

The Academy of Economic Studies Bucharest

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# FISCAL MULTIPLIERS ANALYSIS



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# DISSERTATION PAPER OUTLINE

1. Introduction
2. Objectives
3. Brief literature review
4. Data Description
5. Econometric Methodology
6. Results : Cholesky Identification Scheme
7. Results : Sign Restriction Identification Scheme
8. Summary and conclusions

# INTRODUCTION

- ❖ The economic crises has triggered an increase interest in fiscal policy impact on economic activity :
  - ❖ Advanced countries implemented sizable fiscal stimulus packages in order to boost demand
  - ❖ Emerging economies usually shifted to the other direction, conducting austerity measures in order to finance their fiscal deficits
  - ❖ Monetary transmission mechanism got weaker. Industrialized countries central banks could not longer cut the interest rate (zero bound)
- ❖ There is only a scarce evidence in the economic literature that analyzes the fiscal multipliers in emerging Europe

# OBJECTIVES

❖ Key question : *What are the effects of tax cuts or public spending increase on the Romanian economy?*

1. Analyze government spending and government net revenue multipliers

- ❖ Compute the size of the fiscal multipliers through two identification schemes
  - ❖ VAR approach via Cholesky decomposition method
  - ❖ Sign restriction VAR approach

2. Analyze the composition effect of government spending and government net revenues

- ❖ Disaggregate fiscal policy instruments and calculate their multipliers

3. Present Romania's economic conditions that influence the size of the multipliers

# FISCAL MULTIPLIERS: DEFINITION

- ❖ The **fiscal multiplier** is the change in output caused by a one-unit increase in a fiscal variable.
- ❖ **Cumulative multiplier** is defined as the cumulative change in output over the cumulative change in fiscal variable at some horizon N.

$$\frac{\sum_{t=0}^N \Delta Y(t)}{\sum_{t=0}^N \Delta G(t)}$$

→ cumulated impulse-response of real GDP to one standard deviation fiscal shock

→ cumulated impulse-response of fiscal variable to one standard deviation shock of that fiscal variable

- ❖ *“The size of the fiscal multiplier is country-, time-, and circumstance specific.” Antonio Spilimbergo et al (2009)*

# BRIEF LITERATURE REVIEW

- ❖ **Ilzetzki, Mendoza and Vegh (2011)** find that the size of fiscal multipliers depends on the key country characteristics:
  - degree of openness
  - exchange rate regime
  - the level of public debt
  - They also find that spending multipliers are generally low and insignificant and revenue multipliers are significant and around 0.3 over the short term
  
- ❖ **Auerbach and Gorodnitchenko (2012)** and **Baum, Ribeiro and Weber (2012)** found that the size of the fiscal multipliers depends also on the state of the economy : whether there is recession or expansion
  - Auerbach and Gorodnitchenko (2012) perform an analysis over OECD countries and found that spending multipliers are larger in downturns (0.5 – over 4Q) than in expansions (-0.3 over 4Q)
  - Baum et. all (2012) analyze the link between fiscal multipliers and the state of the economy over G7 economies and they came to the same conclusion: both spending and revenue multipliers are larger in recessions than in expansions

# EMERGING ECONOMIES MULTIPLIERS

Authors	Data	Method	Countries	Fiscal shocks	Cumulative multiplier (quarters after the shock)		
					2Q	4Q	8Q
<b>Cuaresma, J.C., Eller, M. and Mehrotra, A. (2011)</b>	Quarterly data (1995-2009)	SVAR	Czech Hungary Poland Slovakia Slovenia	Spending	-0.00	-0.01	-0.04
					0.01	0.02	0.01
					-0.00	-0.01	-0.02
					-0.01	-0.01	0.00
					0.01	0.00	-0.01
			Czech Hungary Poland Slovakia Slovenia	Revenue	0.00	0.01	0.03
					-0.00	-0.01	-0.01
					-0.00	0.00	0.02
					-0.02	-0.05	-0.1
					0.01	0.02	0.02

Authors	Data	Method	Countries	Fiscal shocks	Cumulative multiplier (long run value)			
<b>Muir, D. and Weber, A (2013)</b>	Quarterly data 1999-2011	SVAR		Spending	0.04			
				Revenue	-0.33			
	Monthly data 2003-2011			Spending	0.31			
				Revenue	-0.32			
	Monthly data 2003-2006			Bulgaria	Spending	0.16		
					Revenue	-0.42		
	Monthly data (2003-2011)			Threshold VAR	Spending	Recession	0.3	
						Expansion	0.2	
Revenue		Recession	-0.5					
		Expansion	-0.4					

