Persistent Appreciations and Overshooting: A Normative Analysis

Ricardo J. Caballero
Massachusetts Institute of Technology and NBER

Guido Lorenzoni
Massachusetts Institute of Technology and NBER

Presentation given at the 8th Jacques Polak Annual Research Conference
Hosted by the International Monetary Fund
Washington, DC—November 15-16, 2007

Please do not quote without the permission from the author(s).

The views expressed in this presentation are those of the author(s) only, and the presence of them, or of links to them, on the IMF website does not imply that the IMF, its Executive Board, or its management endorses or shares the views expressed in the presentation.
Persistent Appreciations and Overshooting: A Normative Analysis

Ricardo J. Caballero and Guido Lorenzoni

IMF, November 2007
Appreciations

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
Policy question

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

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

Does costly ex post adjustment justify intervention ex ante?

A: no
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
Related work

- 'Dutch disease' (Corden, Krugman, van Wijnbergen)
- Broader problem: preventive measures during appreciations and current account deficits (Blanchard)
- Financially constrained exporters (Chaney, Manova), their response to big depreciations (Fitzgerald-Manova)
- Financial development and the negative effects of macro volatility (Aghion-Bacchetta-Ranciere-Rogoff, Aghion-Angeletos-Banerjee-Manova)
Model

- three goods: tradable $T$, non-tradable $N$, capital
  - price of $N$ (RER): $p_t$
  - price of capital: $q_t$
  - $T$ numeraire

- 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 foreign consumers:

$$E \sum \beta^t c_t^T$$
Shocks

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
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 $p_t$
Financial constraint

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

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

- shock: persistent shift in demand for non tradables
- \( \kappa \) endogenous depends on present value of wages \( \rho_t \)
Equilibrium: export units and NT consumption

Market clearing in labor market + Leontief in T sector:

\[ c_t^N + n_t = 1 \]

Market clearing for used units + creation/destruction margin:

- \( q_t \in [0, f] \)
- \( n_t > n_{t-1} \) implies \( q_t = f \)
- \( n_t < n_{t-1} \) 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
- Assumption: \( \theta_A / \theta_D \) and \( n-1 \) sufficiently large
Phase $D$: recovery of export sector

Cost of creating a unit

\[ f \]

Net present value of profits

\[ \frac{1}{1 - \beta} (1 - p_D) \]

Equilibrium value of $p_D$

\[ p_D = 1 - (1 - \beta)f \]
Phase A: operational losses and option value

Cost of keeping a unit operational

\[ p_A - 1 > 0 \]

Expected benefit

\[ \beta \delta f \]

Equilibrium value of \( p_A \)

\[ p_A = 1 + \beta \delta f \]
First best

Figure 1:

A phase

D phase

Motivation  Model  Equilibrium  First best  Constrained equilibrium  Exchange rate policy  Ex ante vs ex post
First best (large $a_0$)

Cutoff $\hat{a}^{fb}$

**Result** If $a_0 \geq \hat{a}^{fb}$ financial constraint not binding
First best (large $a_0$)

Cutoff $\hat{a}^{fb}$

**Result** If $a_0 \geq \hat{a}^{fb}$, financial constraint not binding

High wealth $a_0$ needed for two reasons:

- cover losses in $A$
- cover investment costs in first period of $D$

\[(\rho_A - 1)n_A + \delta \beta f \cdot (n_D - n_A) \leq (1 - (1 - \delta)\beta)a_0\]
First best (large $a_0$)

Cutoff $\hat{a}^{fb}$

**Result** If $a_0 \geq \hat{a}^{fb}$ financial constraint not binding

High wealth $a_0$ needed for two reasons:

- cover losses in $A$

- cover investment costs in first period of $D$

\[(p_A - 1)n_A + \delta \beta f \cdot (n_D - n_A) \leq (1 - (1 - \delta) \beta)a_0\]
Motivation  
Model  
Equilibrium  
First best  
Constrained equilibrium  
Exchange rate policy  
Ex ante vs ex post  

Low $a_0$

Prices no longer pinned down by intertemporal margin

Limited ability to exchange financial assets for physical capital

\[ \rho_A - 1 < \beta \delta f \quad \text{constrained appreciation} \]

\[ f + p_{D,0} - 1 < \beta f \quad \text{overshooting} \]
Result \( a_0 < a \) then constrained appreciation and overshooring

- in \( D \) phase firms invest using retained earnings
- eventually \( p_{D,J} = p_{D}^{fb} \) for some \( J > 0 \)
Constrained equilibrium

Figure 2:
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 problem

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:

$$dU_c > 0$$

$$dU_e = 0$$
Perturbation (continued)

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 ($p_A < p_A^{fb}$ 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
Inefficient destruction (continued)

If \( p_{D,0} < p^{fb}_D \) (overshooting) then:

\[
\frac{dU_e}{dn_A} = \frac{\partial c^{T,e}_{D,0}}{\partial n_A} = 0
\]

- all extra funds tomorrow go to investment
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)

Figure 4:

- blue - CE, red - optimal policy
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
Persistence

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
Persistence (continued)

shaded region - positive taxes
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