Why World Exports Are Susceptible to the Economic Crisis? — The "Export Overshooting" Phenomenon

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This paper provides some evidence of the "export overshooting" phenomenon, i.e., the unusually large deviation of exports from their long-run level. We examined the exports of 11 economies over the period 2000–2009 and found overshooting did occur during the 2001 and 2008 crises. The overshooting, however, was more severe in Taiwan than in other countries, and in the 2008 crisis than in the 2001 crisis. We argue that the bullwhip effect is a major driving force behind the "export overshooting" phenomenon. Following this line of argument, Taiwan's increasing susceptibility to economic crisis can be attributed to an increase in cross-border vertical specialization, offshore outsourcing of downstream production and the concentration of her exports in high-tech products that are sensitive to demand shocks.

Keywords: export overshooting, economic crisis, bullwhip effect, Taiwan
JEL classification: F14, F30, F42

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1 Introduction

In the years leading up to the summer of 2007 when the ensuing U.S. subprime crisis began to unfold, the world saw a period of relative calm and prosperity after the recovery from the dot-com bubble burst in the early 2000s. While the major industrialized nations grew at a modest pace of 1% to 3% per annum, the rise of the BRIC and other emerging markets gave great impetus to the world's economic progress and spurred high growth in world trade. But the subprime loan problem quickly gave way to a broad global crisis marked by slowing economies and dried-up liquidity with unprecedented reach. The scope and devastating impacts of the global financial crisis were greater than anyone had anticipated. Like a game of dominos, the financial crisis started in the United States and spread to the rest of the world. It first lacerated the world's financial systems, then jolted and knocked out the real economy. No country was immune to it. Not the "Wealthy Country Club" with member countries such as the United States, Germany and Japan. Not the usually resilient East Asian NICs. Not even the up-and-coming powerful BRIC group. Among all these, countries with a strong export orientation and opened up most to the world, especially Japan and the East Asian NICs, were hit the hardest.

Figures 1 and 2 clearly show the impacts of the financial crisis of 2008 on the volume of world exports for a sample of eleven countries consisting of major advanced industrialized countries, the Asian NICs and the emerging market economies. World exports began to fall in the second half of 2008 and quickly rebounded towards the end of the first half of 2009, forming a narrow V-shaped pattern of growth trajectory. The dramatic collapse in world exports is not without historical precedence as the same V-shaped pattern was also observed during the dot-com crisis around 2001. In effect, both crises had led to economic downturns which in turn resulted in high levels of unemployment and a sharp fall in global demand and international trade.

It is worth noting that during the economic downturns around 2001 and 2008, the contraction in world exports was far greater than that of world GDP, as revealed in Tables 1 and 2. In 2001, while real world GDP still grew at 1.77%, growth of total exports for the countries in our sample had already turned negative and contracted at a rate of 6.21%. In contrast, the overall export performance was much worse in the recent economic downturn, with the total exports shrinking at an astounding rate of 19.08% a year after the

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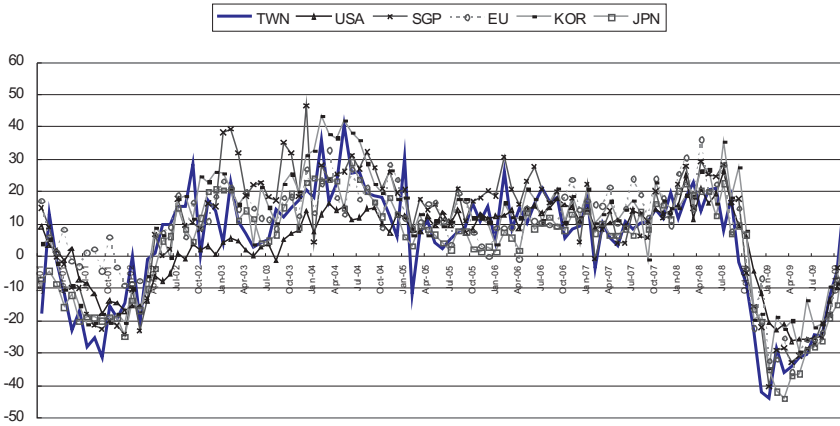


Figure 1: Export Growth 2000–2009, %

Soure: World Trade Atlas.

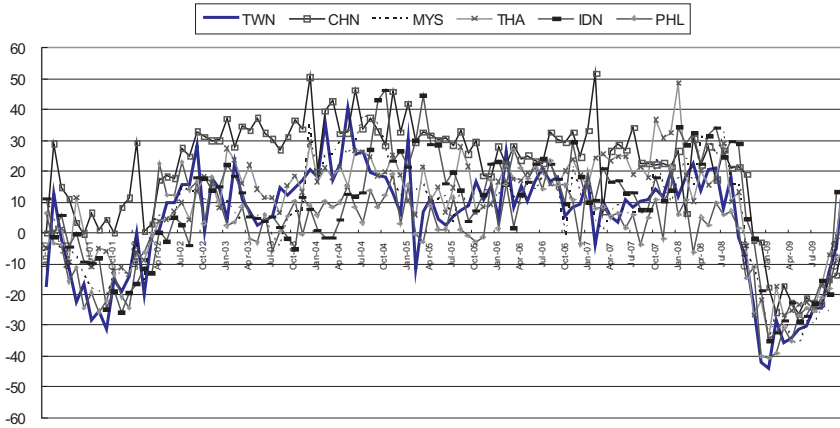


Figure 2: Export Growth 2000–2009, %

Soure: World Trade Atlas.

crisis broke out. Meanwhile real world GDP suffered only a mild decline and growth slowed down to −2.14% in 2009.

Another noteworthy observation was that Taiwan appeared to exhibit a relatively narrower V-shaped export growth pattern than the others in the

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Table 1: 2000–2009 Growth Rates of GDP for OECD, Non-OECD, and World; %

	OECD	Non-OECD	World
2000	4.02	5.69	4.30
2001	1.32	3.74	1.77
2002	1.58	4.15	2.07
2003	1.90	5.86	2.67
2004	3.05	7.62	3.97
2005	2.59	7.09	3.53
2006	2.96	7.92	4.03
2007	2.64	8.26	3.89
2008	0.42	5.96	1.71
2009	−3.41	1.84	−2.14

Source: Global Insight. Annual growth rates were calculated using the quarterly real GDP series.

group. That is, Taiwan was among the first to contract and also the first to recover in exports. Even though all of the eleven nations studied had displayed a similar pattern of ups and downs in exports and were highly influenced by the two economic crises, the crises seemed to have a greater impact on Taiwan's export performance (Figures 1 and 2). In fact, the contractions in Taiwan's exports were the most severe both in terms of timing and magnitude, and Taiwan's recovery was also among the most speedy, particularly in the 2008 crisis. Importantly, in the two economic crises, Taiwan delivered one of the worse export performances among the nations studied.

A number of papers have identified that fluctuations in exports are highly correlated with the changes in worldwide demand, effective exchange rates, the volatility of exchange rates (see for example, Boug and Fagereng (2010); Sapir and Sekkat (1995)), and FDI (Zhang and Song, 2000). These determinants (hereafter referred to as the fundamental factors) are shown to be able to govern adequately the behavior of the export performance of a country in the long run. The fact that the decline in world exports was much greater than the decline in world GDP suggests that the force causing exports to deviate from their long-run trend may have been further magnified by some other factors not accounted for by the short-run dynamics of fun-

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Table 2: 2000–2009 Growth Rates of Exports By Country; %

	Whole Sample	TW	CN	US	SG	MY
2001	−6.21	−16.87	6.89	−6.58	−11.65	−10.14
2002	4.46	7.13	22.24	−4.94	2.85	5.86
2003	15.06	11.29	34.65	4.57	27.93	7.22
2004	21.34	21.10	35.39	12.43	24.15	26.50
2005	12.73	8.81	28.41	10.58	15.54	11.83
2006	15.14	12.89	27.15	13.86	18.39	13.56
2007	15.76	10.12	25.67	11.91	10.11	9.62
2008	12.82	3.63	17.30	12.13	12.94	13.30
2009	−19.08	−20.32	−15.87	−17.97	−20.18	−20.10
	EU	TH	KR	ID	PH	JP
2001	1.42	−5.28	−12.67	−9.34	−15.57	−15.83
2002	6.56	5.68	8.00	1.49	9.13	3.45
2003	16.73	17.00	19.29	6.82	2.78	13.12
2004	20.16	20.99	30.97	17.24	9.78	19.98
2005	10.20	13.13	12.04	19.66	3.59	5.14
2006	11.61	18.91	14.43	17.67	14.70	8.60
2007	16.83	24.88	14.14	13.20	6.88	10.47
2008	12.88	9.03	13.60	20.09	−2.48	9.50
2009	−20.69	−14.65	−13.86	−14.97	−21.89	−25.77

Source: World Trade Atlas. Statistics were calculated using monthly merchandise trade series.
Note: TW (Taiwan), CN (China), US (United States), SG (Singapore), MY (Malaysia), EU (European Union), TH (Thailand), KR (Korea), ID (Indonesia), PH (the Philippines), JP (Japan)

damental factors. In other words, the surprisingly large declines in exports could not have been predicted by the historical relationships linking exports to the fundamental factors.

Based on what we have observed, we formulate several testing hypotheses. Specifically, we look for evidence that addresses the "export overshooting phenomenon" (i.e., the unusually large deviation of exports from their long-run level) during times of economic duress as well as evidence that shows

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that the extent of overshooting was larger in Taiwan than in other countries. Moreover, we offer some explanations for why overshooting occurs and why Taiwan might be especially susceptible to shocks when compared with other countries in the 2008 crisis.

The group of countries being studied in this paper includes three Asian NICs, namely Taiwan, Korea and Singapore; several Asian emerging market economies, namely China, Indonesia, Malaysia, the Philippines and Thailand; and Taiwan's major trading partners, namely U.S., EU and Japan. The data investigated are monthly and balanced panel data for the period of 2000 to 2009. The total number of observations examined here is 1320.

