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?

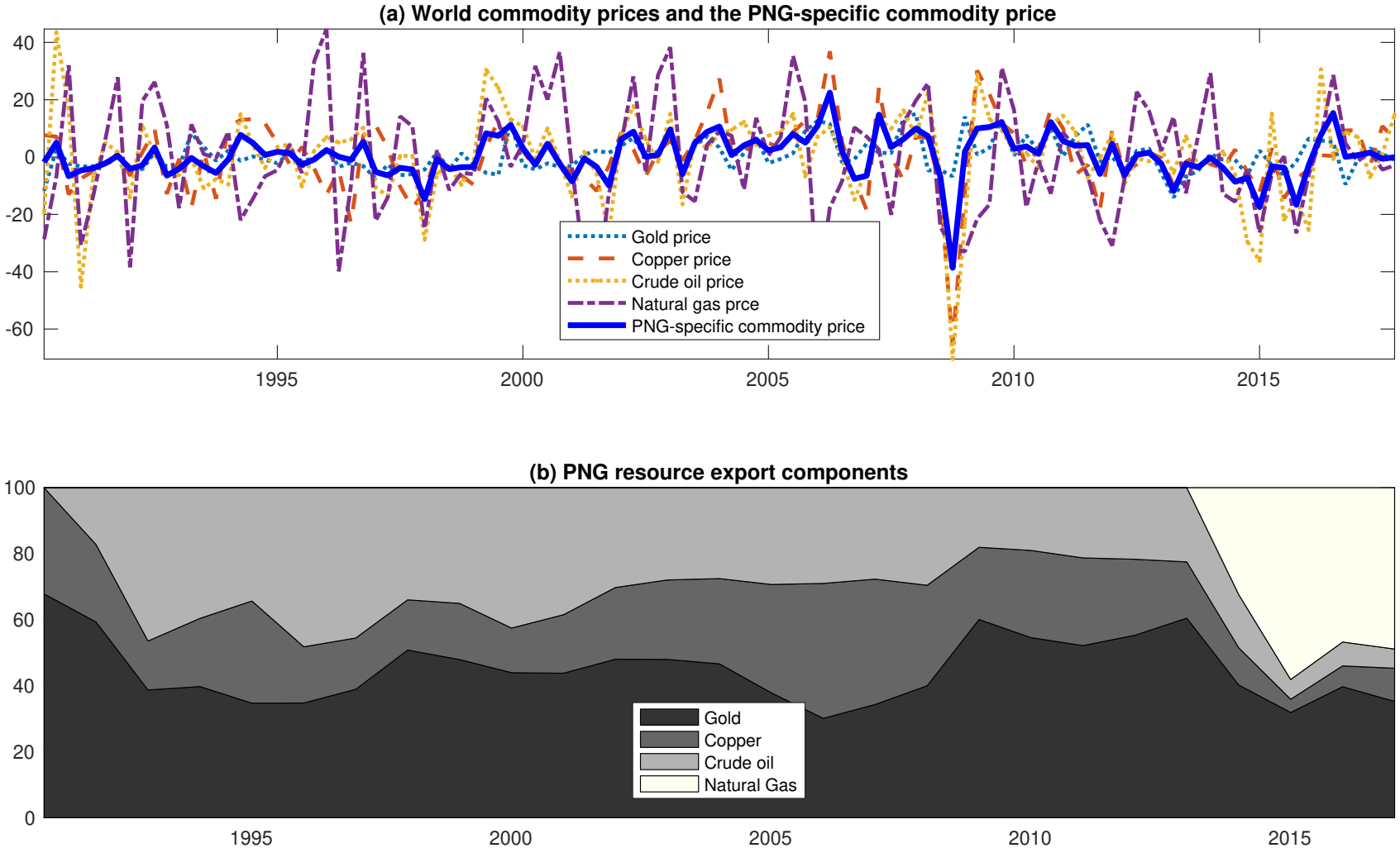
Second question:

- 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?

