Papua New Guinea: Riding or Sinking from the Resource Boom? Evidence from Sectoral and Geographical Employment

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Outline of the talk

Research Question

Does resource boom improve sectoral and geographical employment growth in PNG?

Motivation

First question:

- What drives PNG's resource boom in the first place?
  - Strong global economic activity?
  - High commodity prices?
  - New resource developments in PNG?
  - All three together?

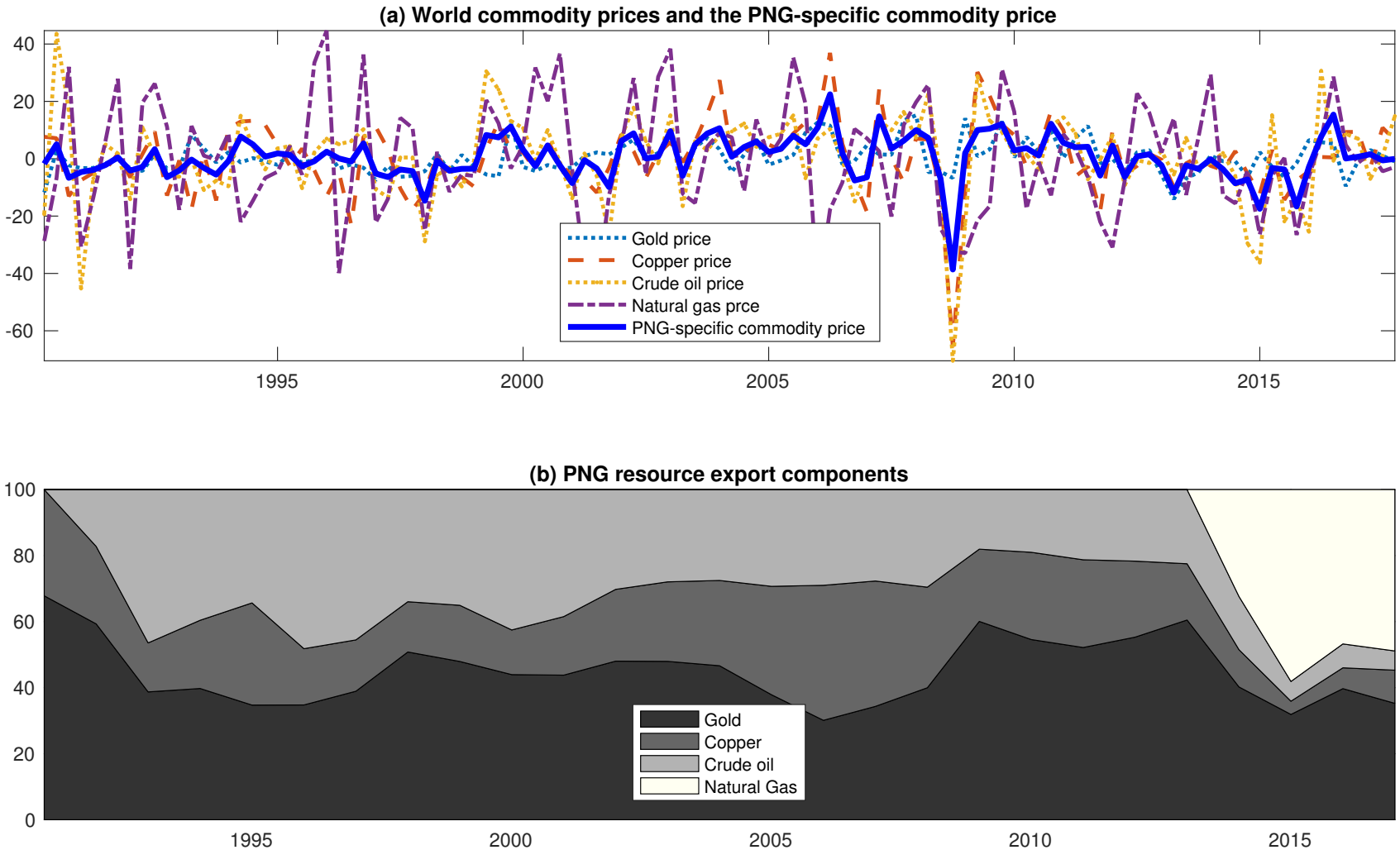
Second question:

- How does PNG employment respond to the shock of each individual variable above?
  - Are the effects of each individual shock on employment growth symmetrical across all economic sectors?
  - Are the effects of each individual shock on employment growth symmetrical across all geographical regions?

