Currency Manipulation

Tarek A. Hassan
University of Chicago, NBER and CEPR

Thomas M. Mertens
Federal Reserve Bank of San Francisco

Tony Zhang
University of Chicago

WCWIF – November 3, 2017

Motivation

- Highly persistent differences in interest rates across developed economies:
  - account for majority of carry trade anomaly. (Lustig & al. 2011, Hassan & Mano 2015)
  - correlate with equally persistent differences in K/Y ratios. (Hassan, Mertens, Zhang 2015)
- Risk-based view of these "unconditional" differences in currency returns: **Currencies with low interest rates pay lower returns because they tend to appreciate in "bad" times.**
  - Various views of what makes a currency appreciate in bad times: *country size* (Hassan 2013, Martin 2012), financial development (Maggiori 2013), resilience to disaster risk (Farhi & Gabaix 2015), etc.

Motivation

- Highly persistent differences in interest rates across developed economies:
  - account for majority of carry trade anomaly. (Lustig & al. 2011, Hassan & Mano 2015)
  - correlate with equally persistent differences in K/Y ratios. (Hassan, Mertens, Zhang 2015)
- Risk-based view of these "unconditional" differences in currency returns: **Currencies with low interest rates pay lower returns because they tend to appreciate in "bad" times.**
- Various views of what makes a currency appreciate in bad times: *country size* (Hassan 2013, Martin 2012), financial development (Maggiori 2013), resilience to disaster risk (Farhi & Gabaix 2015), etc.
- This paper: **interventions in currency markets that change the stochastic properties of exchange rates should change interest rates, expected returns on currencies, and allocation of capital across countries.**

Motivation

- Highly persistent differences in interest rates across developed economies:
  - account for majority of carry trade anomaly. (Lustig & al. 2011, Hassan & Mano 2015)
  - correlate with equally persistent differences in K/Y ratios. (Hassan, Mertens, Zhang 2015)
- Risk-based view of these "unconditional" differences in currency returns: **Currencies with low interest rates pay lower returns because they tend to appreciate in "bad" times.**
  - Various views of what makes a currency appreciate in bad times: *country size* (Hassan 2013, Martin 2012), financial development (Maggiori 2013), resilience to disaster risk (Farhi & Gabaix 2015), etc.
- This paper: **interventions in currency markets that change the stochastic properties of exchange rates should change interest rates, expected returns on currencies, and allocation of capital across countries.**

$\Rightarrow$ Policies that make your currency appreciate in bad times lower your interest rate and increase capital accumulation.

General Argument on one Slide

Risk-based view of unconditional violations of UIP:

- A country's CPI depends on a the world price of traded goods, λ_T, and a country-specific shock x^f.

$$p^f = a\lambda_T - bx^f$$

- The log real exchange rate is

$$s^{f,h} = p^f - p^h$$

- Consumption Euler equation: country that appreciates in bad times has a lower interest rate and accumulates more capital. UIP fails.

$$r^f + \mathbb{E}\Delta s^{f,h} - r^h = cov\left(\lambda_T, p^h - p^f\right)$$

General Argument on one Slide

Risk-based view of unconditional violations of UIP:

- A country's CPI depends on a the world price of traded goods, λ_T, and a country-specific shock x^f.

$$p^f = a\lambda_T - bx^f + \pi\lambda_T$$

- The log real exchange rate is

$$s^{f,h} = p^f - p^h$$

- Consumption Euler equation: country that appreciates in bad times has a lower interest rate and accumulates more capital. UIP fails.

$$r^f + \mathbb{E}\Delta s^{f,h} - r^h = cov\left(\lambda_T, p^h - p^{f*}\right) - \pi\sigma^2_{\lambda_T}$$

General insight:

- A policy that alters the covariance between p^f and λ_T can alter interest rates, currency returns, and the allocation of capital across countries.
- Illustrate implications with an application to exchange rate stabilization.

