The Margins of US Trade

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The Margins of U.S. Trade

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Recent research in international trade emphasizes the importance of firms' extensive margins for understanding the overall pattern of world trade as well as how firms respond to specific events such as trade liberalization.[1] While initial interest concentrated on the extensive margin of firm entry and exit, subsequent theoretical research highlights the number of goods firms export, the number of countries to which they export, and even the frequency with which transactions are scheduled.[2] A key insight of this literature is that the extensive margins of trade can account for a large share of the variation in imports and exports across countries. The well-known "gravity" relationship between trade flows and distance, for example, is driven almost exclusively by the extensive margin: while the number of firms and the number of traded products decline significantly with distance, the intensive margin of average import or export value per firm-product, if anything, *increases*.[3]

We use detailed U.S. trade statistics to provide a broad overview of how the margins of trade contribute to differences in imports and exports across trading partners, types of trade (i.e., arm's-length versus related-party) and both short and long time horizons. We find that variation in imports and exports across trading partners is primarily due to extensive margins, while variation in trade across one-year intervals is dominated by the intensive margin. These seemingly divergent results can be reconciled by considering the small size of new entrants relative to incumbents and their subsequent relatively strong growth conditional on survival. Across five- and ten-year time horizons, we find

[1] A longer version of this paper, Andrew Bernard, J. Bradford Jensen, Stephen J. Redding and Peter K. Schott (2009), contains additional results and is available on the AER website and from the authors.

[2] See, for example, Marc J. Melitz (2003) and Bernard, Jonathon Eaton, Jensen and Samuel S. Kortum (2003), Bernard, Redding and Schott (2006a,b), Eaton, Kortum and Francis Kramarz (2008), and Eaton, Marcela Eslava, Maurice Kugler and James R. Tybout (2008).

[3] See Bernard et al. (2007).

that the relative contribution of extensive margins rises. Comparing arm's-length and related-party trade, we find the intensive margin to be relatively more influential for related-party trade in both the time series and the cross section.

We also investigate the behavior of U.S. exports and imports around the 1997 Asian financial crisis. While there are substantial changes in extensive margins around the crisis, the intensive margin accounts for the majority of the export declines and import increases. We find that related-party trade with Asia reacts quite differently to the crisis: both related-party exports and imports rise relative to arm's length flows due to strong growth in the intensive margin. These outcomes suggest multi-national firms may respond differently to macroeconomic shocks than arm's-length firms.

I. Data

We use the U.S. Linked/Longitudinal Firm Trade Transaction Database (LFTTD), which links individual U.S. trade transactions to U.S. firms.[4] For each export and import transaction, we observe the U.S. firm engaging in the transaction, the ten-digit Harmonized System (HS) classification of the product shipped, the (nominal) value shipped, the shipment date, the destination or source country, and whether the transaction takes place at "arm's length" (AL) or between "related parties" (RP).[5] Export (import) partners are "related" if either party owns, directly or indirectly, 10 percent (6 percent) or more of the other party.

As it is convenient for our analysis of the Asian crisis in Section III, which began in July 1997, we define year t throughout the paper as encompassing July through December of calendar year t and January through June of calendar year $t+1$.

II. Cross-Sectional Variation in U.S. Trade

[4] We match an average of 76 and 82 percent of the value of export and import transactions to firm identifiers, respectively, across the 1993 to 2003 horizon spanned by the data. The current version of the dataset is missing import data for July, 1993 and May, 1995 and export data for June, 1995. See Bernard, Jensen and Schott (2009) for a more details.

[5] HS categories are retired and created over the course of our sample. To eliminate spurious product adding and dropping due to these changes, we use a time-consistent set of HS codes developed by Justing R. Pierce and Schott (2009).

A striking feature of international trade data is the large cross-sectional difference across countries. In 2003, for example, U.S. exports to its largest trading partner were nearly 1700 times as large as its exports to the trading partner at the 25th percentile. This section investigates the contribution of intensive and extensive margins to these cross-sectional differences.

