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The Dynamic Effects of Countercyclical Fiscal Stimulus on Output in Tunisia

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Abstract

With the global financial crisis hitting many countries, policymakers around the world have been weighing different countercyclical policies to support aggregate demand and restore growth. The analysis in this paper estimates a Structural Vector Error Correction model for Tunisia in order to identify the impact of fiscal policy shocks on real output. The authors find that public investment has a small impact on output in the short run but is an important medium-term growth-enhancing countercyclical instrument that has a robust impact on growth. Raising public investment by 1 dinar yields 0.12 dinar the first year, 0.30 dinar the second year, half a dinar the third year, and 1.08 dinars the sixth year. An increase in recurrent expenditure has a smaller but positive and persistent impact on real output. For Tunisia to obtain a larger short-term impact of public spending on output, procurement processes should be made faster and simpler. Finally, the analysis finds a countercyclical pattern of real public investment vis-à-vis real output and a relative rigidity/inelasticity of recurrent expenditures to output fluctuations.

The Dynamic Effects of Countercyclical Fiscal Stimulus on Output in Tunisia

Ndiamé Diop[*] and Nizar Ben Abdallah[¥]

1. Introduction

Because of its limited foreign exposure, Tunisia's financial sector was not directly affected by the global financial crisis that emanated in the US in late 2008.[1] However, Tunisia has built strong trade and investment links with the European Union economies over the past quarter century. The EU absorbs 76 percent of Tunisia's exports and is the origin of 70 percent of FDI inflows in the country. As a result, due to the sharp decline in growth in Europe in 2008 and 2009, Tunisia's export growth (in constant price) dropped from 12 percent in 2007 to 1 percent in 2008 and declined further in the first half of 2009 (-12 percent) as exports of textiles and clothing and automobile components plummeted.

Although textiles and clothing, leather and footwear (henceforth TCLF) and the mechanical and electrical sectors combined account for about 65 percent of exports, the decline in external demand of these products is unlikely to create a balance of payment problem in Tunisia. Indeed, the import content of export in these sectors is about 85 percent and imports typically decline in tandem with exports. Furthermore, continuing growth in FDI allows a convenient financing of the current account. In 2008, FDI increased by 40 percent to 5.6 percent of GDP representing 119 percent of the current account deficit.

Instead, the main concern of Tunisian policymakers is lower GDP growth and declining employment in the manufacturing sector in the short term. The manufacturing sector accounts for 20 percent of total jobs, 63.7 percent of which are in "totally" exporting firms.[2] The TCLF sector alone accounts for 48 percent of manufacturing employment and 9 percent of total employment. The mechanical and electrical sector, on the other hand, represents 16% of manufacturing jobs and 3.5 percent of employment.[3] Clearly, given their weigh in employment within the manufacturing sector, the sharp decline in export in these two sectors is a threat not only to growth but also to employment.

A key question is thus what type of countercyclical policies can help offset the negative shock on exports and moderate the economic slowdown and job losses. Many countries have taken emergency measures in late 2008 to support the exporting sector. The Tunisian government is no

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[1] For instance, the stock market grew by 9 percent in 2008.

[2] Totally exporting firms are those that export 100 percent of their production. In Tunisia, a law enacted in 1971 (offshore regime) grants several fiscal and financial incentives to these firms, including duty-free imports of raw materials and equipments entering the production, 10 year tax holiday and free repatriation of profits. There also are "partially" exporting firms. Exports (in value) over GDP equals 47 percent.

[3] Hydrocarbons, Tunisia's third export item is capital-intensive but not labor intensive.

exception. It has reacted swiftly in December 2008 by adopting several temporary measures to support exporting firms affected by the crisis, including partial exemption of social security contributions, fiscal incentives, and credit guarantees. These measures combined with a strong desire by firm managers to keep their trained employees, seem to have helped reduce significantly job losses.

In addition to emergency measures directed to the exporting sector, governments around the world have considered countercyclical measures to support aggregate demand and restore growth. To this effect, the tool considered by most countries is a fiscal stimulus (discretionary increase in public spending and/or tax reduction). The theoretical case for a fiscal stimulus rests on the fact that (i) the origin of the current crisis is well identified: strong adverse shocks to aggregate demand following the global financial crisis; (ii) conventional monetary policy –e.g. reducing the interest rate—is likely to be ineffective because the pre-crisis investment boom in many countries led to excess capacities and; (iii) monetary transmission from the central bank to the real sector activity is not effective or predictable because of confidence crisis in the credit markets. Factors (ii) and (iii) dramatically reduce the comparative advantage of monetary policy over fiscal policy (IMF 2008).

Empirically, there is a rich literature on the effects of fiscal policy on output and other macroeconomic variables (see, for instance, Blanchard and Perotti 2002, de Castro and de Cos 2008, Giordano, Momigliano, Neri, and Perotti 2005 and Giavazzi and Pagano 1990). However, while the empirical literature for developed countries is rich, not many studies exist on developing countries (see Table A1 for a list of recent studies). Furthermore, the issue of the sign and magnitude of the effects of fiscal policies across different countries is very much an open empirical question.