# DATA DESCRIPTION

Sample : 2001Q1 -2013Q4

Data frequency : Quarterly , 52 observations

Variables	Description	Unit	Treatment	Source
Government Spending	Government purchases of goods and services =government consumption + government investment = compensation of public employees + intermediate consumption + government gross fixed capital formation	Log domestic currency millions*	The variables were deflated with GDP deflator and seasonal adjusted.	Eurostat
Government Net Revenues	Net taxes = government revenues – transfers = indirect taxes + direct taxes +social security contributions – social benefits – subsidies			
Real GDP	GDP at 2000 market prices	Log domestic currency millions*	Seasonally adjusted data	INSSE
EU GDP	European Union (28 countries) GDP at 2000 market prices			Eurostat
Inflation rate	Year on year change of the nationally defined consumer price index	%		NBR
Interest rate	3 month interbank offered rate (ROBOR3M)	% per annum	Monthly average	Eurostat
Exchange Rate	Nominal effective exchange rate, period average; an increase corresponds to an appreciation	Log index 2010=100*		BIS

\* First difference to ensure data stationarity



# VAR MODEL DESCRIPTION

## ○ Structural representation of VAR

$$\mathbf{A}_0 \mathbf{X}_t = \mathbf{A}(\mathbf{L}) \mathbf{X}_{t-1} + \mathbf{B} \mathbf{e}_t \quad (1)$$

- $X_t$  - vector of endogenous variables
- $A_0$  - matrix of contemporaneous influences
- $A(L)$  - matrix of lag operator
- $B$  - matrix that reflects the linear relations between the structural shocks and reduced form innovations
- $e_t \sim N(0, I)$

## ○ Reduced form of VAR

$$\mathbf{X}_t = \mathbf{F}(\mathbf{L}) \mathbf{X}_{t-1} + \mathbf{u}_t, \quad \mathbf{u}_t \sim N(0, \Sigma_u) \quad (2)$$

$$\mathbf{F}(\mathbf{L}) = \mathbf{A}_0^{-1} \mathbf{A}(\mathbf{L}) \quad \text{and} \quad \mathbf{u}_t = \mathbf{A}_0^{-1} \mathbf{B} \mathbf{e}_t \quad (3)$$

$$E[e_t] = 0, \quad E[e_t e_t'] = I, \quad E[e_t e_s'] = 0, \quad \forall t \neq s \quad (4)$$

The relation between structural innovations and the reduced form residuals is given by:

$$\mathbf{A}_0 \mathbf{u}_t = \mathbf{B} \mathbf{e}_t \quad (5)$$

# IDENTIFICATION SCHEMES

## *Cholesky Decomposition*

○  $X_t = F(L)X_{t-1} + u_t$ ,  $u_t \sim N(0, \Sigma_u)$



$$A_0 X_t = A(L)X_{t-1} + B e_t$$

○ We know that

- $F(L) = A_0^{-1}A(L)$
- $u_t = A_0^{-1}B e_t$
- $\Sigma_u = E[u_t u_t'] = A_0^{-1}A_0^{-1'}$



- $B = I$
- $? A_0^{-1}$

### Computational Steps

1. I draw Cholesky decomposition of  $\Sigma_u$ , resulting that  $\Sigma_u = P'P$
2.  $A_0$  is identified as a lower triangular matrix (elements above the main diagonal are zero) and  $P'$  is also a lower triangular matrix, thus the identification scheme is finalized when  $P' = A_0^{-1}$
3. The main caveat of the Cholesky decomposition is that it is not unique and the results depend on the variables ordering.

# IDENTIFICATION SCHEMES

## *Sign Restriction*

○  $X_t = F(L)X_{t-1} + u_t$ ,  $u_t \sim N(0, \Sigma_u)$



$$A_0 X_t = A(L)X_{t-1} + B e_t$$

○ We know that

- $F(L) = A_0^{-1}A(L)$
- $u_t = A_0^{-1}B e_t$
- $\Sigma_u = E[u_t u_t'] = A_0^{-1}A_0^{-1'}$



- $B = I$
- $? A_0^{-1}$

### Computational Steps

1. I draw Cholesky decomposition of  $\Sigma_u$ , resulting that  $\Sigma_u = P'P$
2. For a given, random, orthogonal matrix,  $Q$ , we have that  
 $\Sigma_u = E[u_t u_t'] = A_0^{-1}A_0^{-1'} = P'P = P'Q'QP = \bar{P}'\bar{P}$
3.  $A_0^{-1} = \bar{P}'$ , identification is achieved if the impulse responses computed satisfy a set of sign restrictions
4. The algorithm is replicated  $N$  times and are kept only the draws that satisfy the sign restrictions.

# RESULTS

## *I. Cholesky Decomposition*

# VARIABLES ORDER

**Following Kaldara and Camps (2005), the endogenous variables order is as follows :**

1. Government Expenditure (d\_lgov\_spen)
2. Real GDP (d\_lgdp)
3. Government Net Revenues (d\_lgov\_rev)
4. Inflation rate (inflation)
5. Interest Rate (interest\_rate)

