Working Paper
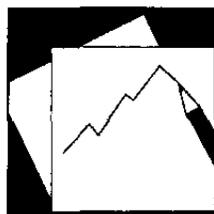
IMF Working Paper

What Happened to Asian Exports During the Crisis?

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What Happened to Asian Exports During the Crisis?

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Abstract

After the large exchange rate depreciations following the 1997 East Asian crisis, export volumes from East Asian countries responded with a notable lag. Two main explanations for this lag have been proposed: that the policy of high interest rates limited access to domestic credit and hence limited the supply of exports; and that "competitive depreciation" neutralized the effects on demand for exports. This paper considers the plausibility of these two mechanisms using a new monthly database on exports of selected industries. We find evidence that "competitive depreciation" did play a fundamental role in the propagation of the East Asian crisis through the trade channel, even at a monthly frequency.

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I. INTRODUCTION

During the financial crisis in 1997-98, export revenues of many East Asian countries did not increase in spite of massive depreciation by the afflicted economies.[2] The depreciations led to sharp declines in dollar-denominated export prices with very modest increases in export volumes. The absence of a quick response of exports to depreciation played a key role in prolonging the East Asian crisis and is puzzling from an analytical point of view.

There are several plausible reasons why exports might have lagged in East Asia even after the huge depreciations following the currency crisis. First, the demand for Asian exports may have been price inelastic in the short run. Second, the contraction of credit to the private sector may have slowed down production and supply of exports. Third, demand may have slowed down in response to an exogenous shift in world demand. Finally, demand for exports in a single country could have slowed because of "competitive depreciations" by others. These different hypotheses lead to very different interpretations of the Asian crisis, its propagation mechanisms, and the policy recommendations for recovery.

This paper considers these alternative hypotheses. To address this question, a new monthly data set on price and quantity of exports for selected commodity groups is constructed. Using these data, demand and supply for Asian exports are analyzed within a vector cointegration framework of estimation.

Our empirical results indicate that the demand for East Asian exports is very sensitive to prices—both own and competitors'—and to the world growth rate. The supply prices of exports are quite insensitive to own quantities but are very sensitive to nominal exchange rate changes. Typically, a nominal depreciation decreases the U.S. dollar denominated export price, thereby increasing the demand for the depreciating country's exports. However, depreciation of every export competitors' currency weakens the positive demand effect of the initial depreciation such that the overall effect is a fall in export prices with a very modest increase in export volumes. A key finding is that these effects occurred within 4 to 6 months, thus confirming that trade played a fundamental role in the transmission of the Asian crisis.

The importance of trade in the transmission of the East Asian crisis has been studied both empirically and theoretically. Empirically, Glick and Rose (1999), Caramazza, Ricci and Salgado (1999) and Van Rijckeghem and Weder (1999) look at market shares in trade for evidence of a contagion effect through the trade channel. These authors conclude that the trade shares are important in explaining the currency crises in general (see, for instance,

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[2] Henceforth Asia will refer to the following six economies in our sample: Hong Kong SAR, Indonesia, Malaysia, Singapore, South Korea, and Thailand. China, Philippines and Taiwan Province of China could not be included in the sample due to lack of data.

Glick and Rose (1999)), and the crisis in East Asia in particular.[3] Looking at trade shares constitutes an important first step in analyzing the role of trade in crises. However, for explicit comparisons between the alternative explanations behind export slowdown, as outlined above, estimation of structural demand and supply equations becomes necessary. Moreover, this paper is the first study on the East Asian currency crisis that looks at the countries' disaggregated trade data at a monthly frequency.[4] This is important because high frequency data reveals how quickly demand and supply can adjust to shocks in the external market. Theoretically, Gerlach and Smets (1995) have formalized the idea that strong competition in the external sector can be responsible for the transmission of a currency crisis. Our paper is an empirical validation of the same idea in the context of East Asia. Finally, our analysis confirms the findings of Abeysinghe (1999) in a vector cointegration estimation framework using data at a monthly frequency.

The paper is organized as follows. Section II presents an overview of the behavior of aggregate East Asian exports during the 1990s. Section III contains the description of the model and data, estimation techniques, and estimation results. Section IV concludes and is followed by one technical Appendix.

II. Overview of Aggregate East Asian Exports

The export performances of the six East Asian countries in our study were remarkable between 1981 and 1995. On average, their export revenues grew by 12 percent per annum, with continuous positive year-to-year growth rates, except in 1983 and 1985. Starting in 1995 however, the export growth rate declined and exports became virtually stagnant in 1996 and 1997, and declined in 1998 (see Figure 1).[5]

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[3] However, not all economists agree that trade has played an important role. For instance, Kaminsky and Reinhart (2000) argue that the trade links between East Asian countries are not strong enough to explain the spread of the crisis.

[4] Barth and Dinmore (1999) study the movements of trade prices and aggregate volumes in East Asia during the crisis at a monthly frequency. They find that although the export prices of the East Asian countries (Hong Kong SAR, Indonesia, Korea, Singapore, Taiwan province of China and Thailand) fell by 4.8 percent in 1997 and 9.1 percent in 1998, their aggregate export volumes went up by 8.8 percent in 1997 and only 0.7 percent in 1998.

[5] Given the strong seasonality of export revenues, both the actual monthly export revenues and a moving annual average are reported.

Figure 1. Monthly East Asian Exports
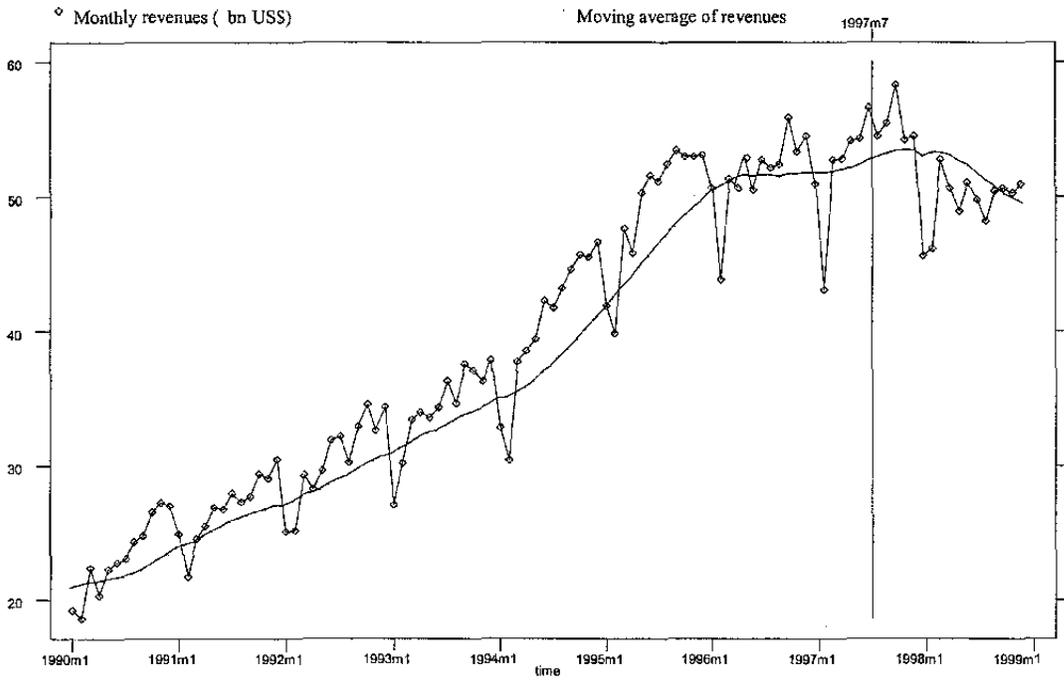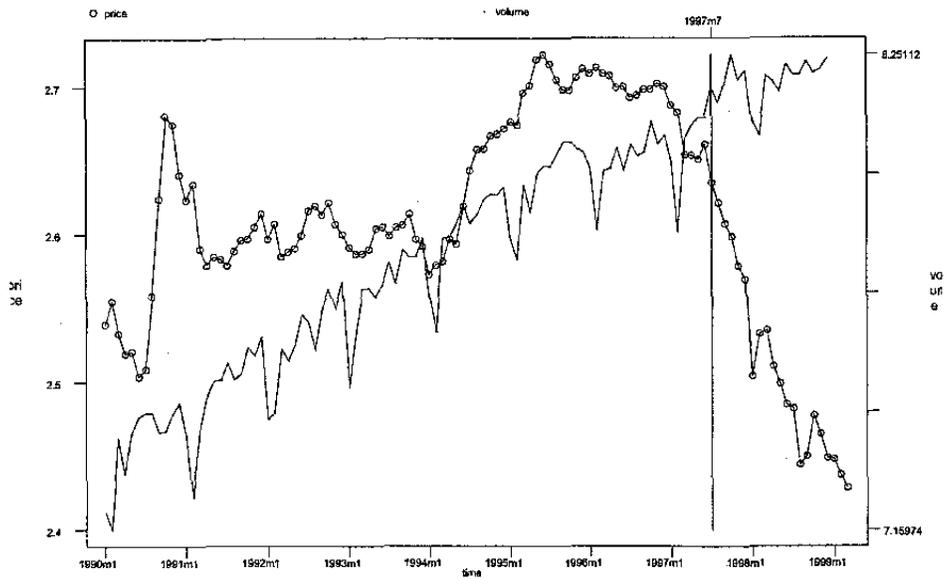### (In US$ billions)

