Trade Prices and the Global Trade Collapse of 2008–2009*

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Abstract

We document the behavior of trade prices during the Great Trade Collapse of 2008-2009 using transaction-level data from the U.S. Bureau of Labor Statistics. First, we find that differentiated manufactures exhibited marked stability in their trade prices during the large decline in their trade volumes. Prices of non-differentiated manufactures, by contrast, declined sharply. Second, while the trade collapse was much steeper among differentiated durable manufacturers than among non-durables, prices in both categories barely changed. Third, the frequency and magnitude of price adjustments at the product level changed with the onset of the crisis, consistent with a state-dependent view of price adjustment. The quantitative magnitudes of the changes, however, were not pronounced enough to affect aggregate prices. Our findings present a challenge for theories of the trade collapse based on cost shocks specific to traded goods that work through prices.

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1 Introduction

The financial crisis and global recession of 2008-2009 was associated with a dramatic collapse in world international trade, in excess of the fall in production and significantly larger than the fall in GDP.[1] The empirical literature has primarily focused on trade values—the product of prices and quantities—and therefore is consistent with large declines in prices, quantities, or both. The details of whether adjustment came about through prices or quantities matter not only in order to better understand the large trade collapse but also because they may improve our understanding of the sources of the recession. To address this we use highly disaggregated data on U.S. import and export prices during the Great Recession from the U.S. Bureau of Labor Statistics (BLS) and compare them to the behavior of U.S. trade values over that period.

We emphasize three findings for the peak period of the trade collapse, which for concreteness we consider here to be the period from August 2008 to March 2009. First, while the dollar price of non-differentiated goods declined by 17 percent for both exports and imports, the price of differentiated goods declined only by around 1 percent for imports and 0.5 percent for exports. The 30 percent decline in the trade value of differentiated goods therefore was almost entirely a quantity phenomenon.

Second, though durable differentiated manufactures experienced a significantly larger decline in trade values than non-durables, the average magnitude of price changes on differentiated durables was 1 percent or less, effectively the same as for non-durables. The only categories that experienced large declines in prices were non-manufactures, consumer non-durables, and durable intermediates, presumably sectors that include a lot of commodities or goods with large commodity content. The contrasting behavior of differentiated versus non-differentiated goods carries through for different end-uses and different source and destination countries.

Third, there were changes in the frequency and size of price adjustment, even for differentiated goods, that coincided closely with the start of the crisis. In particular, the absolute size of price adjustment and the fraction of changing prices in a given month increased during the period of trade collapse. Furthermore, the fraction of price increases out of all price changes decreased, while the fraction of price decreases rose. Although noticeable, these differences

[1] This collapse is frequently referred to as the "Great Trade Collapse," a term which appears to have been first used in Baldwin (2009).

in price-setting behavior were not quantitatively large enough to result in considerable price declines for differentiated goods, consistent with the first observation above.

A number of theories explaining the large disruption in trade have been put forth. As emphasized in Alessandria, Kaboski, and Midrigan (2010b), many of these explanations imply increases in the relative price of imported to domestically sourced goods, even within the same tradable sector. For example, Chor and Manova (2012), Amiti and Weinstein (2010), and a large subsequent literature emphasize the implications of tighter credit conditions for international trade values or volumes.[2] Chor and Manova (2012) find that during the recent trade collapse, U.S. imports declined by more from exporting countries which experienced greater increases in their borrowing costs (proxied for by the interbank rate). Further, they found that this effect was stronger in sectors more intensively requiring credit. Amiti and Weinstein (2010) demonstrate that when the health of banks which provide financing to Japanese exporters deteriorates, the value of exports by those firms also deteriorates, even relative to the value of their domestic sales.[3]

Exports may be more credit or trade finance intensive than domestic sales. An increase in the price of credit might therefore have a disproportionate impact on export prices. Since U.S. demand for imports of a given category of good is likely insensitive to conditions in and relations with the exporting country other than through the import price, the above explanations imply a strong negative correlation between declines in relative import volumes and relative import prices at disaggregated levels.[4]

Simply put, if p^{mi} represents import prices in sector i, then assuming a CES demand specification with elasticity of demand denoted by θ, the relative demand for imports in sector k relative to k' can be expressed as,

$$\frac{v^{mk}}{v^{mk'}} = \left(\frac{p^{mk}}{p^{mk'}}\right)^{1-\theta} \cdot \left(\frac{p^{dk'}}{p^{dk}}\right)^{-\theta} \cdot \frac{d^k}{d^{k'}}, \tag{1}$$

where p^{di} represents domestic prices, $v^{di} = p^{di}q^{di}$ represents total spending on imports, and

[2]See also Auboin (2009), Campbell, Jacks, Meissner, and Novy (2009), and Bricongne, Fontagne, Gaulier, Taglioni, and Vicard (2011).

[3]Their primary results are estimated using data that preceeds the 2008-2009 crisis, though they extend and extrapolate their results to apply them to the recent trade collapse.

[4]An increase in tariffs would also cause firms to shift sourcing from foreign to domestic suppliers by distorting relative prices. Early in the crisis, there were concerns that explicit protectionism might be the culprit, though a subsequent consensus has formed ruling out this explanation (see, for example, Kee, Neagu, and Nicita, 2012).

d^i represents domestic demand, in sector i. In the data we document, within differentiated goods, large movements in $v^{mk}/v^{mk'}$ are associated with negligible movements in $p^{mk}/p^{mk'}$. This implies that explanations of the trade collapse consistent with price facts have to rely on movements in relative domestic prices, $p^{dk'}/p^{dk}$, and/or relative domestic sector demand, $d^k/d^{k'}$. It is not consistent with explanations that rely mainly on trade specific cost shocks, such as financing being more important for international rather than domestic trade, as that would require variations in $p^{mk}/p^{mk'}$ to be the main driver of relative import quantities.

Our result that variation in price changes account for almost none of the variation in quantity changes in differentiated sectors therefore argues against the importance of explanations emphasizing trade financing and other export costs. We in fact corroborate the evidence presented in Ahn, Amiti, and Weinstein (2011) that U.S. manufacturing export prices rose relative to the manufacturing producer price index (PPI), but our evidence suggests that such a comparison is done at too aggregated a level to reach strong conclusions. Price movements were concentrated in non-differentiated goods sectors. Further, differentiated goods continued to exhibit a high degree of nominal ridigity through the crisis and conditional on changing, they did not often increase. The relative price movements in the overall indices, therefore, more likely reflected changing commodity prices than trade financing difficulties for differentiated manufacturers.

Other explanations of the trade collapse are not inconsistent with the relative stability of import prices. For example, Alessandria, Kaboski, and Midrigan (2010b) calibrate a model in which imported inventories decline more than domestic inventories due to fixed costs of trade. Eaton, Kortum, Neiman, and Romalis (2010) use a gravity model with a global input-output structure to attribute the bulk of the decline to a collapse in the share of final spending on durables (both traded and domestically sourced). Since durables represent a disproportionate share of trade, this compositional change generates a decline in trade relative to GDP. These explanations need not imply that import prices rise relative to domestic prices in the same good category.

There are a few previous papers that also study trade prices during the recent global recession. Levchenko, Lewis, and Tesar (2010) show the real and nominal declines in U.S. imports and exports for 10 to 15 end-use industries. Outside of commodity sectors (and sectors intensive in the use of commodities as inputs), they find prices to have been relatively stable. Haddad, Harrison, and Hausman (2010) look at the movement in unit values which they calculate at the 6-digit level. For differentiated goods imported into the United States, they find that prices slightly increased. Behrens, Corcos, and Mion (2012) look at unit values for trades with Belgium and find that price declines played a moderate role in the overall decline in Belgian trade. They consider differences in the decline of trade values for differentiated and non-differentiated goods, but do not consider the differential behavior of prices across those categories.

Our departure from these papers is that we use BLS good-level price data as compared to unit values or aggregated price indices. We can therefore distinguish between market and intra-firm transactions, better observe differences in the prices charged for differentiated and non-differentiated goods, and speak to the frequency of price adjustment and behavior of prices when conditioned on a price change. By observing price series for particular goods we can isolate price changes from shifts in quality or composition within each sector.

Finally, aside from our focus on the recent crisis, our work relates to other papers which consider the dynamic properties of prices over the business cycle. Consistent with our findings, Gagnon (2009) demonstrates that the frequency of overall price changes in Mexico was relatively stable during their low inflation episodes despite large variation in growth rates, in large part due to offseting movements in the frequency of price increases and in the frequency of price decreases. Berger and Vavra (2011) and Vavra (2012) document comovement between price change frequencies and price dispersion in BLS micro data on consumer prices, which they show is countercyclical. We do not find such clear evidence for the cyclical behavior of the overall adjustment frequency in the BLS micro data on trade prices.