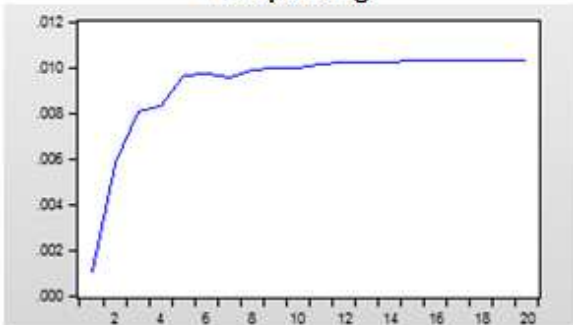
# LAG LENGTH CRITERIA

Lag	LogL	LR	FPE	AIC	SC	HQ
0	410.4919	NA	2.21E-14	-17.25498	-17.05815	-17.18091
1	527.8661	204.7805	4.36E-16	-21.18579	<b>-20.00485*</b>	<b>-20.74140*</b>
2	557.4784	45.36354	<b>3.72e-16*</b>	<b>-21.38206*</b>	-19.217	-20.56733
3	570.1526	16.71909	6.93E-16	-20.85756	-17.70837	-19.6725
4	605.9567	<b>39.61307*</b>	5.33E-16	-21.31731	-17.184	-19.76192

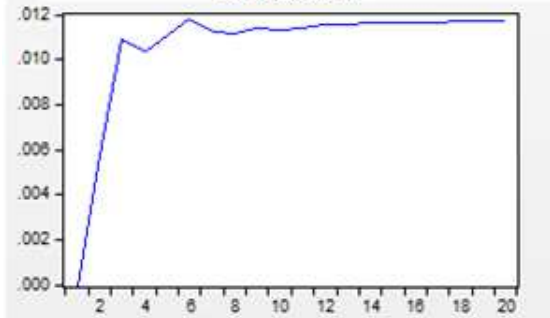
- Lag length criteria suggests a VAR (1), VAR(2) or VAR (4) model.
- Autocorrelation LM Test revealed the lack of residual autocorrelation for VAR(2).

# IMPULSE RESPONSES

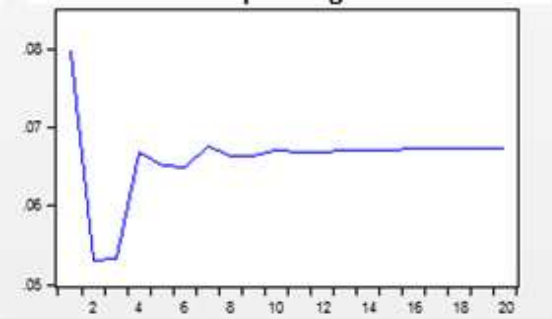
Accumulated Response of Real GDP to Spending



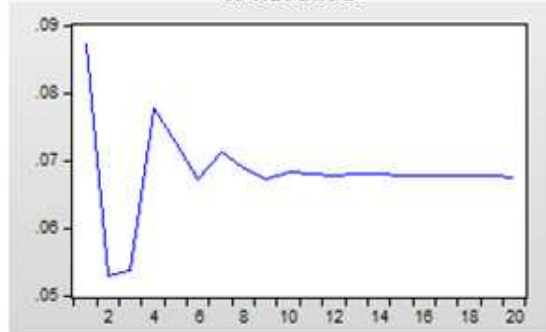
Accumulated Response of Real GDP to Revenue



Accumulated Response of Spending to Spending



Accumulated Response of Revenue to Revenue



## The real GDP response to a spending shock

- is weak and has a small magnitude, around 0.01
- is significant only after two quarters after the shock.
- the level of GDP increases during the first four quarters after the shock

## The real GDP response to a revenue shock

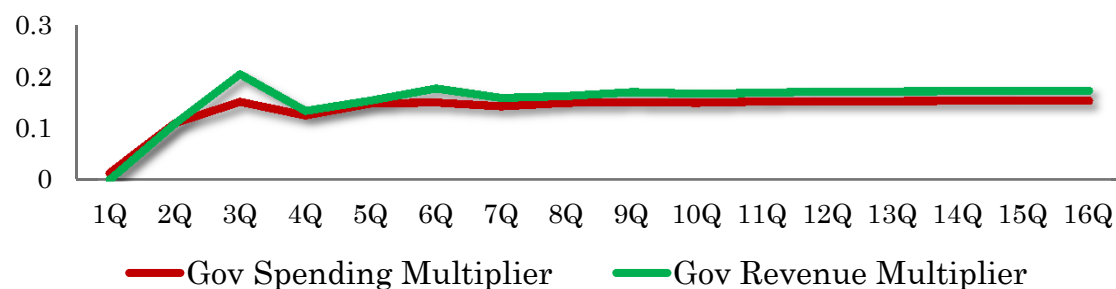
- positive response
- an increase in taxes leads to an increase in real GDP



*fiscal contraction mitigates concerns about debt sustainability and therefore reduces the impact produced by an increase in taxes on private sector, leading to an increase in demand*

- the GDP increases for four quarters after the shock and in the long run tends to the value of 0.12.