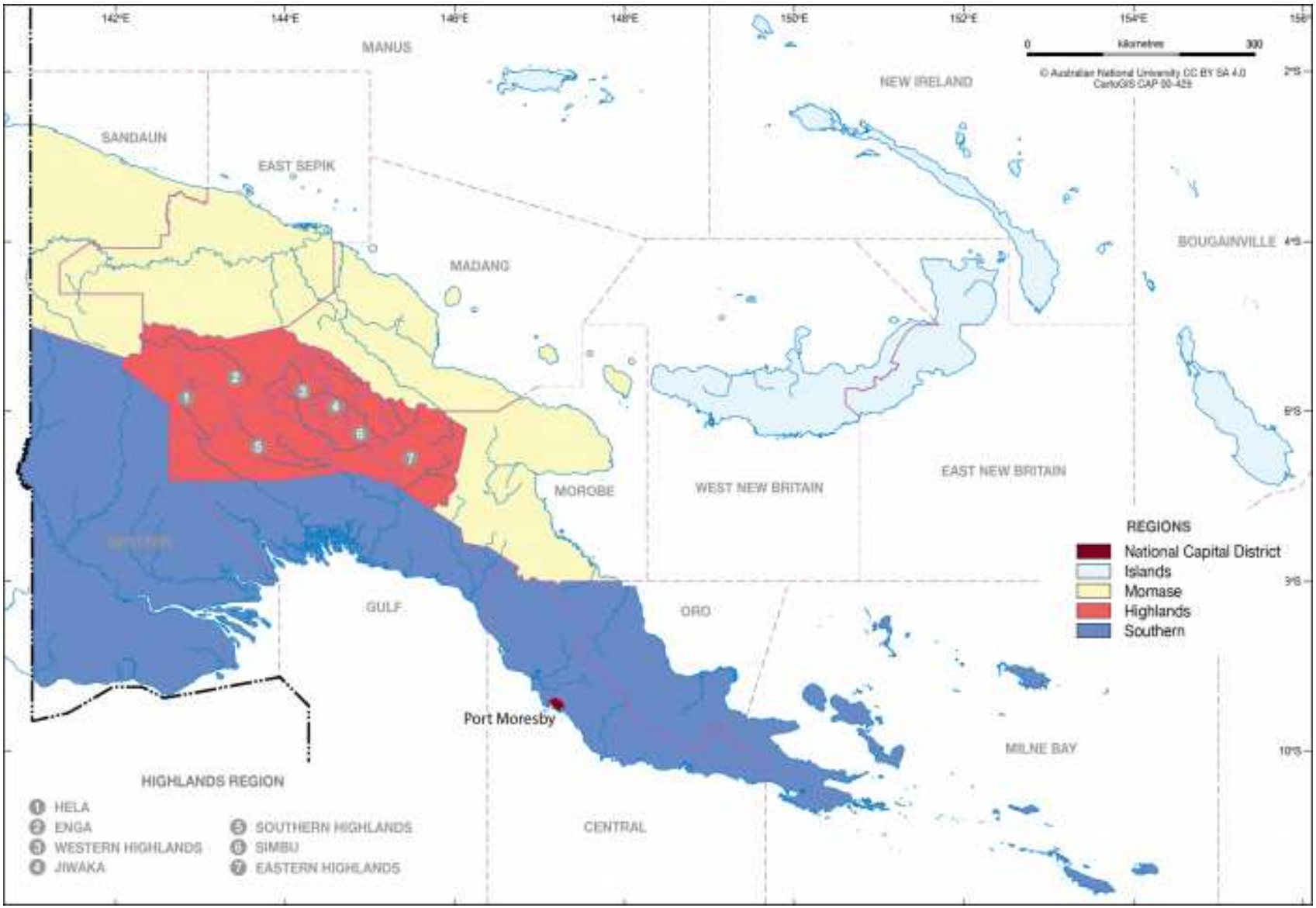
Stylised Facts

- 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

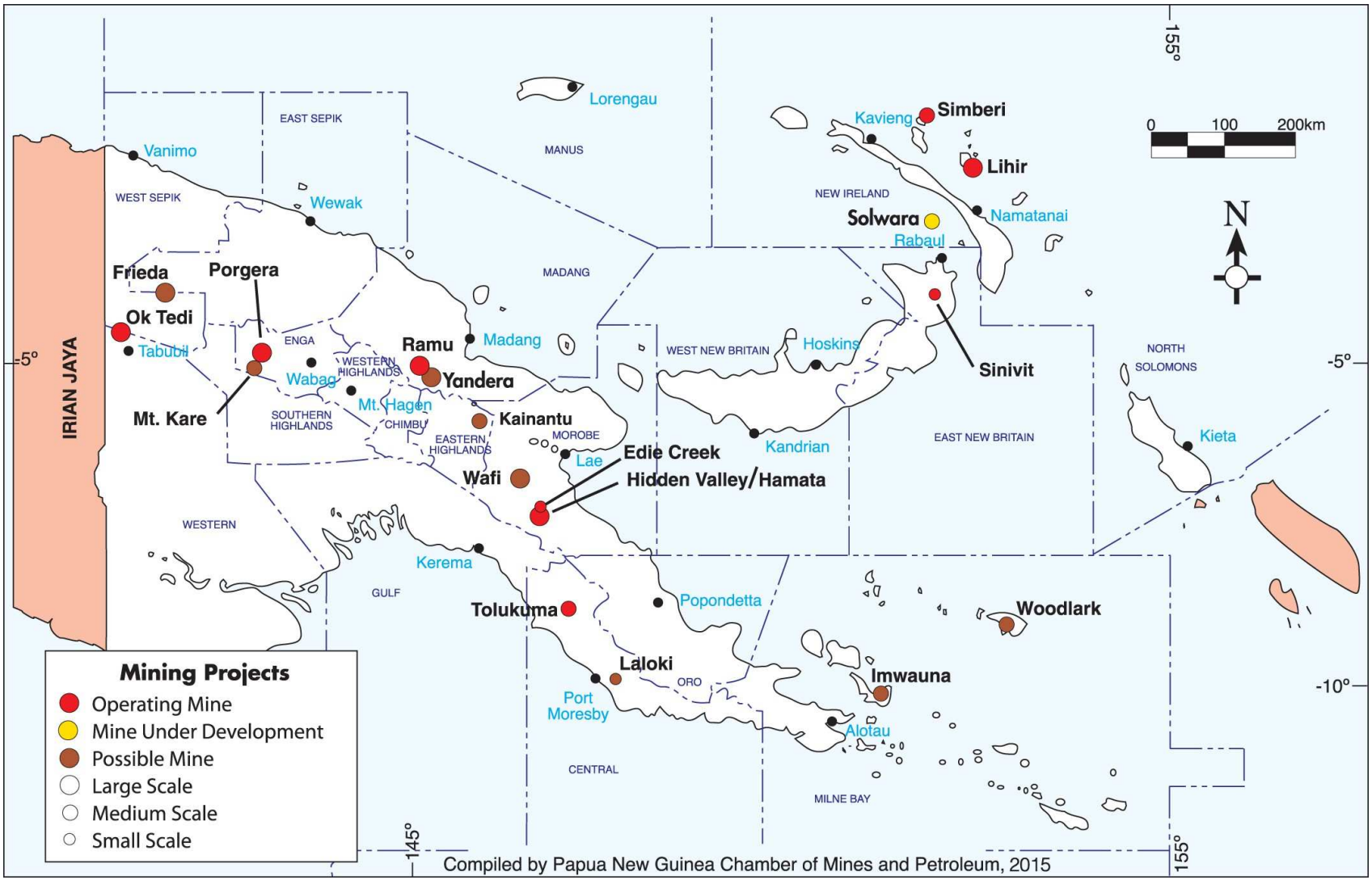
Stylised Fact - PNG resource exports composition and commodity prices movements)