Aggregate U.S. trade with partner country c (x_c) can be decomposed into the unique number of firms that trade with the country (f_c), the unique number of products traded with the country (p_c), and the average value of trade per firm-product, $x_c/(f_c p_c)$. We include an additional term in our decomposition to account for the "density" of trade, i.e., the fraction of all possible firm-product combinations for country c for which trade is positive. Total trade to country c is then product of the number of trading firms, the number of traded products, the density of trade (d_c), and the average value of trade ($\overline{x}_c$), where $d_c = o_c/\left(f_c p_c\right)$, o_c is the number of firm-product observations for which trade with country c is above zero and $\overline{x}_c = x_c/o_c$ is the intensive margin. Density ranges from $\min\{1/f_c, 1/p_c\}$ to unity as the number of observations approaches the product of f_c and p_c. Since firms generally are active in only a small subset of the overall number of products traded, density is typically negatively correlated with the numbers of trading firms and traded products.[6]

The identity $x_c = f_c p_c d_c \overline{x}_c$ provides the basis for a regression decomposition of U.S. trade across countries for a particular year. Separately for both exports and imports, we regress the logarithm of each margin of trade on the logarithm of total trade. Given that OLS is a linear estimator and its residuals have an expected value of zero, the coefficients for each set of regressions sum to unity, with each coefficient representing

[6] As the number of firms and products grows across countries, the number of possible firm-product observations ($f_c p_c$) expands multiplicatively. If firms are active in a relatively constant subset of products across countries, the actual number of firm-product observations with positive trade will expand less than proportionately, causing density to decline. In that case, countries with larger f_c and p_c will have less dense trade, implying a negative correlation between density and the number of trading firms and traded products.

the share of the overall variation in trade explained by each margin.[7] In the extreme, if firms were each to export a different single product, and if each firm were to export a constant value of that product across countries, the coefficients on the extensive margins of firms and products would equal unity, the coefficient on density would equal minus unity, and the coefficient on the intensive margin would equal zero.

Table 1 reports the results of our regression decomposition for 2003. Each cell corresponds to a separate regression and the coefficients in each column sum to unity. Results for exports are reported in the first five columns. As indicated in the last row of the first column, the intensive margin explains an average of 22.6 percent of the variation in overall U.S. exports across destinations. Variation in the number of firms exporting (row 1) and the number of products exported (row 2), on the other hand, account for 69.4 and 58.8 percent of the variation, respectively. As discussed above, there is a negative coefficient on density of -0.508 (row 3) reflecting the fact that density is negatively correlated with the number of traded products, the number of trading firms and the aggregate value of U.S. trade. Nonetheless, the sum of the three extensive margin terms still accounts for the vast majority (77.4 percent) of the variation in overall exports.

The second and third columns of Table 1 report results for AL and RP trade separately, i.e., each column reports the contribution of each margin to variation in each type of exports. As shown in the table, the intensive margin is relatively more important for RP exports than AL exports (31.1 versus 21.1 percent). One potential explanation for this finding relates to the average U.S. multinational being active in a wider range of locations than the average AL firm. As a result, the intensive margins may be relatively more influential.

The second panel of Table 1 reports analogous results for U.S. imports. The firms in these decompositions refer to enterprises located in the U.S. that import goods from

[7] The regression decomposition can be transformed to extract additional information about the margins of trade. For example, the sum of the coefficients for density and the number of products yields the percentage contribution of the number of products per firm that are traded in positive amounts.

Table 1: Cross-Sectional Decompositions, 2003

	Exports			Imports		
Margin	Full Sample	RP	AL	Full Sample	RP	AL
Firms	0.694	0.591	0.711	0.580	0.475	0.619
	(0.016)	(0.017)	(0.017)	(0.016)	(0.015)	(0.017)
Products	0.588	0.598	0.605	0.543	0.511	0.577
	(0.015)	(0.017)	(0.016)	(0.016)	(0.016)	(0.018)
Density	-0.508	-0.500	-0.527	-0.441	-0.398	-0.476
	(0.015)	(0.016)	(0.015)	(0.013)	(0.013)	(0.015)
Intensive	0.226	0.311	0.211	0.318	0.412	0.279
	(0.017)	(0.018)	(0.017)	(0.018)	(0.018)	(0.020)
Countries	231	207	231	227	214	224

Note: Table reports OLS decompositions of U.S. exports and imports across trading partners along extensive and intensive margins. Each cell reports the mean contribution and standard error from a different regression. Data are for 2003. First column is for the full sample; second and third columns are restricted to related-party and arm's-length trade, respectively.

abroad, and *not* foreign firms located abroad that export to the United States. Therefore, in principle, results for U.S. importers could be quite different than those for U.S. exporters. Nevertheless, we find a strikingly similar pattern of results as for U.S. exports. The contribution of the intensive margin is somewhat higher for imports, perhaps reflecting the greater concentration of trade across importers than across exporters (Bernard, Jensen and Schott 2009). As with exports, however, we find that the intensive margin is relatively more important for RP imports than for AL imports.

