Macro and Sectoral Impacts of External and Domestic Shocks: Empirical Evidence from Papua New Guinea

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Outline of the talk

1. Stylized facts and research questions

2. Macroeconomic impacts of external and exchange rate shocks
   - Methodology
   - Data
   - Benchmark results

3. Sectoral impact of external and domestic resource activity shocks
   - Methodology
   - Data
   - Benchmark results

4. Conclusion
Stylized fact 1

Source: IMF IFS
Stylized fact 2

PNG trade balances

-600 -400 -200 0 200

Trade balance
Trade balance with Australia
Trade balance with Japan

Real and nominal exchange rates

-600 -400 -200 0 200

Official exchange rate
Real AUD/KPG
Real JPY/KPG
REER (IMF)

Source: IMF IFS
Research questions

- How does the economy respond to external shocks?
- How does the economy respond to domestic shock, such as supply, demand and real exchange rate shocks?
- Whether exports and imports are sensitive to exchange rate shocks?
Stylized fact 3

GDP per capita by Sector (2010 constant)

Source: UNTACD
Stylized fact 4

PNG LNG - Non-resource sector did well in construction phase but badly afterwards - Resource sector the opposite

Research questions

- How do different sectors respond to external and domestic shocks?
- How do these impacts change overtime?
Effects of Real Exchange Rate and External Shocks on Papua New Guinea’s Trade and Output
Methodology

The structure representation of the vector autoregressive model (SVAR) with $p$ lag for $t = (1, \ldots, T)$ can be expressed as

$$B_0y_t = b + B_1y_{t-1} + \cdots + B_p y_{t-p} + e_t, \quad e_t \sim \mathcal{N}(0, \Omega), \quad (1)$$

where $y_t = (ext_t, \Delta cpi_t, \Delta gdp_t, \Delta rer_t, \text{exp}_t, \text{imp}_t)'$ be a $6 \times 1$ vector of observation at time $t$.

The reduced form of VAR is obtained by premultiplying $B_0^{-1}$ to both side of (1) as

$$y_t = c + A_1y_{t-1} + \cdots + A_p y + \epsilon_t, \quad \epsilon_t \sim \mathcal{N}(0, \Sigma), \quad (2)$$
Identification: Sign restrictions

\[ e_t = B_0 \epsilon_t \equiv \begin{bmatrix} + & + & + & - \\ + & - & + & - \\ + & + & + & + \end{bmatrix} \begin{bmatrix} \epsilon_t^{\text{external}} \\ \epsilon_t^{\text{supply}} \\ \epsilon_t^{\text{demand}} \\ \epsilon_t^{\text{rer}} \\ \epsilon_t^{\text{export}} \\ \epsilon_t^{\text{import}} \end{bmatrix}, \]

where +, − respectively denote positive, negative sign on impact.

For example, the external shock (first column of matrix \( B_0 \)) is defined that a sudden increase in economic activity from abroad that impacts positively on PNG’s output and exports. The impacts on inflation, real exchange rate and import are unrestricted.
Data

- Country’s variables: CIEC Asia database (original sources: IMF, WB).
  - PNG’s output: Annual GDP converted to quarterly frequency using the Chow-Lin (1971) method.
  - Real exchange rate: IMF and bilateral exchange rates with Japan and Australia (main trade partners)
- Proxies of external economic activity
  - World industrial production, Kilian’s real economic activity index, Oil price, LNG price and Australian + Japan GDP growth
- Data span: 1988Q2-2017Q1
- Lag length: 4
- Estimation method: Bayesian
External shock

- GDP growth
- RER
- Export
- Import

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Domestic supply (inflation) shock

GPP growth

RER

Export

Import
Domestic demand (output) shock

CPI Inflation

RER

Export

Import

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RER shock (10% devaluation)

**CPI Inflation**

**GDP growth**

**Export**

**Import**
Recap

- Positive external shock: ↑ GDP, exports, ↓ imports
- Supply shock: ↓ GDP, exports and import
- Demand shock: ↑ inflation, exports, import and RER
- RER shock (devaluation): ↑ GDP, inflation, export but ↓ imports
The Sectoral Impact of Global and Domestic Resource Shocks
Methodology: VAR and Local Projections

We employ a trivariate VAR and recursively identify three distinguished shocks: world economic activity, commodity price and domestic resource activity.

\[
\text{structural shocks} = \begin{bmatrix} \times & \times & \times \\ \times & \times & \times \\ \times & \times & \times \end{bmatrix} \begin{bmatrix} \text{world economic activity shock} \\ \text{commodity price shock} \\ \text{domestic resource activity shock} \end{bmatrix}
\]

We then employ Local Projection Method (Jorda, 2005) to investigate the impact of these shocks on Agriculture, Construction, Manufacturing and Service. This is,

\[
\Delta x_t^s = \alpha_j^s + \sum_{i=0}^{12} \phi_{ji}^s \{\text{structural shock}_{j,t-1}\} + u_{j,t}^s
\]  

(3)
**Methodology: Boxplot and Rolling estimation**

- $\phi_{ji}^s$ are of our interest. They are the impulse response of the sector $x^s$ to the structural shock $j$. Recap:
  - $s = \{Agriculture, Construction, Manufacturing, Service\}'$
  - $j = \begin{bmatrix} \text{world economic activity shock} \\ \text{commodity price shock} \\ \text{domestic resource activity shock} \end{bmatrix}$

- To obtain the time varying impact, we utilize the rolling estimation window of 100 observations.

- The impulse responses are presented by using boxplot technique.
Data

- word economic activity: OECD + 6;
- commodity prices: energy price index and **the price of crude oil**
- country’s data (ie. Gross Value Added) are taken from the UNTACD, from 1970 to 2016.
- Quarterly data obtained by using the Chow-Lin (1971) method.
- global economic activity shock has neutral effect on agriculture.
- commodity (oil) price shock has positive effect on agriculture.
- resource activity shock has negligible/ slightly negative effect on agriculture.
- Global economic activity has neutral effect on construction.
- Oil price, construction demand for resource-related construction.
- Domestic resource activity, construction → machines are imported.
Manufacturing

- ↑ global economic activity, ↑ manufacturing.
- ↑ oil price, ↓ manufacturing (deindustrialisation).
- ↑↓ domestic resource activity, neutral effect on manufacturing.
↑↓ global economic activity has neutral effect on services.
↑ oil price, ↓ service sector (puzzle).
↑↓ resource sector has neutral effect on services. (isolation of rural mine fields).
Recap

- The impacts are time varying, recently.
- Global activity shock: ↑ manufacturing but has neutral effect on service, agriculture and construction sector.
- Commodity (oil) price shock: ↓ manufacturing & service but ↑ agriculture & construction sector.
- Domestic resource activity shock: ↓ agriculture & construction but has neutral effect on manufacturing and & service sector.
Conclusion

- Data, data, and data!
- External shocks, e.g. global economic activity and commodity prices, have a positive impact on the overall economy but not all sectors.
- It is not clear evidence that resource sector has positive spill over effect on non-resource sector.
- Both exports and imports are sensitive to RER and hence (surprised) devaluation can spur GDP growth but comes with costs (higher inflation).
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