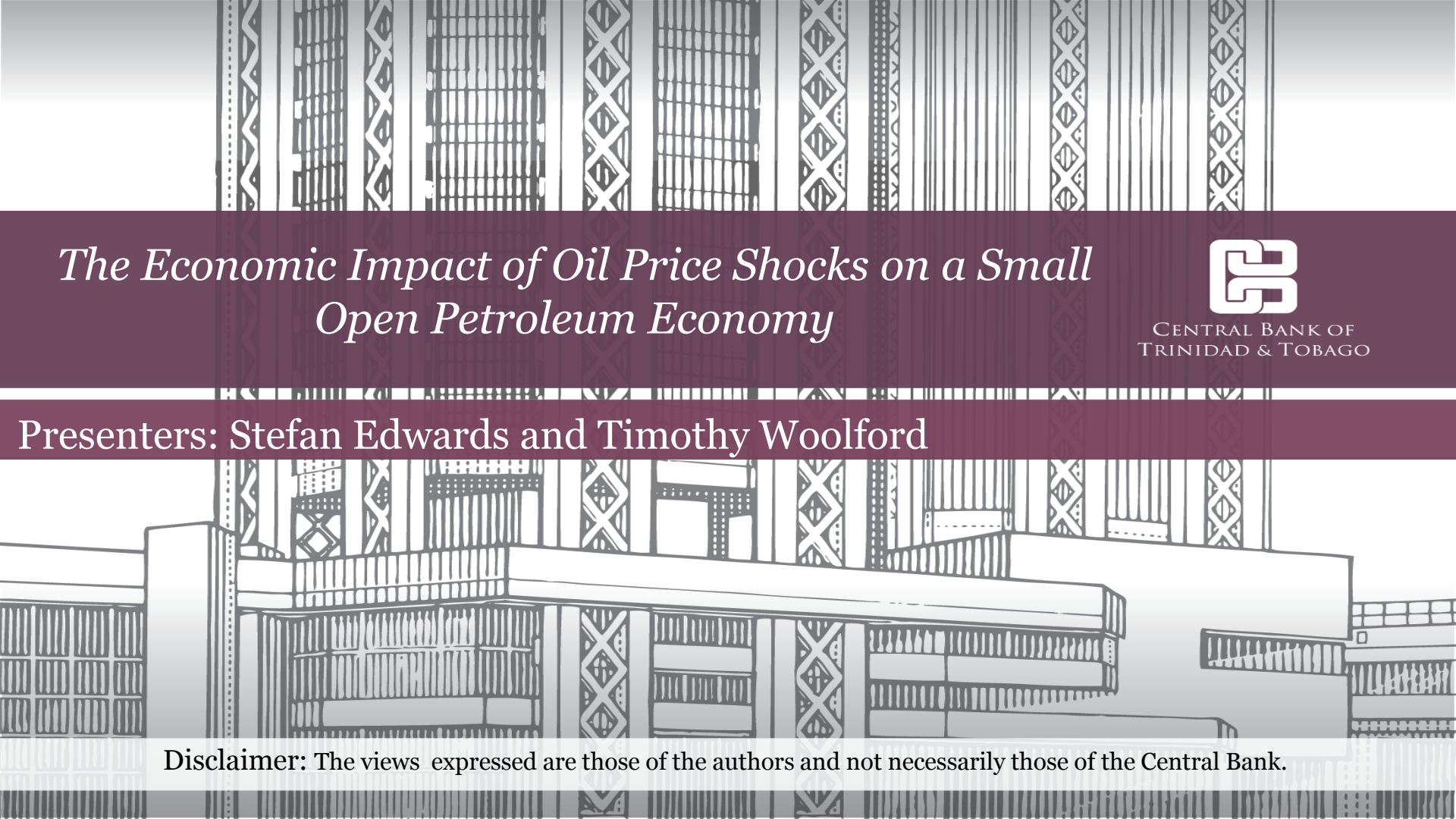
The Economic Impact of Oil Price Shocks on a Small Open Petroleum Economy



Central Bank of Trinidad & Tobago

Presenters: Stefan Edwards and Timothy Woolford

Outline

- Introduction
- Literature Review
- Methodology
- Results
- Constrained Scenario
- Policy Shocks
- Discussion
- Conclusion and Recommendation

Introduction

- Context
  - International Supply Glut leading to Reduced Prices
  - Increased Maintenance
  - Delayed Investments
  - Maturing Acreage

- Over-Reliance has been Overdone

- Expanded Analysis to examine policy constraints faced by an Energy exporter

Literature Review

- **Seers (1964)**
  - Total Employment most important aggregate in the Petroleum Economy.

