Foreign Exchange Interventions in the New-Keynesian Model: Transmission, Policy, and Welfare

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June 27, 2024

The views expressed in this presentation are solely my own and they do not necessarily reflect those of the Bank of Israel.

Motivation and Objectives

Motivation: About 75% of the inflation targeters practice some form of foreign exchange interventions (FXIs), IMF (2022).

Objective: Explore the theoretical foundations for using FXIs, alongside the monetary interest rate:

- Study the transmission mechanism of FXIs
- Solve for the optimal policy and suggest an implementable policy rule
- Evaluate the welfare gains from using FXIs

Main Results

- Transmission: **Portfolio balance channel.** FX purchases depreciate the domestic currency and raise effective returns:
  - Exports ↑
  - Domestic demand ↓
  - Expansionary effect on labor and GDP hinges on wealth effect on labor supply.

- Policy Rule: Stabilize the UIP premium

- Welfare: Lifetime welfare gains of up to 2.4% of annual consumption ($\approx$ NIS 5,070 per household, 2022)

- Effectiveness: FXIs stabilize the economy from the effects of both financial and real shocks

- Robustness: Results are robust to a variety of financial frictions

Literature and Contribution

A growing literature studies the theoretical foundations of FXIs.

- Cost due to foreigners exploiting UIP deviations: Cavallino (2019), Amador et al. (2020), Fanelli and Straub (2021)
- Exclusive focus on financial shocks: Cavallino (2019), Alla et al. (2020), Chen et al (2023)
- FXI Policy rules:
  - Output gap and inflation: Benes et al. (2015), Faltermeier et al. (2022)
  - Exchange rate: Chen et al (2023)
  - UIP premium: Adrian et al (2021), Itskhoki and Mukhin (2023)

Potential contributions:

- FXIs as a macroeconomic stabilizer
- UIP premium stabilization (when is strict targeting optimal?)
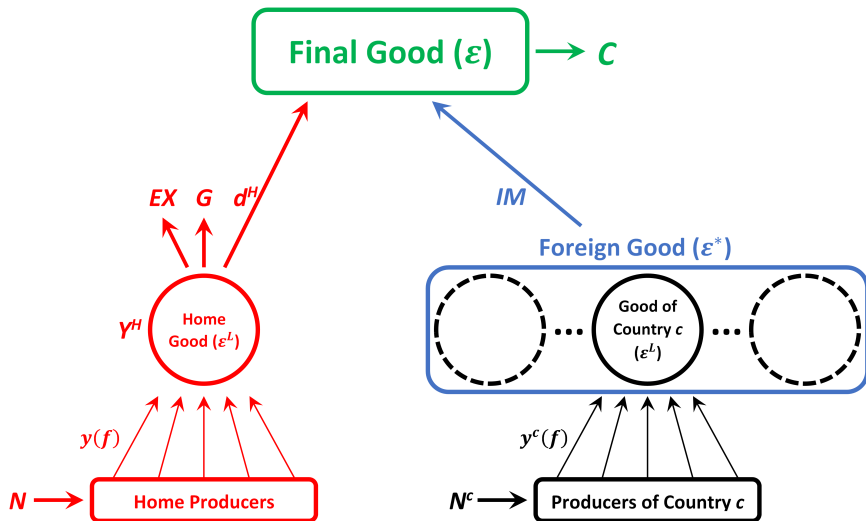- Welfare evaluation
- Robust analysis

Outline

Outline

The Basic Structure

The model is a variant of Gali and Monacelli (2005) with:

- A continuum of countries
- Financial friction: portfolio adjustment cost
- Foreign reserves
- Price and wage rigidities
- Agents: households, firms and a government

The Portfolio Adjustment Cost

Portfolio adjustment cost:

$$\Theta\left(\widehat{b}_t^{*,HH}(h) - \widehat{\theta}_t^*\right)$$

$$\Theta\left(\cdot\right) \geq 0 \qquad, \qquad \Theta\left(0\right) = \Theta'\left(0\right) = 0 \qquad, \qquad \Theta''\left(\cdot\right) > 0$$

where $b_t^{*,HH}(h)$ denotes foreign assets position of household h, and θ_t^* is an exogenous aggregate shock. "Hatted" variables denote values relative to steady-state *annual* GDP.

