# The Extensive Margin of Trade and Monetary Policy

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# Exporter dynamics: long-run versus short-run

Persistence in long-run export participation

- Export continuation rate $= 87.4\%/\text{yr}$
- Non-participation rate $= 86.1\%/\text{yr}$

  (U.S. manufactures 1984-1992, Bernard and Jensen, 2004)

- Little evidence of growth in extensive margin of trade among advanced economies (Kehoe and Ruhl, 2013)

Different picture at the business cycle frequency (Naknoi, 2015)

- Extensive margin of exports is three times as volatile as output

# New dimension for monetary policy and trade

The high volatility of the extensive margin over business cycles raises new questions for policy makers of open economies.

- What are the channels through which monetary policy might affect intensive and extensive margins of international trade?
- Does monetary policy affect the two margins in the same way?

# This paper

- develop a two-country DSGE model with
  - nominal rigidities
  - state-dependent decisions on whether to enter/exit export market
  - firm heterogeneity in productivity, export costs, prices
- calibrate the model to match micro-level exporter characteristics
- examine the effects of monetary policy on the intensive and extensive margins of trade

# Main Findings

- Exporter entry/exit is sensitive to firms' price competitiveness relative to other exporters and firms in the destination market
- Expansionary monetary policy shocks support the intensive margin of trade, but can deter export participation.
  - Currency depreciation and lower interest rates are favorable to export sales and export participation.
  - However, higher expected inflation discourages export participation
- Monetary policy that is more aggressive toward inflation reduces fluctuations in export participation.

# Related Literature

- Export hysteresis in partial equilibrium
  Baldwin (1988), Baldwin and Krugman (1989), Dixit (1989)
- Firm heterogeneity and export decisions
  Melitz (2003), Bernard et al. (2003), Das et al. (2007), Chaney (2008)
- Business cycles and exporter entry/exit in general equilibrium
  Ghironi and Melitz (2005), Alessandria and Choi (2007), Ruhl (2008), Imura (2016)
- Optimal monetary policy with exporter entry and exit
  Cooke (2015)

# Model overview

Two symmetric countries, each with

- Representative household

$$\max \mathbf{E}_t \sum_{t=0}^{\infty} \beta^t \left[\varepsilon_t^c \log C_t + \chi_2(1 - L_t)\right]$$

- Competitive final-good producers

$$\max_{y_t^H(i), y_t^F(i)} P_t D_t - \int_0^1 P_t^D(i) y_t^H(i) di - \int_{i \in \Theta_t} P_t^{X*}(i) y_t^F(i) di$$

- Monopolistically competitive intermediate-good producers
    - Probability of price adjustment increasing in the age of price
    - Entry and exit in the export market, subject to entry/continuation costs

- Monetary authority

$$\hat{i}_t^p = \rho_i \hat{i}_{t-1}^p + (1 - \rho_i)\left[\phi_\pi \hat{\pi}_t + \phi_Y \hat{Y}_t + \phi_Q \hat{Q}_t\right] + \hat{\mu}_t$$

# Intermediate-good firms

- Each producing a differentiated product

$$y_t(i) = z_t(i) A_t K_t(i)^{\nu} L_t(i)^{1-\nu}$$

$z_t(i) =$ firm-specific productivity, $A_t =$ country-specific productivity

- All intermediate-good producers sell in their own country.
- Export participation
  - To enter the export market, a firm pays entry cost, $\eta \sim G^E(\eta)$.
  - Upon entering, an entrant sets a new price for its exports.
  - To continue exporting, a firm pays continuation cost, $\xi \sim G(\xi)$.
  - All export costs are paid in advance of production.
- Probability of price adjustment increases as price gets older

# Potential entrant

Potential entrant with productivity $z_c$ and entry cost $\eta$ solves

$$V_t^E(z_c,\eta) = \max\left\{ \max_{P_{0,t}^X(z_c)} \left[ Q_t \frac{P_{0,t}^X(z_c)}{P_t^*} y_{0,t}^X(z_c) - w_t L_{0,t}^X(z_c) - r_t K_{0,t}^X(z_c) - i_t^p \boldsymbol{\eta} w_t \right.\right.$$
$$\left.\left. + \beta \mathbf{E}_t \frac{\lambda_{t+1}}{\lambda_t} \sum_{\tilde{c}=1}^{n_z} \pi_{c\tilde{c}} H_{1,t+1}\left(z_{\tilde{c}}, z_c, \xi'\right) \right], \quad \beta \mathbf{E}_t \frac{\lambda_{t+1}}{\lambda_t} \sum_{\tilde{c}=1}^{n_z} \pi_{c\tilde{c}} V_{t+1}^E(z_{\tilde{c}}, \eta') \right\}$$

where

$$H_{1,t}\left(z_c, z_s, \xi\right) = \alpha_1 V_{0,t}(z_c,\xi) + (1-\alpha_1) V_{1,t}\left(z_c, z_s, \xi\right)$$

$\Rightarrow$ Maximum entry cost this firm would pay to start exporting, $\eta_t^E(z_c)$, equates the value of entry and the value of no entry.