- **Bruce and Girvan (1972)**
  - Critiqued Seers, providing national income as alternative aggregate.
  - Forex availability limits domestic private sector growth.

- **Bruno and Sachs (1982)**
  - Vulnerability to Dutch Disease

Literature Review

- **Rodrik (2008)**
  - Panel Regression
  - Devaluation can facilitate growth

- **Koh (2015)**
  - Panel VAR
  - Output and Government Consumption decline
  - Role of Exchange Rate Regime

Summary

- This paper proposes to assess whether adverse changes in energy prices impact the economy with respect to fiscal conditions, the financial sector and real sector output.

- SVAR model used to outline the implications of changes in energy prices for the economy.

- The recommendations centre around sustainable and supportive action, described in the context of the monetary authority's approach to the financial sector.

Data

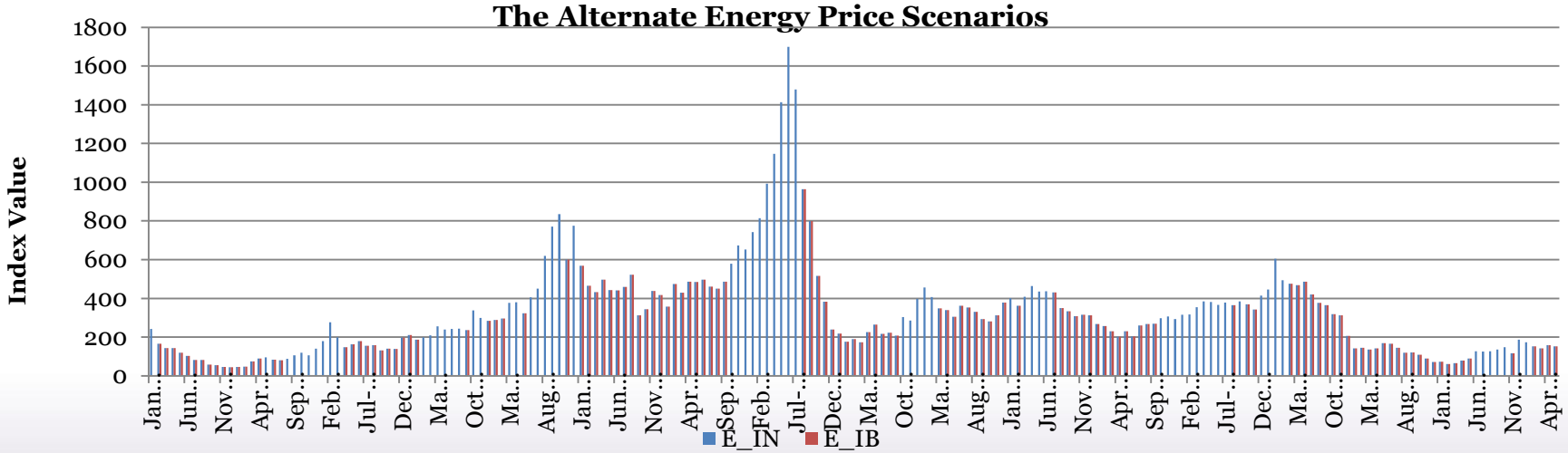
- SVAR model using 194 data points from February – 2001 to May - 2017.
- Data series were subject to log – difference transform.
- Model assesses effects of changes in energy prices on macro economy – fiscal, financial and real sector variables used.
- An energy price index is used to do this, simply calculated as:

WTI*HHUB

Data

- This exercise adopts a threshold based approach, where all values denoted **E_IB** make up the truncated energy index, which represent all values below the upper standard deviation limit of the 12-period moving average of the **E_IN** variable.