Figure 2. East Asia (log) Export Prices and (log) Export Volumes

The decrease in export revenues towards the end of the 1990s was primarily due to a decline in export prices.[6] Export prices peaked in 1995 and sagged continuously throughout the period afterward, while export volumes continued to grow before the crisis and slowed gradually after September 1997 (see Figures 2 and 3). Figure 3 presents the East Asian export data in a price-quantity space, which allows analysis of the actual price-quantity equilibrium points over time. Although, without identifying the demand and supply curves, it is impossible to interpret the movements of the equilibrium path, three different patterns are clearly recognizable. In the period 1989 until June 1994, there was no significant variation in price but a constant expansion of volumes. In the second half of 1994 until the first half of 1995, there was a significant increase in prices and volumes. Finally, after June 1995, export prices fell continuously with little response in volumes, especially after September 1997. The last period is the most striking and is the focus of our analysis.

Figure 4 shows that a simple explanation for the slow growth of East Asian exports—a worldwide decline in demand—is not plausible. The share of East Asian exports in total world imports increased almost without interruption between 1987 and 1995, but started declining in 1996. This is evidence supporting the view that the export decline was specific to East Asia and cannot be explained by worldwide demand slowdown, and hence emphasizes the need to focus on this region.

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[6] Several authors have explored the export slowdown at the end of 1995. Fernald and Loungani (1999) analyze the Chinese effective devaluation in 1994, and show that this devaluation did not change the trade shares in the rest of Asia and hence did not cause the Asian crisis. Corsetti, Pesenti and Roubini (1998) suggest that "...the sharp appreciation of the U.S. dollar relative to the Japanese Yen and European currencies since the second half of 1995 led to deteriorating cost-competitiveness in most Asian countries whose currencies were effectively pegged to the dollar." In addition, there was a price war in the electronic sector, which accounts for an important export share in Korea, Taiwan Province of China, and Indonesia. The weak economic growth in Japan and the over-investment in these countries were the cause of the price war in 1995. This industry is included in our study in recognition of its importance in the development of the crisis. Finally, Chinn (1998) finds mixed evidence on the Asian exchange rates. Using a couple of methods, the author finds that some Asian currencies, like those of Malaysia, Philippines and Thailand, were overvalued before the crises, while some others, like the Korean won, were not.
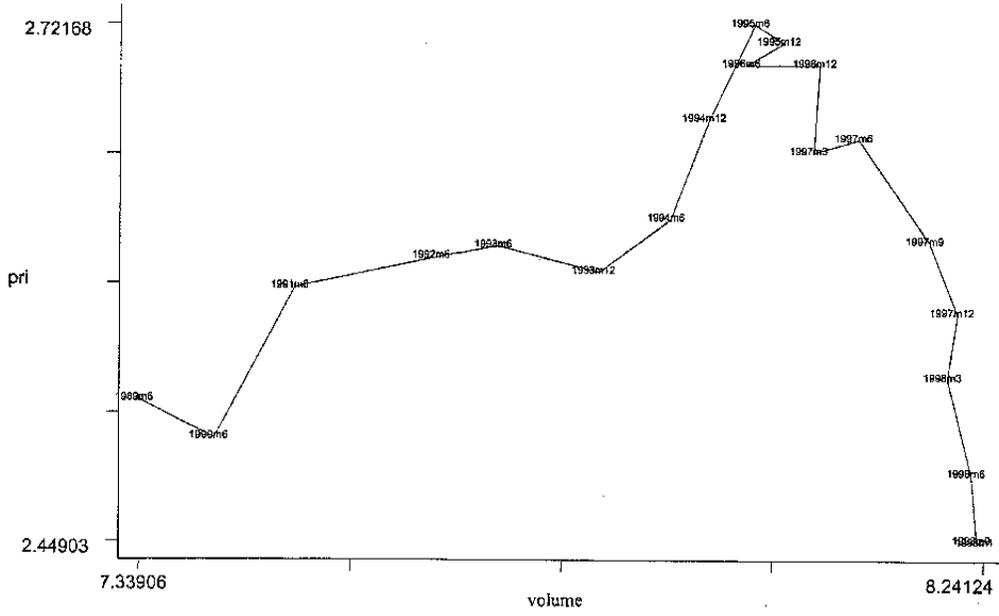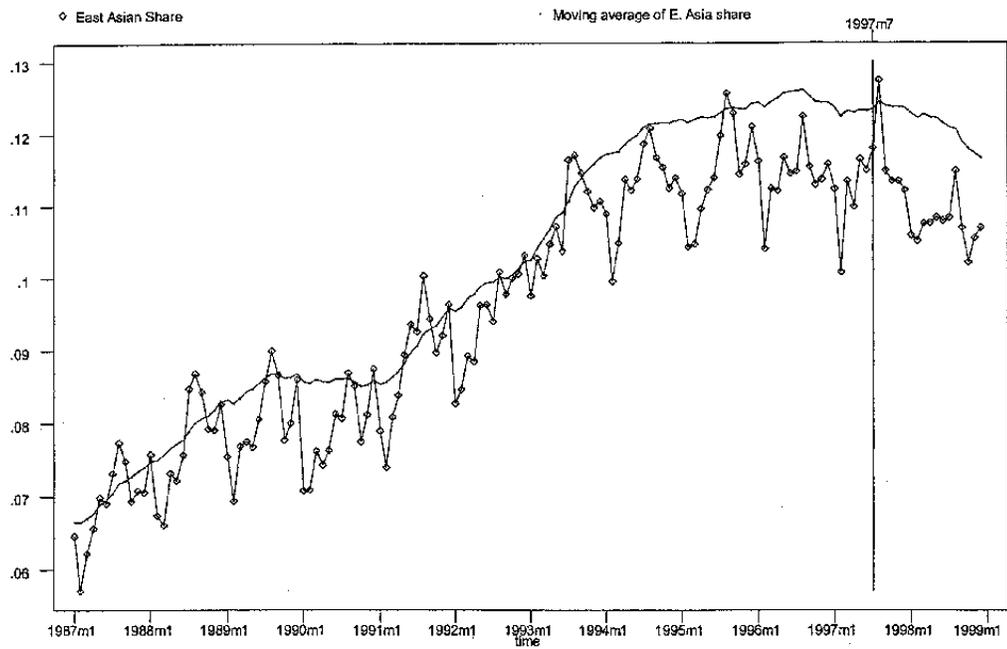
Figure 3. East Asian Price vs. Volume