Geographical Results



Maps


Lorengau
EAST SEPIK
MANUS
Kavieng
Simberi
Lihir
Vanimo
WEST SEPIK
Wewak
NEW IRELAND
Solwara
Namatanai
Rabaul
MADANG
Frieda
Porgera
Ok Tedi
Tabubil
ENGA
Ramu
Madang
WEST NEW BRITAIN
Hoskins
Sinivit
NORTH SOLOMONS
IRIAN JAYA
Wabag
WESTERN HIGHLANDS
Yandera
Mt. Hagen
Mt. Kare
SOUTHERN HIGHLANDS
CHIMBU
Kainantu
EASTERN HIGHLANDS
MOROBE
Lae
Edie Creek
Hidden Valley/Hamata
Wafi
Kandrian
EAST NEW BRITAIN
Kieta
WESTERN
Kerema
GULF
Popondetta
Tolukuma
Woodlark
Laloki
ORO
Imwauna
Port Moresby
Alotau
CENTRAL
MILNE BAY
Mining Projects
Operating Mine
Mine Under Development
Possible Mine
Large Scale
Medium Scale
Small Scale
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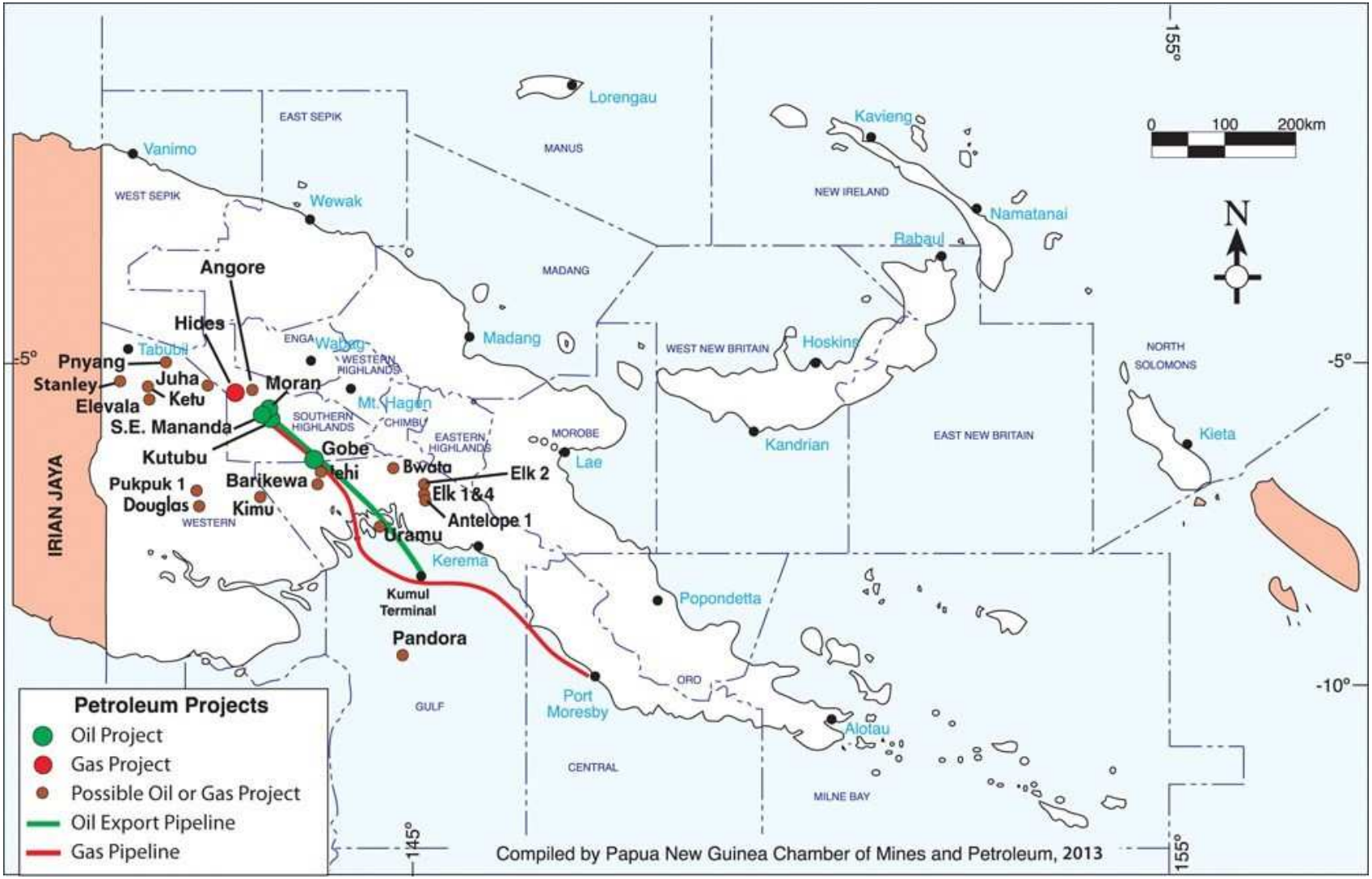
100
200km
N
155°
-5°
-10°
145°
Compiled by Papua New Guinea Chamber of Mines and Petroleum, 2015