# CUMULATED FISCAL MULTIPLIERS



Fiscal Shock	Quarters after the shock					
	1Q	2Q	4Q	8Q	12Q	20Q
G. Spending	0.01	0.11*	0.12	0.15	0.15	0.15
G. Revenue	0.00*	0.11*	0.13*	0.16	0.17	0.17

## Fiscal multiplier of government spending :

- has a small magnitude,
- statistically significant only after two quarters after the shock (0.11)
- Long run value : 0.15

## Fiscal multiplier of government revenue :

- has a tendency to increase and to overcome the value of the spending multiplier
- Statistically significant for the first eight quarters after the shock
- Long run value : 0.17

\* Statistically significant



# DISAGGREGATE APPROACH

## MODEL SPECIFICATION

Model Notation	Variables
Benchmark	Government Expenditure, Real GDP, Government Net Revenues, Inflation , Interest Rate
VAR1_employee_comp	<u>Public Compensation of Employees</u> , Real GDP, Inflation Rate, Interest Rate
VAR2_gfcf	<u>Gross Fixed Capital Formation</u> , Real GDP, Inflation Rate, Interest Rate
VAR3_inter_cons	<u>Public Intermediate Consumption</u> , Real GDP, Inflation Rate, Interest Rate
VAR4_ind_taxes	Real GDP, <u>Indirect Taxes</u> , Inflation Rate, Interest Rate
VAR5_direct_taxes	Real GDP, <u>Direct Taxes</u> , Inflation Rate, Interest Rate

# DISAGGREGATE APPROACH

## RESULTS

### 1. Cumulated fiscal multipliers of expenditure items

Model	Government Spending			
Quarters after the shock	2Q	4Q	8Q	20Q
VAR_benchmark	0.11	0.12	0.15	0.15
VAR1_employee_comp	0.16	0.09	0.12	0.11
VAR2_gfcf	0.03	0.04	0.04	0.04
VAR3_inter_cons	0.00	0.06	0.07	0.09

- *Public compensation of employees* seems to bear the most significant impact on real output.
- Long run value : 0.11

### 2. Cumulated fiscal multipliers of revenue items

Model	Government Revenue			
Quarters after the shock	2Q	4Q	8Q	20Q
VAR_benchmark	0.11	0.13	0.16	0.17
VAR4_ind_taxes	0.11	0.24	0.22	0.23
VAR5_direct_taxes	0.06	0.05	0.07	0.06

- *Indirect taxes* seem to have the most significant impact on real GDP
- Long run value : 0.23

# RESULTS

## *II . Sign Restriction*

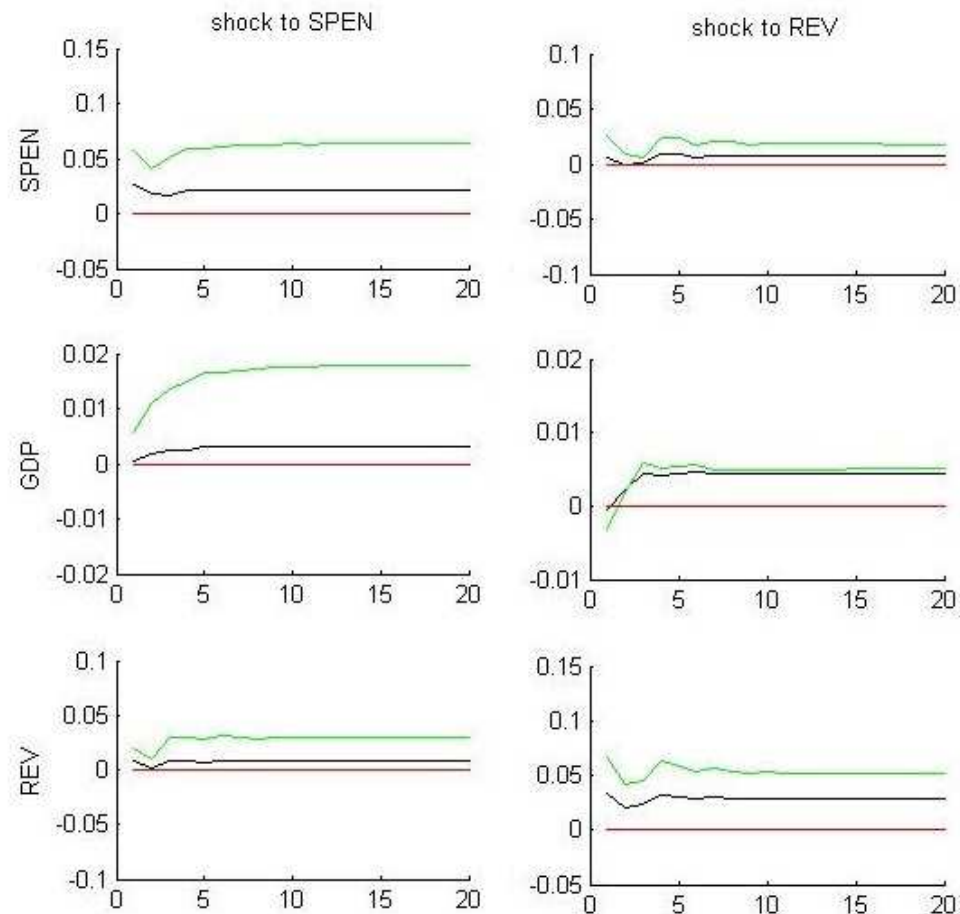
# IDENTIFYING RESTRICTIONS

- Following Caldara and Kamps (2012) and Mountford and Uhlig (2005) three shocks are identified simultaneously :

