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THE MARGINS OF U.S. TRADE (LONG VERSION)

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**ABSTRACT**

Recent research in international trade emphasizes the importance of firms' extensive margins for understanding overall patterns of trade as well as how firms respond to specific events such as trade liberalization. In this paper, we use detailed U.S. trade statistics to provide a broad overview of how the margins of trade contribute to variation in U.S. imports and exports across trading partners, types of trade (i.e., arm's-length versus related-party) and both short and long time horizons. Among other results, we highlight the differential behavior of related-party and arm's-length trade in response to the 1997 Asian financial crisis.

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## 1. Introduction

Recent research in international trade emphasizes the importance of firms' extensive margins for understanding overall patterns of trade as well as how firms respond to trade liberalization. While initial interest concentrated on the extensive margin of firm entry and exit, subsequent theoretical research has highlighted the number of goods firms export, the number of countries to which they export, and even the frequency with which transactions are scheduled.<sup>1</sup> 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. Indeed, the well-known "gravity" relationship between trade flows and distance 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*.<sup>2</sup>

Guided by the recent theoretical literature, we use detailed U.S. trade statistics to provide a broad overview of how the margins of trade contribute to variation in U.S. 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 that the relative contribution of the 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 than arm's-length trade, with both related-party exports and imports rising relative to arm's length flows due to strong growth in their respective intensive margins. These outcomes suggest multinational firms may respond differently to macroeconomic shocks than arm's-length firms.

The remainder of the paper is structured as follows. Sections 2 and 3 provide brief overviews of the literature and our data, Sections 4 and 5 report our results, and Section 7 concludes.

## 2. Theoretical Background

Though the study of international trade has long encompassed analysis of the product margin, e.g., which countries specialize in which types of goods, investigation into the firm margin did not begin in earnest until firm-level data became available in the 1990s.<sup>3</sup>

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<sup>1</sup>See, for example, Melitz (2003), Bernard, Eaton, Jensen and Kortum (2003), Bernard, Redding and Schott (2006a,b), Chaney (2008), Eaton, Kortum and Kramarz (2008), and Eaton, Eslava, Kugler and Tybout (2008).

<sup>2</sup>See Bernard, Jensen, Redding and Schott (2007).

<sup>3</sup>Long and large literatures, for example, examine the country-industry predictions of the Heckscher-Ohlin model and "new" trade theory. See Leamer and Levinson (1995) for a survey of this research. More recent studies quantifying the impact of countries' extensive margins include Evenett and Venables (2002) and Hummels and Klenow (2005).

Theoretical interest in firms began in earnest with the heterogenous-firm models of Melitz (2003) and Bernard, Eaton, Jensen and Kortum (2003). In these models firms self-select into export markets on the basis of productivity, with only the most productive firms able to absorb the costs of exporting. Representative-firm models prior to these, e.g., Krugman (1980) assumed either all or no firms participated in trade, and that their level of trade responded to trade costs solely through the intensive margin.

Growing empirical evidence on the importance of multiple-product firms in both domestic production and trade has led to generalizations of heterogeneous-firm models in which firms are permitted to produce more than a single product.<sup>4</sup> This introduction of endogenous product selection gives rise to additional extensive margins, i.e., the number of products exported by the firm and the number of countries to which each firm-product combination is exported. In the framework of Bernard, Redding and Schott (2006a,b), product-market participation within firms is also governed by self-selection, with the relative costs of becoming an exporter, exporting each product, and exporting to each country influencing the relative importance of each margin.<sup>5</sup>

Theoretical guidance for the response of the extensive and intensive margins to macroeconomic shocks is more limited. A notable exception is Bilbe, Ghironi and Melitz (2007), in which the extensive margin of entry acts as an endogenous propagation mechanism in a Real Business Cycle setting.<sup>6</sup>

### 3. Data

We use the U.S. Linked/Longitudinal Firm Trade Transaction Database (LFTTD), which links individual U.S. trade transactions to U.S. firms. For each export and import transaction, we observe the ten-digit Harmonized System classification, the (nominal) value and quantity shipped, the shipment date, the destination or source country, the transport mode, and whether the transaction takes place at “arm’s length” or between “related parties”.<sup>7</sup> Export partners are “related” if either party owns, directly or indirectly, 10 percent or more of the other party. For imports, the ownership cutoff is 6 percent.

The LFTTD associates transactions in the trade data with firms’ legal identities, allowing firm entry and exit into export and import markets to be tracked over time. Across the 1993 to 2004 sample period, we are able to match an average of 76 and 82 percent of the value of export and import transactions to firm identifiers, respectively.<sup>8</sup>

As it is convenient for our analysis of the Asian crisis in Section 6., which began in July 1997, we define year  $t$  throughout the paper as encompassing July through December of

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<sup>4</sup>See, for example, Klette and Kortum (2004), Lentz and Mortenson (2005), Bernard, Redding and Schott (2006a,b), Eckel and Neary (2006), Nocke and Yeaple (2006), Arkolakis and Muendler (2008), Feenstra and Ma (2008), and Melitz and Ottaviano (2008).