θ_t^* is interpreted as a "risk-premium" shock. A rise in θ_t^* requires households to raise $b_t^{*,HH}(h)$ in order avoid the cost.

The Portfolio Adjustment Cost (continued)

Remarks:

- Technical necessity:
  - With no financial friction the UIP holds and FXIs are ineffective, Wallace (1981), Backus and Kehoe (1989), Cúrdia and Woodford (2011).
  - A friction is required for imposing stationarity, Schmitt-Grohé and Uribe (2003).

- A fraction ϑ of the cost is rebated lump sum to domestic agents (ownership share of the financial sector). I assume $\vartheta \to 1$.

- To a first order approximation this modelling strategy is isomorphic to models with richer micro foundations such as Gabaix and Maggiori (2015), Fanelli and Straub (2021), Itskhoki and Mukhin (2021), Uribe and Yue (2006).

- Empirical relevance: Helps reconciling many exchange rate puzzles, Gabaix and Maggiori (2015), Itskhoki and Mukhin (2021).

Portfolio Choice and the UIP

The optimality conditions for home and foreign bonds:

$$U_{C_t} = \beta \left(1 + i_t\right) E_t \left\{ U_{C_{t+1}} \frac{1}{\pi_{t+1}} \right\}$$

$$U_{C_t} = \beta \frac{1 + i_t^*}{1 + \frac{\Theta'\left(\widehat{b}_t^{*,HH} - \widehat{\theta}_t^*\right)}{Y_{ss}^{H,An.}}} E_t \left\{ U_{C_{t+1}} \frac{\sigma_{t+1}}{\pi_{t+1}} \right\}$$

Remarks:

- Generally, the effective return on foreign bonds deviates from i^*
- $\Theta'\left(\widehat{b}_{ss}^{*,HH} - \widehat{\theta}_{ss}^*\right) = \Theta'(0) = 0 \Rightarrow$ no deviation in steady-state
- $\Theta''(\cdot) > 0 \Rightarrow \widehat{b}_t^{*,HH} \uparrow$ the effective return falls
- The *modified* UIP condition (log-linearized):

$$\widetilde{(1 + i_t)} \cong \widetilde{(1 + i_t^*)} + E_t \left\{ \widetilde{\sigma}_{t+1} \right\} \underbrace{- \frac{\Theta''(0)}{Y_{ss}^{H,An.}} \cdot \left(\widehat{b}_t^{*,HH} - \widehat{\theta}_t^*\right)}_{\text{UIP premium}}$$

Outline

Transmission of FXIs: Key Equations

The balance of payments:

$$FX_t + Y_{ss}^{H,An.}\widehat{b}_t^{*,HH} = TOT_t EX_t - IM_t + EXOG_t$$

A purchase of foreign reserves ($FX_t \uparrow$) can be financed by reducing private holdings of foreign assets ($\widehat{b}_t^{*,HH} \downarrow$) and/or a rise in net exports ($TOT_t EX_t - IM_t \uparrow$). **In equilibrium both happen.**

The Euler equation for foreign assets:

$$U_{IM_t} = \beta \frac{1 + i_t^*}{1 + \frac{1}{Y_{ss}^{H,An.}}\Theta'\left(\widehat{b}_t^{*,HH} - \widehat{\theta}_t^*\right)} E_t \left\{ \frac{U_{IM_{t+1}}}{\pi_{t+1}^{F*}} \right\}$$

Recall that $\Theta''(\cdot) > 0$, therefore: $\widehat{b}_t^{*,HH} \downarrow \Rightarrow \Theta'(\cdot) \downarrow \Rightarrow$ effective return$\uparrow$ $\Rightarrow$ intertemporal substitution.