The structure of the paper is as follows. Section 2 begins with a comparison in terms of causes and economic impacts of the two economic crises. Section 3 describes the structural changes in Taiwan's exports over time and explains what produced the changes. In addition, several testable hypotheses are derived in Sections 2 and 3 based on the revealed trends and patterns of exports during the crisis periods. These hypotheses are then tested in Section 4 using an error correction panel regression model, and we examine in a dynamic context how the response of exports to adverse external shocks may vary across different groups of countries and industries. Some explanations are provided in Section 5 as to why when facing economic crisis, exports overshot its long-run trend and why Taiwan's export performance was among the worse. Finally, the last section summarizes main findings and offer conclusions.

2 Impact of Economic Crisis on Exports

The two economic crises were triggered by different events. The first economic crisis occurred during 2000–2002 and was a direct result of the internet bubble (also referred to as the dot-com bubble) bursting in 2000 and the 9/11 terrorist attacks on U.S. soil in 2001. The second crisis was the recent 2008 global financial crisis, which originated from the subprime crisis and led to a massive global economic downturn.

In retrospect, the internet bubble, a speculative bubble covering roughly the period 1998–2001, originated from the accelerated growth in internet sectors and related industries. Because of the "get-big-fast" strategy adopted by the new internet-based companies and the market confidence on the profitable future of these companies, the internet bubble saw rapid run-ups in market valuations of these companies (Valliere and Peterson, 2004). When

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the bubble burst in 2000, it was followed by an equally rapid collapse of the markets and led to bankruptcy of many internet firms and huge losses in stock markets. The United States, in particular, suffered from a severe economic downturn with unemployment reaching new heights.

The bubble had an important impact on the wealth and the spending habits of consumers, especially those in the developed countries. People spent more because they felt richer with their overvalued assets; but when their wealth was suddenly reduced once the bubble burst, they scaled back on discretionary spending. Changes in discretionary spending are a result of the so-called "wealth effect", which turns out to have important implications for the growth of international trade and the global economy. To many export-oriented countries, this surge in discretionary spending in developed countries, especially in high-tech products, was for a long time a major source of global demand for their exports. After the 9/11 attacks, countries with a heavy reliance on the exports of high-tech products such as Japan, Singapore, South Korea and Taiwan saw the global demand for ICT (information, communication and technology) products slowing in a weak economic outlook. Similarly, the exports of other Asian countries such as Malaysia and the Philippines, who are part of the integrated ICT production/supply chain system in the region, were also negatively affected. China, meanwhile, still managed to experience a positive growth in exports as the volume of Chinese high-tech exports constituted only a small part of its external trade at that time and hence the impacts were limited.

Different from the export contractions seen in 2001, which were largely owing to a collapse in external demand for ICT output, a shrunken export demand in 2008 was truly global as a result of a great economic recession unlike any seen since the early 1930s. In varying degrees, this great economic recession affected virtually every industry and business sector. The reason why the recent economic downturn has had far-reaching consequences lies in the rapid proliferation of speculative financial innovations fueled by a torrent of cross-board capital flows that further quickened the speed of contagion worldwide (Hu, 2011). As a consequence, the economic impacts of a lowered level of world income were felt around the globe, and a collapse in export demand across the board quickly followed. This included a plunge in global demand for Chinese output.

Although the causes of the two crises are different, exports contracted largely because of the decline in worldwide demand, an important growth predictor that has been identified in the trade literature as one of the most

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significant fundamental factors underlying exports. As shown in Tables 1 and 2, world trade fell more rapidly than output in varying degrees across nations. In the 2001 crisis, the growth rate of world GDP slowed to 1.77% from 4.30% in the previous year, while the exports in Japan and Taiwan fell by −16.87% and −15.83%, respectively. In the meantime, growth in the Chinese and European exports remained positive, reaching as high as 6.89% and 1.42%, respectively. In contrast, in the 2008 crisis world GDP fell −2.14% from the previous year but exports fell more rapidly within a range of from −13.86% to −25.77%. With these observations and the distinct V-shaped patterns in exports, we suspect that exports may have fallen much more rapidly to an extent far exceeding what can be attributed to the changes in fundamental factors. Thus, we have the following hypothesis:

Hypothesis 1. During crisis, exports overshoot the deviation bands allowed by the long-run equilibrium relationship governed by the fundamental factors.

In the two episodes of fast-falling export demand, the impacts were much greater in the 2008 crisis, for the contagion was more severe and truly global, leading to a much weaker global demand (Sun, 2009). The drying up of trade credit and traders' overreaction to a possible collapse in demand made the situation even more serious in the 2008 crisis (Authukorala and Kohpaiboon, 2009). However, a variety of economic stimulus packages were put in place in a timely manner to lessen the negative impact, thanks to the quick and coordinated responses from the world's governments in containing the spread and further worsening of the crisis. It is therefore reasonable to believe that exports would rebound more quickly in the 2008 crisis than in the 2001 crisis. And in fact they did, as observed in Figures 1 and 2. Thus, we have:

Hypothesis 2. Although the degree of export contractions was much sharper in the 2008 crisis than in the 2001 crisis, exports also bottomed out much quicker in the 2008 crisis than in the 2001 crisis.

Moreover, because industries were affected to varying degrees by the two crises and their recovery dynamics were also different, we examine how exports were impacted at the industry level by classifying a country's manufacturing industries into two groups, Group A and Group B, based on their industry characteristics. Group A consists of industries which are durables

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in nature and whose production activities tend to be capital-or technology-intensive. Specifically, Group A includes metals, lumber and wood products, electronics, machinery, electrical equipment, transport equipment, precision instruments and miscellaneous manufacturing industries.[1] The demand for Group A is highly income-elastic, and consumer spending on such products tends to follow the ebb and flow of the economy. Spending decreases during economic downturns and increases when the economy expands. Notice that developed countries are the major buyers of Group A. On the other hand, Group B, consisting of all remaining industries,[2] tends to be labor-intensive and of necessity and/or nondurables in nature. While developing countries are the major consumers of Group B, developed countries may reduce their consumption as a result of an increase in income. With this in mind, we postulate:

Hypothesis 3. Group A's capital- or technological-intensive exports tend to increase with the levels of OECD income, while Group B's labor-intensive exports tend to increase with the levels of Non-OECD income.

3 FDI, Outsourcing, Industry Structures and Taiwan's Exports

Over the last few decades, Taiwan has achieved miraculous growth and has since been roundly lauded for being one of the East Asian Tigers that also include South Korea, Hong Kong and Singapore. Its successful export-led economic growth model has been well documented and followed by many developing countries. But things appear to have changed over the course of the last decade. The average compound growth rate for Taiwan's exports for the period of 2000–2007 was only 7.17%, a marked slowdown from the growth rates of 12.87% and 8.5% achieved during the high growth periods of 1981–1990 and 1990-2000. A rapid increase in the nation's outward direct investment (FDI) and the prevalence of export outsourcing practice by Taiwanese exporters, as well as the nation's being excluded from the deepening regional economic integration process within Asia, may all contribute to a worsening of Taiwan's export performance.

[1]The classification of durables and nondurables is provided by Professor Warwick McKibbin.

[2]They are textiles, apparel, footwear, paper, rubbers and plastics, printing, chemicals, and petroleum.

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From the 1980s onwards, Taiwan saw a wave of overseas investment expansion, with the United States and the Southeast Asian countries the major recipients of Taiwan's FDI.[3] But after the lifting of the ban on indirect investment in China by the Taiwanese government in the early 1990s, the vast majority of Taiwan's FDI flooded into China for reasons of low-cost labor and cultural proximity. In 1993, China became the largest recipient of Taiwan's FDI; and by 2005 China had already attracted more than half of Taiwan's accumulative outward investment over the decades.

Prior to 1995, almost all of Taiwan's export orders were processed locally and exported out of Taiwan directly. However, because of the rising labor and land costs at home, the Taiwanese firms gradually lost their competitive edge in labor-intensive goods. To regain competitiveness, many Taiwanese firms chose to relocate the production of their labor-intensive goods and low-end production processes to low-wage countries in Southeast Asia and China, while keeping under the control of the parent firms in Taiwan other activities such as R&D, upstream production, marketing and export order processing. Part of the export orders received was therefore filled by (or outsourced to) the parent firms' overseas affiliates and local firms in the third countries. As Taiwan's FDI started to multiply, the outsourcing ratio increased. Since this practice is mainly limited to export orders, it is referred to as export outsourcing, a term coined by Liu et al. (2007).

The increasing reliance on export outsourcing is evident in an ever shrinking proportion of export orders filled at home. Indeed, the proportion of orders filled by domestic sources had decreased over time, from 85.37% in 2000 to 53.87% in 2007. As a consequence, not only has Taiwan's export growth slowed down but its export structure has also shifted toward upstream industries over time.[4] Having upstream firms as the dominant type of firms in Taiwan may have important implications for Taiwan's increasing sensitivity to external shocks in exports.

Like those of other countries, Taiwan's exports exhibited a V-shaped pat-

[3]By 1990, the United States and the Southeast Asian countries accounted for 43.5% and 35.03% of Taiwan's accumulative FDI, respectively.

[4]According to Liu and Lu (2007), more than 80% of Taiwan's export outsourcing was done in China, while the remaining was distributed among countries in Southeast Asia and in other regions. And in order to effectively manage and control overseas production and export activities, a large part of the export outsourcing activity (close to 80%) was carried out by subsidiaries and affiliate firms in the host country. This is distinctly different from the outsourcing practice used by the Western MNEs, which employ mostly local firms or foreign firms in the host country.

