An Open-Economy DSGE Model with Nontradables and Remittances

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Outline

- Introduction
- Theoretical Structure
- Estimation and Results
- Concluding Remarks
Background, 1

- Traditional PH models (equation-by-equation OLS, ECM)
  - NEDA QMM
  - PIDS
  - Ateneo (AMFM), others

- Simultaneity bias, exogeneity issue
  - Estimates are biased and inconsistent
  - Increasing sample cannot cure bias in estimates

- Lucas (1976) critique
  - Coefficient estimates are not policy invariant
  - Lucas: conclusions and policy advice based on these models are invalid and misleading
Post Lucas critique. Now standard: modern, dynamic quantitative economics

- Dynamic stochastic general equilibrium (DSGE models)
- Microfoundations
- Explicitly specify behavior of rational agents
- Market clearing, rational expectations, dynamics

Bayesian estimation techniques: Priors plus Bayesian updating via Kalman filter; Markov Chain Monte Carlo
DSGE Cookbook

- Specify the model (consumers, firms, etc.)
- First-order conditions; these are expectational stochastic difference equations
- Stationarize/detrend
- Steady state of the model
- Log-linear deviations from the steady state
- Linear rational expectation model
- Bayesian estimation
- Dynare
- Analysis and interpretation, policy implications
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Theoretical Structure

- Acosta, Lartley, Mandelman (JIE 2009)
- Money in the utility function
- Consumption habits
- Capital and investment adjustment costs
- Sticky prices and wages
- Open-economy: exports, imports, exchange rate, etc.
- Remittances, Dutch disease
\[ E_0^j \sum_{t=0}^{\infty} \beta^t \left[ \zeta_t^c \ln(C_{j,t} - bC_{j,t-1}) - \zeta_t^h A_L \frac{(h_{j,t})^{1+\sigma_L}}{1+\sigma_L} + A_q \frac{(Q_{j,t}}{Z_t P_t})^{1-\sigma_q} \right] \]

\[ \zeta_t^c = \rho \zeta_t^c \zeta_{t-1}^c + \epsilon_t^c \]
\[ \zeta_t^h = \rho \zeta_t^h \zeta_{t-1}^h + \epsilon_t^h \]

\[ C_t = \left[ (1 - \omega_N)^{1/\eta_c} (C_{T,t})^{(\eta_c-1)/\eta_c} + \omega_N^{1/\eta_c} (C_{N,t})^{(\eta_c-1)/\eta_c} \right]^{\eta_c/(\eta_c-1)} \]

\[ C_{T,t} = \left[ (1 - \omega_m)^{1/\eta_T} (C_{T,t})^{(\eta_T-1)/\eta_T} + \omega_m^{1/\eta_T} (C_{m,t})^{(\eta_T-1)/\eta_T} \right]^{\eta_T/(\eta_T-1)} \]

Households, 1
Households, 2

\[ L = \left[ \frac{1}{\omega_N^{\eta_c}} (C_{N,t})^{\frac{\eta_c-1}{\eta_c}} + (1 - \omega_N) \frac{1}{\omega_c^{\eta_c}} (C_{T,t})^{\frac{\eta_c-1}{\eta_c}} \right]^{\frac{\eta_c}{\eta_c-1}} + \lambda_t \left[ P_{N,t} C_{N,t} + P_{T,t} C_{T,t} - P_t C_t \right] \]

\[ C_{N,t} = \frac{\omega_c}{1 - \omega_c} \left[ \frac{P_{N,T}}{P_{T,t}} \right]^{-\eta_c} C_{T,t} \]

\[ L = \left[ (1 - \omega_c)^{\frac{1}{\eta_c}} \left( C_{T,t}^{d} \right)^{\frac{\eta_c-1}{\eta_c}} + \omega_c^{\eta_c} (C_{T,t}^{m})^{\frac{\eta_c-1}{\eta_c}} + \right]^{\frac{\eta_c}{\eta_c-1}} + \lambda_t \left[ P_t C_t - P_t C_{T,t} - P_t^{m,c} C_{T,t}^{m} \right] \]

\[ C_{T,t}^{d} = (1 - \omega_m) \left[ \frac{P_{T,t}}{P_{T,t}^c} \right]^{-\eta_T} C_{T,t} \]