The next section provides a brief description of our dataset. Section 3 contains our main findings on the behavior of export and import prices during the trade collapse, both at the aggregate and across sectors and countries. We compare the changes in trade prices with key macroeconomic variables, such as exchange rates, commodity prices, and producer prices, paying particular attention to differences between differentiated and non-differentiated goods and between durable and non-durable goods. We also document differences in price responses between arm's length and related-party transactions. Next, in Section 4, we study the mechanics behind movements in these average prices, including the frequency of price increases and decreases and the magnitude of the typical price change. Finally, we consider alternative margins of adjustment, including substitutions or terminations of existing products. Section 5 provides our concluding remarks.

2 Data on Trade Prices and Trade Volumes

This paper uses transaction-level micro data on trade prices obtained from surveys administered by analysts in the BLS' International Pricing Program (IPP) from 1993 to 2009. As reported in Gopinath and Rigobon (2008) and Neiman (2010), the BLS IPP aims to measure prices each month for a set of more than 20,000 goods that are representative of the universe of all imports and exports. Taken over the 17 years of dataset, the dataset covers roughly 60,000 different goods and well more than 1 million prices, after removing most imputed or estimated prices which are not considered "usable" by the BLS and which we do not include in our analysis. Observations are generally taken at a level of disaggregation refered to by the BLS as an "item code", which is constituted by the combination of a good categeory more disaggregated than the 10-digit level and a particular importer or exporter firm. For additional details on the characteristics of the BLS data, see Gopinath and Rigobon (2008).[5]

Figure 1 depicts our construction of the import and export price indices and compares them to the corresponding BLS indices. We constructed the trade price indices used in these plots and elsewhere in this paper using an unweighted average of price changes in market transactions, excluding outliers.[6] While this methodology does not conform exactly with that used in the BLS' aggregated price indices, Figure 1 demonstrates the close fit of our constructed indices with their "non-oil import" and "nonagricultural commodity export" price series. At the time of writing this paper, we could not obtain micro data subsequent to 2009, but note from the BLS' aggregate data that the steady upward movement of aggregate import and export prices shown at the end of Figures 1(a) and 1(b) continued from mid-2009 through early 2011 when the rate of price growth stabilized at close to zero.

The BLS IPP data are concorded with a 10-digit harmonized system code (HS), which

[5]See also the data descriptions in Gopinath, Itskhoki, and Rigobon (2010), Gopinath and Itskhoki (2010), Mandel (2010), Nakamura and Steinsson (2012), and Auer and Schoenle (2012), which also make use of these data.

[6]For imports, we exclude price changes of a magnitude greater than 2 log points. For exports, the handling of outliers makes less of a difference. We include all prices as this generates the best fit with the BLS series. We construct our measures without weights because the use of a consistent set of weights over the full time period covered by our data is unavailable (the weighting procedure used for the indices reported by the BLS IPP has changed over time and we could not access all components of their weighting calculations). The lack of weighting downplays the contribution of the homogenous goods to the price indices, and hence the BLS counterparts that we track are the Non-oil import price and the Non-agricultural commodity export price series. Consistent with the BLS' treatment, we measure price changes for continuing goods and ignore the observations on the date of entry or exit into the dataset. Section 4.2 discusses further the extensive margin over this period.

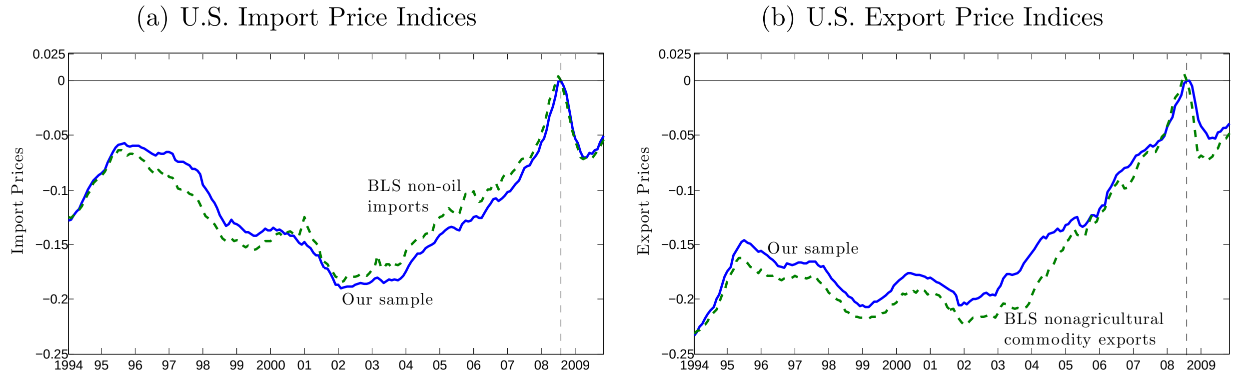

Figure 1: Comparison of GIN and BLS Trade Price Indices

Notes: *Log of import and export price indices in U.S. Dollars; August 2008 values normalized to zero (marked by vertical dashed line). Solid lines correspond to average trade prices aggregated using micro-level data from our sample and dashed lines correspond to official BLS indices available from their website.*

we use to match at the 4-digit level with data on trade volumes publicly available from the U.S. International Trade Commission (ITC). These data on trade values from the ITC are monthly and exclude services. They are not seasonally adjusted.[7] We also use the 4-digit HS codes to match with the 2007 version of the Rauch (1999) classification, downloaded from Jon Haveman's International Trade Data web page. We divide imports and exports into differentiated and non-differentiated goods using this Rauch classification, where we consider goods traded on an "Organized Exchange" or with "Reference Prices" to be non-differentiated.

We use the concordance from Eaton, Kortum, Neiman, and Romalis (2010) to classify goods as non-manufacturers, durable manufactures, and non-durable manufactures, as well as to distinguish among these manufactures those that are capital, intermediate, or consumer goods. The concordance for these definitions is available at the 2-digit HS level and indicates what fraction of the sub-sectors in each 2-digit sector falls into each category. We label any given good as belonging to a category if the concordance suggests the label at the 2-digit level applies to more than 70 percent of the sub-sectors. If no category captures more than 70 percent of the 2-digit aggregate, we leave that sector unmarked. Therefore, for all our analyses, the combination of subcategories need not total the full set of prices. For example, some goods are labeled as neither differentiated nor non-differentiated, and the decline in "all" prices need not always lie between the declines in differentiated and non-differentiated good prices.

[7]Seasonally adjusted data are not available at the disaggregated level used for these categories.

3 The Behavior of Export and Import Prices

We start by examining the aggregate import and export price indices. One feature of the data is the large and highly correlated swing in both export and import prices. Figure 2 plots the log of U.S. import and export price indices, measured in U.S. dollars and normalized to zero in August 2008, along with indices capturing the price of oil, the U.S. dollar's trade-weighted exchange rate, and U.S. manufacturing producer prices (PPI). Starting in 2002, the dynamics of all these indices are very closely correlated. After a long period of increase (alongside with U.S. dollar depreciation), they all peaked in July or August 2008, and then sharply declined during the following six months. For example, import and export prices were growing at an annual rate of about 2.5 percent from 2002 to July 2008, then decreased a bit more than 5 percent between September 2008 and March 2009, and finally quickly regained about half of this decline by the end of 2009. The 11 percent decline in the manufacturing U.S. PPI during the corresponding crisis months was twice as large. The swing in oil prices (plotted against the right y-axis) was largest, with prices during the crisis dipping to a level