Figure 4. East Asian Export Share in World Import

III. THE MODEL AND ESTIMATION METHODOLOGY AND REGRESSION RESULTS

A. Data and the Model

Our analysis focuses on disaggregated Asian manufacturing exports.[7] Three broad export groups are considered (chemicals, manufactures and machinery) corresponding to Standard International Trade Classification (SITC) codes 5, 6, and 7, the sum of which represent over 70 percent of exports for Korea, Malaysia, and Singapore, and 60 percent for Thailand. In addition to these three broad categories, three other specific industries (vehicles, clothing and semiconductors), corresponding to SITC codes 78, 84, and 776, respectively, are also considered.[8] These subindustries have played important roles in Asian trade.[9] Clothing, being labor-intensive, has traditionally been a very important export product for developing countries at the initial stages of industrialization, making this sector quite price sensitive and hence an interesting case for studying the effects of depreciation. The semiconductor industry is relatively new but it is already very important in Korea, Malaysia and Taiwan Province of China. It is characterized by large initial investment, reliance on large volumes to cover the initial outlays, and a very high rate of technological innovation. These characteristics make this industry highly cyclical and sensitive to price competition.[10] The road vehicle industry is also very important for the development strategy of Korea and Indonesia. The original sources of all the data are described in detail in Appendix I.

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[7] Muscatelli, Stevenson and Montagna (1994) provide evidence of the increasing importance of manufacturing exports (relative to traditional or primary exports) in Southeast Asia in recent years.

[8] For Korea and Thailand, data on road vehicles (SITC 78) could not be retrieved. Instead we included data on passenger cars (SITC 7812).

[9] For similar reasons Fernald, et al. (1999) focused on semiconductors and clothing in their study of Chinese exports.

[10] For a description of the highly competitive nature of the semiconductor industry see Macher, Mowery, and Hodges (1999). This industry includes several products such as integrated circuits and memory devises. The memory devises are highly standardized so that competition is mainly through price and timely delivery. The external market for memory devises had three characteristic phases. While the United States dominated this market prior to 1985, Japan dominated the market between 1985 and 1990, and since 1990, the Newly Industrialized Economies have been increasing their market shares.

Table 1 reports the share of particular commodity exports as a percentage of total exports. Note that manufactures and machinery items constitute a significant proportion of total exports for all Asian countries, except for Hong Kong SAR.[11] Among machinery items, semiconductors account for a large proportion of exports for Korea and Malaysia. However, these shares have not changed much between the pre-crisis (1995) and post-crisis (1998) periods.

The aggregate data hide important heterogeneity in composition and destination of exports. Tables 2-4 report the percentage of commodity-specific exports that each Asian country exports to its five Asian competitors (Table 2), to the United States (Table 3) and to Japan (Table 4). Table 2 indicates that these countries engaged in substantial intra-Asian trade. These shares were particularly high in chemicals (especially for Korea, Malaysia, Singapore and Thailand), and manufactures (for Korea and Singapore). After the crisis, the share of Asian trade dropped in particular for these two commodity groups. Correspondingly, the share of exports going to the United States (see Table 3) and Japan (see Table 4) increased after the crisis.[12]

Our sample data set was not readily available in any existing database at a monthly frequency. The database was constructed from the original national sources. Ideally, we would have liked to have data on export prices and volumes for each commodity and country we are interested in. Unfortunately, for many commodity groups in our sample, only data on export revenues were available, so that aggregate price data for the relevant industries were used to deflate revenues and obtain export volumes. Country and industry-specific competitors' price indices were constructed as weighted sums. Weights were constructed as the market shares of each Asian competitor in the total Asian market by particular industry. The construction of the data set is described in Appendix I.

The reduced form, long-run equation of demand for exports that we estimate (in logarithmic form) is:

$$X_{ijt} = \alpha_{ij}^d + \alpha_{ij1}P_{ijt} + \alpha_{ij2}P_{ijt}^c + \alpha_{ij3}Y_t^w + v_{ijt}^d \tag{1}$$

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[11] Hong Kong's export shares are low because the denominator includes exports to China, whereas the numerator does not.

[12] Hong Kong SAR's shares are unusually small as most of Hong Kong SAR's exports go to China, which we were unable to include in our sample.

Table 1: Share of Specific Commodity Sections Out of Total Exports: Comparison
Between 1995 and 1998 Based on Average of Monthly Shares 1/

(In percentage)

	Chemicals	Manufacture	Machinery	Vehicle	Clothing	Semic.
Hong Kong SAR	1 ; 1	2 ; 1	5 ; 3	0.0;0.0	5 ; 5	1 ; 1
Indonesia	3 ; 4	23 ; 18	8 ; 10	7 ; 5	0.8 ; 0.6	0.3 ; 0.4
Korea	7 ; 8	22 ; 22	52 ; 49	6 , 6	4 ; 3	15 ; 14
Malaysia	3 ; 36	9 ; 8	55 ; 59	1 ; 1	3 ; 3	18 ; 19
Singapore	6 ; 7	6 ; 4	66 ; 67	...	...	...
Thailand	3 ; 4	18 ; 15	34 ; 40	0.3;0.5	10 ; 8	4 ; 4

1/ The shares in Table 2 are computed from the monthly national data sources, while the shares in Tables 3, 4 and 5 were computed from annual data from the direction of Trade Statistics. The first figure is from 1995, the second from 1998.

Table 2: Asian Exports to Each Other: Percentage of Specific Exports to Asian
Partners, Based on 1995; 98/97 Values 1/

Country	Chemicals	Manufacture	Machinery	Vehicle	Clothing	Semic.
Hong Kong SAR	10 ; 7	10 ; 8	18 ; 12	7 ; 9*	1 ; 0	32 ; 21
Indonesia	32, 32	26, 22	42, 43	55, 51	4, 2	63, 46
Korea	26 ; 17	27 ; 19	18 ; 15	5 ; 1	2 ; 2	30 ; 30
Malaysia	46 ; 40*	39 ; 39*	34 ; 35*	27; 17*	7 ; 7*	34 ; 36*
Singapore	46 ; 37	53 ; 43	34 ; 28	36; 23	8 ; 5	42 ; 38
Thailand	53 ; 37*	26 ; 26*	34 ; 30*	15 ; 7*	9 ; 3*	41 ; 33*

1/ The first number in every cell is the share in 1995 while the second is the share in 1998. When 1998 values not available, substituted by 1997 values (denoted by '*'). Road vehicles is an insignificant percentage of Hong Kong exports, and it does not export any significant proportion of its total exports of road vehicles to the Asian partners listed here. More than 60 percent of Hong Kong's vehicle exports goes to China which is not listed here.

Table 3: Asian Exports of the Same Commodities to the
United States: 1995; 98/97 Values

Country	Chemicals	Manufactures	Machinery	Vehicle	Clothing	Semic.
Hong Kong SAR	1 ; 1	10 ; 12	19 ; 18	7 ; 9*	48 ; 47	29 ; 27
Indonesia	3 ; 5	7 ; 11	24 ; 15	11 ; 10	33 ; 45	23 ; 15
Korea	5 ; 7	8 ; 13	26 ; 22	22 ; 19	39 ; 44	34 ; 27
Malaysia	9 ; 10*	2 ; 7*	29 ; 25*	3 ; 4*	49 ; 49*	33; 26*
Singapore	8 ; 6	14 ; 4	24 ; 26	4 ; 5	53 ; 54	20 ; 21
Thailand	2 ; 2*	8 ; 15*	21 ; 22*	6 ; 4*	25 ; 43*	22; 24*

Table 4: Asian Exports of the Same Commodities to Japan: based
on 1995; 98/97 Values

Country	Chemicals	Manufactures	Machinery	Vehicle	Clothing	Semic
Hong Kong SAR	3 ; 2	2 ; 1	5 ; 8	- ; -	3 ; 1	5 ; 7
Indonesia	9 ; 7	23 ; 13	8 ; 16	6 ; 9	10 ; 14	7 ; 14
Korea	1 ; 8	13 ; 9	9 ; 6	2 ; 1	37 ; 21	15 ; 9
Malaysia	11 ; 10*	15 ; 17*	9 ; 9*	4 ; 3*	5 ; 5*	8 ; 8*
Singapore	5 ; 5	3 ; 5	8 ; 6	3 ; 5	4 ; 3	9 ; 6
Thailand	9 ; 10*	11 ; 10*	15 ; 13*	6 ; 8*	10 ; 10*	17 ; 17*

where,

α_{ij}^d = constant term in the demand equation.