Maps


Lorengau
EAST SEPIK
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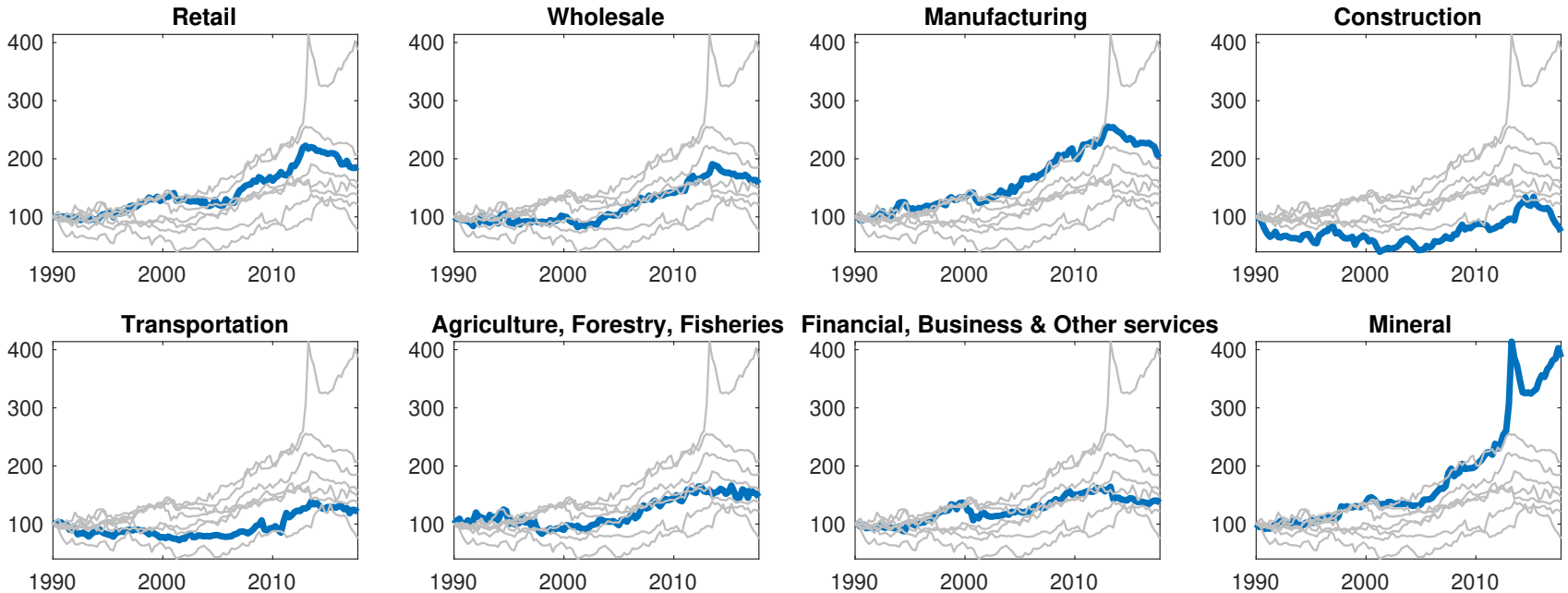
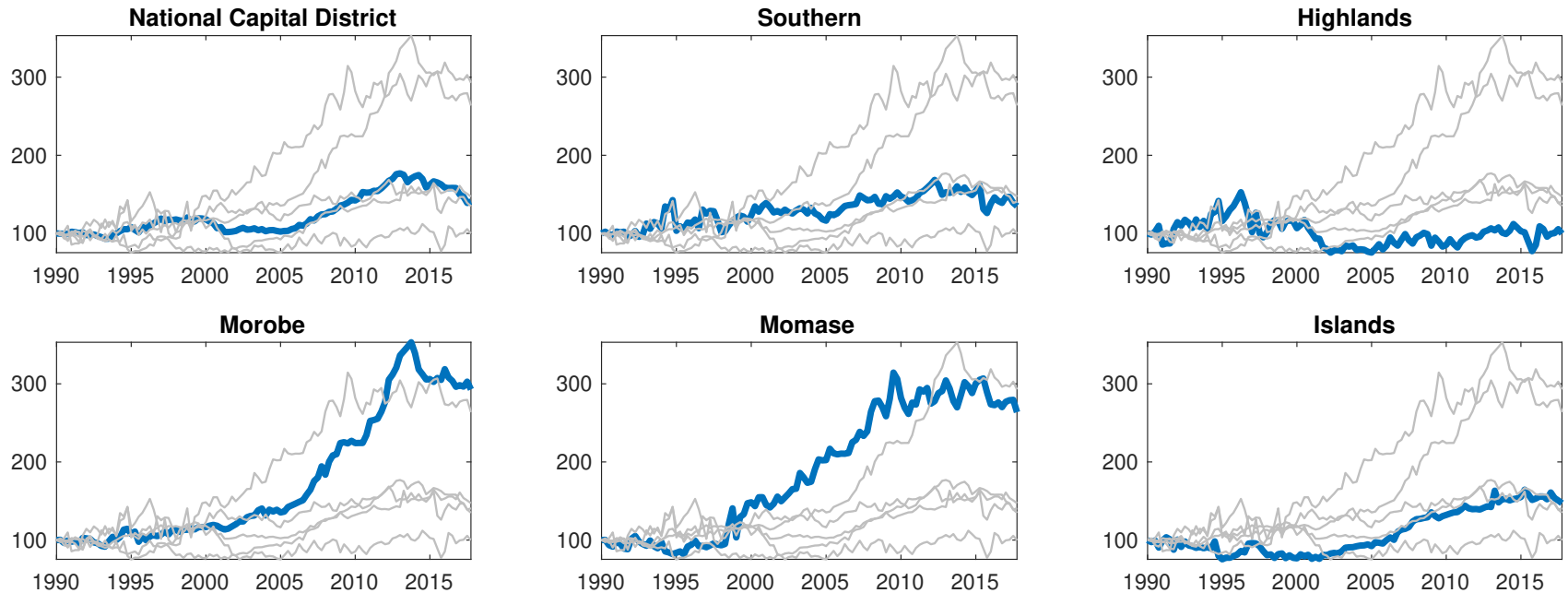
NORTH SOLOMONS
Tabubil
WESTERN HIGHLANDS
Pnyang
Stanley
Juha
Moran
Elevala
Ketu
Mt. Hagen
S.E. Mananda
SOUTHERN HIGHLANDS
CHIMBU
EASTERN HIGHLANDS
MOROBE
Kandrian
EAST NEW BRITAIN
Kieta
Kutubu
Gobe
Lae
Bwata
Elk 2
Pukpuk 1
Barikewa
Elk 1&4
Douglas
Kimu
Antelope 1
WESTERN
Uramu
Kerema
IRIAN JAYA
Kumul Terminal
Popondetta
Pandora
ORO
Port Moresby
GULF
Alotau
CENTRAL
MILNE BAY
Petroleum Projects
Oil Project
Gas Project
Possible Oil or Gas Project
Oil Export Pipeline
Gas Pipeline
Compiled by Papua New Guinea Chamber of Mines and Petroleum, 2013
155°
145°
-5°
-10°

Stylised Fact - Employment Index (March 2002 = 100)



Stylised Fact - Employment Index (March 2002 = 100)



Data

- Sectoral and Geographical Employment Data
  - BPNG Quarterly Economic Bulletin (QEB)
- 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)
- Time series
  - data runs from 1990 to 2018
  - seasonally adjusted
  - quarterly frequency

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

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

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)