<sup>5</sup>Analysis of firm participation in importing has been relatively scarce. Exceptions include Amiti and Davis (2008), Bernard, Jensen, Redding, and Schott (2007), Bernard, Jensen, and Schott (2009), Kasahara and Lapham (2008), and Ramanarayanan (2006). For theoretical research distinguishing between arms-length and related-party trade, see in particular Antràs (2003) and Antràs and Helpman (2004).

<sup>6</sup>Other related research emphasizes the role of sunk entry costs in influencing exporter dynamics, including Alessandria and Choi (2007) and Das, Roberts and Tybout (2007).

<sup>7</sup>HS categories are retired and created over the course of our sample. To eliminate spurious product-country adding and dropping due to these changes, we use a time-consistent set of HS codes developed by Pierce and Schott (2009).

<sup>8</sup>For a more detailed summary of the LFTTD, see Bernard, Jensen and Schott (2009). We note that the current version of the dataset is missing import data for July 1993 and May 1995 and export data for June 1995.

calendar year  $t$  and January through June of calendar year  $t + 1$ .

#### 4. Cross-Sectional Variation in U.S. Trade

Large cross-sectional variation in imports and exports across partner countries is a striking feature of international trade. 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 25<sup>th</sup> percentile. In this section, we investigate the contribution of the 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,  $x_c/(f_cp_c)$ . As firms generally are active in only a small subset of the overall number of products traded, 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. Thus, total trade to country  $c$  is the product of the number of trading firms, the number of traded products, the density of trade ( $d_c$ ), and the average value of trade ( $\bar{x}_c$ ),

$$x_c = f_cp_cd_c\bar{x}_c \tag{1}$$

where  $d_c = o_c/(f_cp_c)$ ,  $o_c$  is the number of firm-product observations for which trade with country  $c$  is above zero and  $\bar{x}_c = x_c/o_c$ , the intensive margin, is average value per observation with positive trade. 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.<sup>9</sup>

Equation (1) 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 the share of the overall variation in trade explained by each margin.<sup>10</sup>

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 four 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 (first row) and

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<sup>9</sup>As the number of firms and products grows across countries, the number of possible firm-product observations ( $f_cp_c$ ) 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.

<sup>10</sup>An advantage of the decomposition (1) is that it can be transformed in a number of ways to extract additional information about the margins of trade. Noting that the decomposition is log linear and  $d_c = o_c/(f_cp_c)$ , 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,  $o_c/f_c$ . Similarly, the sum of the coefficients for density and the number of firms yields the percentage contribution of the number of firms per product that trade positive amounts,  $o_c/p_c$ . Also if all firms export a single product,  $d_c = o_c/(f_cp_c) = 1/p_c$ , and therefore the coefficient for density equals minus the coefficient for the number of products. Similarly, if all firms export all products,  $d_c = o_c/(f_cp_c) = 1$ , and therefore the coefficient for density equals zero.

the number of products exported (second row), on the other hand, account for 69.4 and 58.8 percent of the variation, respectively.<sup>11</sup> As discussed above, there is a negative coefficient on density of -0.508 (third row) 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.<sup>12</sup> Summation of the product and density coefficients in the second and third rows of the table reveals an elasticity of 0.08, i.e., that approximately 8 percent of the variation in exports across trading partners can be attributed to the extensive margin of export products per firm ( $p_c d_c = o_c / f_c$ ).

Table 1: OLS Regression Decomposition of U.S. Exports and Imports Across Trading Partners, 2003

| Margin    | Exports           |                   |                   |                   | Imports           |                   |                   |                   |
|-----------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
|           | Full Sample       | RP                | AL                | Large Countries   | Full Sample       | RP                | AL                | Large Countries   |
| Firms     | 0.694<br>(0.016)  | 0.591<br>(0.017)  | 0.711<br>(0.017)  | 0.701<br>(0.028)  | 0.580<br>(0.016)  | 0.475<br>(0.015)  | 0.619<br>(0.017)  | 0.632<br>(0.045)  |
| Products  | 0.588<br>(0.015)  | 0.598<br>(0.017)  | 0.605<br>(0.016)  | 0.490<br>(0.031)  | 0.543<br>(0.016)  | 0.511<br>(0.016)  | 0.577<br>(0.018)  | 0.531<br>(0.031)  |
| Density   | -0.508<br>(0.015) | -0.500<br>(0.016) | -0.527<br>(0.015) | -0.405<br>(0.037) | -0.441<br>(0.013) | -0.398<br>(0.013) | -0.476<br>(0.015) | -0.455<br>(0.035) |
| Intensive | 0.226<br>(0.017)  | 0.311<br>(0.018)  | 0.211<br>(0.017)  | 0.214<br>(0.024)  | 0.318<br>(0.018)  | 0.412<br>(0.018)  | 0.279<br>(0.020)  | 0.292<br>(0.046)  |
| Countries | 231               | 207               | 231               | 22                | 227               | 214               | 224               | 22                |