X_{ijt} = volume of the i-th commodity exported by the j-th country in period t.

P_{ijt} = export price of i-th commodity (in dollars) exported by the j-th country in period t.

P_{ijt}^c = competitors' export price index for commodity i as faced by country j.

Y_t^w = world real import demand.

v_{ijt}^d = residual term in the demand regression.

According to standard economic theory, an increase in one's own price should decrease, while an increase in competitors' price or world demand should increase the demand for one's own exports. Hence, we expect to see $\alpha_{ij1} < 0$ and $\alpha_{ij2}, \alpha_{ij3} > 0$.

The reduced form long run (inverted) supply equation is given by:

$$P_{ijt} = \beta_{ij}^s + \beta_{ij1} X_{ijt} + \beta_{ij2} E_{jt} + \beta_{ij3} DC_{jt} + v_{ijt}^s, \qquad (2)$$

where,

β_{ij}^s = constant term in the supply equation.

E_{jt} = nominal exchange rate in country j at time t.

DC_{jt} = domestic credit in country j at time t.

v_{ijt}^s = residual in the supply regression.

We expect a nonnegative slope in the supply curve ($\beta_{ij1} \geq 0$). The nominal exchange rate measures the extent to which exporters adjust their price in dollars after depreciation. A nominal depreciation reduces the export supply price expressed in dollars ($\beta_{ij2} < 0$), although the extent of price decline depends on the pass through elasticity.[13] Domestic credit (DC) checks whether credit availability is a constraint on export supply. An increase in domestic credit facilitates export supply, thereby reducing its price ($\beta_{ij3} < 0$). The sign of the

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[13] The empirical literature on whether nominal devaluation results in real devaluation is quite comprehensive. See Reinhart (1995) and the references therein.

coefficient on domestic credit also tests for the possibility of a credit crunch slowing down export supply during the crisis.[14]

Equations (1) and (2) can be estimated using different econometric techniques depending on the time series properties of the data. Given that it is difficult to assess the time series properties—presence of unit roots and cointegration—in time series that are relatively short, we estimate our equations using cointegration techniques in a panel context. As a robustness check, we also estimate the previous equations using single equation approaches and instrumental variables.

B. Time Series Properties and Cointegration Approach

As a first step we evaluate the stationarity of the data series. The Augmented Dickey-Fuller (1979), and Phillips-Perron (1988) tests are both used to check for the presence of unit roots in the variables used in estimation.[15] For each of the six series in every country, the existence of unit roots cannot be rejected by at least one of the two tests, and sometimes by both at the 1 percent level of significance. For the same variables, however, the existence of a unit root in the first difference is always rejected, indicating that the variable series are integrated of order one ($I(1)$).[16]

Next, we assess the existence of any stable long run relationship between the $I(1)$ and $I(0)$ variables, i.e., we test for the existence of cointegration.[17] Johansen's (1988) Maximum Likelihood and residual based approaches are used to test for the existence of cointegration between the six variables: volume, own price, competitor's price, world demand, exchange

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[14] While some authors (e.g., Ghosh and Ghosh (1999), and Ferri and Kang (1999)) have analyzed the impact of a credit crunch on the entire economy, we focus on its effect on specific exports.

[15] The Bayesian Information Criterion is used to determine the optimal lag length.

[16] Notable exceptions are: export volume of manufactures and clothing in Hong Kong SAR, chemicals and semiconductors in Indonesia; manufactures and clothing in Korea; vehicles and clothing in Malaysia and chemicals and miscellaneous manufactures in Singapore. These series appeared to be trend-stationary.

[17] Note that although the sample has a considerable number of observations for most countries (monthly data over 1990-98), they span for a total of nine years only. This span can be too short for a "long–run" relationship in exports. Hence, the power of these tests would generally be low. However, working with monthly data over a short span has an advantage in that it reduces the risk of a major structural change in the estimated relationships. Standard tests for structural change (as described later) indicate that the demand and supply equations have not undergone any major change in their behavioral relationship.

rate and domestic credit. Monthly dummies and time trend are also used in the regression, but not restricted to be a part of the cointegrated vectors. All variables in the cointegrating relationship are individually and (sometimes jointly) significant. Critical values for this test were found in Osterwald-Lenum (1992). The results indicate the existence of at least one cointegrating vector for all commodity groups (for all countries) at the 5 percent level of significance. In some cases (e.g., all commodity groups in Indonesia, clothing and semiconductors in Korea, and all commodity groups in Singapore) two cointegrating vectors were found.

Based on the result that the export variables support at least one cointegrating relationship, the long-run demand and supply are estimated in levels. We use the Dynamic Generalized Least Squares methodology of Stock and Watson (1989) as described in Campbell and Perron (1991). This methodology corrects for: (i) serial correlation (the sample residuals exhibit AR(1)) using Generalized Least Squares (GLS); and (ii) endogeneity of the regressors by including lags and leads of changes in the explanatory variables. The long-run specification for the demand equation (following the Stock and Watson approach) is:

$$X_{ijt} = \alpha_{ij}^d + \alpha_{ij1}P_{ijt} + \alpha_{ij2}P_{ijt}^c + \alpha_{ij3}Y_t^w + d_{ij1}(L)\Delta P_{ijt} + d_{ij2}(L^{-1})\Delta P_{ijt} + d_{ij3}(L)P_{ijt}^c$$
$$+ d_{ij4}(L^{-1})P_{ijt}^c + d_{ij5}(L)\Delta Y_t^w + d_{ij6}(L^{-1})\Delta Y_t^w + \sum_{s=1}^{11}\lambda_{ijs}M_s + v_{ijt}^d, \tag{3}$$

where,

M_s = monthly dummies that control for seasonal effects.

$d_{ijm}(L) = \sum_k d_{ijk}L^k$ for $m = 1,3,5$ and $d_{ijm}(L^{-1}) = \sum_k d_{ijk}L^{-k}$ for $m = 2,4,6$.

L is the lag operator.[18]

The long-run specification for the supply equation is:

$$P_{ijt} = \beta_{ijd} + \beta_{ij1}X_{ijt} + \beta_{ij2}E_{jt} + \beta_{ij3}DC_{jt} + s_{ij1}(L)\Delta X_{ijt} + s_{ij2}(L^{-1})\Delta X_{ijt}$$
$$+ s_{ij3}(L)E_{jt} + s_{ij4}(L^{-1})E_{jt} + s_{ij5}(L)\Delta DC_{jt} + s_{ij6}(L^{-1})\Delta DC_{jt} + \sum_{s=1}^{11}\mu_{ijs}M_s + v_{ijt}^s, \tag{4}$$

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[18] The integer k, the number of lags (or leads), is chosen in the following manner. Starting with a reasonable upper bound of k, on estimation, if the variable (with the biggest lag) is significant, then k is chosen to be the upper bound. If the variable is not significant, the number of lags is reduced by 1 until the last included lag is significant in the estimation. A similar method is used to choose the optimum number of leads.

where, $s_{ijm}(L) = \sum_k s_{ijk}L^k$ for $m = 1, 3, 5$ and $s_{ijm}(L^{-1}) = \sum_k s_{ijk}L^{-k}$ for $m = 2, 4, 6$.

