 2016/17 UGX is published by the Uganda Bureau of Statistics (UBOS), but, due to a recent rebasing, is only available from 2015Q1. To obtain a more usable quarterly series for analysis, the rebased series is combined with the old quarterly series available from 2008Q3 to 2018Q3, using average quarterly multipliers applied to the old series, and then scaled to match the annual series for which a rebased version is available from FY 2009/08[5].

[4]It is not clear from the series metadata which base year was used, likely 2010.

[5]In more detail: the two quarterly GDP series are combined by taking their ratio (new/old) during the period of 3 years (2015Q1 - 2018Q2) in which they overlap, computing the average ratio for each quarter (Q1, Q2, Q3 and

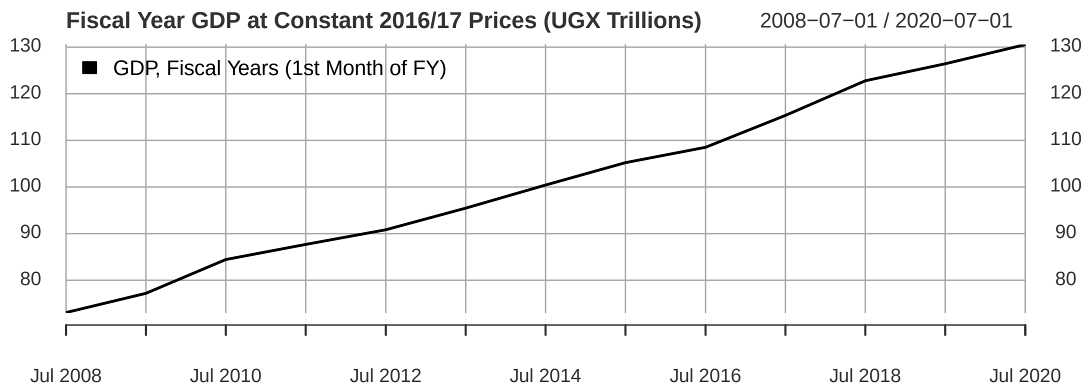
The combined quarterly series is displayed in Figure 6.

Figure 6: UBOS Combined Quarterly GDP Series



The matching fiscal year series is Shown in Figure 7.

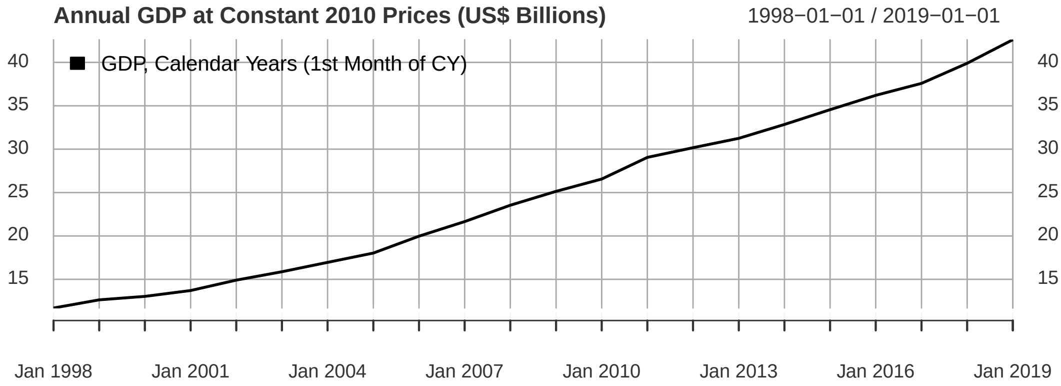
Figure 7: UBOS Fiscal Year GDP Series



A final low-frequency option with extended time coverage is annual GDP from the World Bank World Development Indicators, shown in Figure 8. Just like IP, it is published with a lag.

Q4), multiplying the old series before 2015Q1 with these quarterly averages, and scaling it to match the rebased annual series. Combining the series in this way transfers some seasonal dynamics from the rebased series to the old one while ensuring the quarters add up to the rebased GDP. No trends in the ratio were found during the overlap period, and differences between ratios from the 3 overlapping observations for each quarter were minor, thus taking the average ratio for each quarter and applying it to the old series was a sensible methodological choice.

Figure 8: World Bank Annual GDP Series



2.4 Relating Economic Activity Indicators

Having introduced various indicators of economic activity, it remains to investigate how they relate to one another. Table 2 reports a correlation matrix of monthly indicators in first-differences.

Table 2: Correlation Matrix of Monthly Indicators in First-Differences

	CIEA	QML	2-Step	IP-SA	PMI	BTI
CIEA	1 (186)					
QML	.236* (136)	1 (136)				
2-Step	.338* (136)	.863* (136)	1 (136)			
IP-SA	.047 (164)	-.072 (115)	-.042 (115)	1 (176)		
PMI	.149 (61)	.268* (60)	.366* (60)	.085 (39)	1 (62)	
BTI	.101 (108)	.238* (107)	.214* (107)	.101 (86)	.198 (62)	1 (109)

Notes: Pairwise observations in brackets. A star denotes significance at the 5% level. IP-SA = IPTOTSAKD.

It is interesting to note in Table 2, that the CIEA does not significantly relate to other economic indicators (PMI, BTI or IP) whereas the factor estimates both significantly relate to the PMI and BTI, in about the same order of magnitude as they relate to the CIEA. IP is not significantly correlated with any domestic indicator at monthly frequency.

Table 3 shows the same correlation matrix at quarterly frequency, where monthly indicators where aggregated using the arithmetic mean, and with the addition of seasonally adjusted quarterly GDP at constant prices. In quarterly data the correlations between monthly indicators are higher,

Table 3: Correlation Matrix of Quarterly Indicators in First-Differences

	CIEA	QML	2-Step	IP-SA	PMI	BTI	GDP-SA
CIEA	1 (61)						
QML	.553* (44)	1 (44)					
2-Step	.774* (44)	.888* (44)	1 (44)				
IP-SA	-.038 (54)	.033 (37)	.019 (37)	1 (58)			
PMI	.867* (19)	.636* (19)	.846* (19)	-.548 (12)	1 (20)		
BTI	.686* (35)	.616* (35)	.771* (35)	-.209 (28)	.860* (20)	1 (36)	
GDP-SA	.314* (51)	.327* (44)	.359* (44)	-.007 (44)	.446 (19)	.441* (35)	1 (51)

Notes: Pairwise observations in brackets. A star denotes significance at the 5% level. IP-SA = IPTOTSAKD.

indicating the presence of time-lags and/or noise. IP is still unrelated to all domestic indicators, including GDP. The CIEA and the factor estimates relate similarly to GDP, with correlations between $\rho = 0.31$ and $\rho = 0.36$. Correlations are slightly higher for the factor estimates, particularly for the 2-Step factor which also relates strongly to PMI and BTI, indicating that the trend-cycle decomposition used for the CIEA and repeated KFS for the QML factor remove some important variation in the data. Table 3 further shows that the survey based indicators PMI and BTI relate more strongly to quarterly GDP than either CIEA or factor estimates.

Table 4: Correlation Matrix of FY Indicators in First-Differences

	CIEA	QML	2-Step	IP	PMI	BTI	GDP
CIEA	1 (14)						
QML	.218 (10)	1 (10)					
2-Step	.422 (10)	.917* (10)	1 (10)				
IP	.391 (12)	.492 (8)	.325 (8)	1 (13)			
PMI	.808 (4)	.749 (4)	.942* (4)	1 (2)	1 (5)		
BTI	.434 (8)	.603 (8)	.691* (8)	.048 (6)	.560 (5)	1 (9)	
GDP	.297 (12)	.447 (10)	.419 (10)	.321 (10)	.735 (4)	.452 (8)	1 (12)

Notes: Pairwise observations in brackets. A star denotes significance at the 10% level. IP = IPTOTNSKD.

Table 4 showing correlations at fiscal year frequency is overall very similar to Table 3, with a notable difference that IP now positively relates to all indicators. Table 5 finally shows a matrix at annual (CY) frequency including both aggregated quarterly GDP from UBOS and GDP from the World Bank. It is notable that these two GDP estimates are very different,

Table 5: Correlation Matrix of Annual (CY) Indicators in First-Differences

	CIEA	QML	2-Step	IP	PMI	BTI	GDP	GDP-WB
CIEA	1 (14)							
QML	.679* (9)	1 (9)						
2-Step	.723* (9)	.989* (9)	1 (9)					
IP	-.148 (12)	-.056 (7)	-.055 (7)	1 (13)				
PMI	.932 (3)	.834 (3)	.792 (3)	- (1)	1 (4)			
BTI	.357 (7)	.737* (7)	.669* (7)	.193 (5)	.835 (4)	1 (8)		
GDP	.525* (11)	.614* (9)	.607* (9)	.029 (9)	.996* (3)	.524 (7)	1 (11)	
GDP-WB	.408 (13)	.111 (8)	.038 (8)	.101 (13)	1 (2)	.207 (6)	.598* (10)	1 (21)

Notes: Pairwise observations in brackets. A star denotes significance at the 10% level. IP = IPTOTNSKD.

with a correlation in first-differences of only $\rho = 0.6$. World Bank GDP is also not strongly related to any high-frequency indicator, the highest correlation being with the CIEA at $\rho = 0.41$. Another curious finding of Table 5 is that IP is now again unrelated to the high-frequency indicators as well as GDP - in stark contrast to Table 4.

Overall, the findings of this correlational analysis indicate that data from the World Bank is of limited use for analysing economic developments in Uganda. On the other hand, dynamic factor models and composites such as the CIEA, survey based indicators such as PMI and BTI, and also a carefully constructed and seasonally adjusted quarterly GDP series, all appear to be useful indicators for analyzing current economic developments in Uganda.

3 Direct Effects of Fiscal Spending on Economic Activity

Following the accurate measurement of economic activity, a second critical step is to define what kind of fiscal spending to consider for analysing its effects on growth. There is not a clear answer to this, but several spending aggregates are of potential interest.

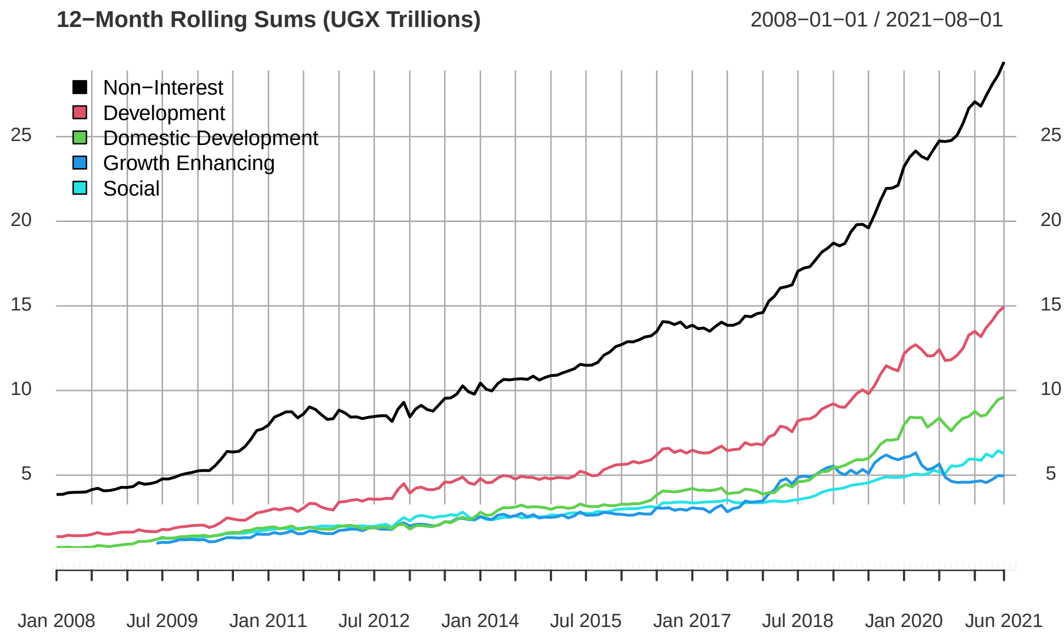
3.1 Fiscal Spending Aggregates

I have selected 5 aggregates to consider in this analysis; the first is total non-interest government expenditure (expenditure excluding net lending and interest payments). This includes spending on wages and salaries of public servants as well as all other spending on infrastructure, health, education etc.. As a subset of non-interest spending, development spending excludes some recurrent expenditures such as the salaries for public servants, health and eduction, and contains spending targeted at projects for development (such as infrastructure). A part of this project expenditure is however financed by foreigners (donor projects such as of the World Bank or Bilateral Partners). The subset of domestic development spending only considers development expenditure by the Government of Uganda.

It is also possible to consider spending by sector, which is however not subdivided into current and development spending. From this sectoral disaggregation I compute two further measures of fiscal spending. The first, which I termed "growth enhancing expenditure" combines spending on roads and works, energy and minerals, trade and industry, information and communication technology, science, and tourism. The second aggregate is a social spending aggregate combining spending on health, education and social development.

Monthly expenditure data is available from July 1997 in local currency, but since the quarterly GDP is only available from 2008, we consider the post 2008 period. At monthly level this data is very volatile and also exhibits mild seasonality. Figure 9 therefore shows 12-month rolling sums of the data.

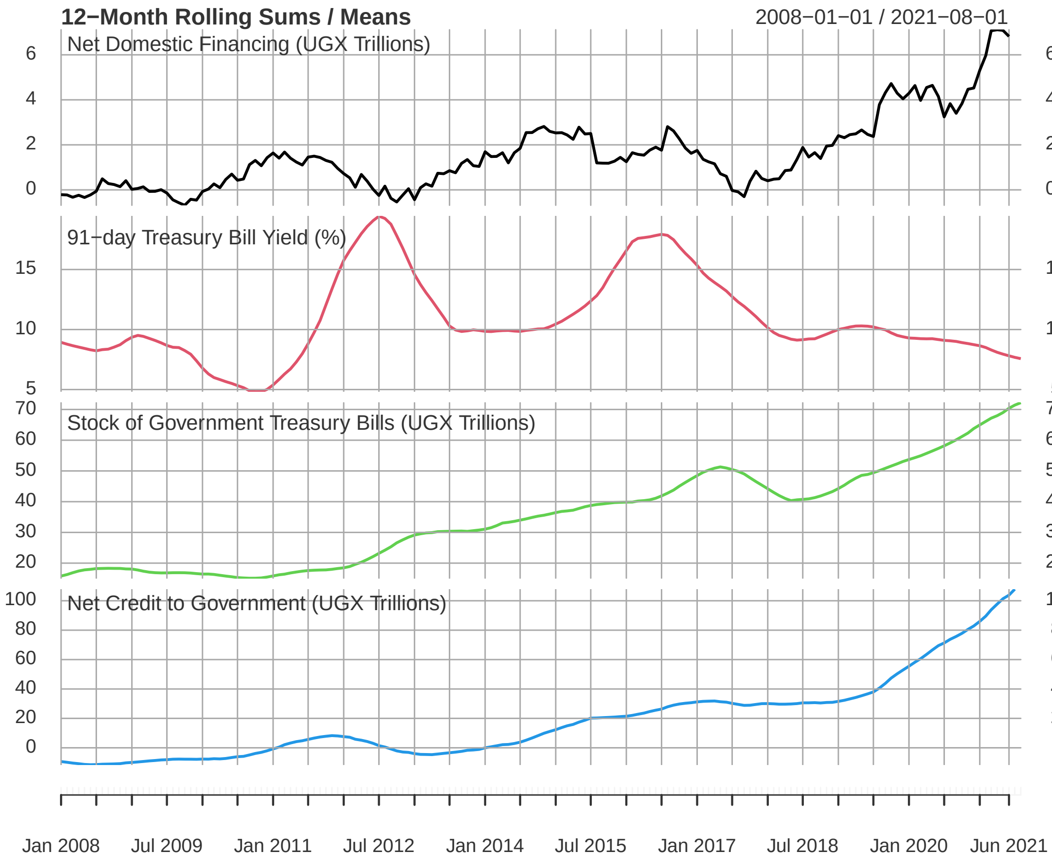
Figure 9: Government Expenditure Series



3.2 Control Variables

When evaluating the effect of government spending on economic activity, some indicators measuring the strain of public spending on the domestic financial sector are of interest, and may also be included as control variables in the regression to obtain an estimate of the growth effect of spending net of borrowing. The 4 series chosen for this role are net domestic financing as a flow measure of government borrowing, the stock of government treasury bills and net credit to the government reported by BOU as corresponding stock measures, and the 91-day treasury bill yield as a variable that can capture the short-term reaction of financial markets to government borrowing. These series are shown in Figure 10.

Figure 10: Monthly Control Measures for Domestic Borrowing



The following regression analysis proceeds in three steps, first, regressions are run using monthly variables. Then, regressions are run using the quarterly outcome measures, aggregating all monthly variables to quarterly frequency using the arithmetic mean for index variables and interest rates, and the sum for all other variables. Finally, the exercise is repeated where all data is aggregated to annual frequency in the same way. Initially, the time series properties of the series are assessed. Testing each series with the Phillips & Perron (1988) unit root test suggested that the dynamic factors, GDP, the TBILL stock and Net Credit to Government are non-stationary. To rule out all potential issues arising from non-stationarity or spurious common trends, and to also reduce issues of increasing variance and while providing a natural interpretation of regression coefficients as elasticities, all series are transformed by taking the natural log and then first-differences. Since Net Domestic Financing and Net Credit to Government have a few negative values as low as -1180 billion UGX, both series were added a value of 1200 Billion UGX before applying log-differences.

Series in log-differences were then tested for seasonal variation by regressing them on a set of monthly dummies and taking the F-statistic of the regression as test for seasonality. This yielded that expenditure items, Domestic Financing and Net Credit to Government exhibited some modest seasonality. In all regressions a set of monthly or quarterly dummies is therefore added to account for seasonality.

3.3 Monthly Analysis

Following the results from the previous section, key monthly outcome measures are the QML and 2-Step factor estimates, the PMI and the BTI. The selected sample where any of these indicators are available ranges from February 2010 to August 2021. Table 6 shows summary statistics of the series in levels, while Tables 7 and 8 show summary statistics and correlations in log-differences.