Identification

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

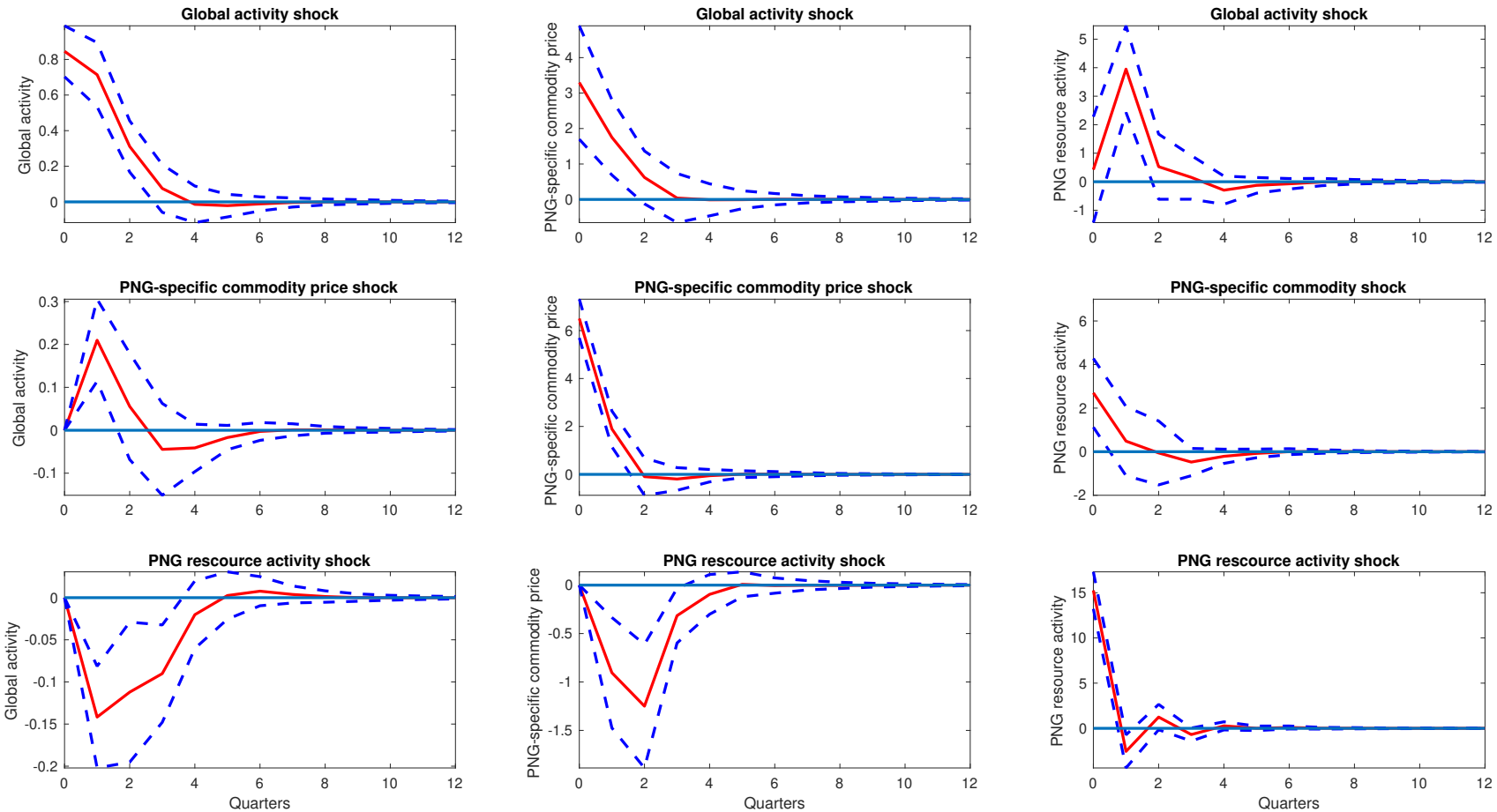
$$\begin{bmatrix} e^{ga} \\ e^{cp} \\ e^{ra} \end{bmatrix} = \begin{bmatrix} b_{11} & 0 & 0 \\ b_{11} & b_{22} & 0 \\ b_{31} & b_{32} & b_{33} \end{bmatrix} \begin{bmatrix} \epsilon^{ga\ shock} \\ \epsilon^{cp\ shock} \\ \epsilon^{ra\ shock} \end{bmatrix} \tag{3}$$

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.

Results

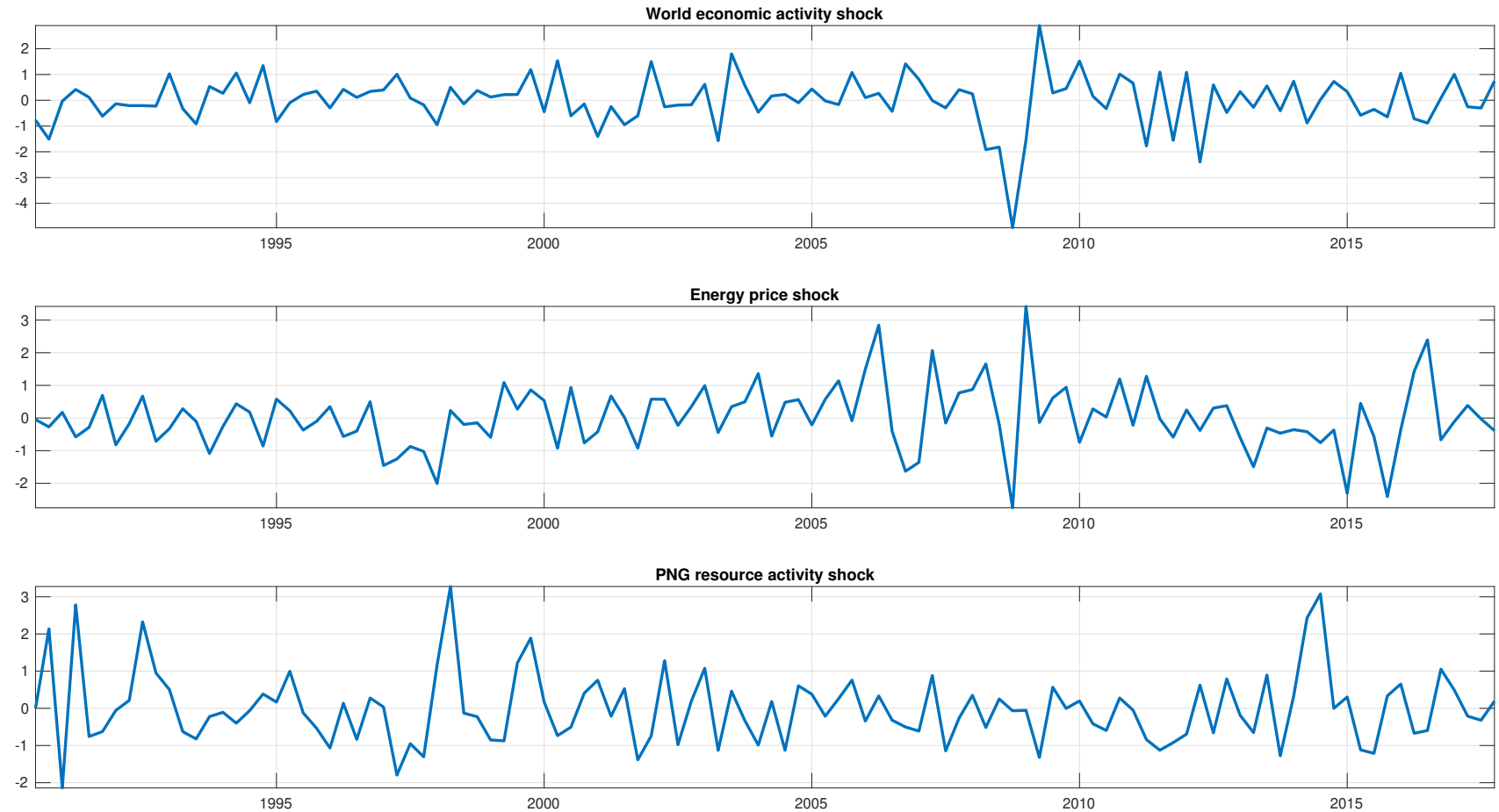


blue curves - 95% confidence interval,

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)

Results


World economic activity shock
2
1
0
-1
-2
-3
-4
1995
2000
2005
2010
2015
Energy price shock
3
2
1
0
-1
-2
1995
2000
2005
2010
2015
PNG resource activity shock
3
2
1
0
-1
-2
1995
2000
2005
2010
2015

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.

