Ricardian Exchange Rate Redux

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2' Summary

- I greatly enjoyed reading this paper: Matthieu, Guillaume, Maury, and Kadee (MGMK below) have the beginning of an important contribution to the literature at the intersection of international trade and macroeconomics—and to the application of this literature to important policy questions.

- MGMK use disaggregated, bilateral trade data to document a set of interesting facts on pass-through of exchange rate movements into export prices:

1. Pass through is stronger for exports into developing economies (the "South").
   - Exporters (countries) from the advanced "North" display higher pass-through when they export to the "South" than when they export to the "North,"
   - and exporters from the "South" show higher pass-through when they export to the "South" than when they export to the "North."
2. At the firm level, pass-through is stronger for firms from the "North" exporting to the "South" than for firms from the "South" exporting to the "North."

- Intuition: All else equal, firms are more likely to face a (technologically) close competitor when selling to the "North" than when selling to the "South."

2' Summary, Continued

- The regressions that document this evidence are based on a partial equilibrium, Ricardian trade model with heterogeneous producers that builds on Atkeson and Burstein (*AER* 08), Eaton, Kortum, and Sotelo (12), and Murakōzy and Russ (14).
- The model features oligopolistic (Bertrand or Cournot) competition between "large" firms.
- Recent advances spearheaded by Kadee's work with Balazs Murakōzy make it possible to solve in closed form for how markups (and, therefore, pricing to market and pass-through) depend on the underlying distributions of firm-level productivity and unobservable frictions across firms competing in a market.
- The paper then presents the beginning of a dynamic, stochastic, general equilibrium (DSGE) version of the model that MGMK plan to use to study classic questions on welfare and the consequences of alternative exchange rate regimes and monetary policies in open economies.
- Beautiful!
- Given the distribution of my "productivity" between theoretical and empirical work, I will focus on the model in my comments. :-)
  - My only comment on the empirical work is that Berthou and di Mauro (VOX 15) have interesting, related results, and Berthou, Demian, and Dhyne (15) are also doing related work.

The Balance of Stats and Econ

- My first comment on the model is a minor quibble that I think follows from the very preliminary nature of the paper at this stage: It would be important in future drafts to put more emphasis on explaining the economic motivations for the distributional assumptions that MGMK make in setting up the model.
  - For instance, what does it imply/mean (in economic terms, not statistics) to assume that unobservable frictions obey a Gamma distribution?
  - Is there any evidence that can be used to motivate this assumption?
- I think increasing the economic content of the model presentation relative to just stating the statistical properties and implications of assumed distributions will avoid a situation where readers who are not familiar with other papers where this is done are left wondering how large a share of the results is hard-wired in pure statistical assumptions.

An Alternative Framework

- My second comment—on which I will spend the majority of this discussion—concerns the choice of a Ricardian framework with Bertrand or Cournot competition between firms of non-negligible size.
- There are very good reasons to work with this framework, but I think it will be important for future versions of the paper to do more to convince readers that the topic of interest cannot be studied, obtaining similar results and policy implications, using a framework that relies on monopolistic competition among a continuum of firms.
- It seems to me that the "translog-Melitz" model developed by Rodríguez-López (*ReStud* 11, R-L below) could provide an alternative foundation for the exercise.
- By assuming a continuum of firms, it avoids the usual questions about alternative possible strategic behaviors that arise when considering models with "large" firms (example: what about the possibility of collusion?).

An Alternative Framework, Continued

- I am going to review some ingredients of R-L's model below.
- For simplicity, consider a two-country model, as in R-L: Home and Foreign.
- The translog, unit expenditure function for the Home country 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, $\tilde{N}$ is the mass of goods over which preferences are defined, N_t is the mass of actually available goods (the mass of the set Ω_t), 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.

An Alternative Framework, Continued

- Taking the derivative of the expenditure function (1) 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.

- Analogous expressions hold in Foreign.

An Alternative Framework, 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.

An Alternative Framework, 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 $mc_t(\omega) > \hat{p}_t$.

An Alternative Framework, 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).

An Alternative Framework, 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 (*Econometrica* 03) 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.

An Alternative Framework, Continued

- 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 pricing to market, exchange rate pass-through, and trade flow dynamics.
  - R-L's DSGE model incorporates the nominal features of interest for MGMK's own DSGE model, so it can be a useful reference also from that perspective.
  - R-L assumes exogenous nominal rigidity.
  - While MGMK's model features a form of endogenous nominal rigidity, it remains to be seen from actual quantitative application of the DSGE version of their model how far this endogenous stickiness can go in capturing evidence.