Table 6: Summary Statistics of Monthly Series in Levels

Variable	N	Mean	Median	Std. Dev.	Min.	Max.
Non-Interest Expenditure (UGX Billions)	137	1,229.66	1,083.83	626.72	319.24	3,213.10
Development Expenditure (UGX Billions)	137	579.37	478.99	369.41	67.74	1,925.66
Domestic Development Expenditure (UGX Billions)	137	355.18	273.03	285.54	36.65	1,641.10
Growth Enhancing Expenditure (UGX Billions)	137	274.37	225.20	192.76	30.64	1,127.57
Social Expenditure (UGX Billions)	137	281.39	251.33	140.08	21.11	864.41
Two-Step Dynamic Factor	137	111.58	111.86	18.12	76.48	142.09
Purchasing Managers Index (Stanbic Bank)	63	52.46	53.55	6.06	21.62	58.75
Business Tendency Indicator (BOU)	110	55.96	56.23	4.91	33.30	66.31
91-day Treasury Bill Yield (%) (BOU)	139	11.25	9.95	4.18	3.78	23.14
Stock of Government T-Bills (UGX Billions) (BOU)	139	3,376.37	3,292.88	1,333.10	1,129.10	6,387.02
Net Domestic Financing (UGX Billions)	137	175.93	112.51	463.08	-1,180.00	2,389.87
Net Credit to Government (UGX Billions) (BOU)	138	2,388.57	1,881.29	2,707.62	-843.51	10,395.91

Table 7: Summary Statistics of Monthly Series in Log-Differences

Variable	N	Mean	Median	Std. Dev.	Min.	Max.
Non-Interest Expenditure	136	0.016	-0.018	0.391	-1.054	1.512
Development Expenditure	136	0.019	-0.026	0.525	-1.261	1.654
Domestic Development Expenditure	136	0.017	-0.052	0.778	-1.423	2.529
Growth Enhancing Expenditure	136	0.016	-0.011	0.857	-1.678	2.817
Social Expenditure	136	0.009	-0.043	0.558	-2.894	2.860
Two-Step Dynamic Factor	136	0.005	0.005	0.009	-0.038	0.031
Purchasing Managers Index	62	-0.000	-0.000	0.157	-0.740	0.661
Business Tendency Indicator	109	-0.002	0.001	0.058	-0.287	0.260
91-day Treasury Bill Yield	138	0.004	0.005	0.081	-0.304	0.219
Stock of Government Treasury Bills	138	0.012	0.010	0.041	-0.127	0.134
Net Domestic Financing	136	-0.005	-0.056	0.735	-3.863	5.190
Net Credit to Government	137	0.023	0.016	0.208	-0.715	1.009

Table 8: Pairwise-Correlations of Monthly Series in Log-Differences

#	*Variable*	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1)	Non-Interest Expenditure	1										
(2)	Development Expenditure	.84*	1									
(3)	Domestic Development Expenditure	.85*	.82*	1								
(4)	Growth Enhancing Expenditure	.72*	.73*	.71*	1							
(5)	Social Expenditure	.63*	.45*	.38*	.29*	1						
(6)	Two-Step Dynamic Factor	.05	.01	.00	.06	.06	1					
(7)	Purchasing Managers Index	-.13	-.14	-.23	.03	.02	.36*	1				
(8)	Business Tendency Indicator	-.05	.01	.18	-.02	-.04	.23*	.01	1			
(9)	91-day Treasury Bill Yield	.16	.14	.14	.11	.09	.05	-.14	-.05	1		
(10)	Stock of Government Treasury Bills	-.02	.01	.01	-.03	-.07	-.04	-.20	-.03	.05	1	
(11)	Net Domestic Financing	.20*	.08	.18*	.10	.14	-.07	-.02	.06	-.04	-.05	1
(12)	Net Credit to Government	.25*	.17*	.17	.16	.27*	.09	.07	.02	-.12	-.07	.43*

Note: A star denotes significance at the 5% level

It is evident from Table 8 that most Government spending aggregates are highly correlated, with the exception of social expenditure which is only mildly correlated with other types of expenditure, most closely with non-interest expenditure ($\rho = 0.63$), indicating that a lot of social spending is recorded as current spending in the GFS.

In monthly log-differences, none of the economic activity indicators appears to be significantly contemporaneously related to fiscal spending of any kind, nor to any financing or credit to the government. With regard to the different financing control items, net domestic financing and net credit to the Government are positively related to the different spending items, in particular to non-interest and social spending ($\rho \approx 0.2$). These two measures of financing are also moderately correlated with one another ($\rho = 0.43$).

Monthly regressions are then run where each of the 3 economic activity measures is regressed on each of the 5 different government spending aggregates, while allowing for up to 3 lags of spending to take effect on economic activity. Each of these regressions includes headline inflation[6] and a set of monthly dummies to control for remaining seasonality in some of the indices and spending aggregates. Each regression is further run with and without controlling for the different financing items. Table 9 reports the regressions with the 2-Step factor as the dependent variable.

Table 9: Monthly Regressions with 2-Step Factor in Log-Differences

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Expenditure Aggregate:	NI	NI	DEV	DEV	DDEV	DDEV	GEH	GEH	SOC	SOC
Expenditure	0.006**	0.007**	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.002
	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)
Lag 1 Expenditure	0.004	0.005	0.002	0.002	0.001	0.001	0.002	0.002	-0.000	-0.001
	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.004)
Lag 2 Expenditure	0.004	0.004	-0.000	-0.000	-0.000	0.000	0.002	0.002	-0.001	-0.002
	(0.004)	(0.004)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.004)
Lag 3 Expenditure	-0.004	-0.004	-0.003	-0.003	-0.003	-0.003	-0.000	0.000	-0.003	-0.003
	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.003)
Headline Inflation	0.131	0.129	0.134	0.124	0.118	0.110	0.121	0.114	0.110	0.109
	(0.105)	(0.106)	(0.113)	(0.113)	(0.116)	(0.118)	(0.113)	(0.115)	(0.110)	(0.116)
Net Domestic Financing		-0.002		-0.002		-0.002		-0.002		-0.002
		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)
91-day Treasury Bill Yield		0.006		0.008		0.007		0.007		0.005
		(0.010)		(0.010)		(0.010)		(0.009)		(0.010)
Stock of Government T-Bills		0.011		0.001		0.002		-0.001		0.004
		(0.022)		(0.022)		(0.023)		(0.023)		(0.026)
Net Credit to Government		0.001		0.001		0.002		0.001		0.000
		(0.005)		(0.005)		(0.005)		(0.005)		(0.005)
Constant	0.004**	0.005**	0.005*	0.005**	0.004**	0.005**	0.003	0.004*	0.004*	0.005**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Observations	133	133	133	133	133	133	133	133	133	133
R^2	0.113	0.139	0.094	0.120	0.095	0.125	0.074	0.098	0.077	0.102
Monthly Dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Durbin-Watson d-statistic	2.117	2.125	2.167	2.161	2.166	2.154	2.137	2.122	2.107	2.114

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 9 suggest that, apart from a minute contemporaneous effect of non-interest spending, government spending has a negligible impact on economic activity as measured by the two-step factor. The results are confirmed with the QML factor, where even the contemporaneous effect of NI spending becomes insignificant. Durbin & Watson (1950) test statistics reported at the bottom of the table suggest very slight (insignificant) negative serial correlation. Including a lag of the dependent variable in the regression brings these statistics closer to 2 but does not change the coefficients.

Table 10 shows the same set of regressions with the log-difference of the PMI as dependent variable. Here some coefficients on the second and third lags of non-interest and development expenditure are negative and significant at the 10% level, suggesting a possibly negative effect of spending on future economic activity. The Durbin & Watson (1950) statistics are very close to 2 suggesting no serial correlation issues, and the R-squared around 0.3 suggests that these variables have some explanatory power. When the BTI is used as dependent variable, also most lagged coefficients are negative, but, except for social spending, insignificant at the 10% level.

Thus, in the short-term, fiscal spending seems to have a zero and possibly lagged negative effect on economic activity.

[6] Because the factor indices and government spending are in nominal terms.

Table 10: Monthly Regressions with PMI in Log-Differences

Expenditure Aggregate:	(1) NI	(2) NI	(3) DEV	(4) DEV	(5) DDEV	(6) DDEV	(7) GEH	(8) GEH	(9) SOC	(10) SOC
Expenditure	-0.217	-0.219	-0.081	-0.117	-0.068	-0.096	-0.010	-0.042	-0.086	-0.089
	(0.165)	(0.186)	(0.065)	(0.082)	(0.068)	(0.085)	(0.058)	(0.080)	(0.096)	(0.104)
Lag Expenditure	-0.211	-0.255	-0.090	-0.129	-0.051	-0.068	-0.047	-0.078	-0.253*	-0.272
	(0.180)	(0.190)	(0.080)	(0.093)	(0.066)	(0.077)	(0.063)	(0.076)	(0.138)	(0.166)
Lag 2 Expenditure	-0.387*	-0.406*	-0.200*	-0.208*	-0.143*	-0.148*	-0.029	-0.042	-0.233	-0.236
	(0.208)	(0.217)	(0.104)	(0.107)	(0.076)	(0.087)	(0.043)	(0.055)	(0.167)	(0.188)
Lag 3 Expenditure	-0.388**	-0.373*	-0.162*	-0.165*	-0.089	-0.096	-0.018	-0.019	-0.248*	-0.244
	(0.189)	(0.185)	(0.086)	(0.089)	(0.058)	(0.064)	(0.033)	(0.042)	(0.128)	(0.156)
Headline Inflation	-14.085*	-15.074*	-13.852*	-13.316*	-10.110	-8.674	-10.362	-10.428	-9.893	-10.146
	(7.945)	(8.339)	(8.036)	(7.573)	(8.480)	(7.816)	(9.943)	(9.753)	(8.533)	(8.870)
Net Domestic Financing		-0.000		-0.025		-0.017		-0.015		-0.013
		(0.019)		(0.023)		(0.029)		(0.030)		(0.021)
91-day Treasury Bill Yield		-0.281		-0.168		-0.047		-0.290		-0.467
		(0.371)		(0.338)		(0.339)		(0.470)		(0.339)
Stock of Government T-Bills		-0.829*		-0.900		-0.745		-1.164		-0.463
		(0.467)		(0.547)		(0.571)		(0.764)		(0.443)
Net Credit to Government		0.050		0.284		0.512		0.217		-0.113
		(0.480)		(0.458)		(0.545)		(0.560)		(0.450)
Constant	0.120	0.110	0.030	0.057	0.037	0.060	-0.025	0.001	-0.016	0.010
	(0.087)	(0.093)	(0.044)	(0.066)	(0.062)	(0.100)	(0.044)	(0.063)	(0.042)	(0.052)
Observations	60	60	60	60	60	60	60	60	60	60
R^2	0.317	0.366	0.320	0.372	0.308	0.357	0.199	0.278	0.256	0.303
Monthly Dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Durbin-Watson d-statistic	2.045	2.025	1.977	1.989	1.851	1.850	1.933	1.948	2.030	2.023

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

3.4 Quarterly Analysis

The analysis is repeated at quarterly frequency, where the combined quarterly GDP series is the main outcome measure, but aggregated factors, PMI and BTI indices are also considered. Quarterly GDP is available from 2008Q3, and the sample considered runs from 2008Q3-2021Q2. Summary statistics in levels and log-differences are again provided in Tables 11 and 12, and correlations in log-differences are provided in Table 13.

Table 11: Summary Statistics of Quarterly Series in Levels

Variable	N	Mean	Median	Std. Dev.	Min.	Max.
Non-Interest Expenditure (UGX Billions)	52	3,386.56	2,821.90	1,799.49	935.55	8,006.45
Development Expenditure (UGX Billions)	52	1,581.61	1,264.45	1,004.79	342.17	4,243.33
Domestic Development Expenditure (UGX Billions)	52	973.21	757.58	669.20	193.10	2,819.91
Growth Enhancing Expenditure (UGX Billions)	52	754.73	661.38	423.57	188.18	1,927.58
Social Expenditure (UGX Billions)	52	779.94	719.42	369.39	281.79	1,680.62
Seas. Adj. GDP at Constant 2016/17 Prices (UGX Billions)	52	25,362.66	25,216.52	4,572.75	17,813.47	33,353.19
QML Dynamic Factor	45	112.06	111.58	17.95	80.83	140.96
Two-Step Dynamic Factor	45	112.08	111.93	17.89	80.01	141.81
Purchasing Managers Index (Stanbic Bank)	20	52.81	53.30	4.30	36.67	57.52
Business Tendency Indicator (BoU)	36	56.09	56.56	4.55	40.28	64.77
Net Domestic Financing (UGX Billions)	52	461.24	340.32	616.65	-501.87	3,019.76
91-day Treasury Bill Yield (%) (BoU)	52	10.90	9.93	4.07	4.25	22.12
Net Credit to Government (UGX Billions) (BoU)	52	5,913.51	4,958.73	8,007.57	-2,499.08	29,778.65
Stock of Government T-Bills (UGX Billions) (BoU)	52	3,098.89	3,164.74	1,379.23	1,165.15	6,147.23

Table 12: Summary Statistics of Quarterly Series in Log-Differences

Variable	N	Mean	Median	Std. Dev.	Min.	Max.
Non-Interest Expenditure	51	0.042	0.013	0.195	-0.483	0.563
Development Expenditure	51	0.048	-0.002	0.367	-0.859	0.889
Domestic Development Expenditure	51	0.053	0.021	0.324	-0.519	0.916
Growth Enhancing Expenditure	51	0.035	0.017	0.383	-0.651	0.781
Social Expenditure	51	0.032	0.041	0.157	-0.461	0.467
Seas. Adj. GDP at Constant 2016/17 Prices	51	0.012	0.013	0.011	-0.019	0.032
QML Dynamic Factor	44	0.013	0.013	0.007	-0.016	0.025
Two-Step Dynamic Factor	44	0.013	0.014	0.012	-0.044	0.043
Purchasing Managers Index	19	-0.004	0.004	0.129	-0.376	0.371
Business Tendency Indicator	35	-0.005	-0.002	0.066	-0.270	0.197
91-day Treasury Bill Yield	51	-0.004	-0.025	0.174	-0.470	0.359
Stock of Government T-Bills	51	0.028	0.041	0.070	-0.137	0.217
Net Domestic Financing	51	0.003	0.028	0.147	-0.374	0.270
Net Credit to Government	51	0.069	0.063	0.202	-0.403	0.602

Table 13 shows that only spending aggregates and economic activity variables among themselves are significantly correlated at the 5% level. GDP does not seem contemporaneously correlated with spending, but it is noteworthy that the factor estimates as well as PMI and BTI are all positively correlated with spending, with coefficients between $\rho = 0.11$ and $\rho = 0.35$.

Table 13: Pairwise-Correlations of Quarterly Series in Log-Differences

#	*Variable*	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1)	Non-Interest Expenditure	1												
(2)	Development Expenditure	.89*	1											
(3)	Domestic Development Expenditure	.76*	.74*	1										
(4)	Growth Enhancing Expenditure	.73*	.87*	.67*	1									
(5)	Social Expenditure	.57*	.52*	.39*	.47*	1								
(6)	GDP in Constant 2016/17 Prices, Seas. Adj.	.09	.01	-.01	-.02	.03	1							
(7)	QML Dynamic Factor	.04	.13	.14	.19	-.01	.33*	1						
(8)	Two-Step Dynamic Factor	.12	.19	.13	.23	.04	.37*	.89*	1					
(9)	Purchasing Managers Index	.25	.25	.18	.35	.22	.43	.62*	.85*	1				
(10)	Business Tendency Indicator	.11	.15	.17	.26	.08	.40*	.57*	.78*	.89*	1			
(11)	91-day Treasury Bill Yield	-.09	-.03	-.19	-.03	-.15	.08	.12	.12	-.05	-.16	1		
(12)	Stock of Government Treasury Bills	-.11	-.05	-.10	-.12	.01	-.08	.05	.05	.03	-.05	.06	1	
(13)	Net Domestic Financing	.16	.15	.26	.16	.25	-.06	-.14	-.19	-.11	.05	-.13	-.07	1
(14)	Net Credit to Government	.16	.01	-.01	-.04	.23	.13	-.04	-.04	-.05	-.18	.10	-.06	.21

Note: A star denotes significance at the 5% level

For the regression analysis, again 3 lags of each expenditure category are used, allowing fiscal spending to have an effect on growth within the course of one year. Table 14 shows the results with seasonally adjusted quarterly real GDP as the dependent variable. Apart from a minute negative effect on the second lag of domestic development spending, and a very small positive effect on the 3rd lag of social spending, the effect on government spending on GDP appears to be zero. This result is robust to removing headline inflation and quarterly dummies as regressors[7], to including a lag of GDP in the regression to improve the DW statistics, and to running all of these regressions with unadjusted real GDP.

[7]Quarterly dummies and headline inflation are included to eliminate mild seasonality and nominal effects in expenditure series - which could still be a source of spurious correlation with real GDP.

Table 14: Quarterly Regressions with Seas. Adj. GDP in Log-Differences

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Expenditure Aggregate:	NI	NI	DEV	DEV	DDEV	DDEV	GEH	GEH	SOC	SOC
Expenditure	0.009	0.005	-0.010	-0.008	-0.007	-0.007	0.004	0.004	0.005	0.010
	(0.017)	(0.017)	(0.011)	(0.011)	(0.010)	(0.011)	(0.009)	(0.008)	(0.013)	(0.011)
Lag Expenditure	0.001	-0.012	-0.019	-0.021	-0.017*	-0.024**	0.002	0.001	0.006	0.007
	(0.020)	(0.021)	(0.015)	(0.015)	(0.009)	(0.010)	(0.010)	(0.010)	(0.014)	(0.014)
Lag 2 Expenditure	0.020	0.006	-0.007	-0.011	-0.001	-0.009	0.010	0.008	0.013	0.012
	(0.017)	(0.022)	(0.014)	(0.016)	(0.010)	(0.012)	(0.009)	(0.010)	(0.015)	(0.014)
Lag 3 Expenditure	0.002	-0.007	-0.006	-0.009	-0.009	-0.014	-0.003	-0.004	0.019*	0.019
	(0.016)	(0.020)	(0.010)	(0.012)	(0.010)	(0.011)	(0.006)	(0.007)	(0.011)	(0.012)
Headline Inflation	-0.045	-0.138	-0.066	-0.155	-0.095	-0.169	-0.048	-0.127	-0.088	-0.168
	(0.119)	(0.139)	(0.088)	(0.127)	(0.074)	(0.113)	(0.082)	(0.127)	(0.083)	(0.117)
Net Domestic Financing		-0.011		-0.008		-0.017		-0.004		-0.014
		(0.011)		(0.012)		(0.013)		(0.012)		(0.012)
91-day Treasury Bill Yield		0.015		0.017		0.013		0.015		0.014
		(0.010)		(0.011)		(0.012)		(0.011)		(0.013)
Stock of Government T-Bills		-0.013		-0.012		0.002		-0.020		-0.014
		(0.018)		(0.016)		(0.016)		(0.016)		(0.017)
Net Credit to Government		0.009		0.008		0.015		0.006		0.003
		(0.013)		(0.012)		(0.010)		(0.010)		(0.009)
Constant	0.015***	0.019***	0.015***	0.018***	0.017***	0.020***	0.014***	0.017***	0.011*	0.014*
	(0.005)	(0.006)	(0.004)	(0.006)	(0.004)	(0.005)	(0.004)	(0.006)	(0.006)	(0.007)
Observations	48	48	48	48	48	48	48	48	48	48
R^2	0.095	0.145	0.116	0.174	0.151	0.229	0.126	0.176	0.054	0.110
Quarterly Dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Durbin-Watson d-statistic	1.634	1.728	1.535	1.682	1.429	1.590	1.545	1.703	1.672	1.760

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 15 shows equivalent results with the 2-Step factor as the dependent variable. Here the second lags of non-interest and social spending appear to have positive effects on economic activity. The result is again quite robust to different specifications.