# Price-adjusting incumbent

Price-adjusting incumbent exporter with current productivity $z_c$ drawing export cost $\xi$ solves

$$V_{0,t}(z_c,\xi) = \max\left\{ \max_{P^X_{0,t}(z_c)} \left[ Q_t \frac{P^X_{0,t}(z_c)}{P^*_t} y^X_{0,t}(z_c) - w_t L^X_{0,t}(z_c) - r_t K^X_{0,t}(z_c) - i^p_t \boldsymbol{\xi} w_t \right.\right.$$

$$\left.\left. + \beta \mathbf{E}_t \frac{\lambda_{t+1}}{\lambda_t} \sum_{\tilde{c}=1}^{n_z} \pi_{c\tilde{c}} H_{1,t+1}\left(z_{\tilde{c}}, z_c, \xi'\right) \right],\quad \beta \mathbf{E}_t \frac{\lambda_{t+1}}{\lambda_t} \sum_{\tilde{c}=1}^{n_z} \pi_{c\tilde{c}} V^E_{t+1}(z_{\tilde{c}}, \eta') \right\}$$

$\Rightarrow$ Max export cost this firm would pay to continue exporting, $\xi^0_t(z_c)$, equates the value of continuation and the value of exit.

# Non-price-adjusting incumbent

Value of non-price-adjusting incumbent of type $(z_c, j, z_s)$ drawing continuation cost $\xi$

$$V_{j,t}\left(z_c, z_s, \xi\right) = \max\left[Q_t \frac{P^X_{j,t}(z_s)}{P^X_t} y^X_{j,t}(z_c, z_s) - w_t L^X_{j,t}(z_c, z_s) - r_t K^X_{j,t}(z_c, z_s) - i^p_t \boldsymbol{\xi} w_t \right.$$
$$\left. + \beta \mathbf{E}_t \frac{\lambda_{t+1}}{\lambda_t} \sum_{\tilde{c}=1}^{n_z} \pi_{c\tilde{c}} H_{j+1,t+1}\left(z_{\tilde{c}}, z_s, \xi'\right), \quad \beta \mathbf{E}_t \frac{\lambda_{t+1}}{\lambda_t} \sum_{\tilde{c}=1}^{n_z} \pi_{c\tilde{c}} V^E_{t+1}(z_{\tilde{c}}, \eta')\right]$$

$\Rightarrow$ Maximum export cost for this firm to continue exporting, $\xi^j_t(z_c, z_s)$, equates the value of continuation and the value of exit.

# Export participation decisions

Export decisions depend directly on

$$V_t^E(z_c,\eta) = \max\left\{ \max_{P_{0,t}^X(z_c)} \left[ \boldsymbol{Q_t} \frac{P_{0,t}^X(z_c)}{P_t^*} y_{0,t}^X(z_c) - w_t L_{0,t}^X(z_c) - r_t K_{0,t}^X(z_c) - i_t^p \eta w_t \right.\right.$$
$$\left.\left. + \beta \mathbf{E}_t \frac{\lambda_{t+1}}{\lambda_t} \sum_{\tilde{c}=1}^{n_z} \pi_{c\tilde{c}} H_{1,t+1}\left(z_{\tilde{c}}, z_c, \xi'\right) \right], \quad \beta \mathbf{E}_t \frac{\lambda_{t+1}}{\lambda_t} \sum_{\tilde{c}=1}^{n_z} \pi_{c\tilde{c}} V_{t+1}^E(z_{\tilde{c}}, \eta') \right\}$$

- Exchange rate

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- Exchange rate
- Relative export price

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- Exchange rate
- Relative export price
- Production costs

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- Exchange rate
- Relative export price
- Production costs
- Interest rate (export cost)

