Exchange Rate Movements, Firm-Level Exports, and Heterogeneity

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Discussion

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45” Summary

- This is the start of a very interesting paper, where Antoine, Vlad, and Emmanuel (AVE) provide results that should be valued by scholars in both international trade and international macro.
- The issue of interest is a classic one—estimation of the elasticity of trade (in this case, exports) to (real) exchange rate (RER) fluctuations.
- AVE exploit the richness of the CompNet database to perform a disaggregated empirical analysis of this issue.
- They find an average elasticity in line with values often used in the recent international macro literature (between 1 and 0.6).
- However, significant heterogeneity underlies this average:
  - Larger, more productive firms display lower elasticity (lower than 1),
  - while smaller, less productive firms are characterized by higher elasticity (above 1).
- Results are corroborated by a variety of robustness exercises.

Micro Elasticities versus Macro Elasticities

- My first comment concerns the possible relevance of different elasticities in the determination of the response of exports to relative prices when we separate substitutability between goods produced within each country (denoted with θ) from substitutability between the bundles of domestic and foreign goods (ω).

- In this environment, assuming for simplicity a world of two countries where foreign variables are denoted with an asterisk, the demand for exports facing Home producer z, denoted $d_H^*(z)$, is:

$$d_{H,t}^*(z) = \left(\frac{p_{H,t}^*(z)}{P_{H,t}^*}\right)^{-\theta} \left(\frac{P_{H,t}^*}{P_t^*}\right)^{-\omega} D_t^*,$$

  where $p_{H,t}^*(z)/P_{H,t}^*$ is the relative price of product z relative to the price of Home's export bundle in the Foreign country, $P_{H,t}^*/P_t^*$ is the relative price of Home's export bundle relative to the price of the overall Foreign consumption basket, and D_t^* is Foreign (real) consumption demand.

- This is a standard setup in international macro models.

- The product-level (or micro) elasticity θ determines the extent of firm-level monopoly power; in the language of Corsetti and Pesenti (*QJE* 01), the elasticity ω instead determines country-level monopoly power over the terms of trade.

Micro Elasticities versus Macro Elasticities, Continued

- Notice: If there is no heterogeneity across firms, $p^*_{H,t}(z) = P^*_{H,t}$ in equilibrium, so that equilibrium export demand is determined by

$$d^*_{H,t}(z) = \left(\frac{P^*_{H,t}}{P^*_t}\right)^{-\omega} D^*_t,$$

  and the only elasticity that matters for the responsiveness of exports to relative prices is the *macro* elasticity ω.

- This is the elasticity that is most crucial in international macro models for the determination of properties pertaining to shock transmission, risk sharing, and macroeconomic policy.

- $\omega = 1$ delivers perfect risk sharing under financial autarky via terms of trade movements (Cole and Obstfeld, *JME* 91; Corsetti and Pesenti, *QJE* 01).

- Corsetti, Dedola, and Leduc (*ReStud* 08) highlight the role of $\omega < 1$ in improving the quantitative performance of their model.

- AVE allow for different elasticities across producers in their estimation but, unless I misunderstood their exercise, they do not differentiate between producer-level elasticities and bundle-level elasticities.

- Does it matter?

Micro Elasticities versus Macro Elasticities, Continued

- Feenstra, Luck, Obstfeld, and Russ (2014—FLOR) estimate macro and micro elasticities in a more general nested C.E.S. preference structure.
- They focus on imports and use disaggregated U.S. data.
- They find that, for about half of the goods in their sample, estimation results are consistent with $\theta = \omega$ (AVE's assumption in their empirical export equation).
- But $\theta >> \omega$ for the other half of the goods in FLOR's sample.
- In the current draft of their paper, there is no clear pattern of producer-level productivity or size associated with this result (i.e., nothing clearly suggests that the goods for which $\theta >> \omega$ are those produced by smaller, less productive firms).
- It may be interesting and important for AVE to disentangle θ versus ω (and it may be similarly interesting and important for FLOR to investigate if there are producer characteristics that are systematically associated with $\theta = \omega$ or $\theta >> \omega$).

Short-Run versus Long-Run Elasticities

- A key facet of the question that AVE are addressing has to do with the fact that, at first sight, macro time series evidence that is used to calibrate international models of business cycle fluctuations suggests elasticities of trade to relative prices in the neighborhood of 1, while the evidence that is used to calibrate the comparative statics of (long-run) trade models in response to trade integration suggests elasticities considerably above 1.
- AVE argue that their results have the potential to reconcile these apparently conflicting pieces of evidence.
- Alessandria, Choi, and Ruhl (2014) develop a dynamic, general equilibrium model of trade with endogenous entry into domestic and export markets subject to sunk costs, with empirically plausible exporter growth dynamics.
- The model generates a short-run elasticity in the neighborhood of 1, and a considerably higher long-run elasticity.
- It may be because of the very early nature of the draft, but it was not clear to me if and how AVE account for the fact that there may be heterogeneity of elasticities in the time dimension.

