Fast Adjustments to Exchange Rate Shocks[1]

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Extended Abstract

We use the universe of U.S. international trade observed at the daily frequency to document how quickly exchange rate shocks pass-through to trade quantities and trade prices. By focusing on large, unanticipated exchange rate shocks and daily trade flows, our specifications rely on exogenous shocks for causal identification. Our results provide new evidence about the degree and speed of pass-through. We close with a discussion of the limited role for price rigidity, highlighting the importance of assumptions about firm-level pricing in models of international trade.

[1] The views expressed in this paper are those of the authors and do not necessarily reflect the views of the U.S. Census Bureau, the Board of Governors, or of any other person associated with the Federal Reserve System. All results have been reviewed to ensure that no confidential information is disclosed.

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Introduction

Equilibrium conditions link financial with real variables in several economic models. Researchers often observe financial variables at relatively high frequency (daily, intra-day, etc…) while observing real variables at low frequency (monthly or quarterly). This paper connects real variables in the form of trade flows with financial variables (exchange rates) at the daily frequency by constructing a dataset of bilateral daily imports and exports and combining it with bilateral exchange rate data. In this paper, we explain some basic features of the data including coverage across countries and products and how we control for complex seasonal patterns, before estimating the effects of exchange rate shocks on trade flows at an unprecedented daily frequency.

Our results are preliminary, but we show trade flows respond rapidly to exchange rate shocks and in directions that theory would predict. The contributions of this paper are severalfold. This paper constructs a daily trade flow database for 60 countries between 1993 and 2016, which forms the basis of our analysis. We also are able to study exchange rate pass-through at an unprecedented level of detail that builds upon previous work which studies both the elasticity and speed of pass-through (see Goldberg & Knetter 1997 for a nice overview of the literature). Previous studies on exchange rate pass-through have relied on monthly and quarterly data (Gopinath et al. 2010; Campa & Goldberg 2005). These studies have also exploited country heterogeneity (Burstein et al. 2005; Berman et al. 2012), product heterogeneity and firm heterogeneity (Amiti, Itskhoki and Konings 2014) in response to exchange rate shocks. Our work can exploit similar heterogeneity, but also look at how related party versus arms length transactions respond to exchange rate shocks, and mode-of-transport. The study that this work most closely resembles is that of Bonadio, Fischer and Saure (2018) who use daily frequency data to assess the impact of Switzerland's abandonment of the CHF-EUR peg.

Data

Trade data used in our study is provided by the Center for Economic Studies (CES) at the United States Census Bureau (Census) and runs from 1993 to 2016. We rely on both export and import transaction data from the Longitudinal Foreign Trade Transactions Database (LFTTD) which is collected by the U.S. Customs and Border Protection Bureau (CBP).

The LFTTD contains an export dataset (EXP) that consists of the universe of transactions during the exportation process and based on the date when the merchandise leaves the U.S.. The variables include export value, date, foreign destination, quantity, harmonized system (HS) code, and others. The LFTTD also includes imports (IMP) which consists of the universe of import transactions by firms operating in the U.S. and contains similar variables, with the addition of an "export" date which allows us to measure the duration of transit. Combined, the two datasets provide bilateral trade flows for more than 100 countries at transaction-level detail.

Much of our data work was focused on generating a tabulated dataset of daily trade flows for the 60 largest trade partners. While tabulating the data, we identified a couple of areas of concern where either the date reported is either incorrect or missing. For imports, there is a spike of transactions that occurs on the 15th of every month, while for exports, we find a relatively high share of missing export dates (month and year are recorded) that occurred prior to the arrival of electronic recording which became mandatory in the early 2000's.

To overcome these issues, we developed an imputation method where we first identified missing dates in the data. For imports, we identified that the bulk of transactions that occur on the 15th of every month are attributed to certain types of imports (namely "oil and gas") and modes of transport. Once we identify the missing dates, we compute the import and export shares by day -HS2-country within each month from the known (i.e. non-missing) transactions. We then allocated the missing daily trade values by these import and export shares uniformly (see Figure 1 for import example).

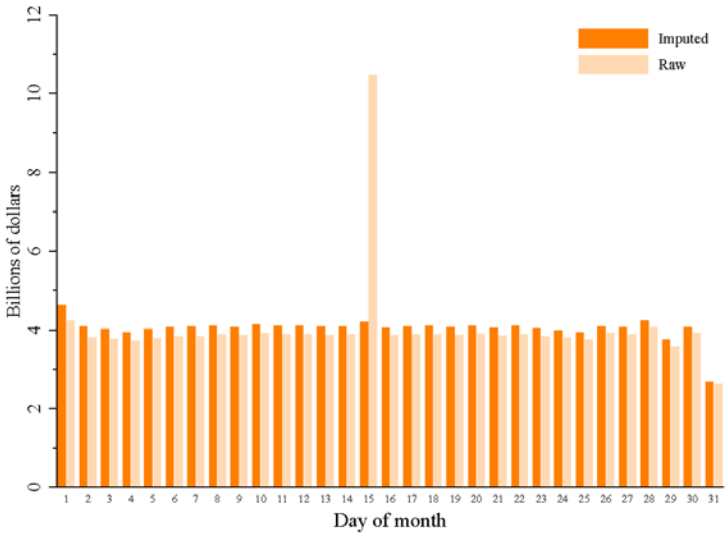


Figure 1: Imputed and Raw Import Values by Day of the Month

Once the imputation is complete, we can tabulate the data by day and begin the estimation process.