Stylised Facts

- PNG exports composition
  - resource (mining + oil and gas extraction exports) - 75% of total exports revenues.
  - LNG, gold, copper, condensate, crude oil, nickel and cobalt (by size, 2018).
  - resource sector (mining + oil and gas extraction) contribute about 30% of PNG's total GDP.
- Important dates (List of operating mine / oil & gas field)
  - 1987 Ok Tedi gold & copper mine.
  - 1990 Porgera gold mine.
  - 1992 Kutubu oil field.
  - 1998 Gobe oil field.
  - 1998 Lihir gold mine.
  - 2002 Moran oil field.
  - 2012 Ramu nickel & cobalt (NiCo) mine.
  - 2014 PNG LNG project

Stylised Fact - PNG resource exports composition and commodity prices movements)



Variables

$$\mathbf{y}_t = (ga_t, cp_t, ra_t)'$$

- ga_t : global economic activity
- cp_t : PNG specific commodity prices
- ra_t : domestic resource activity (resource exports)

SVAR model

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

$$\mathbf{B_0 y}_t = \mathbf{b} + \mathbf{B}_1 \mathbf{y}_{t-1} + \cdots + \mathbf{B}_p \mathbf{y}_{t-p} + \boldsymbol{e}_t, \quad \boldsymbol{e}_t \sim \mathcal{N}(\mathbf{0}, \boldsymbol{\Omega}), \quad (1)$$

where $\mathbf{y}_t = (ga_t \quad cp_t \quad ra_t,)'$ be a 1×3 vector of observation at time t, $\mathbf{B_0}$ is a 3×3 matrix of contemporaneous coefficients, $\mathbf{b}$ is a 3×1 vector of intercepts and $\boldsymbol{e}_t$ is a serially uncorrelated structural innovations (shocks).

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

$$\mathbf{y}_t = \mathbf{c} + \mathbf{A}_1 \mathbf{y}_{t-1} + \cdots + \mathbf{A}_p \mathbf{y} + \boldsymbol{\epsilon}_t, \quad \boldsymbol{\epsilon}_t \sim \mathcal{N}(\mathbf{0}, \boldsymbol{\Sigma}), \quad (2)$$

Identification

$$\boldsymbol{e}_t = \mathbf{B_0}\boldsymbol{\epsilon}_t$$

$$\begin{bmatrix} e^{ga} \\ e^{cp} \\ e^{ra} \end{bmatrix} = \begin{bmatrix} b_{11} & 0 & 0 \\ b_{11} & b_{22} & 0 \\ b_{31} & b_{32} & b_{33} \end{bmatrix} \begin{bmatrix} \epsilon^{ga\ shock} \\ \epsilon^{cp\ shock} \\ \epsilon^{ra\ shock} \end{bmatrix} \tag{3}$$

Identification

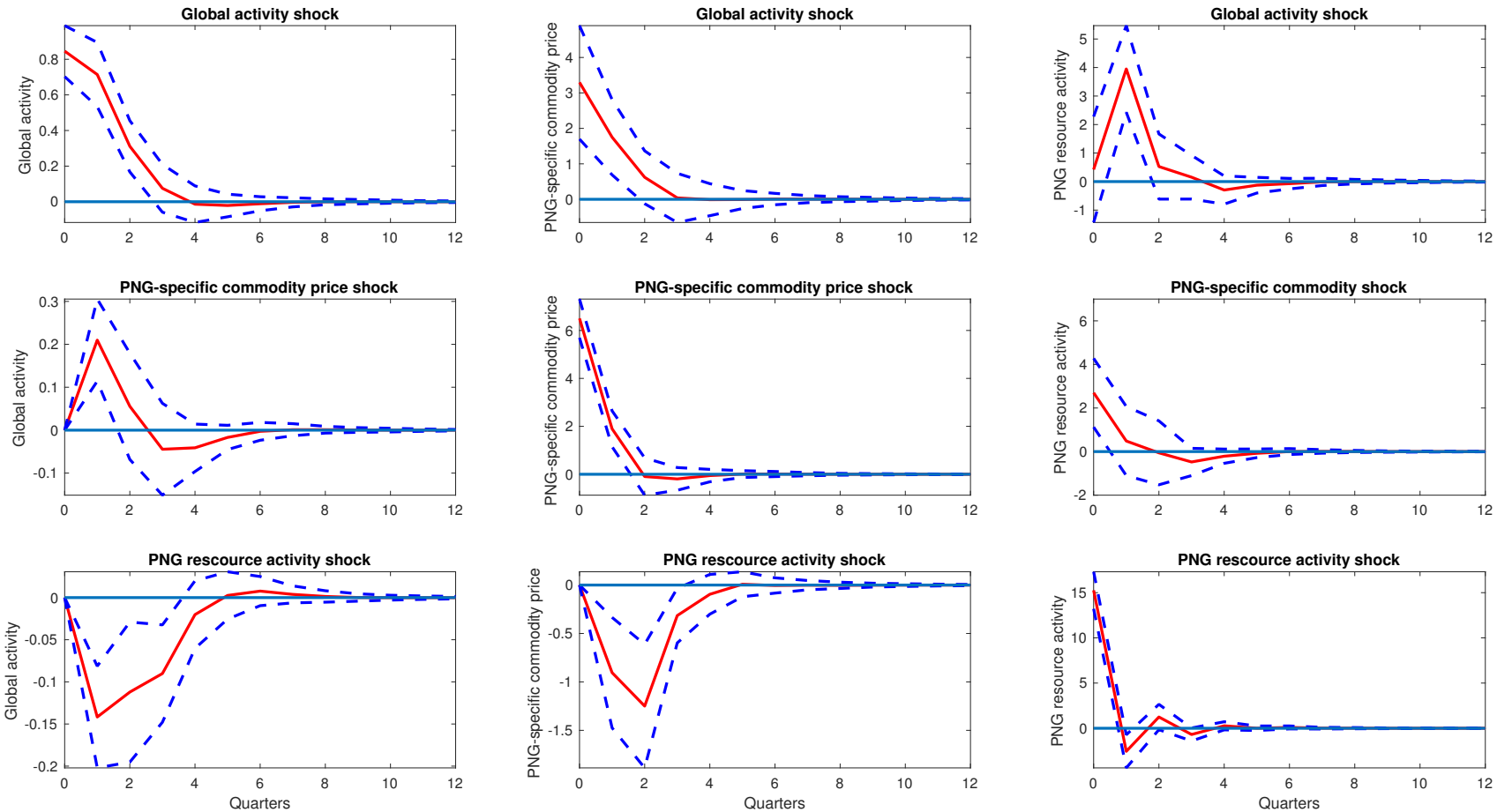
According to our model....