Again, the optimum number of leads and lags are chosen as in the demand regression. The specifications for short-run demand and supply are:

$$\Delta X_{ijt} = \gamma_{ijd} + \gamma_{ij1}ED_{ijt-1} + \gamma_{ij2}ES_{ijt-1} + \gamma_{ij3}(L)\Delta P_{ijt} + \gamma_{ij4}(L)\Delta P_{ijt}^c + \gamma_{ij5}(L)\Delta Y_t^w$$
$$+ \sum_k^{11} \eta_{dijk}M_k + v_{ijt}, \tag{5}$$

$$\Delta P_{ijt} = \delta_{ijd} + \delta_{ij1}ED_{ijt-1} + \delta_{ij2}ES_{ijt-1} + \delta_{ij3}(L)\Delta X_{ijt} + \delta_{ij4}(L)\Delta DC_{it} + \delta_{ij5}(L)\Delta E_t$$
$$+ \sum_k^{11} \sigma_{sijk}M_k + v_{ijt}. \tag{6}$$

The terms ED_{ijt-1} and ES_{ijt-1} are the one period lagged error correction terms from the long run demand and supply regressions where,

$$ED_{ijt} = X_{ijt} - \alpha_{ij}^d - \alpha_{ij1}P_{ijt} - \alpha_{ij2}P_{ijt}^c - \alpha_{ij3}Y_t^w \tag{7}$$

$$ES_{ijt} = P_{ijt} - \beta_{ij}^s - \beta_{ij1}X_{ijt} - \beta_{ij2}DC_{jt} - \beta_{ij3}E_{jt} \tag{8}$$

As a first step, we estimate equations 3 to 6 separately for each commodity and each country.[19] The general results for the long-run demand equations are: (i) price elasticity is negative and statistically significant; (ii) competitors' price elasticity is positive and statistically significant; and (iii) world demand elasticity is usually more than one and statistically significant. While the long-run demand function performs well in almost all countries and industries (there is considerable dispersion across the countries and industries in the actual magnitude of these elasticities), short-run demand does not perform well but is consistent in showing a speedy adjustment to equilibrium.

The general results for the long run supply equations are: (i) the supply price is relatively inelastic to quantity; (ii) the pass through elasticity between nominal exchange rate and export supply price is negative and significant; and (iii) the evidence of the effect of domestic credit on export price is mixed. The short run supply curves vary considerably across countries and industries and no specific pattern is discernable.

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[19] Table 5 and 6 report summary tables for the single equation approach. The regression result tables are too many to be reported here, but they are available upon request.

Table 5. Demand Equation: Single Equation Cointegration Estimation 1/

	Chemicals	Manufactures	Machinery	Vehicles	Semiconductors	Clothing
P_{ijt}	-0.14 (4-, 1+, 1 = 0)	-0.46 (4-, 0+, 2= 0)	-0.48 (3-, 0+, 3= 0)	-0.69 (2-, 0+, 2=0)	-0.68 (3-, 0+, 2= 0)	-0.60 (3-, 0+, 2= 0)
P^c_{ijt}	0.57 (0-, 1+, 5= 0)	1.40 (0-, 5+, 1= 0)	1.47 (0-, 5+, 1= 0)	1.51 (1-, 1+, 2=0)	1.21 (0-, 3+, 2= 0)	-0.18 (2-, 2+, 1= 0)
Y^w_t	2.08 (0-, 5+, 1= 0)	0.68 (1-, 4+, 1= 0)	1.89 (0-, 4+, 2= 0)	0.53 (0-, 1+, 3=0)	2.08 (0-, 4+, 1= 0)	0.03 (1-, 0+, 4= 0)

Table 6. Supply Equation: Single Equation Cointegration Estimation 1/

	Chemicals	Manufactures	Machinery	Vehicles	Semiconductor	Clothing
X_{ijt}	-0.12 (2-, 0+, 4 =0)	-0.13 (1-, 0+, 5= 0)	-0.12 (3-, 0+, 3= 0)	-0.03 (0-, 0+, 4= 0)	-0.14 (2-, 0+, 3= 0)	-0.08 (3-, 0+, 2=0)
DC_t	0.25 (1-, 3+, 2= 0)	0.17 (1-, 4+, 1= 0)	0.10 (2-, 4+, 0= 0)	0.05 (1-, 1+, 2= 0)	0.02 (1-, 2+, 2= 0)	0.17 (0-, 2+, 3= 0)
E_t	-0.48 (5-, 0+, 1= 0)	-0.50 (5-, 0+, 1= 0)	-0.46 (4-, 0+, 2= 0)	-0.32 (4-, 0+, 0= 0)	-0.04 (3-, 0+, 2= 0)	-0.65 (4-, 0+, 1= 0)

1/ See main text for the explanation. Coefficients indicate average value of the estimated parameter. The notation in the parentheses has the following interpretation. Suppose we have (x-, y+, z = 0); this implies that x of estimated coefficients are negative and significant (at 10 percent level or below), y of coefficients are positive and significant (at 10 percent level or below) and z of coefficients are insignificantly different from zero.

In addition, we also test (in the single equation framework) for (i) the existence of price homogeneity in the demand equation; (ii) the existence of serial correlation in the errors; (iii) a structural break test in both equations. The hypothesis of price homogeneity in the demand equations is generally rejected. The few cases in which this hypothesis is not rejected are when price indices are defined imprecisely (due to lack of data on actual prices). With some exceptions (like Indonesia) results also indicate no structural breaks.[20] One explanation is the weak power of the tests (since sample sizes are small with very few data points after the proposed date of structural break). Another explanation, for a structural break of the supply equation, is that any credit crunch resulting in a structural break will possibly be revealed with a delay, possibly in early 1999 for which we do not have data. Finally, the Box-Ljung test results yield inconclusive evidence for residuals exhibiting serial correlation up to six lags.

C. Empirical Results: Panel Approach

The export demand and supply equations estimated above, could suffer due to the relatively small sample sizes. Mark and Sul (1999) show that there are sizeable gains in pooling the data. Kao and Chiang (2000) have compared different estimation techniques for panel data in presence of cointegration and have found that DOLS outperforms both OLS and fully modified OLS.[21]

We perform GLS regressions in panels for the six commodity groups, allowing for country-specific first-order auto-correlation in the error structure as well as contemporaneous correlation across commodities (i.e., cross equation correlation). The panel comprises of exports from Hong Kong SAR, Indonesia, Korea, Singapore, and Thailand for the period March 1993 through July 1998.[22] Malaysia was dropped from the sample as it had very few observations overlapping with the other countries' data in our sample. Besides using monthly dummies to control for seasonality as before, country dummies are used to control for country-specific effects.

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[20] The Chow predictive test (Greene 1997, Chapter 7) is used to check for the possibility of a structural break in demand or supply in July 1997, when the financial crisis started, and in December 1997, when Korea devalued. We also use Andrew's (1993) method of testing for a structural break when the break point is unknown. For the latter test, we restrict the breakpoint to be between July 1997 and December 1997. The results indicate no structural break in demand or supply functions.

[21] A recent example of application of panel DOLS is Lane and Milese-Ferretti (2000).

[22] Using a Hausman test we could not reject a Random Effects model, i.e., GLS is more efficient. Note that for road vehicles (SITC 78) the panel is imprecise, since the Korean and Thai data are on passenger cars (SITC 7812).

The panel estimation results are given in Table 7.[23] The results indicate a very standard demand equation for Asian exports.[24] Price elasticity is always significant except for semiconductors. Similarly, competitors' price elasticity is positive and significant except for chemical, vehicles and clothing. The absolute value of elasticity for competitors' price is large, supporting the argument that there is a considerable degree of intra-Asian competition. Chemicals, machinery and semiconductor are particularly sensitive to world demand. Clothing has a negative and insignificant sign reflecting the fact that Asian exporters have been moving away from this sector.