Exchange rate stabilization

Three facts:

1. **88% of countries stabilize their exchange rates relative to some target currency** Reinhart & Rogoff (2007)
   - Exchange rate stabilization: set of policies that reduce the variance of the real exchange rate relative to a target country without distorting the level.
   - Not sure if they also manipulate the level, but certainly the variance.
   - Examples: China, India, Singapore, Denmark...
2. **Almost all stabilizations are relative to the US dollar.**
3. **Most small economies stabilize their exchange rate while most large economies do not.**

- We provide a framework that rationalizes these facts.

Setup (1/2)

- Time periods $1, 2$; Countries $n = \{m, t, o\}$
- Continuum of households $i \in [0, 1]$ of which measure θ^m live in the "stabilizing country", θ^t live in the "target" country, and θ^o live in an "outside" country.
- CRRA utility over consumption in time=2

$$U(i) = E\left[\frac{1}{1-\gamma} C(i)^{1-\gamma}\right]$$

- Final consumption bundle is country-specific

$$C(i) = C_T(i)^{\tau} C_N(i)^{1-\tau}$$

- At time 2, each household has access to a technology that uses capital and (one unit of) labor in the production of the **non-traded good**

$$Y_N^n = \exp[\eta^n] (K^n)^{\nu}$$

where $\eta^n \sim N(0, \sigma^2)$.

Setup (2/2)

- At time 1, each household is endowed with one unit of the traded good and one unit of capital.
- Capital can be freely shipped internationally only at time 1.
- **Complete set of Arrow-Debreu securities is traded**.

Model solution:

- Choose the homogeneous traded good as numéraire.
- Log-linearize, lowercase variables denote logs.

Freely Floating Exchange Rates (1/2)

- Equilibrium variables under freely floating regime denoted with $*$.
- Households ship traded goods to share risk

$$c_T^{n*} = \frac{(\gamma-1)(1-\tau)}{1+(\gamma-1)\tau}\left(\sum_{j=1}^{N}\theta^j y_N^j - y_N^n\right)$$

- Marginal utility from traded consumption equalized across countries

$$\lambda_T^* = -(1-\tau)(\gamma-1)\sum_{n=1}^{N}\theta^n y_N^n$$

- Real exchange rate is difference in prices of consumption

$$s^{t,m*} = p^{t*} - p^{m*} = \frac{(1-\tau)\gamma}{(1-\tau)+\gamma\tau}\left(y_N^m - y_N^t\right).$$

- All countries appreciate when they suffer a bad shock.
- Bad shocks in larger countries raise λ_T more (spill over to world price of traded good).

Freely Floating Exchange Rates (2/2)

$\rightarrow$ Large countries tend to appreciate when λ_T is higher

$\Rightarrow$ and provide a better hedge again consumption risk.

$\Rightarrow$ have lower interest rates & pay lower returns

$$r^t + \Delta E s^{t,m} - r^m = -cov\left(\lambda_T, p^t - p^m\right)$$

$\Rightarrow$ have lower cost of capital, accumulate more capital per capita.

$$k_N^{t*} - k_N^{m*} = \frac{(\gamma-1)^3(1-\tau)^2\tau}{(1+(\gamma-1)\tau)^2}\ (\theta^t - \theta^m)\sigma^2.$$

$\Rightarrow$ Higher K/Y ratio increases wages.

Key Insight

- **A country can increase capital investment and wages by stabilizing its real exchange rate relative to a larger economy.**

Exchange Rate Stabilization

- The government has two objectives:

P1 Lower the variance of the real exchange rate relative to a target country

$$sd(s^{t,m}) = (1-\zeta)sd(s^{t,m*})$$

P2 without distorting its conditional mean

$$E\left(s^{t,m}|\{K^n\}\right) = E\left(s^{t,m*}|\{K^n\}\right).$$

- To achieve these objectives

1. levy state contingent taxes on traded goods
2. make a lump-sum transfer.

- Government pays for the cost ΔRes of this intervention using currency reserves (an independent source of traded goods).