Estimation

Before beginning the estimation process, as with any high-frequency data, our trade data will be subject to noise and complex seasonal patterns. This becomes especially apparent the more detailed we go in the data (e.g. bilateral flows at a product-mode of transport-transaction type). The noise may be simply attributed to significant fluctuations in purchases or shipments made by large firms.

Seasonal patterns, on the other hand, may be attributed to multiple seasonality effects that occur at different frequencies. For instance, there are yearly effects, monthly effects (as identified in the previous section), weekly effects (weekends see significantly fewer transactions), holidays and that does not yet control for the partner country effects (e.g. if the partner country is on a Hijiri, Jewish, Hindu or Chinese calendar). Hence, to control for these complex seasonality effects, we incorporate the TBATS methodology from Livera, Hyndman and Snyder (2012), which has been used for forecasting complex seasonal time series with multiple seasonal periods, high-frequency seasonality and dual-calendar effects. This is a similar methodology as used in Auerbach & Gorodnichenko (2016) who apply it to daily defense outlays.

Once seasonality has been accounted for, we are left with a detrended set of flows from which we can assess the impact of significant movements in exchange rates. Our estimation procedure uses the impulse response by local projections methodology from Jorda (2005). Specifically, we estimate a series *h = 0, …. , H* regressions where

$$x_{t+h} - x_{t-1} = \alpha_h \Delta e_t + \sum_{i=1}^{I} \beta_i \Delta e_{t-i} + \sum_{j=1}^{J} \gamma_j \Delta x_{t-j} + f(t) + \varepsilon_t$$

Where

$x_{t+h} - x_{t-1}$ is the log difference in exports/imports over *h+1* periods

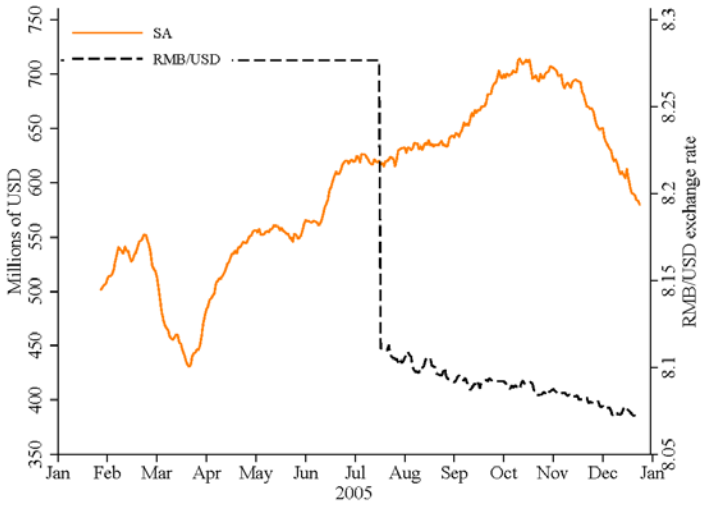
Δe_t is the log difference in exchange rate

Δx_{t-j} is the log difference in exports/imports

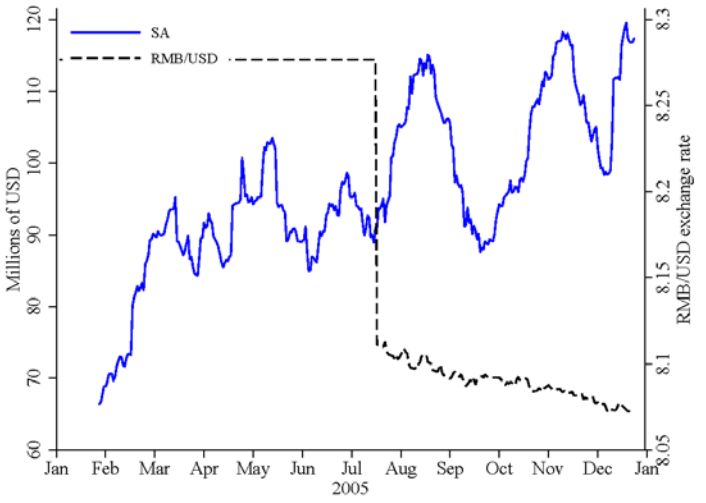
$f(t)$ is the orthogonal polynomial in time that controls for time trends

The sequence $\{\alpha_h\}_{h=0}^{H}$ is the impulse response for the outcome variable

For an example, we use the Renmibi revaluation that occurred on July 22, 2005. Below, we plot the actual import and export flows centered around the revaluation.