Shock	Variable	Government Spending	Government Revenue	Real GDP
	Business Cycle shock		>0	>0
	Government Revenue Shock		>0	
	Government Spending Shock	>0		

- *Note: the sign restrictions are imposed over 2 quarters to rule out, for example, shocks where government spending rises on impact but then subsequently falls after one or two quarters*
- Econometric challenges :
  - The impulse responses result from a mixture of models
  - I decide to use a single median model, which is obtained by minimizing the deviation of all impulse responses functions from their median
  - The results reported further stem from the same model

# IMPULSE RESPONSES



-- Median  
 -- Median Target

**Output response to a spending shock** has a small magnitude, around 0.015 -0.02 when the median target is reported.

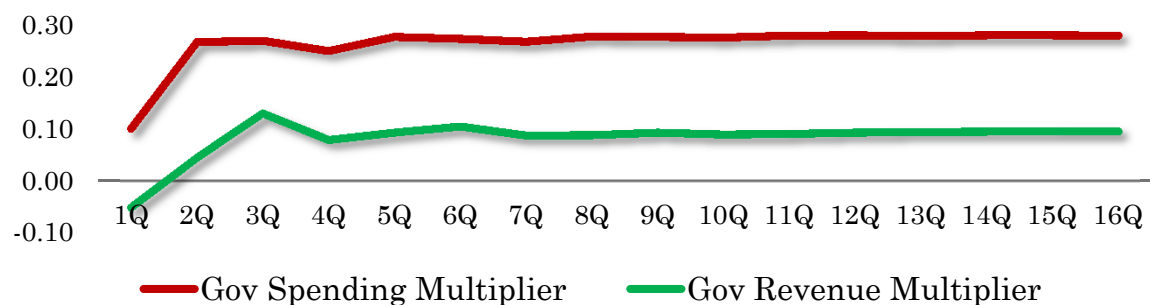
Similar to the previous identification method, a positive **response of output to the revenue shock** is observed.

In the first period the response is negative but it has a tendency to increase around 0.005, being positive for the whole time interval.

Thus, in some cases contractionary fiscal policy could stimulate output in the short run:

*Contractionary measures lower the cost of borrowing and debt service. Therefore people will expect an increase in cumulated disposable income in the long run and will be more prone to increase their current demand.*

# CUMULATED FISCAL MULTIPLIERS



Fiscal Shock	Quarters after the shock				
	1Q	4Q	8Q	12Q	20Q
G. Spending	0.10	0.25	0.28	0.28	0.28
G. Revenue	-0.05	0.08	0.09	0.09	0.10

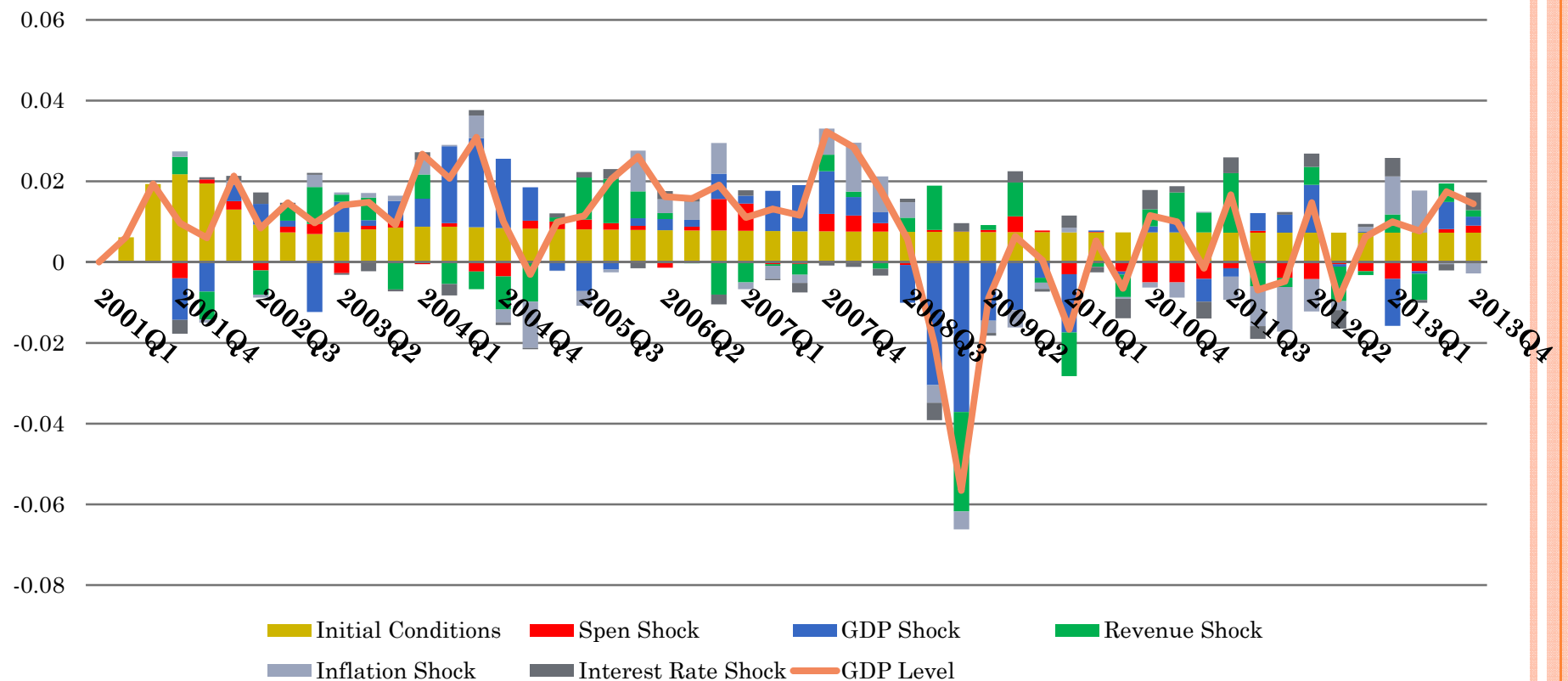
## Fiscal multiplier of government spending :