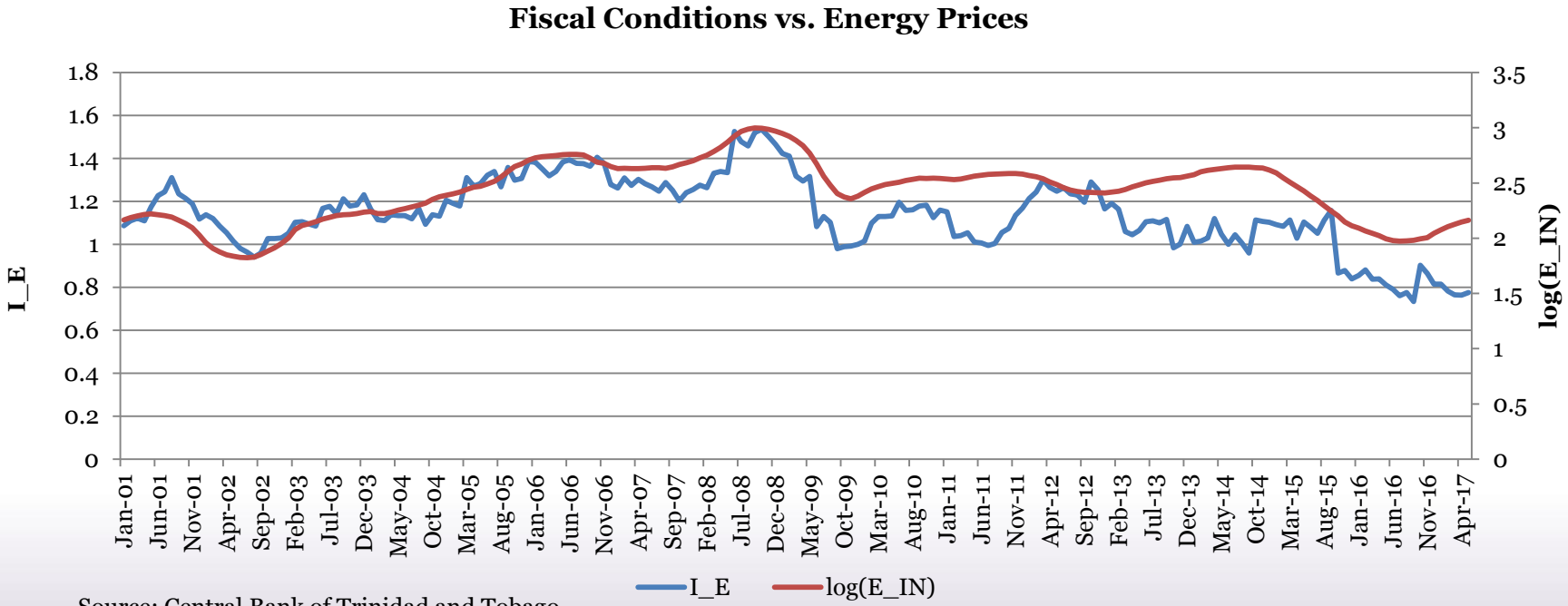
- The E_IN and the E_IB series therefore provide the origins of the structural shocks in their respective scenarios, and the results are compared.



Source: Central Bank of Trinidad and Tobago

Data

- **I_E** - variable reflecting the ratio of **fiscal space** proxied through the yearly sum of the changes to government revenue, debt and seigniorage (Walsh, 2010), and actual government **expenditure**.



Source: Central Bank of Trinidad and Tobago

Data

- **INT** – Foreign exchange market supply conditions are modeled through the identity (I+P/P).

- Ratio measures relative importance of the Central Bank **sales of foreign currency to authorized dealers relative to the total supply of foreign currency**.

- **D_L** - The **ratio of deposits to loans** managed by banks to optimise profit and is used to describe the domestic behavior of the commercial banking system in response to energy price changes.