In Search of a Theory

- AVE argue that the heterogeneity in elasticities across producers that they document is consistent with models with heterogeneous markups, where more productive firms optimally set higher markups and absorb RER fluctuations with smaller changes in their export sales.
- The model they suggest for interpreting their results is the Melitz-Ottaviano (*ReStud* 08) framework with quasilinear-quadratic preferences.
- The Melitz-Ottaviano model has many appealing features but, from a macroeconomist's perspective, it has the problem of not being amenable to work in dynamic, stochastic, general equilibrium (DSGE) macro models.
- An additional framework that AVE may want to consider, especially for marketing their findings to international macroeconomists, is Rodríguez-López's (*ReStud* 11—R-L) Melitz-type trade model with translog preferences.

Translog Melitz

- The translog expenditure function is given by:

$$\ln P_t = \frac{1}{2\sigma}\left(\frac{1}{N_t} - \frac{1}{\tilde{N}}\right) + \frac{1}{N_t}\int_{\omega\in\Omega_t} \ln p_t(\omega)\, d\omega + \frac{\sigma}{2N_t}\int_{\omega\in\Omega_t}\int_{\omega'\in\Omega_t} \ln p_t(\omega)\left(\ln p_t(\omega') - \ln p_t(\omega)\right) d\omega' d\omega, \tag{1}$$

  where $p_t(\omega)$ is the price of good ω, and $\sigma > 0$.

- σ is a scale parameter for substitutability across goods:
  - Higher σ implies higher substitutability for given number of goods available.
- The first term in the expenditure function decreasing in N_t implies that, for given product prices, unit expenditure decreases with the number of goods available.
  - As in the C.E.S. case, preferences exhibit love of variety.

Translog Melitz, Continued

- Taking the derivative of the expenditure function with respect to $\ln p_t(\omega)$—applying Shephard's lemma—yields the share of good ω in expenditure

$$s_t(\omega) = \sigma \ln\left(\frac{\hat{p}_t}{p_t(\omega)}\right),$$

where

$$\hat{p}_t = \exp\left(\frac{1}{\sigma N_t} + \widetilde{\ln p_t}\right)$$

is the maximum price (in Home currency) a firm can set and

$$\widetilde{\ln p_t} = \frac{1}{N_t}\int_{\omega' \in \Omega_t} \ln p_t(\omega')\, d\omega'.$$

- $s_t(\omega)$ is positive only when $p_t(\omega)$ is below $\hat{p}_t$ and is exactly zero when they are equal.
- The representative Home household's demand for good ω is then

$$c_t(\omega) = s_t(\omega)\frac{P_t C_t}{p_t(\omega)},$$

where C_t is consumption.

- Continuing to think in terms of a two-country model, analogous expressions hold in Foreign.

Translog Melitz, Continued

Price Setting

- I will focus on price setting for the domestic market, but the problem for the export price is similar.
- Taking $\hat{p}_t$ as given, the profit maximizing price in the home market solves:

$$\max_{p_t(\omega)} \left(p_t(\omega) - mc_t(\omega)\right) c_t(\omega),$$

  where $mc_t(\omega)$ is marginal cost of production.

- This yields

$$p_t(\omega) = \left(1 + \ln\left(\frac{\hat{p}_t}{p_t(\omega)}\right)\right) mc_t(\omega). \tag{2}$$

- Bergin and Feenstra (*JME* 00 and *JIE* 01) solve this equation through a linear approximation based on assuming small markups.
- R-L shows that the equation can be solved in closed form as follows.

Translog Melitz, Continued

- Define the Lambert W-function, here denoted F, as the inverse relation of the function $x = f(F) = Fe^F$.
- In other words, $F(x)$ solves

$$x = F(x)\, e^{F(x)},$$

  or, as R-L writes, if $x = ye^y$, we solve for y as $y = F(x)$.
- If x is a real number greater than or equal to zero, $F(x)$ is single-valued and such that $F'(x) > 0, F''(x) < 0, F(0) = 0, F(e) = 1$.
- Then, the solution for $p_t(\omega)$ is

$$p_t(\omega) = F\left(\frac{\hat{p}_t}{mc_t(\omega)}e\right) mc_t(\omega), \tag{3}$$

  where

$$F\left(\frac{\hat{p}_t}{mc_t(\omega)}e\right) = 1 \quad \text{when} \quad mc_t(\omega) = \hat{p}_t, \quad F\left(\frac{\hat{p}_t}{mc_t(\omega)}e\right) > 1 \quad \text{when} \quad mc_t(\omega) < \hat{p}_t,$$

  and firm ω does not produce for this market if $mc_t(\omega) > \hat{p}_t$.