\[ C_{T,t}^{m} = \omega_m \left[ \frac{P_{T,t}^{m,c}}{P_{T,t}^c} \right]^{-\eta_T} C_{T,t} \]
\[
E_0^j \sum_{t=0}^{\infty} \beta^t \left[ \zeta_t^c \ln(C_{j,t} - bC_{j,t-1}) - \zeta_t^h A_L \frac{(h_{j,t})^{1+\sigma_L}}{1+\sigma_L} + A_q \frac{(\frac{Q_{j,t}}{Z_tP_t})^{1-\sigma_q}}{1+\sigma_q} \right]
\]
Households, 2

\[
\frac{\beta^t \zeta_t^c}{C_{j,t}} - \beta^t v_t P_t^c (1 + \tau_t^c) - E_t \beta^{t+1} \frac{\zeta_{t+1}^c b}{C_{j,t+1} - b C_{j,t}} = 0
\]

\[
\frac{\zeta_t^c}{C_{j,t}} - E_t \beta \frac{\zeta_{t+1}^c b}{C_{j,t} - b C_{j,t-1}} \frac{v_t P_t^c (1 + \tau_t^c)}{z_t} = 0
\]

\[
\frac{\zeta_t^c}{c_t - b c_{t-1} \frac{1}{\mu_{z,t}}} - b \beta E_t \frac{\zeta_{t+1}^c}{c_{t+1} \mu_{z,t+1} - b c_t} - \psi_{z,t} \frac{P_t^c}{P_t} (1 + \tau_t^c) = 0
\]
\[ M_{t+1} = -\psi_{z,t} + E_t \beta \left[ \frac{1}{\mu_{t+1}} \frac{1}{\pi_{t+1}} \right] \psi_{z,t+1} R_t - \beta E_t \left[ \frac{1}{\mu_{t+1}} \frac{1}{\pi_{t+1}} \right] \psi_{z,t+1} \tau_{t+1}^k (R_t - 1) = 0 \]

\[ \Delta_t = -\psi_t P_{k',t} + \omega_t = 0 \]

\[ K_{t+1} = -\psi_{z,t} P_{k',t} + \beta E_t \left( \frac{\psi_{z,t+1}}{\mu_{z,t+1}} \right) [P_{k',t+1} (1 - \delta) + (1 - \tau_{t+1}^k) r_{t+1}^k u_{j,t+1} + \left( a(u_{j,t+1}) \right)] = 0 \]

\[ I_{t+1} = -\psi_{z,t} \frac{P_{t+1}^i}{P_t} + \psi_{z,t} P_{k',t} Y_t F_1 + \beta E_t \left[ \frac{\psi_{z,t+1}}{\mu_{z,t+1}} P_{k',t+1} Y_{t+1} F_2 \right] = 0 \]
\[
I_t - \psi_{z,t} \frac{p_{t}^{i}}{p_{t}} + \psi_{z,t} P_{k',t} Y_{t} F_1 + \beta E_t \left[ \frac{\psi_{z,t+1}}{\mu_{z,t+1}} P_{k',t+1} Y_{t+1} F_2 \right] = 0
\]

\[
u_t \psi_{z,t} \left( (1 - \tau_{t}^{k}) r_{t}^{k} - \alpha'(u_t) \right) = 0
\]

\[
Q_t \zeta_t^q A_q q_t^{-\sigma_q} - (1 - \tau_{t}^{k}) \psi_{z,t} (R_{t-1} - 1) = 0
\]

\[
B_{t+1}^* - \psi_{z,t} S_t + \beta E_t \left[ \frac{\psi_{z,t+1}}{\mu_{z,t+1} \pi_{t+1}} \left( S_{t+1} R_t^* \Phi \left( a_t, \tilde{\Phi}_t \right) - \tau_{t+1}^k S_{t+1} (R_t^* \Phi \left( a_t, \tilde{\Phi}_t \right) - 1) - \tau_{t+1}^k (S_{t+1} - S_t) \right) \right] = 0
\]
\[ Y_{Nt} = \left[ \int_0^1 Y_{Ni,t} \frac{1}{\lambda_{N,t}} dN_i \right]^{\lambda_{N,t}} \]

\[ \lambda_{N,t} = (1 - \rho_N)\lambda_N + \rho \lambda_N \lambda_{N,t} + \varepsilon \lambda_{N,t} \]

\[ \frac{Y_{Ni,t}}{Y_{N,t}} = \left( \frac{P_{Ni,t}}{P_{N,t}} \right)^{\frac{\lambda_{N,t}}{\lambda_{N,t-1}}} \]