- Shocks from global economic activity, ga_t **can** affect world commodity prices, cp_t and PNG domestic resource activity, ra_t contemporaneously but not vice versa.
- Shocks from commodity prices, cp_t **can** affect PNG domestic resource activity, ra_t contemporaneously but not vice versa.
- Shocks from PNG domestic resource activity, ra_t **cannot** affect global economic activity, ga_t and commodity prices, cp_t contemporaneously.
- consistent with expectations, theory and past literature such as Bjørnland and Thorsrud (2016).
- The results
  - inform us what drives fluctuations in domestic resource activity.
  - disentangle the shocks from global economic activity, commodity prices and resource activity.

Data

- Global Economic Activity (ga_t)
  - industrial production index for OECD countries & 6 emerging markets (include top 7 PNG major trading partners).
  - proxy for global economic activity
- Commodity Prices (cp_t)
  - World Bank Pink Sheet
  - Authors' calculations - price index - weighted average prices of gold, copper, crude oil and natural gas.
- Domestic Resource Activity (ra_t):
  - real resource exports (proxy for resource GDP data - which are not made available in quarterly frequency)
- Sectoral and Geographical Employment Data
  - BPNG Quarterly Economic Bulletin (QEB)
- Time series
  - data runs from 1990 to 2018
  - seasonally adjusted
  - quarterly frequency