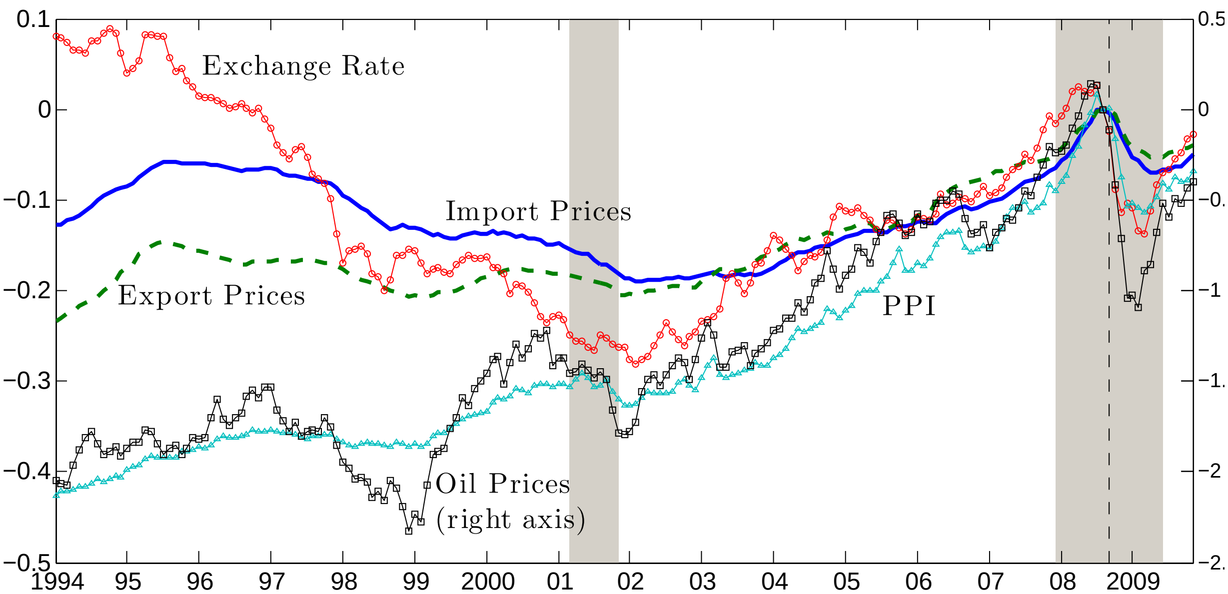

Figure 2: Trade Prices, Producer Prices, Oil Prices, and the Exchange Rate

Notes: *Log index series with August 2008 values normalized to zero (vertical dashed line, marking the beginning of the acute phase of the crisis). Shaded areas mark NBER recession dates (March to November 2001 and December 2007 to June 2009). Exchange Rate is broad trade-weighted exchange rate index from FRED (red line marked with circles); Oil Prices are spot WTI crude oil prices (right axis; black line marked with squares). Blue thick solid line corresponds to Import, green thick dashed line corresponds to Export, and cyan line marked with triangles corresponds to Producer price indices. Import and Export price indices are aggregated using our sample, while PPI is the official series taken from the BLS website.*

66 percent below their peak.

These large swings in import and export prices are closely correlated with movements of the U.S. trade-weighted exchange rate, which steadily depreciated between 2002 and July 2008 at an annual rate of 4.5 percent and then appreciated sharply by 15 percent between August 2008 and March 2009. This was followed by a rapid depreciation, although the U.S. trade-weighted exchange rate remained by the end of 2009 more than 5 percent above its July 2008 level. This pattern is representative of most U.S. bilateral exchange rates with the exception of the Japanese Yen, which appreciated 4.6 percent against the dollar in the months of crisis, and the Chinese Yuan, which remained stable relative to the dollar. The aggregate patterns of exchange rate and trade prices co-movement are consistent with positive but incomplete exchange rate pass-through on both import and export prices.

Motivated by these patterns, we use August 2008 as the baseline month in our analyses relative to which we measure changes in prices during the period of the crisis. We do this despite the fact that the official NBER start date for Great Recession is December 2007 (with June 2009 being the end date). The period preceding August 2008 is the build up of the crisis during which most price indices still increased, and the acute phase of the crisis began in September 2008 with the collapse of Lehman Brothers.

3.1 Differentiated and non-differentiated goods

The movement in aggregate price indices masks the very different behavior of prices for differentiated compared with non-differentiated goods. The solid lines in Figure 3(a) plot indices capturing changes in the dollar value of total U.S. imports (M) and the price of those imports (P_M), and the solid lines in Figure 3(b) plot the equivalent for exports. The value of imports and exports both decline nearly 40 percent in the global recession of 2008-2009, the rightmost shaded region of the plots. Overall import and export prices show a modest decline of around 5 percent during this period.

The picture changes when we isolate differentiated goods using the Rauch (1999) classification and plot these indices using the dashed lines labeled with superscript '*diff*'. The decline in trade values for differentiated goods move largely with the aggregate figures. Differentiated good trade prices, however, do not exhibit the decline witnessed in the aggregated price indices, implying the bulk of price adjustment is due to larger declines in more

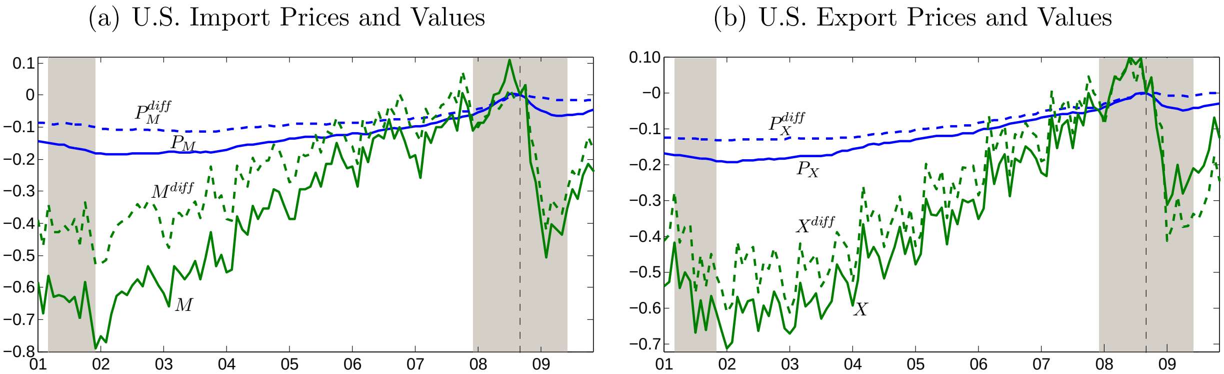

Figure 3: U.S. Trade Prices and Values

Notes: *Log index series with August 2008 value normalized to zero (vertical dashed lines). M and X denote import and export values;* P_M *and* P_X *denote import and export price indices; variables with superscript 'diff' corresponds to the subsample of Rauch differentiated goods (dashed lines).*

commodity-like goods traded with reference prices or on organized exchanges. These same patterns hold for the smaller price decline observed in the earlier shaded region identifying the 2001 recession (March–November 2001).

Zooming in on the recent recession reinforces this point. Figure 4 shows that declines in the average price of imports and exports are almost entirely driven by price changes among non-differentiated goods. In fact, non-differentiated goods prices declined by about 16 percent for both imports and exports, hence contributing significantly to the overall decrease in trade values for non-differentiated goods. In contrast, the trivial decline of about 1 percent in the prices of differentiated goods contributes almost nothing to the very large declines in the values of trade for these goods, which by implication comes almost entirely from the decline in trade volumes. Table 1 further summarizes the price movements for all traded goods, as well as differentiated and non-differentiated subsamples during the months of the crisis. Each column compares changes to August 2008, the month after which the acute phase of the crisis began. We pick periods of varying lengths and find that our general conclusions are robust to the chosen endpoints. In particular, we find that independent of the chosen time window, differentiated good trade prices barely moved.

3.2 Arm's length and related party transactions

Our analyses thus far only use pricing data from market-based trade transactions. It is well-known, however, that transactions between related parties, or intra-firm trades, account for

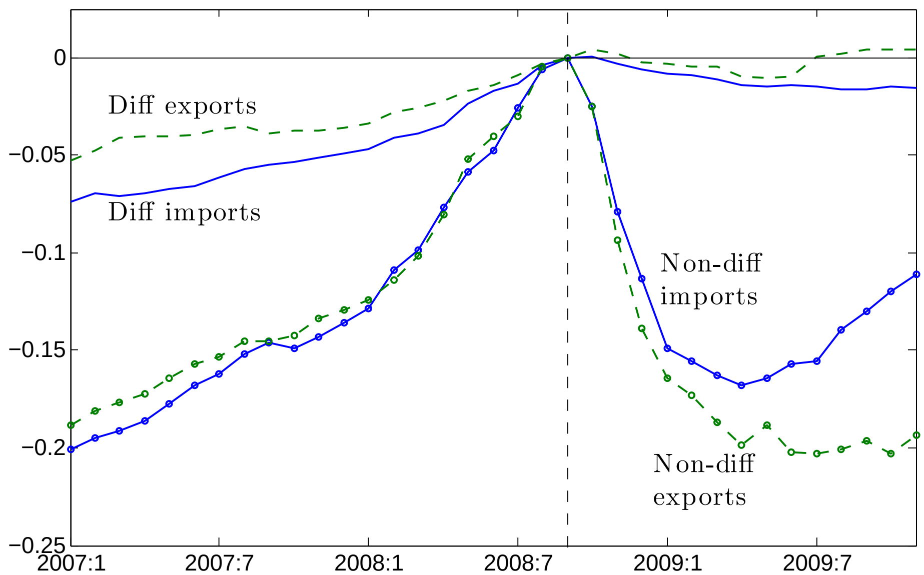

Figure 4: Trade Prices for Differentiated and Non-Differentiated Goods, 2007-2009