Table 15: Quarterly Regressions with 2-Step Factor in Log-Differences

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Expenditure Aggregate:	NI	NI	DEV	DEV	DDEV	DDEV	GEH	GEH	SOC	SOC
Expenditure	0.034	0.043*	0.015	0.019	0.013	0.014	0.022	0.025*	0.018*	0.024**
	(0.021)	(0.024)	(0.014)	(0.016)	(0.013)	(0.013)	(0.013)	(0.013)	(0.010)	(0.010)
Lag Expenditure	0.014	0.019	0.013	0.012	-0.006	-0.016	0.011	0.008	0.019*	0.019*
	(0.018)	(0.020)	(0.020)	(0.021)	(0.012)	(0.011)	(0.018)	(0.018)	(0.010)	(0.011)
Lag 2 Expenditure	0.034**	0.038**	0.026	0.021	0.008	-0.002	0.022	0.017	0.029***	0.033***
	(0.016)	(0.017)	(0.018)	(0.017)	(0.011)	(0.010)	(0.016)	(0.016)	(0.010)	(0.010)
Lag 3 Expenditure	0.007	0.014	0.012	0.009	-0.004	-0.012	0.004	0.002	0.009	0.015*
	(0.012)	(0.013)	(0.009)	(0.009)	(0.007)	(0.008)	(0.011)	(0.010)	(0.010)	(0.008)
Headline Inflation	0.211**	0.266**	0.161**	0.149	0.161*	0.136	0.163**	0.131	0.164**	0.164**
	(0.082)	(0.122)	(0.070)	(0.097)	(0.080)	(0.152)	(0.068)	(0.109)	(0.065)	(0.075)
Net Domestic Financing		-0.022		-0.022		-0.035**		-0.023*		-0.019
		(0.015)		(0.016)		(0.017)		(0.013)		(0.014)
91-day Treasury Bill Yield		-0.011		-0.000		-0.001		0.003		-0.003
		(0.012)		(0.012)		(0.017)		(0.010)		(0.011)
Stock of Government T-Bills		0.006		0.003		0.021		0.011		0.004
		(0.026)		(0.029)		(0.025)		(0.031)		(0.020)
Net Credit to Government		-0.003		0.002		0.011		0.002		-0.004
		(0.010)		(0.010)		(0.012)		(0.010)		(0.008)
Constant	0.013***	0.012**	0.010**	0.012**	0.015***	0.018***	0.014**	0.016***	0.008***	0.009***
	(0.004)	(0.005)	(0.004)	(0.005)	(0.004)	(0.005)	(0.005)	(0.006)	(0.003)	(0.003)
Observations	44	44	44	44	44	44	44	44	44	44
R^2	0.296	0.379	0.291	0.340	0.300	0.417	0.367	0.424	0.181	0.233
Quarterly Dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Durbin-Watson d-statistic	1.954	1.898	2.031	1.965	2.006	1.928	2.043	1.957	2.304	2.280

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The most interesting results with quarterly data were obtained using the QML factor as dependent variable, reported in Table 16. Here all lags 1-3 of growth-enhancing and social spending were found to have a significant positive effect on economic activity. The DW statistics are mediocre, implying some positive serial correlation, but the result is robust to inclusion of a lag of the QML factor as a regressor, as shown in Appendix Table 26. The coefficients can be interpreted as elasticities, thus Table 15 implies that a 100% increase in growth enhancing expenditure is associated with an approx. 5% increase in economic activity after one year, and a 100% increase in social spending is associated with an approx. 7.5% increase in economic activity after one year. These results appear small but could be quite reasonable. Controlling for financial sector variables typically results in a 5-10% increase in the effect size, which is to small to suggest any significant crowding out of credit to the private sector limiting the growth impact of fiscal spending.

Table 16: Quarterly Regressions with QML Factor in Log-Differences

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Expenditure Aggregate:	NI	NI	DEV	DEV	DDEV	DDEV	GEH	GEH	SOC	SOC
Expenditure	0.018	0.022	0.012	0.014	0.010	0.011	0.014**	0.015**	0.014**	0.016**
	(0.012)	(0.014)	(0.008)	(0.009)	(0.007)	(0.008)	(0.006)	(0.006)	(0.006)	(0.006)
Lag Expenditure	0.015	0.022*	0.017*	0.017	0.003	-0.000	0.014**	0.014**	0.022***	0.021***
	(0.010)	(0.012)	(0.010)	(0.010)	(0.007)	(0.007)	(0.007)	(0.007)	(0.008)	(0.008)
Lag 2 Expenditure	0.022**	0.029**	0.020**	0.019**	0.005	0.002	0.017**	0.017**	0.025***	0.027***
	(0.010)	(0.012)	(0.009)	(0.009)	(0.007)	(0.006)	(0.007)	(0.007)	(0.007)	(0.007)
Lag 3 Expenditure	0.006	0.012	0.008	0.007	-0.002	-0.005	0.006	0.005	0.010*	0.013**
	(0.008)	(0.009)	(0.005)	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)	(0.006)	(0.005)
Headline Inflation	0.164***	0.223**	0.139***	0.160**	0.142***	0.150	0.135***	0.162**	0.136***	0.149***
	(0.048)	(0.082)	(0.040)	(0.070)	(0.045)	(0.090)	(0.040)	(0.066)	(0.038)	(0.051)
Net Domestic Financing		-0.006		-0.008		-0.014		-0.006		-0.007
		(0.009)		(0.010)		(0.010)		(0.007)		(0.009)
91-day Treasury Bill Yield		-0.011		-0.004		-0.003		-0.005		-0.004
		(0.010)		(0.009)		(0.012)		(0.008)		(0.007)
Stock of Government T-Bills		0.001		-0.001		0.006		0.002		0.001
		(0.019)		(0.020)		(0.017)		(0.022)		(0.014)
Net Credit to Government		-0.005		0.002		0.004		0.001		-0.002
		(0.007)		(0.007)		(0.008)		(0.007)		(0.005)
Constant	0.011***	0.009**	0.010***	0.010***	0.013***	0.014***	0.012***	0.012***	0.008***	0.008***
	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)
Observations	44	44	44	44	44	44	44	44	44	44
R^2	0.218	0.277	0.253	0.275	0.240	0.298	0.376	0.396	0.269	0.297
Quarterly Dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Durbin-Watson d-statistic	1.164	1.130	1.199	1.156	1.148	1.070	1.334	1.297	1.375	1.323

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

On a second glance these results do not come out of the blue, Table 14 also shows a positive effect of growth enhancing and social spending on GDP, but the effect size is about half the effect on the QML factor, and the coefficients are insignificant. Estimations were also repeated with PMI and BTI, which yielded mostly insignificant coefficients but also positive effects of growth enhancing and social expenditure on economic activity. Particularly the PMI results, provided in Appendix Table 27 are interesting, suggesting contemporaneous quarter elasticities as high as 23% for growth-enhancing spending and 36% for social spending.

3.5 Annual Analysis

Since the quarterly analysis suggested that the effects of government spending could materialize with quite some lag, the analysis is repeated at annual frequency, including only one lag of expenditure, and omitting CPI inflation to gain degrees of freedom. With fiscal year data there are 11 observations for GDP from UBOS and 10 observations on the factor estimates. With such a small sample, no regression yielded a coefficient significant at the 5% level. The results are therefore not reported. It is noteworthy though that the coefficients on growth-enhancing expenditure remained robustly positive with cumulative magnitudes on the level and lag between 0.07 and 0.14. With calendar year data, some significant positive coefficients on growth enhancing expenditure where found using World Bank GDP and the factor estimates as outcome variables. These estimates are reported in Tables 17 and 18.

Table 17: Annual (CY) Regressions with World Bank GDP in Log-Differences

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Expenditure Aggregate:	NI	NI	DEV	DEV	DDEV	DDEV	GEH	GEH	SOC	SOC
Expenditure	-0.021	0.025	-0.052*	-0.036	-0.025	-0.003	0.016	0.044**	0.050	-0.040
	(0.040)	(0.057)	(0.029)	(0.031)	(0.027)	(0.038)	(0.022)	(0.008)	(0.055)	(0.081)
Lag Expenditure	0.042	0.101*	-0.055	-0.047	-0.013	0.016	0.049	0.047	0.032	0.021
	(0.049)	(0.050)	(0.040)	(0.051)	(0.019)	(0.029)	(0.035)	(0.021)	(0.070)	(0.038)
Net Domestic Financing		-0.011		0.023		0.011		-0.000		0.130
		(0.064)		(0.062)		(0.062)		(0.045)		(0.069)
91-day Treasury Bill Yield		0.002		0.011		0.011		0.032**		0.054*
		(0.013)		(0.013)		(0.016)		(0.008)		(0.018)
Stock of Government T-Bills		-0.044		-0.031		-0.043		-0.007		-0.049*
		(0.031)		(0.032)		(0.047)		(0.010)		(0.019)
Net Credit to Government		-0.016**		-0.005		-0.012		0.013		-0.017
		(0.007)		(0.008)		(0.009)		(0.007)		(0.014)
Constant	0.056***	0.051***	0.074***	0.076***	0.066***	0.064***	0.041***	0.034***	0.040***	0.057**
	(0.011)	(0.012)	(0.009)	(0.010)	(0.007)	(0.008)	(0.007)	(0.003)	(0.010)	(0.014)
Observations	21	21	21	21	21	21	10	10	10	10
R^2	0.036	0.279	0.146	0.244	0.056	0.193	0.172	0.946	0.090	0.868
Durbin-Watson d-statistic	1.191	1.859	1.424	1.670	1.312	1.898	1.560	1.882	1.852	2.615

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 18: Annual (CY) Regressions with 2-Step Factor in Log-Differences

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Expenditure Aggregate:	NI	NI	DEV	DEV	DDEV	DDEV	GEH	GEH	SOC	SOC
Expenditure	-0.029	-0.241	0.021	-0.249	-0.066*	-0.208	0.068***	0.092**	-0.064	-0.239***
	(0.083)	(0.217)	(0.041)	(0.133)	(0.034)	(0.139)	(0.015)	(0.017)	(0.066)	(0.009)
Lag Expenditure	-0.157	-0.009	0.017	-0.024	-0.095*	-0.094	0.020	0.047	-0.023	0.000
	(0.094)	(0.144)	(0.052)	(0.047)	(0.042)	(0.107)	(0.038)	(0.062)	(0.069)	(0.009)
Net Domestic Financing		0.169		0.213		0.209		-0.117		0.165***
		(0.102)		(0.092)		(0.105)		(0.081)		(0.011)
91-day Treasury Bill Yield		0.057		0.072		0.004		-0.017		0.085***
		(0.054)		(0.035)		(0.035)		(0.034)		(0.005)
Stock of Government T-Bills		-0.115		-0.061		-0.007		0.018		-0.057***
		(0.071)		(0.030)		(0.056)		(0.027)		(0.003)
Net Credit to Government		-0.051		-0.099		-0.017		0.018		-0.060***
		(0.022)		(0.035)		(0.023)		(0.014)		(0.002)
Constant	0.069***	0.103*	0.041***	0.117*	0.073***	0.095*	0.036***	0.026*	0.058***	0.095***
	(0.016)	(0.031)	(0.008)	(0.033)	(0.009)	(0.028)	(0.005)	(0.009)	(0.013)	(0.002)
Observations	9	9	9	9	9	9	9	9	9	9
R^2	0.365	0.782	0.024	0.820	0.466	0.708	0.641	0.775	0.139	0.991
Durbin-Watson d-statistic	2.266	2.668	1.158	2.672	2.302	2.806	1.948	1.638	1.468	2.532

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Overall, the findings of this annual analysis are not very robust or convincing - mainly due to the very small sample sizes - but they suggest that particularly growth enhancing fiscal spending could affect GDP with an elasticity between 7% and 14% within two years.

4 Structural Analysis

Assuming that a causal relationship between fiscal spending and growth can be established in a dynamic regression setting through the inclusion of spending lags and financial system controls, the estimates in the previous section provide a direct reduced-form impact estimate of fiscal spending on growth. For impact estimates taking into account feedback from other macroeconomic variables, a more structural method of assessment is necessary. To understand the effects of fiscal spending on the economy, at least 3 additional variables apart from economic activity are of interest. The first is inflation: if fiscal spending stimulates economic activity but also inflation - yielding a monetary policy response - it's effect may be limited. Secondly, fiscal spending might let government securities appear less reliable, decreasing demand and raising interest rates on treasury bills and bonds. An increase in interest rates on securities could have adverse second-round effects on financial markets and economic activity. Thirdly, if spending happens by means of bank financing, it might crowd out credit to the private sector, also inducing adverse second-round effects.

The simplest tool to conduct such an assessment is a Structural Vector Autoregression (SVAR)[8]. I consider an SVAR AB model of the form

$$\mathbf{A}\mathbf{y}_t = \mathbf{A}_1^*\mathbf{y}_{t-1} + ... + \mathbf{A}_p^*\mathbf{y}_{t-p} + \mathbf{B}\epsilon_t, \tag{3}$$

where $\mathbf{y}_t$ is a $K \times 1$ vector of economic variables at time t, $\mathbf{A}$ is the $K \times K$ contemporaneous impact matrix and $\mathbf{B}$ is a $K \times K$ matrix providing contemporaneous relationships between the structural errors ϵ_t $(K \times 1)$. Following most of the literature, $\mathbf{B}$ is assumed to be diagonal, ruling out any contemporaneous cross-equation links through the error term while allowing for different structural variances. Since $\mathbf{B}$ is diagonal capturing the structural variances, $\mathbf{A}$ may have a unit diagonal. To identify a SVAR with K variables, $K(K-1)/2$ further restrictions need to be imposed on matrix $\mathbf{A}$.

Following Opolot (2020), I use the 91-Day treasure bill rate as interest rate. I identify the model by with a semi-recursive scheme, by restricting the following contemporaneous impacts coefficients to be zero:

$$\mathbf{A} = \begin{array}{cccccc} & \text{EXP} & \text{EA} & \text{CPI} & \text{TB91} & \text{PSC} \\ \text{EXP} & 1 & 0 & 0 & 0 & 0 \\ \text{EA} & X & 1 & 0 & 0 & X \\ \text{CPI} & 0 & X & 1 & 0 & \mathrm{X} \\ \text{TB91} & \mathrm{X} & \mathrm{X} & 0 & 1 & 0 \\ \text{PSC} & X & \mathrm{X} & \mathrm{X} & X & 1 \end{array} \tag{4}$$

The justification for these restrictions is that government expenditure, being a policy variable, is not contemporaneously affected by any real or financial economic variables. Real economic activity is also presumed to not be affected by inflation or changes to the T-Bill rate in the current period, but could be contemporaneously impacted by government expenditure or a boost of credit to the private sector. CPI inflation is directly impacted by economic activity or, following the quantity theory of money, by excess credit to the private sector that simply produces a hike in prices. It is assumed that government expenditure only generates inflation through second-round effects via economic activity. The treasury bill rate could be contemporaneously affected by government expenditure behavior, or economic activity. Finally, credit to the private sector is presumed fully endogenous to all real and financial variables, which includes the possibility of crowding out credit to the private sector via spending through borrowing.

To assess the empirical robustness of this identification scheme, I also consider a fully recursive ordering:

$$\mathbf{A} = \begin{array}{cccccc} & \text{EXP} & \text{EA} & \text{CPI} & \text{TB91} & \text{PSC} \\ \text{EXP} & 1 & 0 & 0 & 0 & 0 \\ \text{EA} & X & 1 & 0 & 0 & 0 \\ \text{CPI} & X & X & 1 & 0 & 0 \\ \text{TB91} & \mathrm{X} & \mathrm{X} & X & 1 & 0 \\ \text{PSC} & X & \mathrm{X} & \mathrm{X} & X & 1 \end{array} \tag{5}$$

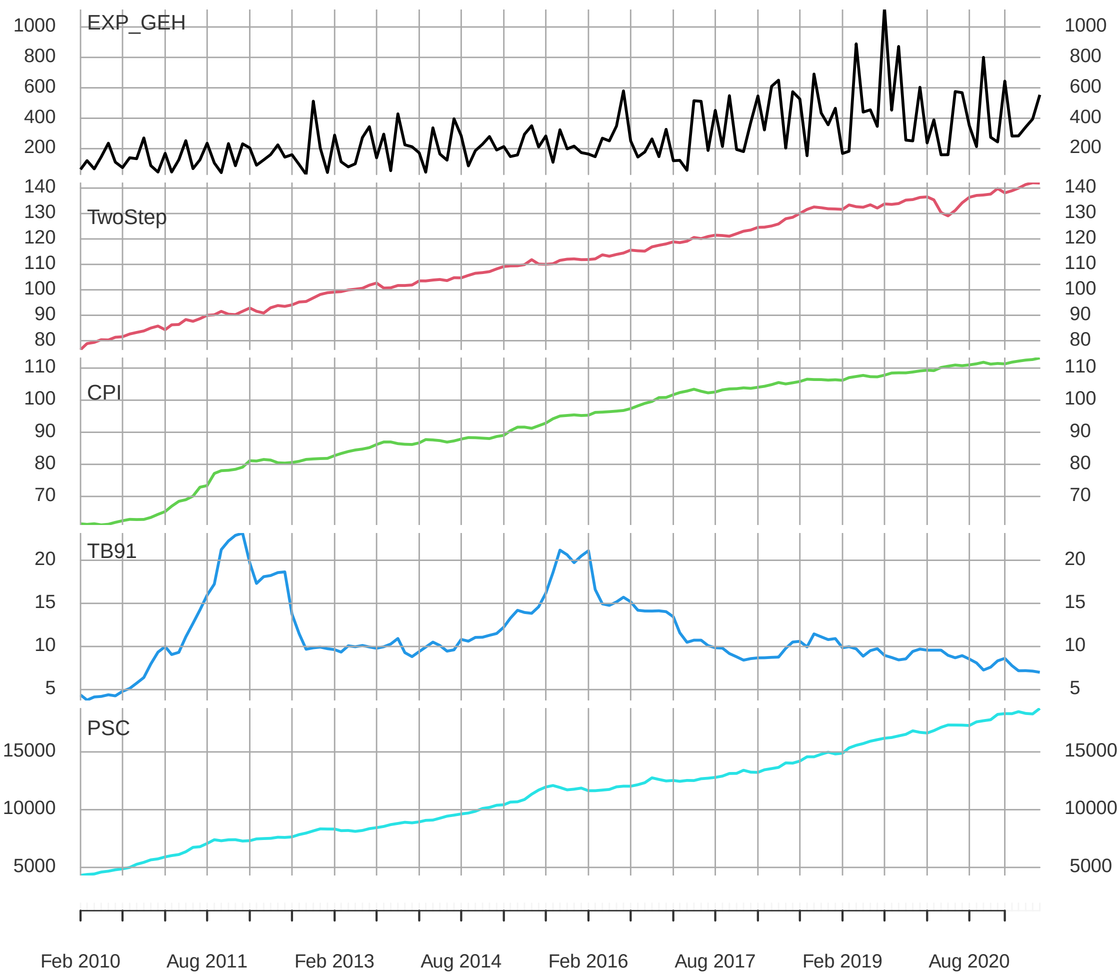
[8]See e.g. Lütkepohl (2005) for theoretical background reading.

which is alternatingly applied both in the short run and in the long run using Blanchard & Quah (1989) type SVAR estimation. Estimations are conducted using the R package *vars* (Pfaff, 2008). SVAR's are estimated using maximum-likelihood estimation and BFGS optimization. The confidence intervals for Impulse-Response Functions are generated using bootstrap resampling.