\[ \frac{Y_{Ni,t}}{Y_{N,t}} = \left( \frac{P_{Ni,t}}{P_{N,t}} \right)^{\frac{\lambda_{N,t}}{\lambda_{N,t-1}}} \]
\[ Y_{N_L \cdot t} = Z_{N_t \epsilon_t^N} H_{N_L \cdot t} - Z_{N_t \phi_N} \]

\[ \frac{Z_t^N}{Z_{t-1}^N} = \mu_{z,t}^N \]

\[ \mu_{z,t}^N = (1 - \rho_{\mu_z^N})\mu_z^N + \rho_{\mu_z^N}\mu_{z,t-1}^N + \epsilon_{z,t}^N \]

\[ \epsilon_t^N = \rho_{\epsilon_N} \epsilon_t^N + \epsilon_{\epsilon_{N,t}} \]
\[
\min_{W_t^N, R_t^f, H_{i,t}^N} W_t^N R_t^f H_{i,t}^N + \lambda_t^N P_{i,t}^N [Y_{i,t}^N - z_t^N \epsilon_t^N H_{i,t}^N + z_t^N \phi] \\
W_t R_t^f = \lambda_t^N P_{i,t}^N z_t^N \epsilon_t^N \\
mc_t^N = \lambda_t^N = \overline{w}_t R_t^f \frac{1}{\epsilon_t^N}
\]
\[
\max_{p_{t+1:n}} \sum_{s=0}^{\infty} (\beta \xi_d)^s v_{t+s} \left[ \left( (\pi_t \pi_{t+1} \ldots \pi_{t+s-1})^{k_d} (\pi_{t+1}^{c} \pi_{t+2}^{c} \ldots \pi_{t+s}^{c})^{1-k_d} p_t^{new} \right) \right] Y_{i,t+s} \\
- MC_{i,t+s} \left( Y_{i,t+s} + z_{t+s} \phi \right)
\]

\[
\max_{p_{i,t+s}} \sum_{s=0}^{\infty} (\beta \xi_d)^s v_{t+s} \left\{ p_{i,t+s} Y_{i,t+s} - MC_{i,t+s} [Y_{i,t+s} + z_{t+s} \phi] \right\}
\]

\[
\mathcal{L} = E_t \sum_{s=0}^{\infty} (\beta \xi_d)^s p_{t+s} v_{t+s} Y_{t+s} \left[ \left( X_{t,s} \tilde{\rho}_t \right)^{1-\frac{\lambda_{d,t+s}}{\lambda_{d,t+s} - 1}} - \frac{MC_{i,t+s}}{p_{t+s}} \cdot \left( X_{t,s} \tilde{\rho}_t \right)^{\frac{\lambda_{d,t+s}}{\lambda_{d,t+s} - 1}} - \frac{MC_{i,t+s}}{p_{t+s} Y_{t+s}} \cdot z_{t+s} \phi \right]
\]

\[
(\hat{n}_t - \hat{n}_t^c) = \frac{\beta}{1 + \kappa_d \beta} \left( E_t \hat{n}_{t+1} - \rho_{\pi} \hat{n}_t^c \right) + \frac{\kappa_d}{1 + \kappa_d \beta} \left( \hat{n}_{t-1} - \hat{n}_t^c \right)
\]

\[
\frac{\kappa_d \beta (1 - \rho_{\pi})}{1 + \kappa_d \beta} \hat{n}_t^c + \frac{(1 - \xi_d) (1 - \beta \xi_d)}{\xi_d (1 + \kappa_d \beta)} (\tilde{m}_g + \hat{\lambda}_{d,t})
\]
Government and Central Bank

\[ P_t G_t + TR_t = R_{t-1}(M_{t+1} - M_t) + \tau_t^c P_t^c C_t + \frac{(\tau_t^y + \tau_t^w)}{1 + \tau_t^w} H_t \]
\[ + \tau_t^k [(R_{t-1} - 1)(M_t - Q_t) + R_t^k u_t K_t + (R_{t+1} \Phi(a_{t-1}, \Phi_{t-1}) - 1)S_t B_t^s + \Pi_t] \]

\[ \Gamma_0 \tau_t = \Gamma(L) \tau_{t-1} + \varepsilon_{\tau,t} \quad \varepsilon_{\tau,t} \sim N(0, \Sigma_\tau) \]