An Alternative Framework, Continued

- R-L assumes that Home and Foreign firms draw their firm-specific productivity levels z upon domestic market entry from the same distribution $G(z)$, as in the benchmark Melitz model and many of its extensions and applications.
- However, one can build, for instance, on Demidova (*IER* 08) to allow for asymmetry in the distribution of productivity levels for Home and Foreign firms.
- Demidova differentiates Home and Foreign productivity distributions in terms of hazard rate stochastic dominance.
- This makes it possible to rank the expectations of increasing functions above some cutoff productivity level z^{cut}.
- In the case of markups (which are increasing in productivity in R-L), if $G_H(z)$ hazard-rate stochastically dominates $G_F(z)$ (capturing the idea that Home is a more advanced, "North" economy), $E_H\left(\mu\left(z\right) \mid z > z^{cut}\right) > E_F\left(\mu\left(z\right) \mid z > z^{cut}\right)$.
- Given a cutoff level z^{cut}, Home entrants have a better chance of drawing $z > z^{cut}$ than Foreign entrants, and they are expected to charge higher markups.

An Alternative Framework, Continued

- An “R-L+Demidova” model could be an alternative way of capturing much of what MGMK have in mind while sticking to monopolistic competition among a continuum of producers.
- There are reasons why we may still want to go with MGMK’s choice of framework (we believe in the empirical relevance of strategically interacting large firms; Ricardian comparative advantage is relevant for the countries we have in mind; others), but it would be great if the paper gave MGMK’s motivation for why we should prefer their modeling strategy to this alternative.

An Alternative Ricardian Framework

- Suppose we remain within the context of Ricardian comparative advantage.
- Then, another model that is relevant for what MGMK are doing is developed by Naknoi (*JME* 08).
- Naknoi uses the Dornbusch-Fischer-Samuelson (*AER* 77) Ricardian model as foundation for a DSGE international macro model with nominal rigidity.
- She uses the model to study (among other things) the consequences of different exchange rate regimes.
- Firms are price takers in Naknoi's model, but it provides an alternative way of embedding Ricardian trade features in a DSGE analysis of exchange rate regimes.
- It would be valuable if MGMK related their work also to this paper.

Within This Framework

- Given the choice ultimately to build a DSGE model with (Bertrand or Cournot) competition among “large” firms, there is also a set of papers in the closed-economy macroeconomic literature that is of relevance to what MGMK are doing.
- These papers extend work I did with Florin Bilbiie and Marc Melitz (*JPE* 12, *NBER Macro Annual* 08) and Florin Bilbiie and Ippei Fujiwara (*JME* 14) to environments with Cournot or Bertrand competition among firms of non-negligible size, including analysis of monetary policy.
- For instance: Colciago and Etro (*EJ* 10), Colciago and Rossi (*MD* 15), Etro and Rossi (*JEDC* 15), Faia (*JEDC* 12), and others.
- If the paper “pushes” the DSGE dimension for analysis of interaction between firms, shock transmission, and the properties of different monetary policies, it will be important to relate its approach and results also to this literature.

Within This Framework, Continued

- I also think that the choice of log-normally distributed, exogenous money growth incorporated in the initial steps toward the DSGE version of MGMK's model, while analytically convenient, may be excessively constraining in terms of delivering empirically appealing results.
- This specification of monetary policy makes it possible to obtain simple analytical results, and it may be useful to illustrate basic properties of the DSGE model.
- However, even without going into the analysis of optimal monetary policy as in Bergin and Corsetti (15) or Cacciatore and Ghironi (12), I would find it important to study at least also the consequences of simple forms of endogenous monetary policy such as simple specifications for endogenous interest rate setting by the central bank.

Within This Framework, Continued

- Endogenous interest rate setting has important implications for exchange rate determination, as shown, among others, by Benigno and Benigno (*JIMF* 08), Cavallo and Ghironi (*JME* 02), and, early in the relevant literature, McCallum (*JME* 94).
- It leads to de-emphasizing the demand for cash currency, which is central to exchange rate determination in MGMK's current setup.
- I would find the results under endogenous interest rate setting more interesting than those from the current specification.
  - And if people worry about the zero lower bound on interest rates, considering that problem would be a natural extension of the analysis to be pursued (in a different paper!) in the future.

Conclusion

- I am a huge fan of MGMK's research agenda.
- It connects evidence and theory, and it explores the importance of micro-level dynamics for macro phenomena that are classic questions of interest in international macroeconomics.
- Exchange rate regimes and monetary policy coordination (or lack thereof) have returned to center stage in academic and policy discussions.
- We need frameworks that allow us to understand the microeconomics of these issues—at a much deeper level than the basic New Keynesian model—in order to provide better policy advice.
- I view this paper, the related work by Bergin and Corsetti and by Matteo Cacciatore and myself, and the papers by Naknoi and Rodríguez-López mentioned above as valuable steps toward the development of such frameworks.