Notes: Table reports 2003 OLS decomposition of variation in U.S. exports and imports across trading partners along four margins: the unique number of firms exporting to that destination, the unique number of products exported to that destination, the density of trade to that destination (observations divided by firms times products) and the intensive margin of average value per observation. Each cell reports the result of a different regression, i.e., each cell reports the coefficient and standard error on the logarithm of export or import value as noted in the text. First column is for the full sample, second and third are restricted to related-party and arm's-length trade, respectively, and fourth and fifth columns are restricted to OECD countries and the trade of the largest ten percent of firms, respectively.

The second and third columns of Table 1 report results for arms-length and related-party 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 related-party exports than arm's-length 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 final column for exports in Table 1 restricts analysis to large countries, i.e., the first 22 members of the OECD. We find the product margin to be relatively less important in the large-country sample than overall (49.0 versus 58.8 percent), perhaps because firms export similar sets of products across the relatively homogeneous markets of the OECD.

<sup>11</sup> While our use of firm-product-country data permits an analysis of the extensive margins of both firms and products, our results for the contributions of these two margins are consistent with previous findings from the literature that has considered each margin separately. Eaton, Kortum and Kramarz (2008) find a cross-country elasticity of the number of French exporting firms with respect to market size of 0.65. Hummels and Klenow (2005) find a cross-country elasticity of the number of products exported with respect to importing country GDP of 0.61.

<sup>12</sup> Results for other years are similar. For the full sample of countries from the first column of Table 1, the contributions of firms, products, density and the intensive margin over the period 1993 to 2003 range from 0.694 to 0.725, 0.588 to 0.644, -0.565 to -0.508, and 0.196 to 0.226, respectively.

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 abroad, and *not* foreign firms located abroad that export to the United States. Though, in principle, results for U.S. importers could be quite different from those for U.S. exporters, we nevertheless find a strikingly similar pattern of intensive- and extensive-margin contributions across samples. Relative to exports, the contribution of the intensive margin is higher for imports, perhaps reflecting the fact that the concentration of trade among importers is higher than that among exporters (Bernard, Jensen and Schott 2009). Like with exports, however, we find that the intensive margin is relatively more important for related-party imports than for arm's-length imports.

Taken together, our OLS decompositions reveal that most of the variation in U.S. trade across countries is due to the number of firms that trade and the number of products that are traded. Results are broadly similar across imports and exports, across arms-length, and related-party trade and for trade with the OECD versus all trading partners.

## 5. Time-Series Variation in U.S. Trade

Having characterized the contributions of the intensive and extensive margin across countries, we now examine their contribution to variation in U.S. exports and imports over time. The change in aggregate U.S. trade between periods  $t - 1$  and  $t$ ,  $\Delta x_t$ , can be decomposed into the increase due to the entry of new trading firms, the decrease due to the exit of existing trading firms, and the change due increases or decreases in trade at continuing firms,

$$\Delta x_t = \sum_{f \in N} x_{ft} - \sum_{f \in E} x_{ft-1} + \sum_{f \in C} \Delta x_{ft}, \quad (2)$$

where  $f$  indexes firms,  $N$  is the set of new firms entering trade,  $E$  is the set of existing firms exiting trade, and  $C$  is the set of firms continuing to trade. We note that entry and exit are defined with respect to trade participation and not domestic production.

The change in trade at continuing firms,  $\sum_{f \in C} \Delta x_{ft}$ , can be further decomposed into changes due to the adding and dropping of country-products, and the growth and decline of continuing country-products,

$$\Delta x_{ft} = \sum_{j \in A_f} x_{fjt} - \sum_{j \in D_f} x_{fjt-1} + \sum_{j \in G_f} \Delta x_{fjt} + \sum_{j \in S_f} \Delta x_{fjt}, \quad (3)$$

where  $j$  indexes country-product trade relationships,  $A_f$  is the set of country-product trade relationships added by firm  $f$ ,  $D_f$  is the set of country-product trade relationships dropped by firm  $f$ ,  $G_f$  is the set of country-product trade relationships with growing trade for firm  $f$ , and  $S_f$  is the set of country-product trade relationships with shrinking trade for firm  $f$ .