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tern during the crisis period. For 8 months before the crisis broke, with the exception of July 2008 (only 7.9%), the nation's exports had been able to post double-digit growth. But in September 2008 the situation was quickly reversed, and in just a short time the export markets deteriorated rapidly. The nation saw its export revenues fall almost by half in just 4 months. By January 2009, the contraction finally let up and the slide came to a stop at −44.1%. While still posting in the red, the Taiwanese export sector gradually improved its position in the following months. And by November, export growth had turned positive for the first time since the crisis began, rising to 19.35%. In terms of export orders, as the impacts of the crisis propagated through the economy, export orders showed a similar decline and fell to their lowest point in January 2009 at −41.67%; after which the sharp decline in export orders also began to slow down.

From the foregoing discussion, it is clear that the fall in Taiwan's total exports was rather dramatic and larger in magnitude than the fall in its exports orders. In effect, export growth recovered more slowly than export orders. By December 2009, when export orders had already bounced back to the pre-crisis level (102% of December 2007), exports were only stabilizing around 15% below their level in December 2007. This suggests that the Taiwanese exporters may have relied more on export outsourcing to weather the financial storm.

To sum up, there are notably differences in how Taiwan was affected by the 2008 crisis, compared with other countries' experiences (Table 3). The differences are summarized as follows: (1) In terms of the timing of experiencing negative growth since the crisis broke out, Taiwan was affected by the crisis much earlier than any other countries studied. Taiwan reported negative growth in exports in September 2008 but neither the European Union nor Singapore was affected until a month later; and for that matter, the United States, Japan and China did not begin to contract until November. (2) In terms of the degree of export contractions, Taiwan had the most severe decline among the countries studied. Its growth rate of exports dropped to −44.1%, the lowest point in 8 years, while Japan reported a comparable decline of −43.92% 2 months later. The contractions were evidently far worse than those of United States (−26.33%), South Korea (−34.53%) and China (−26.34%). (3) In terms of the timing of bottoming out, Taiwan started recovery the most earliest, after bottoming out in January 2009, while Japan's recovery did not until March. The rest of the group was on a slow track to recovery: notably the export slide did not bottom out until April for the

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Table 3: Variation in Timing and Duration of Impacts across Countries

	TW		US		EU	
The first recorded negative growth rate after crisis	Sep-2008	−1.64%	Nov-2008	−4.76%	Oct-2008	−3.73%
Bottom out	Jan-2009	−44.11%	Apr-2009	−26.33%	Apr-2009	−35.76%
The first recorded positive growth rate after bottoming out	Nov-2009	19.35%	Dec-2009	12.30%	Nov-2009	14.35%
Compound Growth Rate, 2000–2008		6.72%		6.46%		11.90%
	JP		SG		KOR	
The first recorded negative growth rate after crisis	Nov-2008	−16.11%	Oct-2008	−5.19%	Nov-2008	−19.45%
Bottom out	Mar-2009	−43.92%	Jan-2009	−40.38%	Jan-2009	−34.53%
The first recorded positive growth rate after bottoming out	Nov-2009	1.83%	Nov-2009	13.43%	Nov-2009	18.14%
Compound Growth Rate, 2000–2008		6.32%		11.88%		11.85%

(to be continued)

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(continued)

	CN		MY		TH	
The first recorded negative growth rate after crisis	Nov-2008	−2.24%	Oct-2008	−6.73%	Oct-2008	−4.19%
Bottom out	May-2009	−26.34%	May-2009	−35.89%	Jan-2009	−34.44%
The first recorded positive growth rate after bottoming out	Dec-2009	17.60%.	Oct-2009	6.35%	Nov-2009	19.53%
Compound Growth Rate, 2000–2008		24.39%		9.29%		12.66%

	ID		PH	
The first recorded negative growth rate after crisis	Nov-2008	−1.81%	Oct-2008	−14.57%
Bottom out	Jan-2009	−34.95%	Jan-2009	−40.64%
The first recorded positive growth rate after bottoming out	Oct-2009	13.46%.	Nov-2009	5.66%
Compound Growth Rate, 2000–2008		10.39%		3.21%

Source: Calculated using the monthly merchandize trade series from World Trade Atlas.

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United States and European Union, and until May for China and Malaysia.

In fact, the above-mentioned differences were also observed in Taiwan's export performance during the dot-com crisis, although in a somewhat less clear picture (Figures 1 and 2). Thus, we have:

Hypothesis 4. Compared with the other countries studied, Taiwan's export performance during the crisis periods is characterized by a quicker and sharper drop in exports. Nevertheless, its exports bounced back more quickly than those of other countries.

4 Empirical Model and Results

To examine how exports adjust to shocks, we need to model their adjustment explicitly by introducing an a-priori long-run equilibrium relationship, with the hypothesis that there exists an error correction mechanism that makes the short-run deviations converge on a long-run trend. Therefore, modeling a long-run export performance in the context of adjustment to external shocks is inherently dynamic.

Assume export performance, E_{it}, is affected by a set of fundamental factors and some global shocks, denoted as Z_{it} and Crisis, respectively. Let the short-run relationship among E_{it}, Z_{it} and Crisis follows an autoregressive-distributed lag model:

$$\mathrm{EX}_{it} = \alpha_0 + \alpha_1 Z_{i,t} + \alpha_2 Z_{it-1} + \alpha_3 \mathrm{EX}_{it-1} + \alpha_4 \mathrm{Crisis}_t + \varepsilon_{i,t}, \quad (1)$$

where E_{it} $(i = 1, \cdots, N, t = 1, \cdots, T)$ is country i's exports in log form at time t. Crisis, which includes 2001Crisis and 2008Crisis, is a period dummy used to capture the common shocks from the 2001 and 2008 crises. $\varepsilon_{it}(= v_i + u_{it})$ includes country-specific variables v_i and the stochastic error term u_{it}, where the former is to reflect country-specific effect stemming from cross-country differences in endowment, technology, and so on.

Two problems may arise, when using panel data regression techniques to determine the dynamic relationships between of EX_{it} and Z_{it} as indicated in Equation (1).[5] First, we run into the endogeneity problem caused by the difficulty of identifying the unobserved country-specific effects such as technological progress in a dynamic setting, in which case the right-hand-side variables are not orthogonal to each other. Second, the problem of

[5] See Yasar et al. (2006).

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persistence occurs because EX_{it} tend to be serial correlated over time, which is often the case for economic research using time series of macroeconomic variables.

An error correction model therefore is adopted, which can be used to solve for these two problems. Most importantly, it has the advantage of allowing us to examine the short-run and long-run dynamics of the relationship between EX_{it}, Z_{it} and global shocks; and this feature becomes very useful, especially in the context of examining how exports behave when an external shock is present.

$$\Delta EX_{it} = \alpha_1 \Delta Z_{it} + \eta ERROR_{it-1} + \alpha_4 Crisis_t + \varepsilon_{it}, \tag{2}$$

where Δ indicates first difference, $ERROR_{it-1}(= EX_{it-1} - \phi_0 - \phi_1 Z_{it-1} - \phi_2 Crisis_{it-1})$ is the error correction term, $\phi_0 = -\alpha_0/(1-\alpha_3)$, $\phi_1 = -(\alpha_1+\alpha_2)/(1-\alpha_3)$, $\phi_2 = -\alpha_4/(1-\alpha_3)$ and $\eta = -(1-\alpha_3)$. In equation (2), ΔZ_{it} and $Crisis_{it}$ capture the short-run effects, while $ERROR_{it-1}$ describes the long-run dynamics in which the long-run effect of the global crisis has been taken into consideration. Exports could deviate from the long-run equilibrium relationship due to shocks in the short run, but eventually converge to the equilibrium when shocks are absent. The error correction coefficient (η), which is negative for such a convergence to occur, therefore measures the speed of adjustment toward the long-run equilibrium.

Crisis variables (Crisis) are included to see whether there exists excessive adjustment in exports that cannot be explained by the fundamental factors and the long-run dynamics. If the coefficient of Crisis is significantly different from zero, then there exists the so-called "export overshooting" phenomenon. We indicate the beginning of a crisis using the timing of export growth once it turns negative. That is, a crisis begins once negative export growth is present in any of the countries in our sample. For example in the 2001 crisis, Taiwan was the country whose exports fell earlier than those of others, so the month when Taiwan's export growth first turned negative is defined as the starting month of the downturn, which was January 2001. The subsequent months of the crisis period are defined as follows: Crisis2001 = 2 if February 2001, Crisis2001 = 3 if March 2001, $\cdots$, and Crisis2001 = 18 if June 2002 when the U.S. was the last country to resume positive growth in exports. By adding Crisis and its square term (Crisis_SQ), we are able to figure out, on average, how many months it took to reach the trough of the contraction in growth. Crisis2008 can be similarly defined with the starting month as September 2008 (see Table 4).

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Table 4: Variable Statistics and Definition for Full Sample-2000–2009

Variables	Definition	Mean	Standard Deviation
EX	Monthly exports, in log; data drawn from World Trade Altas	10.13	1.15
EX_A	Monthly exports for Group A, in log; including metals, lumber and wood products, electronics, machinery, electrical equipment, transport equipment, precision instruments and miscellaneous manufacturing industries; data drawn from World Trade Altas	9.44	1.18
EX_B	Monthly exports for Group B, in log; including textiles, apparel, footwear, paper, rubbers and plastics, printing, chemicals, and petroleum; data drawn from World Trade Altas	8.74	1.12
GDP_world	World GDP, quarterly, in log; data drawn from Global Insight's world Overview	10.70	0.08
GDP_oecd	OECD GDP, quarterly, in log; data drawn from Global Insight's world Overview	10.46	0.06
GDP_xoecd	Non-OECD GDP, quarterly, in log; data drawn from Global Insight's world Overview	9.16	0.18
EER	Effective exchange rate, in log; data drawn from Bank for International Settlements	4.62	0.10
ρ	Volatility of effective exchange rate, in log	0.04	0.03
FDI	inward FDI stock (10^6 millions); data complied by UNCTAD	0.82	1.73
Crisis2001	$= i$, if the ith month of 2001; $= 12 + j$, if the jth month of 2002, $j = 1, 2 \cdots$, 6; $= 0$ otherwise	1.43	3.94
Crisis2001_SQ	Square term of Crisis2001	1.13	3.35
Crisis2008	$= 1$, if 9/2008; $= 2$, if 10/2008; $= 3$, if 11/2008; $= 4$, if 12/2008; $= 4+i$, if the ith month of 2009; $= 0$, otherwise	17.58	57.42
Crisis2008_SQ	Square term of Crisis2008	12.47	43.34
Year	$= 1$ if 2000; $\cdots$, $= 10$ if 2009	5.50	2.87

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The set of fundamental factors Z_{it} affecting a country's export performance includes world demand, effective exchange rates, volatility of exchange rates, and FDI stock. Here, world GDP, OECD GDP and non-OECD GDP are used to measure world demand. As a larger world demand can boost a country's exports, we expect a positive relationship between the two variables. The effective exchange rates, which are trade-weight-based measures with weights being time-varying, are obtained from the Bank for International Settlements. Since the appreciation of a country's currency lowers the competitiveness of its exports, we expect the impact of an increase in EER on exports to be negative.