III. Time-Series Variation in U.S. Trade

The change in aggregate U.S. trade between periods can be decomposed into two extensive margins and one intensive margin. The two extensive margins are firm entry and

exit and continuing firms' adding and dropping of new country-products.[8] The intensive margin is continuing firm-country-products' growth and decline. We note that entry and exit are defined with respect to trade participation and not domestic production.

Table 2 uses these categories to decompose nominal export growth in billions of U.S. dollars from 1993 to 2003. The first ten columns report annual changes while the final column reports the ten-year change. The first nine rows summarize the gross and net contributions of each margin in the order discussed above. The overall growth of exports – which is equal to the sums of each margin's net contribution – is reported in row 10. Finally, rows 12 through 14 report each margin's net contribution as a percent of the overall change in exports.

Short-run changes in U.S. exports are largely accounted for by the intensive margin. Over the 1993 to 2003 sample period, the intensive margin accounted for an average 101 percent of the year-to-year change in exports, ranging from a low of 46 percent for 1995 to 1996 to a high of 294 percent for 2001 to 2002.

One reason for the relatively small contribution of extensive margins over short time intervals is that entering and exiting exporters, as well as recently added and about-to-be-dropped product-countries, are on average relatively small compared to continuing exporters and product-countries. Conversely, conditional on survival, entering exporters and recently added product-countries grow more rapidly than incumbent exporters and product-countries (Eaton et al., Forthcoming). This interpretation is consistent with the results of the long-difference decomposition in the last column of the table. There, we find that the contribution of the intensive margin is 35 percent. As discussed in the longer version of this paper, the contribution of the intensive margin over both short and long time-intervals is more pronounced for related-party trade than for arm's-length

[8] The extensive margin of product-country adding can be further decomposed into three, non-mutually exclusive activities: adding an entirely new product or country; adding a new country for an existing product; and adding a new product for an existing country. Activities associated with product-country dropping are analogous.

Table 2: Time Series Decompositions, 1993 to 2003

		1993-1994	1994-1995	1995-1996	1996-1997	1997-1998	1998-1999	1999-2000	2000-2001	2001-2002	2002-2003	1993-2003
Entry -Exit	Exporter Births	6	8	14	8	9	12	11	40	10	9	166
	Exporter Deaths	-6	-6	-9	-13	-9	-12	-11	-15	-47	-8	-112
	Net Entry	0	2	5	-5	0	0	0	26	-38	1	55
Add-Drop	New Product-Country	48	62	62	65	62	72	79	55	65	73	181
	Retired Product-Country	-47	-47	-55	-57	-64	-56	-69	-76	-55	-59	-85
	Net Extensive	1	15	8	8	-2	16	10	-21	10	14	96
Inten-sive	Product-Country Growth	90	126	112	121	111	156	150	106	147	148	142
	Product-Country Decline	-75	-66	-101	-107	-122	-107	-120	-170	-106	-112	-62
	Net Intensive Margin	15	60	11	14	-11	49	30	-64	42	36	80
Total Change in Exports		16	77	24	17	-13	65	41	-60	14	50	231
Percent of Annual Growth Due to												
% Net entry and exit		2	2	22	-29	-2	-1	1	-42	-265	2	24
% Net add and drop		7	20	32	47	15	25	26	35	71	27	42
% Net intensive margin		91	78	46	82	87	76	74	107	294	71	35

Note : Top panel decomposes change in U.S. exports ($ billion) during the noted periods according to noted firm activities. Bottom panel reports percentage contribution of each net margin in terms of the total change in exports. Each column summarizes growth over the noted interval.

trade.

Another feature of the results is that the gross contributions of each margin of trade are substantially larger than their net contributions. This finding is consistent with the self-selection emphasized by heterogeneous-firm trade models. In those models, stochastic shocks to productivity or demand that are positive for some firms and negative for others implies that some firms will enter export markets or expand even as others withdraw or contract. The substantial contribution of product-country adding and dropping relative to firm entry and exit in Table 2 suggests that this heterogeneity and selection

occurs within as well as across firms, as emphasized by Bernard, Redding and Schott (2006a,b).