Notes: *Log index series with August 2008 value normalized to zero. Solid lines correspond to Imports and dashed lines correspond to Exports; circles indicate differentiated good subsample.*

Table 1: Import and Export Price Changes (% change over 2008m8)

	2008m9	2008m11	2009m3	2009m11
		Imports		
All	−0.5	−2.9	−6.3	−4.9
Non-Differentiated	−1.3	−8.8	−16.1	−11.7
Differentiated	0.1	−0.3	−1.1	−1.5
		Exports		
All	−0.2	−2.1	−4.4	−2.9
Non-Differentiated	−0.6	−8.0	−15.7	−12.8
Differentiated	0.1	0.1	−0.6	0.2

Notes: *Percent price changes cumulated to a given month relative to August 2008.*

Table 2: Changes in Market and Related-party Transaction Prices (%)

	Imports			Exports		
	All	Non-Diff	Diff	All	Non-Diff	Diff
All	−4.4	−13.3	−0.7	−3.8	−13.9	−1.0
Market	−6.3	−16.1	−1.1	−4.4	−15.7	−0.6
Related-party	−2.2	−7.5	−0.3	−2.4	−7.8	−1.7

Notes: *Percent price changes cumulated between August 2008 and March 2009.*

a substantial share (as large as 40 percent) of total import and export values.[8] Table 2 compares the behavior of market and related party transactions. As before, we use August 2008 as our baseline month and report results through March 2009, but we obtain highly similar results for other time windows as well. We avoid much longer windows as these would conflate longer-run reversals with the response to the crisis episode.

Related party prices declined by significantly less than did market transaction prices, but the vast majority of this difference was driven by the smaller decline in intra-firm non-differentiated goods prices. The prices of differentiated goods, whether traded by related parties or at arm's length, moved by little. For the remainder of the paper, as with the analyses preceding this subsection, we only use data on market transactions.

3.3 Durable and non-durable goods

As emphasized in Eaton, Kortum, Neiman, and Romalis (2010), Levchenko, Lewis, and Tesar (2010), and Alessandria, Kaboski, and Midrigan (2010a), reduced trade values in durable and storable goods played a prominent role in generating the recent global trade collapse.[9] We now look at the changes in trade prices and values of durable versus non-durable goods, both for non-differentiated and differentiated goods. We report changes in trade prices for the period August 2008 to March 2009, as in previous analyses. The trade values are reported from June 2008 to June 2009, however, because we do not want the comparison obscured by seasonality. Our conclusions are robust to changes of a few months in the choice of any of these end points. The second panel of Table 3 divides imported goods into three categories: non-manufactures (S), non-durable manufactured goods (N), and durable

[8] See Neiman (2010) for a detailed comparison of arm's length and intra-firm prices in BLS data.

[9] See Engel and Wang (2011) for an analysis of how the intensity of durables in international trade impacts the dynamic properties of trade values in the context of an international RBC model.

Table 3: Changes in Import Prices and Values, by Type and End-Use (%)

	Prices			Values		
	All	Non-Diff	Diff	All	Non-Diff	Diff
All	−6.3	−16.1	−1.1	−32.7	−48.0	−24.4
Non-manufactures (S)	−31.5	−15.5	−3.9	−49.8	−54.1	−21.3
Non-durables (N)	−3.8	−8.3	−0.3	−16.3	−19.7	−18.5
Durables (D)	−4.3	−36.1	−1.3	−29.5	−49.9	−26.4
Consumption-N	−2.6	−5.6	−0.2	−12.0	−15.2	−14.7
Intermediate-N	−1.1	−1.9	0.0	−19.9	−21.9	−8.1
Capital-D	−1.1	—	−0.7	−22.4	—	−23.1
Consumption-D	1.1	—	1.2	−24.3	—	−24.0
Intermediate-D	−18.4	−34.0	−9.6	−60.2	−64.7	−39.3

Notes: *Changes in prices are calculated between August 2008 and September 2009; changes in values are calculated between June 2008 and June 2009. The data contains no non-differentiated capital and consumption durable goods.*

manufactured goods (D). The left panel shows changes in import prices while the right panel shows changes in import values. We refer to the non-manufactured good category with an 'S' because it includes services, but we note that it also includes commodities such as oil products, which is why it features the largest price declines.

The value of trade in durable goods fell substantially more than did trade in non-durables for differentiated and non-differentiated goods alike. Within non-differentiated goods, durable prices dropped by significantly more than non-durables, and we suspect this reflects a large commodity content in non-differentiated durables. Once we focus on the sub-sample of differentiated goods, however, the price declines for both non-durable and durable goods are equally small.

Next, the lower panel of Table 3 splits all manufactured goods into five end-use categories. We divide the non-durable manufactures into consumer (Con-N) and intermediate (Int-N) goods categories and divide durables into capital (Cap-D), consumer (Con-D), and intermediate (Int-D) goods categories. Among capital and consumption durables there are no non-differentiated goods at all. The price changes for differentiated durables in these two categories are all less than 1.2 percent. The only category of differentiated durables which features a significant price decline is differentiated durable intermediates. These goods constitute a very small share of total differentiated durables and likely have a high commodity component in their cost structure as would be the case with, say, copper wire.[10]

These same patterns also hold for export prices and values, as we show in Appendix Table A1. As with imports, though trade value declines were large within all subsamples of manufactured goods, particularly durables, large manufacturing price declines were generally concentrated only in the non-differentiated goods. The behavior of durable and non-durable differentiated manufacturing import and export prices were hardly distinguishable from each other.

3.4 Cross-country evidence

Finally, we consider the possibility of different pricing patterns across source countries for U.S. imports and destination countries for U.S. exports. Table 4 provides evidence on trade prices for some of the largest U.S. trade partners, organized by geographic location. For all export destinations, differentiated good prices did not decrease much and in general do not show much variation. The price of differentiated imports from some European countries and Canada did have moderate decreases (of about 6 percent), but this decline still significantly lags that in corresponding trade values. For the European source countries the decline in differentiated goods prices likely reflects relatively high pass-through of the depreciation of the Euro into U.S. Dollar import prices, while for Canada it likely reflects high content of commodity-intensive goods in their differentiated exports to the U.S. Notably, overall import price indices from many developing countries outside of Asia decreased substantially, but their import price indices for differentiated goods did not decline. All in all, differentiated good prices did not change significantly, regardless of their source or destination.

3.5 A look at the cross-section

Our initial look at the data suggests that there was a very limited trade price movement for both differentiated imports and exports, leaving the bulk of the differentiated trade value collapse due to reduced quantities. Non-differentiated trade value declines, by contrast, involved significant adjustment of prices. This characterization remains accurate and representative even when considering different relationship structures between trading parties,

[10]Prior to the crisis, trade in intermediate goods represented only 5 percent of differentiated durable manufacturing imports and 2 percent of differentiated durable exports.