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

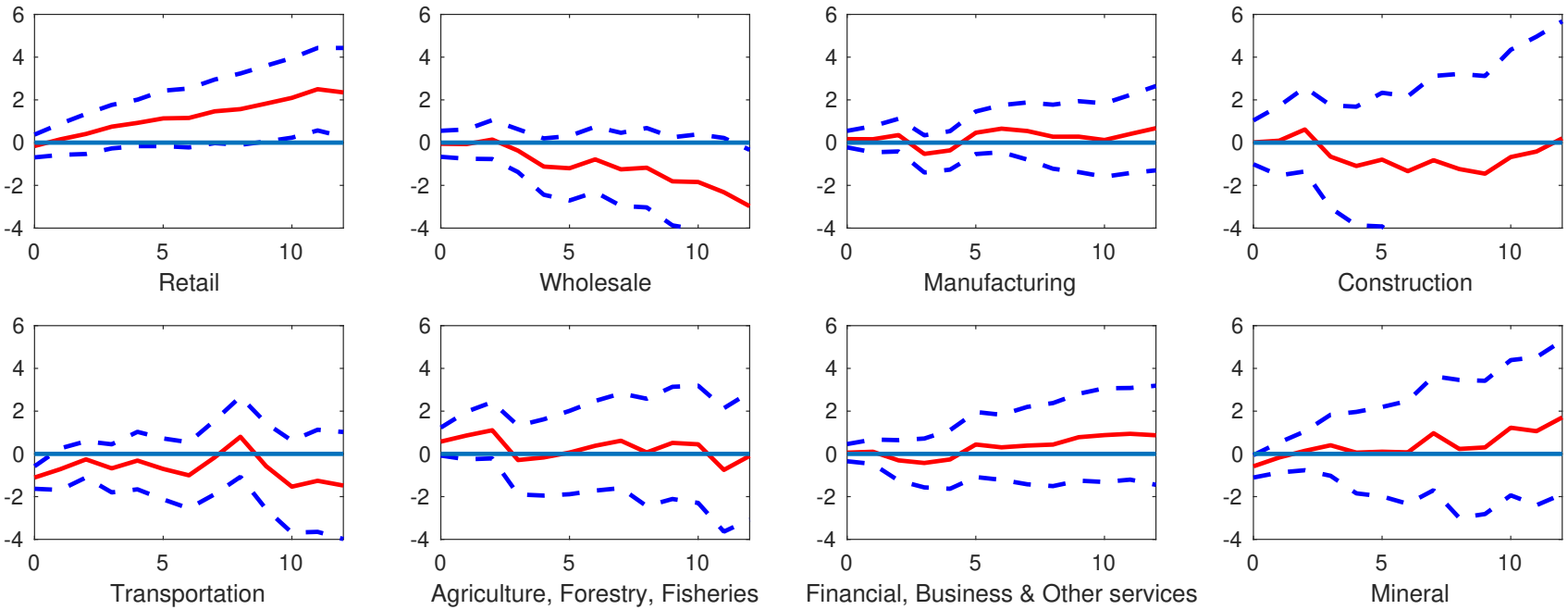
and

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

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.

Results

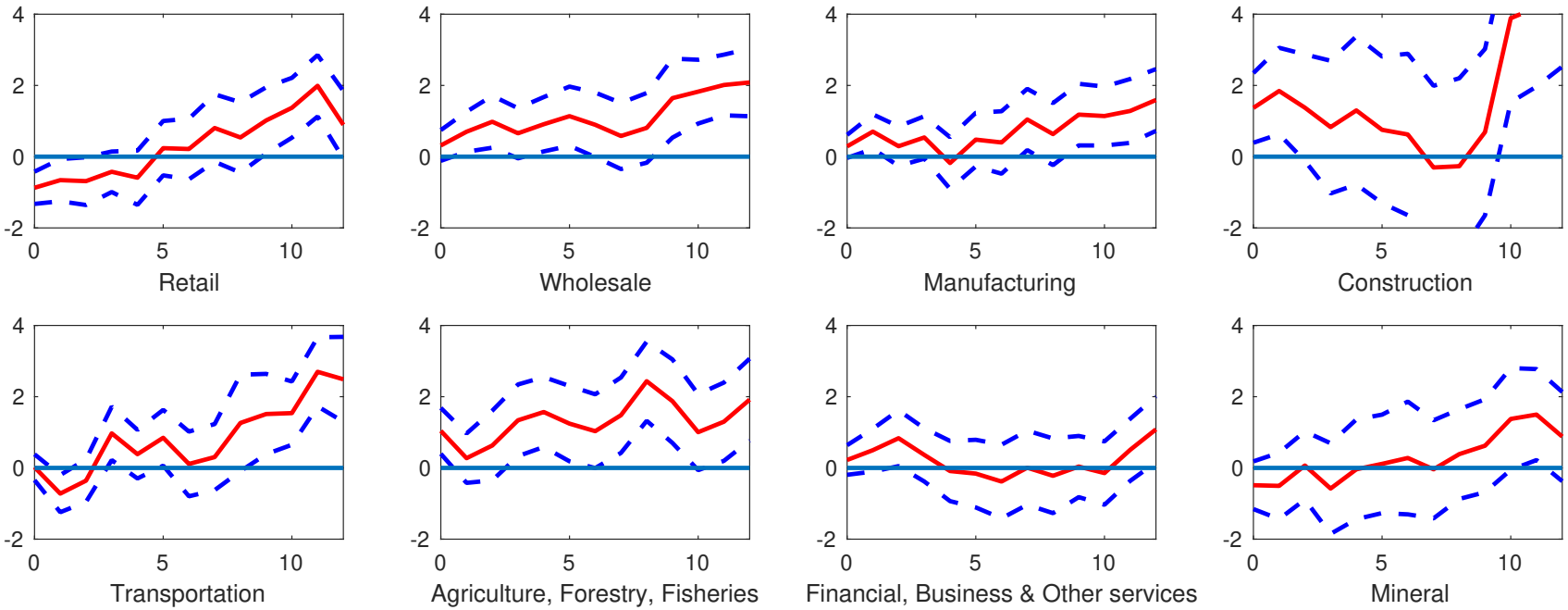
The response of sectoral employment growth to one s.d structural shock from global economic activity, ga_t.