Outline

Optimal Policy and the Tinbergen Rule

For some policy instruments:

$$\text{No Friction} \implies \text{No Traction}$$

$$\text{Friction} \implies \text{Distortion} \implies \text{Policy}$$

Optimal policy seeks to restore the frictionless equilibrium $\Rightarrow$ UIP premium targeting

Tinbergen rule:

$$\text{\# Frictions} = \text{\# Instruments} \implies \text{Strict Targeting}$$

Optimal Policy and FXI Policy Rule

Optimal policy:

- Choose interest rate, i_t, and foreign reserve, FX_t, to maximize welfare, s.t. equilibrium conditions.
- Welfare is measured using aggregate utility across households.

Policy Rule:

Stabilize the UIP premium while smooth foreign reserves:

$$\frac{FX_t}{FX^T} = \left(1 + \frac{\Theta'\left(\widehat{b}_t^{*,HH} - \widehat{\theta}_t^*\right)}{TOT_{ss} Y_{ss}^{H,An.}}\right)^{\Xi} \left(\frac{FX_{t-1}}{FX^T}\right)^{\rho_{FX}}$$

where $\quad \Xi \gg 0 \quad, \quad 0 \leq \rho_{FX} < 1$

In the first parentheses is the *inverse* of the gross UIP premium.
I use $\Xi = 20$ and $\rho_{FX} = 0.9$.

FXIs Against Financial Shocks

FXIs can insulate the economy from the effect of financial shocks (capital flows and risk-premium shocks).
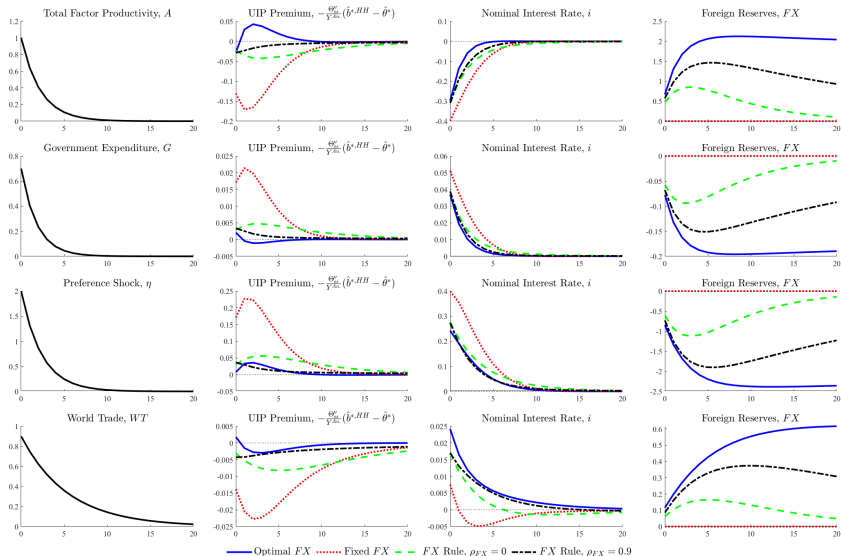
The balance of payments:

$$FX_t + Y_{ss}^{H,An.} \widehat{b}_t^{*,HH} = TOT_t EX_t - IM_t + EXOG_t$$

where $EXOG_t$ includes capital flow shocks.

The Euler equation for foreign assets:

$$U_{IM_t} = \beta \frac{1 + i_t^*}{1 + \frac{1}{Y_{ss}^{H,An.}} \Theta' \left(\widehat{b}_t^{*,HH} - \widehat{\theta}_t^* \right)} E_t \left\{ \frac{U_{IM_{t+1}}}{\pi_{t+1}^{F*}} \right\}$$