\[ \hat{R}_t = \rho_R \hat{R}_{t-1} + (1 - \rho_R) \left( \hat{\pi}_t^c + r_c(\hat{\pi}_{t-1}^c - \hat{\pi}_t^c) + r_y \hat{y}_{t-1} + r_x \hat{x}_{t-1} \right) + r_{\Delta \pi} \Delta \hat{\pi}_t^c + r_{\Delta y} \Delta \hat{y}_t + \varepsilon_{R,t} \]

\[ \hat{\pi}_t^c = \left( (1 - \omega_N) (y^{T,c})^{(1-\eta_c)} \right) \hat{\pi}_t^T + \left( (\omega_N) (y^{N,c})^{(1-\eta_c)} \right) \hat{\pi}_t^N \]
Aggregate Resource Constraint

\[ C_{N,t} + C_t^d + I_t^d + G_t + C_t^\alpha + I_t^\alpha \leq \epsilon_t z_t^{1-\alpha} K_t^\alpha H_t^{1-\alpha} - z_t \phi - a(u_t) \bar{K}_t \]

\[
\omega_c T \left[ \frac{P_{\text{Total},t}}{P_{N,t}} \right]^{\eta_c T} C_{\text{Total},t} + (1 - \omega_c) \left[ \frac{P_t^c}{P_t} \right]^{\eta_c} C_{T,t} + (1 - \omega_i) \left[ \frac{P_t^i}{P_t} \right]^{\eta_i} I_t + G_t + \left[ \frac{P_t^*}{P_t^x} \right]^{\eta_f} C_t^* \\
+ \left[ \frac{P_t^*}{P_t^x} \right]^{\eta_f} I_t^* \\
\omega_{cT}(y^{T,N})^{\eta_{cT}} \frac{c_T}{y} (\hat{e}_{T,t} + \eta_{cT} \hat{y}_{T,N}^{T,N}) + [(1 - \omega_c)(y^{c,d})] \left( \frac{c}{y} \right) \hat{e}_t + [(1 - \omega_c)(y^{c,d})^{\eta_c}] \left( \frac{c}{y} \right) \eta_c \hat{y}_t^{i,d} \\
+ [(1 - \omega_i)(y^{i,d})^{\eta_i}] \left( \frac{i}{y} \right) \hat{i}_t + \\
[(1 - \omega_i)(y^{i,d})^{\eta_i}] \left( \frac{i}{y} \right) \hat{y}_t^{i,d} + \left( \frac{g}{y} \right) \hat{g}_t + \left( \frac{y^*}{y} \right) \left[ -\eta_f \hat{y}_t^{x,\alpha} + \hat{y}_t^\alpha + \hat{z}_t^\alpha \right] \]
Remittances

\[ E_t = P_{\text{mc}}^t \left( E_t^P + E_t^C \right) + P_{\text{mi}}^t \zeta_t^i \]

\[ \text{rem}_t^p \equiv \frac{E_t^p}{Z_t} = \left( \frac{Y_t}{Z_t} \right)^\zeta = (y_t \bar{z}_t)_{\zeta} \]

\[ \text{rem}_t^c \equiv \frac{E_t^c}{Z_t} = \left( \frac{Y_t}{Z_t} \right)^\eta = (y_t)_{\eta} \]

\[ \text{rem}_t^i \equiv \frac{E_t^i}{Z_t} = \left( \frac{Y_t}{Z_t} \right)^\eta = (y_t)_{\eta} \]
\[ \hat{\pi}_t^T = \hat{\pi}_t^c + \left( \frac{\beta}{1 + \kappa_T \beta} \right) (\hat{\pi}_{t+1}^T - \rho_\pi \hat{\pi}_t^c) + \left( \frac{\kappa_T}{1 + \kappa_T \beta} \right) (\hat{\pi}_{t-1}^T - \hat{\pi}_t^c) \]
\[ + \frac{(1 - \xi_T)(1 - \beta \xi_T)}{\xi_T (1 + \kappa_T \beta)} (\hat{mc}_t^T) + \hat{\lambda}_{d,t} - \frac{\kappa_T \beta (1 - \rho_\pi)}{1 + \kappa_T \beta} \frac{\hat{\pi}_t^c}{\hat{\pi}_t} \]