- reaches 0.10 after first quarter.
- its value increases in the first year following the shock
- Long run value : 0.28

## Fiscal multiplier of government revenue :

- has a negative sign in the first quarter
- Has smaller values than spending multiplier
- Long run value : 0.10

# GDP HISTORICAL DECOMPOSITION



Historical decomposition measures the contribution of each shock to the GDP level. During 2009 and 2010, the decrease in revenues contributed more than the decrease in spending to the slowdown in real GDP.

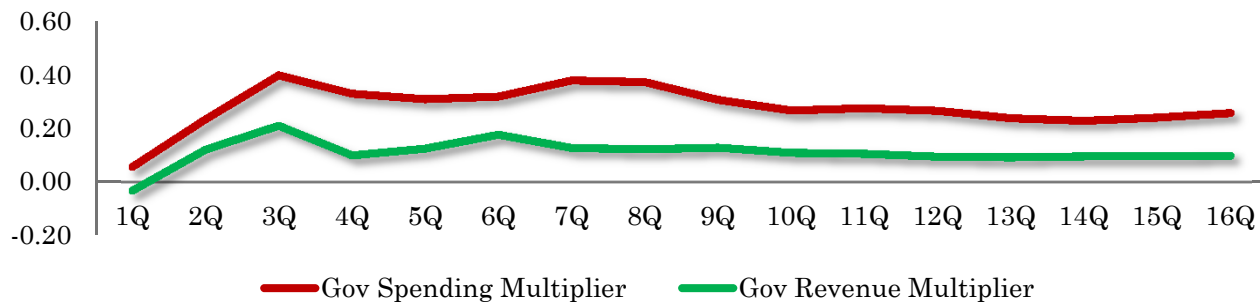
Between 2001 and 2008 Real GDP had a period of growth, reaching in 2008 its highest level. It can be observed that this period has been accompanied with an increase in government spending also.

# ROBUSTNESS CHECK

- For robustness check I have employed another VAR model, by adding EU GDP and nominal effective exchange rate as endogenous variable :

Gov\_Spen Real\_GDP Gov\_Rev Inflation Interest\_Rate EU\_GDP NEER

Cumulated fiscal multipliers of revenue and expenditure



		Quarters after the shock				
Fiscal Shock		1Q	4Q	8Q	12Q	20Q
G. Spending		0.06	0.33	0.37	0.27	0.28
G. Revenue		-0.03	0.10	0.12	0.10	0.10



# WHY FISCAL MULTIPLIERS ARE SMALL?

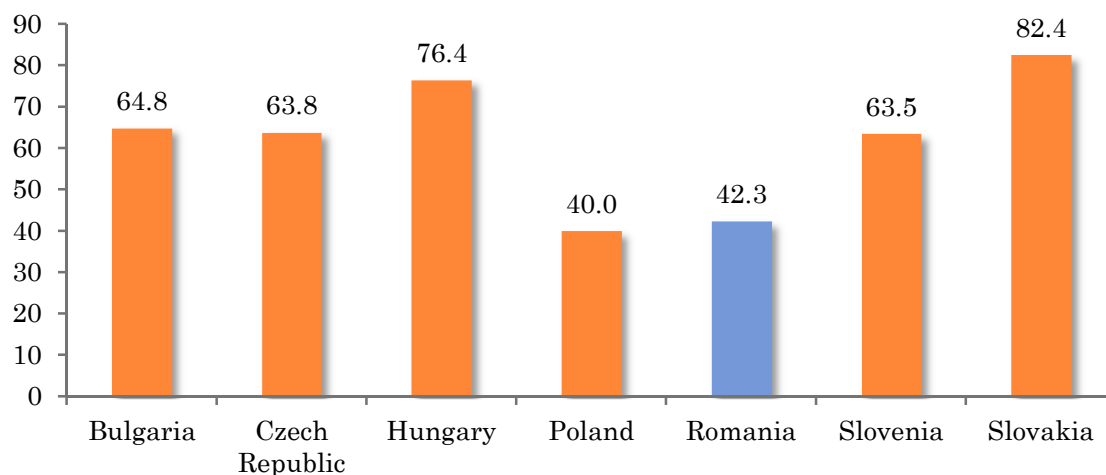
## ○ Exchange rate regime and fiscal policies