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

Sectoral Results

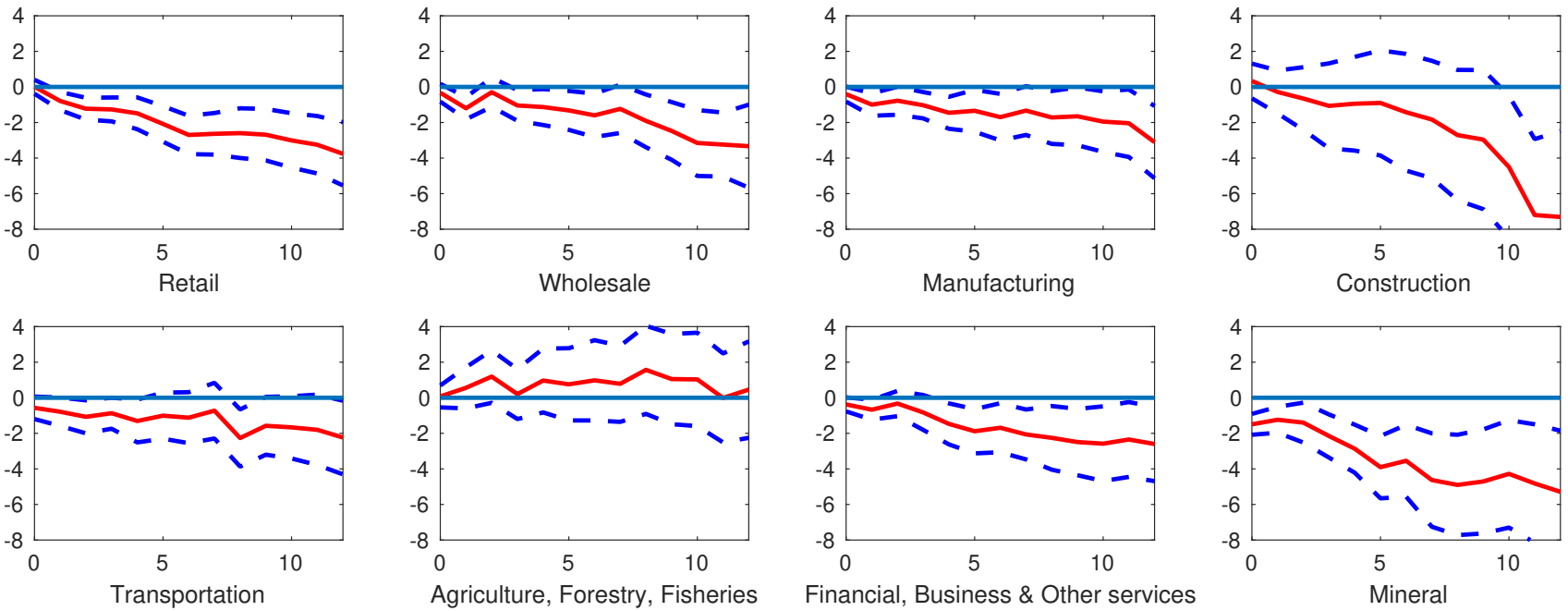
The response of sectoral employment growth to one s.d structural shock from commodity prices, cp_t.



- A general upward trend.
- ↑ commodity prices, ↑ employment across all sectors.

Sectoral Results

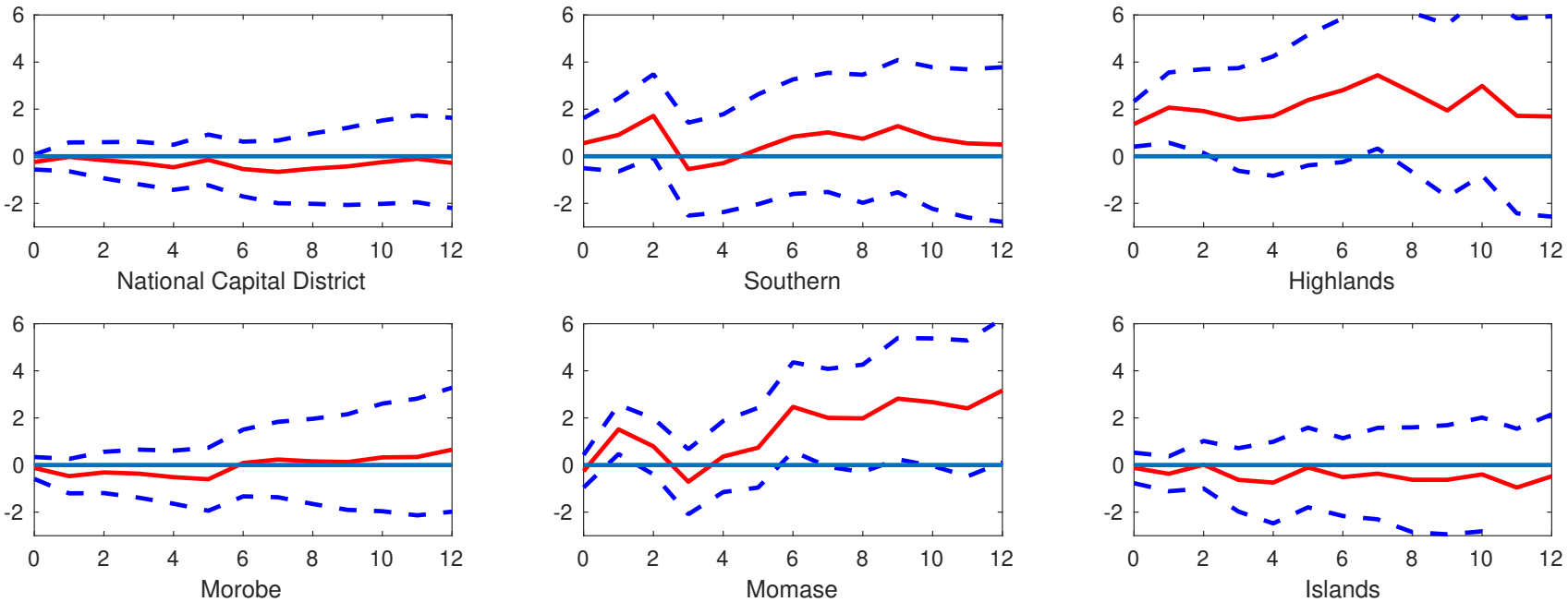
The response of sectoral employment growth to one s.d structural shock from domestic resource activity, ra_t.