Firms' adding and dropping of product-countries provides a useful context for interpreting previous research on the importance of the *product margin* in countries' trade flows. Our findings suggest that a substantial share of countries' product adding and dropping occurs within continuing firms rather than through firms' entry and exit. Finally, as we find substantial net entry and product adding by firms within existing product-country trading pairs, our findings suggest that measures of the welfare effects of increasing product variety based on the number of product-country trading pairs likely understate the true level of gains.

As discussed in the longer version of this paper, a time-series decomposition of imports yields results comparable to those for exports. One reason for this similarity could be the pervasiveness of firms that both export and import. For these globally-engaged firms, a common change in the production process can affect the extensive margins of both exports and imports.

IV. The Asian Crisis

We examine how the margins of U.S. trade respond to a particular macroeconomic shock using the 1997 Asian financial crisis as an event study. We adopt a "differences-in-differences" specification comparing the treatment group of crisis countries to a "control" group of all other countries before and after July, 1997. For the purposes of this section we define the crisis countries to be Indonesia, Korea, Malaysia, the Philippines and Thailand.[9] We refer to the crisis countries as "Asia" and to the remaining, control-group countries as "rest-of-world" or "ROW".

The first two scatterplots in Figure 1 display the evolution of total, RP and AL exports to Asia and ROW around the crisis years. Each series is normalized to 100

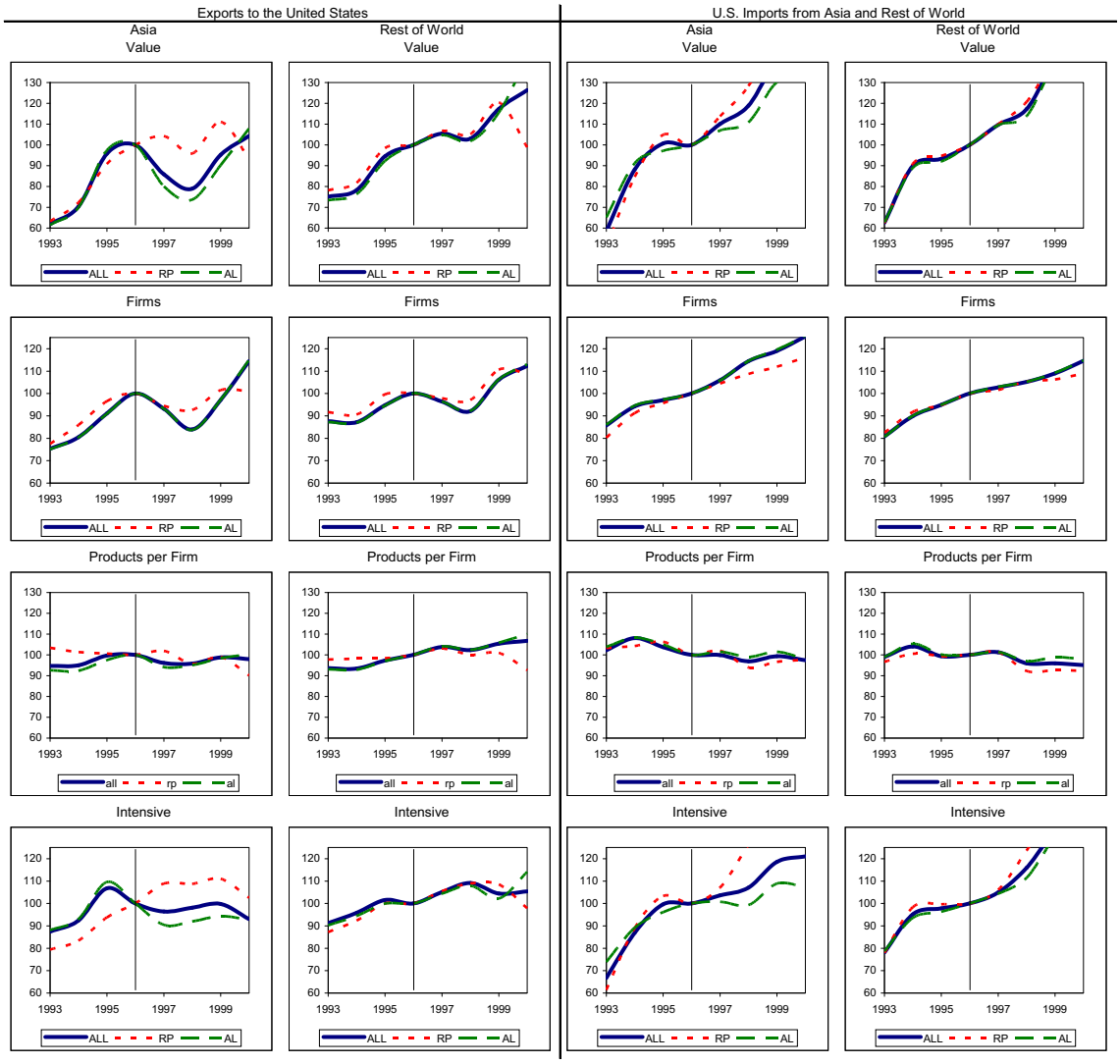
[9] Though these countries do differ from one another in some respects, they exhibit broadly similar responses to the crisis.