Non-Financial Shocks (with Optimal Monetary Policy)
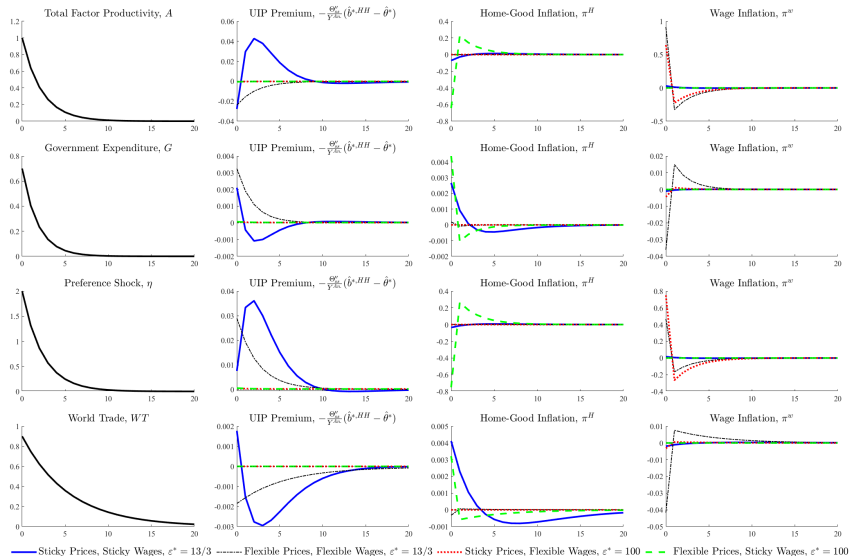
Tinbergen rule:

Frictions $=$ # Instruments $=>$ Strict Targeting

Instruments: Interest rate and FXI

Distortions:

- Price rigidity
- Wage rigidity
- Portfolio adjustment cost $\Rightarrow$ Financial friction
- Downward sloping demand for exports: $EX_t = TOT_t^{-\varepsilon^*} WT_t$
  $\Rightarrow$ Monopolistic power in the global markets, while producers of Y^H are price takers
  $\Rightarrow$ Incentive to manipulate the terms of trade

Optimal Reaction to Non-Financial Shocks

Sticky Prices, Sticky Wages, $\varepsilon^* = 13/3$ ——— Flexible Prices, Flexible Wages, $\varepsilon^* = 13/3$ ········· Sticky Prices, Flexible Wages, $\varepsilon^* = 100$ ·········· Flexible Prices, Sticky Wages, $\varepsilon^* = 100$ - - -

Outline

Welfare Gains from Using Optimal FXIs

Percent of steady-state annual consumption

	Fixed FX		FX Rule			
			$\rho_{FX} = 0$		$\rho_{FX} = 0.9$	
	NR	*RE*	*NR*	*RE*	*NR*	*RE*
Productivity, A	0.56	0.40	0.25	0.16	0.05	0.02
Preference shock, η	0.64	0.70	0.25	0.28	0.03	0.04
Government expenditure, G	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
World trade, *WT*	0.03	0.03	0.01	0.01	< 0.01	< 0.01
Risk premium, $\widehat{\theta}^*$	0.34	0.40	0.03	0.04	< 0.01	< 0.01
Capital inflows, $\widehat{\phi}^*$	0.87	0.91	0.27	0.27	0.03	0.04
All shocks	**2.44**	2.44	**0.81**	0.77	**0.12**	0.10

NR = Nominal Rigidities
RE = Real Economy

Welfare Gains from Owning the Financial Sector

Percent of steady-state annual consumption

Ownership of the financial sector, ϑ:	90%	50%	0%
Productivity, A	0.13	0.29	0.37
Preference shock, η	0.16	0.35	0.46
Government expenditure, G	< 0.01	< 0.01	< 0.01
World trade, WT	0.01	0.02	0.02
Risk premium, $\widehat{\theta}^*$	0.03	0.12	0.21
Capital inflows, $\widehat{\phi}^*$	0.17	0.42	0.58
All shocks	**0.50**	**1.19**	**1.65**

Conclusion: Main Takeaways

Transmission:

- FXIs work by crowding out private sector's holdings of foreign assets, thereby affecting their effective return (UIP premium).
- Purchase of foreign reserves contracts households' demand and expands exports.
- Expansionary effect on employment and output hinges on wealth effect on labor supply.

