Assessing estimates of the exchange rate pass-through

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Introduction

- Exchange rate pass-through*:* degree to which exchange rate changes are reflected in prices of traded goods (Menon, 1995)
- To main approaches to estimate pass-through
  - Single-equation regressions
  - Structural vector autoregressions
- Key finding: the exchange rate pass-through is sluggish and incomplete
- Interpretation: need large amount of local currency price stickiness in macroeconomic models

Introduction

- Suggestion in this paper: standard empirical models exaggerate the sluggishness of prices in response to exchange rate movements
- Basic approach (Chari et al., 2005; Christiano et al., 2006, Corsetti et al., 2006):
  - Generate artificial data from open economy sticky-price model(s)
  - Estimate pass-through regressions and VARs on artificial data
  - Ask whether the standard methods recover the 'true' degree of pass-through
- Main findings:
  - pass-through estimates biased downwards relative to economic model
  - bias attributable to overdifferencing
  - overdifferencing difficult to detect

Empirical models

Single-equation pass-through regressions

- General specification (e.g., Campa and Goldberg, 2005)

$$\Delta p_t^m = \sum_{i=0}^{p} a_i \Delta s_{t-i} + \sum_{i=0}^{p} b_i \Delta mc_{t-i}^f + \sum_{i=1}^{p} c_i \Delta p_{t-i}^m + u_{p,t}$$

  where p_t^m is import price index, s_t is nominal exchange rate and mc_t^f is foreign marginal costs

- Exchange rate pass-through: accumulated response of import price to exchange rate change

- Key assumption: exchange rate is exogenous

Empirical models

Structural vector autoregressions (VARs)

- General specification

$$\Delta y_t = \sum_{j=1}^{p} A_j \Delta y_{t-j} + u_t, \quad , u_t = G\varepsilon_t, \quad E\left[u_t u_t'\right] = GG' = \Omega$$

  where y_t includes a set of price indices (import prices, export prices, producer prices, consumer prices) and the nominal exchange rate

- Exchange rate pass-through: impulse responses of prices to an exogenous 'exchange rate shock'

- Short-run identification scheme: exchange rate placed first in recursive ordering of the variables

Empirical models

Structural vector autoregressions (VARs)

- Potential problems:
  - Incorrect identification of shocks
  - Economic model cannot be approximated by finite order VAR
- In this paper: identification scheme is consistent with the economic model

Illustration using a simple theoretical model

Linearised import price equation

- Log-linearised equation for aggregate import price growth

$$\Delta p_t^m = \beta E_t \Delta p_{t+1}^m + \frac{(1-\beta\eta)(1-\eta)}{\eta}\left(p_t^m - s_t - mc_t^f\right) + \varepsilon_{p,t}$$

where β is steady-state discount factor

- Completing model for forcing variables

$$\begin{aligned} s_t &= s_{t-1} + \varepsilon_{s,t} \\ mc_t^f &= mc_{t-1}^f + \varepsilon_{mc,t} \end{aligned}$$

Illustration using a simple theoretical model

Pass-through regression

- The pass-through regression implied by the model

$$\Delta p_t^m = (1-\eta)\Delta s_t + (1-\eta)\Delta mc_t^f - (1-\eta)(p^m - s - mc^f)_{t-1} + \eta\varepsilon_{p,t}$$

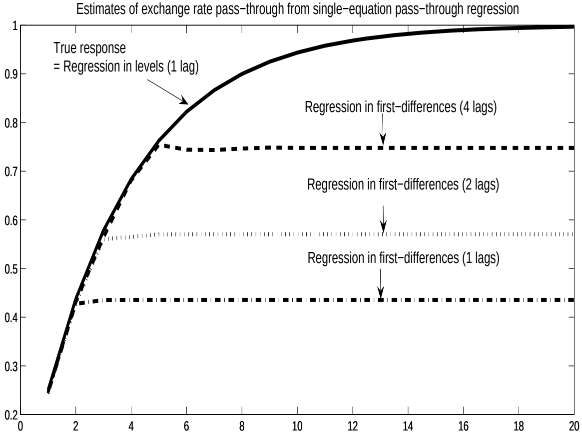
- Or equivalently; in levels

$$p_t^m = (1-\eta)s_t + (1-\eta)mc_t^f + \eta p_{t-1}^m + \eta\varepsilon_{p,t}$$