- *Romania has a type of flexible exchange rate regime : managed floating regime*
- *Capital account liberalization (2005) might have an impact on the fiscal multiplier size*
- *Mundell Fleming predicts that fiscal policy is ineffective under flexible exchange rate*
- *Expansionary fiscal policy :  $G \uparrow \Rightarrow$  Interest Rates  $\uparrow \Rightarrow$  higher interest rates attract inflow of foreign capital  $\Rightarrow$  exchange rate appreciation  $\Rightarrow$  current account deficit  $\uparrow$*

## ○ Openness to trade

- *Romania is a small open economy which has an increased dependence on imports.*
- *A high propensity to imports means that an expansionary fiscal policy, conducted through an increase in spending or through a tax cut, will ultimately increase the demand for imports*

**Imports (% of GDP)**



Imports (% of GDP, average 2001-2013) Source : own processing on Eurostat data

Country	Spending Multiplier	Revenue Multiplier
Bulgaria	0.31	-0.32
Czech Republic	-0.04	0.03
Hungary	0.01	-0.01
Poland	-0.02	0.02
Romania	0.28	0.10
Slovenia	-0.01	0.02
Slovakia	0.00	-0.1

Long run cumulative multipliers (economic literature)

# WHY FISCAL MULTIPLIERS ARE SMALL?

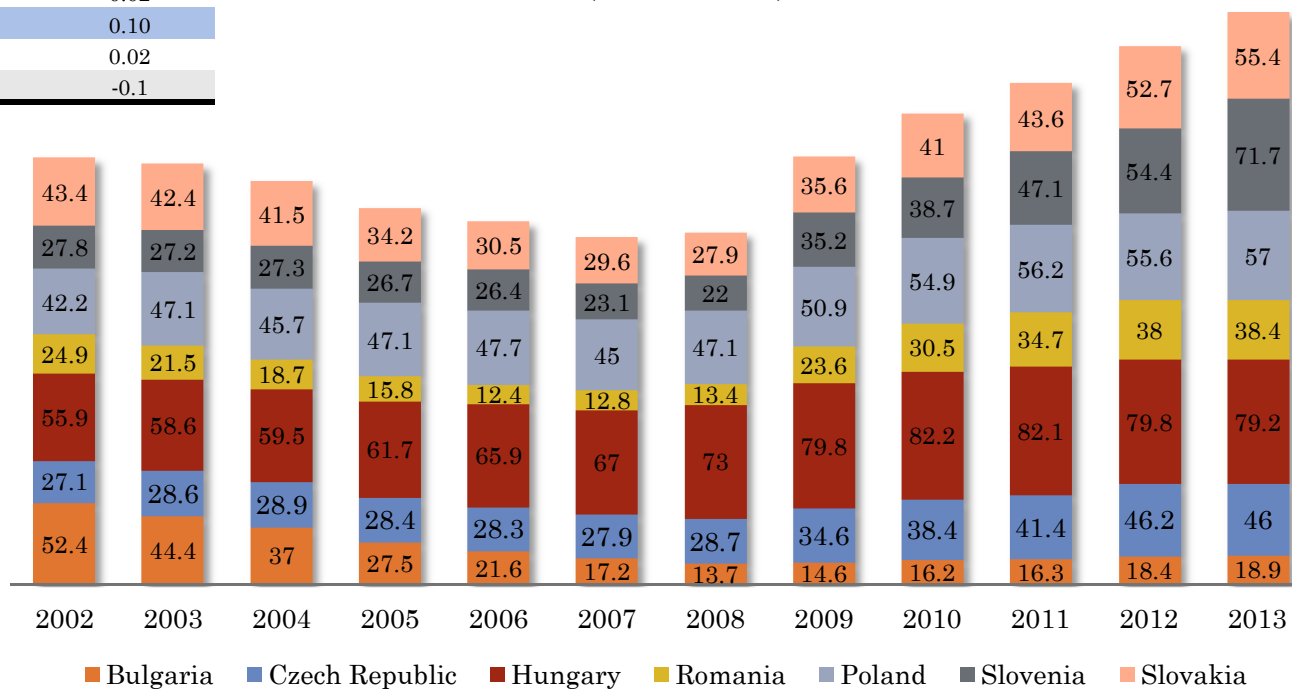
## ○ Public Debt

- *A high debt to GDP will not only lead to a small effect of fiscal policy on economic activity, but also will decrease consumers' and investors' confidence especially in expansionary fiscal policies.*

Country	Spending Multiplier	Revenue Multiplier
Bulgaria	0.31	-0.32
Czech Republic	-0.04	0.03
Hungary	0.01	-0.01
Poland	-0.02	0.02
Romania	0.28	0.10
Slovenia	-0.01	0.02
Slovakia	0.00	-0.1