The volatility of effective exchange rates (ρ) is used to capture the impact of exchange-rate uncertainty, where ρ is constructed as the moving average of the deviation of EER from its mean over the last 12 months:

$$\rho = \left[\frac{1}{12} \sum_{j=1}^{12} \left(\mathrm{EER}_{t-j} - \overline{\mathrm{EER}_t} \right)^2 \right]^{0.5} . \tag{3}$$

Theoretically, the impact of exchange rate volatility on exports may be positive or negative depending on the assumption made with respect to risk preference (De Grauwe, 1988). For risk-averse exporters, higher exchange rate volatility increases the extent of uncertainty and thus negatively affects exports. On the contrary, for those who are risk-loving, higher exchange rate volatility is often associated with higher exports. Moreover, when exports are considered as an option by exporters, exports may increase with exchange rate volatility (Boug and Fagereng, 2010). Since exporters may be able to reduce or hedge against exchange rate uncertainty, the linkage between exchange rate volatility and exports may be insignificant (Solakoglu et al., 2008).

FDI is another factor affecting exports. Whether or not FDI contributes to the export performance depends on the motive of FDI. Tariff-jumping FDI, which aims at host market, may not help the host country to expand exports. Export-oriented FDI, on the other hand, uses the host country as an export platform and may contribute to the exports of the host country. Since aggregate FDI is used, of which motivations cannot be identified, we have no prior expectation of the sign of FDI.

To see whether Taiwan has experienced a much deeper impact as compared with other countries, the interactions of country dummy with the two crisis variables are included, i.e., $I \times$ Crisis2001 and $I \times$ Crisis2008, where

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I denotes country I. Also, their square terms (2001Crisis_SQ, 2008Crisis_SQ, $I \times$ Crisis2001_SQ and $I \times$ Crisis2008_SQ) are added in the regressions to capture the V-shaped nature of the impacts. Please see Table 4 for the definition and descriptive statistics of the variables discussed above.

Since most of the time series variables are non-stationary, before we run the error correction model, we have to check whether or not variables in equation (1) have unit roots and are cointegrated. By using several panel unit-root tests such as Harris_Tzavalis test, Breitung test and Im-Pesaran-Shin,[6] Table 5a suggests that the variables such as world GDP, OECD GDP and exchange rate in equation (1) evolve as non-stationary processes. It is therefore necessary to turn to panel cointegration techniques in order to determine whether a long-run equilibrium relationship exists among the variables in level form. Based on the cointegration tests on the residuals obtained from the long-run equation,[7] Table 5b rejects the null hypothesis of non-stationary process. This implies that there does exist a cointegration relationship among the variables in the long-run equation.

The long-run regression $\mathrm{EX}_{it} = \phi_0 + \phi_1 Z_{it} + \phi_2 \mathrm{Crisis}_{it} + \mu_{it}$ is estimated to derive the error correction term ($\mathrm{ERROR}_{it-1} = \mathrm{EX}_{it-1} - (\hat{\phi}_0 + \hat{\phi}_1 Z_{it-1} + \hat{\phi}_2 \mathrm{Crisis}_{it-1})$), which is then used to run the error correction model (i.e., Regression (2)). The results for the error correction model are reported in Table 6.[8] Since China's exports grew relatively rapidly than other countries studied (see Figure 2), we add the interaction term of China dummy with time trend (*year*) in both long-run equation and error correction model.[9] Three regression results are provided: specification (1) reports the results for the full sample; specifications (2) and (3) summarize the results for Group A and Group B, respectively.

4.1 Results for the Full Sample

Table 6 shows that the effects of world GDP and real effective exchange rates (EER) are insignificant in the full sample. The volatility of effective exchange rates, which has mixed results in the literature (De Grauwe, 1988),

[6] The null hypothesis for these tests is that panels are stationary. See Table 5.

[7] We estimate the parameters of the cointegrating relation on the long-run equation $\mathrm{EX}_{it} = \phi_0 + \phi_1 Z_{it} + \phi_2 \mathrm{Crisis}_i + \mu_{it}$. We then test whether the residuals from such a regression appears to be stationary.

[8] The results for the long-run equations are reported in Appendix 1.

[9] The time trend is defined as follows: $year = 1$ if 2000, $\cdots$, $year = 10$ if 2009.

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Table 5: Unit-root and Cointegration Tests for Panel Data

a: Panel-Data Unit-root Tests

	Harris-Tzavalis Test	Breitung Test	Im-Pesaran-Shin Test
EX	0.7846***	−7.0702***	−8.0895***
EX_A	0.7638***	−8.4577***	−8.8655***
EX_B	0.7466***	−7.5959***	−9.3483***
GDP_world	0.9689	2.2717	1.6026
GDP_oecd	0.9909	5.9600	4.4719
GDP_xoecd	0.9054***	−2.7056***	−3.9731***
EER	0.9767	−0.7337	−1.5202
EER_volatility	0.9604	−1.0628	1.9129**
FDI	0.8868***	−1.3667**	−3.1810***

b: Residual-based Panel Cointegration Test

	Harris-Tzavalis Test	Breitung Test	Im-Pesaran-Shin Test
Full Sample	0.9551***	−3.5074***	−1.6894**
Group A	0.7638***	−8.4577***	−8.8655***
Group B	0.9515***	−3.9342***	−3.3408***

Note: The null hypothesis for Harris_Tzavalis test and Breitung test is that panels contain unit roots and the alternative hypothesis is that panels are stationary. The null hypothesis for Im-Pesaran-Shin test is that all panels contain unit roots and the alternative hypothesis is that some panels are stationary. ***, **, * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

is shown to have a weak positive effect on exports at 10% significance level. FDI stock has a negative sign, implying that inward FDI tends to substitute for exports. The error correction term (ERROR) is negative and statistically significant, suggesting that there exists a long-run relationship among export performance (EX), fundamental factors Z and the global crisis, and that the gap between EX and those explained by Z and Crisis can be closed through the error correction mechanism. The speed of the short-run correction (η) is −0.30, indicating that, on average, about 30% of the gap is corrected in each month.

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Table 6: Error Correction Model

Dependent variable: ΔEX, ΔEX_A, or ΔEX_B	Full Sample (1)		Group A (2)		Group B (3)	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Error Correction	−0.30	(0.02)***	−0.37	(0.02)***	−0.42	(0.02)***
ΔGDP_world	0.30	(0.26)				
ΔGDP_oecd			1.33	(0.33)***	−4.43	(0.35)***
ΔGDP_xoecd			0.65	(0.25)***	1.78	(0.27)***
ΔEER	0.05	(0.04)	0.13	(0.04)***	0.02	(0.05)
ΔEER_volatility	0.17	(0.10)*	−0.09	(0.11)***	0.46	(0.12)***
ΔFDI	−0.02	(0.01)***	−0.02	(0.01)	−0.02	(0.01)**
crisis2001	−0.03	(0.01)***	−0.01	(0.01)**	−0.02	(0.01)**
crisis2001_SQ/100	0.09	(0.04)***	0.03	(0.05)	0.06	(0.05)
crisis2008	−0.09	(0.01)***	−0.06	(0.01)***	−0.15	(0.01)***
crisis2008_SQ/100	0.53	(0.06)***	0.37	(0.07)***	0.88	(0.08)***
TW × crisis2001	−0.05	(0.01)***	−0.06	(0.01)***	−0.03	(0.01)***
TW × crisis_SQ/100	0.32	(0.06)***	0.39	(0.07)***	0.20	(0.07)***
TW × crisis2008	−0.07	(0.01)***	−0.07	(0.01)***	−0.06	(0.01)***
TW × crisis2008_SQ/100	0.53	(0.08)***	0.54	(0.09)***	0.46	(0.10)***
EU × crisis2001	−0.01	(0.01)	−0.01	(0.01)	−0.02	(0.01)*
EU × crisis2001_SQ100	0.08	(0.06)	0.07	(0.07)	0.13	(0.07)**
EU × crisis2008	−0.03	(0.01)***	−0.04	(0.01)***	−0.03	(0.01)*
EU × crisis2008_SQ/100	0.22	(0.08)**	0.25	(0.09)***	0.17	(0.10)*
JP × crisis2001	−0.01	(0.01)	−0.03	(0.01)***	−0.02	(0.01)*
JP × crisis2001_SQ/100	0.09	(0.06)	0.20	(0.07)***	0.12	(0.07)*
JP × crisis2008	−0.03	(0.01)***	−0.06	(0.01)***	−0.04	(0.01)***
JP × crisis2008_SQ/100	0.20	(0.08)**	0.42	(0.09)***	0.28	(0.10)***
KR × crisis2001	−0.02	(0.01)***	−0.06	(0.01)***	−0.02	(0.01)
KR × crisis2001_SQ100	0.14	(0.06)***	0.38	(0.07)***	0.11	(0.07)
KR × crisis2008	−0.03	(0.01)***	−0.003	(0.01)	−0.06	(0.01)*
KR × crisis2008_SQ/100	0.29	(0.08)***	0.04	(0.09)	0.42	(0.10)**
SG × crisis2001	−0.06	(0.01)***	−0.06	(0.01)***	−0.08	(0.01)***
SG × crisis2001_SQ/100	0.32	(0.06)***	0.34	(0.07)***	0.45	(0.07)***
SG × crisis2008	−0.05	(0.01)***	−0.03	(0.01)***	−0.07	(0.01)***
SG × crisis2008_SQ/100	0.33	(0.08)***	0.23	(0.09)***	0.51	(0.10)***
CN × crisis2001	−0.03	(0.01)***	−0.05	(0.01)***	−0.02	(0.01)**
CN × crisis_SQ/100	0.18	(0.06)***	0.31	(0.07)***	0.13	(0.07)*