Table 4: Changes in Trade Prices, by Country (%)

	Imports			Exports		
	All	Non-Diff	Diff	All	Non-Diff	Diff
All	−6.3	−16.1	−1.1	−4.4	−15.7	−0.6
			NAFTA			
Canada	−23.3	−20.8	−7.5	−3.3	−10.9	−1.6
Mexico	−6.4	−6.2	0.1	−7.1	−13.3	−1.7
			Europe			
France	0.5	0.5	1.6	1.2	−15.5	3.3
Germany	−8.1	−7.7	−5.5	−2.9	−6.8	−2.0
Ireland	1.2	1.2	0.0	4.0	1.1	8.4
Italy	−3.9	−3.8	−5.5	−5.5	−9.6	0.0
Spain	−3.9	−3.8	−8.1	−4.1	−2.4	−0.6
Sweden	−2.1	−2.1	−3.0	−1.0	−0.9	−1.9
Switzerland	−6.2	−6.0	−5.0	0.3	−1.2	−3.0
U.K.	−9.0	−8.6	0.1	−0.3	−8.2	3.1
			Asia			
China	0.2	0.2	0.7	−17.1	−40.4	−2.0
Hong Kong	−0.8	−0.8	−0.2	−12.3	−18.4	−7.3
India	−3.1	−3.1	−1.2	−3.1	2.3	−0.7
Japan	2.8	2.9	3.0	1.3	−2.4	2.5
South Korea	−3.4	−3.4	−1.0	−5.7	−14.8	0.3
Taiwan	0.1	0.1	0.5	−4.1	−10.4	−0.2
			Commodity Exporters			
Australia	−11.5	−10.9	−2.2	−2.9	−12.6	−3.1
Argentina	−17.9	−16.4	0.5	−0.2	−14.6	3.9
Brazil	−13.8	−12.9	3.6	−3.4	−6.4	6.6
Russia	−37.4	−31.2	2.8	−5.1	−6.9	−3.5
South Africa	−30.6	−26.4	0.0	2.2	12.5	2.4

Notes: *Percent price changes cumulated between August 2008 and March 2009.*

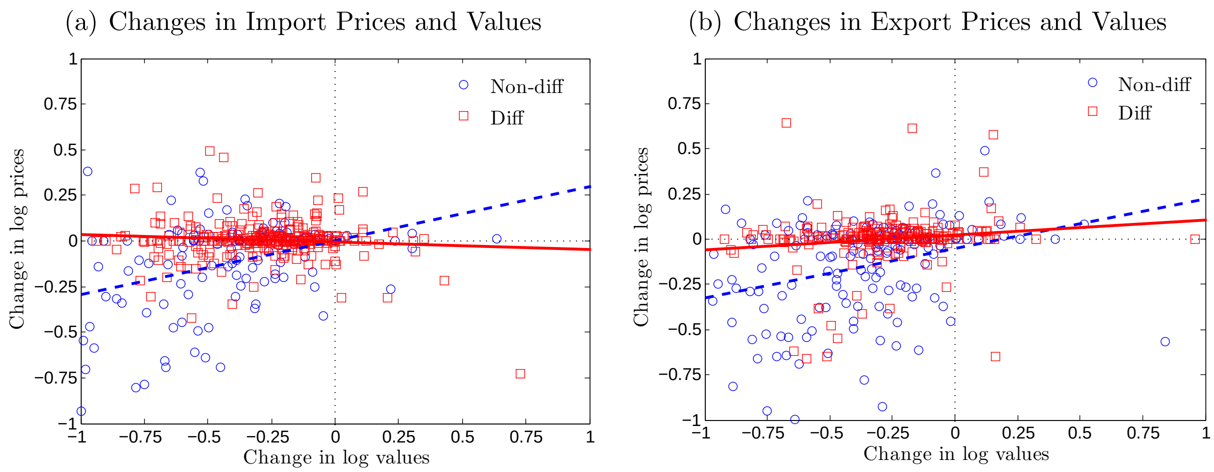

Figure 5: Trade Adjustment in Differentiated and Non-Differentiated Sectors

Notes: *Sample is as described in the text. OLS regression lines of change in log prices on a constant and change in log values (regression slope coefficients and standard errors are reported in Table 5). Each blue circle (red square) corresponds to an HS 4-digit non-differentiated (differentiated) sector according to the Rauch classification; blue dashed (red solid) line is the regression line for non-differentiated (differentiated) sectors.*

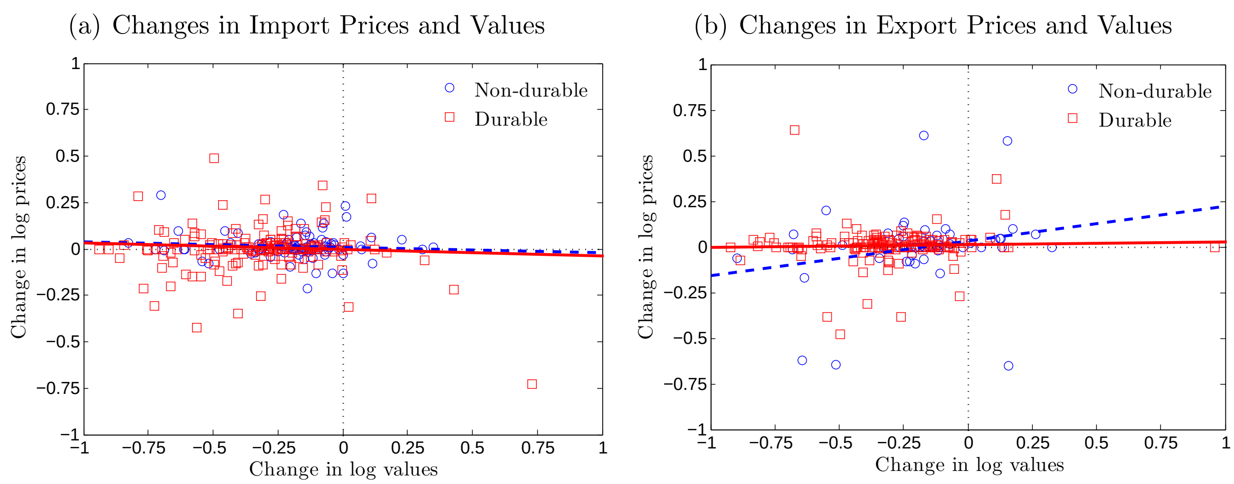

Figure 6: Trade Adjustment in Durable and Non-Durable Differentiated Sectors

Notes: *Differentiated sectors subsample. OLS regression lines of change in log prices on a constant and change in log values (regression slope coefficients and standard errors are reported in Table 5). Each blue circle (red square) corresponds to an HS 4-digit non-durable (durable) differentiated sector; blue dashed (red solid) line is the regression line for non-durable (durable) differentiated sectors.*

different end-uses of the goods, and different locations of the trading partners. We now merge our pricing data with trade value data at the 4-digit HS sector level to further assess whether there is significant heterogeneity in price adjustment within differentiated and non-differentiated manufactures.

Table 5: Regression Coefficients of Changes in Log Prices on Changes in Log Values

	Imports				Exports			
	Non-Diff	Differentiated			Non-Diff	Differentiated		
		All	Non-Dur	Durable		All	Non-Dur	Durable
OLS	0.29***	−0.04	−0.03	−0.04	0.27***	0.08*	0.19*	0.02
	(0.07)	(0.03)	(0.03)	(0.04)	(0.07)	(0.04)	(0.11)	(0.03)
OLS, no zeros	0.37	−0.05	−0.05	−0.05	0.30	0.12	0.22	0.03
Median	0.33	−0.00	−0.01	−0.00	0.23	−0.00	0.09	−0.01

Notes: *Slope coefficients from the regression of the change in log price on the change in log quantities across HS 4-digit sectors. The sample is as described in the text, in particular, footnote 11 reports the number of observations in each bin. Standard errors for OLS specification which includes all classified observations are reported in brackets and *** (*) indicates significance at 1% (10%) level.* 'OLS, no zeros' *specification carries out the same exercise restricting the sample in each case only to sectors with a non-zero change in prices.* 'Median' *row reports the slope coefficient from the robust quantile median regression run on the full sample of sectors as in the baseline OLS specification.*

Figure 5(a) is a scatterplot of the changes in import prices from August 2008 to March 2009 and trade values from June 2008 to June 2009, where blue circles correspond to 4-digit sectors that contain non-differentiated goods and red squares correspond to those containing differentiated goods.[11] Once again, our basic results are highly robust to using alternative time periods for measuring the change in trade prices and trade values.

Most squares and circles are located in the left half of the plot since most sectors exhibited large declines in trade values (the median declines in import values for differentiated and non-differentiated sectors were 22.1 and 39.9 percent). The two sectors clearly exhibit different pricing behavior, however, as can be seen in the differing slopes of the lines fitting the circles and the squares and reported in Table 5. Non-differentiated sectors experiencing larger declines in values typically also experienced larger price declines, while this relation is not found among differentiated goods. Figure 5(b) shows the same relationships for exports. Overall, heterogeneity in trade price changes can explain a sizable amount (about 30 percent, as reflected by the corresponding regression slopes) of the heterogeneity in trade value changes for non-differentiated goods, but zero of the heterogeneity in trade value changes for differentiated sectors.

