Discussion on *"ENSO and its economic impact in the Peruvian economy: economic activity, inflation and monetary policy design"* by J Aguirre, A Ledesma, F Perez, Y Rojas

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Summary of the paper

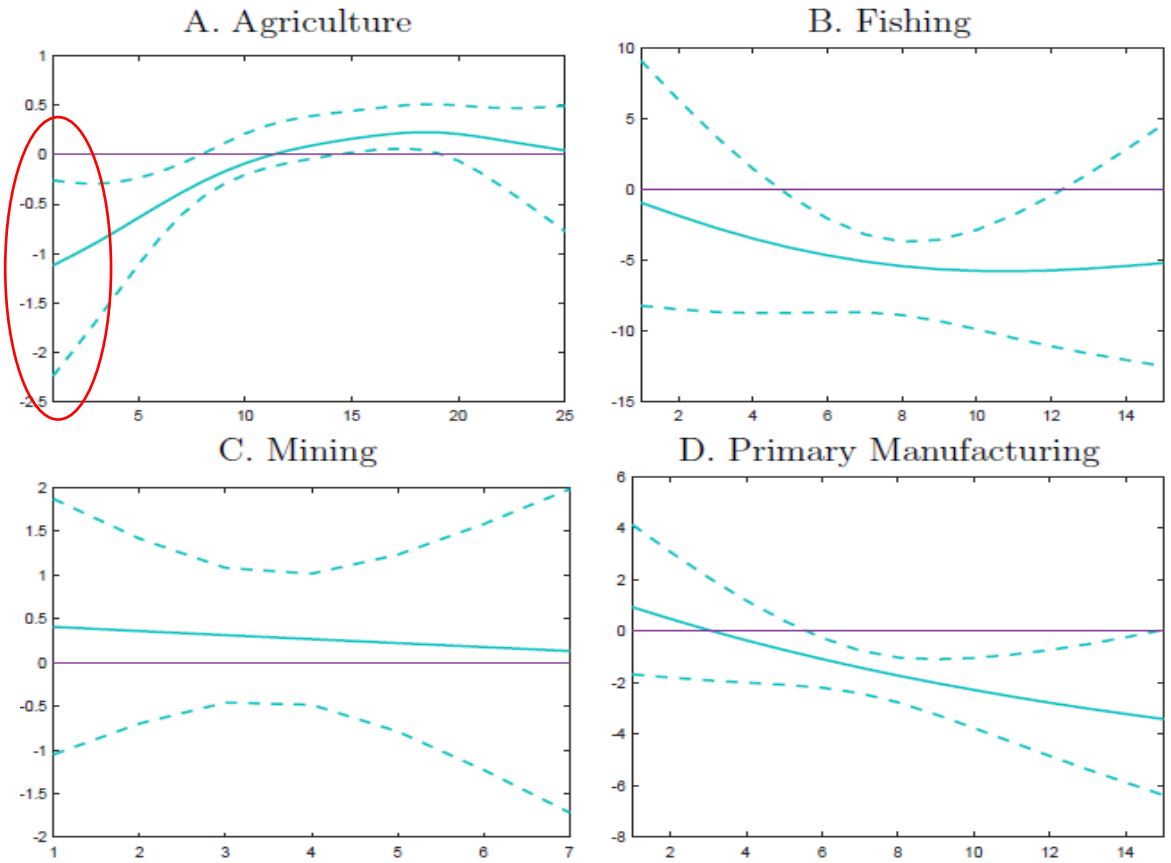
- Main channel:
  Climate change => more frequent and intense El Nino Costero => more frequent and intense adverse weather events => impact on inflation and output => implications for monetary policy
- Main questions
  - What is the dynamic response of inflation and output to *moderate, strong* or *very strong* El Nino shocks?
  - What are their implications for monetary policy design?
- Data
  - Sample period: M1 1994 – M12 2023
  - ICEN index: deviation of 3-month moving average sea surface temperature from the long-term mean in degrees Celsius; monthly
  - Monthly macro data from Banco Central de Reserva del Perú
    - Headline, core, food inflation, GDP and sector-specific production
  - US GDP and Brent oil price index from FRED as controls
  - Terms of trade, liquidity of depository societies as additional controls
- Run non-linear smooth local projection (SLP) as a primary empirical model
  - Run a TVP-VAR-SV model and a Threshold-BVAR model for robustness

Summary of the paper (continued)

- Main results from SLP impulse responses
  - El Nino shocks have similar effects on the economy to a supply shock: increasing inflation and decreasing GDP growth
  - Slowdown in economic activity in *some* primary sectors is immediate and substantial, while it is immediate, slow-moving and persistent in *most* non-primary sectors
- Use a semi-structural model with four non-linear transmission channels kicking in depending on the ACEN index to derive policy implications
  - Moderate El Nino shocks activate food price channel & demand channel
  - Strong El Nino shocks activate potential GDP channel and inflation expectation channel
  - When the standard deviation of ICEN increases, the overall uncertainty of the economy and the loss function become non-linearly larger.
  - In the presence of a severe El Nino shock, an aggressive monetary tightening can stabilize inflation
    - Monetary policy should be actively used to achieve price stability
    - However, tighter monetary policy reduces inflation modestly but output falls strongly and exchange rate depreciates substantially.
  - Therefore, it is important to carefully calibrate monetary policy