Our time-series decomposition gives rise to two extensive margins and one intensive margin. Trading firm entry and exit is captured by the first two terms in (2). Continuing firms' switching of country-products is represented by the first two terms in (3). The intensive margin is summarized by the final two terms in (3). The extensive margin of product-country adding encompasses 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. The three activities associated with product-country dropping are analogous. While it is possible to decompose product-country adding and dropping along these dimensions, we do not do so here in the interests of brevity.

Table 2 decomposes nominal export growth in billions of U.S. dollars from 1993 to 2003. The first ten columns report annual changes, the next two columns report two five-year changes (1993 to 1998 and 1998 to 2003), and the last column the ten-year change (1993 to 2003). The first nine rows summarize the gross and net contributions of each margin in the order discussed above. The overall growth of exports over the noted interval – which is equal to the sums of each margin’s net contribution in that interval – 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.

Table 2: Decomposition of Changes in U.S. Exports Over Time

|    |  | 1993-1994                 | 1994-1995 | 1995-1996 | 1996-1997 | 1997-1998 | 1998-1999 | 1999-2000 | 2000-2001 | 2001-2002 | 2002-2003 | 1993-1998 | 1998-2003 | 1993-2003 |      |
|----|--|---------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------|
| 1  | Exporter Entry and Exit                | Exporter Births           | 6         | 8         | 14        | 8         | 9         | 12        | 11        | 40        | 10        | 9         | 60        | 131       | 166  |
| 2  |  | Exporter Deaths           | -6        | -6        | -9        | -13       | -9        | -12       | -11       | -15       | -47       | -8        | -38       | -108      | -112 |
| 3  |  | Net Entry                 | 0         | 2         | 5         | -5        | 0         | 0         | 0         | 26        | -38       | 1         | 22        | 24        | 55   |
| 4  | Product-Country Switching              | New Product-Country       | 48        | 62        | 62        | 65        | 62        | 72        | 79        | 55        | 65        | 73        | 127       | 138       | 181  |
| 5  |  | Retired Product-Country   | -47       | -47       | -55       | -57       | -64       | -56       | -69       | -76       | -55       | -59       | -92       | -103      | -85  |
| 6  |  | Net Extensive             | 1         | 15        | 8         | 8         | -2        | 16        | 10        | -21       | 10        | 14        | 35        | 35        | 96   |
| 7  | Intensive Margin                       | Product-Country Increases | 90        | 126       | 112       | 121       | 111       | 156       | 150       | 106       | 147       | 148       | 144       | 158       | 142  |
| 8  |  | Product-Country Decreases | -75       | -66       | -101      | -107      | -122      | -107      | -120      | -170      | -106      | -112      | -80       | -107      | -62  |
| 9  |  | Net Intensive Margin      | 15        | 60        | 11        | 14        | -11       | 49        | 30        | -64       | 42        | 36        | 64        | 51        | 80   |
| 10 | Total Change in Exports                |                           | 16        | 77        | 24        | 17        | -13       | 65        | 41        | -60       | 14        | 50        | 121       | 110       | 231  |
| 11 | Percent of Annual Growth Due to        |                           |           |           |           |           |           |           |           |           |           |           |           |           |      |
| 12 | % Net entry and exit (rows (1+2)/10)   |                           | 2         | 2         | 22        | -29       | -2        | -1        | 1         | -42       | -265      | 2         | 18        | 21        | 24   |
| 13 | % Net add and drop (rows (4+5)/10)     |                           | 7         | 20        | 32        | 47        | 15        | 25        | 26        | 35        | 71        | 27        | 29        | 32        | 42   |
| 14 | % Net intensive margin (rows (7+8)/10) |                           | 91        | 78        | 46        | 82        | 87        | 76        | 74        | 107       | 294       | 71        | 53        | 46        | 35   |

Notes: Data are from the LFTTD. Top panel decomposes total change in U.S. exports (\$ billion) during the noted periods according to noted firm activities. Rows 1 to 3 summarize the contribution of firm entry into and exit from the export market. Rows 4 to 6 summarize changes in firms’ product-country combinations. Rows 7 to 9 summarize the growth and decline of continuing product-country exports at continuing exporters. 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.

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 high of 294 percent for 2001 to 2002 and a low of 46 percent for 1995 to 1996. The averages for the entry-exit and add-drop margins, in contrast, are -31 and 31 percent, respectively. Excluding years around the U.S. recession, i.e., 2000 to 2002, we find the average contribution of entering and exiting firms to be negligible. Excluding these years, 76 percent of export growth on average is due to the intensive margin, while 25 percent on average is accounted for product-country switching.