4.1 Monthly Analysis

With monthly data, the two-step factor is used as the main economic activity variable, due to it's availability from 2010 and it's greater responsiveness to economic fluctuations than the QML factor. In terms of expenditure, I consider both total non-interest expenditure and growth enhancing expenditure. The raw input series (with growth enhancing expenditure) are shown in Figure 11.

Figure 11: SVAR Input Series



Following Opolot (2020) I estimate the VAR in log-levels[9]. The AIC and FPE criteria were used to select a lag order of 2 for the VAR. Furthermore, a constant, a linear trend and monthly dummies are included as exogenous elements in the VAR to account for trends and seasonality in the log-level series. The VAR estimated in this way is stable and produces stationary and serially uncorrelated residuals.

[9] In contrast to Opolot (2020), I also put the interest rate in logs as I otherwise encounter difficulties estimating the VAR by maximum likelihood methods. I note that the VAR of Opolot (2020) also contains base money and the exchange rate.

4.1.1 Non-Interest Expenditure

Starting with non-interest expenditure, Figure 12 shows the 36-period Scaled Impulse Response Functions (SIRFs) to a non-interest government expenditure (NIE) shock, identified using structural restrictions as in Eq. 4 or a recursive ordering as in Eq. 5. The third panel shows Blanchard & Quah (1989) (BQ) type identification where the recursive ordering in Eq. 5 is imposed as a long-run rather than a short-run restriction. Usually, orthogonalized IRF's are computed as responses to a 1 standard-deviation shock, but since the variables are in log-levels, the IRF's have been scaled ex-post so that the responses can be interpreted as elasticities[10]. The level of the IRF in period x can thus be interpreted as the impact elasticity in period x to a spending shock in period 0.

It is evident from Figure 12 that SVAR and Recursive scheme provide very similar impulses, with a short spike in economic activity followed by a slight decline over extended periods of time. Inflation appears to initially decrease but then increase. The cumulative IRF, which approximates an overall impact elasticity, is computed in Table 19. For both economic activity and inflation the net effect after 36 Months is close to 0. The most responsive variable appears to be the T-Bill rate, which increases over extended periods of time (20-30 month) after the spending shock. The cumulative effect after 36 Months according to the SVAR is a 27% increase in the T-Bill rate following a 100% increase in NIE in period 0.

Credit to the private sector also appears to increase very slightly (cumulative IRF is 1.6%), suggesting that crowding out is not an issue. Overall the magnitude of responses to is small, and none of the effects discussed to far is significant at the 5% level. Thus a preferred interpretation would be that apart from a very slight rise in treasury bill rates, a NIE shock appears to have no effect on the economy. The BQ responses are larger and quite different from those obtained by short-run restrictions, indicating only modest robustness of the impulses to different identification methods[11].

[10]In particular, a scale factor fas been applied so that the contemporaneous response of a variable to its own shock is 1, which amounts to a 1 unit increase in the log of the variable or approx. a 100% increase in the variable.

[11]BQ estimates are just provided for robustness assessment purposes but not to be interpreted, as there is no theoretical justification for imposing these long-run restrictions.

Figure 12: Non-Interest Expenditure: Scaled Impulse Response Functions

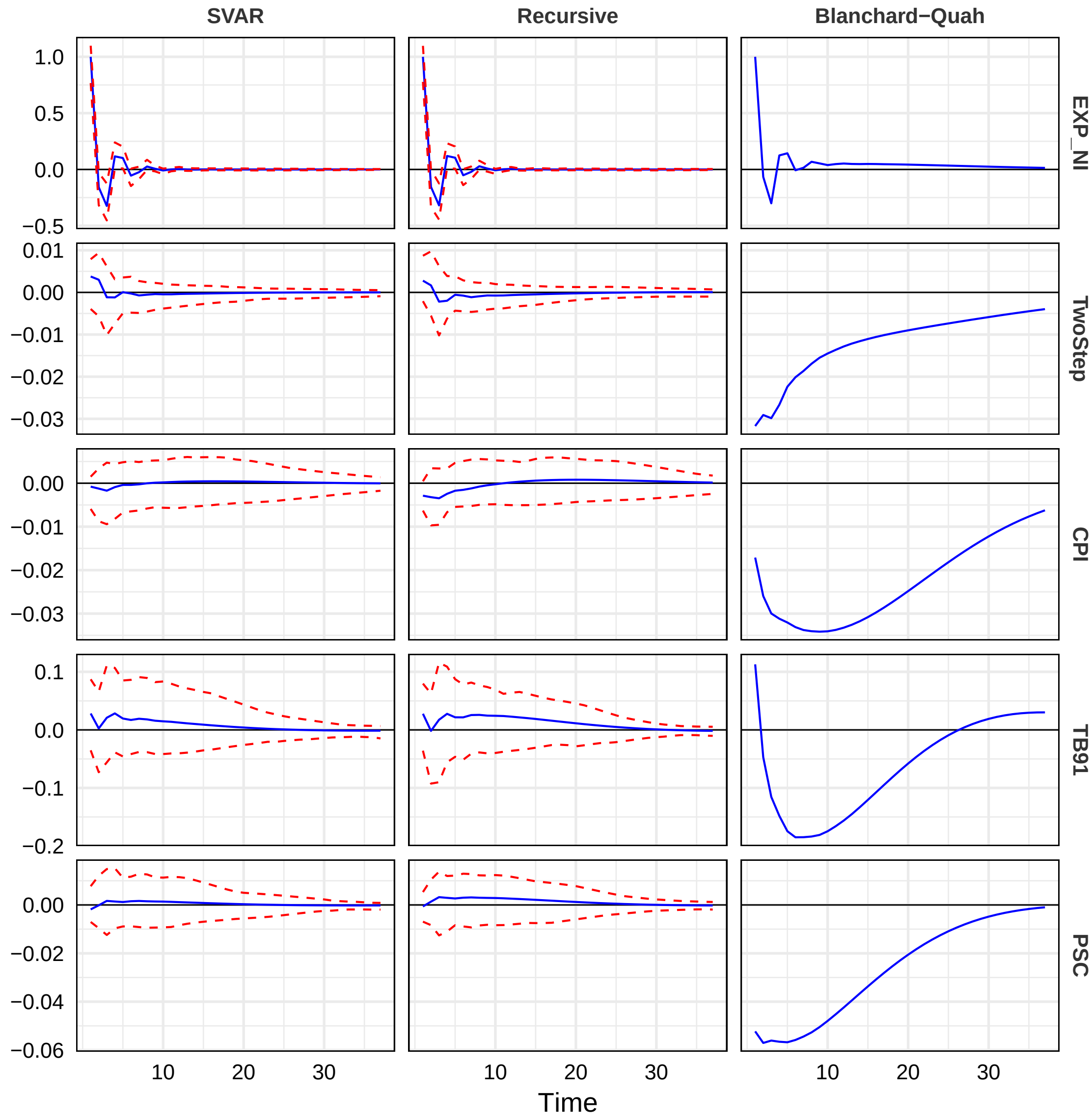
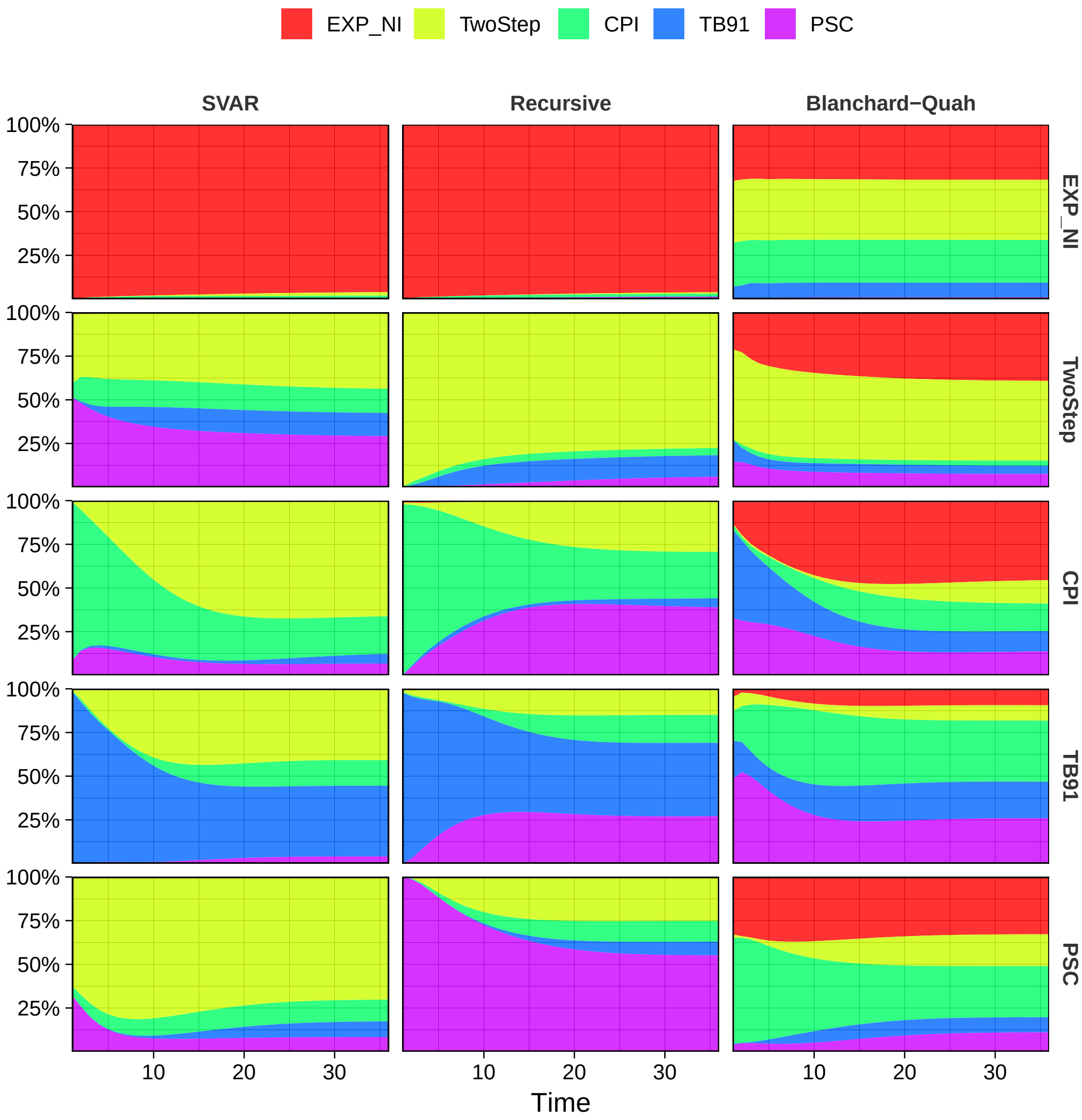


Table 19: Non-Interest Expenditure: Cumulative 36-Month Scaled IRF

Identification	EXP_NI	TwoStep	CPI	TB91	PSC
SVAR	0.674	-0.001	0.001	0.272	0.016
Recursive	0.696	-0.009	-0.004	0.438	0.049
Blanchard-Quah	2.001	-0.441	-0.841	-2.312	-0.989

Figure 13 shows Forecast Error Variance Decompositions (FEVDs), which make it very evident from both SVAR and Recursive ordering that NIE explains nearly 100% of it's on forecast error variance at both short and long horizons, and also doesn't affect any other variables in the system.

Figure 13: Non-Interest Expenditure: Forecast Error Variance Decompositions



4.1.2 Growth-Enhancing Expenditure

The estimation is repeated using growth-enhancing expenditure (GEE). SIRF's shown in Figure 14 indicate a small and short lived impact on economic activity of around 0.15-0.2% in magnitude , which is nearly significant at the 5% level. The cumulative 36-Month impact is 0.21% according to the SVAR and 0.91% according to the recursive identification strategy, reported in Table 20. Inflation seems to first decrease and the pickup yielding a net positive effect on inflation of 0.8-2.1% in magnitude. The biggest response again comes from the 91 day T-bill rate, which shows a sharp rise and gradual decline over the course of 30 Months yielding cumulative elasticities of 35-39%. Credit to the private sector also rises by cumulatively around 4%, which is a bit unintuitive given the small increase in economic activity, but at least suggests no crowding out effect of government spending. In contrast no NIE, even the BQ estimates are in-line with the SVAR and the recursive ordering, indicating a low correlation of the structural errors and giving some confidence that these responses are indeed structural. It is interesting to note that BQ estimates suggest a much greater impact on economic activity of around 8.8% over the course of 36 Month.

Figure 14: Growth Enhancing Expenditure: Scaled Impulse Response Functions

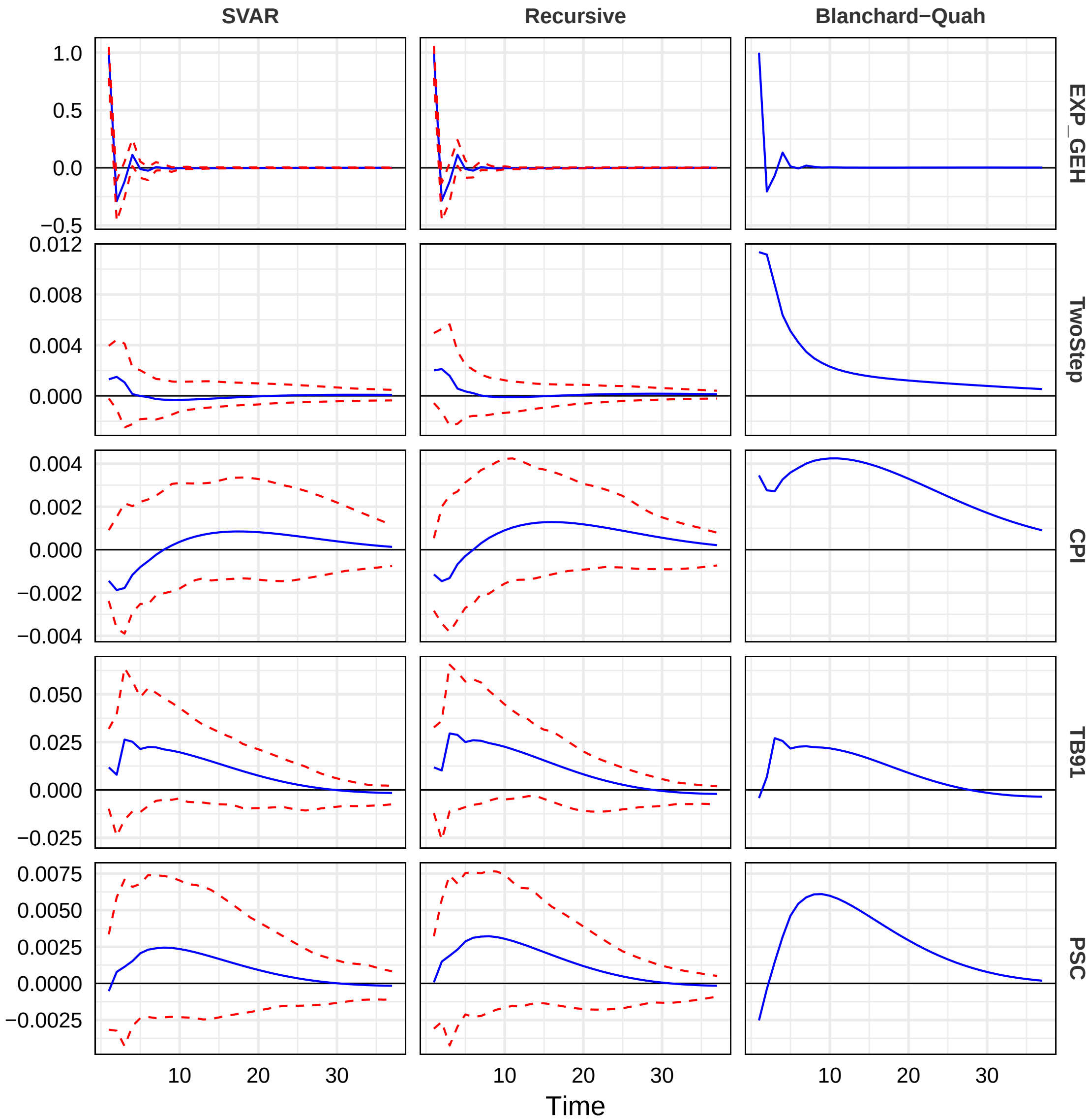


Table 20: Growth-Enhancing Expenditure: Cumulative 36-Month Scaled IRF

Identification	EXP_GEH	TwoStep	CPI	TB91	PSC
SVAR	0.639	0.002	0.008	0.348	0.035
Recursive	0.656	0.009	0.021	0.390	0.049
Blanchard-Quah	0.964	0.088	0.107	0.346	0.099

The FEVD's provided in Appendix Figure 26 are overall very similar to those shone before in Figure 13, and show a 3% contribution of GEE spending to the 91-Day T-Bill rate in the long term, which was not visible in Figure 13.