Dynamic impact on primary sector output

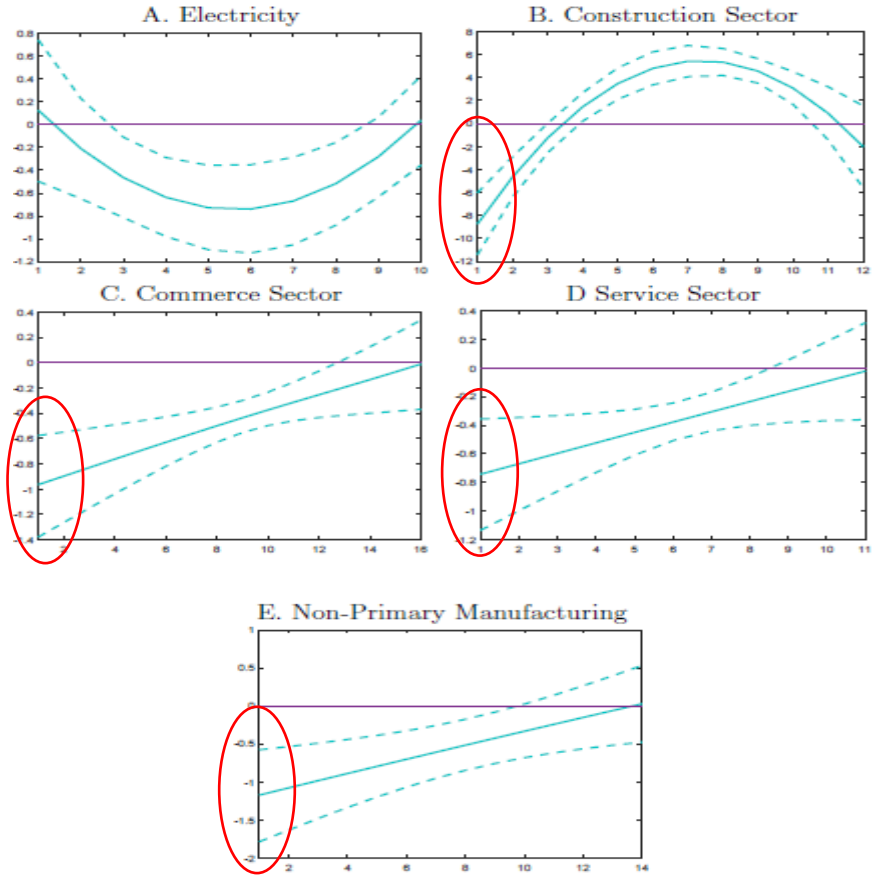
Figure 4. *SLP: Effects of El Niño on Primary GDP sectors*



- Only agricultural sector's output responds immediately negatively to the shock.
- The fishing and primary manufacturing sectors experience a reduction in output only after 6 months.

Dynamic impact on non-primary sector output

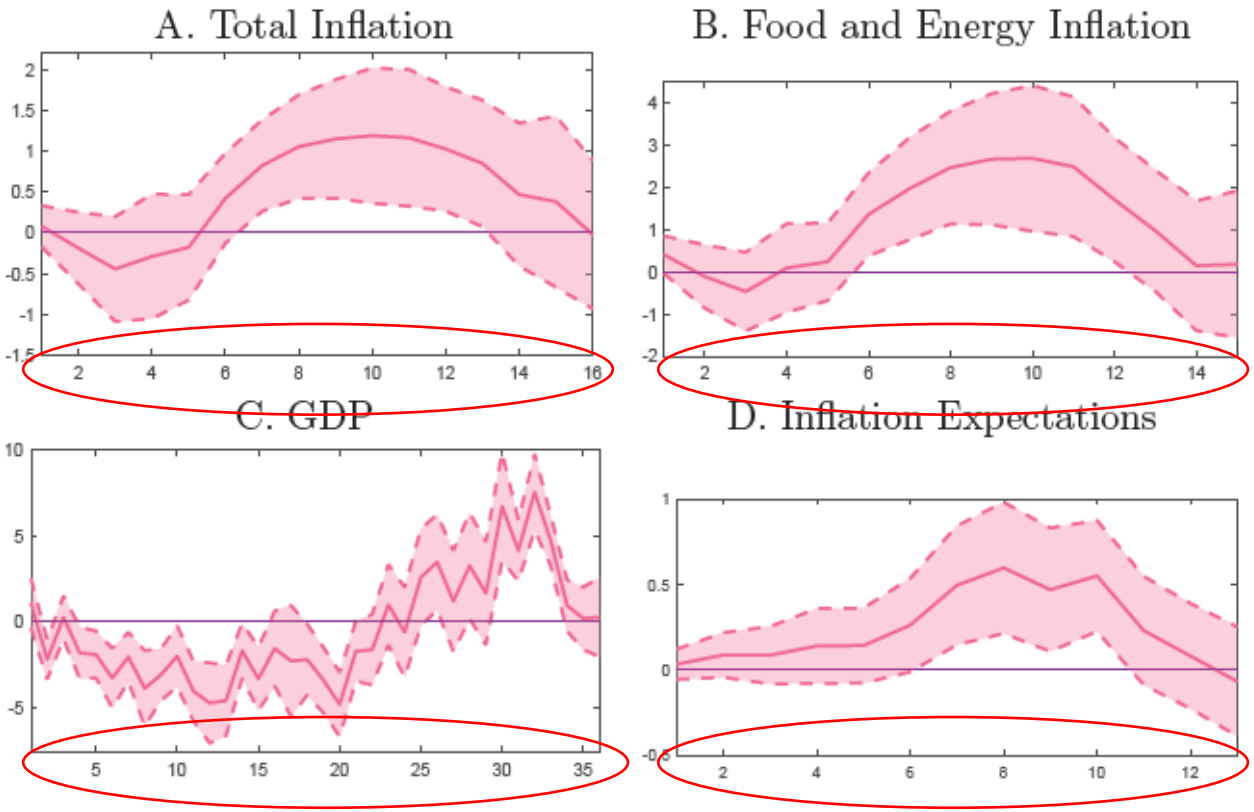
Figure 5. *Effects of Eli Nino on non-primary sector output*