Policy:

- Stabilize the UIP premium to support efficient asset pricing.
- Effective in insulating the economy against financial shocks.

Welfare:

- Lifetime welfare gains of up to 2.4% of annual consumption ($\approx$ NIS 5,070 per household, 2022)

Conclusion: Caveats

- Some deviations from the UIP may be efficient, e.g. default risk.
- Similar to inflation targeting, the CB should "look through" some UIP deviations and react to other.
- Empirical work for estimating and decomposing the UIP premium is needed.

Thank You!

Adrian, T., Erceg, C., Kolasa, M., Linde, J., Zabczyk, J., 2021. "A Quantitative Microfounded Model for the Integrated Policy Framework." *IMF Working Papers* WP/21/292.

Alla, Z., Espinoza, R. A., Gosh, A. R., 2020. "FX Intervention in the New Keynesian Model." *Journal of Money, Credit and Banking* 52(7), pp. 1755-1791.

Amador, M., Bianchi, J., Bocola, L., Perri, F., 2020. "Exchange Rate Policies at the Zero Lower Bound." *The Review of Economic Studies* 87(4), pp. 1605-1645.

Backus, D. K., Kehoe, P. J., 1989. "On the Denomination of Government Debt: A Critique of the Portfolio Balance Approach." *Journal of Monetary Economics* 23(3), pp. 359–376.

Benes, J., Berg, A., Portillo, R. A., Vavra, D., 2015. "Modeling Sterilized Interventions and Balance Sheet Effects of Monetary Policy in a New-Keynesian Framework." *Open Economy Review* 26(1), pp. 81-108.

📄 Cavallino, P. 2019. "Capital Flows and Foreign Exchange Intervention." *American Economic Journal: Macroeconomics* 11(2), pp. 127-170.

📄 Chen, K., Kolasa, M., Linde, J., Wang, H., Zabczyk, P., Zhou, J., 2023. "An Estimated DSGE Model for Integrated Policy Analysis." *IMF Working Papers* WP/23/135.

📄 Cúrdia, V., Woodford, M., 2011. "The Central-Bank Balance Sheet As An Instrument of Monetary Policy." *Journal of Monetary Economics* 58(1), pp. 54-79.

📄 Faltermeier, J., Lama, R., Medina, J. P., 2022. "Foreign Exchange Intervention for Commodity Booms and Busts." *European Economic Review* 143, 104018.

📄 Fanelli, S., Straub, L., 2021. "A Theory of Foreign Exchange Interventions." *The Review of Economic Studies* 88(6), pp. 2857-2885.

Gabaix, X., Maggiori, M., 2015. "International Liquidity and Exchange Rate Dynamics." *The Quarterly Journal of Economics* 130(3), pp. 1369-1420.

Gali, J., Monacelli, T., 2005. "Monetary Policy and Exchange Rate Volatility in a Small Open Economy." *Review of Economic Studies* 72(3), pp. 707–734.

International Monetary Fund, 2022. "Annual Report on Exchange Arrangements and Exchange Restrictions 2021." *Washington, DC: IMF.*

Itskhoki, O., Mukhin, D., 2021. "Exchange Rate Disconnect in General Equilibrium." *Journal of Political Economy* 129(8), pp. 2183-2232.

Itskhoki, O., Mukhin, D., 2023. "Optimal Exchange Rate Policy." Mimeo.

Schmitt-Grohé, S., Uribe, M., 2003. "Closing Small Open Economy Models." *Journal of International Economics* 61(1), pp. 163-185.

Uribe, M., Yue, V. Z., 2006. "Country Spreads and Emerging Countries: Who Drives Whom?" *Journal of International Economics* 69(1), pp. 6-36.

Wallace, N., 1981. "A Modigliani-Miller Theorem for Open-Market Operations." *American Economic Review* 71(3), pp. 267-274.