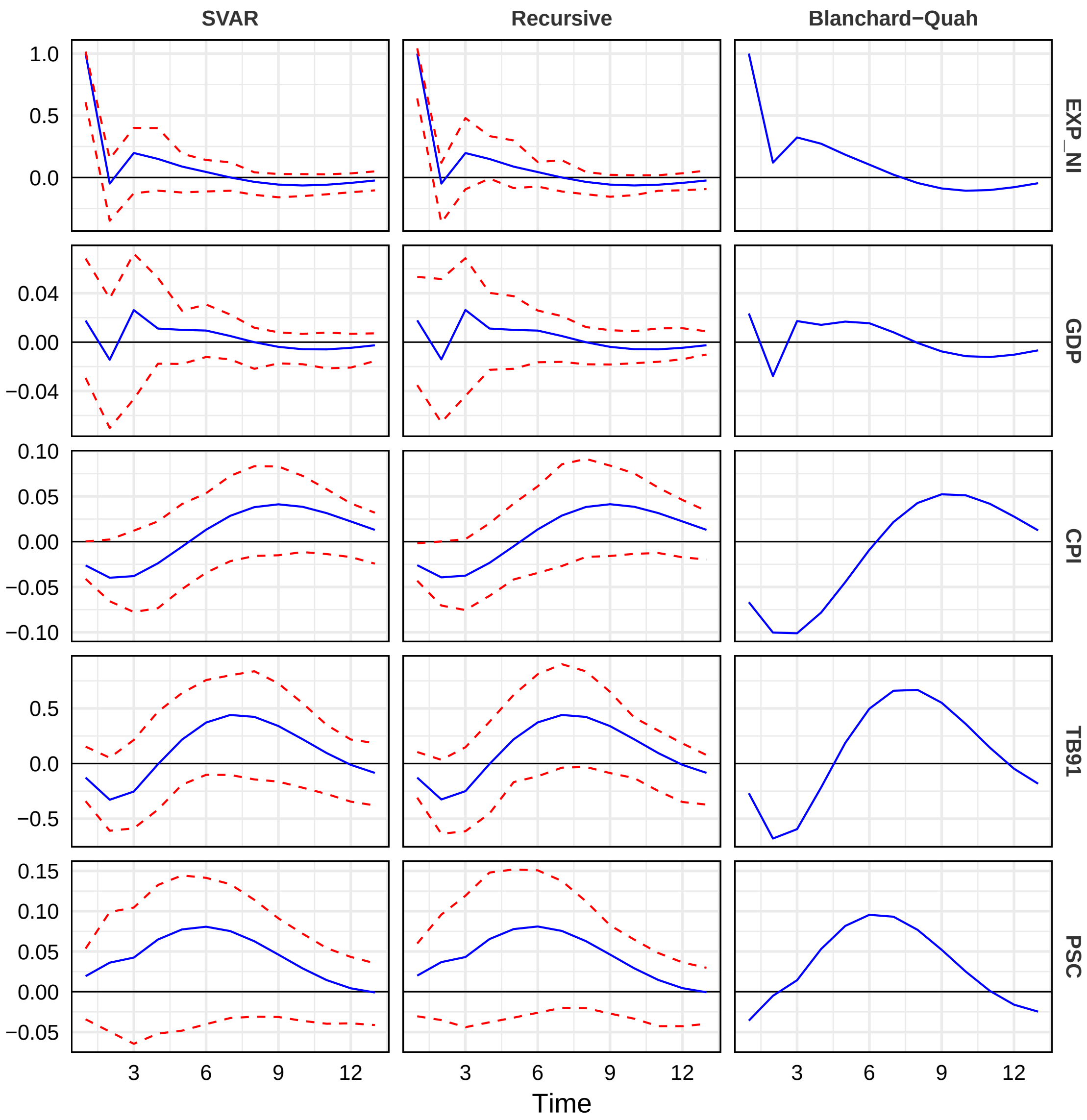
4.2 Quarterly Analysis

The structural estimation is repeated at the quarterly level, where both GDP and the factor estimates are available as measures of economic activity. To improve the fit and maximum-likelihood convergence behavior, the VAR is estimated with unadjusted real GDP, where all series are in log-levels and a linear-trend and quarterly dummies are added as deterministic components to account for constant growth and seasonal components. Again only NIE and GEE are considered as spending aggregates.

4.2.1 Non-Interest Expenditure: GDP

Figure 15 shows the 12-Quarter IRF's from a unit NIE shock. The shape and sequencing of the response is very similar to the monthly data, but the cumulative 12-quarter impact elasticities are overall around 3 times larger larger in magnitude than the 36-month cumulative elasticities. This is expected, since a 100% shock to quarterly expenditure is on average 3 times larger than a 100% shock to monthly expenditure.

Figure 15: NIE-GDP: Scaled Impulse Response Functions



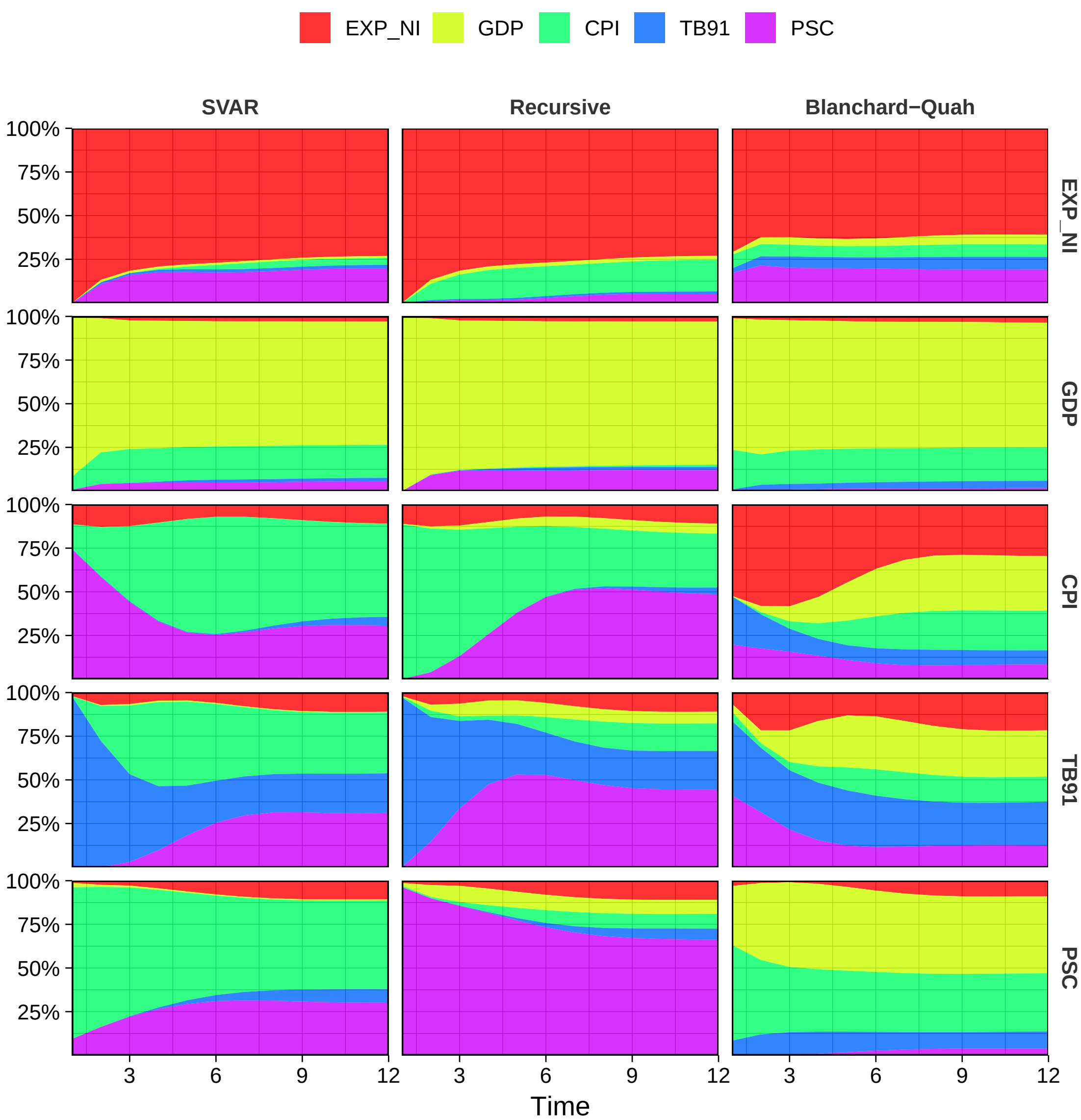
Cumulative 12-period impact elasticities reported in Table 21 imply that a 100% NIE shocks has a small positive impact on GDP of 4.2%, a delayed and small impact on inflation of 9.3%, a sizeable positive impacts on the T-Bill rate of around 130% and a total impact on credit to the private sector of 55%.

Table 21: NIE-GDP: Cumulative 12-Quarter Scaled IRF

Identification	EXP_NI	GDP	CPI	TB91	PSC
SVAR	1.147	0.042	0.093	1.294	0.552
Recursive	1.145	0.043	0.096	1.305	0.556
Blanchard-Quah	1.560	0.018	-0.150	1.075	0.411

Figure 16 shows the corresponding FEVD's. NIE explains a very small portion of GDP, and up to 10% of CPI, TB91 and PSC and longer horizons.

Figure 16: NIE-GDP: Forecast Error Variance Decompositions



4.2.2 Non-Interest Expenditure: 2-Step Factor

The estimation is repeated substituting GDP with the 2-Step factor estimate aggregated to quarterly frequency. Figure 17 shows the 12-quarter IRF's. The effect sizes are small, but curiously the net effect on economic activity, CPI, TB91 and PSC is negative, as shown in Table 22. The FEVD's are very similar to those obtained using GDP, and provided in Figure 27 in the Appendix.

Figure 17: NIE-2-Step Factor: Scaled Impulse Response Functions

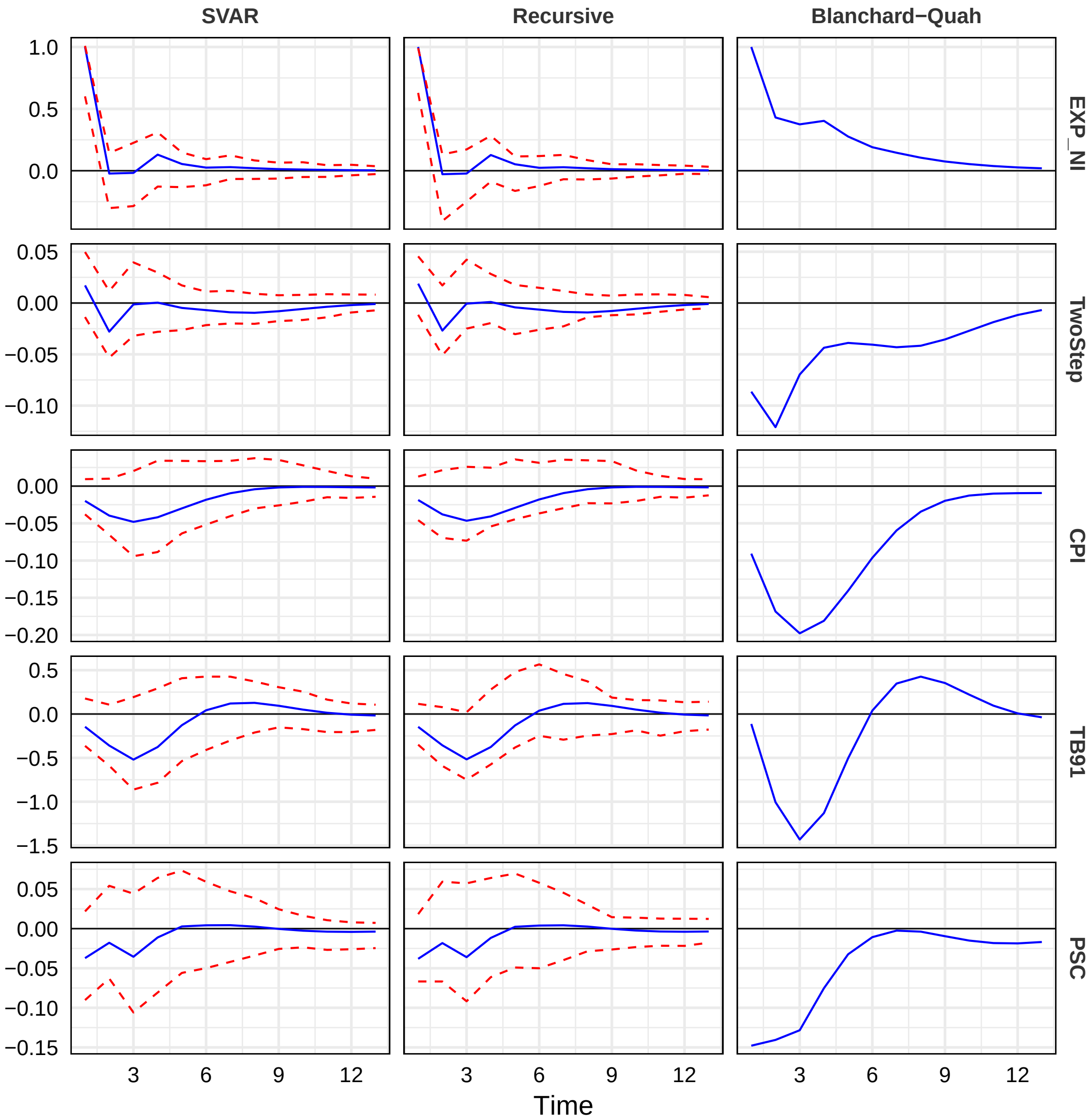


Table 22: NIE-2-Step Factor: Cumulative 12-Quarter Scaled IRF

Identification	EXP_NI	TwoStep	CPI	TB91	PSC
SVAR	1.257	-0.062	-0.219	-1.106	-0.102
Recursive	1.237	-0.056	-0.211	-1.113	-0.105
Blanchard-Quah	3.139	-0.585	-1.030	-2.732	-0.620

4.2.3 Growth-Enhancing Expenditure: GDP

When considering only growth-enhancing expenditure, the IRF's in Figure 18 show a small but significant impact on GDP that lasts for 4 quarters, and a prolonged slight increase in inflation and the 91-day T-Bill rate. PSC also rises for 8 quarters following the shock.

Figure 18: GEE-GDP: Scaled Impulse Response Functions

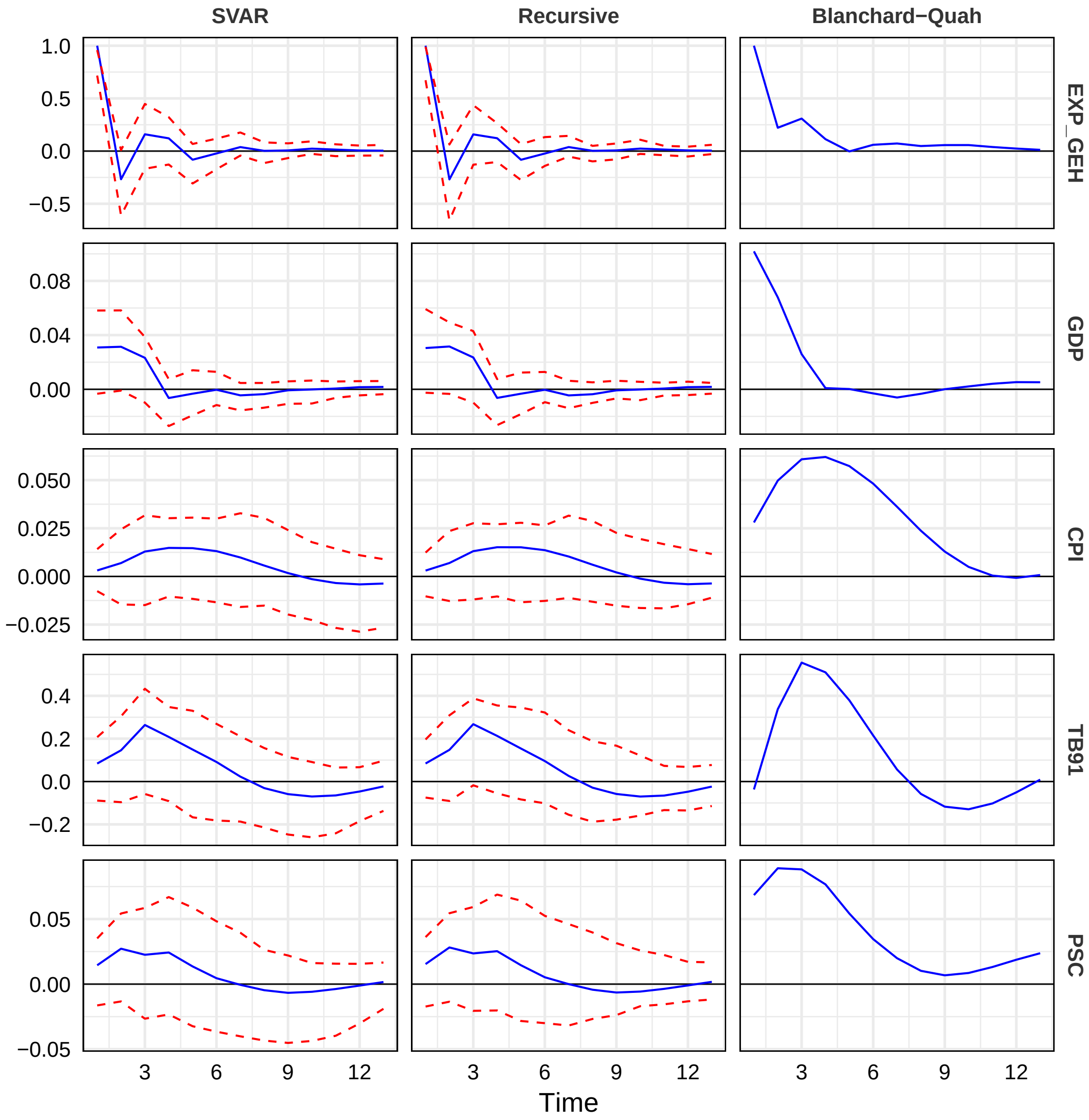


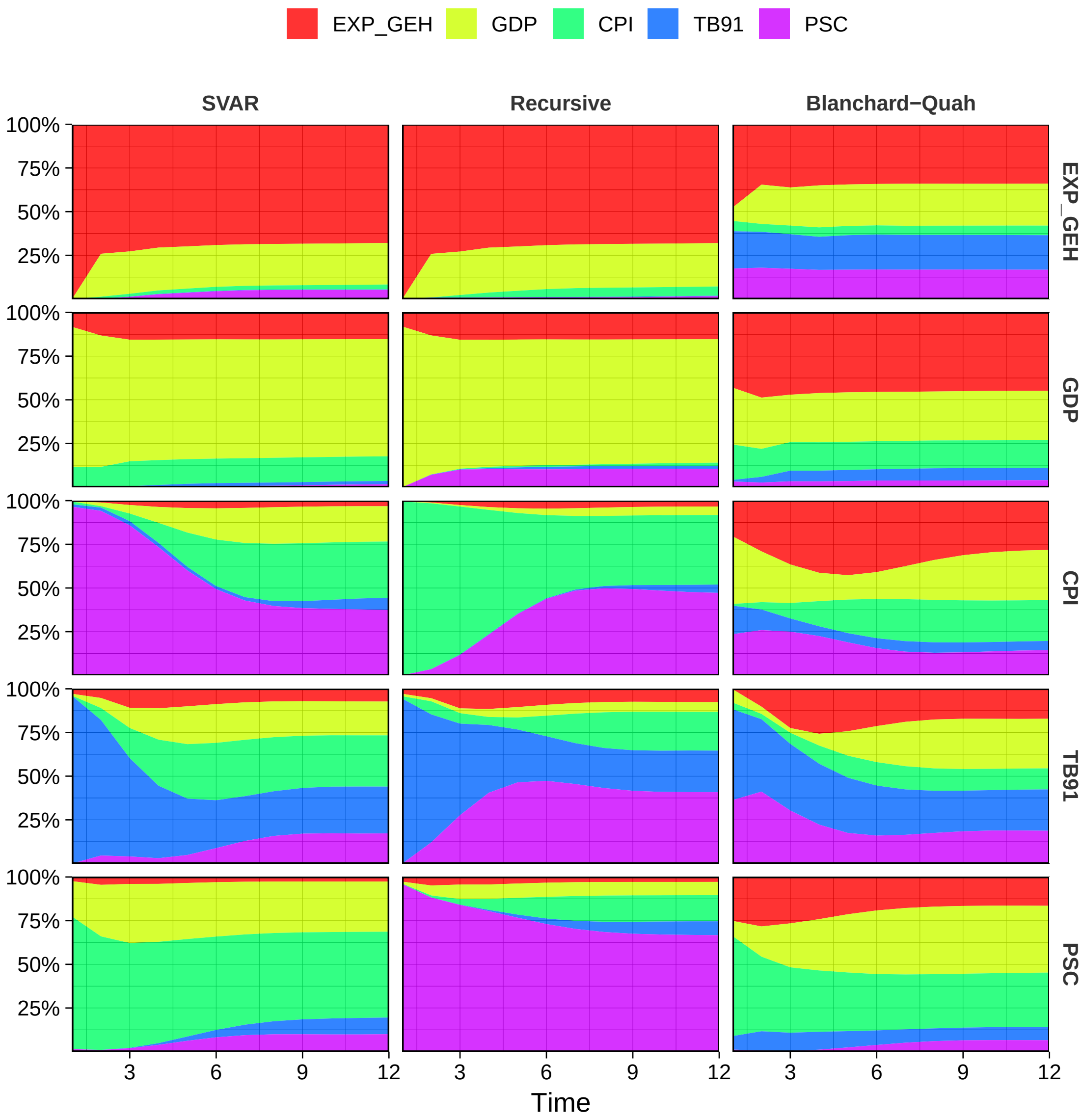
Table 23 shows the corresponding cumulative impact elasticities, indicating a 7% response of GDP and inflation, a 67% response in the 91-day T-Bill rate, and and 8.5% response of credit to the private sector. These overall effects seem quite plausible, also in light of the Monthly estimates in Table 20, and the shape of IRF's is consistent across the 3 identification strategies.