VAR impulse response function

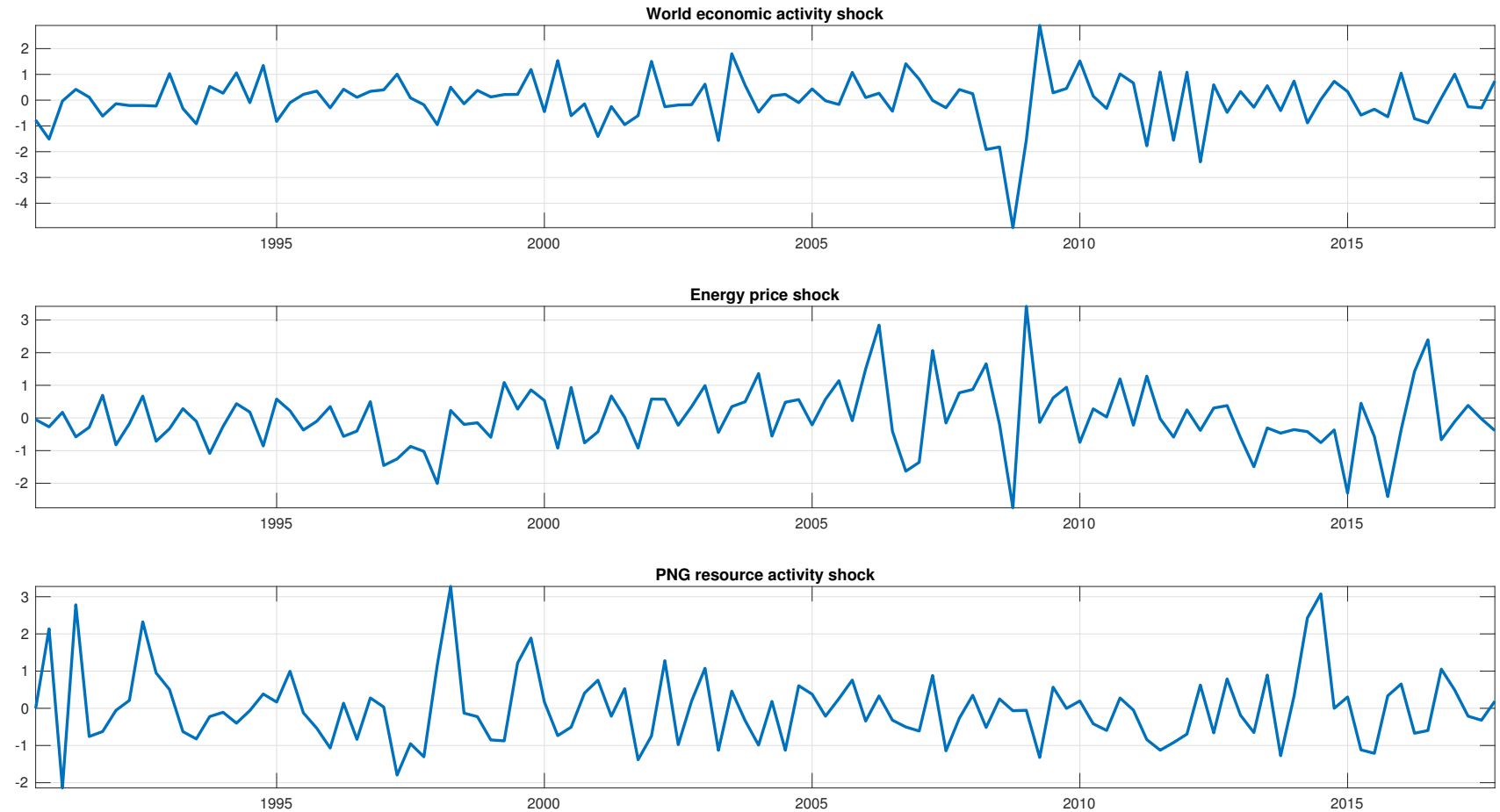


blue curves - 95% confidence interval,

Analysis

- Structural shocks in global economic activity have positive impact on PNG domestic resource activity.
- Structural shocks in commodity prices have positive impact on PNG domestic resource activity, in a slightly smaller and shorter manner.
- Domestic resource activity is mainly driven by its own shock within the sector (ie. the commencement of new resource exports such as the PNG LNG project in 2014)

Structural shocks



Regression model

Then we run a regression model using the structural shocks from VAR model above on PNG employment growth, similar to Kilian (2009) work.

$$\Delta e_t^k = \alpha_j^k + \sum_{h=0}^{12} \beta_{jh}^k \hat{\epsilon}_{jt-h} + v_{jt}^k, \quad j = 1, 2, 3, \tag{4}$$

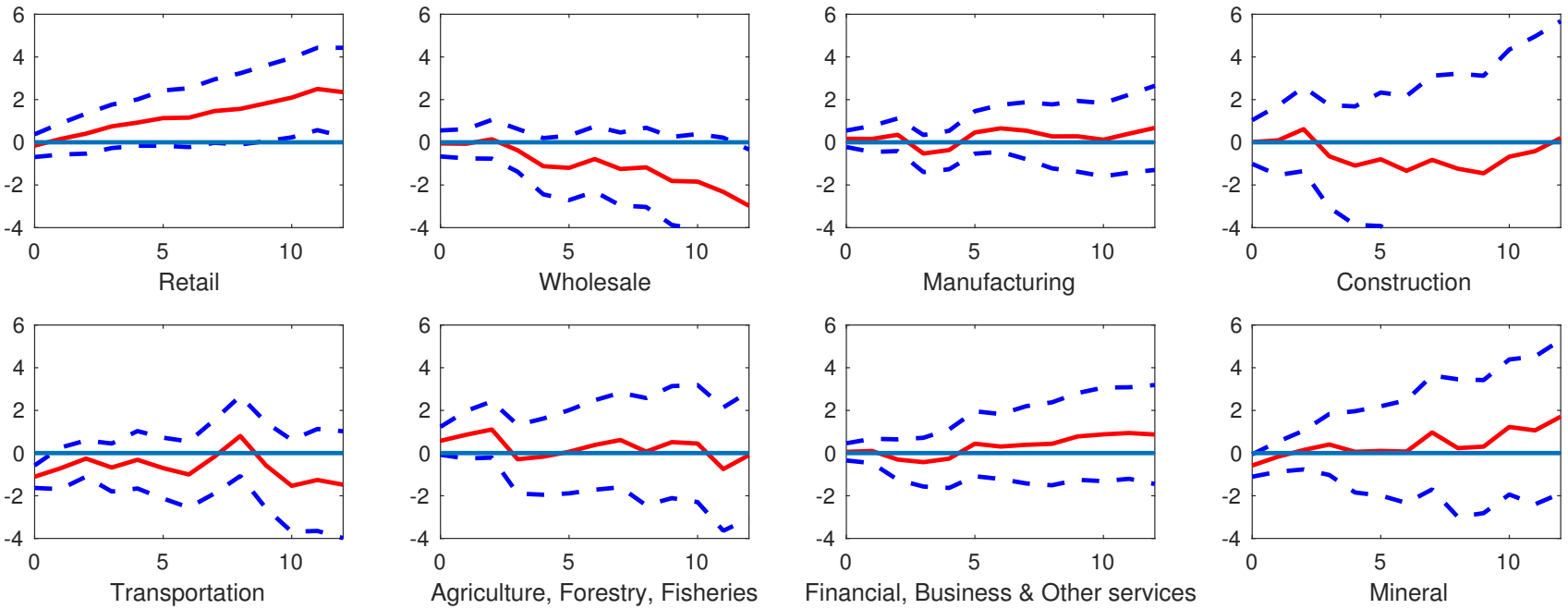
and

$$\Delta e_t^l = \alpha_j^l + \sum_{h=0}^{12} \beta_{jh}^l \hat{\epsilon}_{jt-h} + v_{jt}^l, \quad j = 1, 2, 3, \tag{5}$$

Δe_t^k and Δe_t^l are percentage changes in the level of employment in sector k and region l. $\hat{\epsilon}_{jt}, j = 1, 2, 3$ are disturbances in global economic activity, commodity prices and PNG resource activity, respectively.