\[ \hat{\pi}_t^N = \hat{\pi}_t^c + \left( \frac{\beta}{1 + \kappa_N \beta} \right) (\hat{\pi}_{t+1}^N - \rho_\pi \hat{\pi}_t^c) + \left( \frac{\kappa_N}{1 + \kappa_N \beta} \right) (\hat{\pi}_{t-1}^N - \hat{\pi}_t^c) \]
\[ + \frac{(1 - \xi_N)(1 - \beta \xi_N)}{\xi_N (1 + \kappa_N \beta)} (\hat{mc}_t^N) + \hat{\lambda}_{N,t} - \frac{\kappa_N \beta (1 - \rho_\pi)}{1 + \kappa_N \beta} \frac{\hat{\pi}_t^c}{\hat{\pi}_t} \]

\[ \hat{\pi}_t^{mc} = \hat{\pi}_t^c + \frac{\beta}{1 + \kappa_{mc} \beta} (\hat{\pi}_{t+1}^{mc} - \rho_\pi \hat{\pi}_t^c) + \frac{\kappa_{mc}}{1 + \kappa_{mc} \beta} (\hat{\pi}_{t-1}^{mc} - \hat{\pi}_t^c) \]
\[ + \frac{(1 - \xi_{mc})(1 - \beta \xi_{mc})}{\xi_{mc} (1 + \kappa_{mc} \beta)} (\hat{mc}_t^{mc}) + \hat{\eta}_{mc} - \frac{\kappa_{mc} \beta (1 - \rho_\pi)}{1 + \kappa_{mc} \beta} \frac{\hat{\pi}_t^c}{\hat{\pi}_t} \]
\[ \hat{\pi}^m_{t,i} = \frac{\hat{\pi}^c_t}{1 + \kappa_{m,i} \beta} (\hat{\pi}^m_{t+1} - \rho_n \hat{\pi}^c_t) + \frac{\kappa_{m,i}}{1 + \kappa_{m,i} \beta} (\hat{\pi}^m_{t-1} - \hat{\pi}^c_t) \]

\[ + \frac{(1 - \xi_{m,i})(1 - \beta \xi_{m,i})}{\xi_{m,i}(1 + \kappa_{m,i} \beta)} (\hat{m_c}^m_{t,i}) + \hat{\eta}_{m,c} - \frac{\kappa_{m,i} \beta (1 - \rho_\pi)}{1 + \kappa_{m,i} \beta} \frac{\hat{\pi}^c_t}{1 + \kappa_{m,i} \beta} \]

\[ \hat{\pi}^c_t = \left( (1 - \omega_c)(\gamma^{c,d} - (1 - \eta_c)) \right) \hat{\pi}^d_t + \left( (\omega_c)(\gamma^{c,mc} - (1 - \eta_c)) \right) \hat{\pi}^{m,c}_t \]

\[ \hat{\pi}^x_t = \frac{\hat{\pi}^c_t}{1 + \kappa_x \beta} (\hat{\pi}^x_{t+1} - \rho_n \hat{\pi}^c_t) + \frac{\kappa_x}{1 + \kappa_x \beta} (\hat{\pi}^x_{t-1} - \hat{\pi}^c_t) \]