The results for the supply equations show that supply curves are basically horizontal for all products with the exception of clothing. Export prices are sensitive to depreciation even though the pass-through elasticities of export price with respect to the nominal exchange rate are somewhat smaller in absolute terms than those found in the single equations. Note also that the pass-through elasticity is higher in manufactures, vehicles and semiconductors than in the other industries. This result is consistent with the argument that pass-through elasticities are industry dependent and higher in industries with more market power (see Knetter (1993) for this argument). The pass-through elasticity for chemical industry is zero, supporting the fact that the national value added share in the final value of chemicals (given that its production depends on imports of intermediates) is low so that a depreciation cannot be reflected in prices. Overall, our results with monthly data support similar findings in the literature (c.f. Muscatelli and Stevenson (1995), and Giorgianni and Milesi-Ferretti (1997)) based on lower frequency data.

The evidence on the effect of domestic credit on export supply is ambiguous. Under the panel approach, the sign of the coefficients on domestic credit is negative in five out of six industries and significant for the chemicals, and the vehicle and semiconductor sub-sectors.[25] However, under the single equation approach only 6 equations out of 36 have the negative sign for domestic credit and are significant. Based on these results, we conclude that there is weak evidence for a domestic credit crunch to be responsible for the delayed

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[23] The panel on road vehicles has three countries (Indonesia, Korea, and Thailand) as Hong Kong SAR has an insignificant export of vehicles, and Singaporean data beyond the one-digit level could not be retrieved. For all one digit other commodity groups we have five countries.

[24] For the demand equation see Faini, Clavijo, and Senhadji-Semlali (1991); Muscatelli, et. al (1994); and Reinhart (1995).

[25] Domestic credit is potentially endogenous. However, only a small share of total domestic credit goes to the sectors we consider so that the problem of endogeneity is limited.

Table 7. Estimation Results (Cointegration Approach)
Long Run Demand, Dependent Variable X_{ijt}

	Chemical	Manufactures	Machinery	Vehicles	Semiconductors	Clothing
P_{ijt} ·	-0.556	-1.192	-0.291	-1.481	-0.110	-1.026
	(0.00)	(0.00)	(0.00)	(0.00)	(0.21)	(0.00)
P_{ijt}^c	0.211	1.201	1.086	-0.275	1.128	-0.233
	(0.26)	(0.00)	(0.00)	(0.49)	(0.00)	(0.020)
Y_t^w	1.658	0.128	1.083	0.151	2.715	-0.144
	(0.00)	(0.21)	(0.00)	(0.79)	(0.00)	(0.11)
Log likelihood	296	396	291	104	261	280
Countries	5	5	5	3	4	4
Obs. #	275	275	275	192	240	240

Short Run Demand, Dependent Variable ΔX_{it}

	Chemicals	Manufactures	Machinery	Vehicles	Semiconductors	Clothing
ΔP_{it-1}	-0.206	0.077	0.393	0.548	-0.035	-0.155
	(0.35)	(0.68)	(0.18)	(0.28)	(0.092)	(0.640
ΔP_{it-1}^c	-0.26	-0.169	-0.359	-0.098	1.517	-0.210
	(0.66)	(0.73)	(0.67)	(0.93)	(0.02)	(0.83)
ΔY_{t-1}^w	-1.082	-0.404	-0.264	0.210	-0.012	-0.351
	(0.00)	(0.03)	(0.27)	(0.69)	(0.97)	(0.33)
ECD_{t-1}	-0.203	-0.244	-0.225	-0.309	-0.227	-0.435
	(0.00)	(0.00)	(0.00)	(0.00)	(0.05)	(0.110
Implied Speed (months)	4.9	4.1	4.4	3.2	4.4	2.3
R^2	0.39	0.45	0.42	0.39	0.34	0.56

Table 7 (Concluded). Estimation Results (Cointegration Approach)
Long Run Supply: Dependent Variable: P_{it}

	Chemicals	Manufacture	Machinery	Vehicles	Semiconductors	Clothing
X_{ijt}	-0.001	0.002	0.004	-0.021	-0.028	-0.038
	(0.91)	(0.87)	(0.77)	(0.29)	(0.36)	(0.01)
DC_{jt}	-0.088	-0.045	-0.069	-0.336	-0.3656	0.031
	(0.03)	(0.21)	(0.011)	(.0.00)	(0.00)	(0.10)
E_{jt}	0.004	-0.124	-0.080	-0.136	-0.156	-0.041
	(0.91)	(0.00)	(0.02)	(0.00)	(0.00)	(0.18)
Log Likelihood	558	574	586	307	458	493
Countries	5	5		3	4	4
Obs. #	275	275	275	192	240	240

Short Run Demand: Dependent Variable = Δ_{it}

	Chemicals	Manufactures	Machinery	Vehicles	Semiconductors	Clothing
ΔX_{it-1}	0.031	0.012	-0.020	-0.001	-0.008	0.108
	(0.16)	(0.77)	(0.53)	(0.95)	(0.78)	(0.00)
ΔDC_{t-1}	0.362	0.302	0.292	0.338	0.272	0.385
	(0.22)	(0.28)	(0.33)	(0.41)	(0.47)	(0.20)
ΔE_{t-1}	-0.143	-0.113	-0.118	-0.148	-0.140	-0.104
	(0.44)	(0.53)	(0.52)	(0.53)	(0.53)	(0.53)
ECS_{t-1}	-0.66	-0.077	-0.050	-0.065	-0.076	-0.066
	(0.06)	(0.08)	(0.14)	(0.10)	(0.05)	(0.13)
Implied Speed (months)	15.2	13	20	13.2	13.2	15.2
R^2	0.14	0.14	0.14	0.17	0.19	0.27

Note: Demand and supply regressions are estimated with DOLS as explained in the main text. Each long-run regression includes one lead and lag for (the difference of) each continuous variable. The short-run equations include two lags for each continuous variable. All regressions include fixed effects for each country and monthly dummies. We allow for country-specific first-order auto-correlation in the error structure as well as contemporaneous correlation across countries in the long-run regressions. R-squares are not defined in the long-run regressions (see Greene, 1997). The speed of adjustment is calculated as the inverse of the opposite of the coefficient on the error correction term.

response of East Asian exports. This result is consistent with the findings of Ghosh and Ghosh (1999) for East Asia, and the observation of Krueger and Tornell (1999) who find that the Mexican tradable sector had responded strongly to depreciation in the crisis of December 1994, severe credit crunch notwithstanding.

The clothing industry behaves in an anomalous manner in most regressions. One explanation is that exports of textiles by these countries were constrained by the Multi Fiber Arrangement (MFA) quotas. These quotas are still in effect and will be entirely eliminated only by 2005. Such quantity constraints on exports would naturally distort the relationship between variables in the export demand and supply equations for clothing.

Finally, short-run equations show that price and quantities do not adjust immediately to shocks. However, the speed of adjustment is very fast for demand, ranging from 2.3 months for clothing to 4.9 months for chemicals although it is considerably slower for supply ranging, from 13 months to 20 months.

D. Robustness

We check the robustness of our results with respect to the estimation techniques and with respect to the data. As commonly done in the current literature, we tackle the existence of unit root in variables by estimating exports for Asia within a cointegration framework. To control for the possible simultaneity bias, we use the equation-by-equation estimation methodology proposed by Stock and Watson (1989). Another option would be to use Johansen's (1990) systems' estimation procedure. However, this implicitly allows the possible misspecification in one equation to spillover to the other. To avoid this problem, we estimate demand and supply independently. In other unreported regressions, we also run instrumental variable regressions and the results were similar but weaker to what we have found using the cointegration approach.

As described before, for many commodities in our sample, only data on export revenues were available, so that aggregate price data for the relevant industries were used to deflate revenues and obtain export volumes. As a robustness test, the U.S. import prices were used as alternative deflators. This alternative method (to obtain quantities and prices) did not significantly change our results.