(to be continued)

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(continued)

Dependent variable: ΔEX, ΔEX_A, or ΔEX_B	Full Sample (1)	Group A (2)	Group B (3)
	Coef. Std. Err.	Coef. Std. Err.	Coef. Std. Err.
CN × crisis2008	−0.03 (0.01)**	−0.05 (0.01)	−0.01 (0.01)
CN × crisis2008_SQ/100	0.18 (0.08)**	0.30 (0.09)	0.01 (0.10)
INDO × crisis2001	−0.02 (0.01)**	−0.04 (0.01)***	−0.02 (0.01)**
INDO × crisis2001_SQ/100	0.20 (0.06)***	0.23 (0.07)***	0.11 (0.07)
INDO × crisis2008	−0.06 (0.01)***	0.000 (0.01)	−0.05 (0.01)***
INDO × crisis2008_SQ/100	0.42 (0.08)***	0.01 (0.09)	0.41 (0.10)***
MY × crisis2001	−0.03 (0.01)***	−0.02 (0.01)**	−0.06 (0.01)***
MY × crisis2001_SQ/100	0.23 (0.06)***	0.20 (0.07)***	0.31 (0.07)***
MY × crisis2008	−0.04 (0.01)***	−0.039 (0.01)***	−0.04 (0.01)***
MY × crisis2008_SQ/100	0.28 (0.08)***	0.319 (0.09)***	0.21 (0.10)**
PH × crisis2001	−0.04 (0.01)***	−0.03 (0.01)***	0.00 (0.01)
PH × crisis2001_SQ/100	0.25 (0.06)***	0.29 (0.07)***	0.03 (0.07)
PH × crisis2008	−0.05 (0.01)***	−0.06 (0.01)***	−0.03 (0.01)**
PH × crisis2008_SQ/100	0.36 (0.08)***	0.47 (0.09)***	0.18 (0.10)*
TH × crisis2001	−0.05 (0.01)***	−0.04 (0.01)***	−0.01 (0.01)**
TH × crisis2001_SQ/100	0.34 (0.06)***	0.29 (0.07)***	0.07 (0.07)
TH × crisis2008	−0.01 (0.01)	0.00 (0.01)	−0.03 (0.01)***
TH × crisis2008_SQ/100	0.12 (0.09)	0.05 (0.09)	0.21 (0.10)***
CN × Time	−0.01 (0.004)***	−0.02 (0.005)***	−0.01 (0.01)
constant	0.14 (0.01)***	0.07 (0.02)***	0.15 (0.02)***
R-square: within	0.8497	0.8249	0.8098
between	0.0746	0.0087	0.2717
overall	0.1091	0.0821	0.0515
No. of Observations	1,188	1,188	1,188
No. of Groups	11	11	11

Note: Δ indicates the first difference. ***, **, * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

The signs of Crisis2001 and Crisis2008 are negative but the signs of their square terms are positive, indicating that there exist excessive effects of the two crises on exports, manifested in striking V-shaped growth patterns.[10]

[10]Here, we use the U.S. as the base for comparison, the interaction terms of U.S. dummy with the crisis variables are therefore excluded.

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This supports Hypothesis 1 that exports had contracted excessively during economic downturns such that shrinkage in world demand and changes in other fundamental factors were insufficient to explain the fluctuations in exports. The V-shaped pattern, moreover, is significantly deeper and narrower in the 2008 crisis than in the 2001 crisis for the full sample. That is to say, not only did exports contract at a larger extent but also rebounded more quickly in the 2008 crisis. The numbers of months it took for the economic crises to bottom out were 14.16 and 8.02 months for the 2001 crisis and 2008 crisis, respectively (see Table 9 for the summary report).[11] This supports Hypothesis 2 as discussed in Section 2.

Table 6 also shows that Taiwan was badly hit by the two economic crises in the sense that the extent of excessive export contraction was larger for Taiwan than for other countries except Singapore in the 2001 crisis, but its exports also bounced back more quickly among countries studied. The numbers of months it took for Taiwan's exports to bottom out were 8.75 and 7.26 months for the 2001 crisis and the 2008 crisis, respectively, which is close to Korea in the 2008 crisis (7.23 months) but are shorter than any other countries studied (see Table 9). These support Hypothesis 4 discussed in Section 3.

4.2 Results for Group A and Group B

We divide total exports into two groups, Group A and Group B, according to their industry features. In order to examine how exports of these two types of goods react to the changes in demands from countries with different income levels, we use OECD and non-OECD GDP in replace of world GDP as the measures of world demand. Specifications (2) and (3) in Table 6 show that the demands from OECD and non-OECD countries affect the export performance of Group A and Group B in a different manner. For Group A whose output is durables and tends to be more capital and technology-intensive, the income effect from OECD countries is more than twice of that from non-OECD countries. For Group B, whose output tends to be more labor-intensive and of necessity in nature, the income effect from non-OECD countries is greater than that from OECD countries. In fact, the income effect from OECD countries is negative, implying that Group B

[11] Since the U.S. is used as the base for comparison, the signs of Crisis2001, Crisis 2008 and their square terms may reflect the crisis effects on the exports of the U.S.

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may be inferior goods for OECD countries.[12] These results are consistent with the fact that developed countries tend to be big buyers of Group A while developing countries are the major consumers of Group B as asserted in Hypothesis 3.

The real effective exchange rate (EER), which is insignificant in the full sample, turns out to be positive for Group A. This does not seem to meet the expectation. The reasoning may become clear when the subsamples are examined later.[13] The volatility of exchange rate has negative impact on the exports of Group A. This is consistent with the finding by Lee (1999) that buying (importing) durable goods constitutes both purchasing the flow of service and investing in a risky asset, therefore the variation of exchange rate has a negative effect on the exports of durables. The volatility of exchange rate, however, has a positive effect on the exports of Group B. This implies that international buyers tend to import more when exchange rates fluctuate significantly but buy less when exchange rates exhibit a stable trend, a reflection of its necessity nature.

The adjustment speed (η) associated with the error correction term also differs across different industry groups; it was faster for Group B (-0.42) than that for Group A (-0.37). This implies that Group B moved back to the long-run trend much quicker than Group A, which is consistent with the fact that Group B is of necessity and tend to have smaller oscillations around the trend than Group A.

The comparison of the coefficients of crisis2001 and crisis2008 shows that for both Groups A and B, excessively fall in exports was much bigger in the 2008 crisis than in the 2001 crisis. This can be attributed to the fact that the financial crisis was more widespread such that it affected almost every country and every sector in the world. Whether or not the extent of overshooting is greater in Group A than in Group B depends on the country and the crisis examined. For example, while Taiwan's exports fell more excessively in Group A than in Group B for the 2001 crisis, it was the other way around during the 2008 crisis.[14] Malaysia, on the other hand, suffered a larger extent of contraction in Group B in both crises, as compared

[12]As income effects can be positive or negative at a more disaggregated level (e.g., Group A vs. Group B), this helps explain why the world GDP has insignificant effect on exports at a more aggregated level (i.e., the full sample).

[13]See Tables 7 and 8 and footnote 18 for explanation.

[14]The effect of the 2001 crisis on Taiwan is the joint effects of Crisis2001 and TW × Crisis2001.

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Table 7: Error Correction Model-Asian Countries