in 1996. Overall U.S. exports to Asia *declined* 21 percent between 1996 and 1998, while exports to ROW *increased* 17 percent. Within Asia, the decline in AL exports is substantially greater than the drop in RP exports, 26 versus 4 percent. For exports to ROW, the experience of AL and RP trade is similar.

Subsequent scatterplots in Figure 1 separate the aggregate response in U.S. exports into extensive and intensive margins using the cross-sectional decomposition discussed above. We display the results for three margins, combining the density and product margins into average products per exporting firm ($p_c d_c = o_c / f_c$) to conserve space. As indicated in the second and final rows of the figure, the number of firms exporting to Asia as well as their intensive margin decline substantially more than the respective margins for ROW (-16 versus -8 percent and -2 versus +9 percent, respectively). In terms of value, however, the intensive margin is much more influential, accounting for 66 and 41 percent of the decline in exports to Asia in 1997 and 1998, respectively. This dominance of the intensive margin in value terms – documented further in the longer version of this paper – is consistent with the time-series decompositions discussed above.

Within Asia, the number of exporting firms declines more sharply for AL than RP trade, -16 percent versus -6 percent from 1996 to 1998. A comparison of the intensive margins is even starker, -8 versus +9 percent for AL and RP, respectively. The shallower decline in the number of firms exporting to related parties as well as this increase in the intensive margin explains the less severe impact of the Asian crisis on overall RP exports. By comparison, the average export products per firm, displayed in the penultimate row of the figure, changes relatively little between 1996 and 1998 for either Asia or ROW.

The increase in U.S. imports from Asia from 1996 to 1998, reported in the third column of Figure 1, roughly mirrors the declining exports in the first column. Import growth is slightly stronger for Asia than ROW (19 versus 17 percent), and, within Asia, is stronger for RP than AL trade (28 versus 11 percent). Here, too, AL and RP trade differ most in terms of the reaction of their intensive margins (+26 versus -1 percent). Indeed,



Note: Figure displays evolution of noted margins of trade for Asian crisis countries versus rest-of-world countries from 1993 to 2000. The first two columns summarize U.S. exports to each region while second two columns summarize U.S. imports from each region. Products per firm is density multipled by products (see text). Asian crisis countries defined as Indonesia, Korea, Malaysia, the Philippines and Thailand. All series normalized to 100 in 1996.

Figure 1: Evolution of Asian Crisis-Country and Rest-of-World Trade Around the 1997 Asian Financial Crisis (1996=100)

the similar intensive-margin reactions of RP exports and imports suggests multinationals may have reallocated global production or adjusted internal pricing in response to the crisis.

V. Conclusions

The distinction between firms' extensive and intensive margins highlighted in recent theoretical research in international trade is central to our understanding of variation in trade across countries, over time and in response to macroeconomic shocks. Of particular interest is the differential behavior of related-party versus arm's-length trade. Additional examination of this difference, e.g., investigating whether it is due to price versus quantity responses, would be useful. Also helpful would be further theoretical research into the characteristics of firms and their external environment that shape the respective contributions of the extensive and intensive margins.

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