# Export participation decisions

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$$V_t^E(z_c,\eta) = \max\left\{ \max_{P_{0,t}^X(z_c)} \left[ Q_t \frac{P_{0,t}^X(z_c)}{P_t^*} \boldsymbol{y_{0,t}^X(z_c)} - w_t L_{0,t}^X(z_c) - r_t K_{0,t}^X(z_c) - i_t^p \eta w_t \right.\right.$$
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- Exchange rate
- Relative export price
- Production costs
- Interest rate (export cost)
- Demand for home exports, $y_t^{H*}(i) = (1-\omega)^\rho \left(\frac{P_t^X(i)}{P_t^X}\right)^{-\gamma} \left(\frac{P_t^X}{P_t^*}\right)^{-\rho} D_t^*$

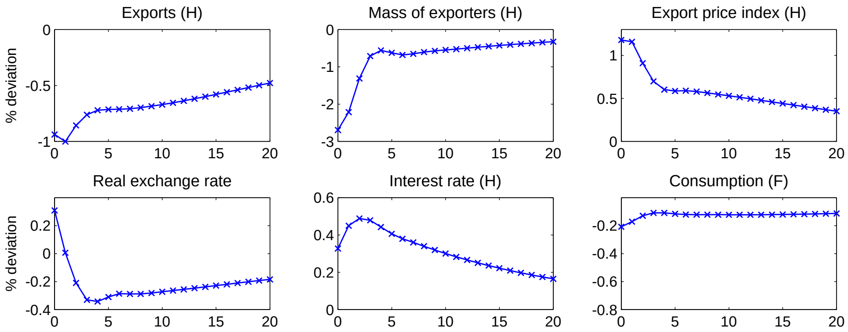
# Calibration

- Home bias, $\omega$
- Entry costs, $U(0, \eta_U)$
- Continuation costs, $U(0, \xi_U)$
- Price adjustment probabilities, $\alpha_j$
- Firm-specific productivity process

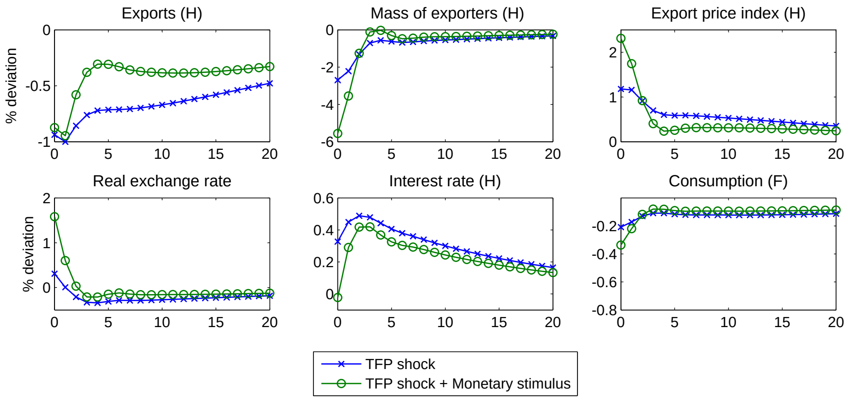
$$\log z' = \rho_z \log z + \epsilon', \ \epsilon \sim N(0, \sigma_\epsilon)$$

| | Data | Model | |
|---|---|---|---|
| Mass of exporters | 0.21 | 0.23 | Bernard et al. (2003) |
| Continuation rate | 0.97 | 0.87 | Bernard & Jensen (2004) |
| Entry rate | 0.04 | 0.04 | Bernard & Jensen (2004) |
| Imports/GDP | 0.12 | 0.13 | Drozd & Nosal (2011) |
| Productivity relative to nonexporters | 1.12-18 | 1.13 | Bernard & Jensen (1999) |
| Mean price adjustment frequency (qtr) | 1.07-3.27 | 2.66 | Bils & Klenow (2004)<br>Nakamura & Steinsson (2008) |