We contribute to the literature by estimating the impact and profile of fiscal stimuli on Tunisia. We start by describing the fiscal policy context. Then, we describe the empirical strategy used to estimate the impacts of fiscal variables on output. This allows one to gauge the magnitude of fiscal stimuli (in the form of discretionary public spending) needed to offset growth slowdown in Tunisia. We use for that an SVEM model, which is the suitable tool if the variables are co-integrated.

2. The fiscal policy context

During the past 10 years, prudent fiscal policies have helped maintain Tunisia's fiscal deficit at or below 3 percent. Indeed, the overall fiscal deficit was reduced from 4.2 percent in 1997 to 1.2 percent of GDP in 2008 (Figure 1). This, combined with intensified efforts to reduce external debt in 2005-2008, contributed to a sharp reduction of public debt, from 58 percent in 2005 to 47.5 percent in 2008 (Figure 2). This in turn helped reduce interest payments and free up space to address the global food and fuel crises in 2008 (food and fuel subsidies increased sharply by 1.3 percent of GDP to reach 3.7 percent of GDP in 2008 and yet overall fiscal deficit remained at 2.1 percent).

Public debt reduction combined with pro-active expenditure reallocation has been the main approach used to manage the budget deficit. However, a question is whether the level of public debt itself is so high as to be a constraint to undertaking countercyclical fiscal policies. Clearly, at 47.5 percent of GDP, Tunisia's public debt remains relatively high (slightly above the median level for emerging economies with similar Sovereign Rating). However, the share of public debt exposed to exchange rate and rollover risks has declined significantly in recent years, owing to efficient debt management. Government-guaranteed loans were estimated at about 11 percent of GDP at end-2007. Risks are contained by the following factors: (i) almost 82 percent of the external debt stock is in medium and long-term liabilities, 70 percent of which is owed to multilateral and bilateral creditors, implying limited rollover risks; (ii) around 75 percent of the debt is contracted in fixed interest rates suggesting little interest rate risk; and (iii) the stock of reserves more than fully covers all short-term liabilities (remaining maturity) in 2007 (IMF 2008).

Thus, to the extent that additional debt is invested in growth-enhancing areas, the level of public debt is not a major constraint in undertaking countercyclical fiscal policies. A fiscal deficit of up to 4 percent of GDP would still leave the public debt-to-GDP ratio below 50 percent (its 2007 level). Furthermore, domestic borrowing is unlikely to crowd out private investment: the deposit to credit ratio of the banking system stood at 1.15 percent in 2008 and 1.10 percent in the first quarter of 2009, denoting a situation of excess liquidity (Central Bank of Tunisia).

Figure 1. Trend in fiscal deficits	Figure 2. Public debt and interest payments
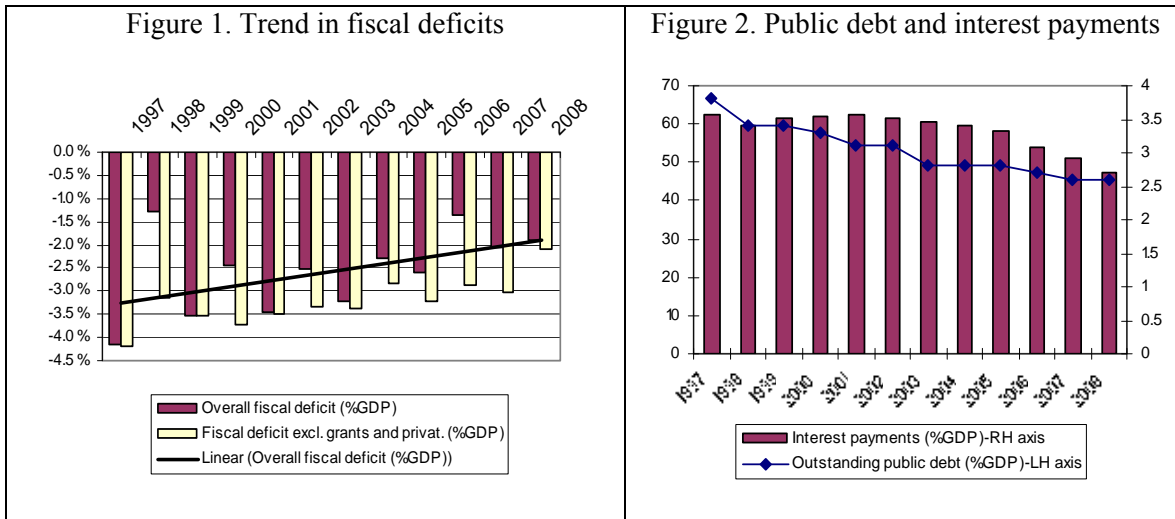
Source: Ministry of Finance, Tunisia

3. Dynamic effects of fiscal policy on output

Our objective is to determine the extent to which increasing public expenditures can help offset the deceleration in growth driven by the decline in external demand. To that effect, we use a model to simulate the effect of 1 dinar of increase in public spending (public investment and recurrent expenditure) on Tunisia's GDP in the short and medium-term. In other words, how much additional GDP can be obtained from 1 dinar additional public spending?