- 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

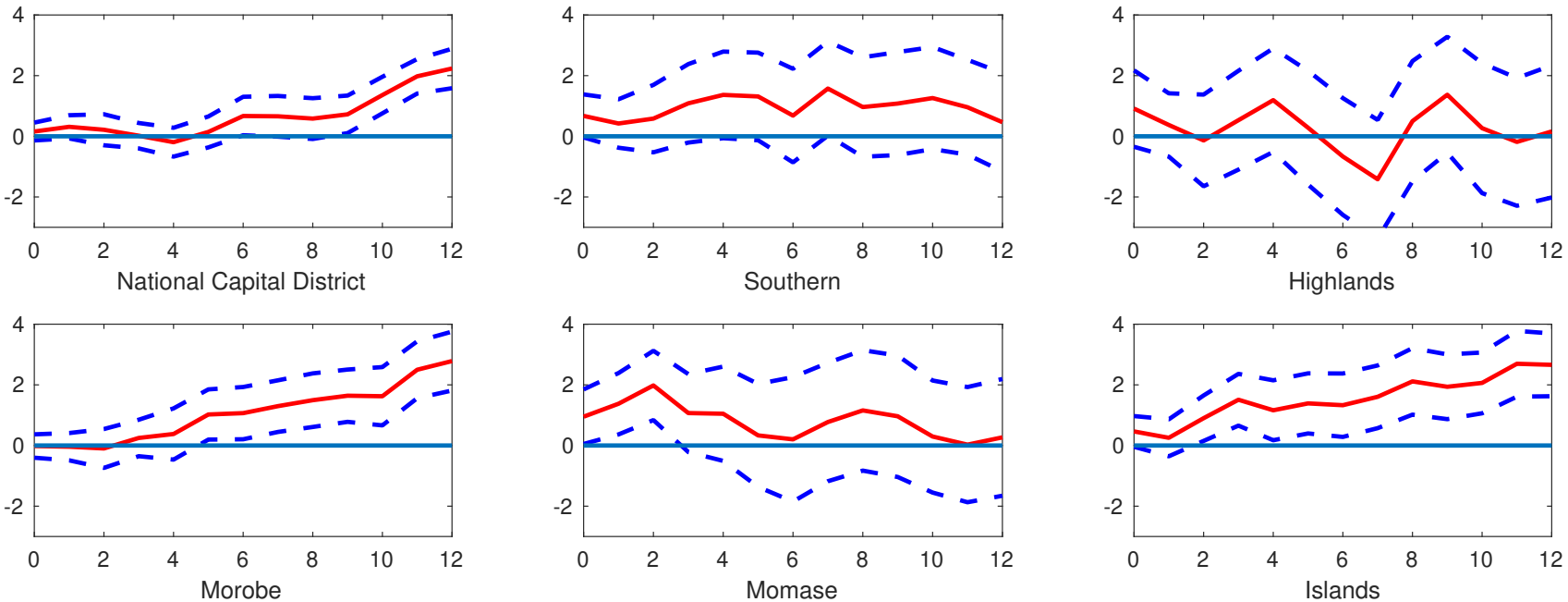
The response of regional employment growth to one s.d structural shock from global economic activity, ga_t



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

Maps

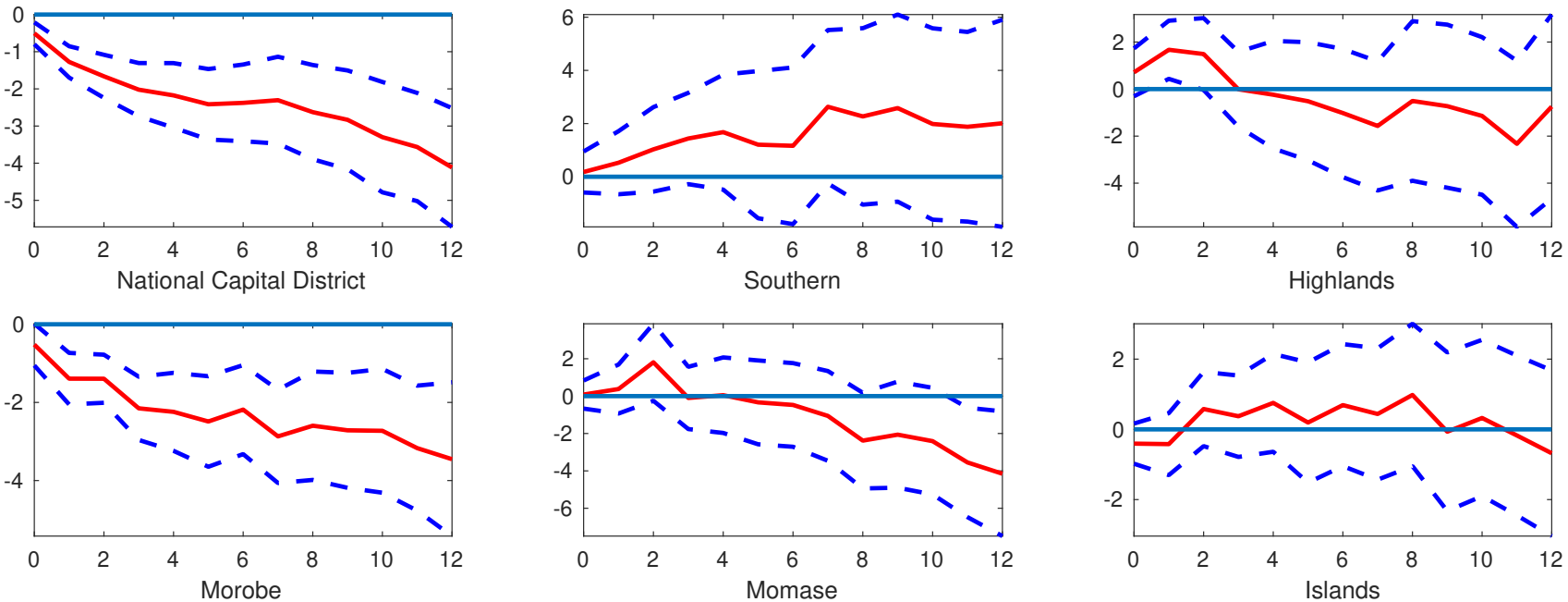
The response of geographical employment growth to one s.d structural shock from commodity prices, cp_t.



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

Geographical Results

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



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

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.