Translog Melitz, Continued

- To obtain (3), observe that (2) can be rewritten as

$$\frac{p_t(\omega)}{mc_t(\omega)} + \ln p_t(\omega) = 1 + \ln \hat{p}_t.$$

- In turn, this implies

$$p_t(\omega)\, e^{\frac{p_t(\omega)}{mc_t(\omega)}} = \hat{p}_t e,$$

  or

$$\frac{p_t(\omega)}{mc_t(\omega)} e^{\frac{p_t(\omega)}{mc_t(\omega)}} = \frac{\hat{p}_t}{mc_t(\omega)} e.$$

- This has the form $x = ye^y$, where $x \equiv (\hat{p}_t / mc_t(\omega))\, e$ and $y \equiv p_t(\omega) / mc_t(\omega)$, and therefore it has solution

$$y = F(x), \quad \text{or} \quad \frac{p_t(\omega)}{mc_t(\omega)} = F\left(\frac{\hat{p}_t}{mc_t(\omega)} e\right),$$

  which yields (3).

Translog Melitz, Continued

- Let $\mu_t(\omega)$ denote the net markup charged by firm ω over marginal cost.
- Then,

$$p_t(\omega) = (1 + \mu_t(\omega)) mc_t(\omega),$$

where

$$\mu_t(\omega) \equiv F\left(\frac{\hat{p}_t}{mc_t(\omega)}e\right) - 1.$$

- Note that the markup is strictly decreasing with marginal cost (or strictly increasing with productivity) for $mc_t(\omega) \leq \hat{p}_t$, reaching zero when $mc_t(\omega) = \hat{p}_t$.
- R-L shows how this structure can be embedded in the Melitz trade model.
- This requires another non-trivial accomplishment, which is to redefine appropriately the market-share-weighted productivity averages that make it possible to solve the model in terms of averages as for Melitz's original model.

Translog Melitz in DSGE

- Next, R-L uses his translog-Melitz trade model as the microfoundation of a DSGE international macro model, showing (among other things) its empirically appealing properties for exchange rate pass-through and trade flow dynamics.
- R-L's model (and the use he makes of it in his paper) seems a natural candidate for a theoretical counterpart to AVE's empirical results with applicability in DSGE international macro analysis.

Endogenous Elasticity and the Estimation Equation

- While AVE's findings are consistent with a non-C.E.S. demand system, the equation they estimate has its roots in the C.E.S. system:
  - Export demand is assumed to be a function of a relative price and the overall demand for exports.
  - Even if additional controls and fixed effects are added, the C.E.S. "roots" of the equation appear evident.

Endogenous Elasticity and the Estimation Equation, Continued

- But if we believe the Melitz-Ottaviano quasilinear-quadratic model, or Rodríguez-López's translog model, shouldn't we make sure that the estimation equation is consistent also with the model we believe?
- For instance, the translog model implies that the price elasticity of demand is endogenous both across firms and over time, and it depends endogenously on a set of variables determined by the model we are working with.
  - Are all relevant variables accounted for by AVE's estimation?
- Estimation of a constant parameter in the appropriately specified equation would uncover the parameter σ of the translog specification (1).
- But the relative price elasticity of export demand would itself be a function rather than a constant.
- Embedding this in the estimation equation may also reconcile AVE's approach more tightly with Alessandria, Choi, and Ruhl's (2014) results on short- versus long-run elasticities.

Is the RER Really Exogenous?

- Especially for economies where a few disproportionately large exporters represent a large share of a country's exports, and, therefore, a large share of the export side of the country's trade balance, should we worry about having endogenous variables on both sides of the regression equations?
  - Put differently, is the RER really exogenous to the behavior of exporters in very granular small open economies?
- I would pay special attention to endogeneity, especially for granular small open economies, and correlation across regressors, especially if the estimation equation becomes more directly tied to general equilibrium modeling that implies a richer equation than the C.E.S. setup.

Conclusion

- This was a fun paper to read, and to consider the directions it could be taken toward.
- I am especially interested in how AVE's current and future results can help shape the design of international macro models with endogenous and heterogeneous flexible-price markups.