Table 23: GEE-GDP: Cumulative 12-Quarter Scaled IRF

Identification	EXP_GEH	GDP	CPI	TB91	PSC
SVAR	1.003	0.070	0.070	0.672	0.086
Recursive	1.003	0.070	0.073	0.695	0.093
Blanchard-Quah	2.008	0.201	0.384	1.566	0.512

The FEVD's in Figure 19 show that GEE explains up to 15% of forecast errors in GDP in the long-run, and less for CPI, TB91 or PSC. The first row of the figure also shows that GEE is itself endogenous to GDP, with GDP explaining up to 25% of GEE forecast errors in the long run.

Figure 19: GEE-GDP: Forecast Error Variance Decompositions



4.2.4 Growth-Enhancing Expenditure: 2-Step Factor

Substituting again the 2-Step factor estimate for GDP, yields very similar IRF's and FEVD's - reported in Figures 20, 21 and Table 24. The effect on economic activity as measured by the 2-Step Factor is slightly smaller than the effect on GDP, with an first-period elasticity just above 2% vs. just above 3% for GDP, and a cumulative impact of 5.9% vs. 7% for GDP. The measured impact on inflation is also smaller with 4.9% vs. 7% for GDP. The effect on the T-Bill rate is similar at 62% vs. 67%, and the impact on PSC is slightly greater at 10.7% vs. 8.6%. Again the SVAR and recursive strategies provide very similar results, and BQ estimates are also not too far off, giving additional confidence in these results.

Figure 20: GEE-2-Step Factor: Scaled Impulse Response Functions

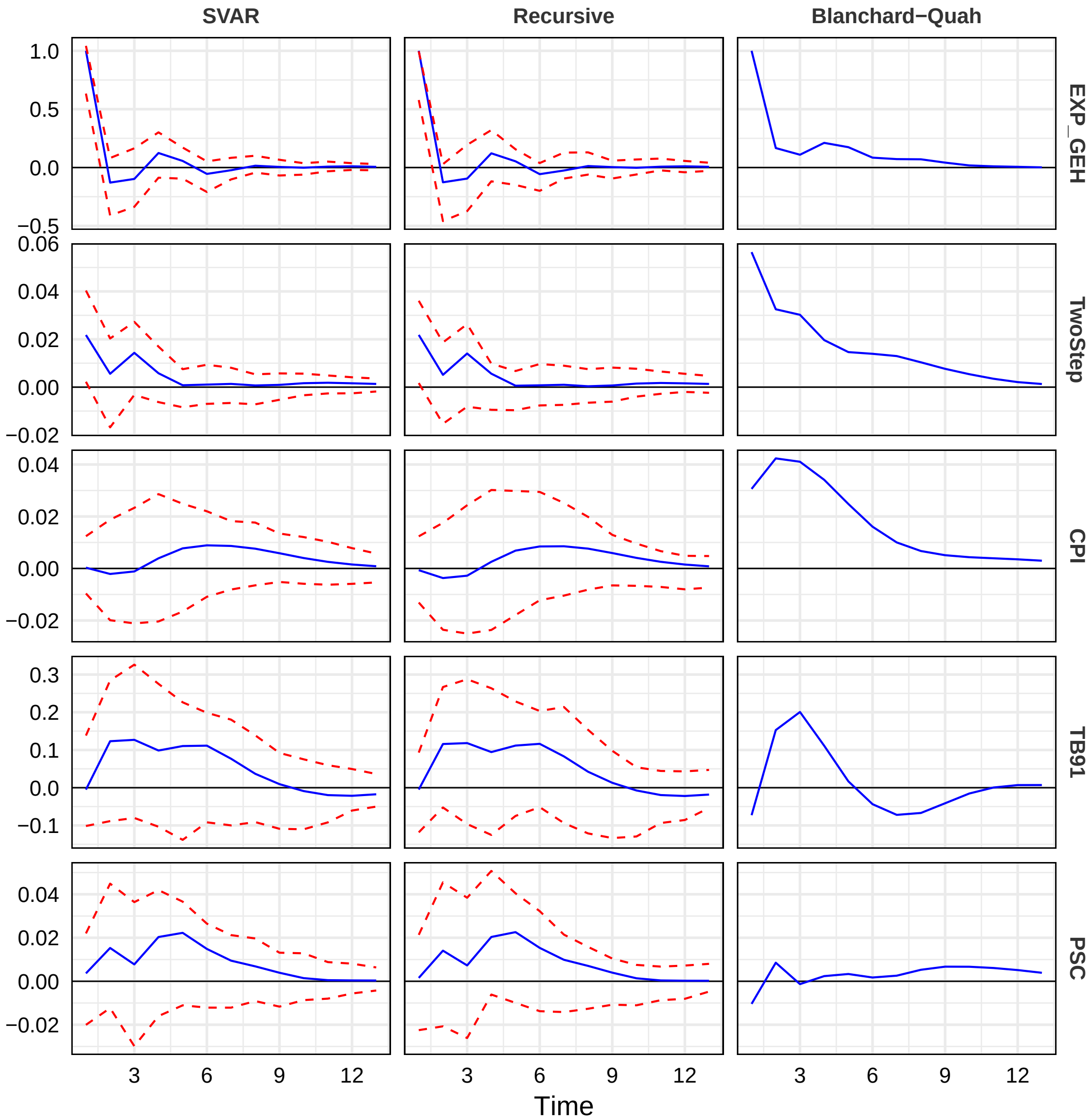
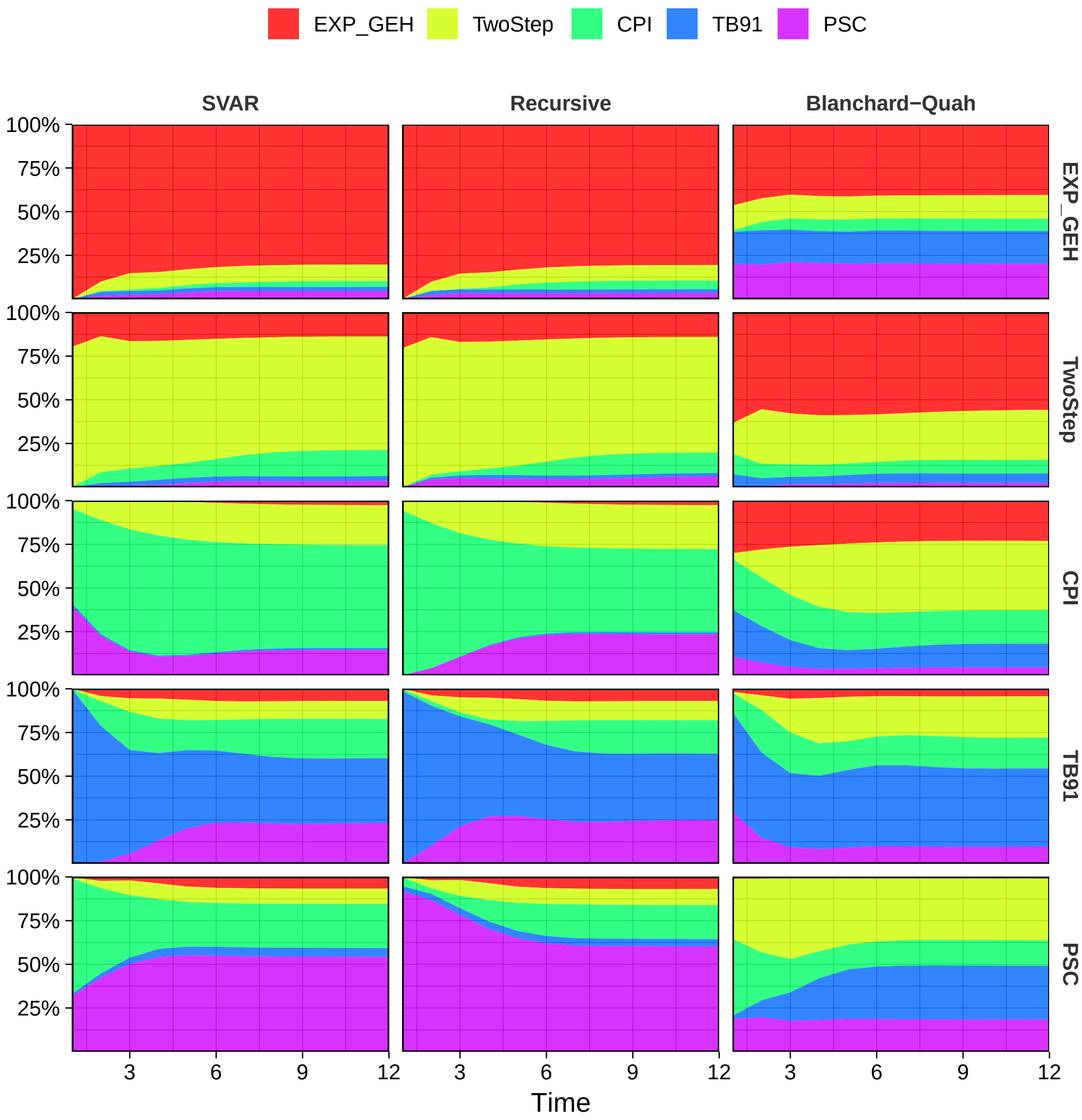


Table 24: GEE-2-Step Factor: Cumulative 12-Quarter Scaled IRF

Identification	EXP_GEH	TwoStep	CPI	TB91	PSC
SVAR	0.920	0.059	0.049	0.621	0.107
Recursive	0.911	0.056	0.042	0.623	0.104
Blanchard-Quah	1.968	0.211	0.226	0.184	0.041

A notable difference in the FEVD is that the GEE is less endogenous to economic activity as measured by the 2-Step factor: at most 10% of the GEE forecast error is accounted for by variation contained in the 2-Step factor vs. up to 25% explained by GDP.

Figure 21: GEE-2-Step Factor: Forecast Error Variance Decompositions



For comparison purposes, and in light of the strong results with the QML factor estimate in Table 26, the quarterly estimation is also done with the QML factor and reported in Appendix Figures 28 and 29 and Table 28. Both IRF's and FEVD's are very similar to the 2-Step results, but the IRF's are smoother, with a first-period impact of only 1.2% but lasting 6 quarters vs. 4 quarters for the GDP or 2-Step estimates, resulting in a total 12-quarter impact of 5.5% which is statistically equal to the 2-Step estimate of 5.9% reported in Table 24. Thus the additional Kalman Filtering and Smoothing in the QML factor estimate results in smoother IRF's and more gradual responses, while preserving the sign and magnitude of the total effect.

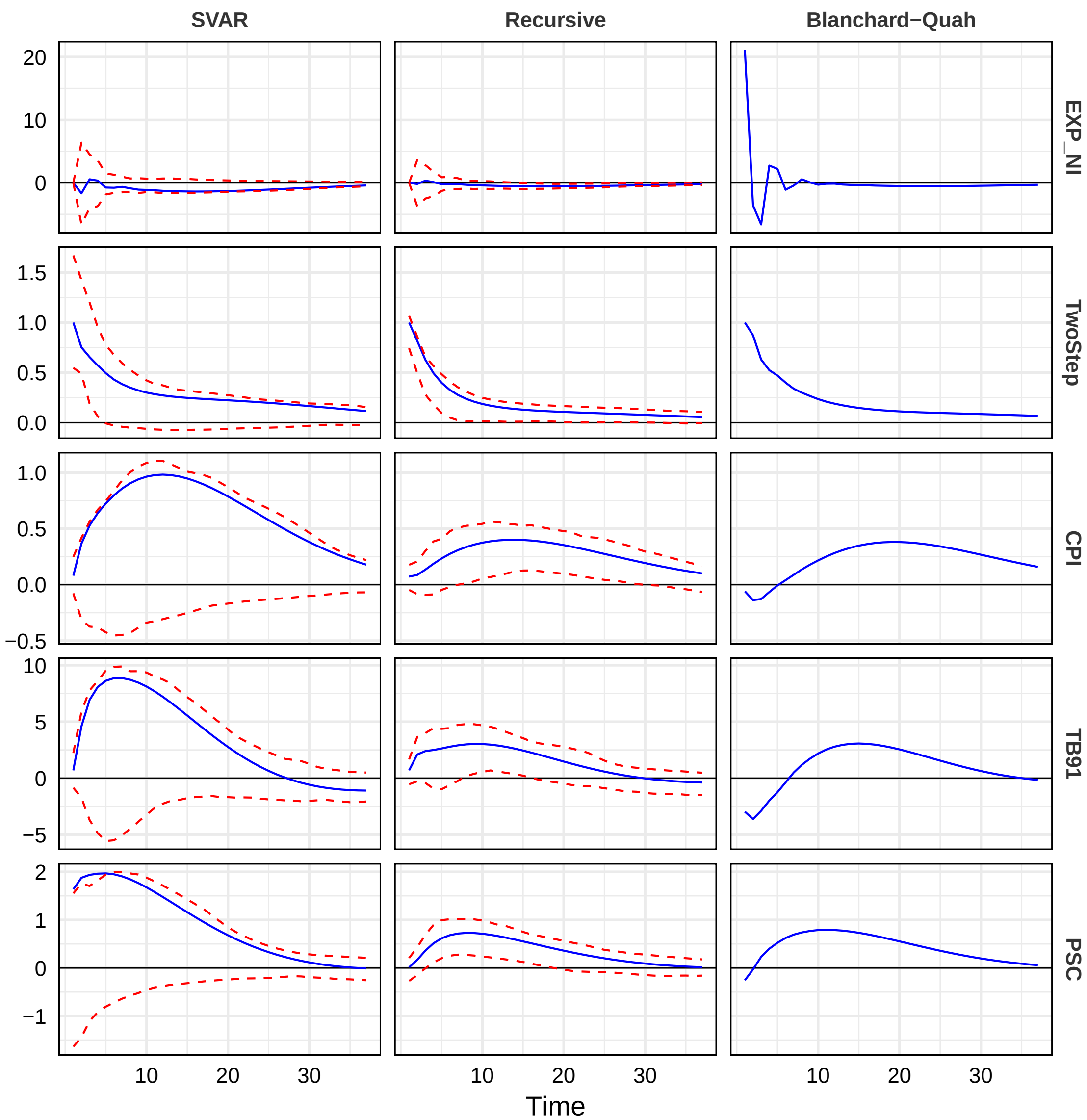
4.3 Government Spending Following an Economic Activity Shock

Some FEVD's in the previous subsection indicated that government expenditure, and in particular GEE, may not be as exogenous as presumed in this study so far. By virtue of estimating a Structural VAR model, the response of any variable to a shock in any other variable can be identified, provided the structural restrictions imposed are valid. The aim of this section is to investigate impulse responses to economic activity shocks using the monthly and quarterly SVAR models introduced above to conclude something about the endogeneity of government spending to economic activity.

4.3.1 Non-Interest Expenditure

Figure 22 shows the NIE response to an economic activity shock using monthly data. It is evident in the SVAR estimate as well as the recursive strategy that NIE does not appear to respond to the shock - in contrast to CPI, TB91, and PSC which all increase following the shock.

Figure 22: NII-2-Step Factor-Monthly: Scaled IRF's Following Economic Activity Shock



The estimation is repeated with quarterly GDP and the response to the GDP shock is reported in Figure 23. Here NIE is shown to increase by a sizeable amount 1 quarter after the shock.

It is curious to note in Figure 23 that the SVAR does not appear to identify responses in CPI, TB91 and PSC following a GDP shock - in contrast to the recursive strategy. The cumulative elasticity reported in Table 25 suggests an elasticity of 74% of spending to GDP which is all spent one quarter after the shock.