Sectoral result: responses to global demand shocks

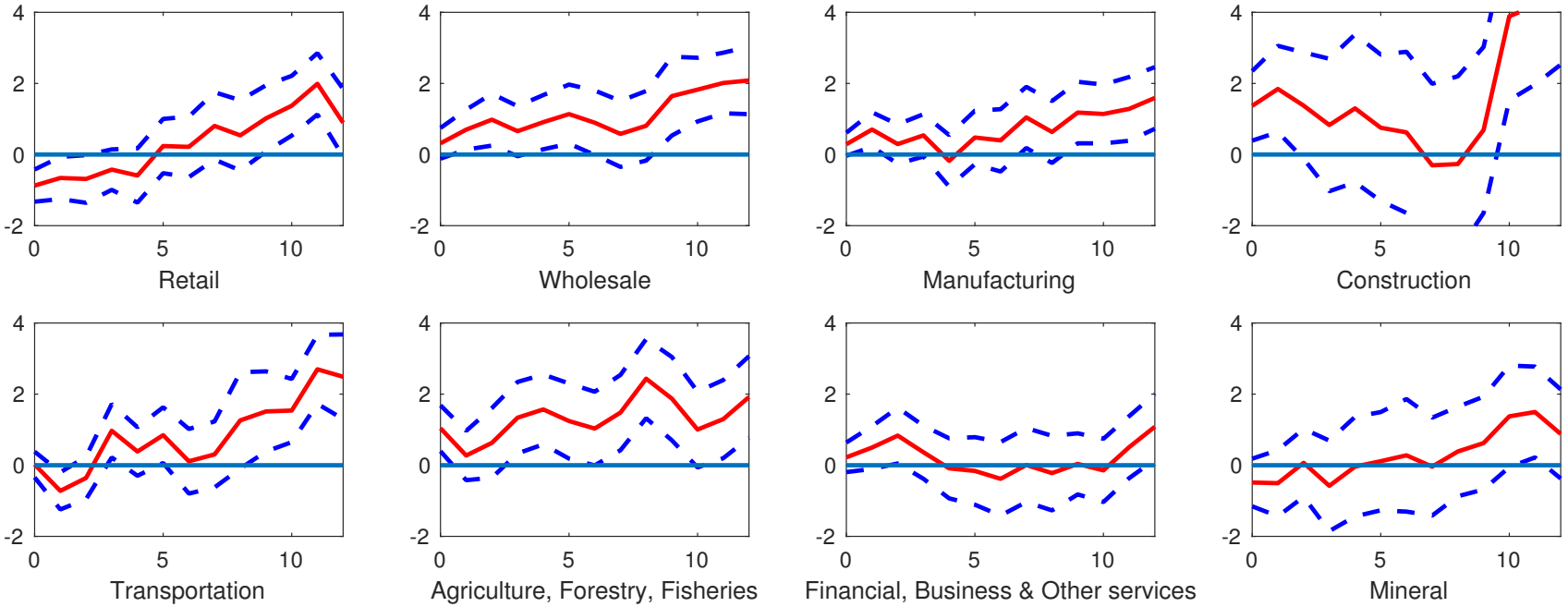
The response of sectoral employment growth to one s.d structural shock from global economic activity, ga_t.



- ↑ global economic activity, mixed response on employment across all sectors.
- Results are not statistically significant in most of the sectors.

Sectoral results: responses to commodity price shocks

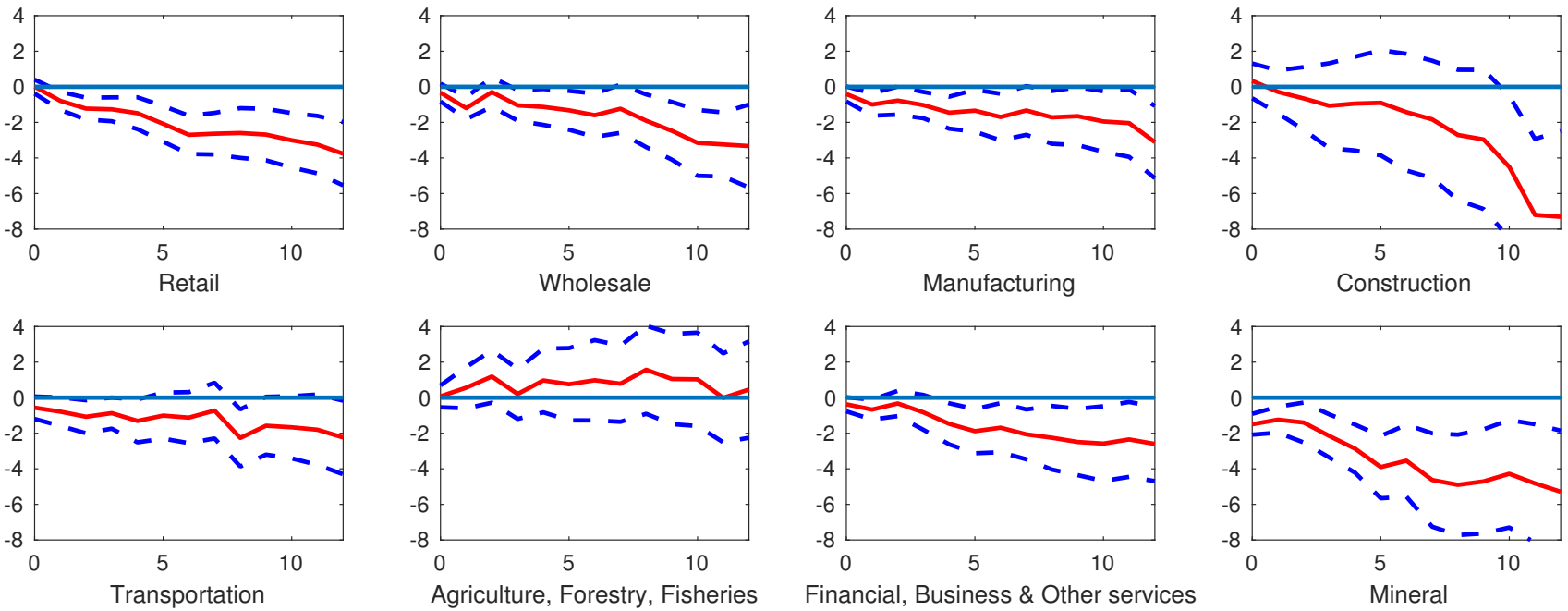
The response of sectoral employment growth to one s.d structural shock from commodity prices, cp_t.