[11] Among the 1209 4-digit import sectors for which we have data on quantities, price data is available for 567 sectors. We further exclude a few price and quantity changes which exceed 2 log points. This constitutes our subsample. Within our subsample, 302 sectors are differentiated and 149 sectors are non-differentiated, while the remaining 116 sectors are unclassified. For 56 differentiated and 18 non-differentiated sectors the sectoral price change over the sample period is zero. Among the differentiated sectors, 179 are durable, 96 are non-durable, and 27 are unclassified. Similar patterns hold for exports.

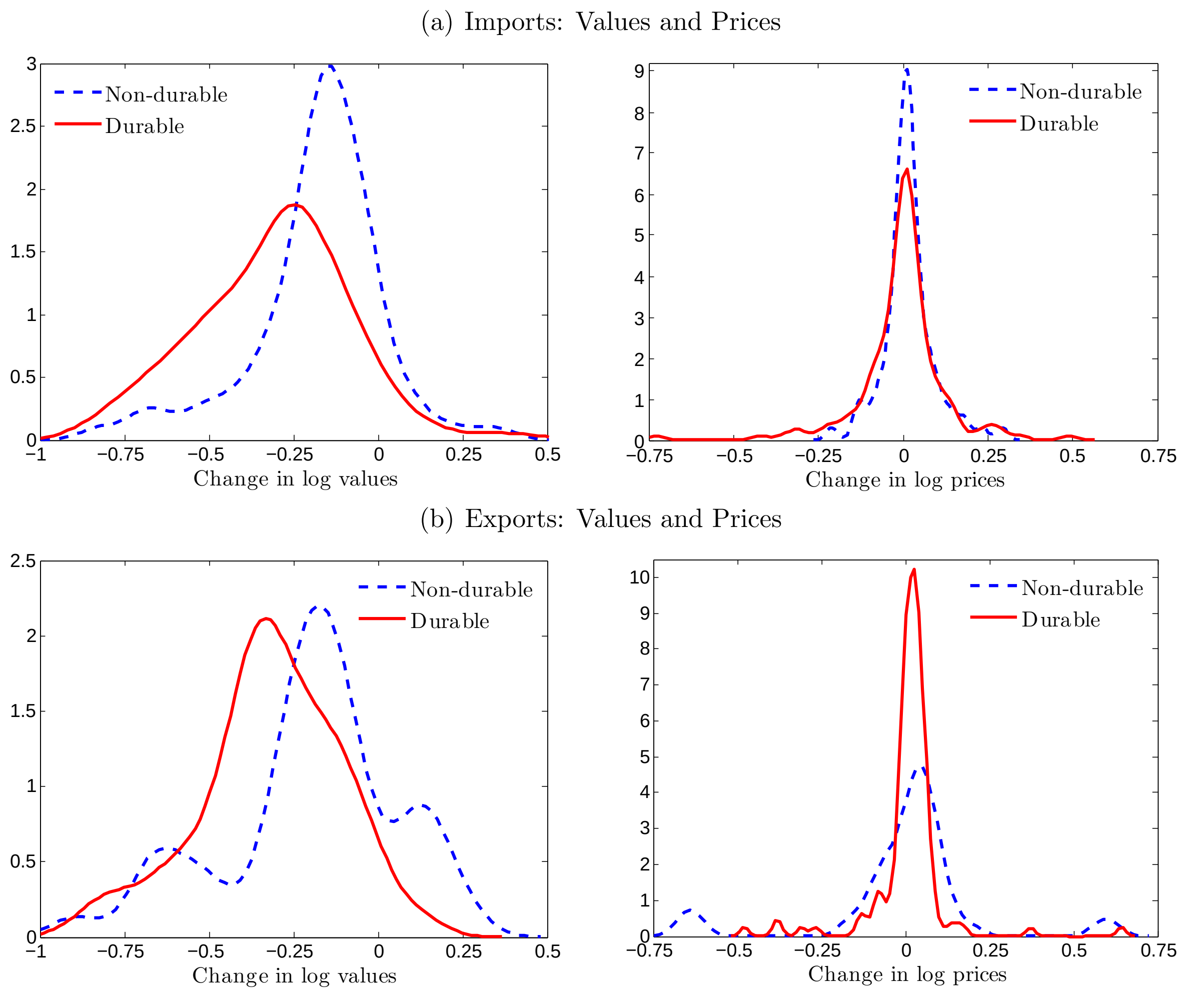

Figure 7: Kernel Densities of Adjustment in Durable and Non-Durables Sectors

Notes: *Kernel densities for changes in log prices and log values across non-durable (blue dashed lines) and durable (red solid lines) differentiated sectors. Around 16% of sectors with zero price changes are excluded; the qualitative patterns remain unchanged when these sectors are included.*

Figure 6 considers the same analysis but now splits the differentiated good subsample into durable (red squares) and non-durable (blue circles) sectors. Though the blue dashed line for non-durable exports is upward sloping, Table 5 shows that none of these four best fit lines is statistically different from zero (in fact, the slopes of the other three lines are precisely estimated zeros). This is unlike Figure 5, where both lines for the non-differentiated goods were statistically significant. Variation in prices across durable and non-durable manufactures does not systematically contribute to the differential decline in trade values across these two sectors.

Figure 7(a) plots the kernel densities of changes in import values and prices across durable and non-durable manufacturing sectors within the set of differentiated goods over the same period. Figure 7(b) plots these densities for exports. The distributions denoted with solid lines in the left panels are clearly shifted to the left of the dotted lines, indicating that durable sectors experienced significantly larger import value declines. Specifically, for differentiated imports, the median decline in sectoral trade values was 26.0 percent for durables and 14.7 percent for non-durables. The right panels, however, show price change distributions that are almost identical for the case of imports and equally centered at zero in the case of exports.

In sum, even when considering the significant heterogeneity present in levels of trade adjustment at the 4-digit HS level, we find that distinguishing between differentiated and non-differentiated goods does a good job of characterizing the role played by price changes in declining trade values. Additional information, such as the durability of the good, gives information on the extent of the quantity decline, but not on the extent of the price decline.

3.6 Relation to Other Findings on the Trade Collapse

It is instructive here to compare our results to other papers that use more aggregated data on prices or unit values. Our results are highly consistent with those reported from aggregated sector-level price information by Levchenko, Lewis, and Tesar (2010). The sectors they report as exhibitting the greatest price declines – Petroleum and products, Industrial supplies and materials, and Foods, feeds, and beverages – are sectors less likely to contain differentiated goods than the remaining categories such as capital goods and consumer goods. Further, within these differentiated goods categories, Levchenko, Lewis, and Tesar (2010) find only limited differences in price changes between durables and non-durables, a key point of our analysis above.

There has also been a focus on trade dynamics in the auto sector during the crisis, such as the analysis in Alessandria, Kaboski, and Midrigan (2010b). Import and export prices for overall and market transactions in HS 87, which includes cars and other vehicles (excluding rail-, tram-, water-, and air-based vehicles), grew moderately in the years prior to the crisis but remained highly stable from August 2008 through late 2009 despite a sharp reduction in demand over that period. This is also consistent with the reporting by end-use in Levchenko, Lewis, and Tesar (2010).

Chor and Manova (2012) follow Braun (2003), who derives from corporate financial information measures of the "external financial dependence" and "asset tangibility" as proxies for a sector's credit sensitivity, and demonstrate that U.S. imports declined by more in response to increases in an exporter's cost of capital when the sector was more credit sensitive.[12] We obtained these measures at the 3-digit ISIC level from Manova (2012), concorded them with our HS codes at the 2-digit level, and examined whether trade price changes from August 2008 to March 2009 relate to the sector's credit sensitivity.[13] There is no statistically significant relationship for external financial dependence and trade price movements during the crisis in our data, though with less than 25 data points, the power in such regressions is limited. There is strong evidence that sectors with greater asset tangibility (and therefore, presumably, less of an increase in the cost of financing) had significantly more import and export price reductions than sectors with few tangible assets. However, consistent with the central result of our work, this result follows entirely from large price reductions in 2-digit industries that are mostly non-differentiated, such as Petroleum refineries, Paper and products, and Iron and steel.

We also find evidence corroborating the finding by Ahn, Amiti, and Weinstein (2011) that the price of manufacturing exports during the crisis increased relative to the price of domestic manufacturing. As with our analysis of trade prices and asset tangibility, we hypothesize that this movement in the relative price of exported goods to domestic sales is concentrated in non-differentiated sectors, and both domestic producer prices and import prices of differentiated goods remain mostly stable. A full assessment of this, however, would require applying the Rauch classification to trade and domestic production categories across multiple countries and is beyond the scope of this paper.

