Introduction

- Real exchange rate appreciations often reflect boom conditions, but they also stress important parts of the economy.
- Most economies experience episodes of this sort. Today, this is the case of commodity producing economies, emerging markets, as well as countries experiencing strong capital inflows.
- In this context the question arises whether there is a need for policy intervention.
- Here we present one framework to address such question (Caballero-Lorenzoni).
Episodes of large and persistent appreciations of real exchange rate

Many sources:

- Absorption of large capital inflows
- Inflation stabilization policies
- Exchange rate adjustments in trading partners
- Favorable price shock for commodity producers
- Discovery of natural resources (Dutch disease)
Slow adjustment in recoveries

- Persistent appreciations drains resources of export sector, lead to destruction/bankruptcies
- May slow down export sector recovery once things turn around
- Depressed input demand from consumers + depressed input demand from export sector
- Real exchange rate overshooting
RER overshooting
Policy question

Is there a need to intervene to protect the export sector?

Does costly ex post adjustment justify intervention ex ante?

A: no

Add extra ingredient: financial constraint

A: in some cases
Suppose consumers reduce their demand for non-tradables in appreciation.

- Less destruction ex-ante and a faster recovery ex-post.
- Higher wages and real exchange rates ex post.
- Rational atomistic consumers ignore this effect.
'Dutch disease' (Corden, Krugman, Wijnbergen)
- learning-by-doing, real externality

Broader problem: preventive measures during appreciations and current account deficits
- inefficient current account deficits (Blanchard)

Financial development and the negative effects of macro volatility
Model

- two goods: tradable $T$, non-tradable $N$
- price of $N$ (RER): $p_t$
- two countries: home, foreign
- two groups in home country: consumers, entrepreneurs
Preferences

Consumers:

\[ E \sum \beta^t \theta_t \left( \log c_t^T + \log c_t^N \right) \]

preference shock \( \theta_t \)

Entrepreneurs and ROW:

\[ E \sum \beta^t c_t^T \]
First shift to $\theta_A$, then shift to $\theta_D$ w.p. $\delta$

$$\theta_A > \theta_D$$

$D$ absorbing state

complete markets
Endowments

Consumers sell 1 unit of labor inelastically

Entrepreneurs, period 0:

\[ a_0 \text{ tradable goods} \]

\[ n_{-1} \text{ production units} \]
Technology

Tradable sector

- $f$ of tradable good to create one production unit

- (*Leontief*) 1 production unit produces 1 tradable using 1 labor

- (*No mothballing*) if production unit inactive $\rightarrow$ destroyed

Non-tradable sector

- 1 unit of labor produces 1 unit of $NT$

- $\rightarrow$ wages are equal to $p_t$
No commitment on entrepreneurs’ side

Portfolio of entrepreneurs:

\[ a(s_{t+1}|s^t) \geq 0 \]
Equilibrium: consumers

Consumers’ optimality + complete markets

Demand for NT

\[ C_t^N = \kappa \frac{\theta_t}{p_t} \]

- shock: persistent shift in demand for NT
- \( \kappa \) endogenous depends on NPV of wages \( p_t \)
Equilibrium: export units and NT consumption

Market clearing in labor and goods market + Leontief:

\[ n_t + c_t^N = 1 \]

Market clearing for used units + creation/destruction margin:

\[ q_t \in [0, f] \]

\[ n_t > n_{t-1} \text{ implies } q_t = f \]

\[ n_t < n_{t-1} \text{ implies } q_t = 0 \]

\( q_t \) price of used unit
Characterization

Proposition

Equilibrium is characterized by:

Phase A

\[ p(s^t) = p_A > 1 \quad q(s^t) = 0 \]

Phase D

\[ p(s^t) = p_{D,j} < 1 \quad q(s^t) = f \]

- \( D, j \): j-th period after reversal
- Assumptions: \( \theta_A / \theta_D \) and \( n_{-1} \) sufficiently large
Cost of holding a unit:

\[ p_A - 1 > 0 \]