- A general upward trend.
- $\uparrow$ commodity prices, $\uparrow$ employment across all sectors.

Sectoral results: responses to resource activity shocks

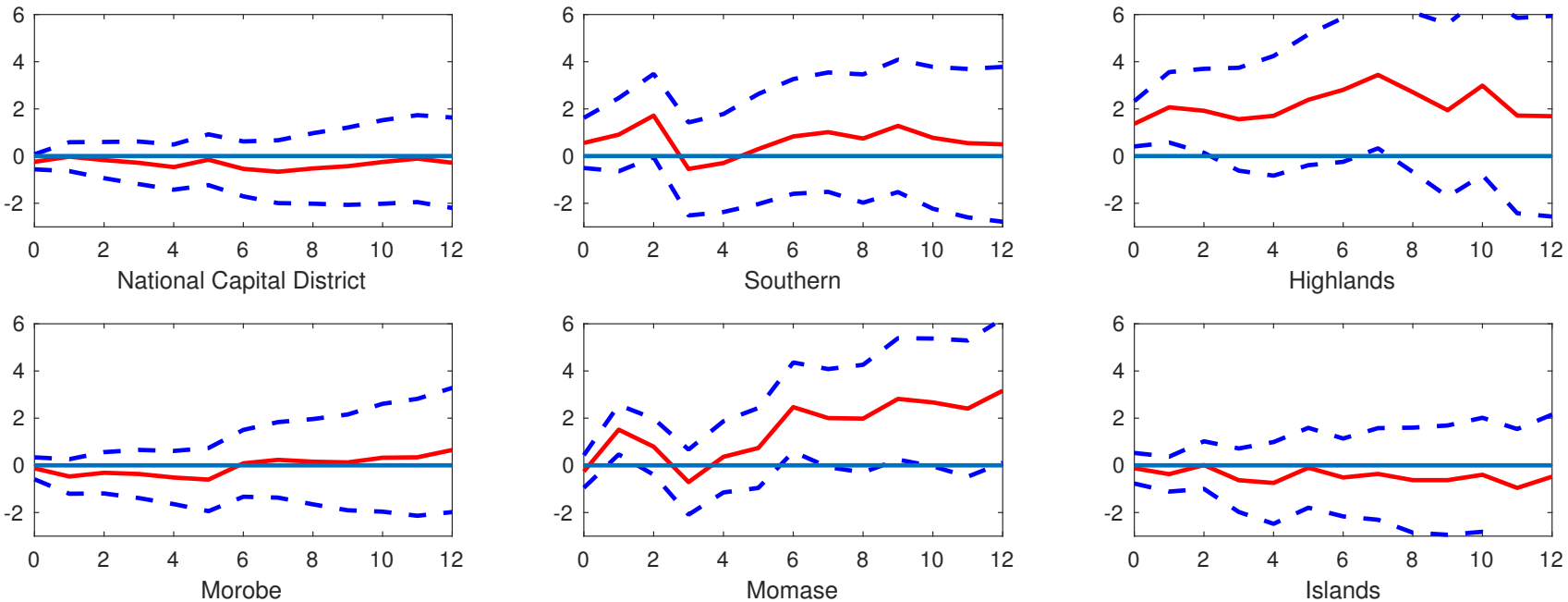
The response of sectoral employment growth to one s.d structural shock from domestic resource activity, ra_t.



- A general downward trend.
- $\uparrow$ resource exports, $\downarrow$ employment across all sectors.
- Statistically significant in almost all sectors and has a prolonged negative effect.