Haddad, Harrison, and Hausman (2010) look at the movement across several countries in unit values, which they calculate at the 6-digit level. For differentiated goods imported into the United States, they find that prices slightly increased. Behrens, Corcos, and Mion (2012) look at unit values for trade with Belgium and find that price declines played a moderate role in the overall decline in Belgian trade. They consider differences in the decline of trade values for differentiated and non-differentiated goods, but do not consider the differential behavior of prices across those categories, nor do they compare changes in prices and quantities across differentiated sectors as we do.

[12]See Amiti and Weinstein (2010) for doubts about how well these measures capture the importance of trade financing for a sector.

[13]These results are available upon request from the authors.

Our focus differs from all of these related papers in that we highlight that within differentiated goods sectors, variation in trade values cannot be explained by variation in trade prices. Further, we look at prices at the transaction level and therefore can be assured that price changes do not reflect differences in quality that may influence unit value calculations.[14]

4 The Mechanics of Price Adjustment

In this section, we make use of the micro data to understand how the evolution of price stickiness, size of non-zero price changes, and product churning contributed to the dynamic behavior of aggregate trade price indices.

4.1 Frequency and size of price adjustment

Figure 8 plots a 12-month moving average of the frequency of price adjustment, price increases, and price decreases, for all import prices in panel (a) and for import prices of the differentiated goods only in panel (b).[15] Figure A1 in the Appendix displays similar plots for export prices. The solid blue line which captures the frequency of price decreases, for example, is the percentage of total observed prices that are smaller than the previously observed price. The percentage of prices which do not change equals one minus the value of the dash-dotted black line, which itself equals the sum of the other two lines.

The frequency of price changes increased in the months of the recent crisis, for both imports and exports. This holds to some extent even in the subsample of differentiated goods, but the effects there are less pronounced, and the frequency increase reverses for the differentiated imports in the middle of the recession. The most stark pattern, however, is the increasing frequency of price decreases and the decreasing frequency of price increases. Quite surprisingly given our earlier results, these patterns are comparably strong for differentiated goods as in the full sample, with the primary difference between the two being the lower average frequency of price adjustment for differentiated goods. The frequency of increases and decreases changes in opposite directions, which produces a more muted movement in the frequency of total changes. This finding is consistent with Gagnon (2009), who demon-

[14] Levchenko, Lewis, and Tesar (2011) examine whether the trade crisis brought a change in the quality of goods imported into the U.S.

[15] Without smoothing, the series are too volatile and have very strong seasonality.

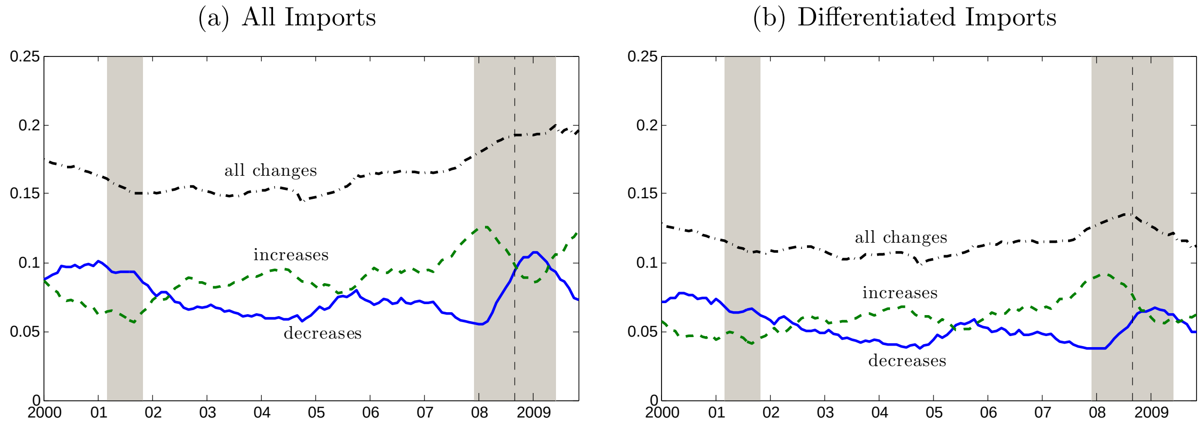

Figure 8: Price Adjustment Frequencies

Notes: *12-month moving averages of monthly frequency of import price adjustment (black dash-dotted lines), as well as its components, frequency of price increases (green dashed lines) and price decreases (blue solid line).*

strates this same phenomenon over business cycle fluctuations during years of low inflation in Mexico.

The observed patterns are consistent with a state-dependent view of price adjustment because the adjustment frequencies appear to respond endogenously to the underlying shocks. The patterns are also directionally consistent with a decline in the corresponding price indices. However, the scale of these movements is quite small and does not stand out relative to other high frequency swings in the series (such as seasonality in the raw series). For example, in the months of the crisis, the moving average of the frequency of decreases reached its peak at 10.7 percent while its pre-crisis low was 5.6 percent. Even the larger of the two frequencies suggests significant amounts of nominal rigidity, consistent with the stability of most trade prices during the trade crisis. And in the differentiated subsample, these frequencies are significantly lower still.

Berger and Vavra (2011) and Vavra (2012) show that price change frequencies and price dispersion are correlated in the BLS micro data underlying the CPI. They document that the latter has a strong countercyclical component. Their plots look at seasonally adjusted and bandpass filtered data, unlike ours which simply show 12-month moving averages. While our data is supportive of state-dependent adjustment, the magnitude of changes in the frequency of price adjustment are relatively muted, particularly given the scale of the economic shock and relative to seasonality in the data. Overall, the trade prices do not exhibit economically large cyclical patterns in adjustment frequencies.

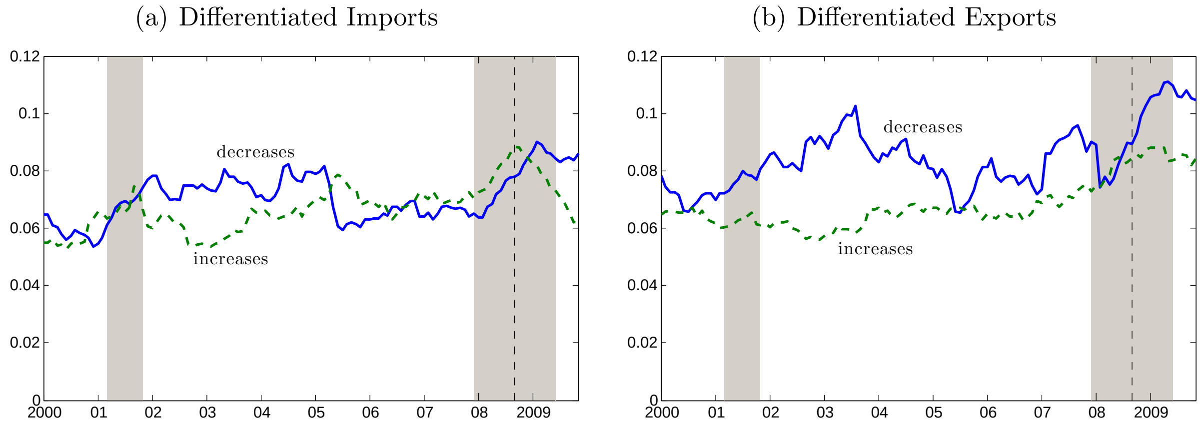

Figure 9: Price Adjustment Magnitudes for Differentiated Goods

Notes: *12-month moving averages of average absolute size of log price increases (green dashed lines) and decreases (blue solid line), conditional on price adjustment.*

Figure 9 plots a 12-month moving average of the average absolute size of price adjustment and separates this measure for price increases and decreases. The left panel shows the results for imports of differentiated goods, while the right panel covers differentiated goods exports. The patterns are similar qualitatively for the full sample and for non-differentiated goods (not shown), but the magnitudes are significantly larger for non-differentiated goods.[16]

At the onset of recession, the absolute size of price adjustment increases for both price hikes and price cuts, perhaps implying that that there was an increase in the dispersion of cost shocks. Further into the recession, the average size of price decreases exceeds the average size of price increases, although not by much. Coupled with uniformly low frequency of both price increases and decreases, this explains why there was only a muted decline in prices at the aggregate for differentiated goods and why the distributions of price changes for differentiated goods in Figure 7 are centered around zero.