Data

- **ENERGY** – Proxy reflecting energy sector activity including weighted monthly 12-MA of **Natural Gas Production, Crude Oil Production, Production of Methanol and Production of Ammonia**.

- **MANUF** – Proxy reflecting manufacturing activity including weighted monthly 12-MA of **DRI Production, Total Production of Cement**.

- **DIST** – Proxy reflecting distribution sector activity including weighted monthly 12-MA of **Sales of New Motor Vehicles, Local Sales of Cement.**

Methodology

- SVAR is set up as:

$$Ay_t = A_1 y_{t-1} + \dots + A_p y_{t-p} + B\varepsilon_t$$

- y_t is a K-dimensional vector of observable variables:

$$y_t = [E\_IN, ENERGY, I\_E, INT, D\_L, MANUF, DIST]$$

- ε_t is a K-dimensional vector of structural innovations with mean zero and identity covariance:

$$\varepsilon_t = [\varepsilon_t^{E\_IN}, \varepsilon_t^{ENERGY}, \varepsilon_t^{I\_E}, \varepsilon_t^{INT}, \varepsilon_t^{D\_L}, \varepsilon_t^{MANUF}, \varepsilon_t^{DIST}]$$

- A is a KxK matrix of contemporaneous feedback effects among the observable endogenous variables.

- The denoted structural form corresponds with a reduced from error term:

$$u_t = A^{-1} B\varepsilon_t,$$

- A set of identifying linear restrictions can be imposed on A and B to find a unique relation.

Methodology

- The following identifying relations were used:

$$U_t^{E\_IB} = \varepsilon_t^{E\_IB} \quad \text{(Energy Price Index)}$$

$$U_t^{ENERGY} = \varepsilon_t^{ENERGY} + U_t^{E\_IB} \quad \text{(Energy Production)}$$

$$U_t^{I\_E} = \varepsilon_t^{I\_E} + U_t^{E\_IB} + U_t^{ENERGY} \quad \text{(Fiscal Space)}$$

$$U_t^{INTERV} = \varepsilon_t^{INTERV} + U_t^{E\_IB} + U_t^{ENERGY} \quad \text{(Forex Interventions)}$$

$$U_t^{D\_L} = \varepsilon_t^{D\_L} + U_t^{ENERGY} + U_t^{I\_E} + U_t^{INTERV} \quad \text{(Ratio of Deposits to Loans)}$$

$$U_t^{MANUF} = \varepsilon_t^{MANUF} + U_t^{E\_IN} + U_t^{ENERGY} + U_t^{I\_E} + U_t^{INTERV} + U_t^{D\_L} \quad \text{(Manufacturing Activity)}$$

$$U_t^{DIST} = \varepsilon_t^{DIST} + U_t^{ENERGY} + U_t^{I\_E} + U_t^{INTERV} \quad \text{(Distribution Activity)}$$

- Significant coefficients outside this system were also included to utilise as many degrees of freedom as possible.