Geographical results: responses to global demand shocks

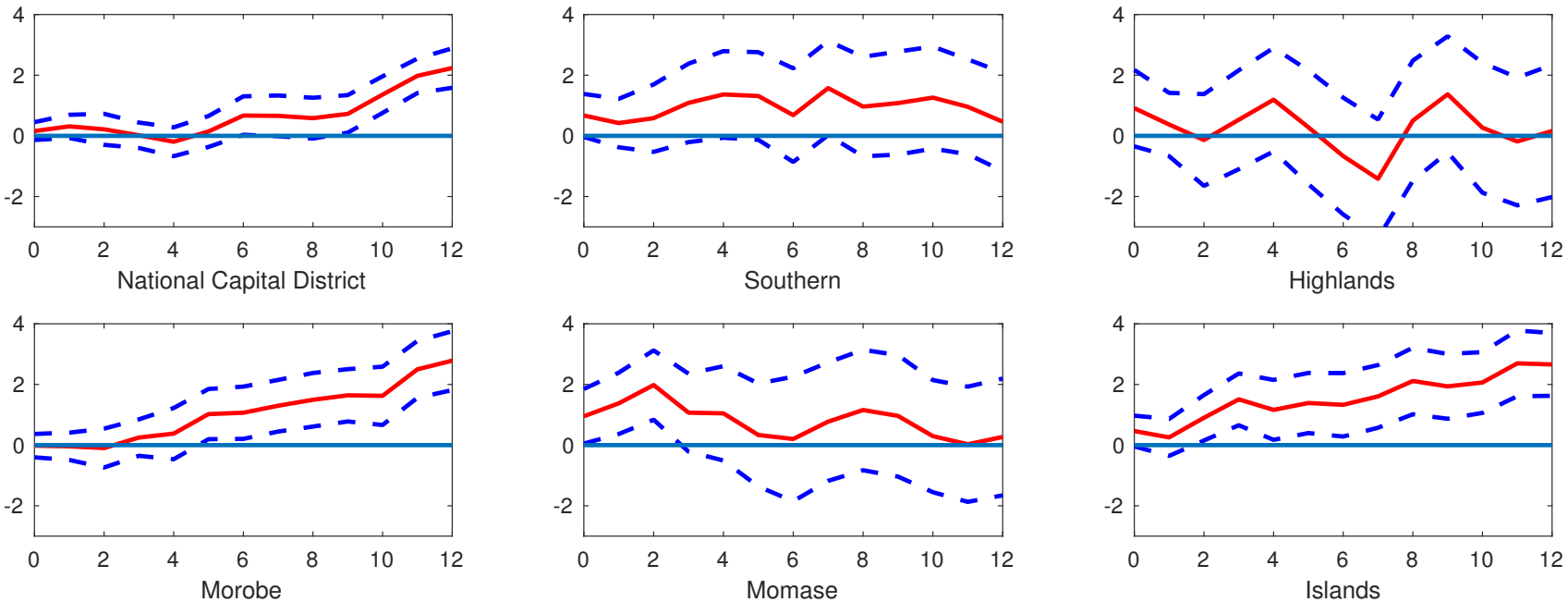
The response of regional employment growth to one s.d structural shock from global economic activity, ga_t



- ↑ global economic activity, mixed response on employment across all geographical region.
- Results are not statistically significant in most of the region.

Geographical results: responses to commodity price shocks

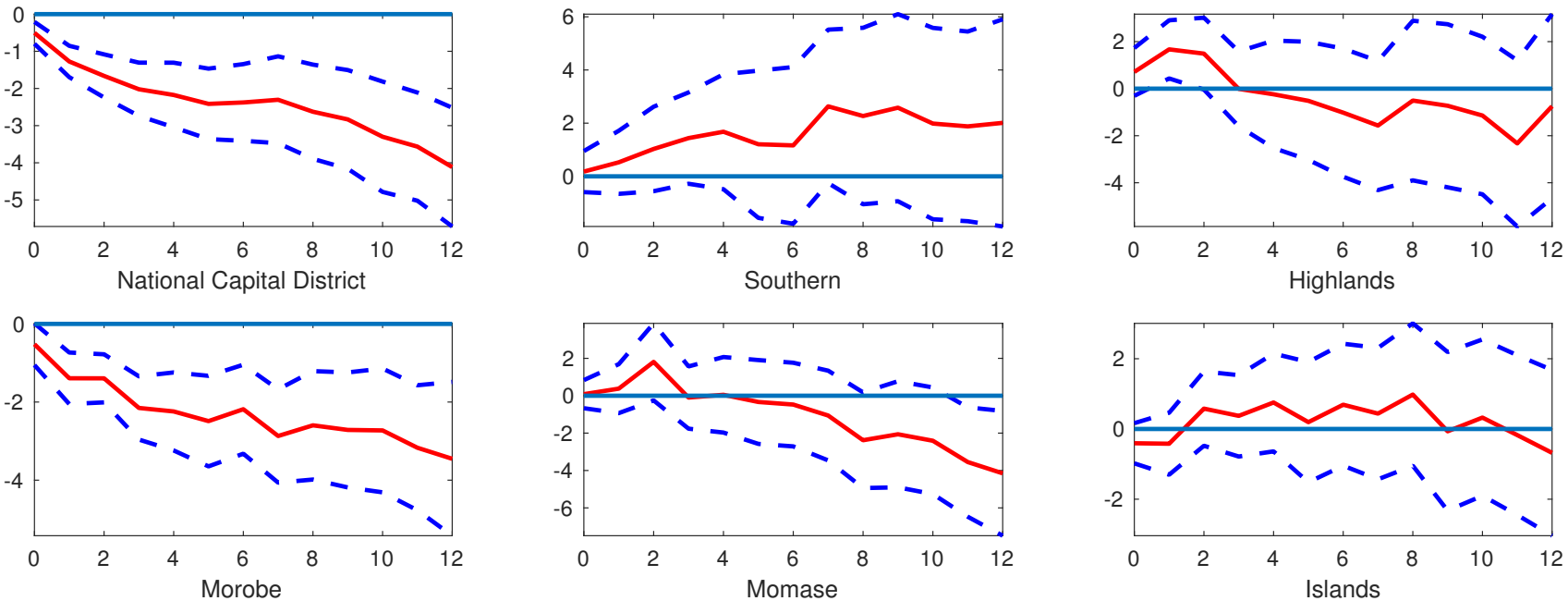
The response of geographical employment growth to one s.d structural shock from commodity prices, cp_t.