Dependent variable: ΔEX, ΔEX_A, or ΔEX_B	Full Sample (1)		Group A (2)		Group B (3)	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Error Correction	−0.30	(0.03)***	−0.40	(0.03)***	−0.43	(0.03)***
ΔGDP_world	0.92	(0.33)***				
ΔGDP_oecd			1.83	(0.41)***	−4.75	(0.46)***
ΔGDP_xoecd			0.61	(0.32)*	2.13	(0.36)***
ΔEER	−0.01	(0.04)	0.05	(0.05)	−0.02	(0.06)
ΔEER_volatility	0.31	(0.12)***	0.03	(0.14)	0.42	(0.16)***
ΔFDI	−1.43	(0.23)***	−0.42	(0.26)	−1.06	(0.30)**
crisis2001	−0.04	(0.01)***	−0.05	(0.01)***	−0.04	(0.01)**
crisis2001_SQ/100	0.27	(0.05)***	0.24	(0.05)***	0.15	(0.06)
crisis2008	−0.14	(0.01)***	−0.06	(0.01)***	−0.20	(0.01)***
crisis2008_SQ/100	0.91	(0.07)***	0.38	(0.08)***	1.30	(0.08)***
TW × crisis2001	−0.02	(0.01)**	−0.02	(0.01)**	−0.01	(0.01)
TW × crisis_SQ/100	0.10	(0.06)	0.16	(0.07)***	0.07	(0.08)
TW × crisis2008	−0.01	(0.01)	−0.06	(0.01)***	−0.01	(0.01)
TW × crisis2008_SQ/100	0.09	(0.08)	0.48	(0.09)***	0.02	(0.10)
KR × crisis2001	−0.005	(0.01)	−0.02	(0.01)**	0.004	(0.01)
KR × crisis2001_SQ100	−0.03	(0.06)	0.15	(0.07)**	−0.02	(0.08)
KR × crisis2008	0.02	(0.01)**	−0.004	(0.01)	−0.003	(0.01)
KR × crisis2008_SQ/100	−0.10	(0.09)	0.05	(0.10)	−0.002	(0.11)
SG × crisis2001	−0.04	(0.01)***	−0.02	(0.01)**	−0.06	(0.01)***
SG × crisis2001_SQ/100	0.16	(0.06)***	0.10	(0.07)	0.30	(0.08)***
SG × crisis2008	0.002	(0.01)	−0.03	(0.01)***	−0.05	(0.01)***
SG × crisis2008_SQ/100	−0.03	(0.08)	0.22	(0.09)**	0.25	(0.10)***
CN × crisis2001	−0.01	(0.01)	−0.02	(0.01)	−0.004	(0.01)
CN × crisis_SQ/100	−0.02	(0.07)	0.10	(0.07)	0.03	(0.08)
CN × crisis2008	0.04	(0.01)***	−0.04	(0.01)***	0.05	(0.01)***
CN × crisis2008_SQ/100	−0.30	(0.08)***	0.24	(0.10)***	−0.40	(0.11)***
MY × crisis2001	−0.03	(0.01)***	0.01	(0.01)	−0.05	(0.01)***
MY × crisis2001_SQ/100	0.11	(0.06)*	−0.01	(0.07)	0.28	(0.08)***
MY × crisis2008	0.02	(0.01)**	−0.03	(0.01)***	0.01	(0.01)
MY × crisis2008_SQ/100	−0.16	(0.08)**	0.28	(0.09)***	−0.21	(0.10)**
PH × crisis2001	−0.02	(0.01)***	−0.004	(0.01)	0.01	(0.01)
PH × crisis2001_SQ/100	0.10	(0.06)	0.10	(0.07)	−0.04	(0.08)

(to be continued)

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(continued)

Dependent variable: ΔEX, ΔEX_A, or ΔEX_B	Full Sample (1)	Group A (2)	Group B (3)
	Coef. Std. Err.	Coef. Std. Err.	Coef. Std. Err.
PH × crisis2008	0.01 (0.01)	−0.05 (0.01)***	0.03 (0.01)*
PH × crisis2008_SQ/100	−0.11 (0.09)	0.36 (0.10)***	−0.27 (0.11)***
TH × crisis2001	−0.04 (0.01)***	−0.01 (0.01)	0.01 (0.01)**
TH × crisis2001_SQ/100	0.18 (0.06)***	0.08 (0.07)	−0.02 (0.08)
TH × crisis2008	0.04 (0.01)***	−0.005 (0.01)	0.02 (0.01)
TH × crisis2008_SQ/100	−0.28 (0.09)***	0.06 (0.10)	−0.17 (0.11)
CN × Year	−0.001 (0.004)	−0.015 (0.005)***	−0.002 (0.01)
constant	0.13 (0.01)***	0.08 (0.02)***	0.14 (0.02)***
R-square: within	0.8553	0.8101	0.8078
between	0.1256	0.2625	0.5965
overall	0.1799	0.0591	0.0882
No. of Observations	864	864	864
No. of Groups	8	8	8

Note: Δ indicates the first difference. ***, **, * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

to Group A. But in all cases, both groups bottomed out more quickly in the 2008 crisis than in the 2001 crisis (see Table 9), which may have something to do with the increasingly vertical specialization worldwide over time. The issue will be discussed in Section 5.

In the 2001 crisis, Taiwan, Korea and Singapore, which were the major exporters of high-tech products, were badly affected by the internet bubble bursting; the excessive falls of exports (indicated by the interaction term of country dummy and crisis2001 in Group A) were the largest among all countries studied. In the 2008 crisis, Taiwan's exports remained badly hit while Korea and Singapore had either insignificant or limited impact. Japan was also a major high-tech exporter, nevertheless it was less affected, especially in the 2001 crisis. These support Hypothesis 4. But what made Taiwan more susceptible to economic crisis remains a question needed to be answered. We will come back to this issue later in Section 5.

For the robustness check, we divide the full sample into two exclusive subsamples, the Asian countries (Table 7) and the developed countries (Ta-

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Table 8: Error Correction Model-Developed Countries

Dependent variable: ΔEX, ΔEX_A, or ΔEX_B	Full Sample (1)	Group A (2)	Group B (3)
	Coef. Std. Err.	Coef. Std. Err.	Coef. Std. Err.
Error Correction	−0.22 (0.05)***	−0.21 (0.04)***	−0.35 (0.05)***
ΔGDP_world	1.53 (0.44)***		
ΔGDP_oecd		0.69 (0.47)	−2.70 (0.45)***
ΔGDP_xoecd		1.69 (0.37)***	1.93 (0.35)***
ΔEER	0.52 (0.07)***	0.55 (0.08)***	0.26 (0.08)***
ΔEER_volatility	0.002 (0.15)	−0.19 (0.16)	0.52 (0.15)***
ΔFDI	−0.03 (0.01)***	−0.02 (0.01)***	−0.02 (0.01)***
crisis2001	−0.04 (0.01)***	−0.03 (0.01)***	−0.03 (0.01)***
crisis2001_SQ/100	0.16 (0.04)***	0.13 (0.04)***	0.11 (0.04)***
crisis2008	−0.08 (0.01)***	−0.07 (0.01)***	−0.12 (0.01)***
crisis2008_SQ/100	0.53 (0.06)***	0.46 (0.07)***	0.75 (0.06)***
EU × crisis2001	0.01 (0.01)	0.01 (0.01)	−0.003 (0.01)
EU × crisis2001_SQ100	−0.03 (0.05)	−0.05 (0.05)	0.06 (0.05)
EU × crisis2008	−0.01 (0.01)	−0.02 (0.01)*	−0.01 (0.01)
EU × crisis2008_SQ/100	0.06 (0.07)	0.08 (0.07)	0.09 (0.07)
JP × crisis2001	0.01 (0.01)*	−0.03 (0.01)***	−0.01 (0.01)***
JP × crisis2001_SQ/100	−0.04 (0.05)	0.19 (0.05)***	0.10 (0.05)**
JP × crisis2008	−0.01 (0.01)	−0.03 (0.01)***	−0.02 (0.01)***
JP × crisis2008_SQ/100	0.04 (0.07)	0.17 (0.07)***	0.15 (0.07)*
constant	0.08 (0.01)***	−0.02 (0.02)	0.07 (0.02)**
R-square: within	0.8753	0.8931	0.8683
between	0.9939	0.5294	0.5036
overall	0.7606	0.8472	0.2167
No. of Observations	324	324	324
No. of Groups	3	3	3

Note: Δ indicates the first difference. ***, **, * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

ble 8).[15] The results are qualitatively the same in terms of the signs of

[15]Developed countries are the U.S., EU and Japan, and the remaining eight are collected under the "Asian countries". The U.S. and Indonesia are used as the base for comparison in the developed sample and the Asian sample, respectively.

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Table 9: Number of Months to Bottom Out

	Full Sample		Group A		Group B	
	Crisis 2001	Crisis 2008	Crisis 2001	Crisis 2008	Crisis 2001	Crisis 2008
Full Sample	14.16	8.02	22.26	7.79	17.03	8.26
TW	8.75	7.26	8.34	6.94	9.95	7.84
EU	10.16	7.86	11.37	7.78	9.50	8.10
JP	10.28	8.04	9.14	7.68	10.70	7.96
KR	10.49	7.23	9.11	7.30	11.82	7.86
SG	9.80	7.65	9.55	7.52	9.96	7.88
CH	9.89	8.31	9.31	7.97	11.43	8.57
ID	8.13	7.55	9.56	7.52	12.14	7.64
MY	9.22	7.71	8.37	6.98	10.33	8.49
PH	9.22	7.78	7.49	7.25	12.52	8.26
TH	9.36	7.60	9.15	7.22	12.06	7.81
Asian Countries	8.00	7.50	9.60	7.40	12.39	7.63
TW	8.84	7.20	8.34	6.85	10.33	7.83
KR	10.10	7.04	8.85	7.05	12.53	7.78
SG	9.84	7.66	9.65	7.47	10.21	7.93
CH	9.82	8.02	9.28	7.86	11.40	8.36
MY	8.99	7.69	8.28	6.90	9.99	8.51
PH	9.04	7.71	7.44	7.14	11.58	8.28
TH	9.27	7.53	9.03	6.93	12.05	7.82
Developed Countries	12.01	7.75	12.18	7.74	12.48	8.02
EU	10.56	7.87	12.34	7.99	9.16	7.97
JP	10.64	8.03	8.92	7.81	10.16	7.85

Note: In full sample and developed country sample, the U.S. is used as the base for comparison; in Asia Sample, Indonesia is used as the base for comparison.

the crisis variables.[16] Moreover, even within the group of highly export-

[16]The effects of other variables may vary with different sample examined. For example, effective exchange rate is insignificant for all cases studied in Asian sample, but it has significant and positive effect in developed sample. As exports by developed countries tend to

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oriented Asian countries, Taiwan's export contraction was excessively higher than other Asian countries in Group A, which accounted for 73.63% of Taiwan's total exports during 2000 to 2009. The excessive fall for Taiwan was especially large in the 2008 crisis than in the 2001 crisis. Unlike Malaysia and the Philippines in which Group B was more adversely affected, Taiwan and Korea were less affected as Group B constituted a small proportion of their exports.[17] Table 9 summarizes the number of months it took for the export contraction to bottom out for the two subsamples as well as for the full sample.

5 Some Possible Explanations

Why did the export contraction significantly overshoot its long-run trend when 2001 and 2008 economic crises occurred? Why did exports fall much deeper and yet bounce back much more quickly in the 2008 crisis than in the 2001 crisis? What made Taiwan's exports so susceptible to economic crises and appear more so in 2008 when compared with other countries? All these observations may very well be explained by the so-called Forrester effect on demand variability, a phenomenon well known in the optimization of supply chain and inventory control systems.