Results

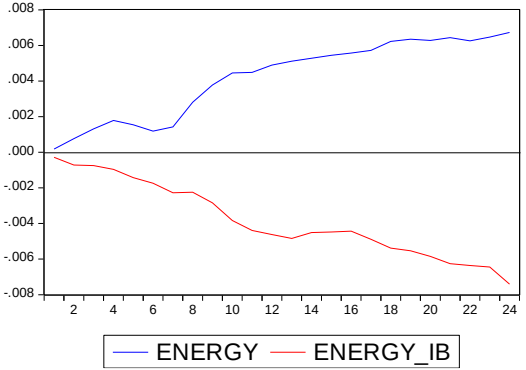
$$u_t = A^{-1} B\varepsilon_t,$$

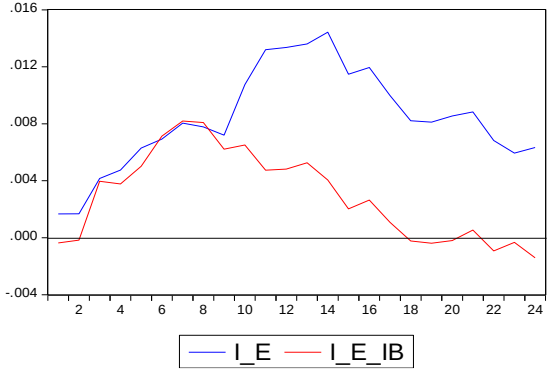
$$U_t \begin{bmatrix} u_t^1 \\ u_t^2 \\ u_t^3 \\ u_t^4 \\ u_t^5 \\ u_t^6 \\ u_t^7 \end{bmatrix} = A^{-1} \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ \alpha_{21} & 1 & 0 & 0 & 0 & 0 & 0 \\ \alpha_{31} & \alpha_{32} & 1 & 0 & 0 & 0 & 0 \\ \alpha_{41} & \alpha_{42} & \alpha_{43} & 1 & 0 & 0 & 0 \\ 0 & \alpha_{52} & \alpha_{53} & \alpha_{54} & 1 & 0 & 0 \\ \alpha_{61} & \alpha_{62} & \alpha_{63} & \alpha_{64} & \alpha_{65} & 1 & 0 \\ \alpha_{71} & \alpha_{72} & \alpha_{73} & \alpha_{74} & 0 & 0 & 1 \end{bmatrix} \cdot B \begin{bmatrix} b_{11} & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & b_{22} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & b_{33} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & b_{44} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & b_{55} & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & b_{66} & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & b_{77} \end{bmatrix} . \varepsilon_t \begin{bmatrix} E\_IN_t \\ ENERGY_t \\ I\_E_t \\ INT_t \\ D\_L_t \\ MANUF_t \\ DIST_t \end{bmatrix}$$

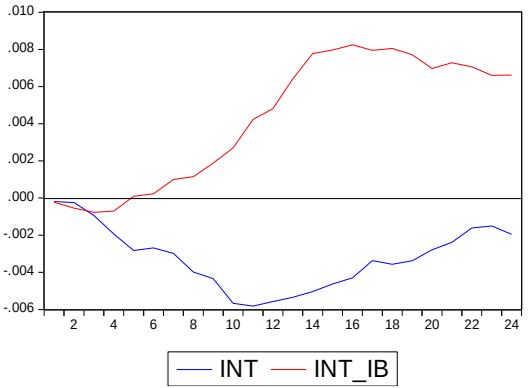
$$U_t \begin{bmatrix} u_t^1 \\ u_t^2 \\ u_t^3 \\ u_t^4 \\ u_t^5 \\ u_t^6 \\ u_t^7 \end{bmatrix} = A^{-1} \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ \alpha_{21} & 1 & 0 & 0 & 0 & 0 & 0 \\ \alpha_{31} & \alpha_{32} & 1 & 0 & 0 & 0 & 0 \\ \alpha_{41} & \alpha_{42} & 0 & 1 & 0 & 0 & 0 \\ 0 & \alpha_{52} & \alpha_{53} & \alpha_{54} & 1 & 0 & 0 \\ \alpha_{61} & \alpha_{62} & \alpha_{63} & \alpha_{64} & \alpha_{65} & 1 & 0 \\ 0 & \alpha_{72} & \alpha_{73} & \alpha_{74} & 0 & \alpha_{76} & 1 \end{bmatrix} \cdot B \begin{bmatrix} b_{11} & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & b_{22} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & b_{33} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & b_{44} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & b_{55} & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & b_{66} & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & b_{77} \end{bmatrix} . \varepsilon_t \begin{bmatrix} E\_IB_t \\ ENERGY_t \\ I\_E_t \\ INT_t \\ D\_L_t \\ MANUF_t \\ DIST_t \end{bmatrix}$$