# Negative home aggregate TFP shock

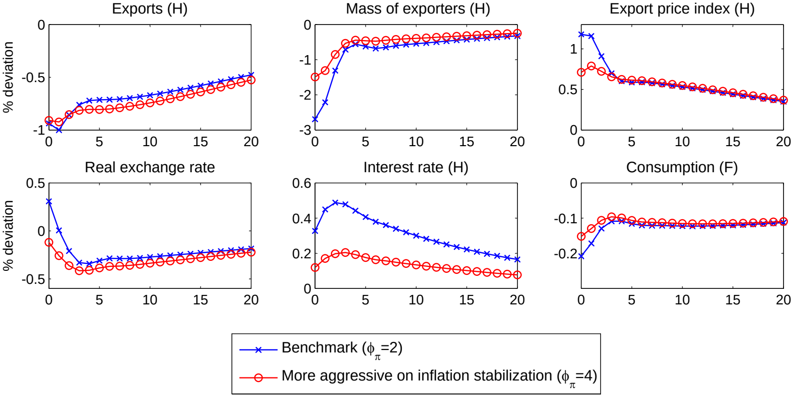


# Negative aggregate TFP shock and monetary stimulus



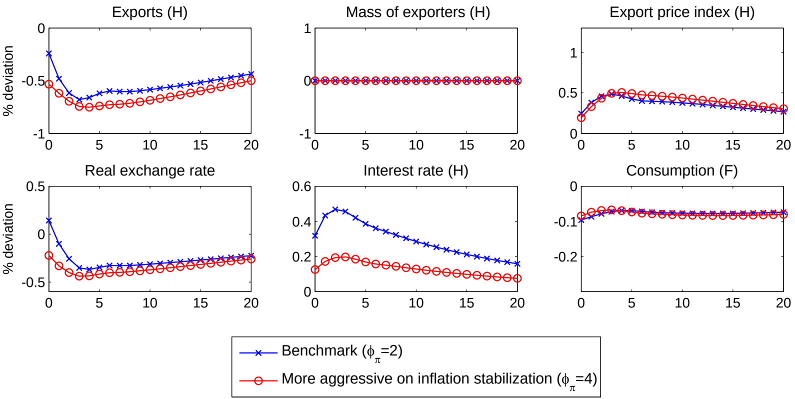

Monetary stimulus to counter negative TFP shock is effective on intensive margin, but worsens initial decline in extensive margin.

# Monetary policy rule and extensive margin of trade




Response of extensive margin is dampened when monetary policy is more aggressive on inflation

# Without extensive margin adjustment




Aggressive inflation stabilization increases volatility of exports

# Conclusion

- Monetary stimulus may have different implications for intensive margin and extensive margin of trade.
  - Currency depreciation and lower interest rates are favorable to export sales and, to some extent, export participation.
  - However, inflationary effects deter entry of new firms and erode competitiveness of some incumbent exporters.
- Monetary policy that is more aggressive toward inflation stabilization reduces fluctuations in extensive margin.

Appendix

# Parameter Values

| | | | |
|---|---|---|---|
| Discount factor | $\beta$ | 0.99 | 4% annual interest rate |
| Weight on leisure in utility | $\chi_2$ | 1.8 | s.s. labor = 0.33 |
| Elasticity of substitution | $\gamma$ | 3.8 | Ghironi & Melitz (2005) |
| Armington elasticity | $\rho$ | 1.5 | Backus et al. (1995) |
| Labor income share | $1-\nu$ | 0.6 | Cooley & Prescott (1995) |
| Depreciation rate of capital | $\delta$ | 0.025 | 10% depreciation/year |
| # of firm-specific productivity | $n_z$ | 2 | |
| Monetary policy rule (Clarida, Gali, Gertler, 1998) | | | |
| inflation | $\phi_\pi$ | 2 | |
| output | $\phi_Y$ | 0.5 | |
| real exchange rate | $\phi_Q$ | 0.1 | |
| persistence | $\rho_i$ | 0.8 | |

# Household

Representative household chooses $C_t$, $L_t$, $K_{t+1}$, $B_{t+1}(s^{t+1})$, $B^D_{t+1}$

$$\max \mathbf{E}_t \sum_{t=0}^{\infty} \beta^t \left[\varepsilon^c_t \log C_t + \chi_2(1 - L_t)\right]$$

subject to

$$C_t + I_t + \sum_{s^{t+1}} q(s^{t+1}|s^t)\frac{B(s^{t+1})}{P_t} + \frac{B^D_{t+1}}{P_t} \leq w_t L_t + r_t K_t + d_t + \frac{B(s^t)}{P_t} + i^p_t \frac{B^D_t}{P_t}$$

$$K_{t+1} = (1-\delta)K_t + I_t - \frac{\kappa}{2}\left(\frac{I_t}{K_t} - \delta\right)^2 K_t$$

where

$B(s^{t+1})$ = state-contingent international bond

$q(s^{t+1}|s^t)$ = price of $B(s^{t+1})$ in units of home currency in state $s^t$

$B^D_t$ = non-contingent domestic bonds

$\varepsilon^c_t$ = demand shock