One reason for the relatively small contribution of extensive margins over short time horizons 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., 2008). This interpretation is consistent with the results of the long-difference decompositions in the last three columns of the table. There, we find that the contributions of the intensive margin are 53 to 46 percent in the five-year differences and 35 percent in the ten-year difference. Over both short and long time-intervals, the contribution of the intensive margin (not shown) is more pronounced for related-party trade than for arm’s-length trade. Its average contribution for related-party trade is 93 percent for annual changes and 41 percent for ten-year changes.

A second message of Table 2 is that the gross contributions of each margin of trade are larger than their net contributions. This phenomenon, referred to as “excess reallocation” in

the labor literature by Davis and Haltiwanger (1992), is also consistent with the self-selection emphasized by heterogeneous-firm trade models. In those models, stochastic shocks to productivity that are positive for some firms and negative for others imply that some firms will enter export markets or expand even as others withdraw or contract. Relatedly, the relatively strong contribution of product-country adding and dropping versus firm entry and exit in Table 2 provides additional support for models emphasizing heterogeneity and selection within firms such as Bernard, Redding and Schott (2006a,b).

Our ability to observe firms' adding and dropping of product-countries provides a useful context for interpreting previous efforts to discern the importance of the *product margin* in countries' trade flows by, for example, Evenett and Venables (2002), Hummels and Klenow (2005) and Kehoe and Ruhl (2008). As apparent from our results, a substantial share of countries' product adding and dropping occurs within continuing firms rather than through firms' entry and exit. Additionally, 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 (e.g., Broda and Weinstein 2006) likely understate the true level of gains.<sup>13</sup>

A final message emerging from Table 2 is that substantial macroeconomic shocks such as the 2001 U.S. recession and the 1997 Asian financial crisis are clearly evident in aggregate trade data, a topic we pursue further in the next section.

Table 3 reports a similar decomposition exercise with respect to imports. As with the cross-section results discussed above, the pattern of results for imports is very similar to that for exports. One possible reason for this similarity is that a substantial amount of US trade is undertaken by firms that both export and import, for which there can be a direct relationship between the extensive margins of exports and imports (e.g. if a firm drops an exported final product that uses an imported intermediate input).<sup>14</sup>

## 6. The Asian Crisis

In this section 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" approach, 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.<sup>15</sup> We refer to the crisis countries as "Asia" and to the remaining, control-group countries as "rest-of-world" or "ROW".<sup>16</sup>

<sup>13</sup>To the extent that HS categories are too broad to discern the adding and dropping of even more disaggregate product varieties, the true contribution of the extensive margin may be even greater than in Table 2. Recent research by Schott (2004), Hummels and Klenow (2005) and Hallak and Schott (2008), for example, highlights horizontal and vertical differentiation within ten-digit HS categories.

<sup>14</sup>Again if we exclude years around the U.S. recession, 2000-2001 and 2001-2002, we find that import growth is dominated by the expansion of imports by firms in existing product-country pairs, 89%, with a smaller role for new product-country pairs by existing importers, 14%.

<sup>15</sup>While individual crisis countries clearly differ from one another in some respects, they exhibit broadly similar responses to the crisis across margins, motivating our aggregation of them into a single treatment group. Results appear robust to variation in the set of crisis countries. Our findings are substantially similar, for example, if we focus on just Indonesia, Korea and Thailand.

<sup>16</sup>One concern about our choice of control group is that the treatment group could differ from other U.S. trade partners along dimensions other than the occurrence of a crisis in 1997. In principle, we could construct an alternative control group of countries with similar observable characteristics to the treatment group except for the absence of a crisis. In practice, we find that the treatment group exhibit similar trends