3.1. The impact of fiscal stimulus: empirical strategy

The system to be estimated consists of four variables: $X_t = \left[G^{Inv}, G^R, I^{Priv}, Y \right]$.

G^{Inv} is public investment, G^R current expenditure, I^{Priv} private investment and Y output. The extent to which an increase in G^{Inv} and G^R affect Y, as well as the temporal profile of the impact (lag and persistence of the shock) is the main focus of this paper.

Most recent studies of the impact of fiscal shocks on macroeconomic variables use the structural vector autoregressive regression (VAR) approach proposed by Blanchard and Perotti (2002) and Perotti (2002). This approach consists of isolating the structural shocks in a VAR system by imposing restrictions based on economic theory and institutional features that constrain the behavior of policy makers. For instance, government spending categories are generally contemporaneously unaffected by GDP. Therefore, reactions of fiscal policy to output changes only result from so called "automatic" responses, which are defined by existing laws and regulations. All fiscal policy developments in a given quarter or a year in some instances, which

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do not reflect automatic responses, are basically seen as structural fiscal policy shocks, which are exogenous to output. This approach allows the identification of genuine shocks that hit the economy. We describe below the specific restrictions imposed in the coefficients of the model used here.

In matrix form, a Structural VAR (SVAR) could be written as:

$$AX_t = DX_{t-1} + B\varepsilon_t \qquad (2)$$

It follows that the reduced-form VAR is equal to:

$$X_t = A^{-1}DX_{t-1} + A^{-1}B\varepsilon_t \qquad (3)$$

or, equivalently:

$$X_t = FX_{t-1} + u_t \qquad (4)$$

with

$$F = A^{-1}D \qquad \text{and} \qquad u_t = A^{-1}B\varepsilon_t$$

In order to identify the structural shocks in vector $\varepsilon_t = (\varepsilon_t^{G^{Pub}}, \varepsilon_t^{G^R}, \varepsilon_t^{I^{Priv}}, \varepsilon_t^{Y})$ and the structural coefficients, once VAR is estimated, one needs to impose restrictions on the relationship between the innovations u_t and the structural shocks ε_t. We will come back to this below.

SVAR models are appropriate when there is co-integration between the variables of the system. If co-integration tests cannot reject the hypothesis of one or more co-integration relationships among the variables, a structural vector error-correction model (SVEC) should be used. An SVEC is a transformed SVAR to include an error correction term necessary when the variables are co-integrated.

The reduced-form of a first–order VEC can be written as:

$$\Delta X_t = \prod X_{t-1} + \Gamma \Delta X_{t-1} + \eta_t \qquad (5)$$

$$\eta_t = A^{-1}B\varepsilon_t \qquad (6)$$

3.2. Variable measurement and data source

All variables are expressed in real terms and in logarithm. Public investment (called *Titre 2* in Tunisia's fiscal jargon) is the gross fixed capital formation by the public sector, including state-

owned enterprises. It includes direct expenditures on infrastructure and equipment in all sectors, donor-financed projects and the state's external borrowing on behalf of the private sector. Current expenditures are expenses under Tunisia's *Titre 1*, i.e, salaries and wages, goods and services, interest payments and transfers and subsidies. In this paper, we exclude interest payments from recurrent expenditures. Private investment is measured as the gross fixed capital formation by the domestic private sector.

Both recurrent expenditures and GDP are converted to real terms by using the GDP deflator. Public and private investment variables are adjusted by the deflator of investment (base 2000) from both the *Institut National des Statistiques* and the World Development Indicators. Because the deflators for 2006 and 2007 were missing in both databases, we approximated them by assuming that the deflator has changed at the same rate as on average in the period 2000-2005.

3.3. Unit roots and co-integration tests

Tables 2 and 3 in annex show the results of the unit root tests. They show that all the variables in the system have a unit root in level but are stationary in first difference. We then apply the Johansen (1988 and 1991) and Johansen and Juselius (1990 and 1992) co-integration tests.[4] As Table 4 shows, both tests indicate that the null that there is no co-integration relationship between the two variables (r=0) is rejected at 5 percent. On the other hand, one cannot however reject the hypothesis that there is *one* co-integration relationship (r<=1) against *r=2*. An SVEC model is thus the correct specification.

3.4. Impact of fiscal shocks –impulse responses

Restrictions imposed on short-term multipliers

For the multiplier matrix to be identified, some assumptions should be made regarding the contemporaneous relationships between the variables of the system. In our case, we have four variables and have imposed the following restrictions in the SVEC short-term multiplier matrix based on economic theory and specific institutional constraints (see Table 5):

- Output does not affect public investment or recurrent expenditures instantaneously. This assumption may be seen as strong a priori because we use annual data and Tunisia does undertake revised budget laws from time to time (twice in the 1990s and 4 times since

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[4] In the Johansen framework, this a full information maximum likelihood estimation of a system characterized by Π co-integrating vectors.