Figure 23: NII-GDP-Quarterly: Scaled IRF's Following Economic Activity Shock

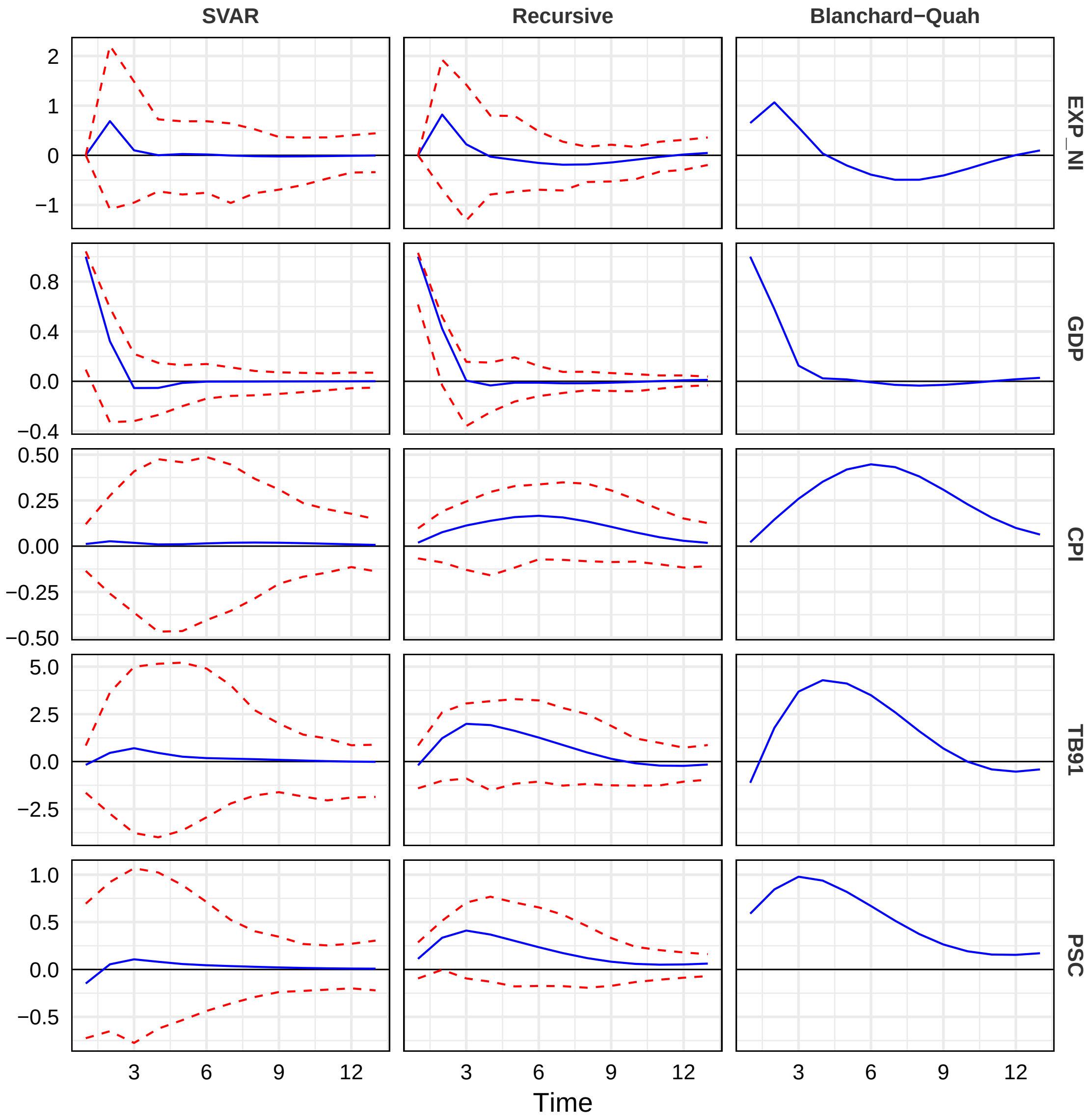


Table 25: NIE-GDP: Cumulative 12-Quarter Scaled IRF Following EA Shock

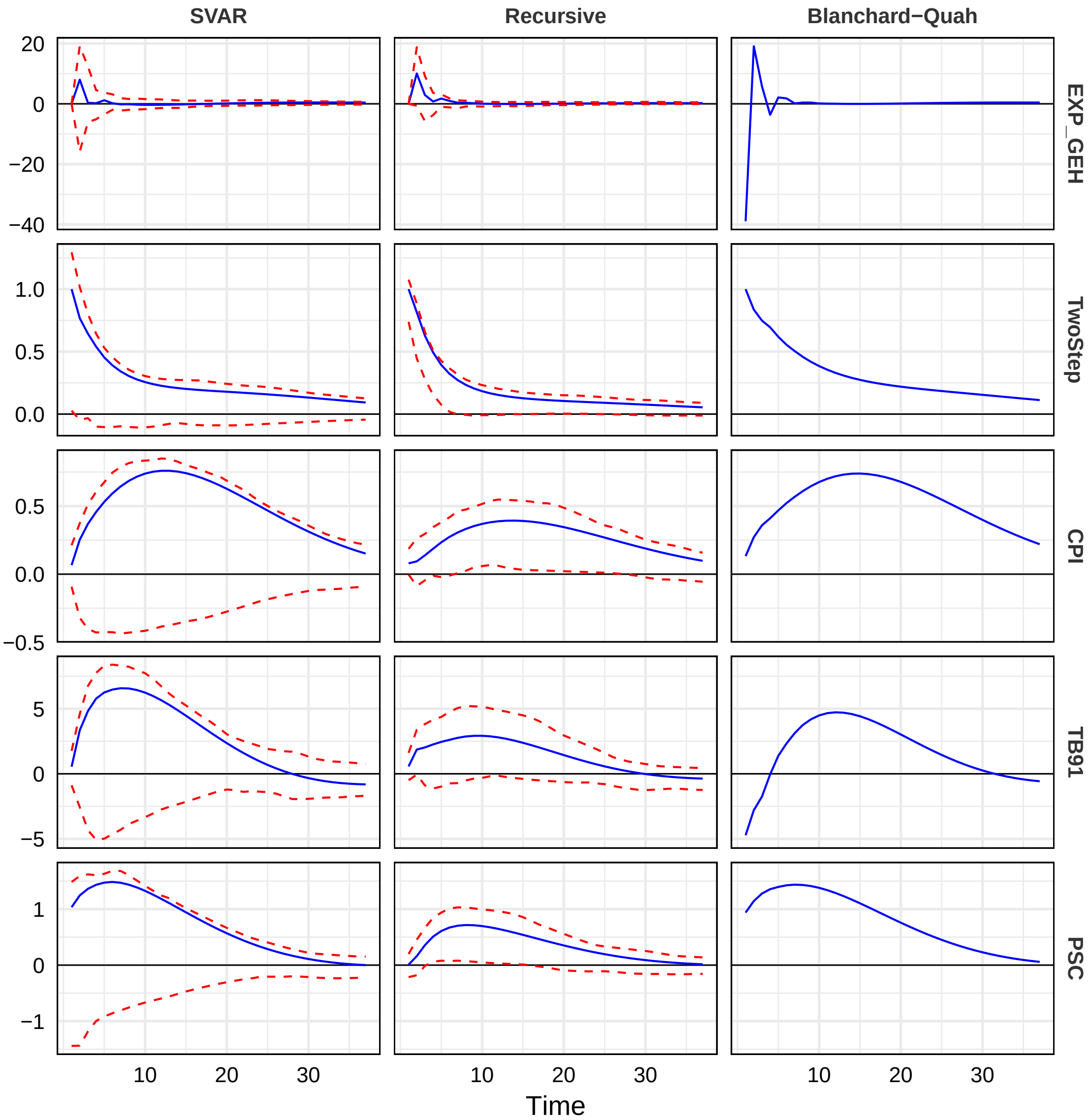
Identification	EXP_NI	GDP	CPI	TB91	PSC
SVAR	0.738	1.191	0.195	2.306	0.328
Recursive	0.187	1.346	1.240	8.638	2.361
Blanchard-Quah	0.034	1.674	3.312	19.756	6.664

Repeating this exercise with shocks to the 2-Step and QML factors yields heterogeneous results - sometimes giving large positive and sometimes large negative results, which also vary across identification strategies. This suggests, together with the monthly estimates in Figure 22, that non-interest fiscal spending in Uganda is not very reactive to economic activity shocks, and further that the system is likely not identified well enough to analyse this shock. Nevertheless, Figure 23 maintains the possibility of sizeable procyclical fiscal spending, and most results imply that spending is unlikely to be countercyclical as in most advanced economies.

4.3.2 Growth Enhancing Expenditure

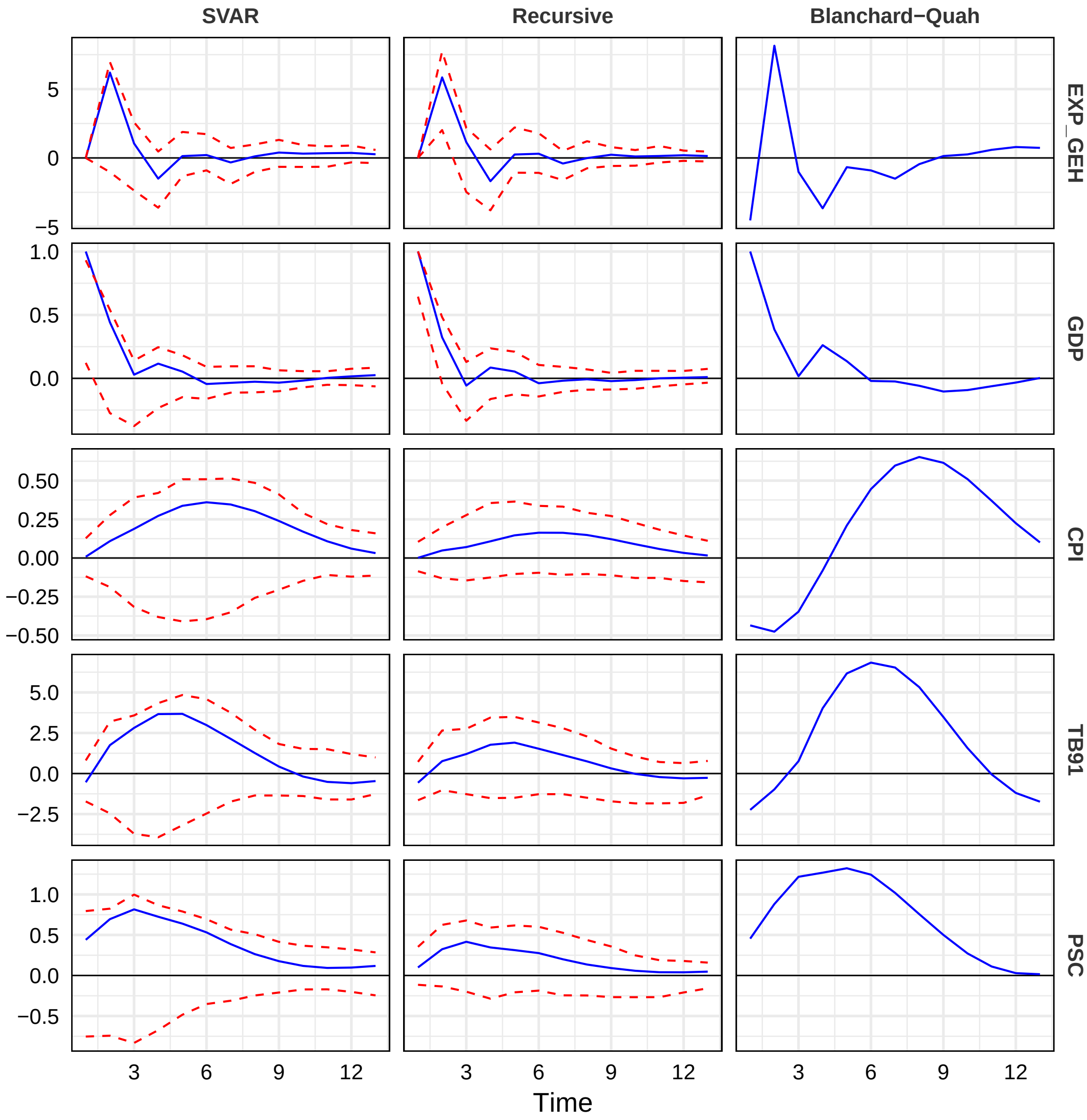
In search of more robust results, the exercise is repeated with GEE. Figure 24 shows the IRF of GEE following a 100% economic activity shock, proxied for by the 2-Step factor. The IRF's suggest a short-lived but huge response with at elasticity of 8 in the quarter after the shock. Other responses like the 91-day T-Bill rate are also on that order, calling into question the structural identification.

Figure 24: GEE-2-Step Factor-Monthly: Scaled IRF's Following Economic Activity Shock



The same short-lived but huge in magnitude response (elasticity ≈ 7) is visible in Figure 25 showing the IRF's following a quarterly GDP shock.

Figure 25: GEE-GDP-Quarterly: Scaled IRF's Following Economic Activity Shock



Although it remains questionable whether these responses are really structural, and the magnitudes are unrealistic, they suggest that spending that is good for growth occurs most when growth has been good beforehand. This would imply a strained fiscal situation in which it is not feasible or politically possibly to conduct countercyclical fiscal policy.

In summary, not much can be said about the response of fiscal spending to economic activity / GDP from this analysis, except that it is likely not contercyclical and possibly significantly procyclical. The SVAR model was mainly set up to identify the effects of fiscal spending shocks, and more careful analysis, including reduced-form regression or instrumental-variable analysis, is needed to evaluate the effects of growth on fiscal spending.

5 Summary and Conclusion

This paper started with an excursus concerning the measurement of economic activity in Uganda at high frequencies over extended periods time, and independently of government spending - which feeds into BOU's CIEA, making it unusable for macroeconomic analysis of fiscal policy.

A dynamic factor index was proposed which combines 7 monthly series (CIC, PSC, VAT, EXD, PAYE, EX and IM) in nominal terms. This index was shown to be highly correlated with the CIEA, quarterly GDP and survey based indicators such as Stanbic Banks PMI and BOU's BTI. In terms of methodology, the 2-Step dynamic factor estimate following Doz et al. (2011) where the Kalman Filter and Smoother is run only once and initialized with PCA estimates, appears to have superior properties capturing high-frequency variation in the data than the quasi-maximum likelihood approach of Doz et al. (2012). Furthermore, an extended quarterly GDP series running from 2008Q3 was constructed by appending the rebased series (2015Q1-Present) with the old one (2008Q3-2018Q2) using average multipliers for each quarter during the overlap period (2015Q1-2018Q2), and scaling the series to match the annual rebased series[12]. Comparing the aggregated high-frequency indicators to this series in quarterly first-differences yielded moderate correlations with the PMI ($\rho = .446$), BTI ($\rho = .441$), 2-Step factor ($\rho = .359$), QML factor ($\rho = .327$) and CIEA ($\rho = .314$), which emphasizes the empirical value of the PMI and the BTI. Monthly industrial production by the World Bank is uncorrelated with these high-frequency indicators, and annual GDP by the World Bank is only moderately correlated ($\rho = 0.6$) with annual GDP by UBOS, suggesting limited utility of World Bank data for analysis of the domestic economy.

Using these measures of economic activity, regressions on several measures of fiscal spending were run at various frequencies, allowing for spending to take effect with a lag, and controlling for the governments strain on domestic financial markets. Analysis with monthly data did not yield statistically significant effects of spending on economic activity, but results with quarterly data and factor estimates yielded cumulative elasticities of 5-8% for the growth-enhancing expenditure (GEE, combining spending on infrastructure, mineral development, trade and industry, ICT, science and tourism) and social expenditure (SOE, combining spending on health, eduction and social development) categories. In both cases the total effect was evenly distributed over the level and 2 lags of these spending aggregates, indicating time lags of up to 9 month for spending to take effect. Using quarterly GDP also yielded positive elasticities of 2-3% for the GEE and SOE aggregates, but the coefficients were insignificant at the 10% level. Including financial sector controls in the regression typically yielded 5-10% larger coefficients, which is to small of a change to suggest meaningful crowding out of credit to the private sector through government spending. Annual results were roughly in line with the quarterly estimates, suggesting a growth effect of GEE spending between 7 and 14% within 2 years time. It should be noted that due to the small effect sizes, combined with small sample sizes (especially for quarterly and annual analysis), the regression results are overall not very robust or convincing.

Analysis was taken further with a Structural Vector Autoregression seeking to identify the effects of fiscal shocks in an system of 5 variables including economic activity, interest rates, inflation and private sector credit. Shocks to this system were identified using Structural short-run restrictions, a recursive Choleski ordering, and also long-run restrictions a la Blanchard & Quah (1989), using the same recursive ordering[13]. Monthly results yielded that a total non-interest spending (NIE) shock has a 0 net effect on the real economy after 36 month (congruent to the regression results), but increases the T-bill rate with an elasticity of 30%. Forecast Error Variance Decompositions (FEVD's) show that monthly NIE is basically exogenous to the system. With GEE, cumulative IRF's suggest a 0.2-0.3% impact on economic activity over the course of 36 month, a 0.8% impact on inflation, a 35-39% impact on the T-bill rate, and a 3.5% impact on credit to the private sector. With quarterly data and GDP, a NIE shock is estimated to have a 4.2% impact on GDP, a 9.3% impact on infaltion, 130% impact on the T-Bill rate and 55% impact on credit to the private sector within 12 quarters. With GEE, the real effects are stronger and the financial sector effects weaker: a quarterly GEE shock is estimated to yield a 7% increase in economic activity and

[12]The annual rebased GDP series runs from FY 2008/09 and is consistent with the rebased quarterly series. See footnote 5 for details on the methodology applied to combine the series.

[13]Recursive Choleski and Blanchard & Quah (1989) identification is only reported to assess the empirical robustness to the structural identification strategy.

inflation, a 67% increse in the T-Bill rate and a 8.6% increase in credit to the private sector. The effect on GDP is characterized by a positive effect of around 10% realized within 4 quarters, with a slight negative backlash in the remaining 8 quarters bringing the total effect down to 7%. The financial sector response is more gradual. FEVD's imply that GEE spending explains up to 15% of GDP forecast errors at a 3-year horizon. Overall, the IRF's from different identification strategies and economic activity measures are quite similar providing additional confidence in these quarterly results.

Quarterly FEVD's also suggest that 10-25% of long-term GEE spending could be explained by changes in economic activity itself, prompting some additional analysis of the response of fiscal spending to an economic activity shock. This analysis indicated a possibly large response of fiscal spending (and GEE spending in particular) to economic activity, with elasticity estimates around 1. The estimates also suggest a procyclical fiscal policy - as also demonstrated by the recent reduction in fiscal spending during the COVID-19 pandemic.

To conclude, fiscal spending has effects on both the real and financial sectors. All types of spending appear to trigger a financial sector response, characterized by a significant increase in the T-Bill rate (with an elasticity between 0.3 and 1.3) during the 1-2 years following the shock, but no decrease in credit to the private sector or crowding out effect. In terms of real effects, only a subset of GEE spending relates significantly and positively to economic activity. Results suggest at the cumulative effects within a 3-year time frame lie between 5% and 15%, with the most credible quarterly models suggesting cumulative effects around 7%. These impact elasticity estimates appear small but do not imply at all that fiscal spending is ineffective, minding that total NIE is 5 times smaller in magnitude than GDP, and GEE spending is around 30 times smaller than GDP. At these relative magnitudes an elasticity of 10% of GDP to GEE spending would imply a 3-fold return in value-added for every shilling the government invests in these sectors. If the elasticity is 7% as suggested by most quarterly models, the return to GEE spending is still 2-fold.