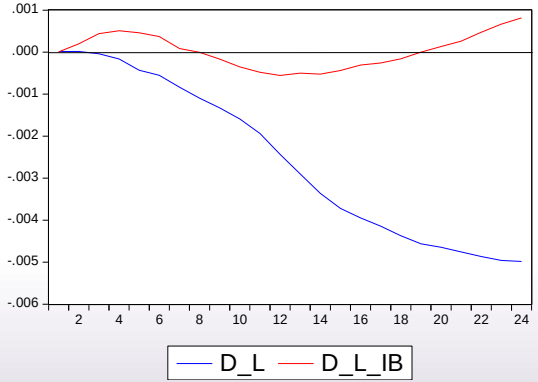
Results

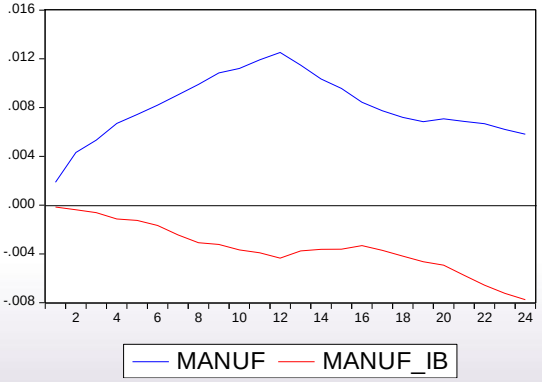
Impulse Response Functions for E_IN and E_IB scenarios

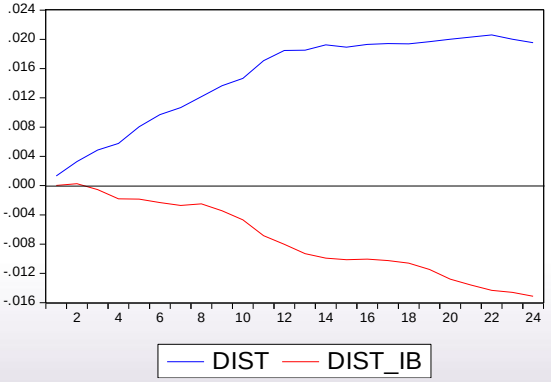












The Constrained Scenario

- The results suggest that positive economic results in Trinidad and Tobago since the early 2000's have been driven by a combination of oil and gas prices that can be described as statistically 'high'.

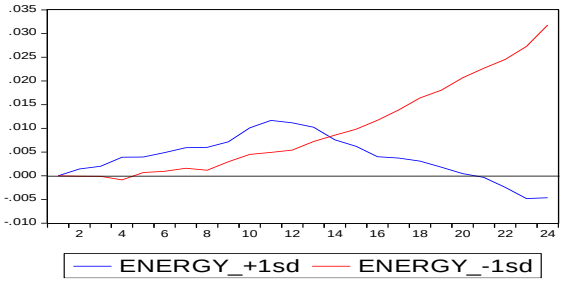
- However it is considered unlikely that the long term prices of hydrocarbons will reach levels seen in the late-2000's and early-2010's for any significant period in foreseeable future.

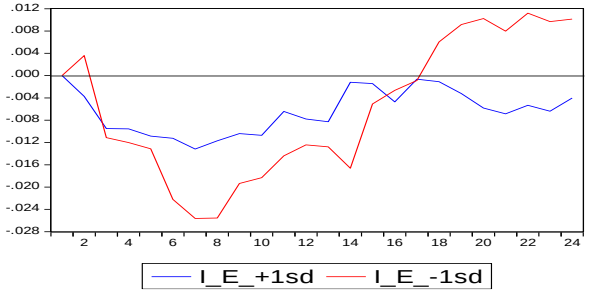
- The constrained scenario becomes important in this context, and investigating the relationship between energy prices and the rest of the economy in this scenario can provide a framework for developing an appropriate **policy response**.

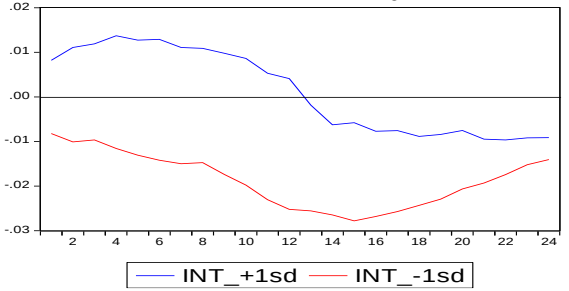
The Constrained Scenario – Policy Shocks