The demand for East Asia exports could be sensitive to individual economic activity in the United States, Japan, or other Asian countries such that both aggregate world demand and its composition become important determinants of demand for Asian exports. In unreported regressions, we used alternative specifications with several scale variables corresponding to different geographical areas and for specific industry. These regressions indicate that there is no significant difference between using some composition of world income or using aggregate world income. Hence world import demand is used as the scale variable helping us avoid losing degrees of freedom.

Finally, we test the different specifications for demand and supply equations. In particular, we use real interest rate as an alternative to domestic credit. Even though our results of interest rate are not conclusive, the results on the other coefficients are the same as for the equations with domestic credit.

E. Interpretations

As noted in the introduction, four reasons could explain why exports have lagged in East Asia even after the huge depreciations. First, a credit crunch could choke off export supply. Second, world demand slowdown might adversely affect East Asian exports. Third, the export demand could be highly inelastic in the short run. Fourth, export demand for a single country might have slowed down due to currency depreciation of its competitors. Table 8 summarizes the expected coefficient in each of the explanations using our estimation results.

Table 8: Implied Coefficients of Alternative Explanations for Slow
Response of Exports to Depreciation

Explanation	X_i (Quantity in Demand Curve)			P_i (Price in Supply Curve)		
	P_i	P_i^c	Y^w	X_i	DC	E
Credit crunch					...	
Contraction of world demand			...			
J-curve effect	0(short run)					...
Competitive depreciation	...	++				...

Our results do not support the credit crunch explanation for three reasons: First, we find mixed evidence on the sign of the coefficient on domestic credit. Second the calculated speed of adjustment for the supply curve (over one year) indicates that any effect of a credit crunch would not be reflected before a year. Finally, an upward shift of the supply curve along the demand curve should *increase* the equilibrium price not *decrease* it. An upward shift of the supply curve without any change in prices is possible only if the demand curve is horizontal and our estimated demands indicate that this is not the case for virtually any commodity.

On the second explanation, although our estimation results support large and positive income elasticity of demand for exports, there was no collapse of world import demand at the end of the nineties that can explain the contraction of East Asian exports (as shown in Figure 4). Hence, a world demand contraction explanation is ruled out by the data.

The third explanation, which implies a vertical demand curve in the short run, is rejected by our short-run analysis, which indicates a rapid adjustment in export demand.

The fourth explanation—a competitive depreciation—implies that exports of an individual country did not pick up because competitors were depreciating and cutting their export prices as well. In the supply equation, depreciation has to translate into lower export prices, while in the demand equation, export quantity has to be very sensitive to own and competitors' prices. Our results support both these requirements.[26] Hence, a nominal depreciation in each country shifts down its export supply curve by some proportion, thereby reducing the export prices. At the same time, nominal depreciation by its competitors' shifts its demand curve to the left, such that quantity sold in exports does not increase by much in spite of a sharp decline in export price.

Finally, the fact that export price from East Asia collapsed during the crisis begs the question as to why East Asian exports as a whole did not increase significantly given that the rest of the world was appreciating versus East Asian countries. In other words, the elasticity of substitution between goods from single East Asia countries is very high while the elasticity of substitution between East Asia as a whole and the rest of the world is less strong. This fact is consistent with several studies that have looked specifically at the issue of different elasticities of substitution for goods from different countries. For instance, Faini, Clavijo, and Senhadji-Semlali (1991) find that the competition in exports between two LDC countries is much stronger than the competition between a DC and a LDC country. Giorgianni and Milesi-Ferretti (1997) find that using two exchange rates —one versus industrialized and another versus non-industrialized countries—explains export demand for Korea better than using one exchange rate. Finally, Spilimbergo and Vamvakidis (2000) show that the assumption of equal elasticity of substitution of export demands for LDC and DC countries is not supported by the data and export equations work much better using two exchange rates.

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[26] Note that the only way to verify the depreciation explanation is by estimating demand and supply systems as we do. The shortcut of looking at changes in market shares cannot work because countries that engage in competitive devaluation could end up with the same market shares.

IV. CONCLUSION

This paper attempts to identify demand and supply curves for specific export groups at a monthly frequency, whereas most of the empirical trade literature has so far focused on lower time frequencies. Analyzing high frequency data is the only possible choice if we want to analyze the development of the East Asian currency crisis. Working with recent monthly trade data posed several challenges. First, there was no readily available database. Second, there was a risk that trade equations, which may work well at low frequency, would stop working at high frequency. We have dealt with the data availability problem by constructing an original database on monthly prices and quantities for selected industries for six Asian economies. When the data were not available from the original sources we used several alternatives and checked the robustness of our results. The specification challenge is dealt with by using a vector cointegration framework in panel. Our results are robust to different specifications and different ways of constructing the data set.

The main results are that demand for East Asian exports is very sensitive to prices—both its own and competitors'—and to the world growth rate. Export supply is very sensitive to depreciation. These results indicate that competitive depreciation played a key role in exacerbating the real effects of the crisis by working through a trade channel and that these effects occur quite rapidly—in about 4 months. This paper calls for an interpretation of the Asian crisis that would put a stronger emphasis on, the role of trade, the importance of competitive depreciation in prolonging the crisis, and the causes underlying the slowdown in export supply. We also offer an optimistic forecast about the immediate future for East Asian exports. As the economies strengthen and depreciation stops, the demand and supply of exports should return to their pre-crisis growth rates, as is already evidenced from the fast recovery of the Korean and Malaysian exports.

Data

Our sample covers monthly data between 1990-1999 (April), with a few exceptions when data could not retrieved. A complete description of the variables and the data sources is given below:

Price and volume of exports: Export prices were used to deflate the export revenues and obtain volumes of exports. For commodities disaggregated at the one-digit level, such as chemicals, manufactured items, and machinery, commodity-specific export price indices for Korea, Singapore and Thailand were available. At the two and three digit levels, the best available country- and commodity-specific export price index is used. For instance, export price index of SITC 7 (machinery) was used to obtain volumes of SITC 78 (road vehicles) and 776 (semiconductors) and so on. For Indonesia and Malaysia, commodity-specific export prices could not be retrieved and unit value of exports was used to deflate all export revenues. Hong Kong SAR had export price indexes for clothing and semiconductors. For other commodities, the unit value of exports was used.

The use of alternative proxies for price indexes when individual price information is missing is not uncommon. For instance, Muscatelli, et al. (1994), have used import (and sometimes export) price indices of the United States to obtain volumes of developing country manufacturing exports. However, there is a problem with this deflator. Ideally we would like to have $X_{ij} = R_{ij}/P_{ij}$, where R_{ij} is the export revenue earned by the j-th country in the i-th good. However, when P_{ij} is not available, and a proxy like the U.S. import price index for i (denote it by $P_{i,USA}$) is used, a new variable, X_{ij}°, is created such that, $X_{ij}^{\circ} = R_{ij}/ P_{i,USA}$. $P_{i,USA}$ depends on the exports of commodity i from all exporters of i to the United States. Hence, an increase in the exports of i from all other countries (except j) leads to a decline in the import price faced by the United States ($P_{i,USA}$) which, increases the value of X_{ij}° even though X_{ij} does not increase. This is one caveat we have to keep in mind when using the commodity specific import price indices from United States. However, in order to check the robustness of our results, we use U.S. import prices as an alternative proxy for Asian export price variables.

Competitor's price: For every commodity group geometric average weights were constructed (average of 1992-96) by taking the annual share of country j's exports of commodity i (to the world) as a proportion of total Asian exports of that commodity. The weights were then used to obtain a geometric mean of export prices of the competitors. Thus, by construction,

$$\ln P_{ij}^{c} = \sum_{\substack{h=1 \\ h \neq j}}^{H} w_{ih} \ln P_{ih} \ ; \ w_{ih} = X_{ih} / \sum_{k=1}^{K} X_{ik} \ , \tag{7}$$

where h are all the other Asian competitors of good i for country j. The term H refers to the five other competitors. The variable X_{ih} is the total (annual) export of commodity i by country h. When country h does not have a commodity-specific export price, we simply

use the overall export price, i.e., the unit value of exports. The term K refers to the six countries in our sample. The weights are constructed with annual data obtained from the IMF's *Direction of Trade Statistics*.