Table 3: Decomposition of Changes in U.S. Imports Over Time

|    |  | 1993-1994                 | 1994-1995 | 1995-1996 | 1996-1997 | 1997-1998 | 1998-1999 | 1999-2000 | 2000-2001 | 2001-2002 | 2002-2003 | 1993-1998 | 1998-2003 | 1993-2003 |      |
|----|--|---------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------|
| 1  | Importer Entry and Exit                | Importer Births           | 9         | 10        | 23        | 16        | 16        | 14        | 13        | 80        | 16        | 16        | 142       | 249       | 318  |
| 2  |  | Importer Deaths           | -7        | -7        | -13       | -24       | -12       | -19       | -17       | -28       | -94       | -43       | -61       | -253      | -149 |
| 3  |  | Net Entry                 | 2         | 3         | 9         | -8        | 4         | -5        | -5        | 52        | -79       | -27       | 81        | -4        | 169  |
| 4  | Product-Country Switching              | New Product-Country       | 75        | 65        | 62        | 84        | 68        | 77        | 83        | 91        | 77        | 252       | 262       | 401       |      |
| 5  |  | Retired Product-Country   | -62       | -56       | -79       | -70       | -58       | -58       | -66       | -88       | -80       | -65       | -139      | -141      | -131 |
| 6  |  | Net Extensive             | 13        | 9         | -17       | 14        | 10        | 20        | 17        | 3         | -4        | 12        | 113       | 121       | 270  |
| 7  | Intensive Margin                       | Product-Country Increases | 205       | 137       | 165       | 168       | 181       | 261       | 224       | 146       | 273       | 241       | 206       | 245       | 175  |
| 8  |  | Product-Country Decreases | -51       | -123      | -120      | -114      | -148      | -137      | -184      | -273      | -134      | -168      | -60       | -127      | -41  |
| 9  |  | Net Intensive Margin      | 154       | 14        | 44        | 54        | 33        | 124       | 40        | -127      | 139       | 73        | 146       | 118       | 135  |
| 10 | Total Change in Imports                |                           | 169       | 26        | 37        | 60        | 47        | 140       | 52        | -72       | 56        | 59        | 339       | 235       | 574  |
| 11 | Percent of Annual Growth Due to        |                           |           |           |           |           |           |           |           |           |           |           |           |           |      |
| 12 | % Net entry and exit (rows (1+2)/10)   |                           | 1         | 13        | 25        | -13       | 10        | -3        | -9        | -72       | -139      | -46       | 24        | -2        | 29   |
| 13 | % Net add and drop (rows (4+5)/10)     |                           | 8         | 34        | -45       | 24        | 21        | 14        | 32        | -4        | -7        | 21        | 33        | 51        | 47   |
| 14 | % Net intensive margin (rows (7+8)/10) |                           | 91        | 54        | 120       | 90        | 69        | 89        | 77        | 176       | 246       | 125       | 43        | 50        | 23   |

Notes: Data are from the LFTTD. Top panel decomposes total change in U.S. imports (\$ billion) during the noted periods according to noted firm activities. Rows 1 to 3 summarize the contribution of firm entry into and exit from the import market. Rows 4 to 6 summarize changes in firms' product-country combinations. Rows 7 to 9 summarize the growth and decline of continuing product-country imports at continuing importers. Bottom panel reports percentage contribution of each net margin in terms of the total change in imports. Each column summarizes growth over the noted interval.

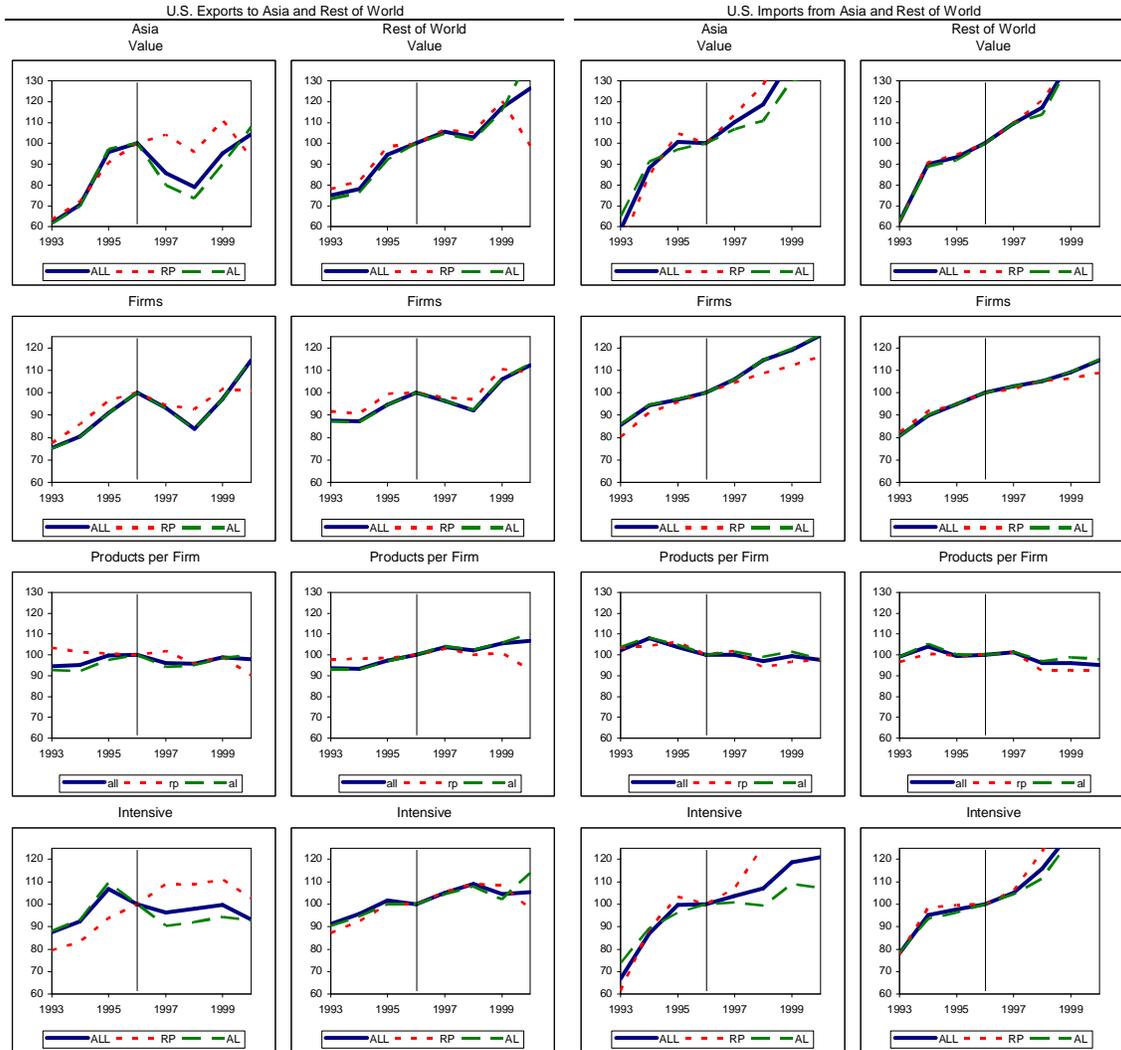
The first two scatterplots in Figure 1 display the evolution of total, related-party (RP) and arm's-length (AL) exports to Asia and ROW around the crisis years. Each series is normalized to 100 in 1996. Overall U.S. exports to Asia *declined* 21 percent between 1996 and 1998, while exports to ROW *increased* 3 percent. Within Asia, the decline in AL exports was substantially greater than the drop in RP, 26 versus 4 percent by 1998. For exports to ROW, the experience of arm's-length and related-party trade is similar.