Expected benefit:

\[ \beta \delta f \]
Phase $D$: Recovery

Cost of holding a unit:

$$f - (1 - p_{D,j}) > 0$$

Expected benefit:

$$\beta f$$
Price pinned down by \textit{intertemporal margin} on the supply side

Indifference between financial assets and physical capital

\[ p_{A}^{fb} - 1 = \beta \delta f \]

\[ f + p_{D}^{fb} - 1 = \beta f \]
First best

\[ p \]

\[ p_A \]

\[ p_D \]

\[ n_A \quad n_D \quad l \quad n \]
First best

- A phase
- D phase
Cutoff $\bar{a}^{fb}$

If $a_0 \geq \bar{a}^{fb}$ financial constraint not binding

High wealth $a_0$ needed for two reasons:

- cover losses in $A$

- cover investment costs in first period of $D$

\[(p_A - 1)n_A + \delta \beta a_{D,0} = (1 - (1 - \delta)\beta)a_0\]
Constrained equilibrium: Low $a_0$

Prices no longer pinned down by intertemporal margin

Limited ability to exchange financial assets for physical capital

\[ p_A - 1 \leq \beta \delta f \]

\[ f + p_{D,j} - 1 \leq \beta f \]
Entrepreneur’s problem: recursive setup

Equilibrium prices taken as given: \( q(s^t) \) and \( p(s^t) \)

Individual state variables:

- financial wealth \( a \)
- physical capital \( n^- \)

Lemma

The value function \( V(a, n^-; s^t) \) takes the linear form

\[
V(a, n^-; s^t) = \psi(s^t) + \phi(s^t) (a + q(s^t)n^-)
\]
Bellman equation

\[ \phi (s^t) (a + q(s^t) n^-) = \]

\[ = \max_{c^{T,e}, n, a(\cdot)} c^{T,e} + \beta E \left[ \phi(s^{t+1}) (a(s_{t+1}) + q(s^{t+1})n) \right] \]

s.t.

\[ c^{T,e} + q(s^t) \cdot n + \beta E [a(s_{t+1})] = (1 - p(s^t)) \cdot n + a + q(s^t) \cdot n^- \]

\[ a(s_{t+1}) \geq 0, n \geq 0, c^{T,e} \geq 0 \]
Optimality conditions

For physical capital (production units):

\[(q(s^t) + p(s^t) - 1) = \beta E \left[ \frac{\phi(s^{t+1})}{\phi(s^t)} q(s^{t+1}) \right] \]

For securities:

\[\phi(s^t) \geq \phi(s^{t+1}) \quad a(s_{t+1}|s^t) \geq 0\]

For consumption:

\[1 \leq \phi(s^t) \quad c^{T,e}(s^t) \geq 0\]
Limited funds $a_0$

\[(p_A - 1)n_A + \delta \beta a_{D,0} = (1 - (1 - \delta)\beta)a_0\]

- keep resources for $A$
- insure the recovery

Low $a_0$ can bite in $A$, in $D$, both...
Constrained appreciation

Units only pay back in state $D$

$$(p_A - 1) \phi_A = \beta \delta f \phi_{D,0}$$

$$\phi_A \geq \phi_{D,0}$$

If constraint is binding then

$$p_A - 1 < \beta \delta f$$
Constrained appreciation (continued)

**Proposition**

If $a_0 < a^A$, then price is depressed $p_A < p^b_A$, destruction is bigger $n_A < n^b_A$.

Smaller appreciation, symptom of financial distress
Constrained appreciation (continued)
Overshooting

Proposition

If $a_0 < a^D$ then overshooting:

\[ p_{D,0} < p_{D}^{fb} \]
\[ p_{D,j} \to p_{D}^{fb} \]

- constrained recovery

\[ f + p_{D,0} - 1 < \beta f \]

→ low wages help recovery of financially constrained firms
Overshooting (continued)
Constrained equilibrium

![Graph showing constrained equilibrium with variables p and n over time.](image-url)
Back to consumers’ demand

\[ \kappa = \frac{\mathbb{E} \sum \beta^t p_t}{2\mathbb{E} \sum \beta^t \theta_t} \]