2000). However, all revisions of the budget laws are so far driven by response to exogenous shocks: oil and commodity price shocks chiefly.

- Public investment cannot react instantaneously to recurrent expenditures and vice-versa. In other words, once credits for public investment and recurrent expenditures are allocated, these are not changed within the fiscal year; Tunisia's *virement* rules provide a little flexibility within and between major recurrent budget heads (wages, goods and services, etc.) but no flexibility regarding reallocations between recurrent and investment budgets.[5]

- Recurrent expenditure does not affect private investment instantaneously even though its non-contemporaneous effect is expected to be positive. Indeed, maintenance of road, electricity, communication infrastructures for instance increases the marginal productivity of existing private inputs (both capital and labor), thereby lowering marginal production costs and increasing the level of private investment and production.

- Private investment does not affect public investment and recurrent expenditures instantaneously.

Impact of public investment and recurrent expenditures on output

Table 1 below shows the impact of one dinar of increase in public investment, recurrent expenditure and private investment on GDP over time. Clearly, the impact of fiscal stimulus is positive and effective in the case of Tunisia in the medium-term. Raising public investment by 1 dinar yields 0.12 dinar the first year, 0.30 dinar the second year and half a dinar the third year. The multiplier is greater than 1 in the 6th years following the 1 dinar shock to public investment. Although public investment is not only about infrastructure, this finding is consistent with the empirical literature that finds a positive impact of infrastructure spending flows on output, growth, or productivity (Agenor, Nabli and Youssef 2005). We also find a positive and consistent impact of public investment on private investment. Public investment in road, electricity, communication infrastructures, public capital in education, health, etc. can increase the marginal productivity of existing private inputs (both capital and labor), thereby lowering marginal production costs and increasing the level of private investment and production.

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[5] Since 2004, ministers can reallocate up to 2 percent of total expenditure within major budget heads (wages, goods and services, etc.) and additional amounts with approval of the MoF. Virements between major budget heads are permitted, with MoF approval, for only up to 2 percent of the lower budgeted amount of the two heads. Inter-head virements of amounts greater than 2 percent require Council of Ministers approval, but such requests are quite rare.

Interestingly, recurrent expenditure has a small but positive impact on output. As defined above, recurrent expenditures include salaries and treatment, public spending in goods and services and transfers and subsidies. The positive impact on output reflects the first two items. An increase in salaries and treatment leads to either immediate rise in private consumption or an increase in private savings, ultimately transformed into demand for investment goods. Either way, a rise in salaries and treatment affects output. Public spending in goods and services can also support in a straightforward fashion. Indeed, some components of current spending such as maintaining of roads and schools are important to maintain the quality of the services financed by public capital and contribute to ensuring the profitability of infrastructure investments. Spending on operation and maintenance that keeps existing infrastructure in good condition or spending that contributes to health outcomes and the accumulation of human capital–can promote growth more effectively than capital expenditure per se (Moreno-Dodson 2008). Finally, a reallocation of subsidies to public investment or recurrent spending is growth-enhancing, all things being equal.

There are not many studies of the impact of dynamic fiscal shocks to output on countries similar to Tunisia. The study by Restrepo and Rincon (2006) on Chile and Colombia is an exception. These authors use an SVAR and SVEC model respectively to calculate spending multipliers for Chile and Colombia using quarterly data over 1989 through 2005. They find that a one Chilean peso increase in government spending has a transitory positive effect of 1.9 pesos on real GDP growth, which stabilizes at 1.37 cents. For Colombia, the authors find that a one peso increase in public spending translates, at impact, into a 0.12 increase in the level of GDP and stabilizes at 0.15 peso.

The size of fiscal multipliers depends, among other things, on leakages into saving and imports. Multipliers tend to be smaller for economies more open to trade (i.e., higher leakages into imports) and more susceptible to financial market constraints (i.e., upward pressure on real interest rates), or when it is subject to monetary policy that offsets the fiscal stimulus (e.g., IMF, 2008). Many cross-country studies have found small fiscal multipliers and in some cases multipliers with a negative sign (Christiansen 2008). The most notable studies with "negative multipliers" are found in the literature on expansionary fiscal contraction initiated by Giavazzi and Pagano (1990) and surveyed in Hemming, Kell, and Mahfouz (2002).

Finally, a result that requires further investigation is the small impact of private investment on growth. Indeed, real private investment has a positive but smaller impact on GDP that public

spending (Table 1). This finding is consistent the widely held view that private investment in the period of investigation went mostly to low value-added sectors.