Subsequent rows in the left panel of Figure 1 separate the aggregate response of trade for Asia and ROW into three components – firms, products per firm and intensive – using the cross-sectional decomposition terms from equation (1). Here, products per firm ( $o_c/f_c = p_c d_c$ ) is the result of multiplying the density and product extensive margins. As indicated in the second and final rows of scatters, the number of firms exporting to Asia as well as their intensive margin decline substantially more than they do for ROW (-16 versus -8 percent and -2 versus +9 percent, respectively).

Within Asia, the number of exporting firms declines more sharply for AL than RP trade, -16 percent versus -7 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 number of products exported 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 1996 to 1998, reported in the last two columns of Figure 1, roughly mirrors the decline in exports in the first two columns. 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, the similar intensive-margin reactions of RP exports and imports suggest multinationals may have reallocated global production or adjusted internal pricing in response to the crisis.

in the margins of trade to all other U.S. trade partners prior to 1997, which motivates our choice of all other U.S. trade partners as the control group.



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 multiplied 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)

While the panels of Figure 1 are useful for summarizing the behavior of the margins of trade relative to their own past, they do not describe the relative contribution of each margin to overall changes in export or import value. For that we turn to Tables 4 and 5, which repeat the time-series decompositions from Section 5 for the crisis countries as a group.

Table 4: Decomposition of Changes in U.S. Exports to Asian Crisis Countries Over Time

|    |  | 1993-1994 | 1994-1995 | 1995-1996 | 1996-1997 | 1997-1998 | 1998-1999 | 1999-2000 | 2000-2001 | 2001-2002 | 2002-2003 |
|----|--|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| 1  | Exporter                               |           |           |           |           |           |           |           |           |           |           |
| 2  | Entry and Exit                         |           |           |           |           |           |           |           |           |           |           |
| 3  |  |           |           |           |           |           |           |           |           |           |           |
| 4  | Product-Country                        |           |           |           |           |           |           |           |           |           |           |
| 5  | Switching                              |           |           |           |           |           |           |           |           |           |           |
| 6  |  |           |           |           |           |           |           |           |           |           |           |
| 7  | Intensive Margin                       |           |           |           |           |           |           |           |           |           |           |
| 8  |  |           |           |           |           |           |           |           |           |           |           |
| 9  |  |           |           |           |           |           |           |           |           |           |           |
| 10 | Total Change in Exports                | 3.3       | 10.0      | 1.6       | -5.6      | -2.7      | 6.4       | 3.6       | -4.6      | 2.5       | 4.3       |
| 11 | Percent of Annual Growth Due to        |           |           |           |           |           |           |           |           |           |           |
| 12 | % Net entry and exit (rows (1+2)/10)   | 5         | 6         | 13        | 12        | 20        | 8         | 13        | -32       | -77       | 14        |
| 13 | % Net add and drop (rows (4+5)/10)     | 14        | 22        | 37        | 22        | 39        | 12        | 33        | 28        | 2         | 25        |
| 14 | % Net intensive margin (rows (7+8)/10) | 81        | 72        | 51        | 66        | 41        | 80        | 54        | 105       | 175       | 60        |

Notes: Data are from the LFTTD. Top panel decomposes total change in U.S. exports (\$ billion) during the noted periods according to noted firm activities. Crisis countries are Indonesia, Korea, Malaysia, the Philippines and Thailand. Rows 1 to 3 summarize the contribution of firm entry into and exit from the export market. Rows 4 to 6 summarize the growth and decline of continuing product-country exports at continuing exporters. Rows 7 to 9 summarize changes in firms' product-country combinations. 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.