The Forrester effect suggests that demand variability increases as one moves up a supply chain. It is a feedback mechanism set forth by external shocks to the supply chain where small fluctuations in demand at the retailer end are dramatically amplified as they proceed up the chain. Such an effect may be caused by the demand forecast updating that reflects not only the need to replenish the stocks to meet the requirements for future demands but also the need for safety stocks which are considered necessary because of the large demand uncertainty and fluctuation (Lee et al., 1997). As a result, the readjustment of demand forecast by the upstream manager is often greater than the change of demand in the downstream. Similarly, periodic ordering (which makes suppliers face a highly erratic stream of orders), special sales promotion (which triggers irregular buying pattern of

be more sophisticated and of high quality, their export prices (P_{EX}) and foreign demand for their exports (Q_{EX}) are less sensitive to exchange rates. The export value in dollars ($= ER \times P_{EX} \times Q_{EX}$) may therefore increase when the exchange rate appreciates (i.e., an increase in ER).

[17] During 2000 and 2009, Group B accounted for only 26.37% and 25.57% of total exports in Taiwan and Korea, respectively.

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customers) and rationing (which occurs when demands exceed supply) may all distort demand information (Lee et al., 1997). Inaccuracies and volatility of orders from the retailer to the primary suppliers therefore cause relatively greater readjustments at each point in the chain. Apparently, the amount of safety stock contributes significantly to the Forrester effect. As in the visual metaphor of cracking a bullwhip, demand in the chain fluctuates in a continuous and long lasting oscillatory movement upstream; therefore, it is also labeled the bullwhip effect.

To make things clear, consider a 5% drop in retail sales. In order to deplete the surplus stocks and reduce inventory, given that there is a weaker sales outlook, orders placed by retailers to wholesalers one step upstream in the chain (e.g., downstream producers, see Figure 3) will thus decrease by more than 5%, say 10%. The decrease in demand amplifies and propagates through the chain as upstream firms react in much the same way as downstream firms do, trying to adjust their stock level and empty the pipeline. Hence the longer the chain is, the more pronounced the upstream demand amplification (or the larger the oscillatory movement) will become. This will result in an even greater decrease, say 15%, in purchase orders to the suppliers further upstream in our example.

The "export overshooting" phenomenon as seen in the 2001 and 2008 crises, in essence, captures the bullwhip effect. As shown by the regressions in Section 4, the extent of export contraction for the countries studied is greater than that can be explained by the changes in fundamental factors (which include the real world GDP, exchange rates, the volatility of exchange rates and FDI) and the long-run reaction to the crisis. Apparently, the overcorrection of the demand forecast by every entity of the global supply chain was indeed the force at work that caused manufacturing exports to fall more than the decline in demand at the retailer end of the chain. When the economy recovered, the bullwhip effect also worked in much the same way but in the opposite direction; exports bounced back by a much larger extent than the actual increase in demand as every entity of the supply chain increased its safety stocks to meet unexpected increase in future demand.

Generally, when production becomes more specialized vertically around the world (e.g., Ando (2006); Kimura et al. (2007); Dean et al. (2009); Turkcan and Ates (2011)),[18] the length of a supply chain increases, and so

[18]Vertical specialization can be defined as the decomposition of production into separable component blocks connected by service links (Jones and Kierzkowski, 2001). For the

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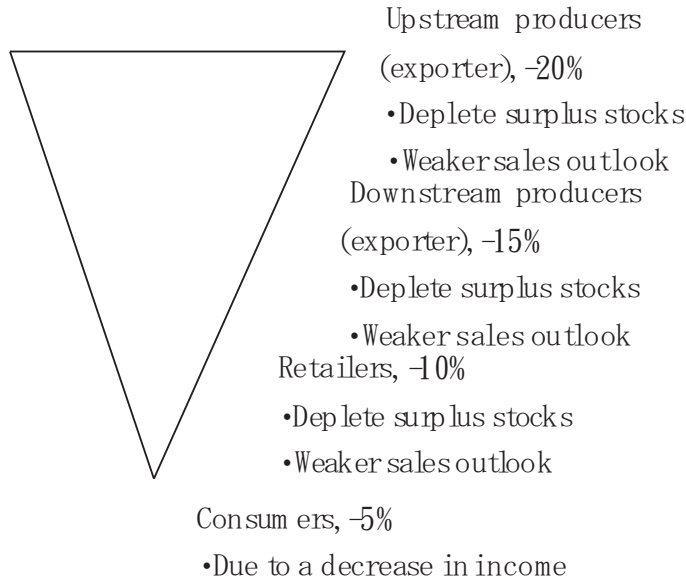


Figure 3: An Illustration of Bullwhip Effects

does the bullwhip effect (or the extent of overshooting). As already discussed earlier, the bullwhip effect causes modest changes at one end of the chain to be magnified with a fast-cascading impact when they reach the other end. This means literally that the longer the supply chain, the larger the demand swings for the upstream end of the chain. Therefore, as the degree of cross-border vertical specialization increases over time, the demand variability is also increased in an elongated chain, thus enhancing the global supply system's tendency to overcorrect. This helps explain why the over-

last decade, the costs of cross-border service links have been greatly reduced because of the constant advances in telecommunication and decreases in tariffs on trade between production blocks (Kimura et al., 2007), which, according to Jones et al. (2005) and Dean et al. (2009), makes the vertical specialization become more significant over time. By using the vertical intra-industry trade (vertical IIT) as an indicator of vertical specialization (international fragmentation), the vertical IIT is shown to have been rising since early 2000s for the US auto industry (Turkcan and Ates, 2011), machinery industry in East Asia (Kimura et al., 2007) and economies in East Asia (Ando, 2006). This provides some evidence that vertical international production-sharing has become an essential part of some industries and economies, especially in East Asia. The extent of vertical specialization, however, varies across countries. For example, Kimura et al. (2007) shows that it is more significant in East Asia than in Europe.

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shooting phenomenon was more pronounced in the 2008 crisis than in the 2001 crisis. The findings from Vlasenko (2009) that firms' inventory levels were quickly deteriorating in the 2008 crisis at a faster speed than the average rate in the previous recessions provide some evidence of overcorrection in the supply system. This in turn, we believe, led to an increase in the extent of overshooting (the bullwhip effect), supporting our argument that the recent financial crisis was worse than the previous crisis in terms of the rates of decline in world exports.

For the last two decades or so, East Asian countries has been gradually integrated into the global production networks, in which not only Japan but also Korea, Singapore and Taiwan have been growing into upstream suppliers (Jones et al., 2005). The exports structures of these countries therefore shift from final goods toward intermediate inputs, causing the export contractions become larger during an economic crisis as implied by the bullwhip effect. According to Authukorala and Kohpaiboon (2009), the export share of parts and components in ICT, electronics, machinery and transport equipment was 56.2% for Taiwan in 2006 and 2007, which was comparable to Singapore (60.7%) but much higher than Japan (39.5%) and Korea (46.1%) and was also greater than NAFTA (43.4%) and EU15 (34.4%).[19] Compared with Japan, Korea and Singapore, Taiwan's export sector seems to be more vulnerable to such debilitating effects especially in the more recent crisis. This is mostly due to a persistent large FDI outflow from Taiwan and as the practice of export outsourcing becomes a standard among firms. Taiwanese firms that receive international orders subcontract the downstream or labor-intensive assembly processes to overseas Taiwanese firms or firms that are based in a host country or a third country. Such process has made upstream components and parts a major and increasing part of Taiwan's export sector. The export share of intermediate inputs in Taiwan's total exports had increased dramatically over the last decade, from 61.07% in 2000 to over 70% in 2006; by 2010 it had already accounted for 74.1% of Taiwan's total exports.[20] The large and increasing proportion of upstream exports

[19]In addition to the vertical intra-industry trade (vertical IIT) as shown in Footnote 18, the export share of parts and components is also used as a measure of the degree of vertical specialization (Kimura et al., 2007; Turkcan and Ates, 2011).

[20]According to Industrial Economics and Statistics Newsletter issued by Ministry of Economic Affairs in Taiwan, the export share of intermediate inputs in Taiwan's total exports was 61.07%, 61.51%. 68.03%. 71.78%, 73.89% and 74.1% for the years of 2000, 2002, 2004, 2006, 2008 and 2010.

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has an unintended consequence of exposing Taiwan further to the risks of the bullwhip effects during crisis periods. To put it another way, there is sufficient reason to believe that the bullwhip effects are much enhanced in Taiwan's case especially in 2008 crisis, largely as a result from an increasing export outsourcing ratio signaling a process of increased vertical specialization across border and the positioning of the Taiwanese parent firms as the upstream primary suppliers in an elongated global supply chain.

In addition to the bullwhip effect, Taiwan's export performance is also highly influenced by the type of products it exports. Group A, which accounted for 73.63% of Taiwan's total exports during 2000 to 2009, are highly income elastic in both OECD and non-OECD countries and see greater sales volatility when wealth effects become large enough to affect consumption during times of economic upheaval. Similar reason can be used to explain why Japan, Korea and Singapore were among the countries hit hard by the economic crises.[21] It is important to also note that not only are these high-tech exports more capital-intensive they also have a rather sophisticated manufacturing process. This means that compared to labor-intensive manufacture, the supply chain of Group A is relatively longer and the exports are therefore more susceptible to the bullwhip effect.

One may argue that Japan has been a major input supplier of Taiwan for quite a long time, which according to the bullwhip effect discussed above, should have exposed Japan in a greater risk than Taiwan during the crisis periods. This, however, turns out not to be the case here. Japan's specialization in the production of durable consumer goods and hence having a relatively smaller share of parts and components in exports may provide part of the answer. In addition, unlike Taiwan whose exports may be easier to replace, Japan's exports tend to be high-end durable consumer goods and key components, which are relatively difficult to find substitutes in the world markets and may therefore deter its exports from falling as much as Taiwan. This suggests that to reduce export risk stemming from the bullwhip effects, Taiwan has to upgrade and/or differentiate its exports in both intermediate inputs and final goods so as to minimize the adverse impacts.