The regression analysis found a similar positive effect of SOE on economic activity as GEE, which could however not be confirmed in the SVAR analysis (not reported). This invites further research on the effects of SOE on growth. Theoretical considerations suggest that even if GEE spending has a more robust impact on growth, more SOE will be required for Ugandans to reap the benefits of this GEE spending in an equitable manor. The nexus between growth, GEE investments, SOE and welfare in Uganda opens up vast possibilities for further research, but it will likely require more comprehensive empirical studies and micro-data to uncover some of these linkages.

A final contribution of this study is the anecdotal evidence it provided on the procyclicality of fiscal spending in Uganda. This also opens up possibilities for further research on the nature and magnitude of this procyclicality, and into the feasibility and benefits of making fiscal policy in Uganda more countercyclical.

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Appendix

Additional Quarterly Regression Tables

Table 26: Quarterly Regressions with Lagged QML Factor in Log-Differences

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Expenditure Aggregate:	NI	NI	DEV	DEV	DDEV	DDEV	GEH	GEH	SOC	SOC
Lag QML Dynamic Factor	0.351*	0.408**	0.323	0.361*	0.402**	0.509***	0.245	0.291	0.239	0.268
	(0.185)	(0.195)	(0.191)	(0.204)	(0.158)	(0.166)	(0.184)	(0.196)	(0.158)	(0.173)
Expenditure	0.021*	0.027*	0.014*	0.015*	0.008	0.008	0.014**	0.014**	0.017***	0.020***
	(0.012)	(0.014)	(0.008)	(0.008)	(0.006)	(0.006)	(0.006)	(0.006)	(0.005)	(0.005)
Lag Expenditure	0.005	0.013	0.012	0.011	-0.005	-0.010	0.009	0.009	0.019**	0.017**
	(0.008)	(0.010)	(0.009)	(0.009)	(0.007)	(0.007)	(0.006)	(0.007)	(0.008)	(0.007)
Lag 2 Expenditure	0.013	0.022**	0.015*	0.014*	0.000	-0.004	0.014*	0.013	0.021***	0.023***
	(0.010)	(0.010)	(0.008)	(0.008)	(0.006)	(0.006)	(0.007)	(0.008)	(0.007)	(0.007)
Lag 3 Expenditure	-0.002	0.005	0.005	0.004	-0.007	-0.011**	0.003	0.002	0.006	0.009
	(0.009)	(0.009)	(0.005)	(0.005)	(0.004)	(0.005)	(0.005)	(0.005)	(0.007)	(0.006)
Headline Inflation	0.103**	0.174**	0.080**	0.109*	0.056	0.075	0.091*	0.116*	0.101**	0.122**
	(0.047)	(0.074)	(0.039)	(0.063)	(0.049)	(0.090)	(0.045)	(0.065)	(0.039)	(0.047)
Net Domestic Financing		-0.007		-0.008		-0.017*		-0.005		-0.006
		(0.008)		(0.008)		(0.009)		(0.007)		(0.008)
91-day Treasury Bill Yield		-0.014		-0.007		-0.008		-0.007		-0.006
		(0.009)		(0.008)		(0.010)		(0.007)		(0.006)
Stock of Government T-Bills		-0.004		-0.007		0.012		-0.001		-0.005
		(0.018)		(0.019)		(0.014)		(0.021)		(0.013)
Net Credit to Government		-0.005		-0.002		0.004		-0.002		-0.005
		(0.006)		(0.006)		(0.006)		(0.007)		(0.005)
Constant	0.009***	0.007*	0.008**	0.008**	0.010***	0.010***	0.010***	0.009***	0.006**	0.006**
	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Observations	43	43	43	43	43	43	43	43	43	43
R^2	0.326	0.418	0.362	0.410	0.372	0.473	0.427	0.460	0.294	0.342
Quarterly Dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Durbin-Watson d-statistic	1.611	1.717	1.679	1.728	1.965	2.064	1.694	1.698	1.900	1.900

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 27: Quarterly Regressions with PMI in Log-Differences

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Expenditure Aggregate:	NI	NI	DEV	DEV	DDEV	DDEV	GEH	GEH	SOC	SOC
Expenditure	0.355	0.373	0.191	0.346*	0.081	0.172*	0.223	0.270**	0.359	0.435
	(0.274)	(0.370)	(0.170)	(0.145)	(0.122)	(0.085)	(0.157)	(0.105)	(0.456)	(0.606)
Lag Expenditure	-0.728**	-0.740	-0.310	0.163	-0.237**	-0.178	-0.081	0.010	-0.071	-0.558
	(0.251)	(0.625)	(0.181)	(0.267)	(0.102)	(0.107)	(0.155)	(0.114)	(0.343)	(1.037)
Lag 2 Expenditure	-0.147	-0.163	-0.036	0.552	-0.012	0.012	0.012	0.279	0.106	0.178
	(0.245)	(0.779)	(0.215)	(0.387)	(0.113)	(0.147)	(0.134)	(0.180)	(0.384)	(0.640)
Lag 3 Expenditure	-0.419*	-0.472	-0.233	0.098	-0.093	-0.185	-0.138	0.044	-0.401	-0.474
	(0.204)	(0.439)	(0.156)	(0.246)	(0.098)	(0.096)	(0.098)	(0.102)	(0.361)	(0.534)
Headline Inflation	-5.995*	-8.329	-4.504	-7.202	-1.895	-4.146	0.123	-8.698*	-0.124	-8.230
	(2.943)	(4.476)	(3.066)	(4.395)	(3.305)	(3.350)	(3.522)	(4.394)	(5.544)	(11.944)
Net Domestic Financing		-0.042		0.336		-0.190		0.214		0.065
		(0.237)		(0.296)		(0.168)		(0.199)		(0.228)
91-day Treasury Bill Yield		-0.210		-1.185*		-0.718		-1.336*		-0.990
		(0.709)		(0.565)		(0.404)		(0.647)		(0.760)
Stock of Government T-Bills		0.567		1.080**		0.673*		1.653**		1.210
		(0.390)		(0.357)		(0.304)		(0.662)		(1.524)
Net Credit to Government		-0.213		-0.962*		-0.265		-0.728*		-0.613
		(0.490)		(0.449)		(0.314)		(0.309)		(0.534)
Constant	0.150**	0.168	0.102	-0.039	0.019	0.080*	0.021	-0.051	0.002	0.007
	(0.059)	(0.146)	(0.064)	(0.104)	(0.037)	(0.035)	(0.066)	(0.055)	(0.064)	(0.092)
Observations	19	19	19	19	19	19	19	19	19	19
R^2	0.792	0.860	0.746	0.875	0.721	0.920	0.630	0.831	0.332	0.540
Quarterly Dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Durbin-Watson d-statistic	1.923	2.128	2.107	2.449	2.289	1.722	2.713	2.689	2.602	2.848

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Additional Forecast Error Variance Decompositions

Figure 26: Growth Enhancing Expenditure: Forecast Error Variance Decompositions

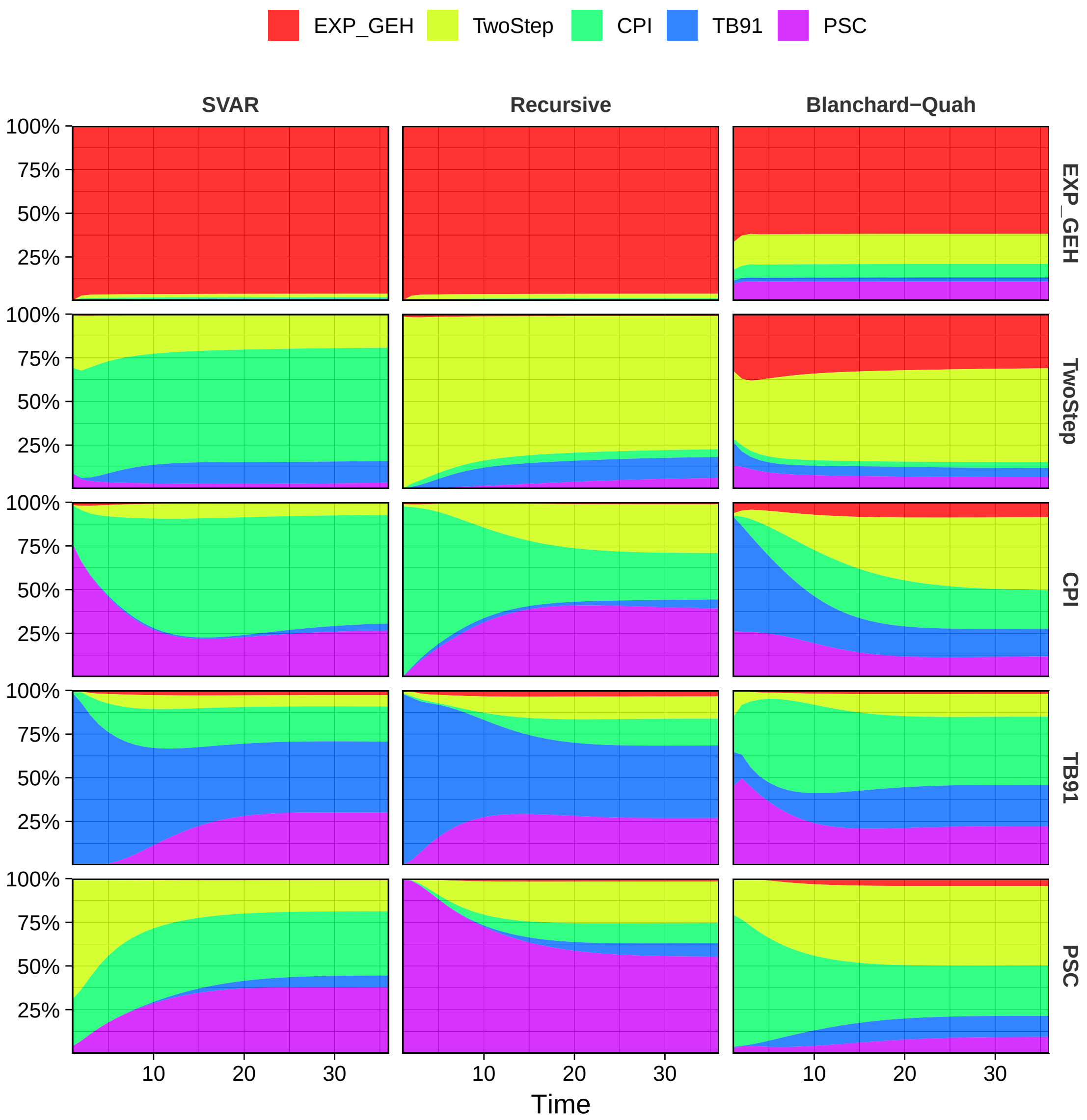
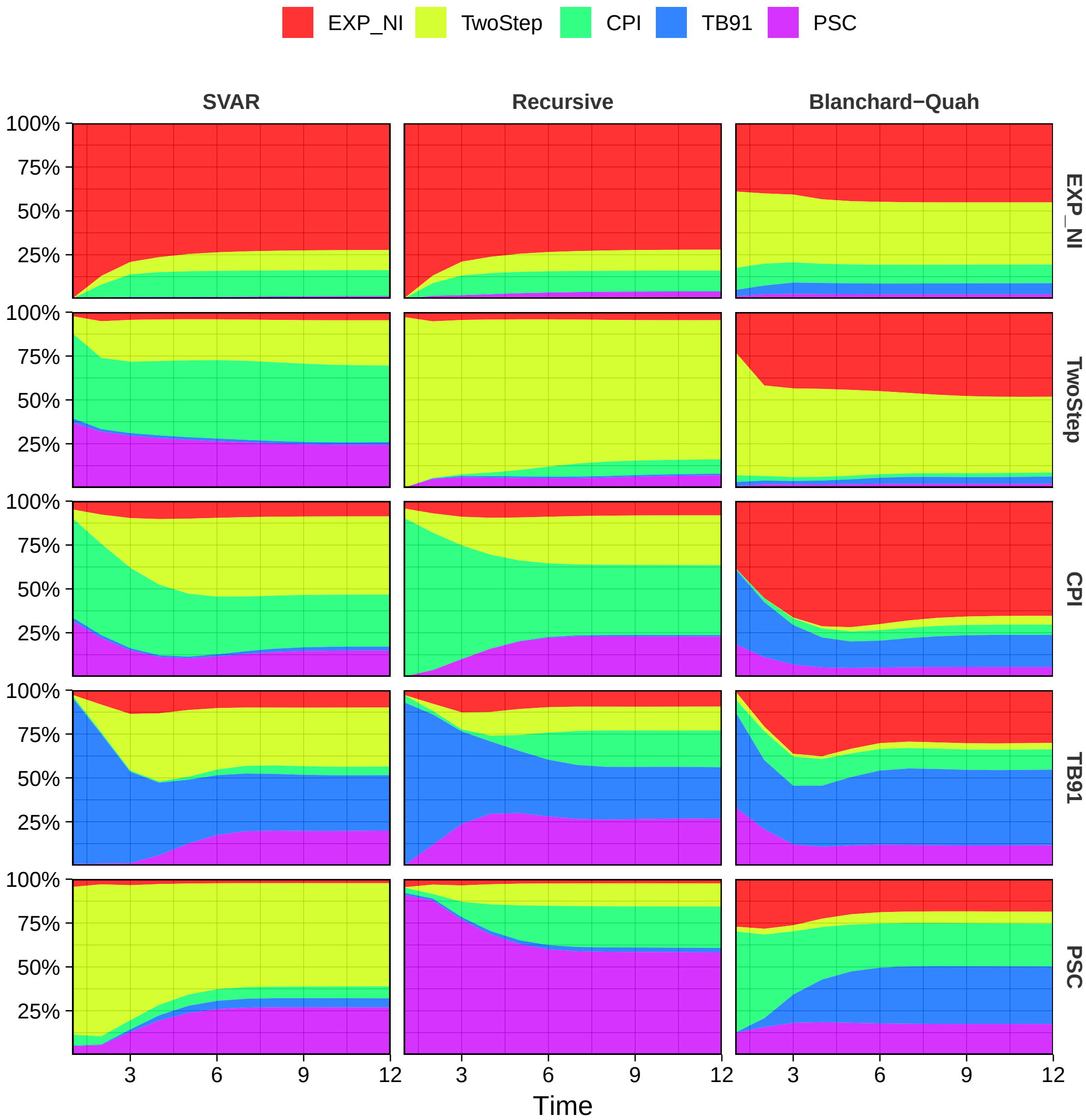


Figure 27: NIE-2-Step: Forecast Error Variance Decompositions



Quarterly GEE Impacts using QML Factor Estimate

Figure 28: GEE-QML Factor: Scaled Impulse Response Functions

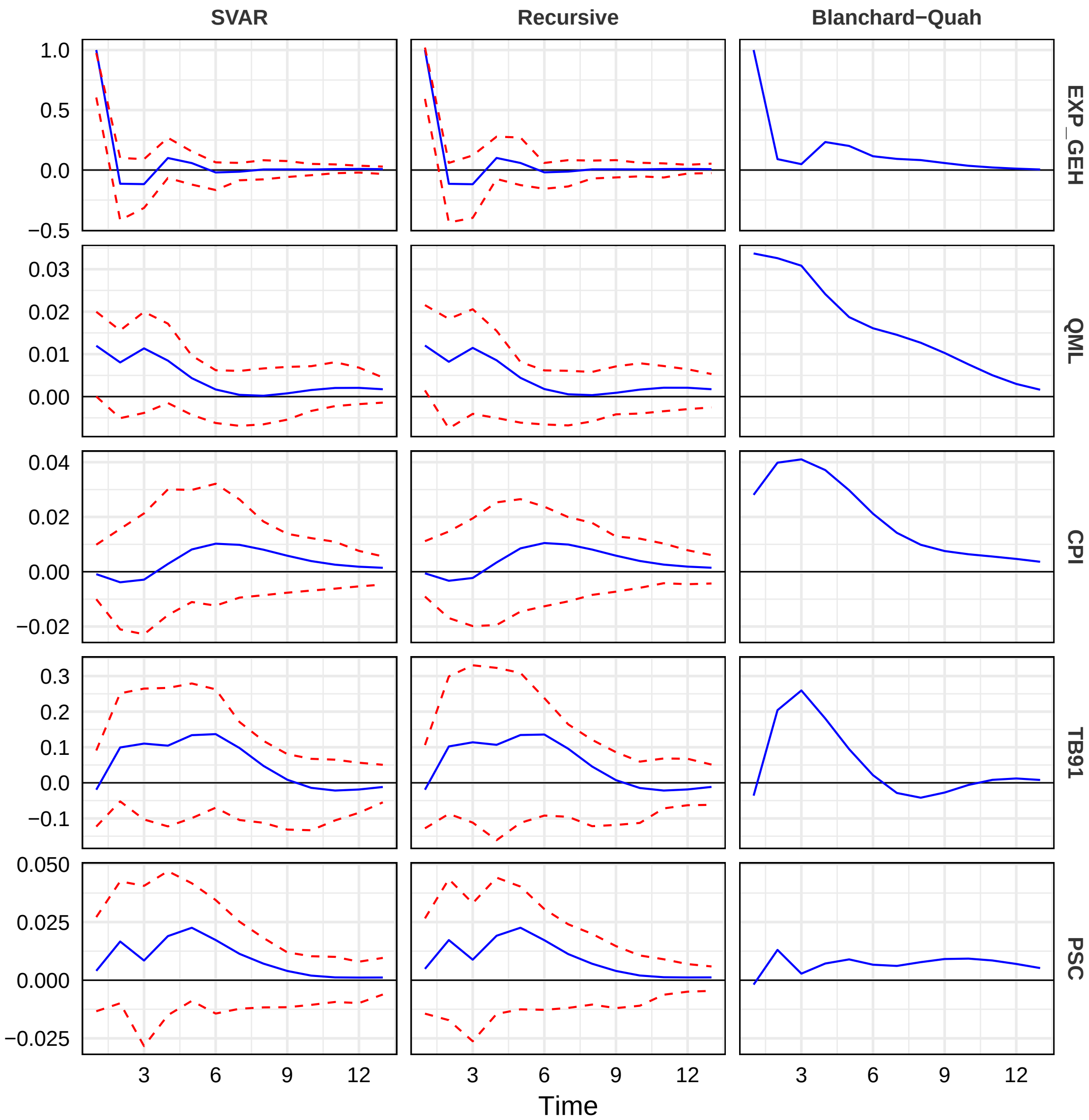


Table 28: GEE-QML Factor: Cumulative 12-Quarter Scaled IRF

Identification	EXP_GEH	QML	CPI	TB91	PSC
VAR	0.932	0.055	0.047	0.653	0.116
Recursive	0.936	0.056	0.050	0.656	0.118
Blanchard-Quah	1.997	0.211	0.249	0.649	0.090

Figure 29: GEE-QML Factor: Forecast Error Variance Decompositions