Finally, we note that the patterns of frequency and size of price adjustment that we document for the current crisis were to some extent also observed during the 2001 recession (with the exception of the trending decline in frequency in the early 2000s). During the 2001 recession, prices decreased more often and increased less often, while the absolute size of price decreases (and increases in the case of imports) also went up.

[16]For example, the average absolute size of price decline for differentiated goods increases from 6.4 percent before the crisis to a peak of 9.0 percent in the months of the crisis, while in the full sample which incorporates both differentiated and non-differentiated goods the average absolute size of price declines increase from 7.2 percent to 11.7 percent. It appears that the very large size of price decreases was the key driver of sharp reduction in the price index of non-differentiated goods.

4.2 Extensive Margin

As highlighted in Gopinath and Neiman (2012) and Bernard, Jensen, Redding, and Schott (2009), the bulk of high frequency trade adjustment takes place via the intensive margin. The economy as a whole typically does not quickly stop importing or exporting products which previously accounted for a large share of trade. The BLS data we use are not well equipped to evaluate the importance of the extensive margin for aggregate adjustment because it is sampled and constitutes only a small subset of total U.S. trade. Nonetheless, we now consider whether the churning of products with prices surveyed by the BLS changed at all during the recession.

Figure 10(a) plots the 12-month moving average of the number of product entries and exits relative to the total number of products in the previous period. Both entry and exit rates are low, averaging 3 to 4 percent in any given month. There is some evidence of an increase in product churn during the recent recession, as both entry and exit rates increased by 1 to 2 percent, but this trend is not quantitatively pronounced. The highest level of product exits in the recent recession still remained quantitatively similar to the levels seen throughout the 2000s and the rate of product entry hovered near its sample average. Figure 10(b) disaggregates the differentiated good exit rate between arm's length and intrafirm trades. There is some evidence in other measures that intrafirm and arm's length trades responded somewhat differently to the crisis, but their patterns of differentiated product

(a) Product Entry and Exit Rates (b) Product Exit Rates by Trade Structure

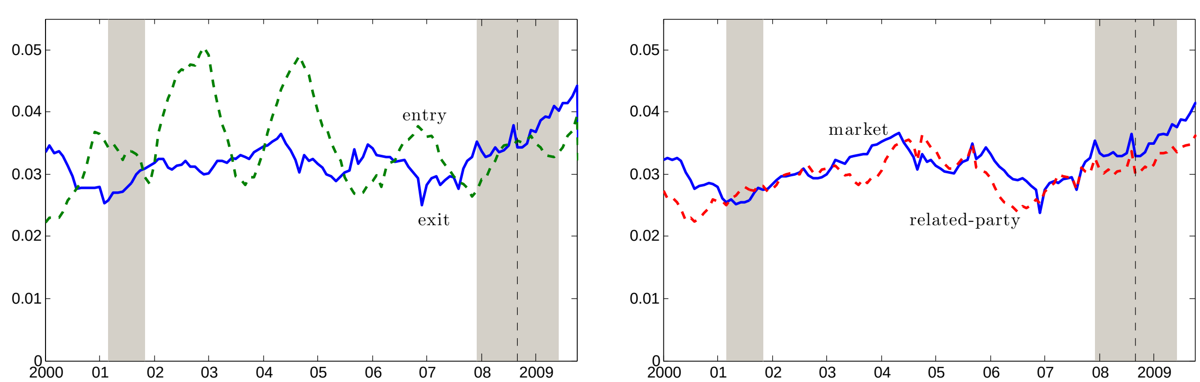

Figure 10: Product Extensive Margin for Differentiated Goods in BLS Data

Notes: *12-month moving averages of product exit and entry to continuation ratios. Blue solid line in both panels corresponds to the market exit ratio; green dashed line in Panel (a) corresponds to market entry ratio; red dashed line in Panel (b) corresponds to related-party exit ratio.*

discontinuation appear highly similar. In sum, it appears unlikely that the conclusions we draw from comparisons of BLS prices, which would not capture extensive margin adjustment, with trade values obtained from U.S. customs data, which do reflect extensive margin adjustments, are impacted by firm or product churning during the recession.

5 Conclusion

Starting in the summer of 2008, the dollar value of international trade plunged relative to the scale of economic activity and was likely the biggest such decline since the Great Depression. A large literature has characterized this Great Trade Collapse of 2008-2009 and built models seeking to explain the decline and relate it to the broader global recession. Prior studies which approximate prices by measuring unit values at more aggregated levels may conflate price changes with changes in the composition or quality of traded goods. Relative to this literature, we offer new information on the behavior of U.S. trade prices, measured at the individual good level.

This micro data allows us to focus on the difference between differentiated and non-differentiated goods, and we show that this distinction is crucial for understanding the extent to which price declines contributed to the decline in trade values. Though price declines contributed to the overall trade collapse, the sharp reduction in differentiated goods trade was entirely a quantity-driven phenomenon. The typical differentiated manufacturing good sector shipped 30 percent less physical goods across the U.S. border without any corresponding reduction in the price of those goods. This stability of trade prices was equally apparent in differentiated durables and non-durables sectors, even though the decline in trade values was far more dramatic for durables. In contrast, differences in price changes can explain a moderate share of the different trade patterns in the non-differentiated sectors.

Lastly, we explore the mechanics of price changes such as the size of changes, their frequency, and the relative share of price increases and decreases, and show how these characteristics of pricing dynamics all changed with the onset of the trade crisis. Although the patterns we document are supportive of the state-dependent view of price adjustment, they are not pronounced enough to noticeably affect the aggregate price indexes for differentiated goods.

A Additional results

Table A1: Changes in Export Prices and Values, by Type and End-Use (%)

	Prices			Values		
	All	Non-Diff	Diff	All	Non-Diff	Diff
All	−4.4	−15.7	−0.6	−26.8	−31.1	−34.7
Non-manufactures (S)	−14.4	−12.6	−17.9	−40.8	−30.7	−41.2
Non-durables (N)	−8.4	−11.7	−3.4	−14.5	−24.3	−15.9
Durables (D)	−2.0	−31.2	0.4	−28.8	−42.2	−38.3
Consumption-N	−9.2	−11.2	−8.4	−11.2	−18.9	−14.7
Intermediate-N	−0.2	−0.5	4.9	−14.1	−16.1	−3.5
Capital-D	−0.2	—	0.8	−23.5	—	−51.4
Consumption-D	0.0	—	0.3	−19.3	—	−19.6
Intermediate-D	−19.8	−33.7	−4.7	−42.8	−46.2	−26.4

Notes: *Changes in prices are calculated between August 2008 and September 2009; changes in values are calculated between June 2008 and June 2009. The data contains no non-differentiated capital and consumption durable goods.*

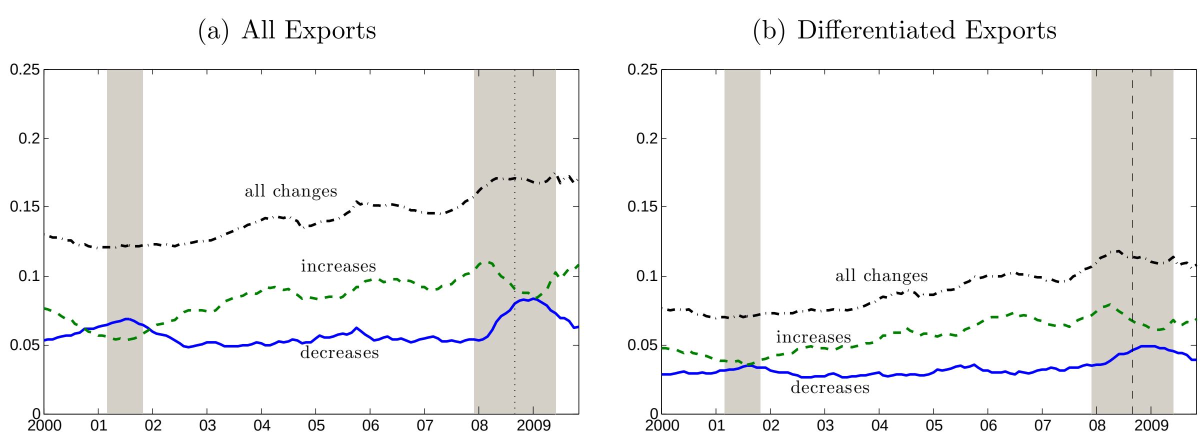

Figure A1: Price Adjustment Frequencies for Exports

Notes: *12-month moving averages of monthly frequency of export price adjustment (black dash-dotted lines), as well as its components, frequency of price increases (green dashed lines) and price decreases (blue solid line).*

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