Illustration using a simple theoretical model

Pass-through regression

- Experiment:
  - Assume $\beta = 0.99$ and $\eta = 0.75$ and $\sigma_s = \sigma_{mc} = \sigma_p = 1$
  - Derive population versions of first-differenced pass-through regressions for different lag-orders
  - Compute dynamic response of import prices to a one unit exchange rate shock $\varepsilon_{s,t}$


Estimates of exchange rate pass−through from single−equation pass−through regression
True response
= Regression in levels (1 lag)
Regression in first−differences (4 lags)
Regression in first−differences (2 lags)
Regression in first−differences (1 lags)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0
2
4
6
8
10
12
14
16
18
20

A medium-scale DSGE model with sticky prices

- Small open economy DSGE model with incomplete pass-through based on Choudhri et al. (JIE, 2005)
- Firms:
  - Two goods: nontraded final good, traded intermediate good
  - Two inputs: labour, intermediate good
  - Monopolistic competition
  - International market segmentation
  - Distribution costs
  - Nominal price stickiness
  - Mix of PCP and LCP

A medium-scale DSGE model with sticky prices

- Households:
  - Derive utility from leisure and consumption of final good
  - Habit persistence
  - Debt elastic interest rate on foreign bonds
  - Monopolistic competition in the labour market
  - Nominal wage stickiness
- Monetary authority: simple feedback rule
- Structural shocks: four mark-up shocks + shock to modified UIP condition

Simulation experiments

Design

1. Generate 5000 datasets of length $T = \{100, 200\}$ from log-linearised solution to DSGE model
2. Estimate VAR on each artificial dataset
3. Compute accumulated responses of prices to exogenous exchange rate shock identified using model consistent short-run identification scheme

Simulation experiments

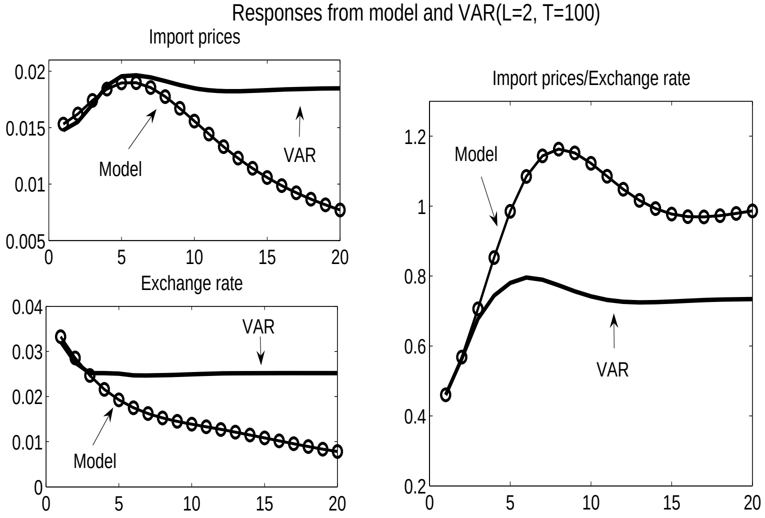
- VAR in first differences:

$$\Delta y_t = A_1 \Delta y_{t-1} + A_2 \Delta y_{t-2} + \cdots + A_p \Delta y_{t-p} + \varepsilon_t$$