Table 1. Impact of 1 Tunisian Dinar Increase in Public Investment, Current Expenditure and Private Investment on GDP over time

	Real Public Investment	*Real current expenditure*	
T=1	0.12	0.08	0.04
T=2	0.30	0.16	0.10
T=3	0.50	0.25	0.14
T=4	0.69	0.33	0.19
T=5	0.89	0.41	0.23
T=6	1.08	0.48	0.26

Note: The shock that hits the VAR is of size 1. Thus from table 8's coefficient (see annex), one can approximate the dinar for dinar response as follows (for public spending G):

$$\frac{\Delta Y}{\Delta G} \approx \frac{Multipliercoef}{1} * \frac{Y_{t-1}}{G_{t-1}} \quad \text{with} \quad \Delta \log G = 1 \approx \frac{G_t - G_{t-1}}{G_{t-1}} \quad \text{and} \quad \Delta \log Y \approx \frac{Y_t - Y_{t-1}}{Y_t}$$

Impulse responses

Figures 3 to 5 provides more details regarding the profile of the response of output to shocks to public investment, recurrent expenditure and private investment. They suggest that public investment is strongly growth-enhancing countercyclical instrument in the medium-term that can effectively counterbalance the shortfall in growth driven by the sharp decline in external demand. Figures 6-8 show the feedback effect of real GDP to the fiscal variables (starting t+1) and on private investment. Public investment follows a contra-cyclical pattern in the medium-term in contrast with recurrent expenditures that display a relative rigidity and insensitivity of output fluctuations. The contra-cyclicality of public investment seems at odd with what is found in most developing countries where a pro-cyclical bias is more prevalent (Gavin and Perotti 1997, Kaminsky, Reinhart and Vegh 2004 and Calderon and Schmidt-Hebbel 2008). Indeed, public investment tends to increase in good times because higher growth leads to increased public revenues and greater ease in financing public investment. The relationship between real GDP and real investment, on the other hand, displays an "accelerator" model pattern in the medium term. In his "accelerator" hypothesis, Samuelson (1958) showed that higher expected demand (a proxy for higher GDP) stimulates investment and capital accumulation, further boosting future growth.

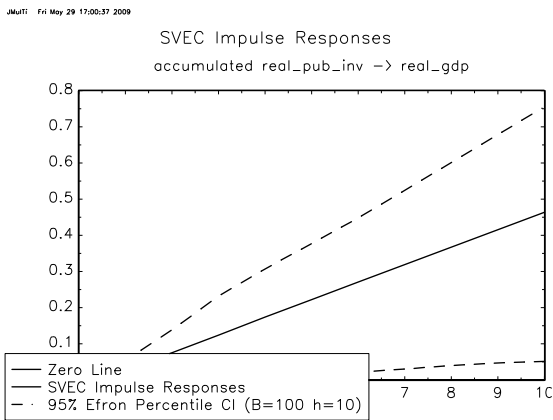## Figure 3. Accumulated impact of public investment on output

SVEC Impulse Responses

accumulated real_pub_inv -> real_gdp

- Zero Line
- SVEC Impulse Responses
- 95% Efron Percentile CI (B=100 h=10)

Figure 4. Accumulated impact of Recurrent expenditure on output

SVEC Impulse Responses

accumulated real_curr_exp -> real_gdp

- Zero Line
- SVEC Impulse Responses
- 95% Efron Percentile CI (B=100 h=10)
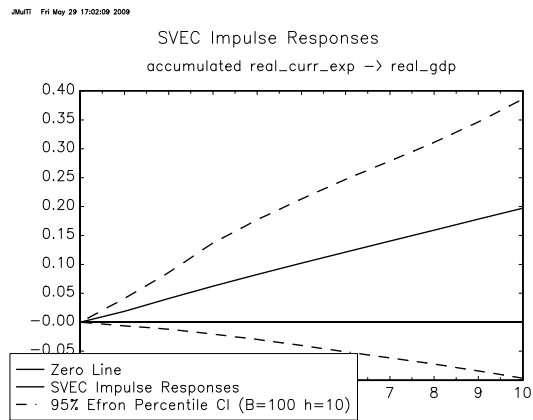
Figure 5. Accumulated impact of private investment on output

SVEC Impulse Responses

accumulated real_inv_priv -> real_gdp

- Zero Line
- SVEC Impulse Responses
- 95% Efron Percentile CI (B=100 h=10)
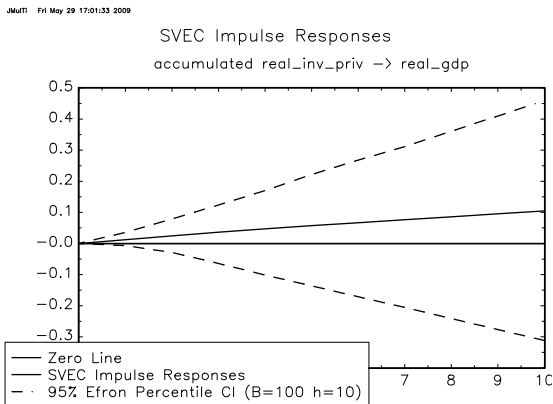
Figure 6. Accumulated feedback effect of output on public investment