The country-specific sources on the price and quantities of exports are:

Hong Kong SAR: Data on export revenue of chemicals, manufactures and machinery were obtained from Hong Kong SAR's *Census and Statistic Department's Monthly Digest of Statistics*. Data on exports of road vehicles, clothing and semiconductors were obtained from the same department's Trade Analysis Section (Hong Kong SAR's External Trade). Unit value index numbers for domestic exports (from the same source) were used to deflate export revenues of chemicals, manufactures, machinery and road vehicles. The specific export price index was used for clothing, while that of electronic components was used for semiconductors (these price data were retrieved from the Census and Statistics Department). The price data was available from 1988:10-1999:01.

Indonesia: Export data were obtained from the Bank of Indonesia's Economics and Statistics Department. The following data points for export revenue were missing in our sample of estimation for chemicals, manufactures and machinery: 94:10 and 94:12; for road vehicles, clothing and semiconductors: 1994:01-02, 1994:10, 1994:12, 1995:1, 1995:2, 1995:12, 1996:1, 1996:2, 1996:4, 1996:5, 1996:11, 1997:12, and from 1998:06-98:12. The unit value of export index (in dollars) was used to obtain volumes of exports of these commodities (Source for the latter is *International Financial Statistics* Database (IFS), series 74DZF). This series was available from 1980:01-1998:12 and were interpolated to obtain the missing values for the data points 1981:07-08 and 1987:01-02.

Malaysia: Export revenue data was obtained from Malaysia's *Monthly External Trade Statistics*, Department of Statistics covering 1994:01-1999:02. Values for 1998:4 were missing for all the series. The unit value of export index was used to deflate export revenues and obtain volumes. Source for the latter is *IFS*. (series 74DZF). The series was interpolated to obtain the missing data points between 1992:04 to 1993:06 and 1996:07 and 1998:2. After interpolation the series was complete till 1998:05.

South Korea: Export revenue data was obtained from the Bank of Korea's *Monthly Bulletin*. Data for chemicals, manufactures and machinery covered the period 1990:01 – 1999:04 and for passenger cars, semiconductors and clothing, it covered the period 1990:01–1998:06. Export price indices for the first three commodity groups were also obtained from the same source.

Singapore. Data on revenue and prices was collected from the *Monthly Digest of Statistics*, Singapore Dept. of Economics. Data on revenue covered the period 1989:01 to 1999:02 (missing between 1998:02-1998:06), while that on export prices covered the same period with missing points between 1998:01-1998:06. The missing points were interpolated to complete the series.

Thailand. *Monthly Bulletin*, Bank of Thailand was the source for exports of chemicals, manufactures and machinery (available from 1989:01–1999:02), and of the following subcategories: integrated circuits and parts: 18a of the bulletin, a proxy for SITC 776, semiconductors; textile products: 2 of the bulletin, a proxy for SITC 84, clothing (these two series covered the period 1989:01-199:02); and Passenger cars and parts: 51a of the bulletin, a proxy for SITC 7812 covering the period 1993:01– 1999:04. Data on export prices covered the period 1993:01-1999:04. Some price data points had to be interpolated (for SITC 5-8, 97:1-97:5, 97:7, 97:8, 97:10, and 97:11 were missing). General export price index for Thailand was obtained from the IFS (series 74DZF).

The data for **United States import price index** (used to deflated export revenues for the alternative definition of volume) was obtained from the Bureau of Labor Statistics. For chemicals, manufactures, machinery and clothing we retrieved quarterly series between 1990:03 and 1992:08, and monthly thereafter until 1999:05. For semiconductors the data was quarterly from 1989:09 to 1993:12, and monthly thereafter (till 1999:05). The quarterly series for vehicles started from 1989:09 and ended at 1993:12 and was monthly thereafter until 1999:05. All quarterly data were interpolated.

Scale variable: As discussed before, we first constructed a trade weighted world demand for each export commodity for the scale variable. However the use of this variable did not alter the performance of our estimated equations. This is because export data is highly trended, and therefore as long as we use a scale variable that is suitably trended, it performs well in the demand equation. Therefore we used world import demand for our estimation retrieved from the IFS database (series 71D). The world unit value of imports (the series 75D) is used to deflate revenues and obtain volume of imports. The series for real world import is available from 1980:01-1998:09.

Domestic credit. The data source is *IFS* (Domestic credit, based on claims on private sector, series, 32DZF). This series (in domestic currency) covered the period 1980:01- 199:04/05 for all countries except Hong Kong SAR. For Hong Kong SAR, the series was annual between 1990 and 1993, quarterly between 1994:1-1995:12 and then monthly till 1999:04. Real domestic credit is obtained by deflating with the country-specific consumer price index (CPI) data for which was also obtained from *IFS* (series 64ZF) covering 1980:01-1999:03 (For Hong Kong SAR, CPI data was available from 1990:01). Hong Kong SAR real domestic credit had to be interpolated for the cointegration tests. However all estimations were carried out without interpolating this variable.

Nominal Exchange Rate. This monthly series was retrieved from *IFS* (period average market rate, series RFZF) and covers the period 1980:01-1999:05.

To focus on the idiosyncrasies of country-specific regressions, the estimation results for each country are discussed separately:

For **Korea**, long run demand equations work quite well; own price elasticity is always significant (at less than a 10 percent level) and ranges in magnitude between -0.15 and 1.32. Sensitivity to competitors' price for all commodity groups is also very high with the exception of clothing. Again, other than clothing, Korean exports are extremely sensitive to world demand. The short-run demand equations generally confirm the patterns found in the long-run equations although the evidence is weaker. The supply curves are horizontal with the exception of chemicals and clothing, which are downward sloping. The pass-through elasticity of the exchange rate ranges between -0.36 and -0.56 and significant, indicating that the supply prices of Korean exports are quite sensitive to the nominal exchange rate. Domestic credit has the expected negative sign in three cases but a positive sign in other three industries, showing no clear evidence of a credit crunch. Short-run equations show a similar pattern as the long-run equations, with the exception of the direction of the sensitivity to the exchange rate: in the short-run, a depreciation seems to increase export prices.

For **Hong Kong SAR**, the demand equations for clothing and semiconductors, for which appropriate price indices are available, have negative and statistically significant signs for own price elasticity. Competitors' price elasticity is positive and significant for all products except clothing. Long-run supply curves are horizontal with the exception of semiconductors. The price indexes for chemicals, manufactures and machinery are not precise making the results for these industries difficult to interpret.

For **Singapore**, the demand equations perform quite well both in the long and short runs. Again the elasticity to world demand is positive, well above one and significant. Similar results are confirmed in the short-run equations with the exception of world demand. Supply equations indicate a horizontal curve for manufactures, but slightly downward sloping for chemicals and machinery. Price sensitivity of supply price to domestic credit and exchange rate are strong and statistically significant.

For **Thailand**, the long-run demand equations work very well for all commodity groups except passenger cars (SITC 7812). The latter regression also has a very low fit. Average own price elasticity ranges between –0.23 and –1.04, while the sensitivity to competitors' price ranges between 0.27 and 1.44. The income elasticity of world demand is usually greater than one. The short-run demands do not have any clear pattern. The long run-supply equations indicate that the supply curves are horizontal or slightly downward sloping. The pass-through elasticity of the exchange rate is between –0.08 and –0.47 (and usually significant at the 1 or 5 percent level). However, domestic credit enters positively in the supply equation while we expect a negative sign. The short run supply equations do not show any clear pattern and have a very poor fit.

Indonesia and **Malaysia** have fewer observations than the other countries and the data on prices are sometimes missing. The results, in general, confirm the general findings for the other countries.

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