Exports to the crisis countries declined by \$5.6 and \$2.7 billion in 1997 and 1998, respectively, before recovering in 1999. Imports from Asia, on the other hand, increased by \$5.8, \$5.1 and \$12.6 billion in the three years following the crisis. In both cases, we find the intensive margin to be most influential in these changes, though the contribution of the extensive margin to 1998 export declines was substantially higher than in other years. More broadly, the pattern of relatively large percentage changes in the extensive margin accounting for relatively small shares of the changes in the value of overall trade is consistent with the idea that exiting firms are small relative to those that survive.

## 7. 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 the nature of goods encompassed by each type of trade, or 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.

Table 5: Decomposition of Changes in U.S. Imports from Asian Crisis Countries Over Time

|    |  | 1993-1994 | 1994-1995 | 1995-1996 | 1996-1997 | 1997-1998 | 1998-1999 | 1999-2000 | 2000-2001 | 2001-2002 | 2002-2003 |  |
|----|--|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|--|
| 1  | Importer Births                        | 1.0       | 1.3       | 2.1       | 2.5       | 2.2       | 2.5       | 1.8       | 8.5       | 1.8       | 1.9       |  |
| 2  | Importer Deaths                        | -0.9      | -1.0      | -2.0      | -1.9      | -2.3      | -1.8      | -2.2      | -3.5      | -10.8     | -2.0      |  |
| 3  | Net Entry                              | 0.1       | 0.3       | 0.1       | 0.6       | -0.1      | 0.8       | -0.4      | 5.0       | -9.0      | -0.1      |  |
| 4  | New Product-Country                    | 6.3       | 9.0       | 5.0       | 6.0       | 4.9       | 6.0       | 7.8       | 6.8       | 5.1       | 4.9       |  |
| 5  | Retired Product-Country                | -5.4      | -4.7      | -11.7     | -4.8      | -4.2      | -4.8      | -5.2      | -10.0     | -5.0      | -4.5      |  |
| 6  | Net Extensive                          | 0.9       | 4.3       | -6.7      | 1.2       | 0.7       | 1.1       | 2.6       | -3.2      | 0.1       | 0.5       |  |
| 7  | Product-Country Increases              | 20.7      | 14.1      | 17.4      | 16.3      | 18.7      | 24.7      | 21.9      | 16.0      | 26.7      | 22.7      |  |
| 8  | Product-Country Decreases              | -4.6      | -11.5     | -11.2     | -12.2     | -14.2     | -14.0     | -19.9     | -26.2     | -15.0     | -16.0     |  |
| 9  | Net Intensive Margin                   | 16.1      | 2.6       | 6.2       | 4.0       | 4.5       | 10.7      | 2.0       | -10.2     | 11.7      | 6.7       |  |
| 10 | Total Change in Imports                | 17.1      | 7.2       | -0.4      | 5.8       | 5.1       | 12.6      | 4.2       | -8.4      | 2.8       | 7.1       |  |
| 11 | Percent of Annual Growth Due to        |           |           |           |           |           |           |           |           |           |           |  |
| 12 | % Net entry and exit (rows (1+2)/10)   | 1         | 5         | -15       | 10        | -2        | 6         | -9        | -59       | -325      | -1        |  |
| 13 | % Net add and drop (rows (4+5)/10)     | 5         | 59        | 1,715     | 21        | 14        | 9         | 62        | 39        | 3         | 7         |  |
| 14 | % Net intensive margin (rows (7+8)/10) | 94        | 36        | -1,600    | 70        | 88        | 85        | 47        | 121       | 422       | 94        |  |

Notes: Data are from the LFTTD. Top panel decomposes total change in U.S. imports (\$ billion) from the crisis countries during the noted periods according to noted firm activities. Crisis countries are Indonesia, Korea, Malaysia, the Philippines and Thailand. Rows 1 to 3 summarize the contribution of firm entry into and exit from the export market. Rows 4 to 6 summarize the growth and decline of continuing product-country imports at continuing importers. Rows 7 to 9 summarize changes in firms' product-country combinations. Bottom panel reports percentage contribution of each net margin in terms of the total change in imports. Each column summarizes growth over the noted interval.

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