\[ + \frac{(1 - \xi_x)(1 - \beta \xi_x)}{\xi_x(1 + \kappa_x \beta)} (\hat{m_c}^x_t) + \hat{\lambda}_{x,t} - \frac{\kappa_x \beta (1 - \rho_\pi)}{1 + \kappa_x \beta} \frac{\hat{\pi}^c_t}{1 + \kappa_x \beta} \]
\[
\hat{\bar{w}}_t = -\frac{1}{\eta_1} \left[ \eta_0 \hat{\bar{w}}_{t-1} + \eta_2 \hat{\bar{w}}_{t+1} + \eta_3 \hat{\pi}_t^d + \eta_4 \hat{\pi}_{t+1}^d + \eta_5 \hat{\pi}_{t-1}^c + \eta_6 \hat{\pi}_t^c \right] \\
\hat{c}_{TOTAL, t} = -\left( \frac{1}{\mu_z^2 + b^2 \beta} \right) \left[ -b \beta \mu_z \hat{c}_{t+1} - b \mu_z \hat{c}_{t-1} + b \mu_z (\hat{\mu}_{z,t} - \beta \hat{\mu}_{z,t+1}) \\
+ (\mu_z - b \beta) (\mu_z - b) \hat{\psi}_{t,t} + \frac{\gamma^c}{1 + \tau^c} (\mu_z - b \beta) (\mu_z - b) \hat{\xi}_t^c \\
+ (\mu_z - b \beta) (\mu_z - b) \hat{\xi}_{t+1}^c - (\mu_z - b) (\mu_z \hat{\xi}_t^c - b \beta \hat{\xi}_{t+1}^c) \right] \\
\hat{c}_t^d = \eta_c \hat{\gamma}_{t}^{c,d} + \hat{c}_t \\
\hat{i}_t^d = \eta_i \hat{\gamma}_{t}^{i,d} + \hat{i}_t \\
\hat{\epsilon}_t^{m} = -\eta_c (1 - \omega_c) (\nu^{c,d}) - (1 - \eta_c) \hat{\gamma}_t^{mc,d} + \hat{\epsilon}_t \right)
\]
\[
\begin{align*}
\hat{c}_t^{TRAD} &= \left[ (1 - \omega_m)^{1/\eta_T} \left( \frac{c^d}{c} \right)^{(\eta_T^{-1})/\eta_T} \right] \hat{c}_t^d + \left[ \omega_m^{1/\eta_T} \left( \frac{c^m}{c} \right)^{(\eta_T^{-1})/\eta_T} \right] \hat{c}_t^m \\
\left[ \omega_N^{1/\eta_c} \left( \frac{c^N}{cT} \right)^{(\eta_cT^{-1})/\eta_cT} \right] \hat{c}_t^N &= \hat{c}_{TOTAL,t} - \left[ (1 - \omega_N)^{1/\eta_cT} \left( \frac{c^{TRAD}}{cT} \right)^{(\eta_cT^{-1})/\eta_cT} \right] \hat{c}_t^T \\
\hat{c}_{N,t} &= \hat{c}_{N,t} \\
\hat{i}_t &= \left[ \frac{1}{(\bar{s}'' \mu_2^2)(1 + \beta)} \right] \left[ (\bar{s}'' \mu_2^2)(\hat{i}_{t-1} + \beta \hat{i}_{t+1} - \hat{\mu}_z + \beta \hat{\mu}_{z,t+1}) + \tilde{P}_{k',t} + \tilde{Y}_t - \hat{Y}_t^{i,d} \right] \\
\hat{\psi}_{z,t} &= \hat{\psi}_{z,t+1} - \hat{\mu}_{z,t+1} + \frac{1}{\mu_t} \left( \mu_t - \beta_t \tau_t^k \right) \hat{R}_t - \hat{\mu}_{z,t+1}^d + \frac{1}{\mu_t} \left( \frac{\tau_t}{1 - \tau_t} \right)(\beta_t - \mu_t) \hat{t}_{t+1}^k
\end{align*}
\]
\[ \dot{P}_{k', t} = -\dot{\psi}_{z, t} - \dot{\mu}_{z, t+1} - \ddot{\psi}_{z, t+1} + \left( \frac{\beta(1-\delta)}{\mu_z} \right) \dot{P}_{k', t+1} \]

\[ - \left( \frac{\tau_t}{1 - \tau_t^k} \right) \left( \frac{\mu_z - \beta(1-\delta)}{\mu_z} \right) \dot{\xi}_{t+1}^k + \left( \frac{\mu_z - \beta(1-\delta)}{\mu_z} \right) \dot{\xi}_{t+1}^k \]

\[ \text{RiskP} = \left( (1 - \phi_s)\Delta \hat{S}_{t+1} - \phi_s \Delta \hat{S}_t - (\tilde{R}_t - \tilde{R}_t^*) - \phi_t \alpha \hat{a}_t + \tilde{\phi}_t \right) - \left( \Delta \hat{S}_{t+1} - (\tilde{R}_t - \tilde{R}_t^*) \right) \]