Exchange Rate Stabilization

- The government has two objectives:

P1 Lower the variance of the real exchange rate relative to a target country

$$sd(s^{t,m}) = (1-\zeta)sd(s^{t,m*})$$

P2 without distorting its conditional mean

$$E\left(s^{t,m}|\{K^n\}\right) = E\left(s^{t,m*}|\{K^n\}\right).$$

- To achieve these objectives

1. levy state contingent taxes on traded goods
2. make a lump-sum transfer.

- Government pays for the cost ΔRes of this intervention using currency reserves (an independent source of traded goods).
- **How to stabilize:**

$y_N^t \downarrow$: target's marginal utility is higher than yours

$\rightarrow$ sell extra traded goods to increase yours.

Effect on Capital Accumulation

Proposition

A country that stabilizes its real exchange rate relative to a target country sufficiently larger than itself lowers its risk-free rate, increases capital accumulation, and increases the average wage in its country relative to the target country.

Example: A small country

- Has no effect on prices outside its own country
- But it can increase it covariance of its exchange rate with λ_T by stabilizing relative to a large country

Cost of Stabilization

- Stabilization changes states in which you buy and sell traded goods.

$$\Delta Res = \int_{\omega} Q(\omega)\ C_T^m(\omega)d\omega - \int_{\omega} Q^*(\omega)\ C_T^{m*}(\omega)d\omega$$

- When $y_N^t \downarrow$, ship out additional traded goods.

$\rightarrow$ Stabilization relative to large country induces you to provide insurance to the world market.

Proposition

If the stabilizing country is small ($\theta^m = 0$),

1. *the cost of stabilizing decreases with the size of the target country.*
2. *the cost of stabilization is negative if the target country is sufficiently large.*

Cost of Stabilization

- Stabilization changes states in which you buy and sell traded goods.

$$\Delta Res = \int_{\omega} Q(\omega)\ C_T^m(\omega)d\omega - \int_{\omega} Q^*(\omega)\ C_T^{m*}(\omega)d\omega$$

- When $y_N^t \downarrow$, ship out additional traded goods.

$\rightarrow$ Stabilization relative to large country induces you to provide insurance to the world market.

Proposition

If the stabilizing country is small ($\theta^m = 0$),

1. *the cost of stabilizing decreases with the size of the target country.*
2. *the cost of stabilization is negative if the target country is sufficiently large.*

- BUT: cost of stabilization increases with size of stabilizing country. Price impact. Do more of what you usually do.

$\Rightarrow$ Potential reason why most large countries do not stabilize.

Effect on the Target Country

- Currency manipulation by a large country changes prices everywhere.
- Stabilizing country sells traded goods when $y_N^t \downarrow$, dampens shocks that affect target country, but amplifies world-wide effects of $y_N^m \downarrow$.

$\Rightarrow$ Reduces the covariance between the target country's real exchange rate and λ_T.

Proposition

A country that becomes the target of stabilization imposed by a large country experiences a rise in its risk-free interest rate, a fall in capital accumulation, and a fall in average wages relative to all other countries. If the stabilizing country is smaller than the target country ($\theta^m < \theta^t$), the stabilization lowers the volatility of consumption in the target country.

- When China stabilizes relative to the dollar, its peg diverts capital accumulation from the US to China, even if it does not distort the level of the real exchange rate!
- However, China also provides consumption insurance to the US.
- In the absence of valuation effects, overall positive effect on welfare in target country.

Welfare

- Prior literature: currency stabilization can be a second-best policy in the presence of monetary and other frictions.
- Now show that it can increase stabilizing country's welfare even in absence of such frictions due to valuation effects.

Close the model:

- Government rebates cost of stabilizing exchange rate to its households ($\Delta Res = 0$). Drop objective P2 (stabilization now endogenously affects the mean of the exchange rate, but all qualitative results continue to hold).
- Now it matters what assets households own, how we decentralize the equilibrium.
- Assume that, at announcement households own portfolio of country-specific risk-free bonds that decentralize equilibrium allocation under freely floating regime.