SVEC Impulse Responses

accumulated real_gdp -> real_pub_inv

- Zero Line
- SVEC Impulse Responses
- 95% Efron Percentile CI (B=100 h=10)
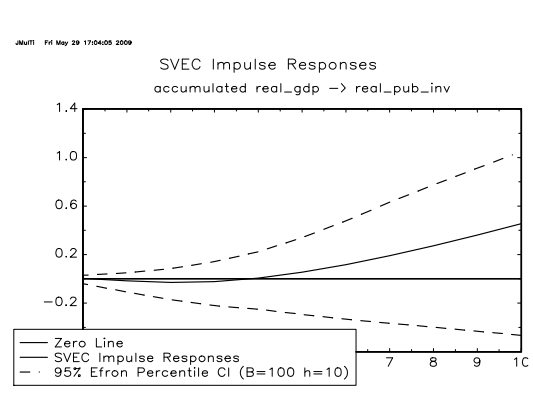
Figure 7. Accumulated feedback effect of output on recurrent expenditures

SVEC Impulse Responses

accumulated real_gdp -> real_curr_exp

- Zero Line
- SVEC Impulse Responses
- 95% Efron Percentile CI (B=100 h=10)
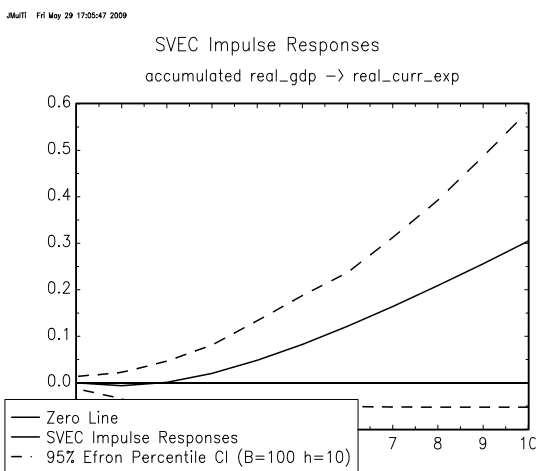
Figure 8. Accumulated impact of output on private investment

SVEC Impulse Responses

accumulated real_gdp -> real_inv_priv

- Zero Line
- SVEC Impulse Responses
- 95% Efron Percentile CI (B=100 h=10)

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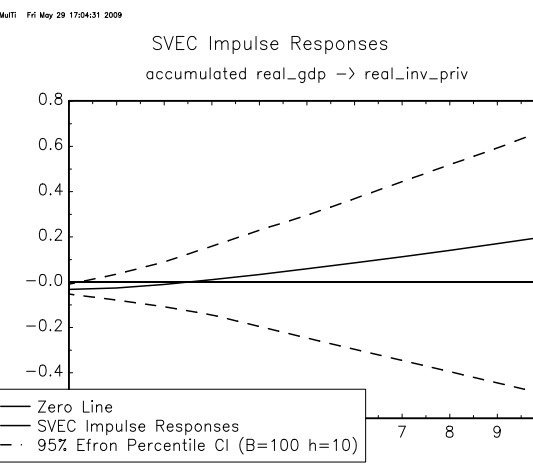
4. **Conclusion**

This paper attempted to examine whether a fiscal stimulus can be an effective countercyclical tool in Tunisia. Indeed, Tunisia is now affected by the global crisis, through the EU. About 80% of Tunisia's exports are shipped to Europe, which is now in recession. Growth has declined by 6 percentage points in the EU –compared to 2008 and this is leading to a significant drop in the EU's external demand, thereby hitting Tunisia. The latter's exports dropped from 12% growth in 2007 to only 1% in 2008 and have entered the negative territory in the first quarter of 2009. Therefore, it is urgent to identify policies that can counterbalance somewhat the expected decline in GDP growth.

We estimate a Structural Vector Error Correction model for Tunisia in order to identify the impact of fiscal policy shocks on real output. The results suggest that public investment is an important growth-enhancing medium-term countercyclical instrument that can effectively counterbalance the shortfall in growth driven by the sharp decline in external demand. The multipliers endogenously estimated from the SVEC model show that raising public investment by 1 dinar yields 0.12 dinar the first year, 0.30 dinar the second year, half a dinar the third year and 1.08 dinars the 6th years. An increase in recurrent expenditure has a small but positive and persistent impact on real output. The feedback effect from real output to fiscal variables indicate a countercyclical pattern of real public investment and a relative rigidity/inelasticity of recurrent expenditures to output fluctuations.

This result provides some confidence regarding the effectiveness of a fiscal spending stimulus in the case of Tunisia. Indeed, our results are based on historical data and on an average level of efficiency of public spending. If Tunisia speeds up procurement procedures and targets high-growth-enhancing projects, our spending multipliers can be considered as a lower band, i.e., one dinar spent today could yield a higher additional output than in the past. In addition to a rapid execution, to maximize impact, the public spending should be well-targeted. We also find that reallocation of public spending is not growth neutral. Indeed, reducing fuel subsidies to increase public investment or even maintenance or other non-subsidies items can help boost growth. A finding that deserves further investigation however is the contra-cyclical nature of public investment. Does it reflect an explicit or implicit fiscal rule or does it indicate the existence of strong stabilizers?