Long run cumulative multipliers (economic literature)

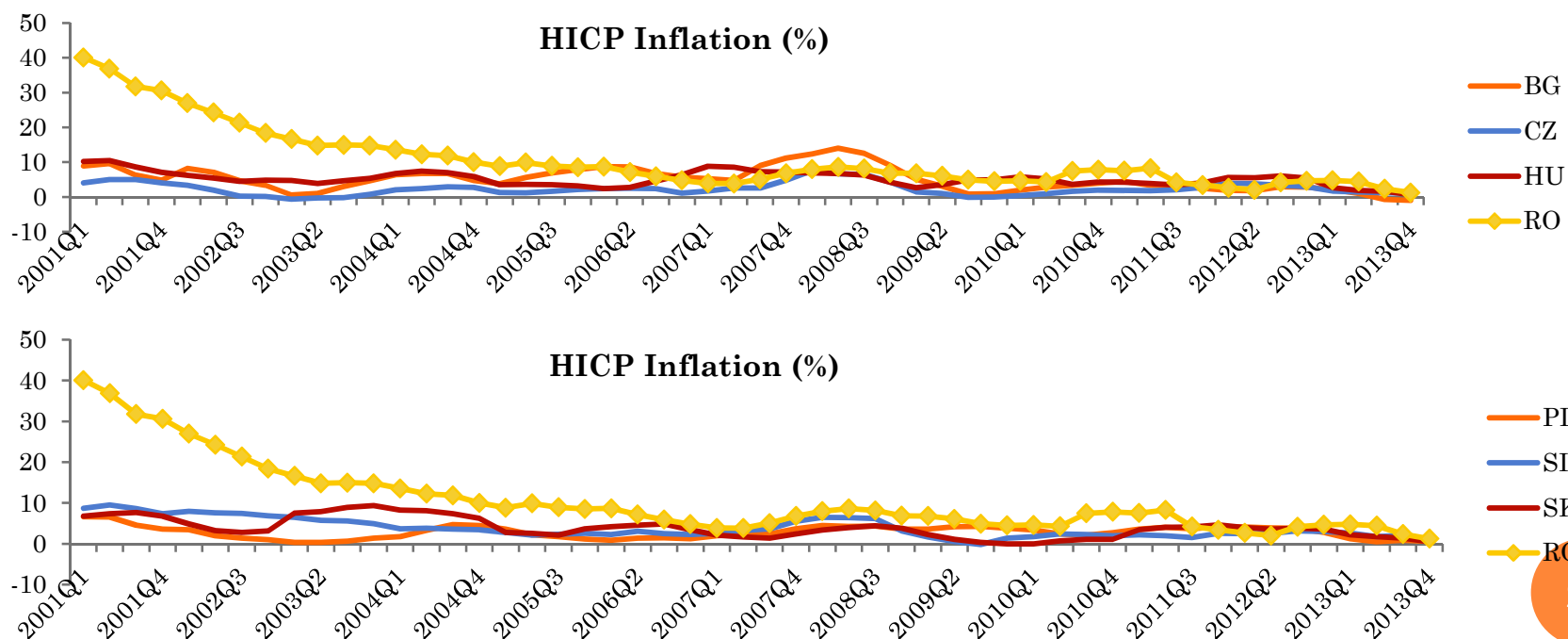
Public Debt(% of GDP)



# WHY FISCAL MULTIPLIERS ARE SMALL?

## ○ Inflationary environment

- *In a high inflationary environment, an increase in spending conducts to a decrease in output. Fiscal expansion increases inflationary expectations and raises the cost of credit offsetting the fiscal stimulus on output growth in the short run.*
- *The tables below present the HICP inflation evolution during 2001-2013*



Source : Eurostat

# SUMMARY AND CONCLUSIONS

Model	Fiscal Shocks	Cumulated fiscal multiplier					
		1Q	2Q	4Q	8Q	12Q	20Q
Cholesky Decomposition	Government Spending	0.01	0.11	0.12	0.15	0.15	0.15
	Government Revenues	0.00	0.11	0.13	0.16	0.17	0.17
Sign Restriction	Government Spending	0.10	0.27	0.25	0.28	0.28	0.28
	Government Revenues	-0.05	0.05	0.08	0.09	0.09	0.10
Sign Restriction Robustness Check	Government Spending	0.06	0.24	0.33	0.37	0.27	0.28
	Government Revenues	-0.03	0.12	0.10	0.12	0.10	0.10

- Small values of the multipliers were recorded for both models.
- Overall, the estimations show that the fiscal multipliers are broadly statistically non-significant.
- The results are in line with the empirical evidence for the emerging economies : Cuaresma et all (2011), Muir and Weber (2013), Ilzetzky et all (2011).
- The fiscal multiplier of government spending had larger values than the revenue multiplier, when sign restriction model was employed
- The results obtained through sign restriction approach are confirmed by the two VAR specifications employed.

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THANK YOU FOR YOUR  
ATTENTION !