[21] The export shares of Group A were 81.25%, 74.43% and 71.38 for Japan, Korea and Singapore, respectively, which rank among the top three of the countries studied.

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6 Concluding Remarks

This paper provides some evidence of the "export overshooting" phenomenon, i.e. the unusually large deviation of exports from their long-run level. We show that export overshooting occurred in the 2001 and 2008 economic crises. In fact, it prevailed in all of the eleven countries in our sample that represent different income groups: developed countries, Asian NICs, and emerging market countries. All of them experienced an excessive fall in exports. Moreover, the extent of overshooting is shown to have been more severe in Taiwan than in other countries. And it was also more severe in those industries with high income elasticity of demand.

We argue that the bullwhip effect was indeed the driving force behind the "export overshooting" phenomenon. Because of the overcorrection in demand forecast by every entity of the supply chain, exporting countries, which were at the upper stream end of the supply chain, faced a much greater demand oscillation than the demand at the retailer end. As a result, exports fell more than demand at the retail end; but when the economy recovered exports also bounced back by a larger extent than a change in final demand. The export overshooting phenomenon discussed in this paper may therefore be regarded as a magnified version of the bullwhip effect in world exports, which was triggered by the large negative aggregate demand shocks resulting from the global economic crises.

As production becomes more vertically specialized across countries over time, the supply chain becomes longer accordingly. This helps explain why the extent of overshooting was greater in the 2008 crisis than in the 2001 crisis. And while vertical disintegration of production can also be used to explain the export overshooting phenomena of Taiwan, it alone is insufficient to explain why Taiwan was more susceptible to economic crisis than other Asian countries. It is argued in this paper that the persistent large FDI outflow and the common practice of export outsourcing has caused Taiwan's production bases to shift towards the upstream end of the supply chain. Moreover, as Taiwan geared toward more high-tech export manufacturing activities for which demand is highly income elastic, its sensitivity to demand shocks and business cycles also increased. All these structural shifts have exposed Taiwan further to the risks of rapid and large demand variability. To reduce export vulnerability, Taiwan will have to upgrade its export structures toward high-end consumer goods and key components and to develop branding strategy so as to lower foreign demand elasticity and make it

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harder for exports to be replaced.

Although the bullwhip effect is well known in the optimization of supply chain and inventory control systems, some efforts may be made to incorporate such an effect into the theory of vertical specialization in order to derive a more rigorous relationship between the length of supply chain and export variability when a shock occurs. Also, some efforts may also be needed to extend this study to include more countries and more time span in order to generalize the conclusions found in this paper. All these may deserve some future research.

Appendix 1. Long-run Regression

	Full Sample (1)	Group A (2)	Group B (3)
EX	Coef. Std. Err.	Coef. Std. Err.	Coef. Std. Err.
GDP_world	3.55 (0.06)***		
GDP_oecd		1.70 (0.85)*	−3.51 (0.67)***
GDP_xoecd		1.14 (0.31)***	3.22 (0.24)***
EER	0.20 (0.05)***	0.43 (0.06)***	0.28 (0.05)***
EER_volatility	0.07 (0.26)	0.08 (0.30)	0.87 (0.23)***
FDI	0.0001 (0.01)	−0.01 (0.01)	−0.002 (0.008)
crisis2001	0.03 (0.01)**	0.03 (0.01)*	0.01 (0.01)
crisis2001_SQ/100	−0.16 (0.08)*	−0.002 (0.001)*	−0.001 (0.001)
crisis2008	−0.04 (0.01)***	−0.07 (0.02)***	−0.10 (0.02)***
crisis2008_SQ/100	0.24 (0.11)***	0.004 (0.001)***	0.01 (0.001)***
TW × crisis2001	−0.04 (0.02)***	−0.05 (0.02)***	−0.02 (0.02)
TW × crisis_SQ/100	0.24 (0.12)**	0.28 (0.14)**	0.13 (0.11)
TW × crisis2008	−0.05 (0.02)**	−0.04 (0.02)*	−0.04 (0.02)*
TW × crisis2008_SQ/100	0.33 (0.16)**	0.31 (0.18)*	0.21 (0.14)
CH × crisis2001	−0.14 (0.02)***	−0.18 (0.02)***	−0.07 (0.02)***
CH × crisis_SQ/100	0.71 (0.12)***	0.92 (0.14)***	0.34 (0.11)***
CH × crisis2008	0.09 (0.02)***	0.11 (0.02)***	0.03 (0.02)*
CH × crisis2008_SQ/100	−0.40 (0.16)***	−0.47 (0.18)***	−0.14 (0.14)
SG × crisis2001	−0.07 (0.02)***	−0.06 (0.02)***	−0.09 (0.02)***
SG × crisis2001_SQ/100	0.34 (0.12)***	0.29 (0.14)**	0.43 (0.11)***
SG × crisis2008	0.00 (0.02)	0.00 (0.02)	0.002 (0.02)
SG × crisis2008_SQ/100	0.04 (0.16)	0.04 (0.18)	0.06 (0.14)

(to be continued)

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(continued)

	Full Sample (1)		Group A (2)		Group B (3)	
EX	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
MY × crisis2001	−0.04	(0.02)**	−0.03	(0.02)	−0.06	(0.02)***
MY × crisis2001_SQ/100	0.21	(0.12)*	0.15	(0.14)	0.26	(0.11)**
MY × crisis2008	−0.01	(0.02)	−0.03	(0.02)	0.01	(0.02)
MY × crisis2008_SQ/100	0.11	(0.16)	0.23	(0.18)	−0.08	(0.14)
EU × crisis2001	−0.04	(0.02)**	−0.03	(0.02)	−0.03	(0.02)
EU × crisis2001_SQ100	0.20	(0.12)*	0.16	(0.14)	0.16	(0.11)
EU × crisis2008	0.01	(0.02)	0.01	(0.02)	0.0002	(0.02)
EU × crisis2008_SQ/100	−0.01	(0.16)	−0.03	(0.18)	0.001	(0.15)
KR × crisis2001	−0.07	(0.02)	−0.06	(0.02)***	0.01	(0.02)
KR × crisis2001_SQ/100	0.33	(0.12)	0.30	(0.14)**	−0.09	(0.11)
KR × crisis2008	0.04	(0.02)	0.05	(0.02)*	−0.02	(0.02)
KR × crisis2008_SQ/100	−0.14	(0.16)	−0.21	(0.18)	0.12	(0.14)
TH × crisis2001	−0.02	(0.02)***	−0.06	(0.02)***	−0.01	(0.02)
TH × crisis2001_SQ100	0.09	(0.12)***	0.30	(0.14)**	0.06	(0.11)
TH × crisis2008	0.01	(0.02)*	0.07	(0.02)***	0.00	(0.02)
TH × crisis2008_SQ/100	0.03	(0.16)	−0.35	(0.19)*	0.06	(0.15)
INDO × crisis2001	−0.01	(0.02)	−0.03	(0.02)	−0.02	(0.02)
INDO × crisis2001_SQ/100	0.09	(0.12)	0.15	(0.14)	0.08	(0.11)
INDO × crisis2008	−0.08	(0.02)***	0.01	(0.02)	−0.02	(0.02)
INDO × crisis2008_SQ/100	0.44	(0.16)***	−0.05	(0.18)	0.23	(0.14)
PH × crisis2001	−0.03	(0.02)*	−0.03	(0.02)	0.02	(0.02)
PH × crisis2001_SQ/100	0.18	(0.12)	0.19	(0.14)	−0.09	(0.11)
PH × crisis2008	−0.05	(0.02)***	−0.07	(0.02)***	−0.07	(0.02)***
PH × crisis2008_SQ/100	0.32	(0.16)*	0.40	(0.18)**	0.33	(0.14)**
JP × crisis2001	−0.04	(0.02)**	−0.01	(0.02)	−0.01	(0.02)**
JP × crisis2001_SQ/100	0.21	(0.12)*	0.07	(0.14)	0.08	(0.11)
JP × crisis2008	0.01	(0.02)	−0.06	(0.02)***	−0.03	(0.02)
JP × crisis2008_SQ/100	−0.02	(0.16)	0.33	(0.18)*	0.19	(0.14)
constant	−28.82	(0.69)***	−20.68	(6.13)	14.66	(4.82)***
R-square: within	0.8516		0.8112		0.8886	
between	0.0172		0.2423		0.0000	
overall	0.0729		0.0540		0.0915	
No. of Observations	1,320		1,320		1,320	
No. of Groups	11		11		11	

Note: ***, **, * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

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為何世界貿易對於經濟危機之反應如此敏感? — 出口過度反應現象之探討

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本文主要針對出口過度脫離長期趨勢的現象 (本文稱之爲出口過度反應現象, export overshooting), 提供一些例證。本文研究2000年至2009年期間11個國家 (經濟體) 的出口變動, 發現2001年與2008年之經濟危機, 的確有促使出口過度下跌的現象, 且各國在2008年經濟危機之出口過度反應的程度高於2001年經濟危機, 而台灣出口過度反應的程度也高於其他國家。長鞭效果 (bullwhip effect) 是造成出口過度反應現象背後的主因之一。台灣由於位處供應鏈上游, 長鞭效果尤其顯著, 受到經濟危機之影響程度因而高於其他國家。此外, 台灣廠商進行台灣接單海外生產的運籌操作, 以及出口偏集於所得彈性較高之電子科技產品, 也促使台灣在面對經濟危機時, 出口下跌幅度較其他國家來得快、也來得深; 不過, 一旦景氣回升, 出口回漲速度與幅度也較其他國家來得快與大。

關鍵詞: 出口過度反應, 經濟危機, 長鞭效應, 台灣
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