- A general upward trend across all provinces.
- ↑ commodity prices, ↑ employment in all provinces except Highlands region.

Geographical results: responses to resource activity shocks

The response of regional employment growth to one s.d structural shock from domestic resource activity, ra_t.

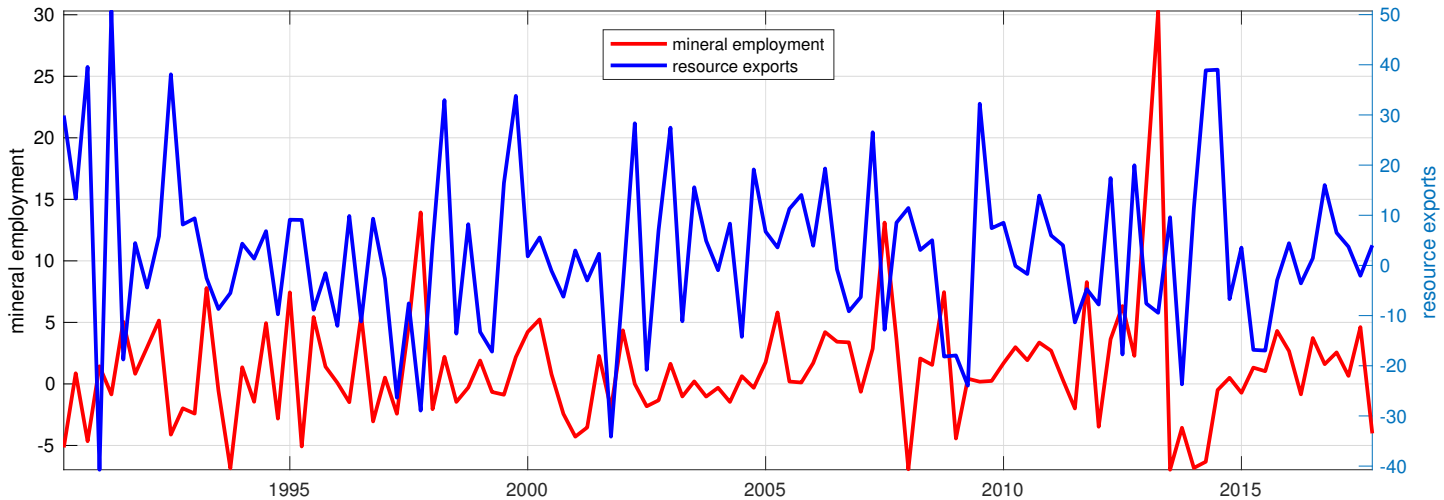


- ↑ domestic resource activity has a prolonged ↓ impact on two major cities in PNG, NCD and Morobe (Lae).
- Highlands region (where most mining projects take place) benefits shortly from ↑ domestic resource activity.

Reservations

- Resource boom must not be confused with construction boom.
  - Construction boom refers to the early-cycle of resource boom where the construction of a resource project takes place.
  - Resource boom refers to the end-cycle of construction boom, where a resource project is fully constructed and ready to commence productions & exports.
  - This paper focuses on the employment growth in response to resource boom (after the resource project is fully constructed).
- BPNG employment survey does not take into consideration artisanal mining.

The evolution of resource exports and mineral employment



Conclusions

- Positive shocks in global economic activity have mixed response on sectoral and geographical employment in PNG. - formal employment in PNG's is independent from developments in rest of the world.
- Positive shocks in commodity prices generally have positive spillover employment across all sectors and geographical region.
- Positive shocks in domestic resource activity ($\uparrow$ in resource exports) have prolonged negative impact on employment across all sectors.
- Employment across all provinces have little to gain from the rise in domestic resource activity - NCD (Port Moresby) & Morobe (Lae) are the biggest losers!

Tenkyu tru! & Vinaka
Comments/Questions/Suggestions?

References I

Bjørnland, H. C. and Thorsrud, L. A. (2016). Boom or Gloom? Examining the Dutch Disease in Two-speed Economies. *The Economic Journal*, 126(598):2219–2256.

Kilian, L. (2009). Not all oil price shocks are alike: Disentangling demand and supply shocks in the crude oil market. *American Economic Review*, 99(3):1053–69.