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Table A1. Non-exhaustive list of relevant papers in the recent empirical literature

Authors	Paper's title	Methodological approach	Key variables in model	Countries covered
Francisco de Castro, Pablo Hernandez de cos *2008*	The economic effects of fiscal policy : the case of Spain	Structural VAR	✓ Public expenditure ✓ Net taxes ✓ GDP ✓ GDP deflator ✓ Interest rate	Spain
Alfred M.Pereira *2009*	Long-term effects of fiscal policies in Portugal	VAR	✓ GDP ✓ Current transfers ✓ Public consumption ✓ Compensation of employees ✓ Publics investment ✓ Direct tax revenues ✓ Indirect tax revenues	Portugal
Antonio Afonso, Ricardo M.Sousa *2009*	The macroeconomic effects of fiscal policy in Portugal: a Bayesian SVAR analysis	SVAR	✓ Interest rate ✓ Government primary expenditures ✓ Government revenues ✓ Inflation ✓ GDP ✓ Price level ✓ Real growth rate of GDP ✓ debt to GDP	Portugal
Raffaela Giordano, Sandro Momigliono, Stefano Neri and Roberto Perotti *(2008)*	The effects of fiscal policy in Italy: Evidence from a VAR model	Structural VAR	✓ Real private GDP ✓ Inflation rate ✓ Private employment ✓ Nominal interest rate ✓ Real government spending on goods and services ✓ Real government wages ✓ Real net taxes	Italy
Antonio Afonso and Peter Claeys *2007*	The dynamic behavior of budget components and output	Structural VAR	✓ Real output (GDP) ✓ Expenditure ✓ Revenue side of the government budget	France, Germany, Portugal and Spain
Alfredo M.Pereira *2006*	Public investment, Economic Performance and Budgetary consolidation, VAR Evidence for the 12 Euro countries	VAR	✓ GDP ✓ Employment ✓ Private gross fixed capital formation ✓ Gross fixed capital formation	Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal and Spain
Olivier Biau, Elie Girard	politique budgétaire et dynamique	VAR structurel	✓ Pib ✓ Dépenses	France

2005	économique en France : l'approche VAR structurel		✓ publiques ✓ Recettes publiques ✓ Taux d'intérêt ✓ Niveau des prix	
Louis Phaneuf et Etienne Wasner *2005*	Une étude économétrique de l'impact des dépenses publiques et des prélèvements fiscaux sur l'activité économique au Québec et au Canada	VAR structurel	✓ PIB ✓ Dépenses publiques ✓ Recettes publiques	Canada
Kenneth N.Kuttner and Adam S.Posen *2002*	Fiscal policy effectiveness in Japan	VAR structurel	✓ Real tax revenue ✓ Real expenditure ✓ Real GDP	Japan
Kirsten H.Heppke-Falk, Jorn Tenhofen and Guntram B.Wolff *2006*	The macroeconomic effects of exogenous fiscal policy shocks in Germany: a disaggregated SVAR analysis	Structural VAR	✓ Real GDP ✓ Rate of inflation ✓ Nominal short-term interest rate ✓ Real government direct expenditure ✓ Real government net revenue	Germany
Olivier Blanchard et Roberto Perotti *2002*	An empirical characterization of the dynamic effects of changes in government spending and taxes on output	Structural VAR	✓ GDP ✓ Taxes ✓ spending	United States

Table 1. Trade intensity and business cycle correlation

Countries	Average annual growth export (%)	Average annual growth import (%)	Trade intensity	Correlation of business cycles
France	1,723781	-0,7116	0,568361	0.858798 {10.46855}
Spain	37,156841	7,60946	0,214904	0.741353 {6.898589}
Italy	0,022012	2,858586	0,466145	0.671510 {5.659391}
Germany	3,218947	0,355446	0,149672	0.245181 {1.579361}
Belgium	5,442043	2,682732	0,137855	0.847657 {9.977711}

SVEC Model:

Table 2: Unit roots tests* – variables in level

Variable**	Critical values			ADF
	1%	5%	10%	Level
Current_exp	-2.56	-1.94	-1.62	3.1235
Real_gdp	-3.43	-2.86	-2.57	-1.7581
Real_priv_inv	-3.43	-2.86	-2.57	-2.6161
Real_pub_inv	-3.96	-3.41	-3.13	-2.8538

*Ouput from J-multi
**Variables are in logs of their real

Table 3: Unit roots tests* - variables in first difference

Variable**	Critical values			ADF
	1%	5%	10%	First difference
dCurrent_exp****	-3.96	-3.41	-3.13	-4.3326
dReal_gdp***	-3.43	-2.86	-2.57	-6.6626
dReal_priv_inv	-2.56	-1.94	-1.62	-2.7818
dReal_pub_inv	-2.56	-1.94	-1.62	-3.9877

Table 4: Tests of co-integration rank*

	Critical value	prob	1%	5%	10%
$r = 0$	134.64	0.0000	60.81	53.94	50.50
$r = 1$	30.73	0.1408	40.78	35.07	32.25
$r = 2$	12.17	0.4419	24.69	20.16	17.98
$r = 3$	3.68	0.4734	12.53	9.14	7.60