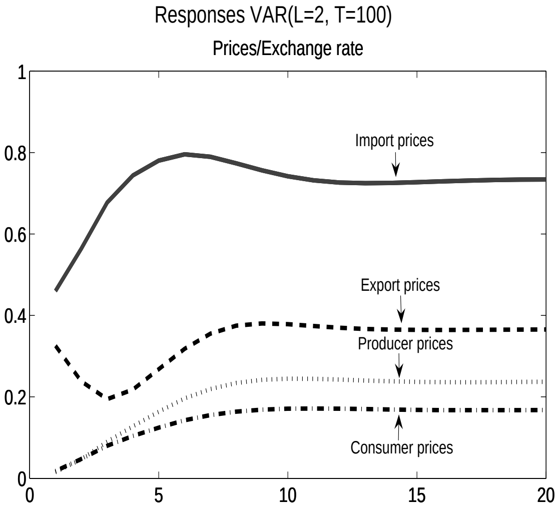
where

$$\Delta y_t' = \left\{ \Delta \ln P_t^m, \Delta \ln P_t^x, \Delta \ln P_t^y, \Delta \ln P_t^c, \Delta \ln S_t \right\}$$

- Focus on results for $L = 2$ and $T = 100$



Responses from model and VAR(L=2, T=100)
Import prices
Model
VAR
Exchange rate
VAR
Model
Import prices/Exchange rate
Model
VAR


Responses VAR(L=2, T=100)
Prices/Exchange rate
Import prices
Export prices
Producer prices
Consumer prices
0
0.2
0.4
0.6
0.8
1
0
5
10
15
20

- Decomposition of bias:
    1. Lag-truncation bias
    2. Small sample estimation bias
- Results:
    - Lag-truncation bias is main source of bias
    - Lag-truncation bias remains even for $L = 20$

Simulation experiments

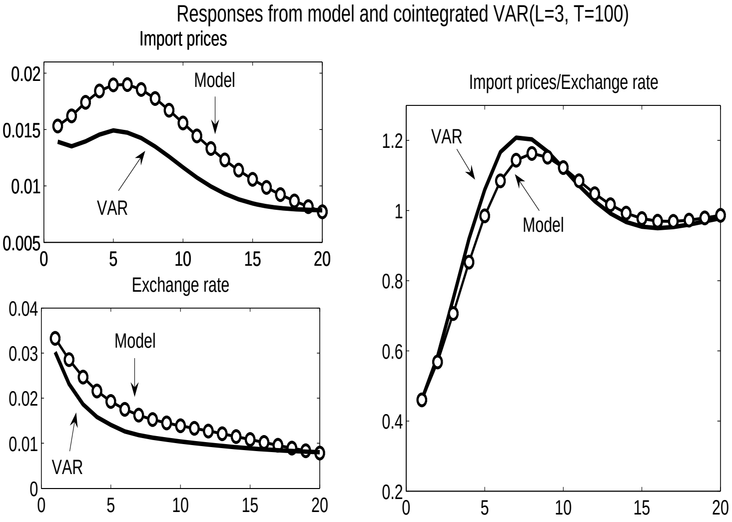
Results for cointegrated VAR

- VAR including cointegration relations

$$\Delta y_t = \alpha\beta' y_{t-1} + A_1^* \Delta y_{t-1} + A_2^* \Delta y_{t-2} + \ldots + A_p^* \Delta y_{t-p} + \varepsilon_t$$

with

$$\beta' y_{t-1} = \left\{ \begin{array}{c} \ln P_{t-1}^m - \ln P_{t-1}^c \\ \ln P_{t-1}^x - \ln P_{t-1}^c \\ \ln P_{t-1}^y - \ln P_{t-1}^c \\ \ln S_{t-1} + \ln P_{t-1}^f - \ln P_{t-1}^c \end{array} \right\}$$



Responses from model and cointegrated VAR(L=3, T=100)
Import prices
Model
VAR
Exchange rate
Model
VAR
Import prices/Exchange rate
VAR
Model

Simulation experiments

Can we detect the misspecification?

- General answer: Hard!
- Lag-order selection criteria do not detect the need for longer lags
- Autocorrelation tests do not reject more often than expected
- Cointegration tests (Johansen, 1988): In VAR($L = 3$, $T = 100$) in levels trace test suggests NO cointegration in 61.2% of the datasets

Concluding remarks

- Results indicate that first-differenced pass-through regressions and VARs exaggerate the sluggishness of prices in response to exchange rate movements
- We should be cautious to interpret the estimates from first-differenced pass-through models as stylised facts against which to evaluate DSGE models