- Four out of five non-primary sectors' output responds immediately negatively to the shock. Therefore, the impact on primary sectors' output is less immediate than that on non-primary sectors' output.
- The negative effects last up to 8 – 12 months.

Different horizons for local projections

Figure 3. *LP: Effects of El Niño on aggregate macroeconomic variables*



- The local projection horizon for aggregate GDP is up to 36 months, while that for inflation expectations is up to 13 months.
  - Why use/show different horizons?
- Also different horizons across panels in Figures 4 and 5 in the previous slides.

"Identified" El Nino shock vs its calibration for LP exercise

- The paper identifies an ICEN shock by using the residual $\hat{\varepsilon}_t$ from the following ARMA model

$$x_t = \rho_0 + \sum_{j=1}^{2} \rho_j x_{t-j} + \varepsilon_t + \sum_{j=1}^{3} \phi_j \varepsilon_{t-j} \text{ with } \varepsilon_t \sim \mathcal{N}(0, \sigma_\varepsilon^2), \quad (3.2)$$

and estimate the following specification

$$y_{t+h} = (1 - I_{t-1})[\alpha_{0,h} + \beta_{0,h}\hat{\varepsilon}_t + B_{0,h}X_t] + I_{t-1}[\alpha_{1,h} + \beta_{1,h}\hat{\varepsilon}_t + C_{1,h}X_t] + e_{t+h} \quad (3.3)$$

- Figure 3 shows the impulse responses to an ICEN shock calibrated to simulate an El Nino event that matches its historical average occurrence in terms of duration and magnitude
  - Footnote 2 says that the calibrated average ICEN shock has the duration of 9 months and the mean magnitude of 1.7°C.
- Historical average values of duration and magnitude are calculated from the actual value of the ICEN index, x_t.
  - Do we need to calibrate the shock differently, for example, by using the model in (3.2)?

Policy implications

- The paper says

  " … a more hawkish monetary policy … play a crucial role in stabilizing inflation dynamics in the presence of large-scale shocks like El Nino."

  "While inflation, core inflation and inflation expectations exhibit a slightly smaller response compared to a less aggressive monetary policy stance, … the output gap and FX depreciation show significantly more pronounced responses"

  "These findings underscore the importance of **carefully calibrating** monetary policy to minimize the adverse impacts on both inflation and real economic activity."
- The inflation-growth tradeoff due to supply shocks is well known.
- How to deploy monetary policy depends on the size of supply-shocks (as in the paper) and country characteristics (eg degree of inflation expectations anchoring, central bank mandate(s)) and thus on the shape of loss function.
- When supply shocks become structural (repeated) or persistent, it may be better not to rely on monetary policy but to use other longer-term policies.
- More importantly, how can we consider the role of other tools such as fiscal policy, macroprudential measures, etc (especially sectoral tools) to mitigate such tradeoffs?

Other comments

- In Figure 3, it will be good to show food inflation and energy inflation separately.
- It will be important to show the effect of Eli Nino on sectoral inflation by looking at corresponding CPI basket components in a similar way to Figures 4 and 5.
- Why use six lags of inflation and 12 lags of GDP growth as lagged dependent variable?
- In specification (3.1), control variables in inflation regression include lagged dependent variables, lagged ICEN index, oil price and US GDP.
  - How about including the exchange rate here?
  - Equation (4.5) includes imported inflation in domestic currency.
  - VAR in annex includes the exchange rate.
- What are "dummy variables" in vector X_t in sectoral GDP regressions?
- Better to use 90% confidence interval in Figures 3–5?