Now \( \kappa \) depends on initial wealth of entrepreneurs
Exchange rate policy

Exchange rate appreciation in $A$ leads to

$\rightarrow$ more destruction in $A$

$\rightarrow$ slower recovery in $D$

**Policy:** Relieve pressure on demand for NT, increase $n_A$, save units for the recovery

**Q:** Is this policy welfare improving?
Policy instruments

- no transfers between consumers and entrepreneurs
- taxes on consumption of T/NT, rebated lump-sum to consumers

Interventions with effects in this direction:
- contractionary fiscal policy
- policies to encourage savings
- currency interventions/reserves management (?)
Planner chooses:

- state contingent path for $c^T(s^t), c^N(s^t)$

Takes as given:

- market clearing in labor market $n(s^t) = 1 - c^N(s^t)$
- entrepreneurs’ optimality
- Map $n(.) \rightarrow p(.), a(.), c^{T,e}(.)$

- maximize consumers’ utility for fixed entrepreneurs’ utility
Perturbation

Increase $n_A$ locally, around CE

Effects on consumers’ welfare (leaving entrepreneurs indifferent)

**Result** If constrained appreciation and overshooting then:

\[
\begin{align*}
    dU_c &> 0 \\
    dU_e &= 0
\end{align*}
\]
Change $n_A$ locally, around CE

$$\frac{dU_c}{dn_A} = -\theta_A u'(1 - n_A) + p_A \lambda +$$

$$+ \lambda \left( \frac{\partial p_A}{\partial n_A} n_A + \beta \delta \frac{\partial p_D,0}{\partial n_A} n_{D,0} \right)$$

- $\lambda$ lagrange multiplier on consumers BC
- first row zero (private FOC)
Inefficient destruction

If constrained appreciation + overshooting \((p_A < p_A^{fb} \text{ and } p_D,0 < p_D^{fb})\) then

\[
\frac{\partial p_A}{\partial n_A} n_A + \delta \beta \frac{\partial p_D,0}{\partial n_A} n_D,0 = 1 - p_A + \beta \delta f > 0
\]

- total wage loss today = cost of saving an extra unit
- total wage gain tomorrow = savings in investment costs
If $p_{D,0} < p^f_{D}$ (overshooting) then:

$$\frac{dU_e}{dn_A} = \frac{\partial c^T_{D,0}}{\partial n_A} = 0$$

- all extra funds tomorrow go to investment
Constrained efficiency

If no overshooting optimal policy is no intervention

\[ \frac{\partial p_A}{\partial n_A} n_A + \delta \beta \frac{\partial p_{D,0}}{\partial n_A} n_{D,0} = 1 - p_A < 0 \]

- only wage losses today
- then reduce \( n_A \)?
- no, the entrepreneur PC binding now
Optimal policy

Optimal policy if no constrained appreciation? Intervention during *recovery* phase still good

In general **optimal to combine intervention in** $A$ and $D$

**Hindrances:**

- real wage rigidities in recovery
- nominal wage rigidities $+$ peg
Optimal policy (continued)

blue - CE, red - optimal policy
Ex ante vs ex post: Three cases
Three cases (continued)

- First case, low $a_0$
  - intervention in $A$ is very effective
  - tax NT in $A$ and subsidy in $D$
  - subsidy eventually vanishes

- Second case, middle $a_0$
  - intervention in $A$ is effective but also leave some for $D$
  - all intervention in $D$ frontloaded

- Third case, high $a_0$
  - intervention more effective in $D$
  - over-overshooting
$a_0$ and intervention (against CE)
Implementation: tax on nontradable
How does $\delta$ affect the equilibrium, the incentive to intervene?

- High $\delta$: switch is very likely
  small losses, easy to hedge

- Low $\delta$: switch is very unlikely
  optimal to destroy many units also in first best, easy to hedge
shaded region - positive taxes
Incomplete markets
Conclusions

- Appreciation can generate excessive destruction
- For inefficiency, it is crucial that there is a constrained recovery
- Trade-off wage cut in $A$ v. faster recovery in $D$
- Menu of intervention depends on initial conditions: more constrained entrepreneurs, more preventive policy