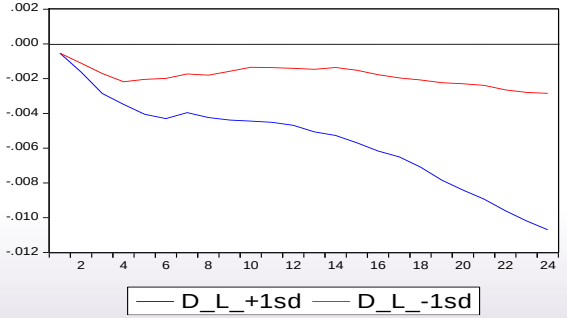
- The vector ε_t is modified to remove the first round effects of the restricted elements, meaning that the IRF's of the restricted variables represent the summary responses to the shocks originating from the unrestricted variables.

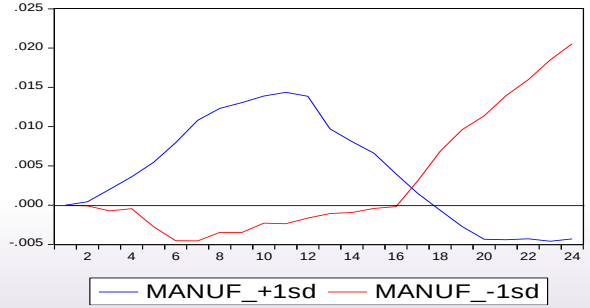
$$\varepsilon_t = \begin{bmatrix} E\_IB_t \\ 0 \\ 0 \\ INTERV_t \\ D\_L_t \\ 0 \\ 0 \end{bmatrix}$$

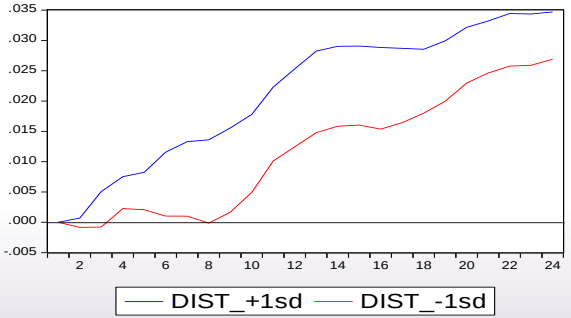












Discussion

Choice emerges between Increased vs. Decreased Interventions

Increased Interventions	Decreased Interventions
• Favourable for real sector activity in the short term. • Increased supply of forex drives import dependent industries thus facilitating greater activity.	• Favours long run energy output. • Fiscal conditions improve in the long term compared to the alternative scenario. • Manufacturing constrained in early periods but improves in later periods. • Distribution sector activity not significantly affected.

Conclusion

- Trinidad and Tobago benefitted from high commodity prices.
- Fiscal, financial and real sector **all deteriorate** in a constrained price scenario in comparison to the unconstrained scenario.
- Monetary authority can however act to facilitate economic activity in a constrained price scenario.
- Evidence suggests role for Monetary authority primarily through managing the extent of interventions.
- Lowered interventions and a small bias toward credit creation are in the best interest of a more sustainable macroeconomic stance.
- Reduced interventions also result in greater long run fiscal space.

Conclusion

- The results of the model suggest that the alternative scenarios of increased and decreased forex interventions reflect a choice between short and long term results.
- The longer term responses of the **I_E** and **MANUF** IRF's in particular suggest that lowering interventions appears more **sustainable**.
- Lowered interventions may spur more efficient investment patterns by firms, as immediate conditions for forex access become more competitive, but long term availability becomes less uncertain (lowered reserve depletion).
- This approach provides an alternative to the typical response of an energy based SOE to a TOT shock i.e., accumulate debt and defend a currency peg as per Buetzer et al., (2012).

Recommendation

- **The results of the model suggest that allowing forex market flexibility and an expansion of loans well within the bounds of statistical normality in response to adverse energy prices delivers favourable returns to fiscal and output conditions over the medium to long term.**

Thank you for your attention!

Any Questions?

Please feel free to e-mail your comments to

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