Table 5. SVEC B Matrix of coefficient

Real Public Investment	Real private investment	Real_GDP	Real current expenditure
0.1143	-0.0049	0.0034	0.0000
0.0000	0.0849	-0.0320	0.0000
0.0000	0.0000	0.0731	0.0000
0.0000	0.0000	-0.0003	0.0347

Table 6. SVEC Impulse Function: Response of GDP to Shocks

	Real Public Investment	Real current expenditure	Real private investment
T=1	0.03	0.019	0.011
T=2	0.075	0.041	0.024
T=3	0.124	0.062	0.036
T=4	0.173	0.082	0.047
T=5	0.222	0.102	0.057
T=6	0.27	0.121	0.066

Table 7. Impact of 1 Tunisian Dinar Increase in Public Investment, Current Expenditure and Private Investment on GDP over time

	Real Public Investment	Real current expenditure	Real private investment
T=1	0.12	0.08	0.04
T=2	0.30	0.16	0.10
T=3	0.50	0.25	0.14
T=4	0.69	0.33	0.19
T=5	0.89	0.41	0.23
T=6	1.08	0.48	0.26

Note: The shock that hits the VAR is of size 1. Thus from table 8's coefficient, one can approximate the dinar for dinar response as follows (for public spending G):

$$\frac{\Delta Y}{\Delta G} \approx \frac{Multipliercoef}{1} * \frac{Y_{t-1}}{G_{t-1}} \text{ with } \Delta \log G = 1 \approx \frac{G_t - G_{t-1}}{G_{t-1}} \text{ and } \Delta \log Y \approx \frac{Y_t - Y_{t-1}}{Y_t}$$

Table 8. SVEC impulse (feedback effect of GDP on fiscal variables and private investment)

	Real Public Investment	Real private investment	Real current expenditure
T=1	-0.017	-0.02	-0.006
T=2	-0.03	-0.009	0.001
T=3	-0.023	0.011	0.02
T=4	0.005	0.034	0.048
T=5	0.05	0.059	0.082
T=6	0.11	0.085	0.121

The Johansen Co-Integration Tests:

We apply the Johansen (1988 and 1991) and Johansen and Juselius (1990 and 1992) co-integration tests. In this framework, the hypothesis of co-integration is formulated as a hypothesis of reduced rank of the long run impact matrix of the ECM. The procedure for testing co-integration is based on the error correction (ECM) representation given by

$$\Delta Y_t = \sum \Gamma \Delta Y_{t-i} + \prod Y_{t-i} + \mu + \beta t + \varepsilon_t \tag{1}$$

Where Yt denotes an (n x 1) vector of I (1) variables. The k-th order vector autoregressive (VAR) representation of Yt is written as:

$$Y_t = \sum \prod Y_{t-i} + \mu + \beta t + \varepsilon_t \qquad t = 1,2,\dots T \tag{2}$$

Each of the $\prod$ is a (n x n) matrix of parameters, ε is an identically and independently distributed (i.i.d) n-dimensional vector of residuals with zero mean and variance matrix Ω, μ is a constant term and t is a trend.

The estimates of $\Gamma = -(1 - \prod_i - \dots - \prod)$ describe the short run dynamics of Yt;
The estimates of $\prod = -(1 - \prod - \dots - \prod)$ capture the long run adjustment of Yt. In other words, it is the $\prod$ matrix that conveys information about the long run relationship among the Yt. The rank of $\prod$, r, determines the number of co-integrating vectors since it determines how many linear combinations of Yt are stationary.[6]

Johansen (1988, 1991) proposed two statistics to test for the co-integration rank (r) for which he derived the statistical distribution, the trace statistics and the maximum eigenvalue. The trace stat, *λtrace*, tests the null hypothesis that at most r co-integrating vector exist against a general alternative hypothesis of more than r co-integrating vectors;

Trace Statistics: $(\lambda - trace) = -T \sum \ln(1 - \lambda i)$

The maximum eigenvalue statistics, λmax, and which tests the null of r co-integrating vector against the alternative of r+1.

Maximum Eigenvalue Statistic: $(\lambda - \max) = -T \ln(1 - \lambda r + 1)$

λ s are the estimated eigenvalues (characteristic roots) obtained from the $\prod$ matrix; T is the number of usable observations.

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[6] There are three possible cases in the testing procedures:
(i) If r = n, the $\prod$ matrix has a full rank and all the variables are stationary in level.
(ii) If r = 0, Π contains no long-run information, and a VAR in differences would be the correct specification.
(iii) If $0 < r < n$ and there are (n x r) matrices α and β such that $\prod = \alpha\beta'$. And there are r co-integrating relations among elements of *Yt*. β denotes the co-integration vectors. It has the property that $\beta'Y$ is stationary even though *Y* itself in non-stationary. The matrix α measures the strength of the co-integrating vectors in the VECM, as it represents the speed of adjustment parameters (adjustment coefficients).