\[ \bar{H}_{T,t}[\lambda_d(1 - \alpha)] = \begin{bmatrix}
(1 - \omega_c)\gamma_{c,d}^\epsilon \frac{\epsilon_c}{y} \left( \hat{c}_t + \eta_c \tilde{v}_{t}^{c,d} \right) \\
(1 - \omega_i)\gamma_{i,d}^\gamma \frac{\gamma_i}{y} \left( \hat{i}_t + \eta_i \tilde{v}_{t}^{i,d} \right) + \frac{g}{y} \hat{g}_t + (\gamma_f^\eta_f \gamma^* \frac{y^*}{y} \left( \tilde{v}_{t}^* - \eta_f \tilde{v}_{t}^{x,*} + \tilde{z}_{t}^* \right) \\
(1 - \tau^k) \gamma^k \frac{\gamma}{y} \frac{1}{\mu_z} \left( \tilde{k}_t - \tilde{k}_{t-1} \right) - \lambda_d \epsilon_t - \lambda_d \alpha (\tilde{k}_t - \tilde{\mu}_{z,t})
\end{bmatrix} \]
\[ \hat{y}_{N,t} = \omega_N (y_{TC,N}^T) \eta_{CT} \frac{cT}{y} (\hat{\xi}_{T,t} + \eta_{CT} \hat{y}_{T,t}^{TC,N}) \]

\[ \hat{y}_t = \frac{y_T}{y} y_{T,t} (\hat{\xi}_t^{T,t} + \hat{y}_{T,t}^{T,t}) + \frac{y_N}{y} y_{N,t} (\hat{\xi}_t^{N,t} + \hat{y}_{N,t}^{N,t}) \]

\[ \hat{y}_t^{T,t} - \hat{y}_{t-1}^{T,t} = \hat{\eta}_{T,t} - \hat{\eta}_t \]

\[ \hat{\eta}_t = (1 - w) y_t^{T,t} \hat{\xi}_t^{T,t} \hat{\eta}_t + w y_t^{N,t} \hat{\xi}_t^{N,t} \hat{\eta}_t \]
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Impulse responses to a government spending shock
Impulse Response of Total Remittances, 3

- Foreign variables also affect remittances. Consider foreign inflation shock. A positive shock will result in an increase in remittances. It certainly is more favourable in countries where monetary policy aims to maintain price stability.

- In contrast, the effect of foreign output shocks is to reduce remittances.
Impulse responses to a foreign inflation shock
Impulse responses to a foreign output shock
Impulse Response of Remittances, by Components, 1

- Sector specific stationary technological shocks appear to have divergent effects on remittance components. A positive shock in the tradable sector appears to induce increases in all remittance components.

- On the other hand, if the shock emanates from the nontradable sector, robust negative effects are observed instead.

- Unit root technological shocks robustly cause a decline in countercyclical.
Impulse responses to a stationary tradable sector specific technology shock
Impulse responses to a stationary nontradable sector – specific technology shock
Impulse responses to a unit root technology shock
Impulse Response of Remittances, by Components, 2

- When there is a positive government spending shock, all remittance components are affected negatively.
- As expected, a consumption preference shock will increase remittances via its procyclical and countercyclical components but the effect diminishes quickly. The strategic component does not react positively to such as shock at all.
Impulse responses to a consumption preference shock
Impulse responses to a labor supply preference shock
Investment specific shocks indicate that the positive over-all effect on total remittances come consistently from the strategic component. The Figure shows that there is a very sizable increase in remittances after the occurrence of the shock.

Mark-up shocks in the tradable goods sector induce a reduction in strategic remittances but causes an increase in countercyclical remittances.
Impulse responses to an investment specific shock
Impulse responses to domestic (tradable) markup shock
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Concluding Remarks
Concluding Remarks

In this paper, we augment the existing Open Economy DSGE model of ALLV by distinguishing the nontradable and tradable sectors and including remittances. This makes our model more stylized given the fact that the Philippines remain as one of the top remittance – receiving countries in the world.
Concluding Remarks

- We estimated the dynamics of various macroeconomic variables after individually considering exogenous shock processes. We focused our analysis on the response of remittances to shock processes. This is an important undertaking because of the role remittances play in stabilizing foreign exchange markets and providing support to economic activities involving households and firms.
Concluding Remarks

While the model appears to capture fairly well some stylized facts, we recognize that there are some inadequacies.

- First, the paper did not define a stochastic process for remittances.
- Second, the impulse response functions, while informative, were based on stochastic simulation methods, not actual data.
- Third, the model made the assumption that while there are two sectors with their own production processes for their respective intermediate goods firms, there is only one real wage which implies total labor was the one considered.
Concluding Remarks

While the model appears to capture fairly well some stylized facts, we recognize that there are some inadequacies.

- Fourth, the model assumes that households have access to capital markets, which may not be reflective of the real situation as other households can be classified as rule–of–thumb households.

- Fifth, the model does not integrate the financial markets and its various agents, thereby ignoring financial frictions as one probable cause of economic fluctuations.
Thank You!