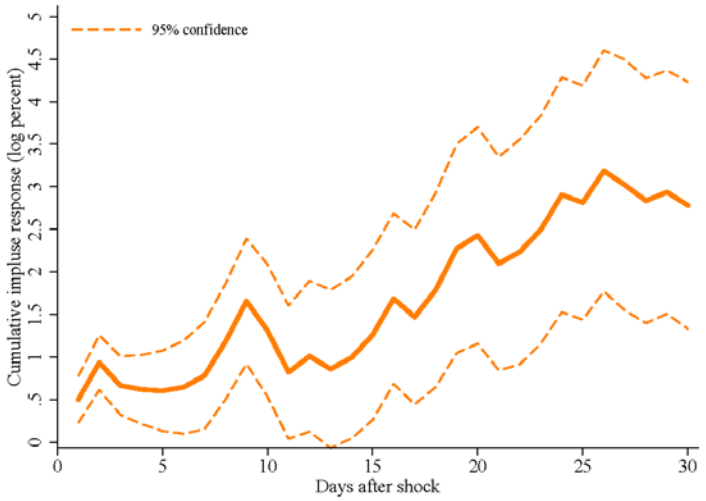


a. Chinese Imports and Exchange Rates

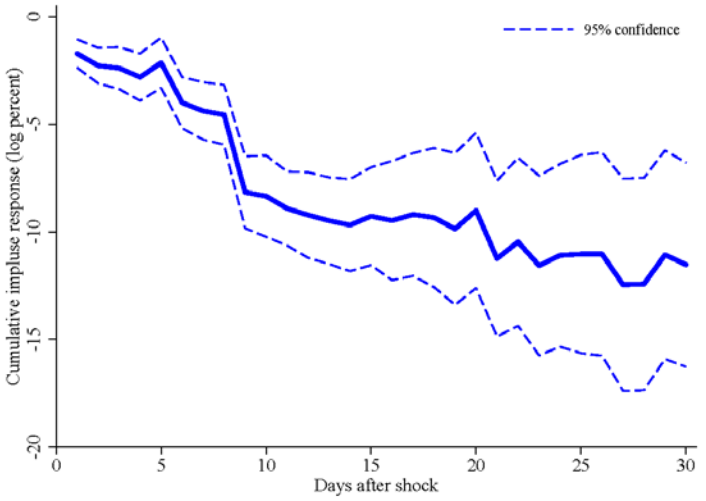


b. Chinese Exports and Exchange Rate

After implementing our seasonal adjustment and running the local projection, we get the following outcome.



a. Chinese Cumulative Import Response



b. Chinese Cumulative Export Response

Conclusion

To conclude, we have constructed to a daily import and export trade transaction database to assess the response of exchange rate shocks at a higher frequency than has been measured previously. Our new database uses an imputation to improve daily coverage and our paper provides some new stylized facts on daily trade flows. We control for complex seasonality patterns using the TBATS methodology and then are able to measure the cumulative impulse response from exchange rate shocks on imports and exports. We find that trade flows adjust quite rapidly (quicker than the previous literature would identify).

Reference

Amiti, M., O. Itskhoki, and J. Konings (2014, July). Importers, exporters, and exchange rate disconnect. American Economic Review 104 (7), 1942--78.

Auerbach, A. J. and Y. Gorodnichenko (2015, April). Effects of fiscal shocks in a globalized world. Working Paper 21100, National Bureau of Economic Research.

Bonadio, B., A. M. Fischer, and P. Saur´e (2016, March). The speed of exchange rate pass-through. CEPR Discussion Papers 11195, C.E.P.R. Discussion Papers.

Burstein, A. and G. Gopinath (2014). Chapter 7 - international prices and exchange rates. In G. Gopinath, E. Helpman, and K. Rogoff (Eds.), Handbook of International Economics, Volume 4 of Handbook of International Economics, pp. 391 -- 451. Elsevier.

Campa, J. M. and L. S. Goldberg (2005). Exchange rate pass-through into import prices. The Review of Economics and Statistics 87 (4), 679--690.

Gopinath, G., O. Itskhoki, and R. Rigobon (2010). Currency choice and exchange rate pass-through. American Economic Review 100 (1), 304--336.

Livera, A. M. D., R. J. Hyndman, and R. D. Snyder (2011). Forecasting time series with complex seasonal patterns using exponential smoothing. Journal of the American Statistical Association 106 (496), 1513--1527.