Welfare: Country-Specific Bonds

Proposition

If households in the stabilizing country directly bear the cost of implementing stabilization ($\Delta Res = 0$) and if all households own the requisite number of risk-free bonds denominated in the consumption bundles of the stabilizing, target, and outside countries that decentralize the Pareto-efficient allocation of consumption under freely floating exchange rates at the time of the announcement of the stabilization policy, then there exists a $\overline{\gamma}$ such that for $\gamma > \overline{\gamma}$ stabilizing relative to a larger target country strictly increases the welfare of households in the stabilizing country.

- In equilibrium, each country endogenously holds disproportionately more of its own bond (home bias).
- Small stabilizing country affects only the price of its own bond (interest rate goes down).
- Value of its portfolio goes up relative to the rest of the world $\Rightarrow$ valuation effect!

Welfare: Country-Specific Bonds

Proposition

If households in the stabilizing country directly bear the cost of implementing stabilization ($\Delta Res = 0$) and if all households own the requisite number of risk-free bonds denominated in the consumption bundles of the stabilizing, target, and outside countries that decentralize the Pareto-efficient allocation of consumption under freely floating exchange rates at the time of the announcement of the stabilization policy, then there exists a $\overline{\gamma}$ such that for $\gamma > \overline{\gamma}$ stabilizing relative to a larger target country strictly increases the welfare of households in the stabilizing country.

- In equilibrium, each country endogenously holds disproportionately more of its own bond (home bias).
- Small stabilizing country affects only the price of its own bond (interest rate goes down).
- Value of its portfolio goes up relative to the rest of the world $\Rightarrow$ valuation effect!

$\Rightarrow$ **Stabilization can be an optimal non-cooperative policy, even in this frictionless world!**

Political Economy

Even if politicians are not be maximizing welfare, they may favor policies that:

- generate revenues at the central bank (Cukiermann & al., 1992)
- increase capital accumulation and wages (of the median voter). (Persson & Tabellini, 2002)

$$EU^n + \mu_1 K^n - \mu_2 \Delta Res,$$

In this sense, the model also generates **a political economy rationale** for stabilization relative to a large economy.

Nominal Stabilization when Prices are Sticky

- Extend our model to allow for the price of traded goods to be rigid in terms of local currency (Mussa (1986), Engel (1999), Cavallo et al (2014)).
- All consumed goods must be paid for in local currency and the Central Bank sets the money supply M^n.
- If Central Banks adjust money supply to neutralize nominal price rigidity, same allocation emerges as under freely floating regime.

Proposition

If the price of the traded good is rigid in terms of the stabilizing country's currency **a nominal stabilization implements a real stabilization** *of equal strength* $\zeta = \tilde{\zeta}$

- Can implement real exchange rate stabilization by announcing a set of nominal exchange rates at which Central Bank buys and sells currency.

How General are these Results?

- Floating bands and interventions with a lack of credibility are simply weaker stabilizations.
- Positive results are robust to a wide range of models of exchange rate determination:
  - Preference shocks (Pavlova & Rigobon, 2007).
  - Segmented markets and nominal shocks (Alvarez, Atkeson, Kehoe, 2007).
  - CES aggregator between traded and non-traded goods
  - Stochastic endowments/production of traded goods
  - Differentiated traded goods.
- Key ingredients:
  1. Shocks to price of consumption in large countries spill over more to the rest of the world.
  2. Risk premia determine long-term differences in interest rates across countries.
  3. Currency manipulation primarily operates by placing a wedge on the domestic and foreign prices of traded goods.

Conclusion

- Most countries stabilize their exchange rate. Existing theories give relatively little guidance on the effects of such stabilizations, on what might be special about the U.S. dollar as a target currency, and on the external effects of these stabilizations.
- Proposed a risk-based transmission mechanism for the effects of currency manipulation.

1. Policies that induce a country's currency to appreciate in bad times lower its risk premium, lower the country's risk-free interest rate, and increase domestic capital accumulation and wages.
2. Stabilizing the exchange rate relative to a larger country is such a policy.
3. In addition, stabilizing towards larger countries is cheaper and can generate positive revenues, increase welfare.
4. Exchange rate stabilization has external effects: Target country experiences a rise in interest rates, fall in investment and average wages. But stabilization lowers volatility of consumption in target country may increase welfare.